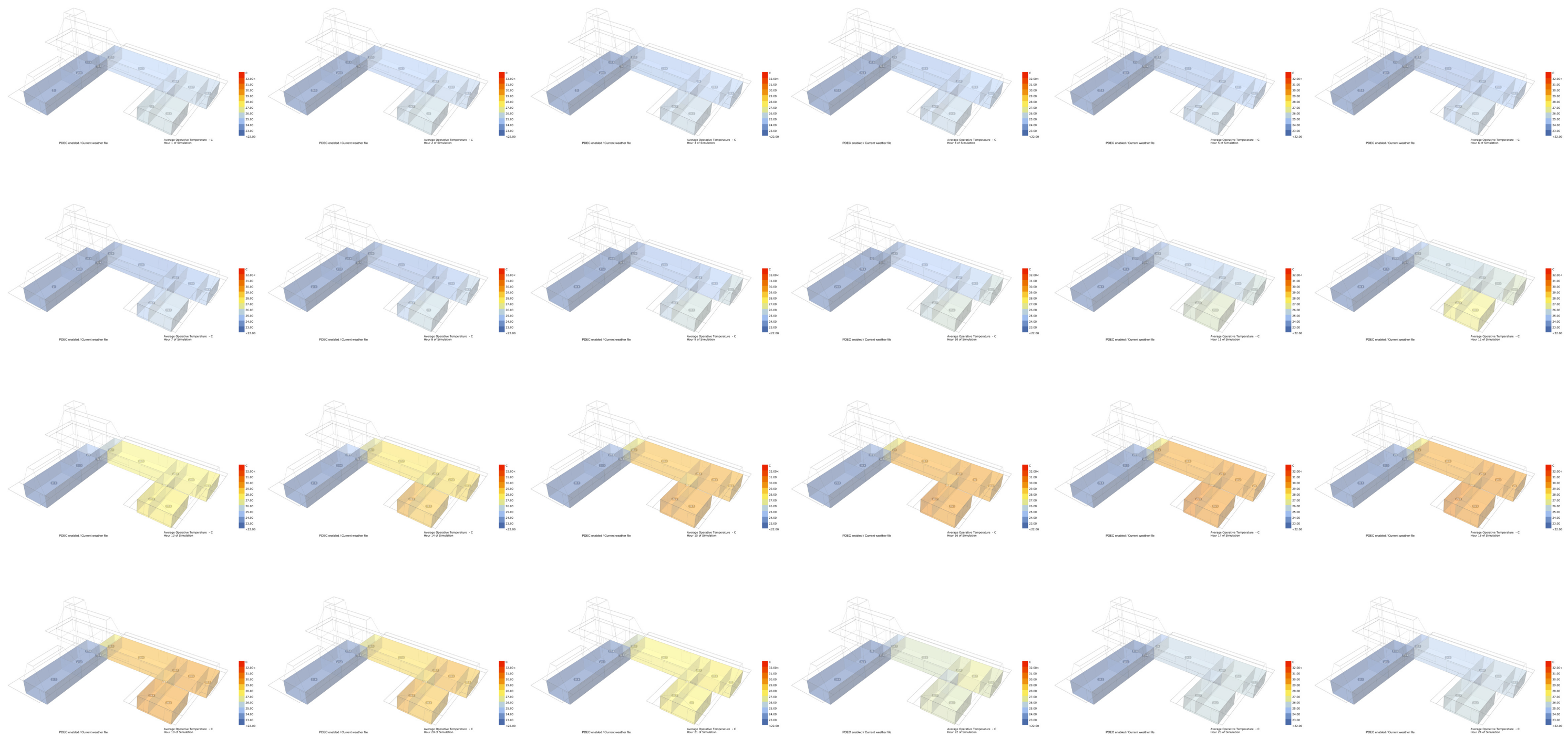


Appendix A

Full Thermal Modelling Results

A247 Breach House

Current Climate Scenario - With Evaporative Cooling Tower



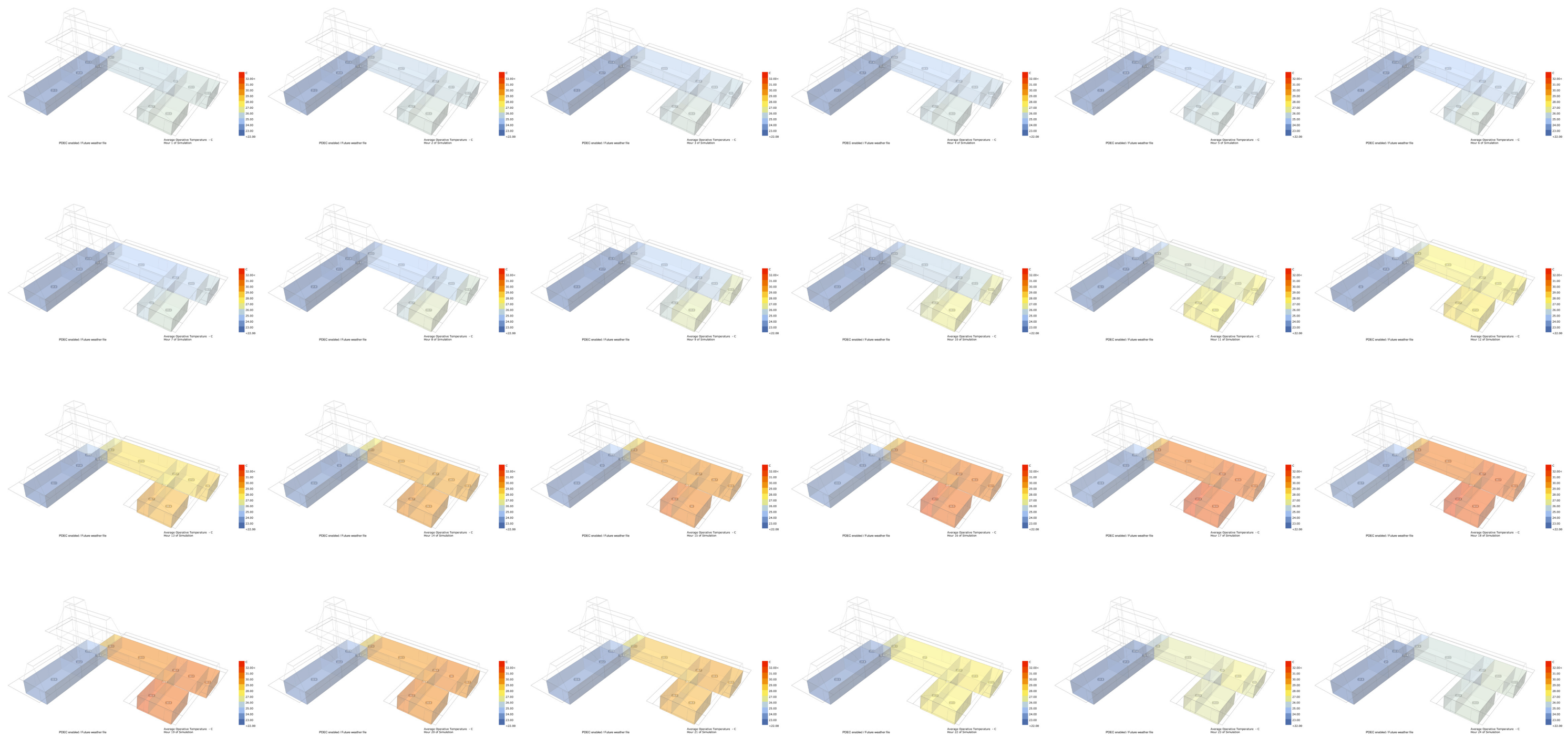
NOTES

- Results images show operative temperatures for thermal zones for 24 hour period, modelled on hottest day of the year for weather data (22nd July).
- Weather data file: Birmingham DSY 2020



NOTES

- Results images show operative temperatures for thermal zones for 24 hour period, modelled on hottest day of the year for weather data (22nd July).
- Weather data file: Birmingham DSY 2050

