

Passivhaus Verification

LETI Operational and Embodied Carbon

Concept Stage

Summary Report



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Ref:	22-109-2.4-O&EC Summary
Revision	A

Rev A: Operational Calculations and summary sheet added for the supporting living for autistic adults block, 16.01.24

Introduction

This report outlines the methodology we have used to assess the proposals for Ryebank against Passivhaus criteria as well as calculate the Concept Stage Operational and Embodied Carbon emissions. These are then benchmarked against LETI targets.

We have modelled 7 block types which represent the typical proposed building types across the site including.

- Age friendly apartments— southern block. (20 dwellings)
- Age friendly apartments—northern block (22 dwellings)
- Southern Terrace Terrace. HT1A&B (10 dwellings)
- A semi-detached villa HT (2 dwellings)
- A northern terrace HT4 (7 dwellings)
- Co-housing apartments (12 dwellings)
- Supported Living for Autistic Adults (8 dwellings)*

A summary sheet of each block type is provided in Appendix B.

Methodology

Using Design PH, a plugin to Sketchup we have created a 3D model of each block type and the surroundings. This model establishes the building orientation, area of thermal envelope, window openings and shading from surrounding buildings, landscape and trees, both in winter and summer.

This data is then exported into the Passivhaus Planning Package (PHPP) for the detailed calculation of the energy performance.

* NOTE The embodied carbon calculations for the Autism Block have not yet been carried out.

Ryebank — Chorlton

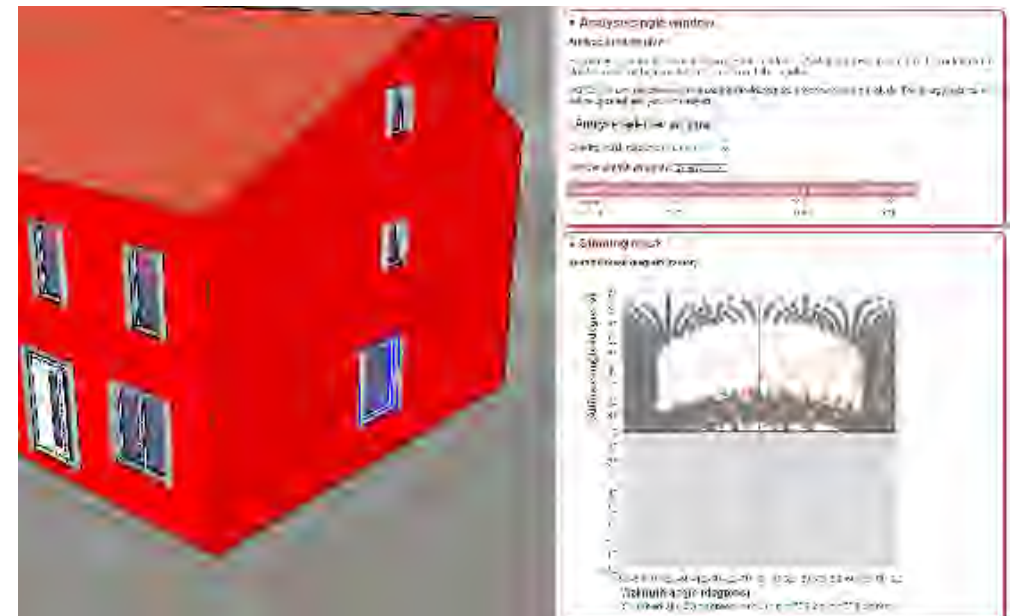
Winter



Summer



Shading of windows



PHPP Analysis

Within the PHPP we add data for each block, including the U values of the external fabric, performance of windows, MVHR system, heating, hot water and ancillary electrics as well as the area and performance of the Photovoltaics.

All of the 6 block types are meeting the Passivhaus performance requirements at this stage which are.

- An annual space heating demand <=15KWh/m² annum
- Or
- A peak heating load <= 10W/m²
- And
- Overheating < 10% annum
- A Primary Energy Renewable (PER) <=60KWh/m² annum.

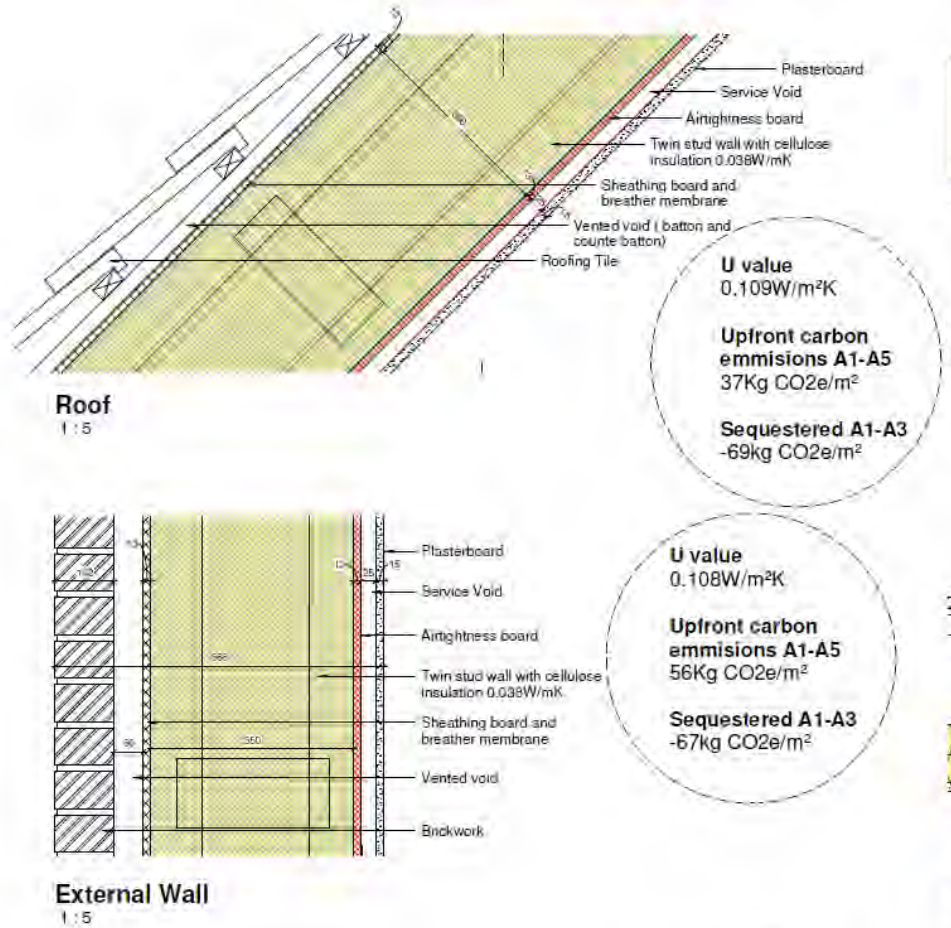
The Passivhaus criteria for Space Heating Demand is in line with the guidance in Places for Everyone for flats and an improvement on the target for houses.

	Space Heat Demand	Hot Water Energy Demand	Renewable Energy Generation
2025 - onwards	Houses (20kWh/m2) Flats (15kWh/m2)	20% energy demand reduction in the total heat required for water heating	*Photovoltaic installation: 40% ground floorspace
Proposed scheme Houses	15kWh/m2/a	Reduce demand by • Low flow showers	Roof PVs are maximised
Flats	15kWh/m2/a	• Waster water recycling	Roof PVs provide approx 70% of EUI

Places for Everyone—Metrics for Domestic Buildings

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Fabric build ups



Verification

Passive House-Verification

Building: Rybank Fields
Street: Terrace House Type 1A and 1B
Postcode/City: Manchester
Province/Country: Greater Manchester GB-Vereiniges Königreich
Building type: 4-Row house
Climate data set: GB0008a-Fairfield, Altitude corrected
Climate zone: 3: Cool-temperate Altitude of location: 28 m
Home owner / Client: Step Places
Street: Unit 4, Royal Mills, 17 Redhill Street
Postcode/City: M4 5BA Manchester
Province/Country: Greater Manchester GB-Vereiniges Königreich
Mechanical engineer: Ridge and Partners
Street: 2nd Floor, 100 Embankment, Cathedral Approach
Postcode/City: M3 7FB Manchester
Province/Country: Greater Manchester GB-Vereiniges Königreich
Certification: Zero Energy and Passivhaus
Street: Suite 6, 3 Elm Grove, Didsbury
Postcode/City: M20 6PL Manchester
Province/Country: Greater Manchester GB-Vereiniges Königreich

Architecture: S Plus Architects
Street: 4th Floor, The Hive, 47 Lever Street
Postcode/City: M1 1FN Manchester
Province/Country: Greater Manchester GB-Vereiniges Königreich
Energy consultancy: phi Low Carbon
Street: Bank Chambers
Postcode/City: SK1 1AR Stockport
Province/Country: Greater Manchester GB-Vereiniges Königreich

Year of construction: 2026
No. of dwelling units: 10
No. of occupants: 25.2

Interior temperature winter [°C]: 20.0
Interior temp. summer [°C]: 25.0
Internal heat gains (IHG) winter [W/m²]: 2.6
IHG summer [W/m²]: 2.6
Specific heat capacity [Wh/K per m² TFA]: 84
Mechanical cooling:

Specific building characteristics with reference to the treated floor area					
	Treated floor area m²		Criteria	Alternative criteria	Fulfilled?²
Space heating	Heating demand kWh/(m²a)	9	≤ 15	-	Yes
	Heating load W/m²	8	≤ 10	-	-
Space cooling	Cooling & dehum. demand kWh/(m²a)	-	≤ -	-	-
	Frequency of overheating (> 25 °C) %	1	≤ 10	-	Yes
Airtightness	Frequency of excessively high humidity (> 12 g/kg) %	0	≤ 20	-	Yes
	Pressurisation test result n50 1/h	0.6	≤ 0.6	-	Yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	45	≤ -	-	-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	36	≤ 60	60	Yes
	Renew. energy generation (in rel. to kWh/(m²a) projected building footprint area)	93	≥ -	-	Yes

² Empty field: data missing; ∅ No requirement

I confirm that the values given here have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

Task: First name: Surname: Signature:
Certificate-ID: Jeremy Poulter Issued on: City:

Passive House Classic? Yes

Project data imported from designPH 2.2.20 2024-11-29 11:49:17 -0000



Summer strategy

Summer overheating is a key consideration within the PHPP which considers the risk of overheating to the whole block. It is our view that the frequency of overheating should be brought down to at least 2% within the PHPP calculations to allow for extraordinary situations.

