

Chalkstream House



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Context & Approach

Glossary

Whole Life Zero Carbon: When the carbon emissions resulting from the materials, construction (embodied) and the use of a building over its entire lifecycle (operational) are equal to or less than the carbon drawdown.

Carbon Negative: when a scheme removes more carbon emissions (CO2e) from the atmosphere than it emits, creating a net negative carbon footprint and going beyond carbon neutrality

Operational Carbon: The carbon used in the day to day running of a house, from heating and lighting, to cooking and using appliances

Embodied (Upfront) Carbon: The carbon used to produce materials and components, transport them to site and construct the building, both initially and in any maintenance

Climate Emergency Declaration: An action taken by governments and scientists to acknowledge humanity is in a climate crisis

Energy Modelling: The process of using computer systems to analyse the energy systems of a proposal

Carbon Drawdown: The process of capturing carbon from the atmosphere and locking it away, in this instance through on-site tree planting and energy generation

Fabric First: Design principles which maximise the performance of the components and materials that make up the building fabric itself, (passive) before considering the use of mechanical or electrical building services systems (active).

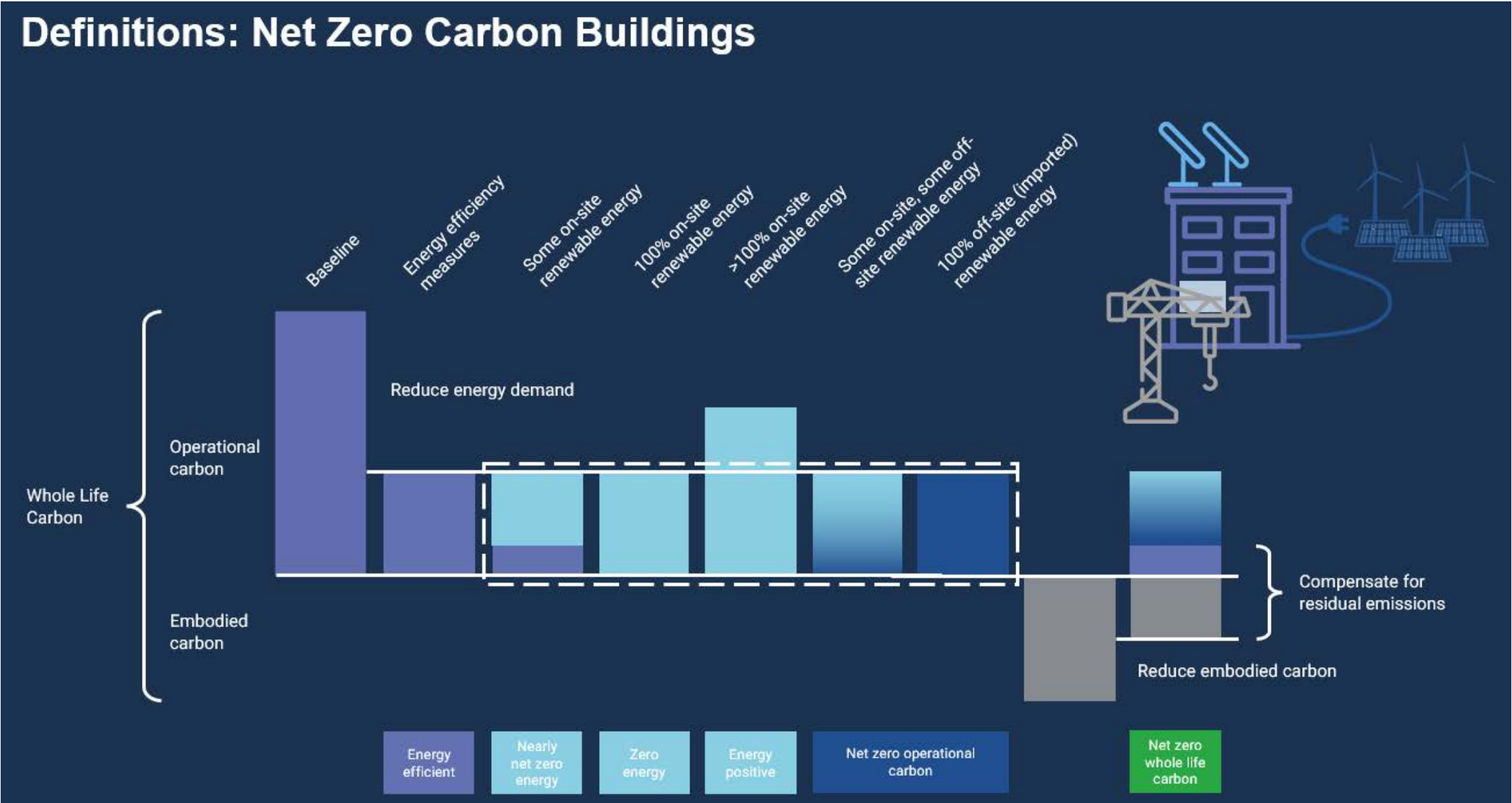


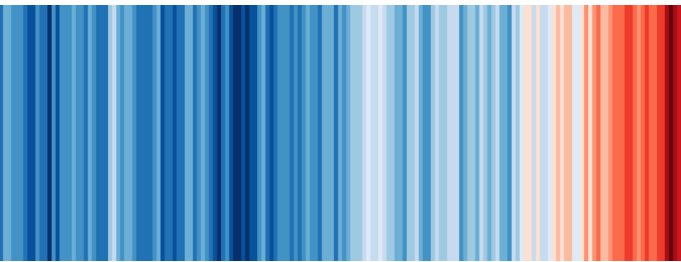
Diagram from World Green Building Council illustrating the different definitions and types of net zero buildings.

Context: Climate Crisis

“The alarm bells are deafening, and the evidence is irrefutable: greenhouse gas emissions from fossil fuel burning and deforestation are choking our planet and putting billions of people at immediate risk”

- António Guterres, UN Secretary-General

- The concept of the ‘greenhouse effect’ dates back the Victorian era.
- 1960s and 70s detailed research began on the greenhouse effect and its climatic implications.
- Intergovernmental Panel on Climate Change (IPCC) formed in 1988 and subsequently the United Nations Framework Convention on Climate Change (UNFCCC) in 1994.
- Today, climate science is a vast and sophisticated discipline which has reached a remarkable and alarming consensus regarding our present course. It is the most pressing and all-encompassing issue facing humanity today. Over the next few decades its impacts, already felt in many places, will accelerate, leaving no aspect of our societies, economies and lives untouched.



Visual representation of temperature increases over the past several decades.

Impacts

“Increasing temperatures, rising sea-levels and modified rainfall patterns will change the climate-related risks to people and the built environment.”

- UK Climate Change Committee (CCC)

- IPCC reports make clear the causal link between a warming climate and extreme weather events.
- A plethora of scientific literature documents how climate change will destabilise the dependable climatic rhythms of the Holocene, resulting in ‘no normal’.
- Overheating in buildings is becoming an increasing problem. Our current building stock is designed for a different climate than the one we are moving into. According to the CCC there are currently around 2000 heat-related deaths per year, which is expected to rise by 250% by 2050.
- The frequency of flood events in the UK is expected to increase.
- The summer of 2022 has also illustrated our vulnerability to droughts and water scarcity which will likely also be an increasing issue to be addressed.

Taking Stock

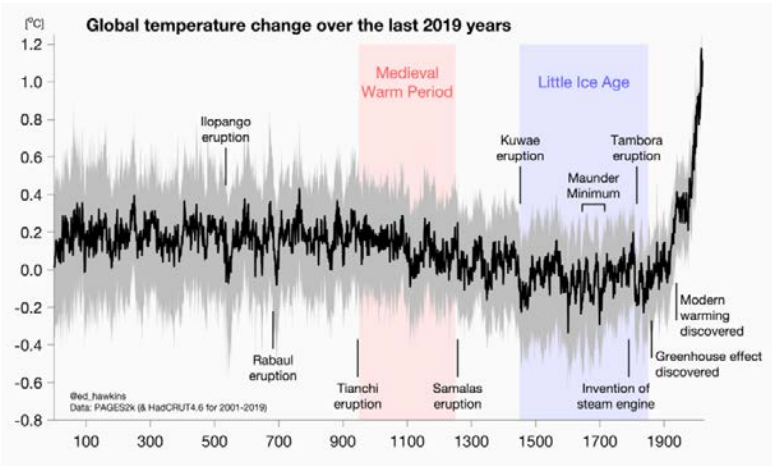
Th UK Green Building Council claim the built environment accounts for around 42% of the UK’s carbon emissions. The impact of embodied carbon in construction is reckoned to be around 10% of the total UK emissions. According to the Committee on Climate Change: “substantial gaps and weaknesses remain in the Governments set of policies for decarbonisation of manufacturing and construction.”

Climate Emergency Declaration

- In May 2019, UK Parliament became the first national legislature to declare a ‘climate emergency’.
- The UK has a legally binding target to achieve carbon neutrality by 2050. More recently (4th December 2020) a further announcement declared aims for at least 68% reduction in greenhouse gas emissions by the end of the decade (2030), compared to 1990 levels.
- Various initiatives emerged in response to this including Architects Declare. Launched by a coalition of high-profile practices in 2019, AD UK now has over 1200 signatory practices, including Studio Bark. Members of Studio Bark have also been involved in the Architects Climate Action Network (ACAN).
- North Herts District Council declared climate change emergency in 2019 and developed a Climate Change Strategy and a Climate Hive; a community group to gather ideas.
- A Sustainability SPD was published by the council in 2024.

Design Response

- The twin aspects of mitigation and adaptation are always present in this issue.
- The first priority needs to be mitigation, to stop adding to this problem and find a way to draw carbon down out of the atmosphere.
- The carbon balance of the project will be quantified to ensure that construction impacts are offset through onsite aforestation, and that the carbon balance of the scheme as a whole, over the medium and longer term is contributing positively to efforts to tackle the climate crisis.
- In parallel, the design must acknowledge inevitable changes, including how buildings can adapt to hotter, less stable weather conditions and the stresses that this will put upon our infrastructure.
- Thus, we will model the performance of the house under future climate scenarios and look at future-proofing strategies.
- The notion of resilience will also be embedded into our proposal through an off-grid strategy for energy and water, reducing stresses on existing infrastructure and resources and enabling the house to withstand future shocks and instabilities within those wider systems.



Spike in temperatures as a result of industrialisation. Source: <https://www.climate-lab-book.ac.uk>

A Climate Emergency

The built environment is responsible 42% of carbon emissions in the UK. For homes, this is made up of Embodied Carbon and Operational Carbon.

It is often only the operational carbon which is considered when people talk about ‘zero carbon’ buildings, as traditionally this has been a higher proportion of a building’s carbon impact. However as steps to reduce Operational Carbon have been made over recent years, focusing on reducing Embodied Carbon has become more important.

What is Whole Life Carbon?

Whole Life Carbon = Embodied Carbon + Operational Carbon

Operational Carbon is the energy used in the day to day running of a house, from heating and lighting, to cooking and using appliances.

Embodied Carbon is the energy required to produce materials and components, transport them to site and construct the building. It makes up roughly half of a building’s emissions over the course of a building’s life.

Achieving Zero Carbon

Studio Bark are targeting all of our new builds to be Whole Life Zero Carbon (WLZC) by 2025.

Ultimatley, this means our buildings remove more carbon from the atmosphere than they create.

‘Net zero means that the total greenhouse gas (GHG) emissions would be equal to or less than the emissions removed from the environment. This can be achieved by a combination of emission reduction and emission removal’ (ONS). Within net zero, the approach is always to maximize emissions reduction first before offsetting the remainder.’ - Office for National Statistics

Studio Bark’s Approach

Studio Bark seeks to create high quality, sensitive design to raise awareness and inspire change. Our pioneering approach aims to meet the needs of people whilst maintaining a positive relationship with the planet.

At this stage, to ensure Whole Life Zero Carbon remains feasible, our initial design decisions are grounded in best practice ‘fabric first’ principles ensuring key decisions such as orientation, form, location and glazing set the proposed design on the right tracks. Furthermore, we intend to interrogate the entire material specification to choose solutions which have the least ‘whole life’ impact on our environment.