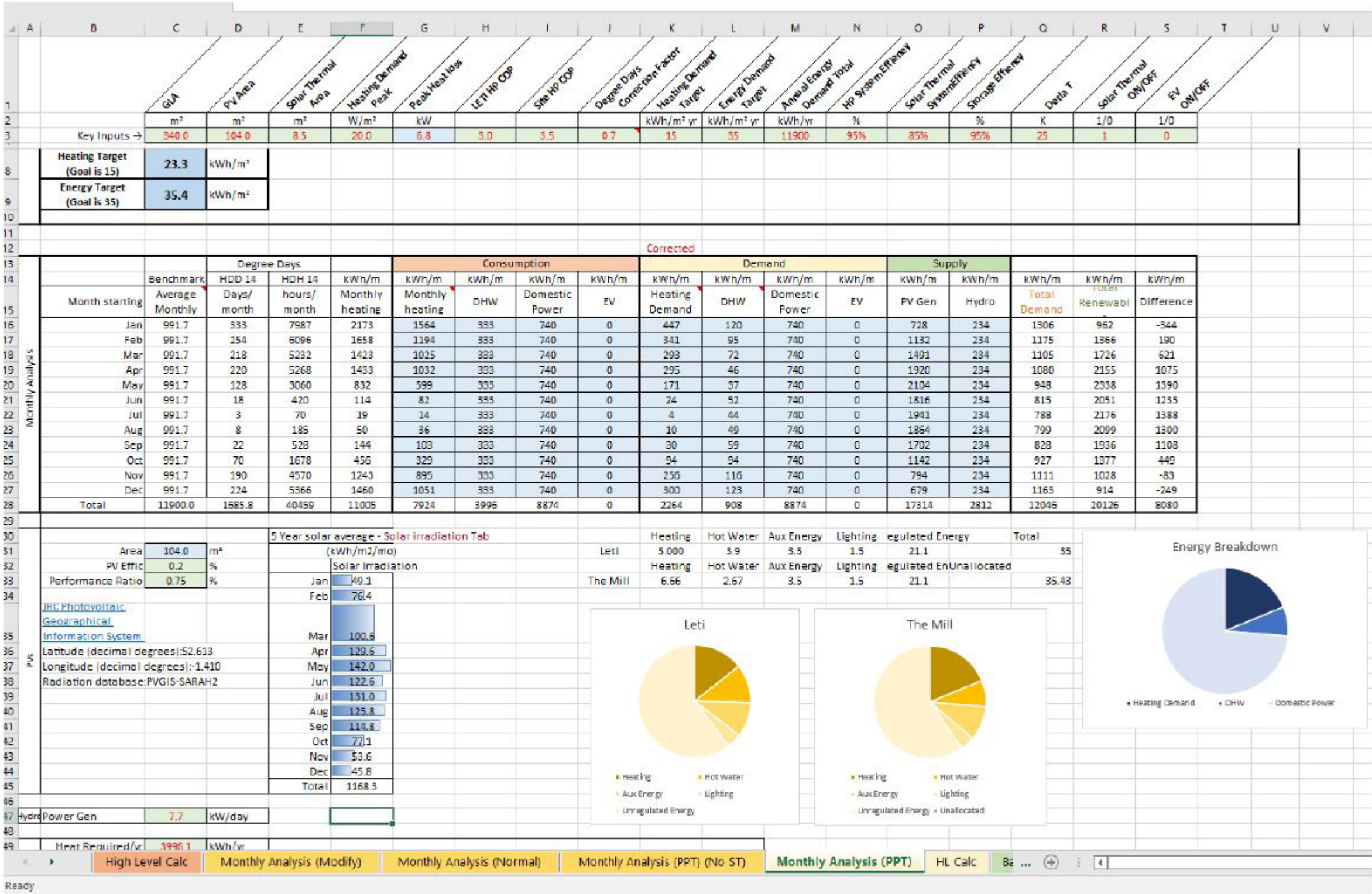


NOTES

- Results images show operative temperatures for thermal zones for 24 hour period, modelled on hottest day of the year for weather data (22nd July).
- Weather data file: Birmingham DSY 2050