The PHPP includes a stress test to these extraordinary situations which includes reduced window ventilation, removal of any temporary shading, increased occupancy or increased external temperatures.

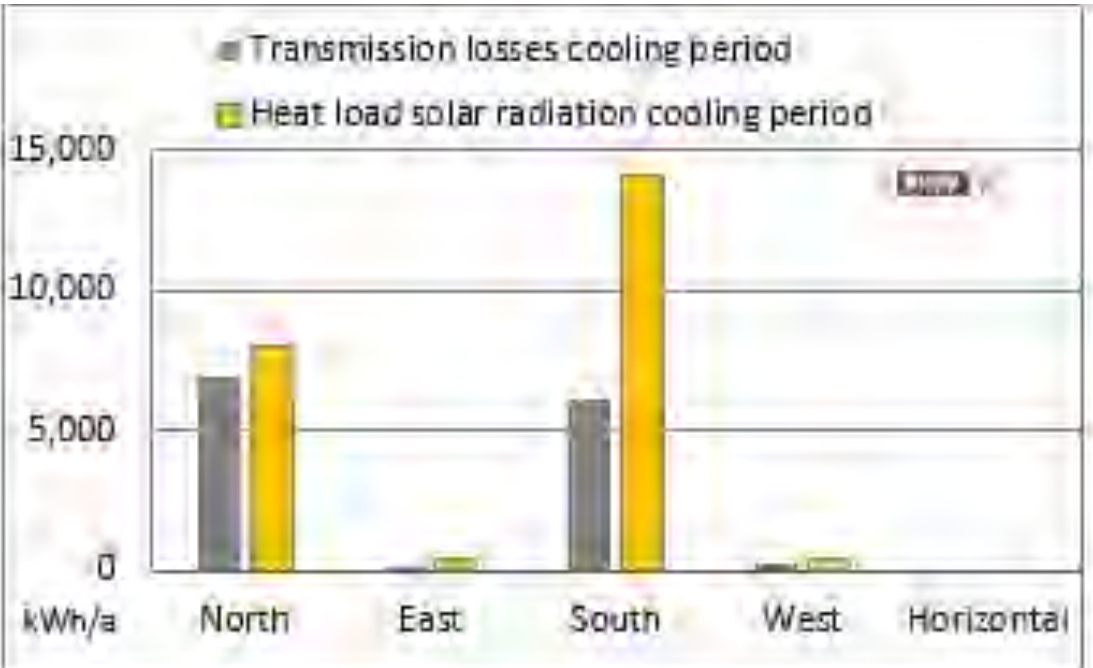
Our baseline summer strategy assumes that for reasons of security, windows cannot be opened during daytime hours and that as with TM59 guidance, internal blinds cannot be relied upon to be drawn during the daytime.

It is however assumed that overnight a small amount of natural ventilation can be provided through windows on tilt only. For the apartment blocks, opening the ground floor windows at night might not be possible, due to security, therefore a strategy for secure opening vents should be incorporated.

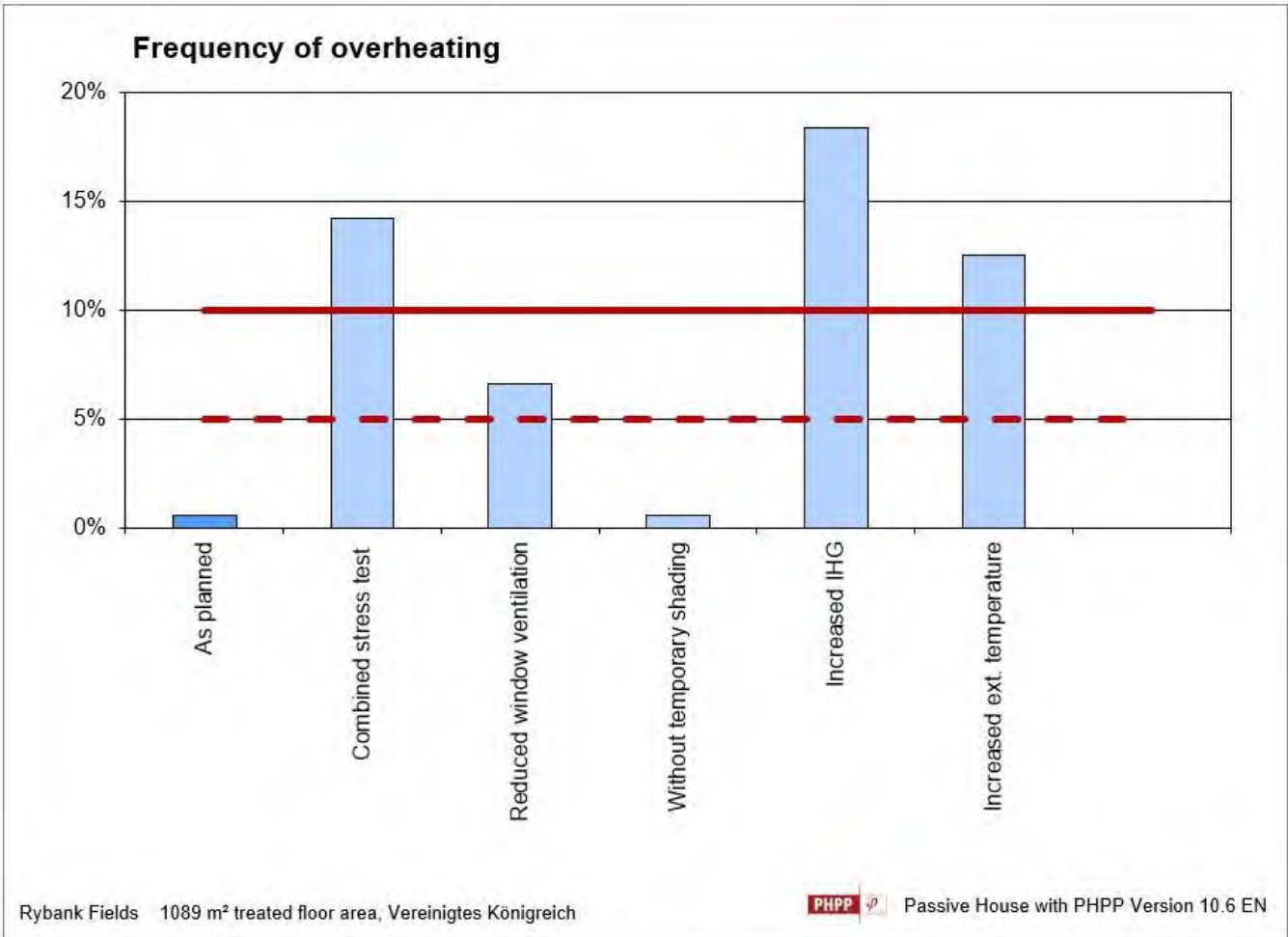
The MHVR system operates at its normal rate during the day but is boosted overnight to increase the air change rate and benefit from the cooler nighttime temperatures.

As the PHPP calculations are an analysis of the whole block, individual rooms or houses may be susceptible to overheating due to their orientation and shading and these will need more specific dynamic modelling.

Summer solar gains and heat losses through windows.



Summer stress test



Benchmarking— LETI Operational Energy

The PHPP also generates information on the overall energy use or Energy Use Intensity (EUI) of the block, based on occupancy. This includes

- Household electricity
- Domestic hot water generation
- Space Heating
- Cooling and dehumidification