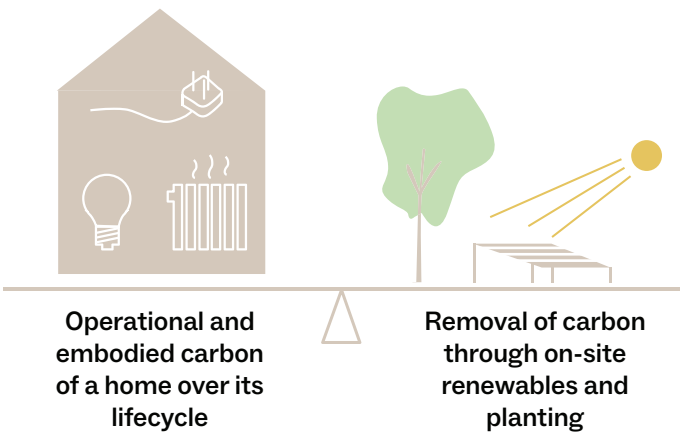
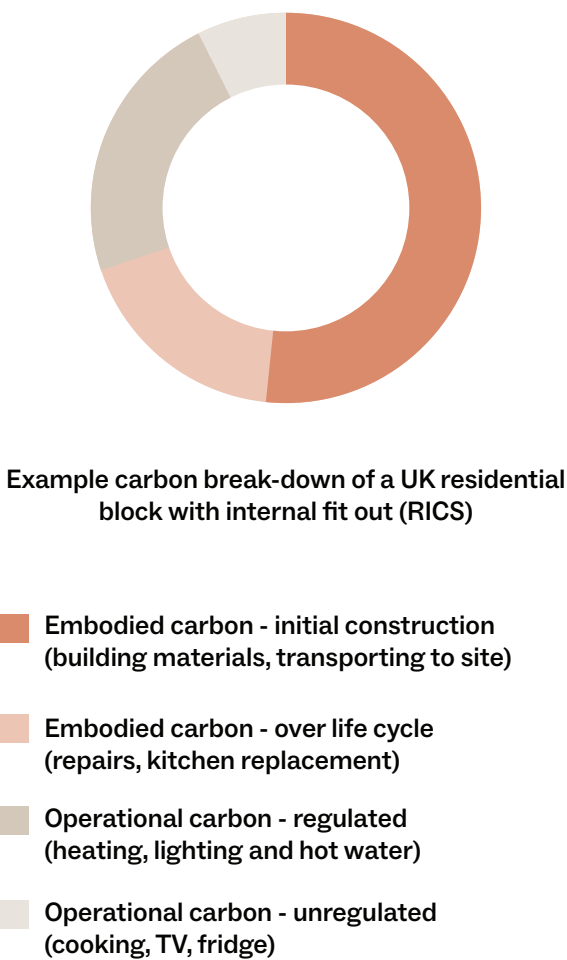
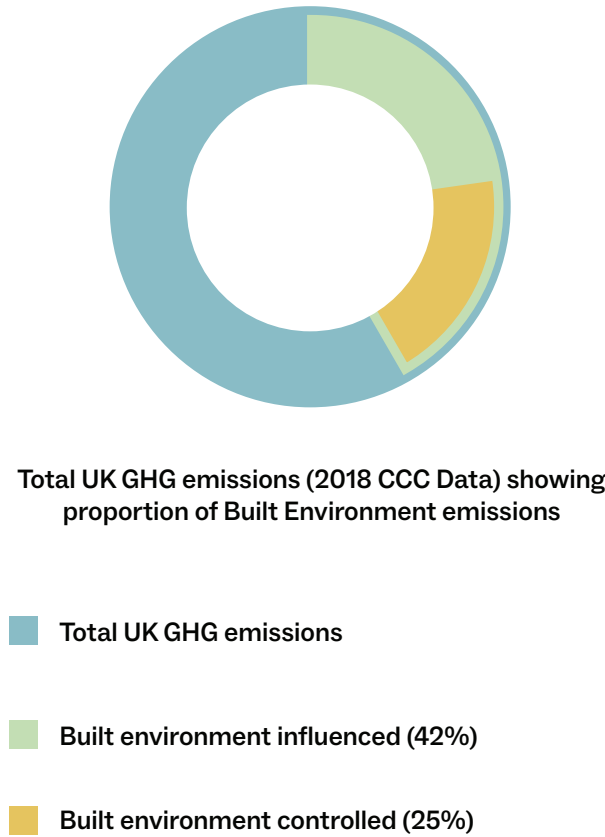


Diagram: Visualising Whole Life Net Zero - adapted from the LETI Climate Emergency Design Guide

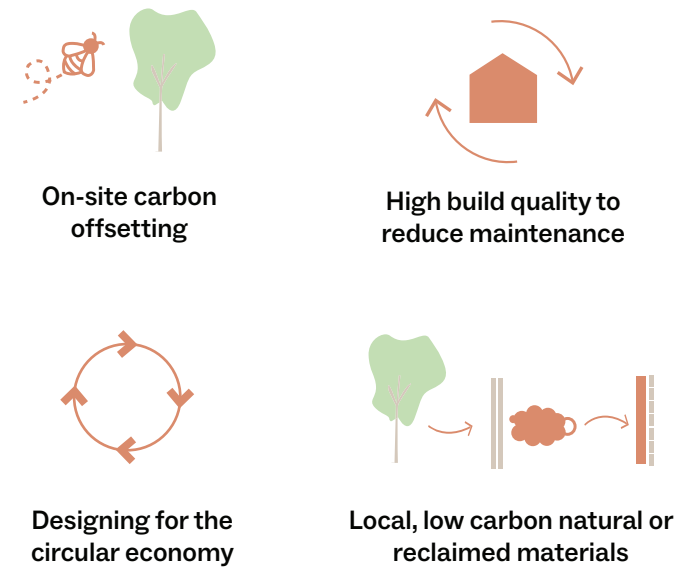


Diagram: Design moves for WLZC

Gold Standard

In September 2024, the council published a Sustainability Supplementary Planning Document (SPD).

This document outlines how the proposals satisfy the gold standard for 6 of the 9 categories, where the remaining 3 have been deemed inapplicable:

Optimising Passive Design & Fabric Performance

Achieving Low Carbon Energy

Minimising Carbon Footprint

Promoting Biodiversity

Conserving Water

Incorporating Sustainable Drainage

Checklist 1 - Optimising Passive Design & Fabric Performance

Optimising Passive Design & Fabric Performance			
	Bronze	Silver	Gold
Minor residential schemes less than 10 dwellings	Achieve an EPC rating of at least C on all dwellings Submit a Sustainability & Energy Statement showing compliance with Policy and Building Regulations (this should include the Energy Use Intensity (EUI) & the total Space Heating Demand (SHD) calculations with recommendations on methods that could be investigated during technical design to improve performance)	Achieve 80% EPC ratings of at least B and 20% rating of at least C Submit a Sustainability & Energy Statement showing: - maximisation of solar gain through site layout, orientation, and design (for the purpose of energy efficiency) - measures to prevent over-heating - lower carbon alternatives to gas boilers - on-site reductions of 35% (minimum) in CO₂ emissions over and above Building Regulations Part L (including	Achieve an EPC rating of B on all dwellings Submit a Sustainability & Energy Statement showing: - on-site reductions of 50% (minimum) in CO₂ emissions over and above Building Regs Part L (including at least 10% reductions through fabric first measures) - commitment to achieve Passivhaus certification and site assessment at planning stage using Passive House Planning Package (PHPP) to confirm compliance against
		at least 10% reductions through fabric first measures) (inclusive of MHVR) EUI ≤ 60 kWh/m²/yr (inclusive of estimated unregulated energy) (RIBA 2025) SHD ≤ 30 kWh/m²/yr (Passivhaus low energy building) or ≤ 40 kWh/m²/yr (AECB/ Energiesprong new build)	Or assessment of the development using CIBSE TM54 or alternative operational energy modelling software and confirms compliance with LETI or RIBA 2030 standards: - EUI ≤35 kWh/m²/yr - SHD ≤15 kWh/m²/yr

Example of requirements checklist from Sustainability SPD

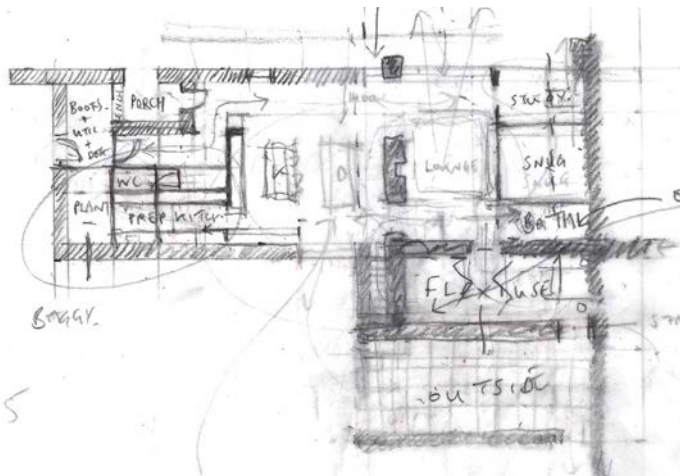
Overview

To ensure WLZC design, every stage of design development needs to incorporate low impact, and therefore low carbon decisions.

- Fabric first principles were applied from the beginning of the scheme to ensure the best low impact trajectory and a WLZC scheme, such as:
- Designing for the context, in terms of sun paths, wind, shadows and orientation of building and rooms.
 - Material choices included stone, chalk and timber from an early stage, all of which are natural and local materials.
 - Tree planting and pond creation as a way of contributing to on-site carbon offsetting and biodiversity enhancement.
 - Designing for future-proofing different climate scenarios.

Stage 0&1

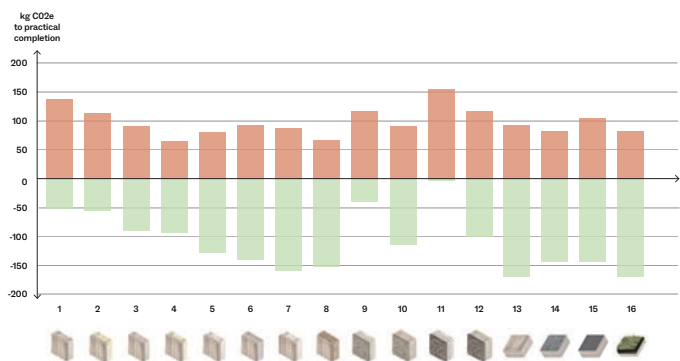
At the earliest design stages a commitment to whole life net zero design was already made and communicated.



Early Stage 0 sketch exploring spatial layout against site orientation and solar path

Stage 2

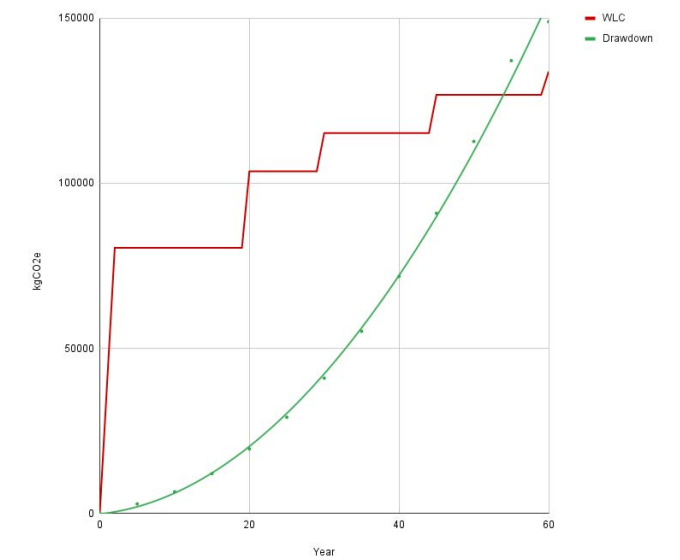
Continual, iterative development testing options for optimal design.



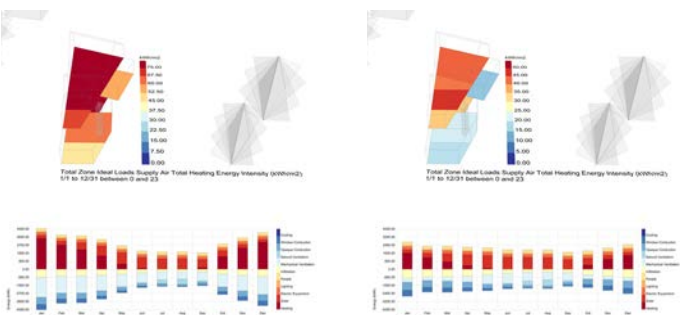
Comparing build-ups for embodied carbon values to help inform design decisions

Stage 3

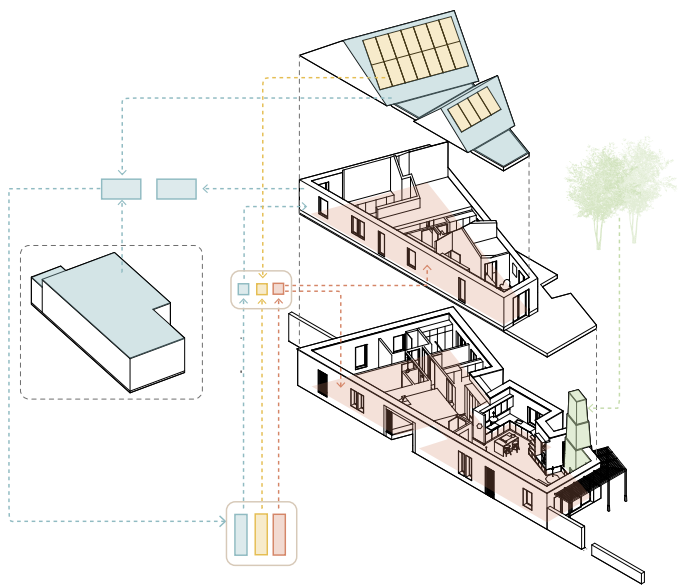
Fabric first design, energy modelling and lifecycle assessments to ensure a WLZC proposal



Showing carbon drawdown of tree planting on site to contribute to a WLZC proposal



In-house energy modelling to understand the implications of glazing arrangement and MVHR system