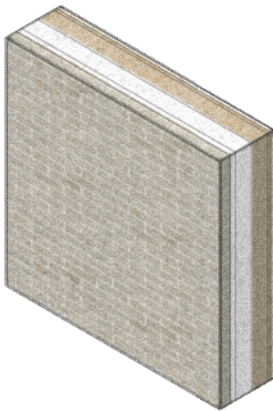
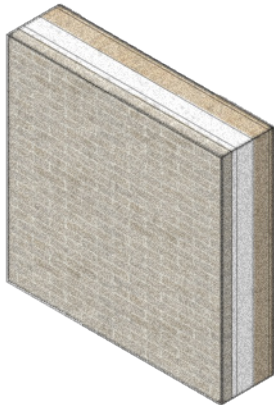
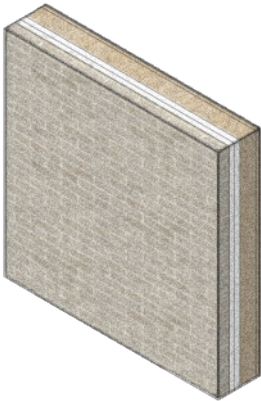
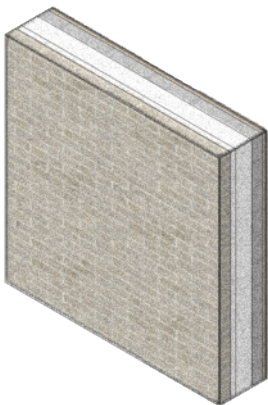
Appendix B

Max Fordham Operational Energy Calculator



Appendix C

Stage 2 - Upfront Embodied Carbon Study



1. Brick - Blockwork - PIR - Gypsum

Outside

102mm Brickwork
50mm Cavity
150mm PIR insulation
100mm Medium density blockwork
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 442mm
U-Value: 0.131 W/m²K

CO2e: 145 kg/m²

CO2e (including biogenic): 142 kg/m²

2. Brick - Timber - PIR - Gypsum

Outside

102mm Brickwork
50mm Cavity
50mm PIR insulation
150 x 50mm Douglas Fir Studwork (with PIR)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 392mm
U-Value: 0.139 W/m²K

CO2e: 121 kg/m²

CO2e (including biogenic): 100 kg/m²

3. Brick - Timber - Wood Fibre - Gypsum

Outside

102mm Brickwork
50mm Cavity
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 492mm
U-Value: 0.136 W/m²K

CO2e: 146 kg/m²

CO2e (including biogenic): 45 kg/m²

4. Brick - Timber - Wood Fibre - Clay Plaster

Outside

102mm Brickwork*
50mm Cavity
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
30mm Straw board
3mm Clay plaster skim finish

Inside

Total depth: 510mm
U-Value: 0.136 W/m²K

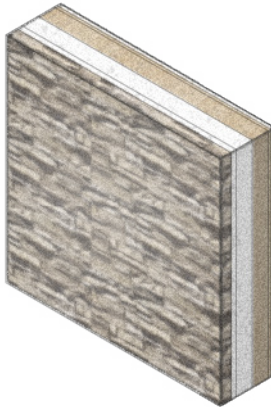
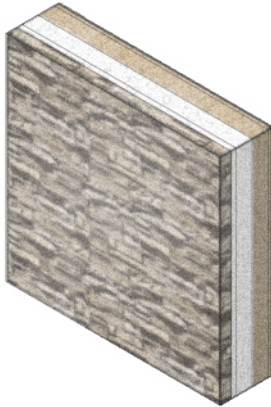
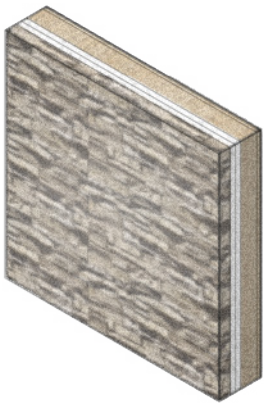
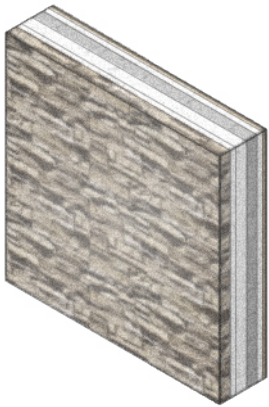
* 5. - 102mm Reclaimed Brick