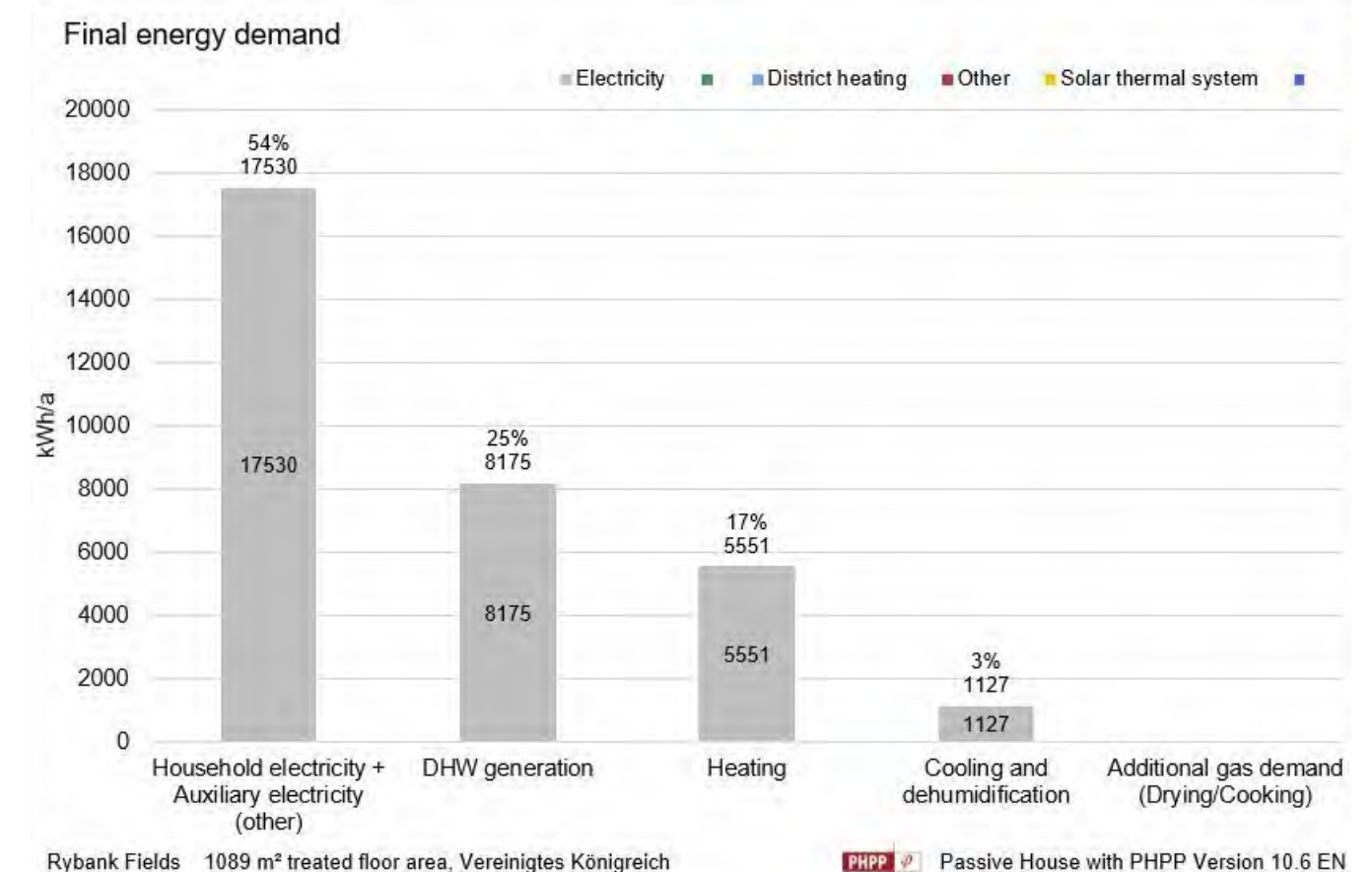
This total figure can then be benchmarked against the LETI Operational Energy EUI target of 35KWh/m² annum.

At this concept stage we have added a 15% contingency to the total figures in accordance with RICS Whole Life Carbon assessment procedures.

For the houses, where an Air Source Heat Pump is proposed for both the heating and hot water we are coming in under the target.

For flats where, for simplicity and maintenance, we are using a direct electric heating and hot water, the figures are coming out above the target.

However, sitewide, these two strategies are balancing each other out. A sitewide summary is provided in Appendix A , whilst a summary sheet for each of the block types is provided in Appendix B



Benchmarking— LETI Renewables

The PHPP also includes a Photovoltaic systems sheet which calculates the estimated annual yield based upon the orientation and performance of the panels and any shading.

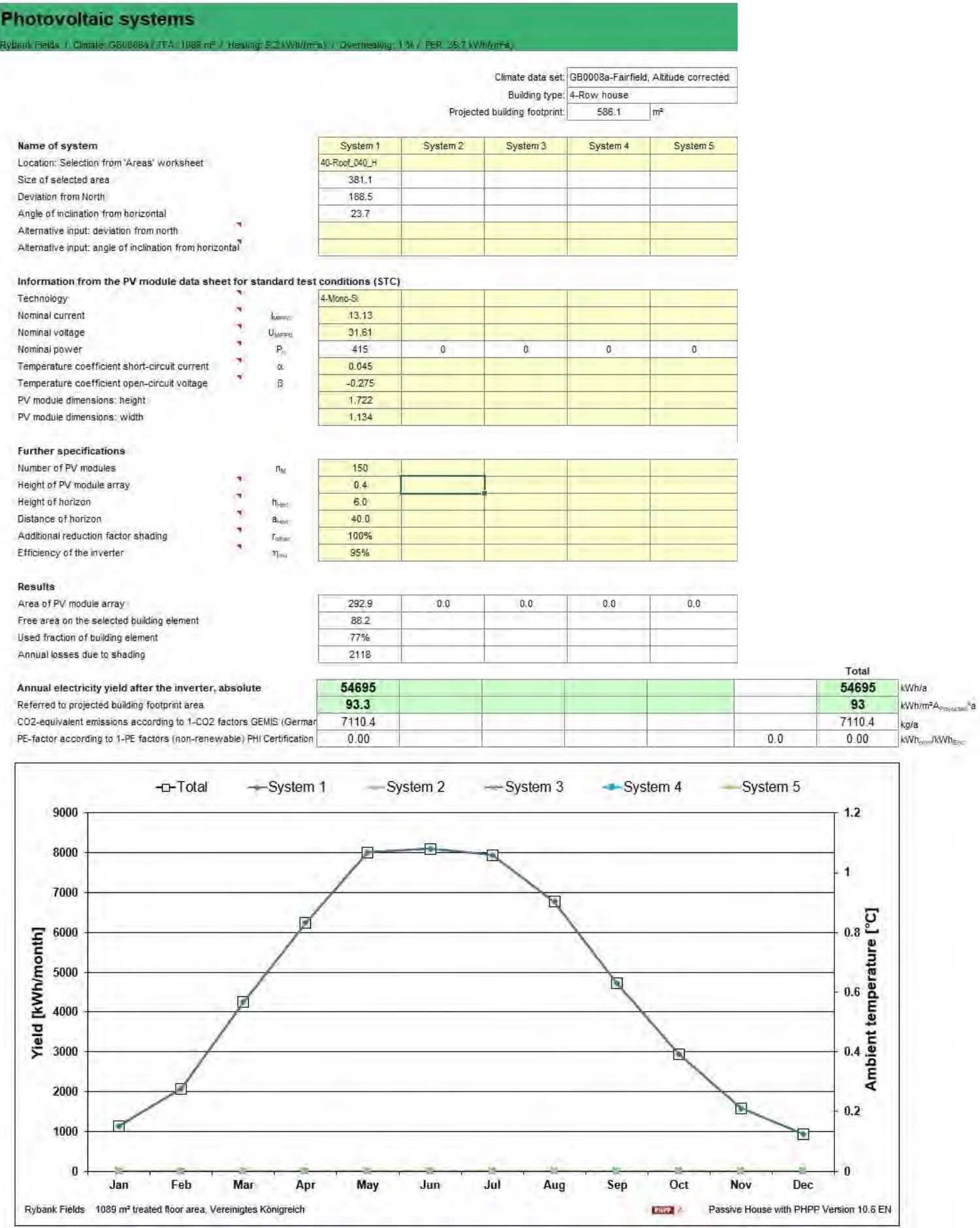
LETI guidance advices that 100% of the energy demand for houses should be matched by the PV yield. For flats the guidance recommends that 70% of the roof area is covered with PV.

On this project there are certain house types where there is not the space for PV panels on the roof, such as the Villas, where the annual yield is relatively low. However other types, such as the terraces with their south facing roofs achieve a higher yield than 100% balancing this out.

Demand Response.

The dwellings will include smart metering and battery storage to make full use of variable rate tariffs and draw electricity when it is at its cheapest and lowest carbon.

In the flats, the use of either a direct electric cylinder or heat battery will allow occupants to heat and store their hot water when electricity is at its cheapest.



Benchmarking— LETI Embodied Carbon

The embodied carbon of the development is the sum of the carbon emitted in the manufacture of the construction materials, their transport to site, their erection and ultimately their demolition. The recognised method of calculating Embodied Carbon is using the RICS Whole Life Carbon Assessment version 2 which became effective in July 2024.

The LETI Climate Emergency Design Guide sets targets using this methodology for both the upfront embodied carbon (A1-3) and Cradle to Grave embodied carbon (A1-5, B1-5, C1- C4) and uses an A**-G rating scale. As a benchmark a B rating is considered good practice whilst A** represents best practice. An F/G rating represents the current average design.

We have used PHRibbon, a plug in to PHPP to carry out Concept Stage Embodied Carbon assessments on the key building types following the RICS methodology. This concept stage assumes a 15% contingency and the results are generally showing that the proposals are falling within a B rating.

This primarily is achieved through the use of a timber framed superstructure for all of the buildings using bio based cellulose insulation. The other key driver is the compact form factor of all the buildings, which means that more floor area is provided for less external fabric.