Taking a holistic approach to building services

Optimising Passive Design & Fabric Performance

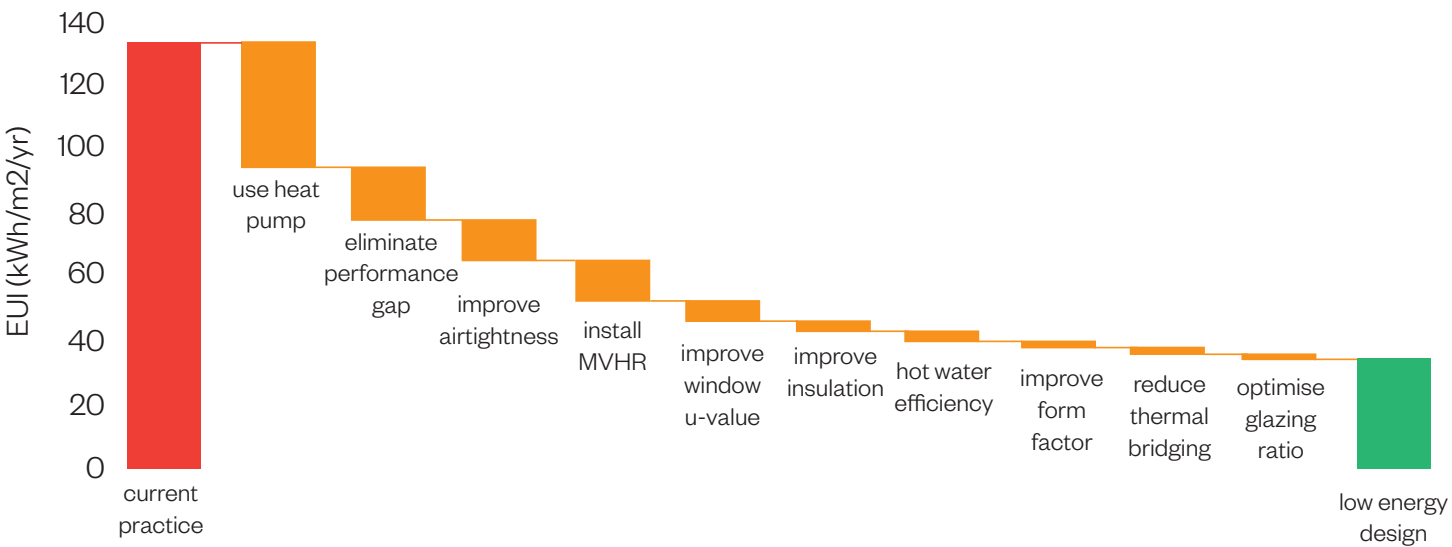
	Gold Standard	Evidence
Minor residential schemes less than 10 dwellings	Achieve an EPC rating of B on all dwellings	Can be provided on completion of construction
	Submit a Sustainability & Energy Statement showing:	-
	- on-site reductions of 50% (minimum) in CO2 emissions over and above Building Regs Part L (including at least 10% reductions through fabric first measures)	Page 19
	- commitment to achieve Passivhaus certification and site assessment at planning stage using Passive House Planning Package (PHPP) to confirm compliance against Passivhaus Classic, Plus or Premium.	Compliance with LETI and RIBA 2030 standards shown instead as below
	OR assessment of the development using CIBSE TM54 or alternative operational energy modelling software and confirms compliance with LETI or RIBA 2030 standards: o EUI ≤35 kWh/m2/yr o SHD ≤15 kWh/m2/yr	Page 18

Approach

The **environmental design approach** seeks to first reduce energy demand through adoption of best practice fabric-first principles. These include exceptionally low U-Values, continuity of thermal envelope and minimising uncontrolled air-leakage.

A mix of low carbon technologies and an efficient (mainly passive) building services strategy then further reduces the anticipated energy use of the house.

The site and the house demonstrates **exemplar practice in decarbonised energy provision** for a net zero future.



Adapted Diagram from LETI, opportunities to reduce energy consumption in new residential development

On-Site Renewable Energy

Whilst the house will be connected to the mains grid for electrical supply, a 9kWp PV system on the roof of the garage will produce an estimated **8,393kWh/yr to be used in conjunction with this.**

Fossil fuels have been completely eliminated from the site.

EV Charging is to be installed within the garage.

Fabric First Principles

A fabric first approach **maximises the performance of the buildings fabric** (passive approaches) before looking at ways of actively increasing efficiency. A few of these approaches are explored in the diagrams below:

Natural cross ventilation to ensure passive cooling.

Green roof beneficial for biodiversity, water attenuation and thermal mass.

Highly insulated fabric to help reduce energy demands.

PV panels for on-site renewable energy generation.

Local, natural and reclaimed materials to reduce embodied carbon, invest in local economy and ensure sensitive design.

Triple glazing for improved U-values.

Placement of deciduous trees to provide shading from the hot summer sun, but allow for solar gains in the winter when leaves have dropped.

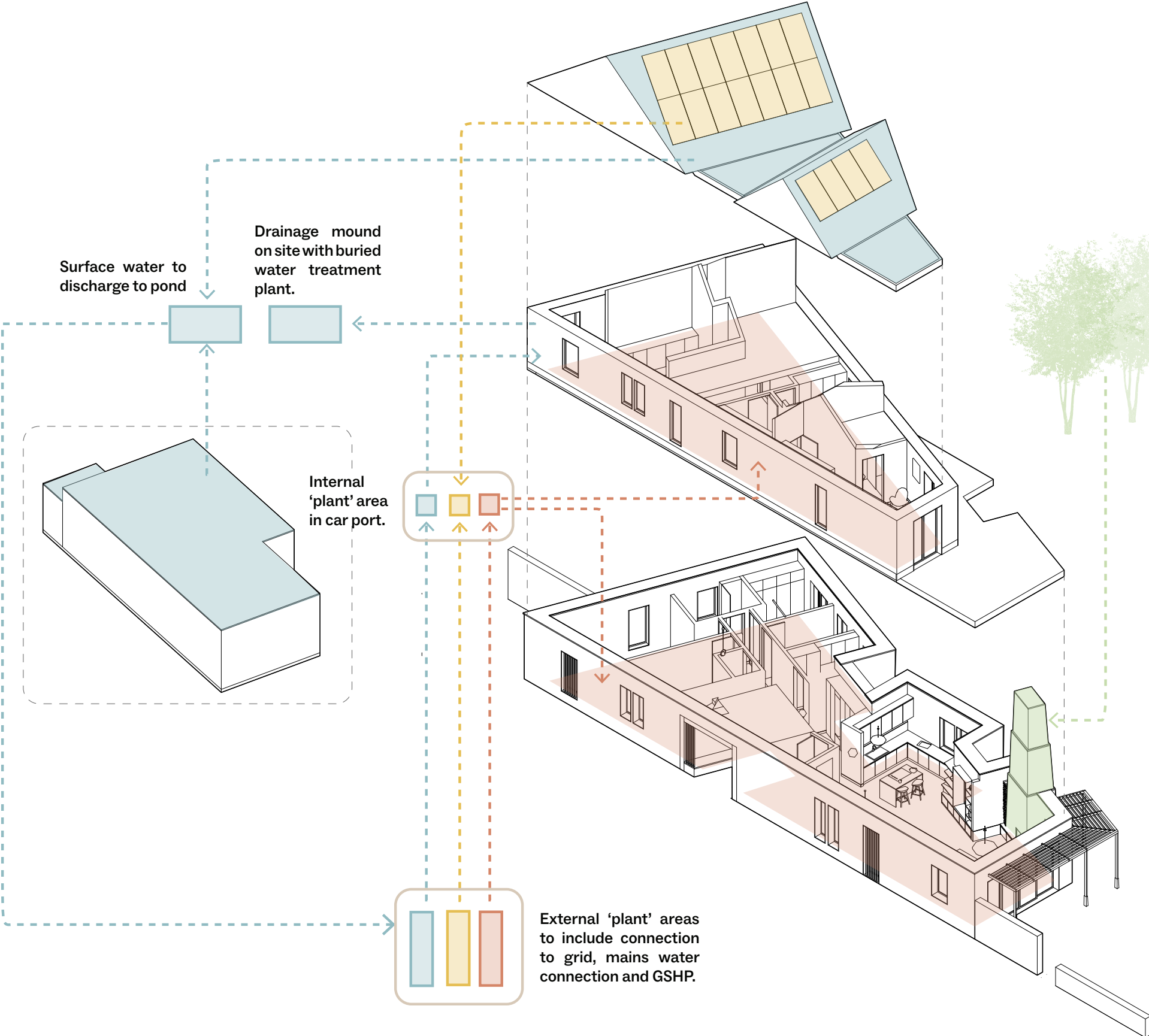
Ensuring onsite spoil is redistributed and not removed from site.

Strategy

Building services have been informed by energy modelling to ensure efficient operational energy and low carbon technologies that are most appropriate for the site and house as a whole.

Chalkstream House does not use gas. Water is supplied from a mains connection, with foul waste water being treated and directed to a drainage mound for attenuation, and surface water being redirected to an on-site pond. Electricity generation is created from a combination of PV panels with backup from a renewable energy grid connection.

-  Water - mains connection with surface water discharging to the pond for attenuation and then the ditch. Foul water to be treated then discharged to a drainage mound.
-  Electricity generation - Connection to the mains grid, with additional support from PV panels and battery storage on site.
-  Energy distribution - Ground Source Heat pump with MVHR system and underfloor heating distribution.
-  Small wood burner in living space using locally sourced firewood.



Occupant Comfort

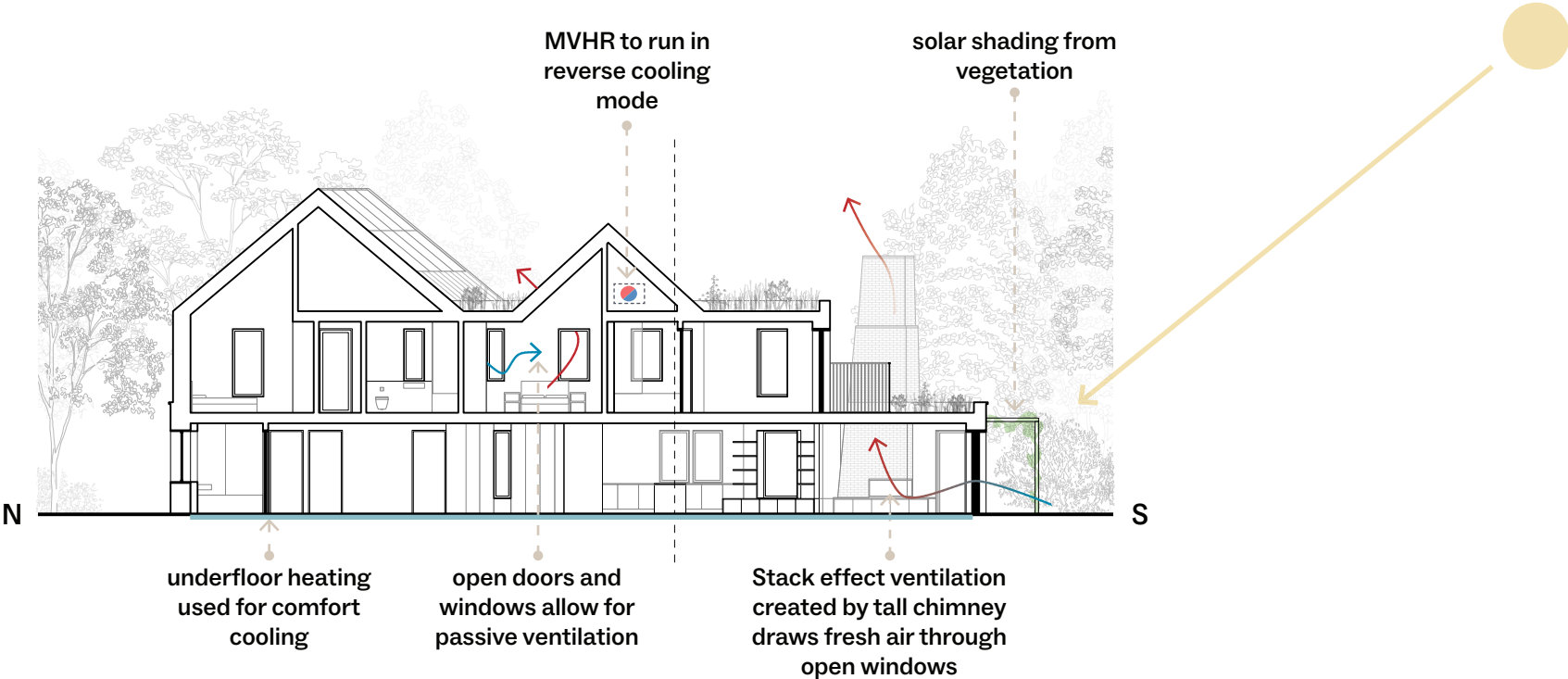
As seen in the energy modelling results on the following pages, the risk of overheating and over-reliance on active heating and cooling has been minimised from passive and active approaches and technologies with regards to building services and design.

These strategies work in tandem to create regulated, comfortable temperatures throughout the year.