CO2e: 155 kg/m²

CO2e (including biogenic): 29 kg/m²

*108 kg/m²

*-18kg/m²



6. Stone - Blockwork - PIR - Gypsum

Outside

100mm Sandstone
50mm Cavity
150mm PIR insulation
100mm Medium density blockwork
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 440mm
U-Value: 0.131 W/m²K

CO2e:	CO2e (including biogenic):
108 kg/m²	104 kg/m²

7. Stone - Timber - PIR - Gypsum

Outside

100mm Sandstone
50mm Cavity
50mm PIR insulation
150 x 50mm Douglas Fir Studwork (with PIR)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 390mm
U-Value: 0.139 W/m²K

CO2e:	CO2e (including biogenic):
84 kg/m²	62 kg/m²

8. Stone - Timber - Wood Fibre - Gypsum

Outside

100mm Sandstone
50mm Cavity
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 490mm
U-Value: 0.136 W/m²K

CO2e:	CO2e (including biogenic):
109 kg/m²	7 kg/m²

9. Stone - Timber - Wood Fibre - Clay Plaster

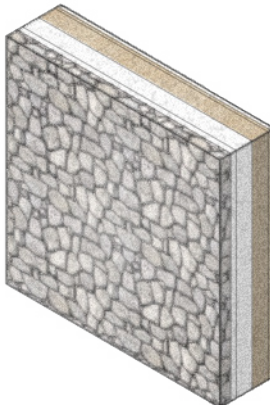
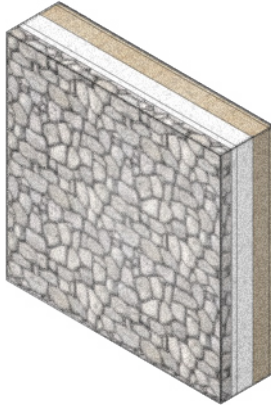
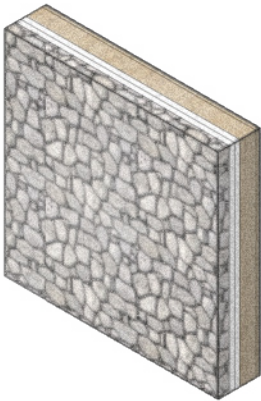
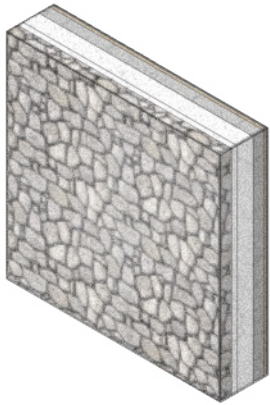
Outside

100mm Sandstone
50mm Cavity
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
30mm Straw board
3mm Clay plaster skim finish

Inside

Total depth: 508mm
U-Value: 0.136 W/m²K

CO2e:	CO2e (including biogenic):
117 kg/m²	-9 kg/m²



10. Flint - Blockwork - PIR - Gypsum

Outside

103mm Flint blocks
50mm Cavity
150mm PIR insulation
100mm Medium density blockwork
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 443mm
U-Value: 0.131 W/m²K

CO2e:	CO2e (including biogenic):
123 kg/m²	119 kg/m²

11. Flint - Timber - PIR - Gypsum

Outside

103mm Flint blocks
50mm Cavity
50mm PIR insulation
150 x 50mm Douglas Fir Studwork (with PIR)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 393mm
U-Value: 0.139 W/m²K

CO2e:	CO2e (including biogenic):
99 kg/m²	77 kg/m²

12. Flint - Timber - Wood Fibre - Gypsum

Outside

103mm Flint blocks
50mm Cavity
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 493mm
U-Value: 0.136 W/m²K

CO2e:	CO2e (including biogenic):
124 kg/m²	23 kg/m²

13. Flint - Timber - Wood Fibre - Clay Plaster

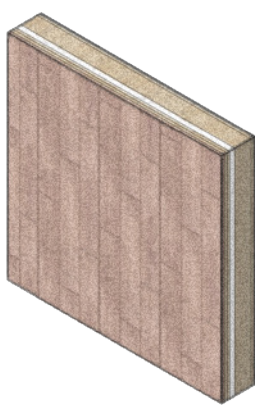
Outside

103mm Flint blocks
50mm Cavity
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
30mm Straw board
3mm Clay plaster skim finish