A sitewide summary is provided in Appendix A , whilst a summary sheet for each of the block types is provided in Appendix B

Assumptions

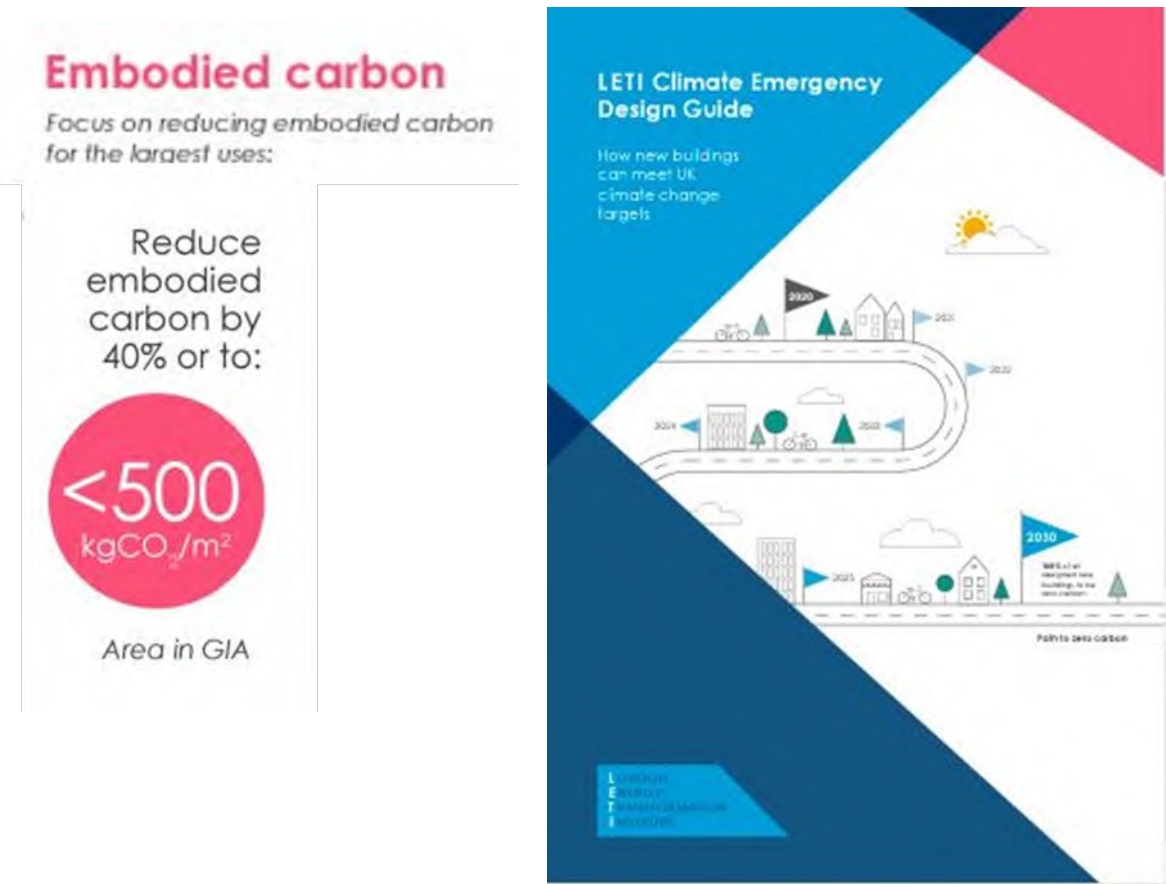
This is a Cradle to Grave calculation (stages A-C) for RIBA/RIAI and LETI targets. Data is also laid out in the RICS layout, though RICS requires a lot more, for example site based emissions, estimation of plug loads (if not already in PHPP), and Module D. It follows the RICS professional statement edition 2 version3, Aug 2024 for concept design stage though is not an official RICS calculation. It is based on the external dimensions in PHPP which overestimates quantities slightly.

- A0 Non material** - not calculated but could be added, not needed for RIBA or LETI
- A1-A3 Sequestration** is only included if 100% FSC/PEFC, or it uses a proportion pro-rata
- A1-A3 Manufac** emissions from raw material extraction, transport and processing, these can be per m3, m2, m or kg
- A4 Transport to site** includes the 43% empty running factor for the return journey, except for in-situ concrete where the empty running factor is 100% (always empty)
- A5.1 Preconstruction demolition** is a fixed amount per m2 GIA
- A5.2 Construction** is calculated for totals only
- A5.3 Construction waste** is a fixed percentage for each material type, most are specified by RICv2

- B1.1 Use**, data taken from EPD if given, but factored to the RSP 60yrs, this includes carbonation by concrete during the RSP (not the life of the concrete which is much longer, 150yrs)
- B1.2 Refrigerants**, data taken from EPD if given, factored up to the whole RSP
- B2-3 Repair**, data taken from EPD if given, factored up to the whole RSP
- B4 Replacement**, repeats module A and C for the number of replacements
- B5 Refurb**, optional figures to be manually adjusted, life of product becomes the refurb interval and B4 emissions become B5.
- B6.1-6.3 Operational Energy Use** only the emissions in PHPP are included, the rest, e.g. plug loads could be added but are not automatically included in PHPP, so would require extra assumptions.
- B7.1-7.3 Water** cells are provided for you to enter the use in the Embod tab, though carbon figures are not required for RIBA or LETI.
- B8.1-8.2 User Activities** not reported here yet

- C1 Demolition** calculation based on GIA and user selection of business as usual (BAU), Good Practice or Best Practice
- C2 Transport**, includes empty running factor for return journey. Reuse is included only if the reuse is expected to be offsite
- C3 Waste Processing**, uses the RICSv2 reuse/recycling rates and user selection of business as usual (BAU), Good Practice or Best Practice. Includes incineration only if an R1 facility
- C4 Waste Disposal**, uses the RICSv2 landfill rates and user selection of business as usual (BAU), Good Practice or Best Practice. Includes incineration local sites not R1 facilities
- D1 Potential Benefits / D2 Exported Benefits** - not calculated but could be added, not needed for RIBA or LETI

Ryebank — Chorlton



Project Name Rybank Fields Project Sector Domestic Assessment Date 29/11/2024 Assessment By (company) phi Low Carbon Location of Data -		Embodied Carbon A1-5, B1-5, C1-4 kgCO ₂ e/m ²
A++ A+ A B C D E F G	Upfront Carbon A1-5 exc. Sequestration	
	100	150
	200	300
	300	450
	400	625
	500	800
	675	1000
	850	1200
	1000	1400
	1200	1600

Exclusions— LETI Embodied Carbon

Some key points about the scope of the calculations.
Based on LETI guidance the calculations exclude.

Renewables.

This is because PV panels have a high embodied carbon which would skew the results, whilst not capturing the benefits they provide from the displacement of carbon that would be required to generate energy from the grid. This is a key difference between LETI and RIBA 2030 Climate Challenge figures.

Non fixed FFE

To avoid any difficulty comparing buildings that are fitted out with those that aren't, most often developer dwellings, this element is excluded.

External Works

Both within and outside the site boundary. This is primarily to allow buildings to be compared against each other, without any confusion over the extent of the surroundings that should, or should not be included.

At this stage we have not included calculations for these elements but that is not to say that these elements cannot be calculated and reported separately.

Ryebank — Chorlton

Calculation Scope Summary

Date of assessment	29/11/2024	Year of project completion	2026
Carried out by	phi Low Carbon		
Project type	New build		
Assessment objective	Brief assessment purpose statement		
Project location	Rybank Fields		
Property type	Domestic		
Building description	2 and a half storey terrace of 10 houses		
Size: TFA 1089 m ² GI 1222 m ² for scenario 1			
Reference Study Period:	60 years		
Assessment scope:	Cradle to Grave as in RICSv2		
Assessment stage:	Concept stage (Design stage would require uncertainty factors not yet implemented)		
Data sources:	PHribbon: PHPP for external dimensions of thermal elements Specific EPD certificates, (possibly also some ICE Database 2019)		

Building elements coverage		RIBA and LETI say 95% of the cost should be included		
# Building parts	Building elements	Tonnes CO ₂	% incl	Clarification if needed
0 Facilitating works	0.1 Temporary/Enabling works/Preliminaries	0	100%	
1 Substructure	1.1 Substructure	90	100%	
2 Superstructure	2.1 Frame	41	100%	
	2.2 Upper floors incl. balconies	41	100%	
	2.3 Roof	41	100%	
	2.4 Stairs and ramps	41	100%	
	2.5 External Walls	140	100%	
	2.6 Windows and External Doors	140	100%	
	2.7 Internal Walls and Partitions	30	100%	
	2.8 Internal Doors	30	100%	
3 Finishes	3.1 Wall finishes	13	100%	
	3.2 Floor finishes	13	100%	
	3.3 Ceiling finishes	13	100%	
4 Fittings, furnishings and	Fixed (Building-related)	2	100%	
	Non Fixed (Non Building-related), excluded by LETI	0	100%	
5 Building Services/MEP	5.1 Public Health	20	100%	
	5.2 Heating, Ventilation and Cooling (HVAC) & Refrigerant	121	100%	
	5.3 Electrical installations	33	100%	
	5.4 On site renewable energy generation	348	100%	
	5.5 Systems including life safety, fuel installations, lift and convey	0	100%	
6 Prefab Buildings/Units	6.1 Prefabricated Buildings and Building Units	0	100%	
7 Existing Building	7.1 Minor Demolition and Alteration Works	0	100%	
8 External works	Within site boundary	0		
	Outside the site boundary	0		