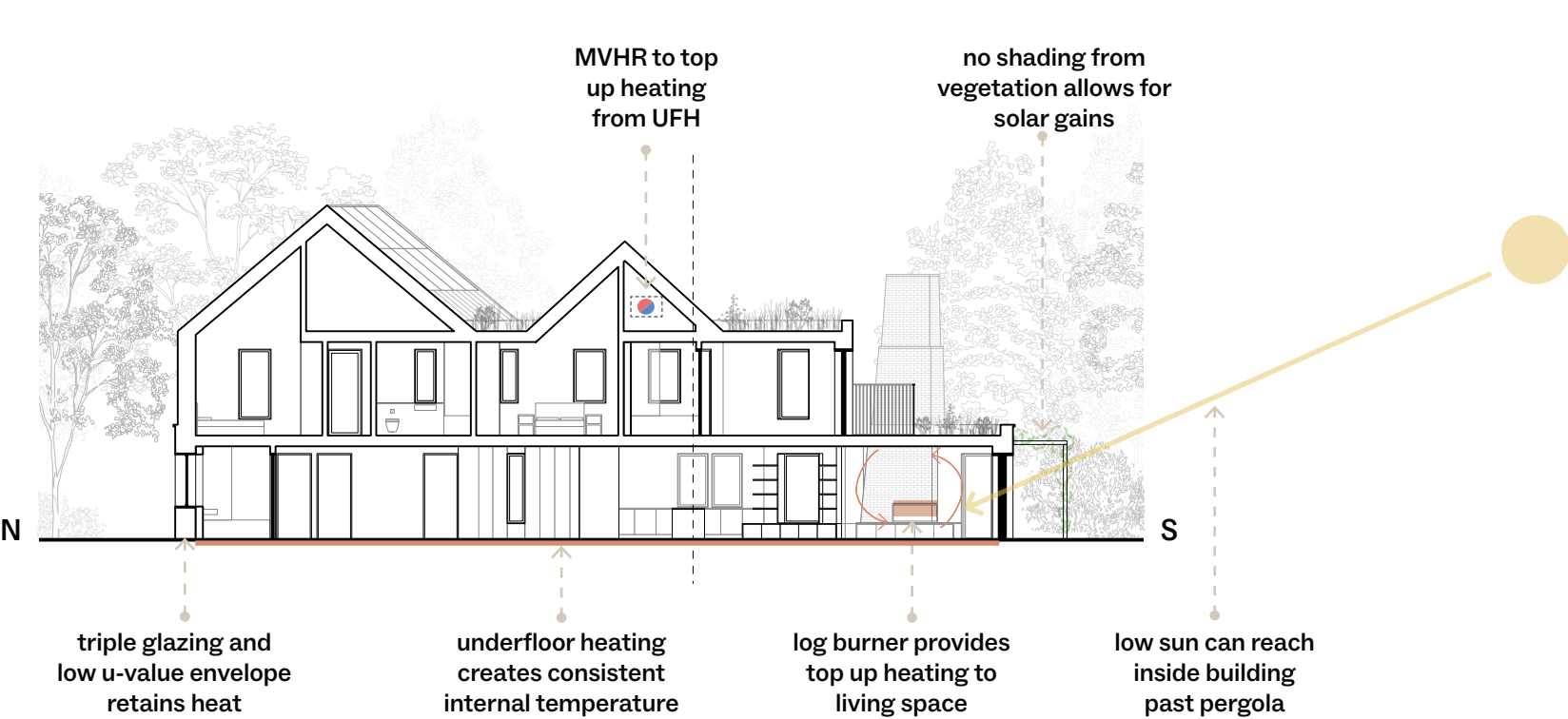
The cooling strategy follows the passive cooling hierarchy:

- Passive design through the consideration of orientation, fenestration and shading.
- Passive cooling through natural ventilation, green roofs, and landscaping.
- Local mechanical ventilation such as circulation and extract fans.
- MVHR system and comfort cooling from underfloor heating.

Summer Cooling



Winter Heating



Honeybee Energy Modelling

Energy modelling was undertaken at different stages in development in order to make performance predications regarding the thermal behaviour of the building in its given climatic context.

Dynamic thermal modelling was undertaken using a program called ‘Honeybee’. This toolset runs on the Grasshopper platform within Rhino.

The toolset links with other environmental softwares such as Therm, EnergyPlus and Open Studio, in order to run different energy simulations. As such the software is an ecosystem of functionality, calling upon open-source industry standard protocols and formats.

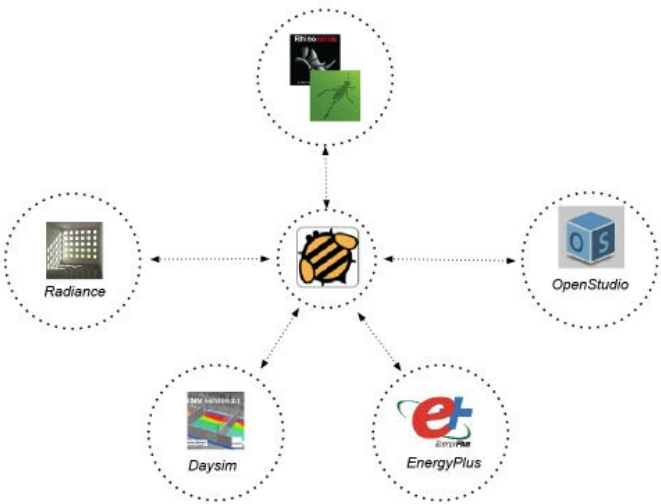
Analysis results are based upon hourly thermodynamic calculations over the course of a simulated year. The modelling accounts for material properties, building characteristics (airtightness etc), user behaviour, loads, and climate (hourly weather data, EPW format).

Assumptions

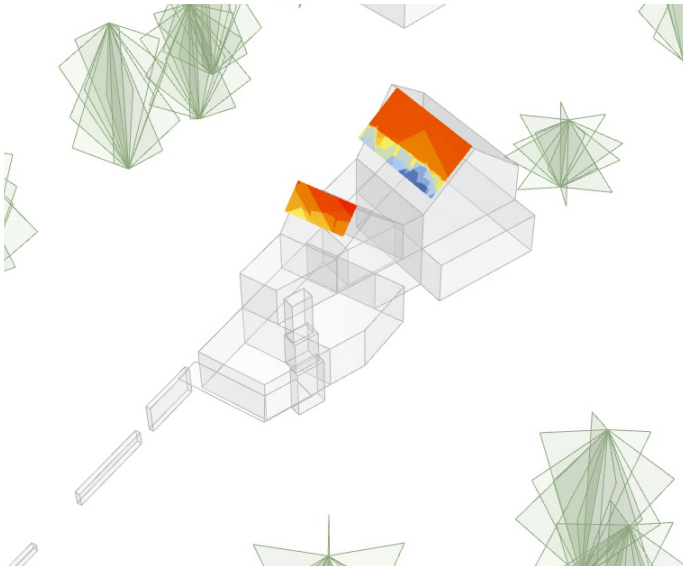
Performance predictions are based upon a number of assumptions about the building and the way that it will be used. In reality, the energy consumption of a building is heavily impacted by user behaviour and occupancy schedules.

Key assumptions which have been kept constant in this study are as follows:

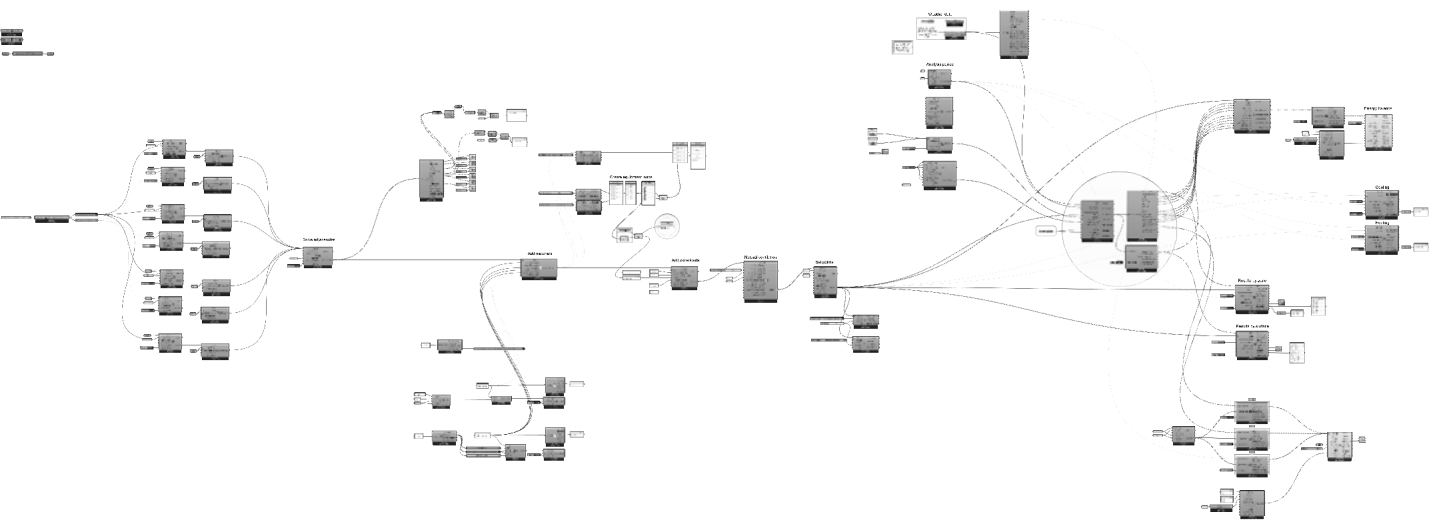
- Weather file: RAF.Wynton-Henlow.Camp
- Heating set-point: 20°C
- Cooling set-point: 26°C
- Zone loads and schedules - typical apartment type
- Airtightness - 0.000071 m3/h/m2 of facade area @50pa
- MVHR tests with 90% recovery
- U-values - defined as per build-ups



Relationship between platform (rhino/grasshopper), honeybee (plug-in) and other external softwares and protocols.



Chalkstream House PV study model screenshot



Grasshopper definition - Honeybee energy model. Different components serve various functions, such as creation of model ‘zones’, set-up of materials or applying loads.

U-Value Calculations

Build-up u-values have been calculated and benchmarked against the London Energy Transformation Initiative (LETI)’s ‘small housing’ typology targets, which is a point of reference and nationally accepted standard for best practice.

In addition, proposed build-ups balance minimising up-front embodied carbon while sequestering significant biogenic carbon over short time periods.

The combination of both high operational performance and low embodied carbon material choices results in exemplary performance in whole life carbon terms.

Roof 1

Roof build-up, anticipated U-Value: 0.10 W/m2K

(LETI roof target: 0.10 - 0.12 W/m2K)
(Part L targets: 0.11 W/m2K)

- Corrugated metal sheet roofing and ventilated battens (~70mm)
- Membranes, rigid woodfibre insulation and sheathing board to provide final line of water defence and reduce thermal bridging (~135mm)
- Insulation and structural zone - rafters with flexible wood fibre infill (~250mm)
- Internal insulated service void and finishes, carrier board and clay plaster (~70mm)

Roof 2

Roof build-up, anticipated U-Value: 0.10 W/m2K

(LETI roof target: 0.10 - 0.12 W/m2K)
(Part L targets: 0.11 W/m2K)

- Green roof build upwith substrate, drainage layer and protection fleeces (~180mm)
- Membranes, PIR insulation and structural deck (~170mm)
- Insulated rafters with internal carrier board and clay plaster (~270)

Wall

Wall build-up, anticipated U-Value: 0.11 W/m2K

(LETI wall target: 0.13 - 0.15 W/m2K)
(Part L targets: 0.18 W/m2K)

- Timber cladding and ventilated batten zone/ flint block and cavity liner (~75-150mm)
- Membrane, rigid wood fibre insulation and sheathing board (~115mm)
- Insulation layer and structural zone - timber studs with flexible wood fibre infill (~250mm)
- Internal insulated service void and finishes, carrier board and clay plaster (~70mm)

Floor

Floor build-up, anticipated U-Value: 0.08 W/m2K

(LETI floor target: 0.08 - 0.10W/m2K)
(Part L targets: 0.13 W/m2K)

- Engineered timber floors finish with underfloor heating slab (~70mm)
- Insulation and damp proof membrane (~200mm)
- Concrete slab (~200mm)
- Base - void former with compacted hardcore base (~500mm)

Glazing

Proposed window U-Value: 0.80 W/m2K

(LETI window target: 0.80)

- Triple glazing throughout
- G-value of glass 0.6 - 0.5

Overview

In Stage 2, a benchmark model which was developed using contextual fabric first principles, was used to test different parameters to tweak the design.

Testing the glazing percentages for north/east/south/west facades demonstrated that the current glazing arrangement was working relatively well in comparison.