Inside

Total depth: 511mm
U-Value: 0.136 W/m²K

CO2e:	CO2e (including biogenic):
133 kg/m²	7 kg/m²



14. Cedar - Timber - PIR - Gypsum

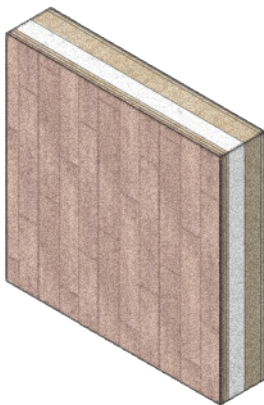
Outside

25mm FSC Western red cedar cladding
25mm Horizontal battens
25mm Vertical battens
Facade membrane
50mm PIR insulation
150 x 50mm Douglas Fir Studwork (with PIR)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 315mm
U-Value: 0.139 W/m²K

CO2e:	CO2e (including biogenic):
64 kg/m²	13 kg/m²



15. Cedar - Timber - Wood Fibre - Gypsum

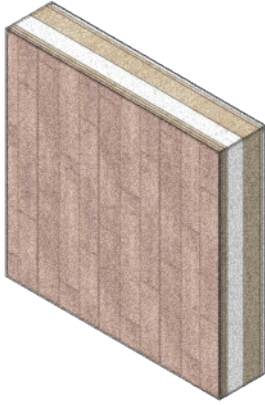
Outside

25mm FSC Western red cedar cladding
25mm Horizontal battens
25mm Vertical battens
Facade membrane
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish

Inside

Total depth: 415mm
U-Value: 0.136 W/m²K

CO2e:	CO2e (including biogenic):
89 kg/m²	-41 kg/m²



16. Cedar - Timber - Wood Fibre - Clay Plaster

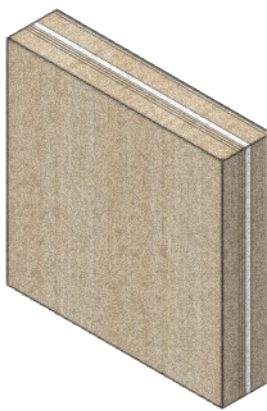
Outside

25mm FSC Western red cedar cladding
25mm Horizontal battens
25mm Vertical battens
Facade membrane
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
30mm Straw board
3mm Clay plaster skim finish

Inside

Total depth: 433mm
U-Value: 0.136 W/m²K

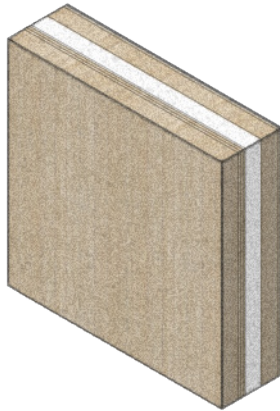
CO2e:	CO2e (including biogenic):
98 kg/m²	-57 kg/m²



17. Thatch - Timber - PIR - Gypsum

Outside
150mm Thatch cassette
25mm Horizontal battens
25mm Vertical battens
Facade membrane
18mm OSB sheathing board
50mm PIR insulation
150 x 50mm Douglas Fir Studwork (with PIR)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish
Inside
Total depth: 458mm
U-Value: 0.136 W/m²K

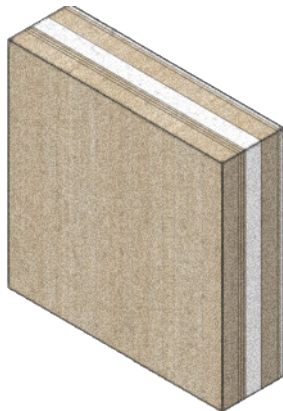
CO2e:	CO2e (including biogenic):
68 kg/m²	20 kg/m²



18. Thatch - Timber - Wood Fibre - Gypsum

Outside
150mm Thatch cassette
25mm Horizontal battens
25mm Vertical battens
Facade membrane
18mm OSB sheathing board
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
12mm Plasterboard
3mm Plaster skim finish
Inside
Total depth: 558mm
U-Value: 0.134 W/m²K