RIBA/RIAL CHALLENGE includes
LETI includes

Appendix A

Ryebank Fields Sitewide Operational and Embodied Carbon Calculation														
Block	no of dwellings	GIA (m²)	Operational		Embodied		A1-A5 B1-B5 (Total		Sequestered		Module D		Renewables	
			EUI (KWh/m²annum)	Total EUI (KWh annum)	A1-A5	Total	A1-A5 B1-B5	Total	Sequestered	Total	Module D	Total	Generated	
Z2 Block 1 South - Age Friendly	20	1297	54	70038	370	480	533	691	-302	-392	0	0	38993	56%
Z2 Block 1 North - Age Friendly	22	1420	51	72420	310	440	447	635	-220	-312	0	0	37816	52%
Z2 Block 4 HT1A&B Terrace	10	1222	31	37882	298	364	518	633	-157	-192	-5	-6	54695	144%
Z1 Block 6 HT 2A&B Villas 1	2	340	28	9520	316	107	502	171	-150	-51	0	0	5179	54%
Z1 Block 6 HT 2A&B Villas 2	2	340	28	9520	316	107	502	171	-150	-51	0	0	5179	54%
Z1 Block 6 HT 2A&B Villas 3	2	340	28	9520	316	107	502	171	-150	-51	0	0	5179	54%
Z1 Block 6 HT 2A&B Villas 4	2	340	28	9520	316	107	502	171	-150	-51	0	0	5179	54%
Z1 Block 6 HT 2A&B Villas 5	2	340	28	9520	316	107	502	171	-150	-51	0	0	5179	54%
Z1 Block 7 HT4 A&B Terrace 1	7	887	35	31045	309	274	421	373	-174	-154	-2	-2	33386	108%
Z1 Block 7 HT4 A&B Terrace 2	7	887	35	31045	309	274	421	373	-174	-154	-2	-2	33386	108%
Z1 Block 8 HT4 A&B Terrace 1	7	887	35	31045	309	274	421	373	-174	-154	-2	-2	33386	108%
Z1 Block 9 HT4 A&B Terrace 2	7	887	35	31045	309	274	421	373	-174	-154	-2	-2	33386	108%
Z1 Block 8 HT4 A&B Terrace 1	4	507	35	17745	309	157	421	213	-174	-88	-2	-1	19077	108%
Z2 Co housing apartments	12	1059	54	57186	422	447	559	592	-279	-295	0	0	48718	85%
Z2 Co housing Terrace	6	420	31	13020	298	125	518	218	-157	-66	-5	-2	18749	144%
Autism Friendly (Embodied not modelled)	8	619	55	34045	TBC	TBC	TBC	TBC	TBC	TBC	TBC	TBC	13805	41%
Total	120	11792		474116		3646		5329		-2218		-16	391291.8	
Sitewide average per m²			Operational		Embodied								Renewables	
			EUI		A1-A5		A1-A5 B1-B5 C1-C4		Sequestered		Module D		Generated	
			40 KWh/m²annum		326 kgCO2e/m²		477 kgCO2e/m²		-199 kgCO2e/m²		-1.5 kgCO2e/m²		83%	
			minus 15% plus 15%		minus 15% plus 15%		minus 15% plus 15%		minus 15% plus 15%		minus 15% plus 15%		minus 15% plus 15%	
Range			35 46		284 375		415 549		-173 -228		-1 -2		72% 95%	
NOTE: Text in Purple are the blocks that have been modelled. All other blocks are estimates based upon similar block types.														

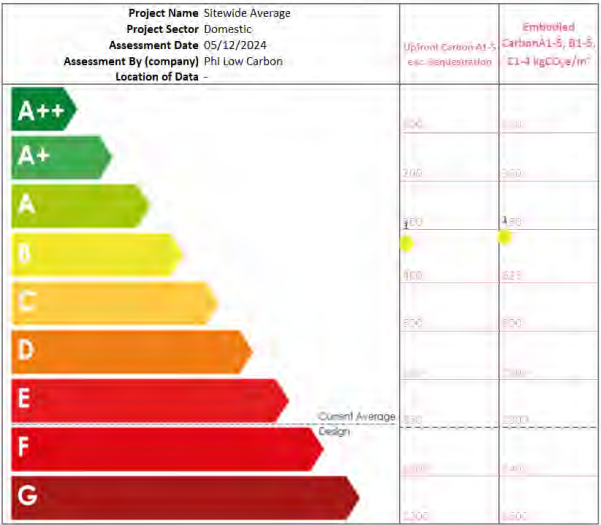
Operational Energy

These figures include a 15% contingency as this is a Concept Stage assessment. Whilst the houses are below the target, the flats are above it. However, these 2 average out across the scheme.

Whilst the sitewide average is above the 35KWh/m² EUI LETI target is within range and given that the proposals are to be certified as Passivhaus, we would expect the actual operational energy performance to be close to the designed target with no performance gap. With the contingency this is likely an overestimate of performance. .

Embodied Carbon

The proposals average below the 500KgCO2e/m² LETI Target and this includes the 15% contingency required at Concept Stage. Overall, this makes the proposals a solid B rating on LETI Embodied Carbon Graph.



Appendix B

Block Operational and Embodied Carbon Summary Sheets

Summary Sheet

Passivhaus Verification

LETI Operational and Embodied Carbon Report

Block	Age Friendly South
No of Dwellings	20 apartments
Orientation of Principal (street)Elevation	9 (North elevation)
Treated Floor Area m² (TFA)	1051.7m2
Form Factor	1.8
Performance against Passivhaus Criteria	
Annual Heating Demand <= 15KWh/m²y	10
Heat Load <=10W/m²	8
Airtightness <=0.649 @50pa	0.649
Frequency of overheating <10%	7% (without window vent)
PER <=75 KWh/m²y	69
Space Heating method	Electric
Hot Water method	Electric cylinder or heat battery

Further overheating analysis is required to check the apartments on the second floor on the south and west elevations for Part O compliance on a room by room basis.

The model assumes the following Summer Ventilation strategy.

MVHR to have automatic summer bypass controlled by temperature difference with boost.

No window opening during daytime hours for security reasons whilst people are likely to be away from home.

Overnight ventilation via tilted windows to the first floor bedrooms only. Closed bedroom doors mean no significant through ventilation. 0.1ach achieved for the whole house. NOTE, These dwellings are away from a main road where noise

NOTE: Results in the tables and graphic include a 15% contingency as required by RICSv2 for early design phase. The Range shows the potential for reductions or additions as the proposals are developed.

Ryebank — Chorlton

Specification of Thermal Elements		U Value W/m²K
Ground Floor	75mm screed; 190mm PIR Insulation; Beam and Block	0.11
External Walls	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, cavity and wall ties, brickwork	0.15
Roof	12.5mm plasterboard; posi joists, WBP decking on firrings, vcl, 190mm PIR insulation, roofing membrane	0.11
Window Frames	Ideal Combi frames	1.76 (jamb)
Glazing	Triple glazing (g value 0.53) (1.04 ave U value installed)	0.57
MVHR	Zehnder Group Nederland B.V. - ComfoAir200 Heat recovery Efficiency 92% NOTE: Must be Passivhaus certified otherwise efficiency is penalised	

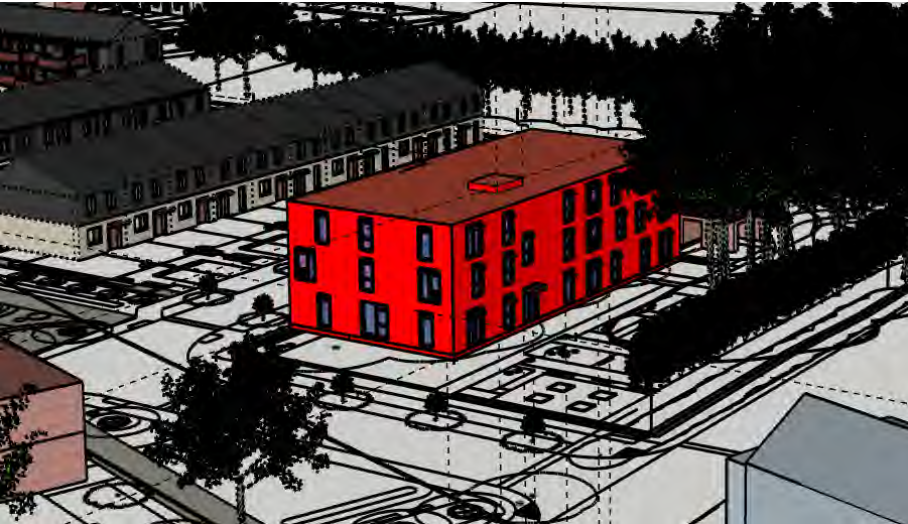
Performance against LETI	
GIA m²	1297

Operational Energy		Range –15%/+15%
EUIkWh/m2/annum	54	43.35—58.65

Embodied Carbon		Range –15%/+15%
Upfront Carbon A1-A5 kgCO2e/m²	370	314.5-425.5
Embodied Carbon A1-A5, B-B5,C1-4 kgCO2e/m²	533	453-613
Sequestered Carbon kgCO2/m²	-302	256.7- 347.3
Module D kgCO2/m²	0	

Renewable Energy Generation		Range –15%/+15%
KWh/annumn	38993	33144—44842
%of EUI	56%	

phi Low Carbon



Operational energy

Implement the following indicative design measures:

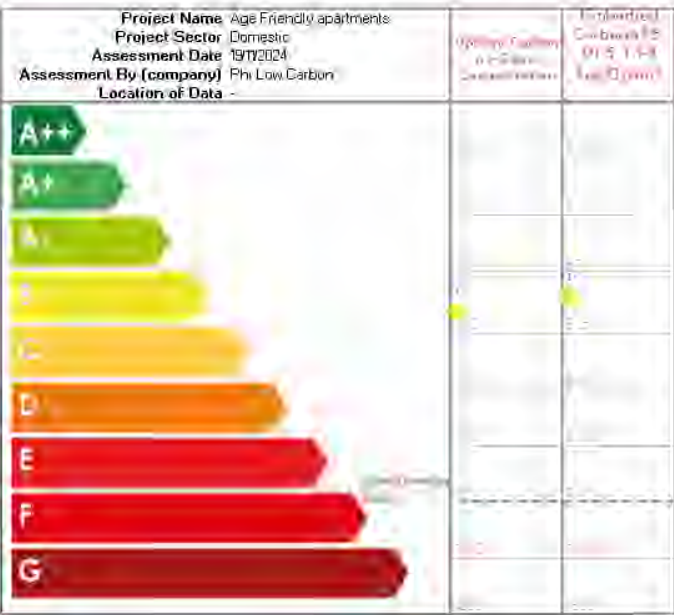
Reduce energy consumption to:

35 kWh/m².yr

Energy Use Intensity (EUI) in GIA, excluding renewable energy contribution

LETI Embodied Carbon Rating

LETI Results graphic: Coloured dots labelled 1-12 are the results for scenarios 1-12.



Summary Sheet

Passivhaus Verification

LETI Operational and Embodied Carbon Report

Block	Age Friendly Apartments
No of Dwellings	22 apartments
Orientation of Principal (street)Elevation	196 (South~)
Treated Floor Area m² (TFA)	1133m2
Form Factor	1.83
Performance against Passivhaus Criteria	
Annual Heating Demand <= 15KWh/m²y	8
Heat Load <=10W/m²	7
Airtightness <=0.649 @50pa	0.649
Frequency of overheating <10%	7% (without window vent)
PER <=75 KWh/m²y	71
Space Heating method	Electric
Hot Water method	Electric cykinder or heat battery

Further overheating analysis is required to check the apartments on the upper floors on the south and west elevations for Part O compliance on a room by room basis.