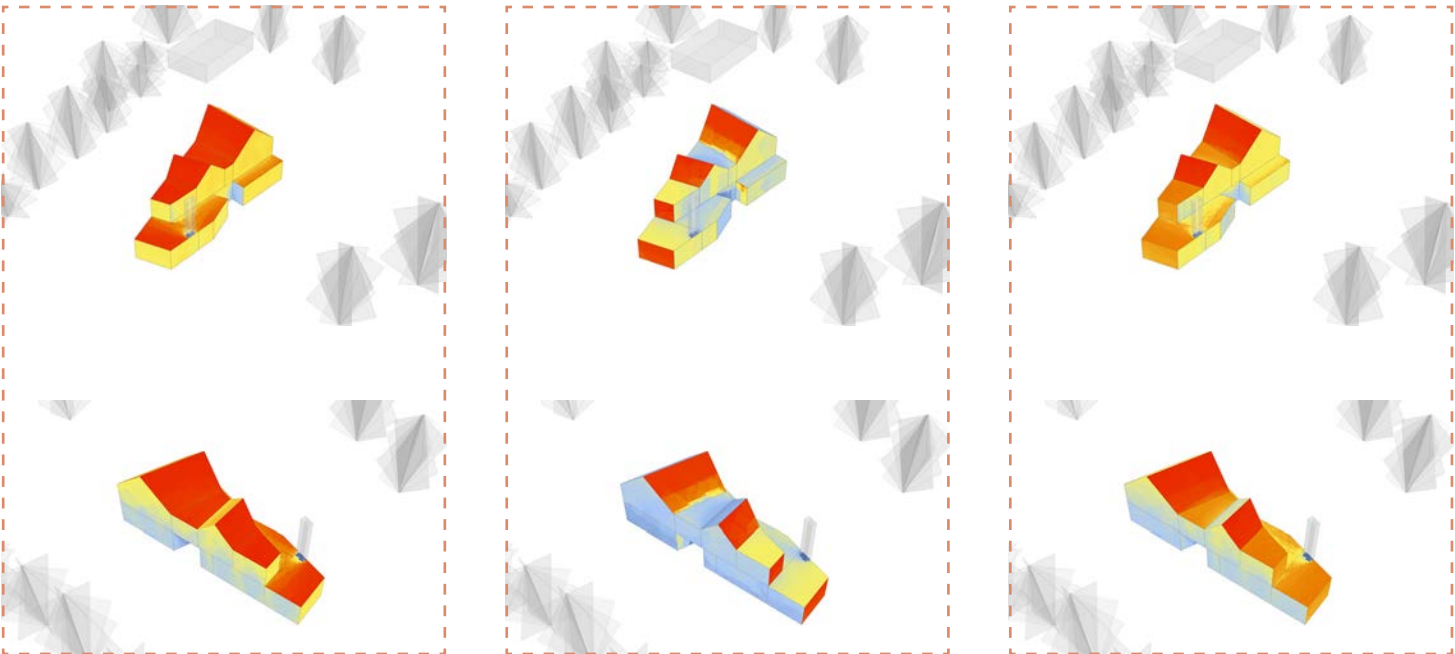
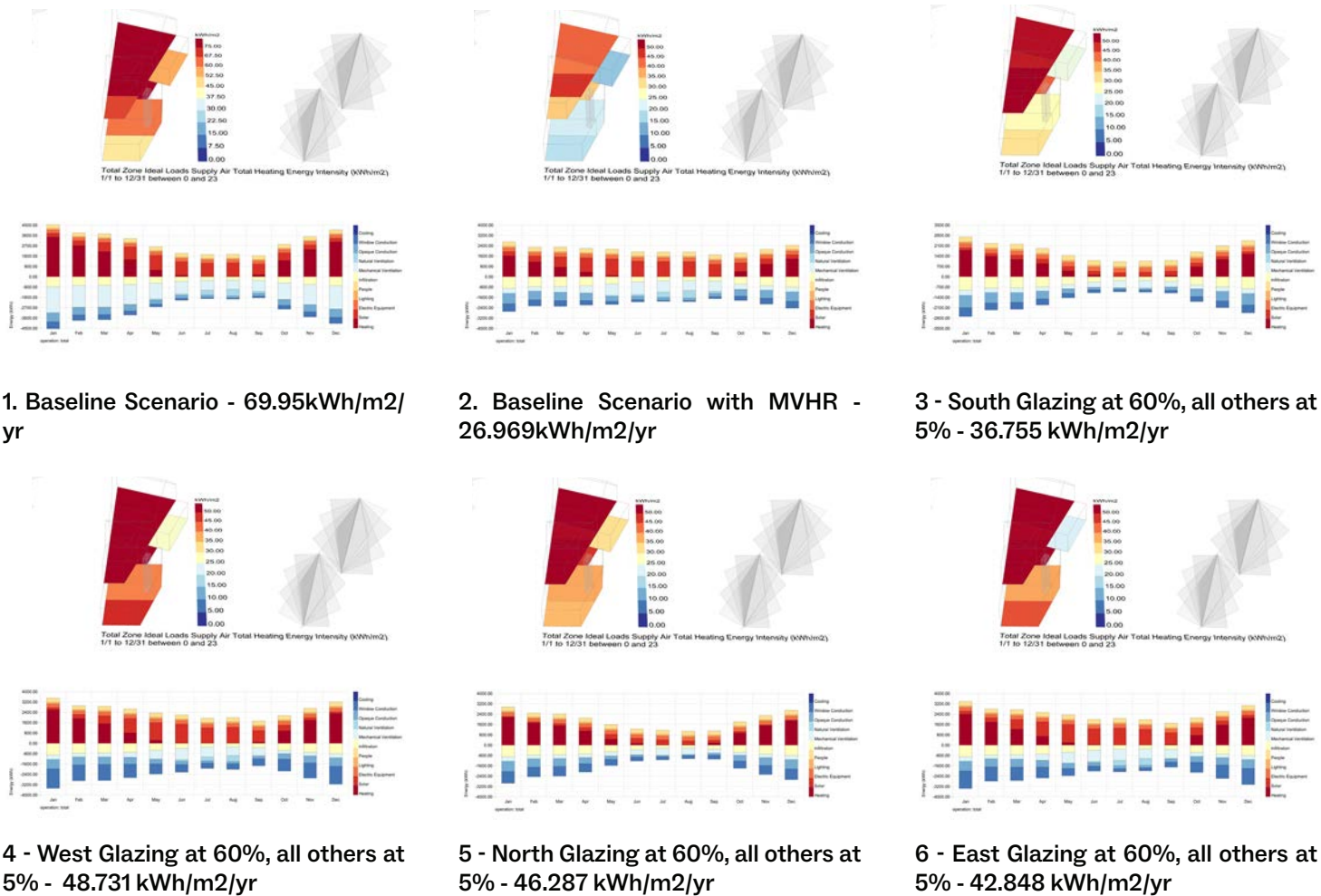
However, radiation studies highlighted areas that could be improved to reduce overheating in summer, and excessive heat loss in winter.

Takeaways

- Glazing along the western elevation is best reduced to avoid excessive heat loss.
- South facing glazing could be increased to improve winter solar gains, but would need shading consideration for summer.
- Rooflights could be a potential source of overheating so are best avoided, or would need shading consideration.
- South facing roof pitches are better oriented for PV panels.

Design Implications

- Vertical louvres for shading across some larger glazed elements, and additionally privacy and lower impact on dark bat corridors. Helps to reduce the potential for overheating from direct solar gains in summer.
- A timber pergola to the south provides vegetative shading to the large area of glazing.
- Reduction in glazed areas to the west and north reduces heat losses throughout the winter, and reduces space heat demand.



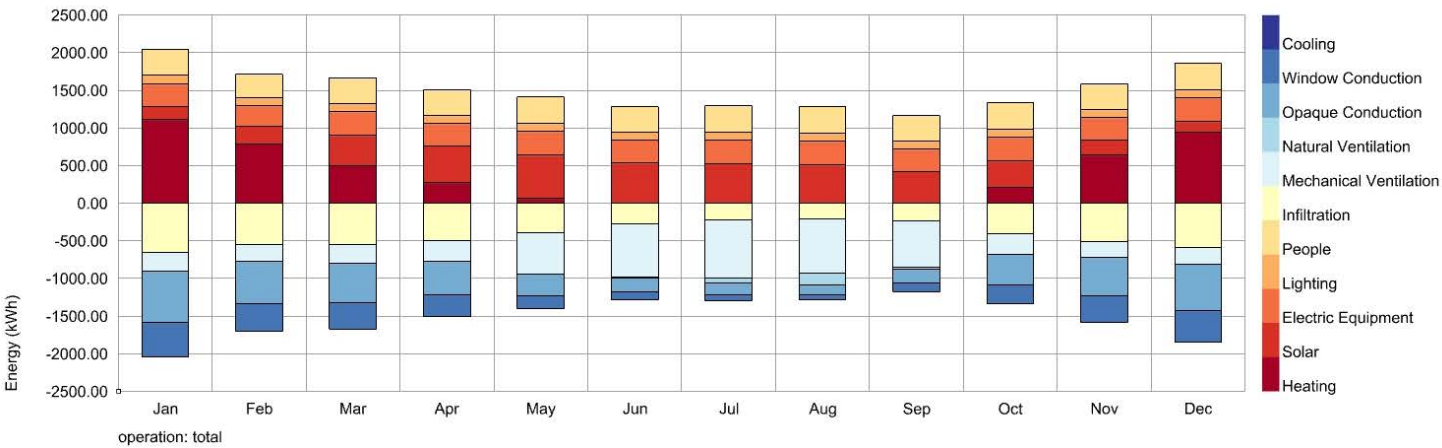
Radiation studies over summer (left), winter (centre) and an all year average (right)

Energy Balance

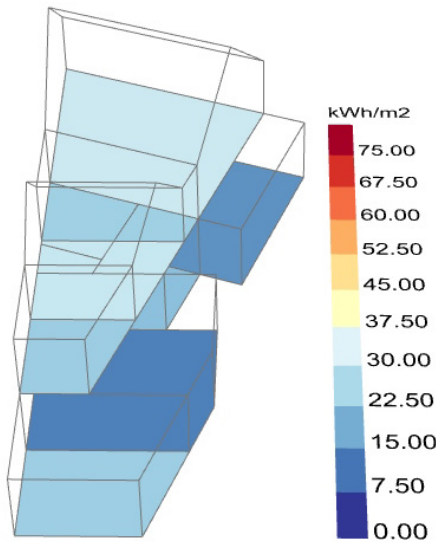
The graph and image to the right show the energy gains and losses over a year period. These are generally balanced which allows for a stable, comfortable temperature to be maintained.

Heat losses are roughly balanced between air leakage, conduction through glazing and conduction through solid envelope.; no one factor is having an out-sized impact upon heat demand. Solar gains meet most of the heat demand passively from spring through to autumn.

In summer whilst some active cooling requirements will be needed, excess gains can be mitigated by increased ventilation. However, with global heating escalating, this may need additional mechanical ventilation in future along with reverse running of a heat-pump to create a refrigerant effect.



Graph showing Energy Balance between natural and mechanical heating and cooling throughout the year

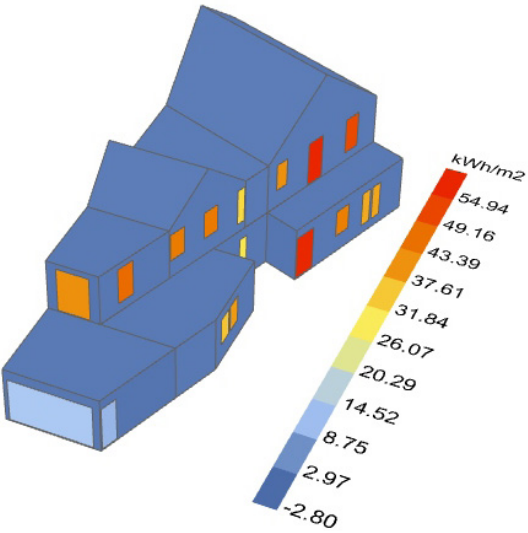


Total Zone Ideal Loads for Supply Air Total Heating Energy Intensity (kWh/m2) year average

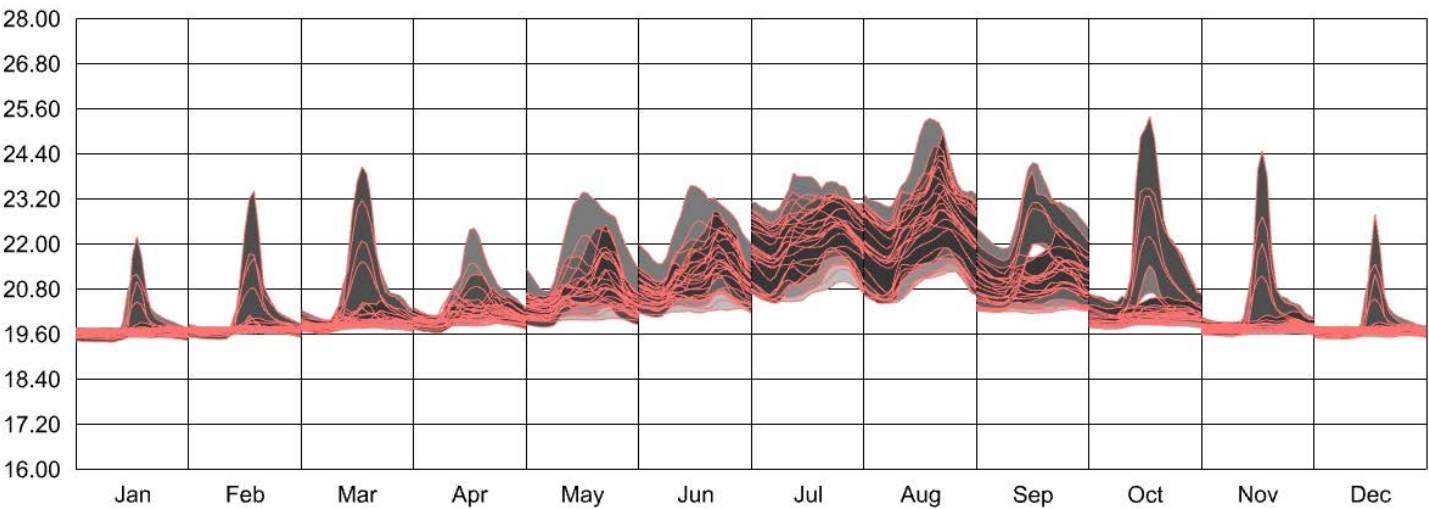
Energy Flows & Temperature

The image to the right shows net energy flow gains-losses for different surfaces, normalised per square metre. The colder colours indicate net loss or low gain, which is preferable for summer but not winter. The warmer colours indicate net gain or low net loss which is optimal for winter, but not summer.

The graph to the far right shows that the operative temperature throughout the year falls between 19-25.5 degrees celcius which is well within the acceptable range for thermal comfort.