CO2e:	CO2e (including biogenic):
93 kg/m²	-35 kg/m²



19. Thatch - Timber - Wood Fibre - Clay Plaster

Outside
150mm Thatch cassette
25mm Horizontal battens
25mm Vertical battens
Facade membrane
18mm OSB sheathing board
150mm Wood fibre insulation
150 x 50mm Douglas Fir Studwork (with Wood fibre)
Airtightness layer
25mm Battens
30mm Straw board
3mm Clay plaster skim finish
Inside
Total depth: 433mm
U-Value: 0.134 W/m²K

CO2e:	CO2e (including biogenic):
102 kg/m²	-51 kg/m²

A247 Breach House

[illegible]

Appendix D

Stage 3 -Example Embodied Carbon Calculation + Tree Drawdown Calculation

Studio Bark

A247 Breach House

	Broadleaf trees												
	Slow	Moderate	Fast		Slow	Moderate	Fast		Slow	Moderate	Fast		
												TOTAL (KgCO2e)	
Age	Carbon absorption (KgCO2) - cummulative total				Number of				Total sequestration				Years
1	5	8	11		15	15	60		75	120	660	855	1
5	22	39	63		15	15	60		330	585	3,780	4,695	5
10	60	115	192		15	15	60		900	1,725	11,520	14,145	10
15	119	237	403		15	15	60		1,785	3,555	24,180	29,520	15
20	199	409	706		15	15	60		2,985	6,135	42,360	51,480	20
25	303	634	1106		15	15	60		4,545	9,510	66,360	80,415	25
30	433	916	1611		15	15	60		6,495	13,740	96,660	116,895	30
35	589	1258	2225		15	15	60		8,835	18,870	133,500	161,205	35
40	772	1663	2954		15	15	60		11,580	24,945	177,240	213,765	40
45	984	2132	3801		15	15	60		14,760	31,980	228,060	274,800	45
50	1225	2668	4771		15	15	60		18,375	40,020	286,260	344,655	50
55	1496	3274	5868		15	15	60		22,440	49,110	352,080	423,630	55
60	1799	3951	7097		15	15	60		26,985	59,265	425,820	512,070	60
Age	Carbon absorption (KgCO2) - cummulative total				Number of				Total sequestration				Years
5	22	39	63		40	30	30		880	0	1,890	2,770	5
10	60	115	192		40	30	30		2,400	3,450	5,760	11,610	10
15	119	237	403		40	30	30		4,760	7,110	12,090	23,960	15
20	199	409	706		40	30	30		7,960	12,270	21,180	41,410	20
25	303	634	1106		40	30	30		12,120	19,020	33,180	64,320	25
30	433	916	1611		40	30	30		17,320	27,480	48,330	93,130	30
35	589	1258	2225		40	30	30		23,560	37,740	66,750	128,050	35
40	772	1663	2954		40	30	30		30,880	49,890	88,620	169,390	40
45	984	2132	3801		40	30	30		39,360	63,960	114,030	217,350	45
50	1225	2668	4771		40	30	30		49,000	80,040	143,130	272,170	50
55	1496	3274	5868		40	30	30		59,840	98,220	176,040	334,100	55
60	1799	3951	7097		40	30	30		71,960	118,530	212,910	403,400	60
65	1799	3951	7097		40	30	30		71,960	118,530	212,910	403,400	65
	Slow	Moderate	Fast										Years
Age													
1+	15	15	60									16,305	5
5+	40	30	30									38,105	10
												70,930	15
												115,800	20
												173,545	25
												244,945	30
												330,595	35
												431,115	40
												546,970	45
												678,755	50
												827,030	55
												915,470	60

Appendix E

Micro Hydro PowerSpout LH Advanced Calculator Results

POWERSPOUT RESULTS

Below please find the requested results from the PowerSpout Advanced Calculator:
Your Reference is: LH9369
Your Job Reference is: The Barn, Market Bosworth

Preferences
These are the preferences you indicated and any applicable safety notes.
Units: Metric
Type: LH/LH Pro

Operation of the LH hydro generates voltages that exceeds the ELV (Extra Low Voltage) limits for non electrical workers to maintain.
Please ensure you hire a registered electrical worker.