The model assumes the following Summer Ventilation strategy.

MVHR to have automatic summer bypass controlled by temperature difference with boost.

No window opening during daytime hours for security reasons whilst people are likely to be away from home.

Overnight ventilation via tilted windows to the upper floor apartments only. 0.1ach window ventilation assumed. NOTE, Ground floor flats to be considered with SBD

NOTE: Results in the tables and graphic include a 15% contingency as required by RICSv2 for early design phase. The Range shows the potential for reductions or additions as the proposals are developed.

Ryebank — Chorlton

Specification of Thermal Elements		U Value W/m²K
Ground Floor	75mm screed; 190mm PIR Insulation; Beam and Block	0.11
External Walls	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, cavity and wall ties, brickwork	0.15
Roof	12.5mm plasterboard; posi joists, WBP decking on firrings, vcl, 190mm PIR insulation, roofing membrane	0.11
Terrace	As above	
Window Frames	Ideal Combi frames	1.76 (jamb)
Glazing	Triple glazing (g value 0.53) (1.04 ave U value installed)	0.57
MVHR	Zehnder Group Nederland B.V. - ComfoAir200 Heat recovery Efficiency 92% NOTE: Must be Passivhaus certified otherwise efficiency is penalised	

Performance against LETI	
GIA m²	1420

Operational Energy		Range –15%/+15%
EUIkWh/m2/annum	51	43.3—58.7

Embodied Carbon		Range –15%/+15%
Upfront Carbon A1-A5 kgCO2e/m²	310	263.5 - 356.5
Embodied Carbon A1-A5, B-B5,C1-4 kgCO2e/m²	447	380 - 514
Sequestered Carbon kgCO2/m²	-220	187-253
Module D kgCO2/m²	0	

Renewable Energy Generation		Range –15%/+15%
KWh/annumn	37816	32143.6—43488
%of EUI	52%	



Operational energy

Implement the following indicative design measures:

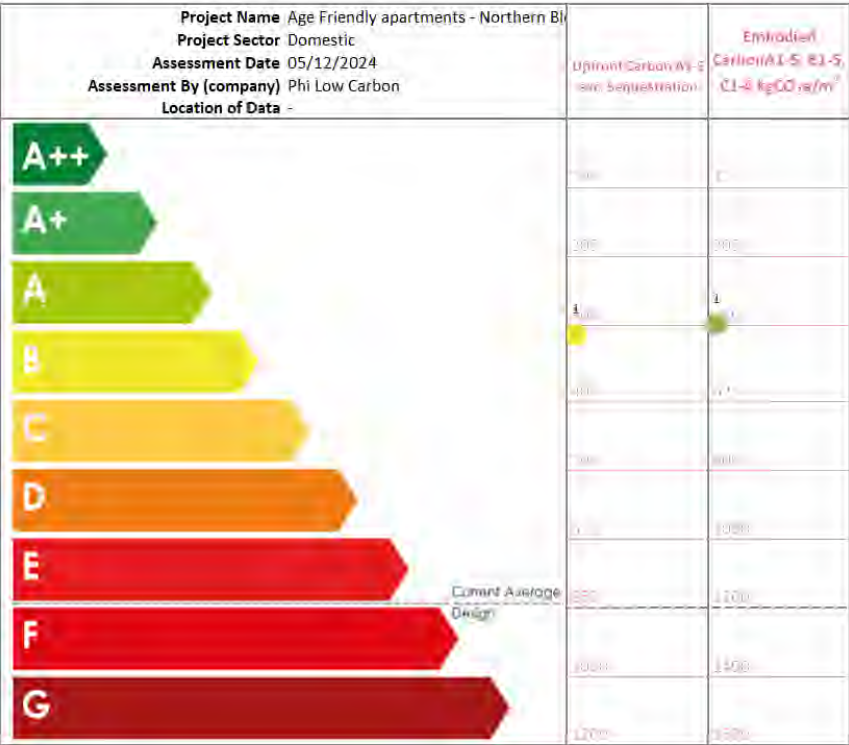
Reduce energy consumption to:

35 kWh/m².yr

Energy Use Intensity (EUI) in GIA, excluding renewable energy contribution

LETI Embodied Carbon Rating

LETI Results graphic. Coloured dots labelled 1-12 are the results for scenarios 1-12.



Summary Sheet

Passivhaus Verification

LETI Operational and Embodied Carbon Report

Block	Terrace Block 7 HT4B
No of Dwellings	7
Orientation of Principal (street)Elevation	West
Treated Floor Area m² (TFA)	796.6
Form Factor	2.23
Performance against Passivhaus Criteria	
Annual Heating Demand <= 15KWh/m²y	10
Heat Load <=10W/m²	8
Airtightness <=0.649 @50pa	0.649
Frequency of overheating <10%	15% (no window vent)
PER <=60 KWh/m²y	41
Space Heating method	Air Source Heat Pump
Hot Water method	Air Source Heat Pump and Cylinder

Further overheating analysis is required to check the apartments on the second floor on the south and west elevations for Part O compliance on a room by room basis.

The model assumes the following Summer Ventilation strategy.

MVHR to have automatic summer bypass controlled by temperature difference with boost.

No window opening during daytime hours for security reasons whilst people are likely to be away from home.

Overnight ventilation via tilted windows to the first floor bedrooms only. Closed bedroom doors mean no significant through ventilation. 0.1ach achieved for the whole house. NOTE, These dwellings are away from a main road where noise

NOTE: Results in the tables and graphic include a 15% contingency as required by RICSv2 for early design phase. The Range shows the potential for reductions or additions as the proposals are developed.

Ryebank — Chorlton

Specification of Thermal Elements		U Value W/m²K
Ground Floor	75mm screed; 200mm PIR Insulation; Beam and Block	0.11
External Walls	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, cavity and wall ties, brickwork	0.11
Roof	12.5mm plasterboard; posi joists, WBP decking on firrings, vcl, 190mm PIR insulation, roofing membrane	0.11
Terrace	12.5mm plasterboard, Psi joists, OSB deck, VCL, insulation and membrane	0.1
Window Frames	Ideal Combi frames	1.76 (jamb)
Glazing	Triple glazing (g value 0.53) (1.04 ave U value installed)	0.57
MVHR	Zehnder Group Nederland B.V. - ComfoAir200 Heat recovery Efficiency 92% NOTE: Must be Passivhaus certified otherwise efficiency is penalised	

Performance against LETI	
GIA m²	887.3

Operational Energy		Range -15%/+15%
EUIkWh/m2/annum	35	30/ 40

Embodied Carbon		Range -15%/+15%
Upfront Carbon A1-A5 kgCO2e/m²	309	263/355
Embodied Carbon A1-A5, B-B5,C1-4 kgCO2e/m²	421	358 / 484
Sequestered Carbon kgCO2/m²	-174	-148 /- 200
Module D kgCO2/m²	-2	- 1.7 / -2.3

Renewable Energy Generation		Range -15%/+15%
KWh/annumn	31056	26397 / 35714
%of EUI	108%	91.8/124%

phi Low Carbon



Operational energy

Implement the following indicative design measures:

Reduce energy consumption to:

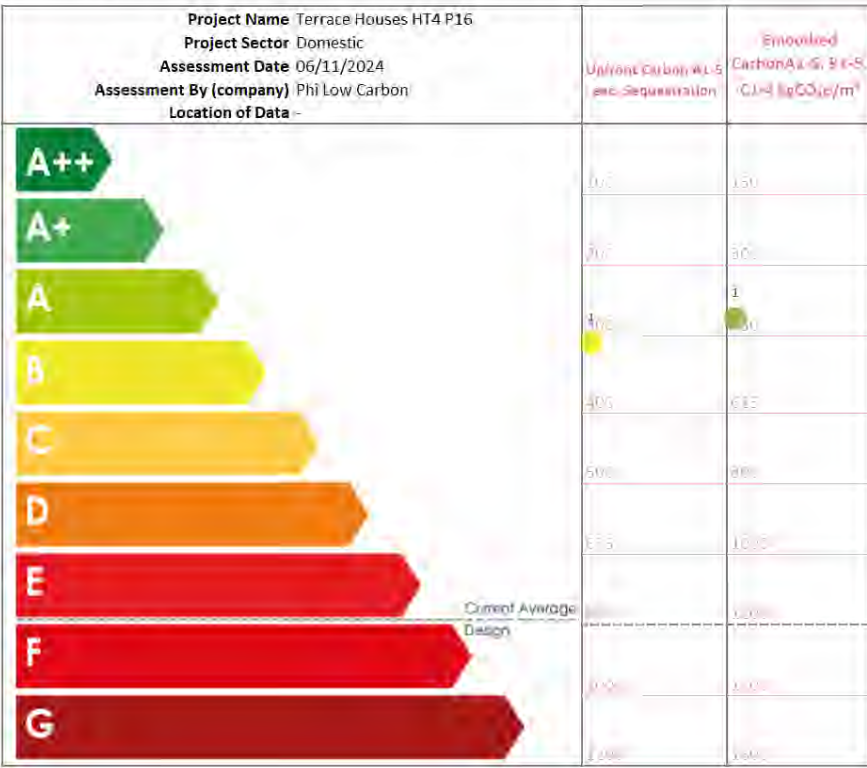
35

kWh/m².yr

Energy Use Intensity (EUI) in GIA, excluding renewable energy contribution

LETI Embodied Carbon Rating

LETI Results graphic. Coloured dots labelled 1-12 are the results for scenarios 1-12.