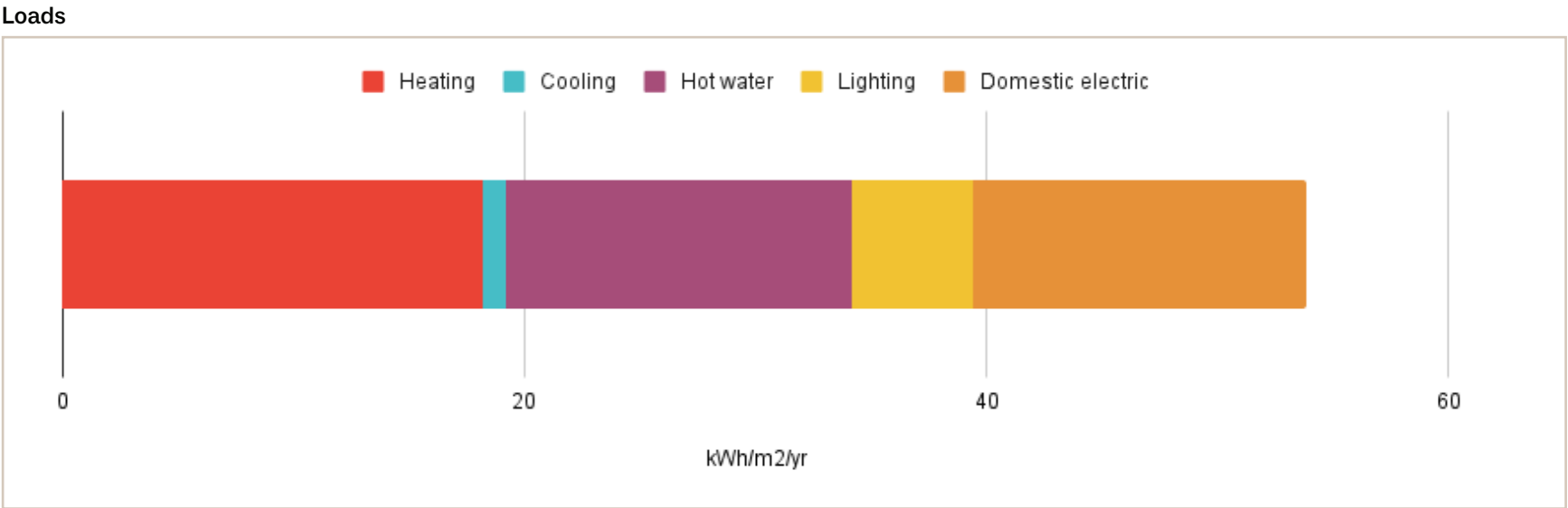
Energy flows by surface



Graph to show the potential range of operative temperatures in chalkstream house throughout the year

Heating & Cooling

The heating and cooling demands have been determined via dynamic thermal modelling as described over the preceding pages. Heating demand is generally the most significant demand category for a house in the UK; for the proposal this is 17.6kWh/m2, just marginally short of the LETI target of 15 kWh/m2. A ground source heat pump (GSHP) with an efficiency of 3.5 is the proposed method of meeting this. The cooling load in comparison is modest, though may increase over time due to climate change. We propose to run the heat-pump in reverse to provide cooling.



Domestic Hot Water

Hot water need will be met partly by the heat-pump, and partly by immersion top-up to reach the upper set point for hot water. The immersion system runs at a slightly lower efficiency rate than a GSHP on its own.

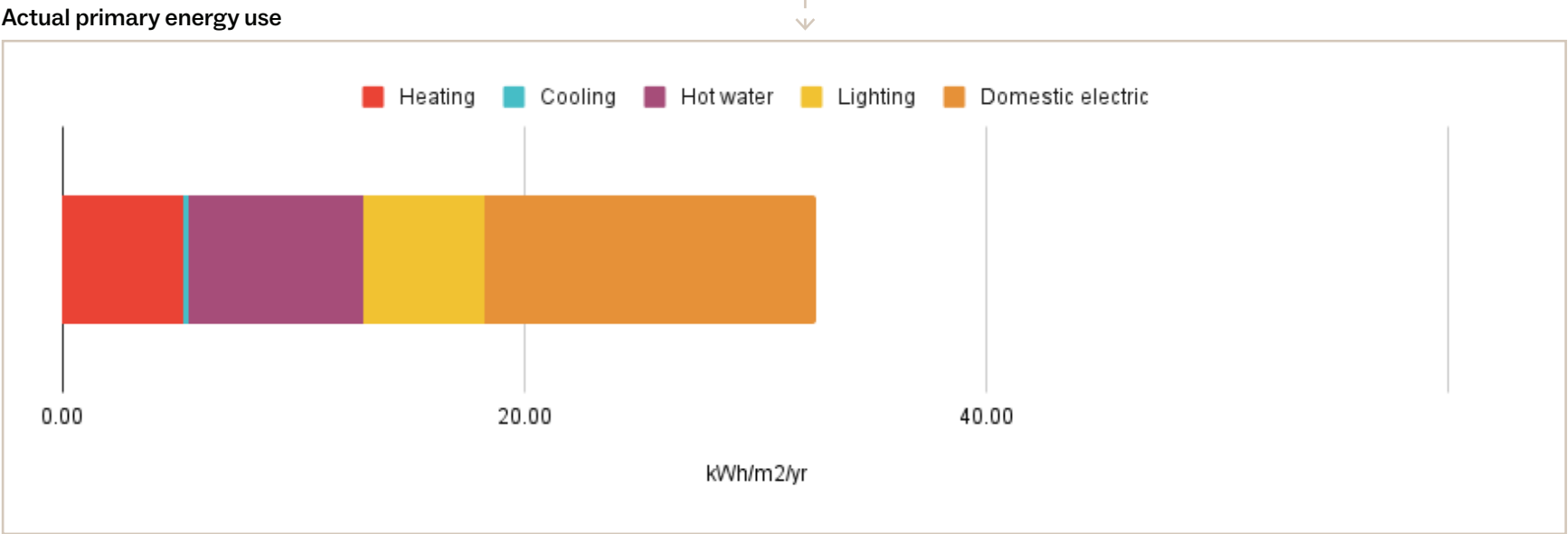
Technologies and efficiencies

Loads	Heating	Cooling	Hot water	Lighting	Domestic electric		
	18.2	1.0	15	5.3	14.4		
System	ASHP	ASHP	ASHP + imersion	direct AC	direct AC		
Efficiency	3.5	3.5	2	1	1	TOTAL EUI	
Primary use	Heating	Cooling	Hot water	Lighting	Domestic electric		
	5.19	0.29	7.50	5.26	14.41	32.65	kWh/m2/yr
						GIA	251 m2
						Total	8195 kWh/yr

Lighting & Domestic Electric

Lighting is typically one of the most significant electrical loads. We have assumed efficient lighting systems at 10W / m2.

Sometimes known as unregulated energy, domestic electrical power ‘mops up’ everything else and includes the use of electrical equipment within the home, (TVs, kettles, ovens etc). We have based this upon OFGEM’s Typical Domestic Consumption Values.



The Energy Use Intensity is calculated by dividing the total energy consumed by the building in one year by the total gross floor area of the building.

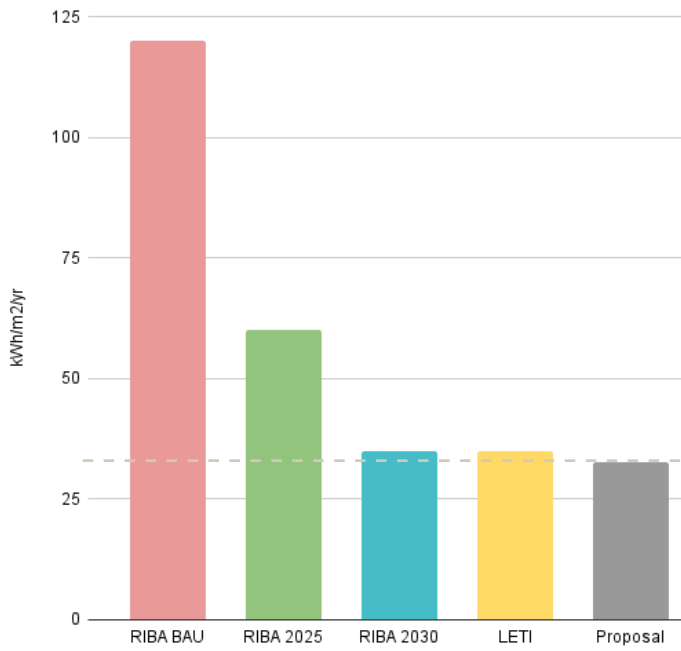
The actual primary energy consumption for the house depends upon the technologies and systems used to meet that need and their efficiencies.

The total EUI for Chalkstream House is 32.65kWh/m2/yr.

Meeting Benchmarks

The graph shows Chalkstream House as a comparison to industry standard benchmark EUIs, from ‘business as usual’ down to extremely stringent RIBA/ LETI/ Passivhaus guidelines. Chalkstream House meets and surpasses these requirements, and is an exemplar project of this nature, raising the standard of design.

Energy modelling also shows that the raw loads of Chalkstream House provide a 64% reduction from a Part L notional building.



The total EUI for Chalkstream House is 32.65kWh/m2/yr, which surpasses industry benchmarks.

Scenario	LETI (reference)	1	2	3
Description		As modelled	As modelled	Part L - notional
Shading		As modelled	As modelled	
Windows		As modelled	As modelled	
Rooflights		-	-	
Total glazing ratio				
Heating setpoint		20	20	20
Cooling setpoint		26	26	26
MVHR		Y	Y	N
Weather file		RAF.Wynton-H enlow.Camp	RAF.Wynton-H enlow.Camp	RAF.Wynton-H enlow.Camp
U-Values				
Floor	0.08 - 0.1	0.08	0.08	0.13
Wall	0.13 - 0.15	0.11	0.11	0.18
Roof	0.1 - 0.12	0.10	0.10	0.11
Glazing	0.8	0.80	0.80	1.2
Airtightness		Passivhaus	Passivhaus	Tight
Airtightness valu <1 (m3 /h. m2 @		0.000071	0.000071	0.0001
LOADS kWh/m2		1	2	
Heating	kWh/m2	18.179	17.659	84.613
Cooling		0	0.022	0.011
Interior Lighting		5.263	5.263	5.263
Electric Equipment		14.408	14.408	14.408
		1	2	
Total demand	kWh/m2	37.9	37.4	104
			36%	
		Reduction	64%	

Scenario comparisons

Net Zero Operational House

Requirement
Fully powered by renewable energy, with no fossil fuels used.

Achievement
Chalkstream House has eliminated all use of fossil fuels from the site. Over the year, PV panels will generate more than the house’s annual demand for energy. In the winter months, the grid will provide back up whilst in the summer months, surplus energy will be sold back to the grid.

Requirement
All energy use minimised to meet local energy use targets and limits.

Achievement
Chalkstream House has been designed with fabric first principles and low U-values which minimise the energy intensity from the outset. Further measures are in place through the use of energy efficient systems such as MVHR and a ground source heat pump. This results in the Energy Use Intensity surpassing the LETI target, at 32.65kWh/m2/yr.

Requirement
Residual emissions to be offset.

Achievement
As will be explained in the next section, tree planting will offset the remainder of emissions that result from operational carbon and embodied carbon.

Chalkstream House meets the requirements as set out in the definitions provided earlier in the document for Net Zero Operational buildings.

Achieving Low Carbon Energy

	Gold Standard	Evidence
Residential development	In addition to Silver level requirements: 100% dwelling’s energy demand is supplied from onsite renewable technology such as PV (assuming low carbon heating/ hot water technology is used such as ASHPs)	Page 23
	[Silver] Show that 75% or more of dwellings energy demand is supplied from onsite renewable technology such as PV (assuming low carbon heating/hot water technology is used such as ASHPs)	Superseded by above
	[Silver] Show that roof shape and orientation is optimised to maximise solar PV outputs	Page 22
	[Silver] Show that the development commits to investigating better uses of PV (if present) and detail what these are (connecting any array directly to the landlord supply should NOT be allowed. Options could include: SolShare (or similar), connecting to thermal stores of communal heat pumps).	The proposal is for an isolated home that cannot help serve other properties, but excess energy generated in summer months will be sold back to the grid.

Solar Gains

The stage 2 radiation studies showed the areas of the house that are most exposed and susceptible to solar gains in the summer and winter.

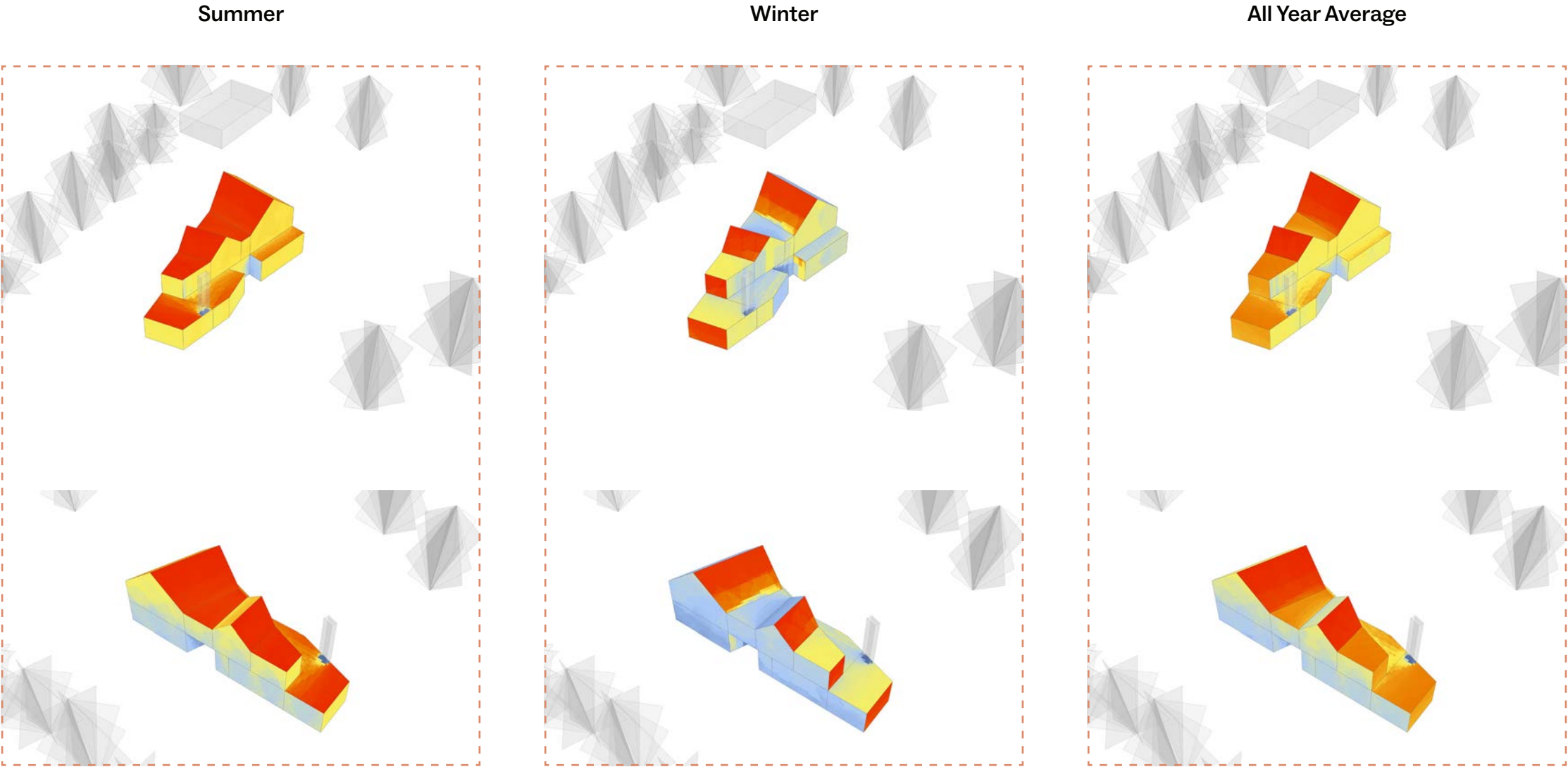
In summer the red areas will require shading or no glazing to avoid overheating.