Please note
Only the performance of the LH Hydro turbine is warranted to meet the predictions made in this tool. The losses calculated in the flow of water through the flume/pipe to your LH Hydro(s) is your responsibility and are provided here free of charge for your guidance only. If you require guaranteed performance for your flume/pipe then please obtain independent engineering advice.

HYDRO

Notes:

Results:
Available Flow: 30.0 Ips
Used Flow: 30.0 Ips
LH Head: 3.2 m
Pipe Material: Drawn plastic tube
Pipe Fall: 28 mm
Pipe Diameter: 400 mm
Pipe Length: 100.0 m
Water Depth in Pipe: 249 mm at 0.4m/s
Pipe Capacity: 46.17 Ips
Draft Tube Diameter:240 mm
Number of Powerspout LH Units: 1
Operating RPM: 805 rpm
“No Load” RPM: 1846 rpm

ELECTRICAL

Notes:
Your cable efficiency target has been ignored and a larger cable size calculated to carry the current from the LH hydro unit(s). If you only have a smaller sized cable to use then either increase the operating voltage or reduce the number of LH hydro units.

Cable size is within 50% of likely current rating. Cable loss calculations are based on a 20 deg C (68 deg F) conductor temperature. Please check with your cable supplier for suitability for current handling, temperature rise and loss at this current.

The no load voltage from the LH Hydro is close to the Vmax of your inverter/charge controller will accept. Exceeding Vmax for a charge controller/inverter is usually destructive. Failure to follow documented commissioning procedures may result in the damage of your inverter/charge controller at your expense! No warranty is provided for failure to follow instructions.

Table mode (in some inverters) can be used to resolve MPPT tracking stability issues. Below is a suggested table that will help in getting you started. On site adjustment (by trial and error) will be needed to get the best result when using table mode. Only Power-One, EnaSolar and Ginlong inverters have a table mode setting. Some off grid MPPT regulators also have table modes.
Suggested table
min voltage setting, min power setting
93, 109
104, 218
116, 437
127, 655
139, 874
max voltage setting, max power setting

Recommended SD stator is 80-7s-2p-delta(provisional)
(This code is copyright of Ecolnnovation)

The following are other SD type code options and may be more suitable for your site.
These are the most useful SD stator/rotors of the 193 options found.
Operating at 0.538 W/rpm

SD code	Vo	Voc	V/rpm
100-14S1P-D	90	281	0.152
80-7S2P-D	118	367	0.199
60dc-4S3P-D	113	351	0.213
100-7S2P-S	79	246	0.133

60-2S7P-S	86	268	0.145
60dc-2S6P-S	99	308	0.187
60dc-3S4P-D	84	263	0.16
80-2S7P-S	59	184	0.1
60R85-6S2P-S(4)-HP	101	350	0.242
60R85-12S1P-D(4)-HP	116	399	0.276
60R120-4S3P-S(3)-HP	111	356	0.23
60R90-6S2P-S(4)-HP	108	375	0.259
60R120-6S2P-D(3)-HP	95	304	0.197
60R110-4S3P-S(3)-HP	102	327	0.211
60R110-6S2P-D-HP	117	333	0.18
60R100-4S3P-S-HP	124	354	0.192
60R100-6S2P-D-HP	106	303	0.164
60R90-4S3P-S-HP	112	319	0.173
60dc-2S6P-D	56	176	0.106
60R90-6S2P-D-HP	95	272	0.147

Results:
LH Output Voltage: 120 V
LH “No Load” Voltage: 367 V
Target Cable Efficiency: 90 %
Actual Cable Efficiency: 96 %
CableLength: 20 m
Load Max Voltage: 400 V
Load Min Voltage: 50 V
ActualLoadVoltage: 116 V
Cable Material: Copper
Cable Size: 0.571 mm^2
Cable AWG: 19 AWG
Cable Amperage: 3.8 A

ACTUAL TOTAL OUTPUT: 437 W

Studio Bark

Environmental Design

www.studiobark.co.uk