Summary Sheet

Passivhaus Verification

LETI Operational and Embodied Carbon Report

Block	Semi detached villas
No of Dwellings	2
Orientation of Principal (street)Elevation	East
Treated Floor Area m² (TFA)	311
Form Factor	2.3
Performance against Passivhaus Criteria	
Annual Heating Demand <= 15KWh/m²y	14
Heat Load <=10W/m²	10
Airtightness <=0.649 @50pa	0.649
Frequency of overheating <10%	4
PER <=60 KWh/m²y	32
Space Heating method	Air Source Heat Pump
Hot Water method	Air Source Heat Pump and

Further overheating analysis is required to check for Part O compliance particularly the east facing windows which are currently showing a high level of summer solar gain.

The model assumes the following Summer Ventilation strategy.

MVHR to have automatic summer bypass controlled by temperature difference with boost.

No window opening during daytime hours for security reasons whilst people are likely to be away from home. Temporary shading is provided to the rooflight

Overnight ventilation via tilted windows to the upper floors and opening rooflight. . 0.1ach achieved for the whole house. NOTE, These dwellings are away from a main road where noise could be an issue.

NOTE: Results in the tables and graphic include a 15% contingency as required by RICSv2 for early design phase. The Range shows the potential for reductions or additions as the proposals are developed.

Ryebank — Chorlton

Specification of Thermal Elements		U Value W/m²K
Ground Floor	75mm screed; 200mm PIR Insulation; Beam and Block	0.11
External Walls	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, cavity and wall ties, brickwork Or vented void, ply with standing seam metal clad-	0.11
Roof	12.5mm plasterboard; posi joists, WBP decking on firrings, vcl, 190mm PIR insulation, roofing mem-brane	0.11
Window Frames	Ideal Combi frames	1.76 (jamb)
Glazing	Triple glazing (g value 0.53) (1.04 ave U value installed)	0.57
MVHR	Zehnder Group Nederland B.V. - ComfoAir200 Heat recovery Efficiency 92% NOTE: Must be Pas-sivhaus certified otherwise efficiency is penalised	

Performance against LETI	
GIA m²	340

Operational Energy		Range –15%/+15%
EUIkWh/m2/annum	28	24 / 32

Embodied Carbon		Range –15%/+15%
Upfront Carbon A1-A5 kgCO2e/m²	316	275 /363
Embodied Carbon A1-A5, B-B5,C1-4 kgCO2e/m²	502	436/ 577
Sequestered Carbon kgCO2/m²	-150	-130 /- 173
Module D kgCO2/m²	0	-0

Renewable Energy Generation		Range –15%/+15%
KWh/annum	5179	4503 / 5956
%of EUI	55%	48% / 63%



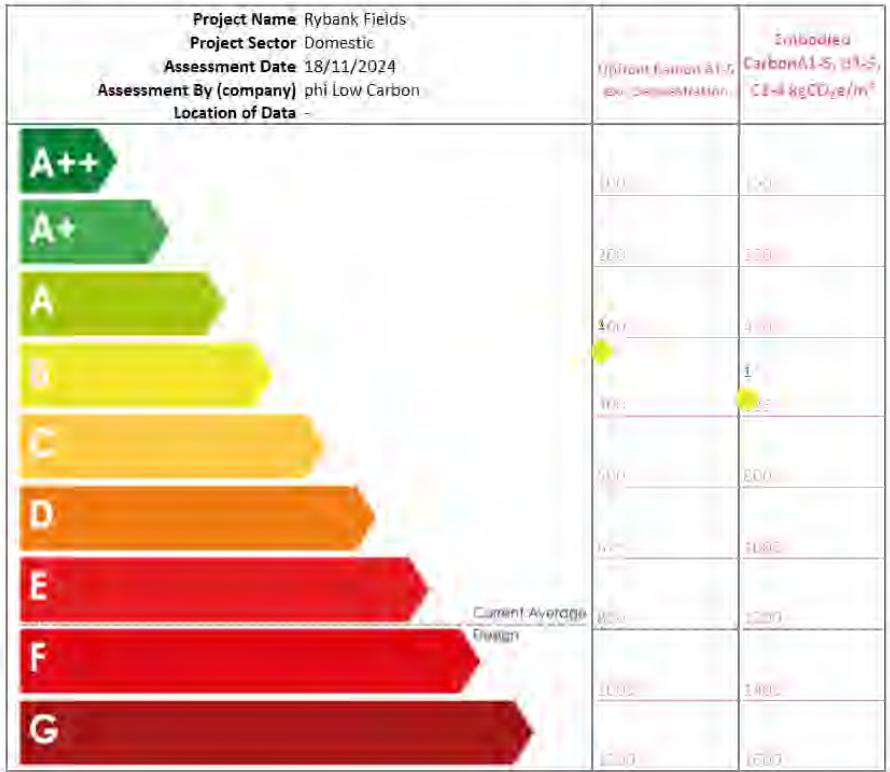
Operational energy

Implement the following indicative design measures:

Reduce energy consumption to:



LETI Embodied Carbon Rating



Summary Sheet

Passivhaus Verification

LETI Operational and Embodied Carbon Report

Block	Terrace HT1A and B
No of Dwellings	10
Orientation of Principal (street)Elevation	South
Treated Floor Area m² (TFA)	1089
Form Factor	2.03
Performance against Passivhaus Criteria	
Annual Heating Demand <= 15KWh/m²y	9
Heat Load <=10W/m²	8
Airtightness <=0.649 @50pa	0.649
Frequency of overheating <10%	1
PER <=60 KWh/m²y	37
Space Heating method	Air Source Heat Pump
Hot Water method	Air Source Heat Pump and Cylinder

Further overheating analysis is required to check for Part O compliance

The model assumes the following Summer Ventilation strategy.

MVHR to have automatic summer bypass controlled by temperature difference with boost.

No window opening during daytime hours for security reasons whilst people are likely to be away from home.

Overnight ventilation via tilted windows to the first floor bedrooms only. Closed bedroom doors mean no significant through ventilation. 0.1ach achieved for the whole house. NOTE, These dwellings are away from a main road where noise could be an issue.

NOTE: Results in the tables and graphic include a 15% contingency as required by RICSv2 for early design phase. The Range shows the potential for reductions or additions as the proposals are developed.

Ryebank — Chorlton

Specification of Thermal Elements		U Value W/m²K
Ground Floor	75mm screed; 200mm PIR Insulation; Beam and Block	0.11
External Walls	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, cavity and wall ties, brickwork or board cladding	0.11
Roof	Pitched 12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, vented void, ply and metal roofing Dormer 12.55mm plasterboard; joists, WBP decking on firrings, vcl, 190mm PIR insulation, roofing membrane	0.11
Window Frames	Ideal Combi frames	1.76 (jamb)
Glazing	Triple glazing (g value 0.53) (1.04 ave U value installed)	0.57
MVHR	Zehnder Group Nederland B.V. - ComfoAir200 Heat recovery Efficiency 92% NOTE: Must be Passivhaus certified otherwise efficiency is penalised	

Performance against LETI

GIA m²	1222
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Operational Energy	Range -15%/+15%	
EUIkWh/m2/annum	32	28 / 37

Embodied Carbon	Range -15%/+15%	
Upfront Carbon A1-A5 kgCO2e/m²	298	259/343
Embodied Carbon A1-A5, B-B5,C1-4 kgCO2e/m²	518	450 / 596
Sequestered Carbon kgCO2/m²	-157	-137 /- 181
Module D kgCO2/m²	-5	- 4 / -6

Renewable Energy Generation	Range -15%/+15%	
KWh/annumn	54695	47561 / 62899
%of EUI	140%	122% / 161%



Operational energy

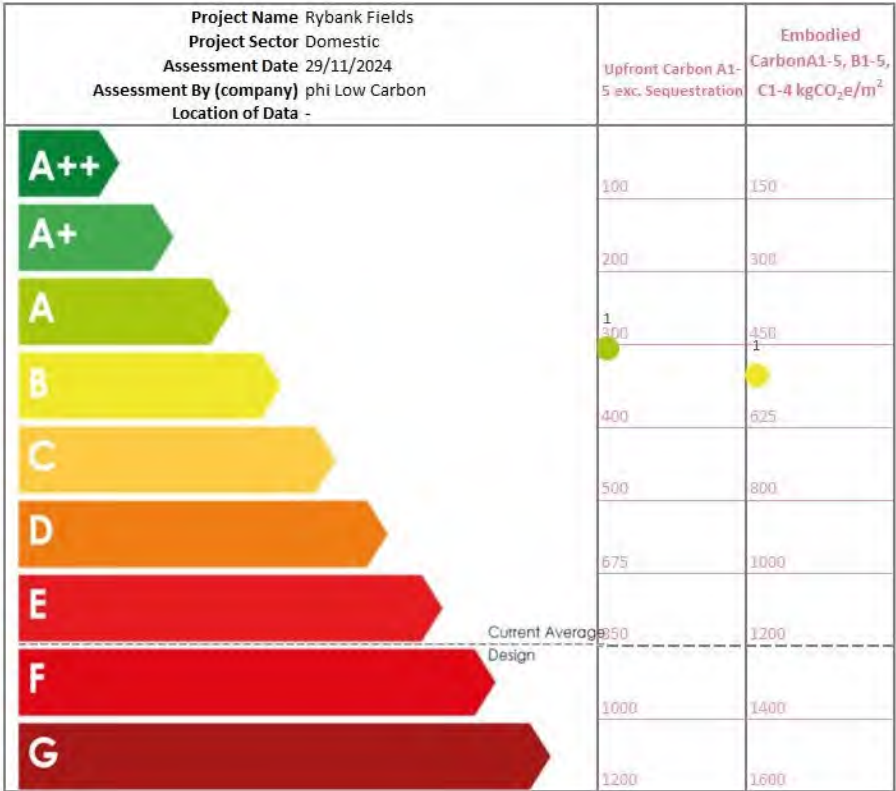
Implement the following indicative design measures:

Reduce energy consumption to:

35
kWh/m².yr

Energy Use Intensity (EUI) in GIA, excluding renewable energy contribution

LETI Embodied Carbon Rating



Summary Sheet

Passivhaus Verification

LETI Operational and Embodied Carbon Report

Ryebank — Chorlton

phi Low Carbon

Block	Co Housing Apartments
No of Dwellings	12
Orientation of Principal (street)Elevation	North and East
Treated Floor Area m ² (TFA)	914
Form Factor	2.34
Performance against Passivhaus Criteria	
Annual Heating Demand <= 15KWh/m ² y	16
Heat Load <=10W/m ²	10
Airtightness <=0.649 @50pa	0.649
Frequency of overheating <10%	0
PER <=67 KWh/m ² y	67
Space Heating method	Electric Panel Heaters
Hot Water method	Electric cylinders

Further overheating analysis is required to check the apartments on the east facing elevations for Part O compliance , particularly the ground floor where opening windows overnight may not be an option.