In winter, the red areas are ideal for windows to benefit from solar gains.

These studies were used to optimise the positioning and sizing of windows, and to understand the requirements for a shading strategy better.

This resulted in an improvement in shading strategies including a timber pergola to the large area of glazing to the south and vertical shading to some west facing windows. Larger areas of glazing, particularly to the west were also reduced.

They have also been used to indicate the optimal positions for PV panels.

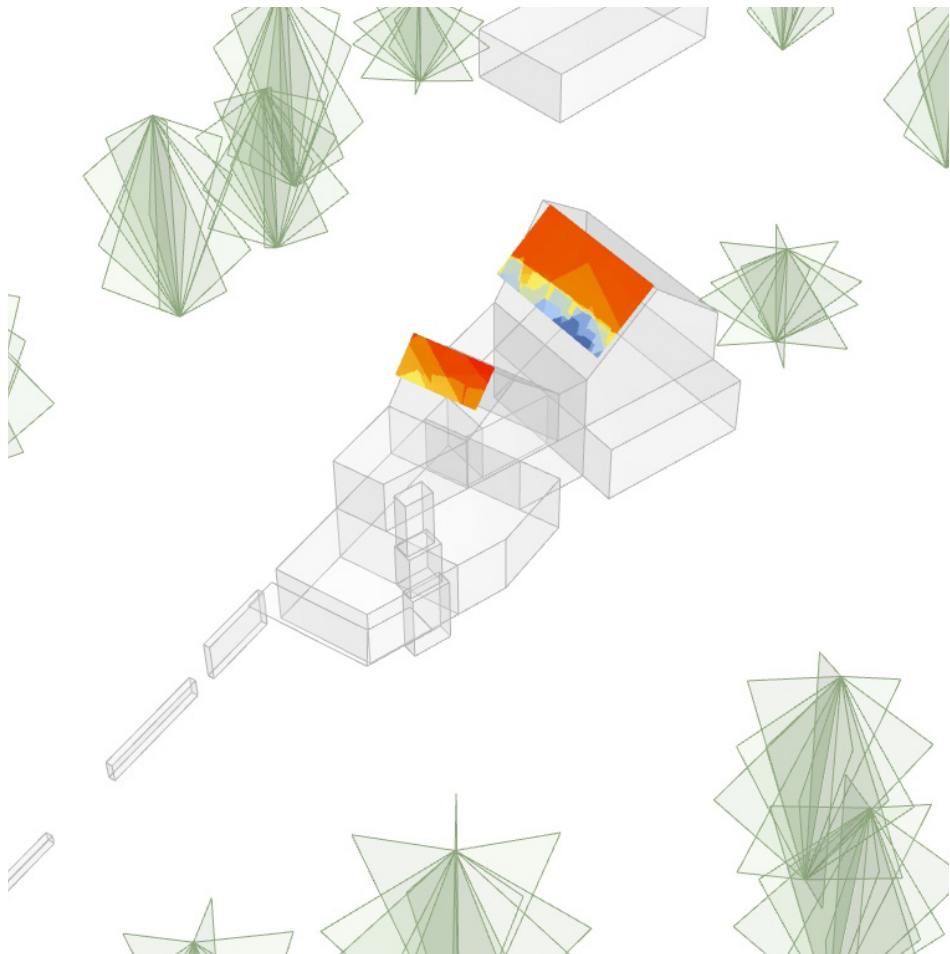


Generating Energy

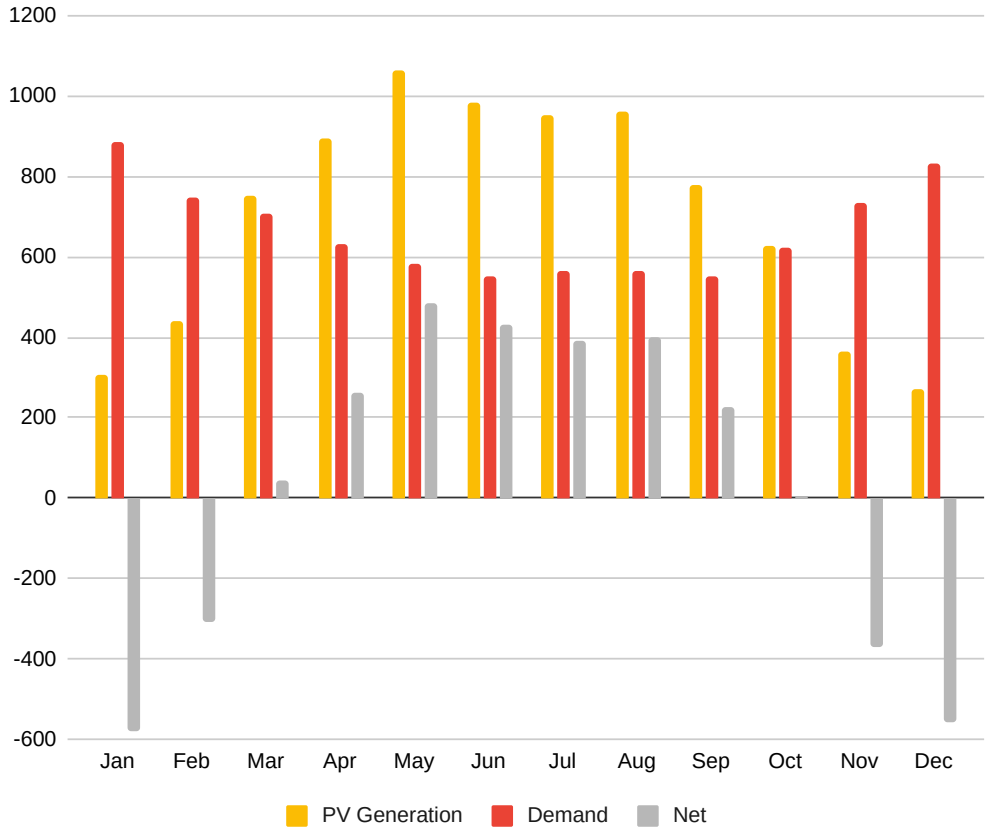
Undertaking radiation studies has shown that the south-facing pitched roofs are the areas of the house that most benefit from solar gains throughout the year.

PV panels are located on these pitches to generate renewable energy for the house.

As can be seen in the graph, the PV panels would generate more energy than demanded by the house for the majority of the year, with only 4 months relying on additional support from the main grid.



PV Study energy modelling



Graph to show PV Generation vs Demand

Area of PV m2	Total kWh / yr	Intensity kWh/m2/yr			
34	8,393	247			
	PV Generation	Demand	Net	Energy exported	Energy imported
Jan	306	882.7	-577		577
Feb	442	748.3	-306		306
Mar	750	704.9	45	45	
Apr	894	629.7	264	264	
May	1063	580.3	483	483	
Jun	982	550.3	432	432	
Jul	953	562.7	390	390	
Aug	962	562.7	399	399	
Sep	776	550.7	225	225	
Oct	629	624.6	4	4	
Nov	363	734.3	-371		371
Dec	273	831.0	-558		558
sum	8,393	7,962	431	2,243	1,812

PV Generation vs Demand

Minimising Carbon Footprint

	Gold Standard	Evidence
Whole life carbon assessment: All residential development	In addition to Silver level requirements: Ensure the scheme achieves the following (kgCO2e/m²GIA) scores: • A1 - A5 score <500 • B1 - 5, C1 - 4 (incl. sequestration) <300 OR • LETI Band C	Page 31 and Appendix B
	[Silver] Incorporate the findings of pre-demolition audits (where applicable) into the WLC assessment for the development	N/A
	[Silver] Applicants must commit to updating the assessments at pre-commencement (Stage4) and pre-occupation (Stage5/6) ensuring alignment with the targets	Clients are committed to continual assessments at each RIBA stage
	[Silver] Ensure the scheme achieves the following (kgCO2e/m²GIA) scores: • Embodied Carbon – Product & construction (A1 - A5) score = 675 • Embodied Carbon – maintenance, replacement repair and end of life (B1 - 5, C1 - 4, sequestration) score = 325 Or • LETI Band D	Superseded by above

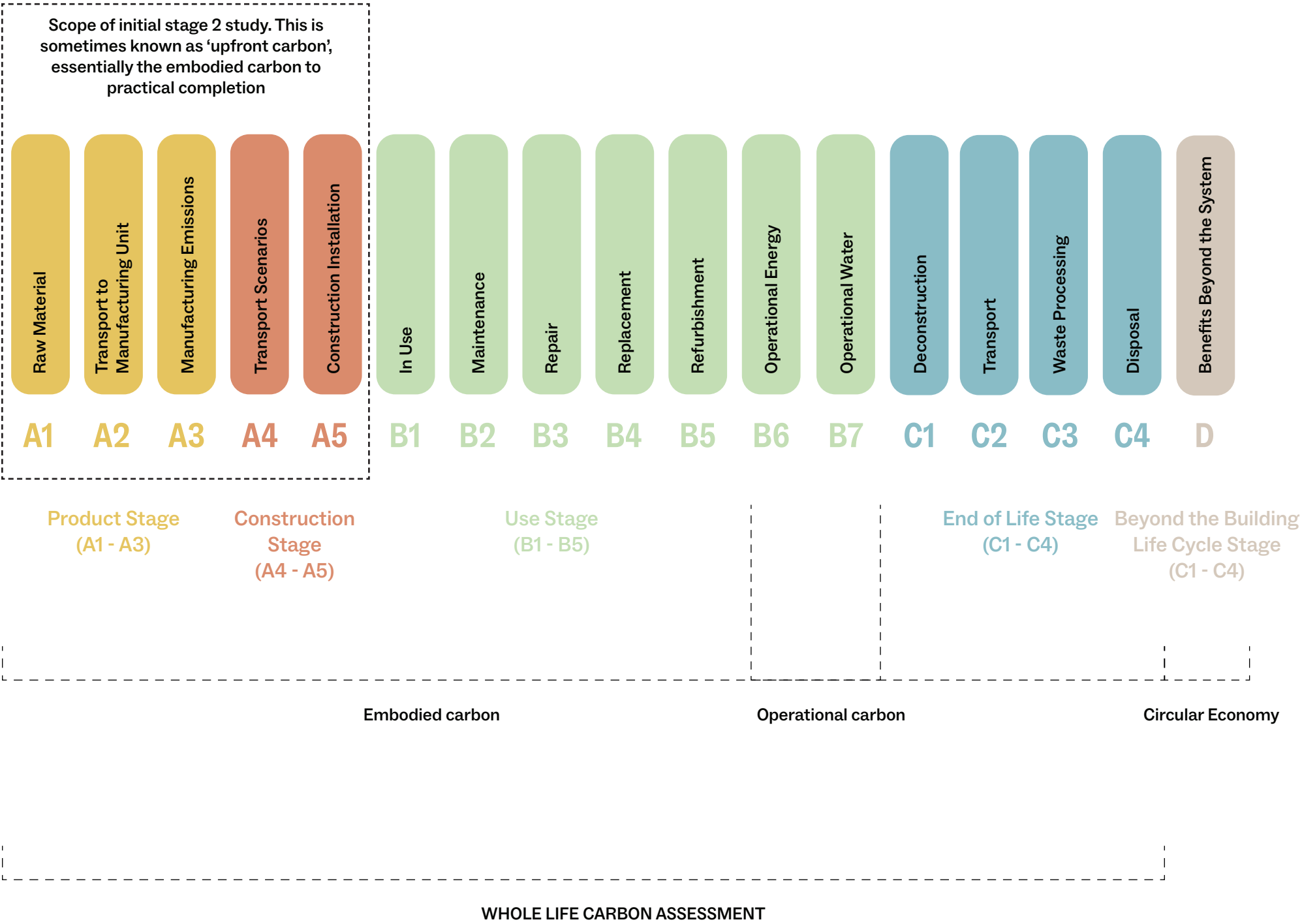
RICS Framework

The framework for appraising the environmental impacts of the built environment is provided by EN 15978: 2011. It is part of the EN 15643 family of standards for the sustainability assessment of buildings. However the standard is quite open to interpretation - in response the RICS has developed a modular framework to provide a unified approach to undertaking whole life carbon assessments for buildings and infrastructure.

The diagram here has been adapted from ‘RICS Whole life carbon assessment for the built environment by iStructE’ and details the project life cycle and carbon categories through stages: A product (and materials), construction process, B in use and C end of life.

Stage 2 Study

The purpose of this initial study is to look at upfront carbon for some typical build-ups, in order to understand the relative carbon impact of different material choices that are being explored in the context of this specific project.