The model assumes the following Summer Ventilation strategy.

MVHR to have automatic summer bypass controlled by temperature difference with boost.

No window opening during daytime hours for security reasons whilst people are likely to be away from home.

Overnight ventilation via tilted windows to the first floor bedrooms only. Closed bedroom doors mean no significant through ventilation. 0.1ach achieved for the whole house. NOTE, These dwellings are away from a main road where noise could be an issue.

NOTE: Results in the tables and graphic include a 15% contingency as required by RICSv2 for early design phase. The Range shows the potential for reductions or additions as the proposals are developed.

Specification of Thermal Elements		U Value W/m ² K
Ground Floor	75mm screed; 200mm PIR Insulation; Beam and Block	0.11
External Walls	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, cavity and wall ties, brickwork or board cladding	0.11
Roof	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, vented void , ply with metal roofing	0.11
Window Frames	Ideal Combi frames	1.76 (jamb)
Glazing	Triple glazing (g value 0.53) (1.04 ave U value installed)	0.57
MVHR	Zehnder Group Nederland B.V. - ComfoAir200 Heat recovery Efficiency 92% NOTE: Must be Passivhaus certified otherwise efficiency is penalised	

Performance against LETI	
GIA m ²	1059

Operational Energy		Range –15%/+15%
EUIkWh/m2/annum	52	45 / 60

Embodied Carbon		Range –15%/+15%
Upfront Carbon A1-A5 kgCO2e/m ²	422	367 / 485
Embodied Carbon A1-A5, B-B5,C1-4 kgCO2e/m ²	559	486 / 643
Sequestered Carbon kgCO2/m ²	-279	-243 /- 320
Module D kgCO2/m ²	0	0

Renewable Energy Generation		Range –15%+15%
KWh/annum	48718	42363 / 56026
%of EUI	88%	77% / 101%



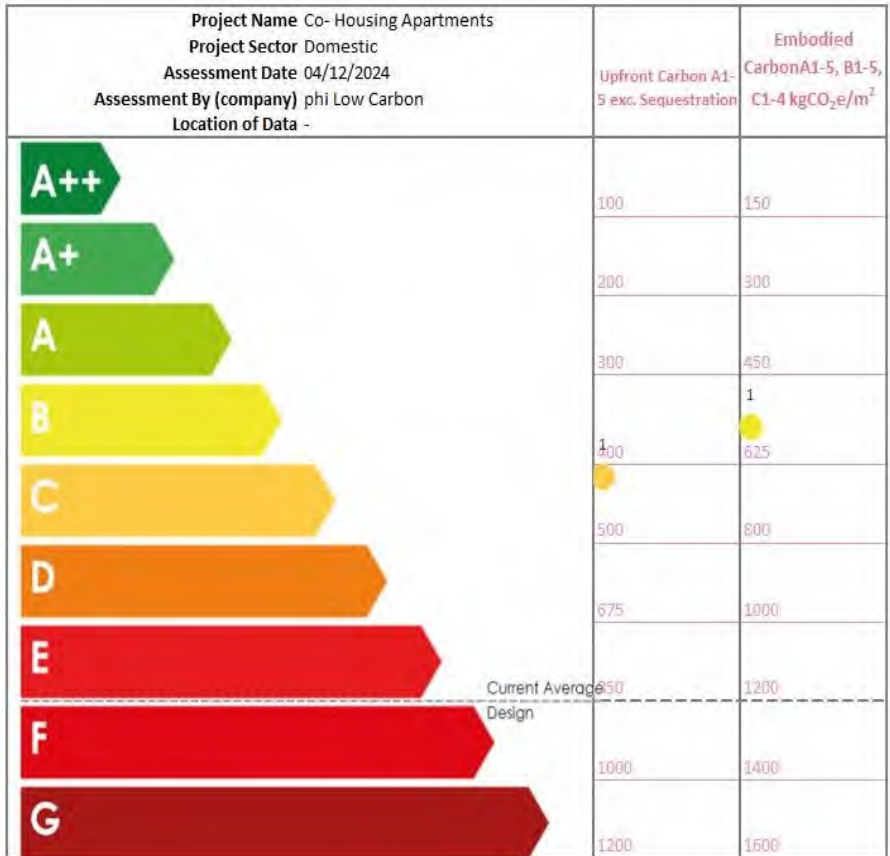
Operational energy

Implement the following indicative design measures:

Reduce energy consumption to:



LETI Embodied Carbon Rating



Summary Sheet

Passivhaus Verification

LETI Operational and Embodied Carbon Report

Block	Supported Living for Autis-
No of Dwellings	8 apartments
Orientation of Principal (street)Elevation	207°(South~)
Treated Floor Area m² (TFA)	521 m2
Form Factor	2.6
Performance against Passivhaus Criteria	
Annual Heating Demand <= 15KWh/m²y	12
Heat Load <=10W/m²	9
Airtightness <=0.649 @50pa	0.649
Frequency of overheating <10%	0%
PER <=75 KWh/m²y	69
Space Heating method	Electric
Hot Water method	Electric cylinder or heat

Further overheating analysis is required to check the apartments on the south elevation for Part O compliance on a room by room basis.

The model assumes the following Summer Ventilation strategy.

MVHR to have automatic summer bypass controlled by temperature difference with boost.

Given the occupancy it is assumed that there may be no daytime or nighttime window opening for security reasons and that ventilation can come entirely from the boosted MVHR system. However the windows can be opened if desired.

The Part O analysis of the south facing windows may identify that external shading is required to these particular windows.

The building occupancy is also an issue that requires further consideration. The modelling assumes 14 occupants based upon a standard occupancy rate . However , given that this is a specialist facility with residents and support staff, the actual occupancy may be much higher, with the main impact being the increased risk of summer overheating.

Therefore the designed occupancy needs to be agreed with the provider and certifier to ensure the modelling will reflect the actual occupancy levels.

Ryebank — Chorlton

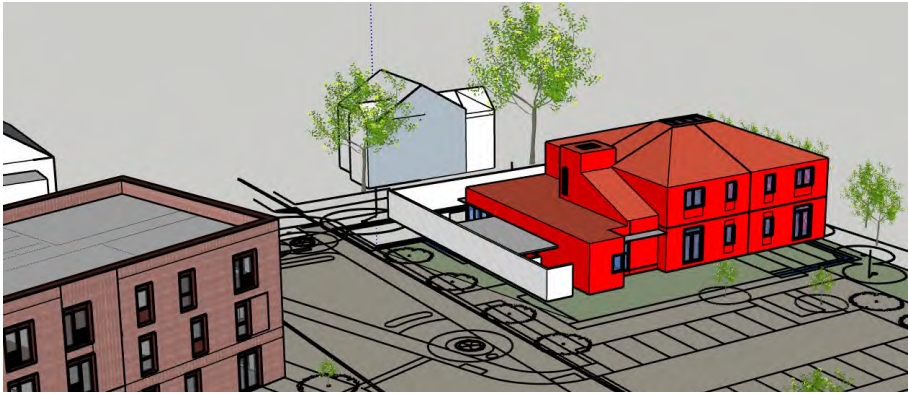
Specification of Thermal Elements		U Value W/m²K
Ground Floor	75mm screed; 190mm PIR Insulation; Beam and Block	0.11
External Walls	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, cavity and wall ties, brickwork	0.15
Pitched Roof	12.5mm plasterboard, service void, OSB Propassiv board, Timber studs and insulation, panelvent, breather membrane, vented void , ply with metal roofing	0.11
Flat Roof	12.5mm plasterboard; posi joists, WBP decking on firrings, vcl, 190mm PIR insulation, roofing membrane	0.11
Window Frames	Ideal Combi frames	1.76 (jamb)
Glazing	Triple glazing (g value 0.53) (1.04 ave U value installed)	0.57
MVHR	Zehnder Group Nederland B.V. - ComfoAir200 Heat recovery Efficiency 92% NOTE: Must be Passivhaus certified otherwise efficiency is penalised	

Performance against LETI	
GIA m²	619.2

Operational Energy		Range –15%/+15%
EUIkWh/m2/annum	55	47.8 -

Embodied Carbon		Range –15%/+15%
Upfront Carbon A1-A5 kgCO2e/m²	TBC	TBC
Embodied Carbon A1-A5, B-B5,C1-4 kgCO2e/m²	TBC	TBC
Sequestered Carbon kgCO2/m²	TBC	TBC
Module D kgCO2/m²	TBC	

Renewable Energy Generation		Range –15%/+15%
KWh/annumn	13805	11734—15875
%of EUI	47%	



Operational energy

Implement the following indicative design measures:

Reduce energy consumption to:

35 kWh/m².yr

Energy Use Intensity (EUI) in GIA, excluding renewable energy contribution

LETI Embodied Carbon Rating

TBC

NOTE: Results in the tables and graphic include a 15% contingency as required by RICSv2 for early design phase. The Range shows the potential for reductions or additions as the proposals are developed.