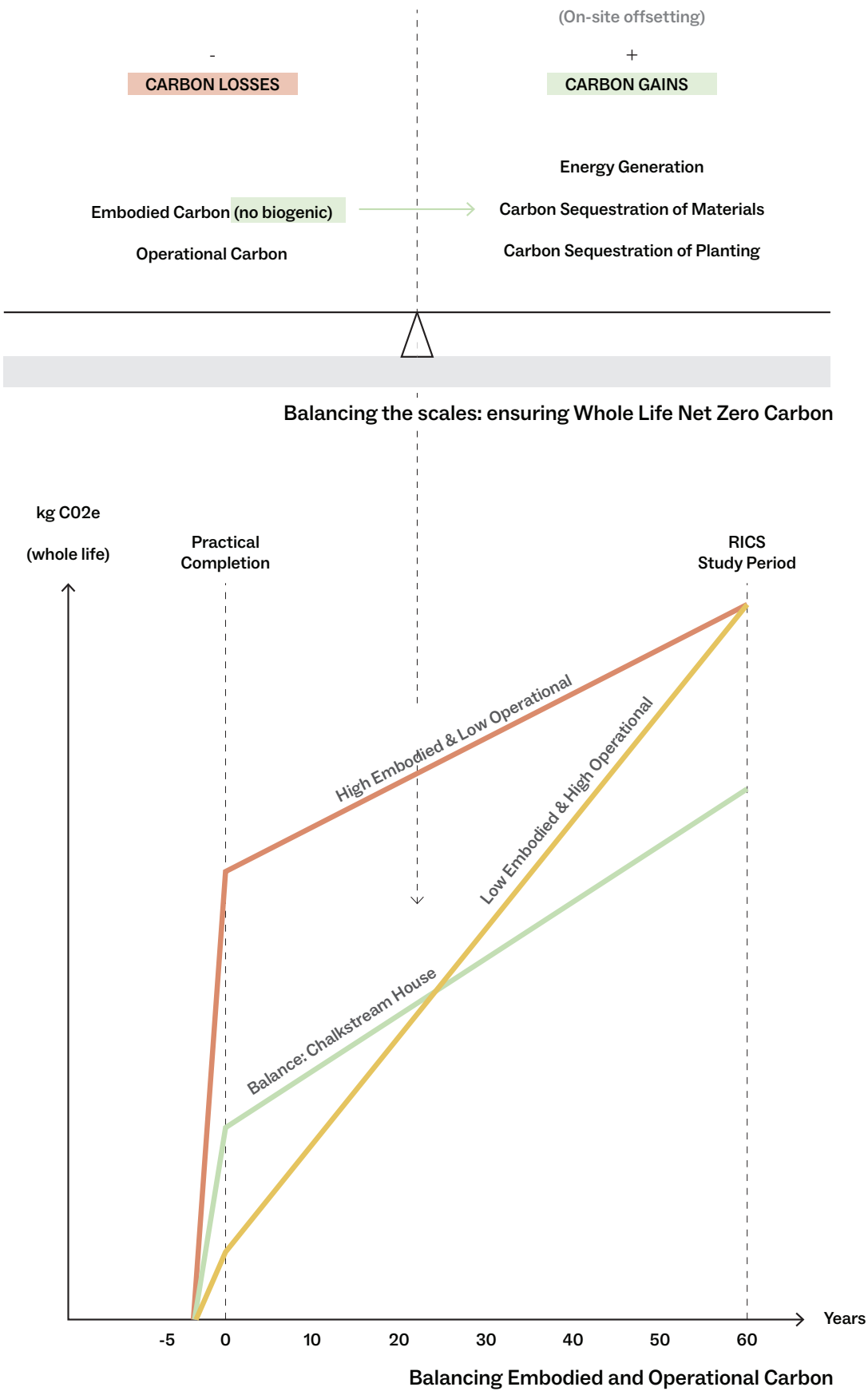


Studio Bark’s Approach

In very basic terms, we need to find that balance between embodied carbon (aka. the environmental impact of our buildings pre-occupation) and the ongoing operational environmental impact. Studio Bark’s principles for this are outlined below:

1. The Site should:
- have potential for energy generation
 - have potential for solar gain
 - have potential for shrub/tree planting
 - have sufficient space to negate the requirement for tree removal, and if it occurs it is kept to a minimum
 - have potential for biodiversity enhancements
2. Client Brief and Aspirations should demonstrate that:
- they are committed to low energy principles
 - they have the budget to deliver a low energy building
 - they want to limit car use or switch to electric
3. Design Concepts should:
- make the most of passive solar gain through orientation and location
 - make the most of fixed and seasonal solar shading
 - make the most of natural and passive stack ventilation through the careful placement of operable windows oriented with prevailing wind in mind
 - think carefully about a concept which is structurally logical so as to reduce the need for concrete or steel

4. Low Carbon Material Palette
- should be carefully assessed and optioneered through Life Cycle Assessment tools
 - should be considered against durability and relevance to local vernacular
 - should be assessed based on material locality and transport requirements
 - should be assessed for ‘End of Life’ scenarios
5. Operational Energy
- a fabric first approach should be used to drive down space heat demand
 - low energy fittings and appliances must be specified
 - heat-pumps, MVHR systems, solar thermal panels should be considered to reduce operational energy
6. Carbon Gains
- materials that sequester carbon from the atmosphere should be specified to address the carbon balance
 - renewable energy systems connected to the grid should be specified
 - new tree planting should be specified to sequester more carbon
 - offsetting (off-site) should be avoided



Why Calculate Embodied Carbon?

As time progresses embodied carbon becomes more important in the construction process: as operational demands decrease and we move towards grid decarbonisation, the proportion embodied carbon takes up in the impact of our building becomes larger.

The initial upfront carbon studies included in this document help to inform design decisions, ensuring that embodied carbon is considered at very early design stages, and is inherently embedded within the proposal.

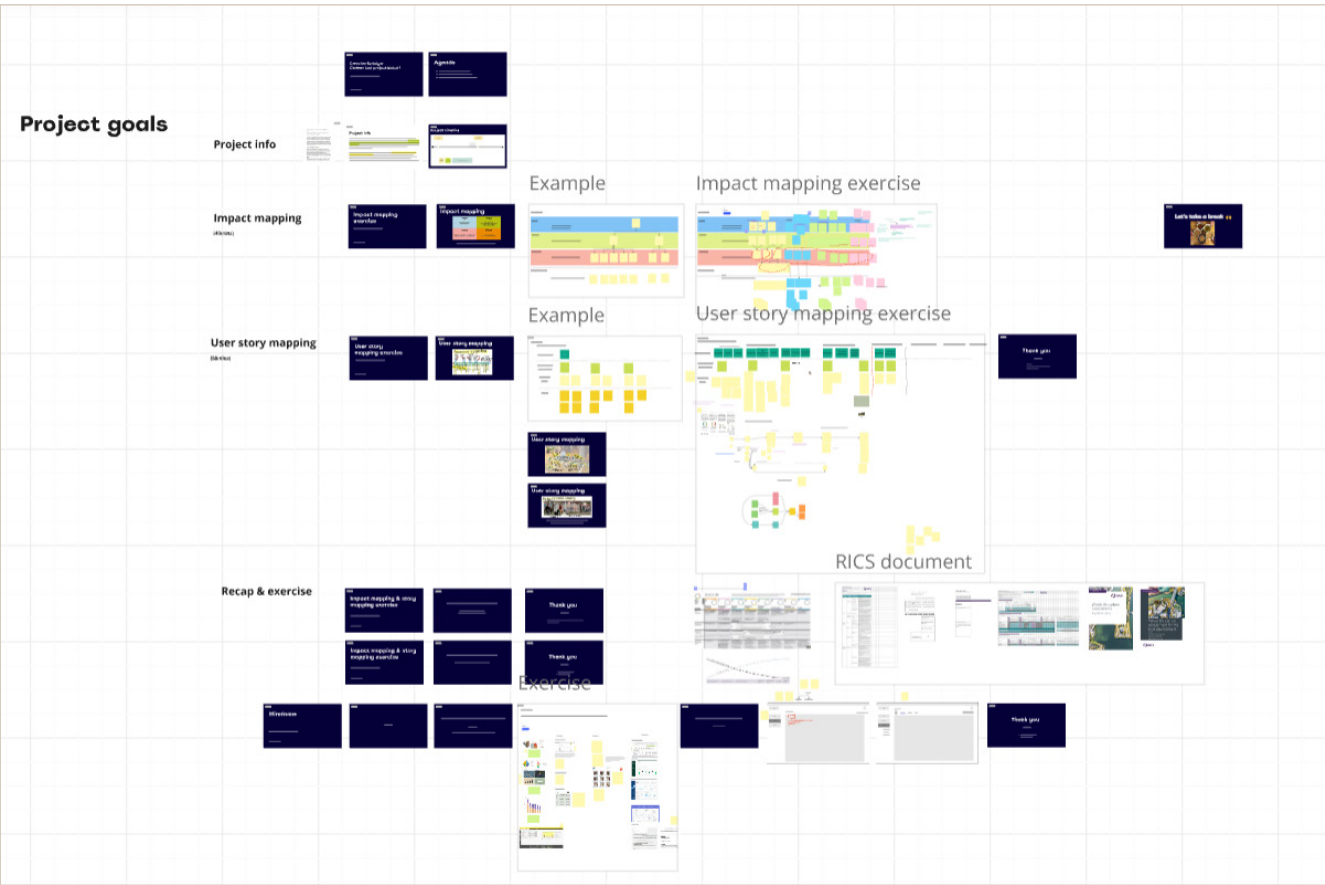
SmallCarbon® - Carbon Tool

After securing funding from Innovate UK's Creative Catalyst, Studio Bark is developing a carbon tool specifically for small and medium architectural enterprises.

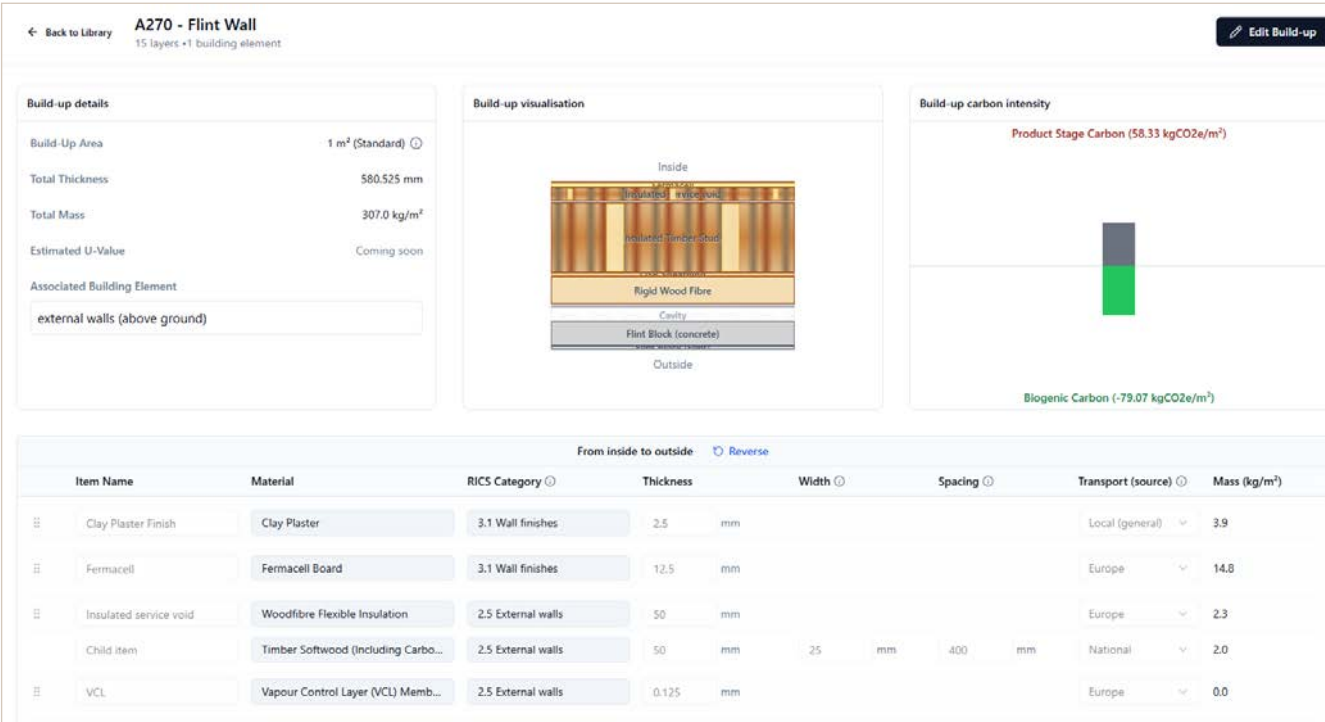
This tool builds on the beta version created by Studio Bark since 2020, which has been used for both Life Cycle Assessments (LCA) and the testing of embodied carbon of our designs.

In collaboration with software developer Looper, the goal is to create an innovative tool to boost climate literacy across both the profession and the planning system.

Testing and analysis of Chalkstream House has informed the current development of this tool, which hopes to ensure zero carbon design is accessible for designers, which in turn will raise national design standards.



Software development workshops



Example build up calculation for Chalkstream House on new SmallCarbon® tool

Local Materials

One of the ways to reduce the embodied carbon of the proposal is to source **local and reclaimed** materials wherever possible.

The map to the right shows initial studies into local sawmills and reclamation yards within a 10 mile radius of the site with further options within a 20 mile radius.

We are confident that the vast majority of the materials required for the construction of Chalkstream House can be sourced within close proximity to the site.



- Timber Merchants/ Sawmills
- Reclamation Yards

Stage 2 Material Testing

Material testing in RIBA Stage 2 was undertaken as part of design development.

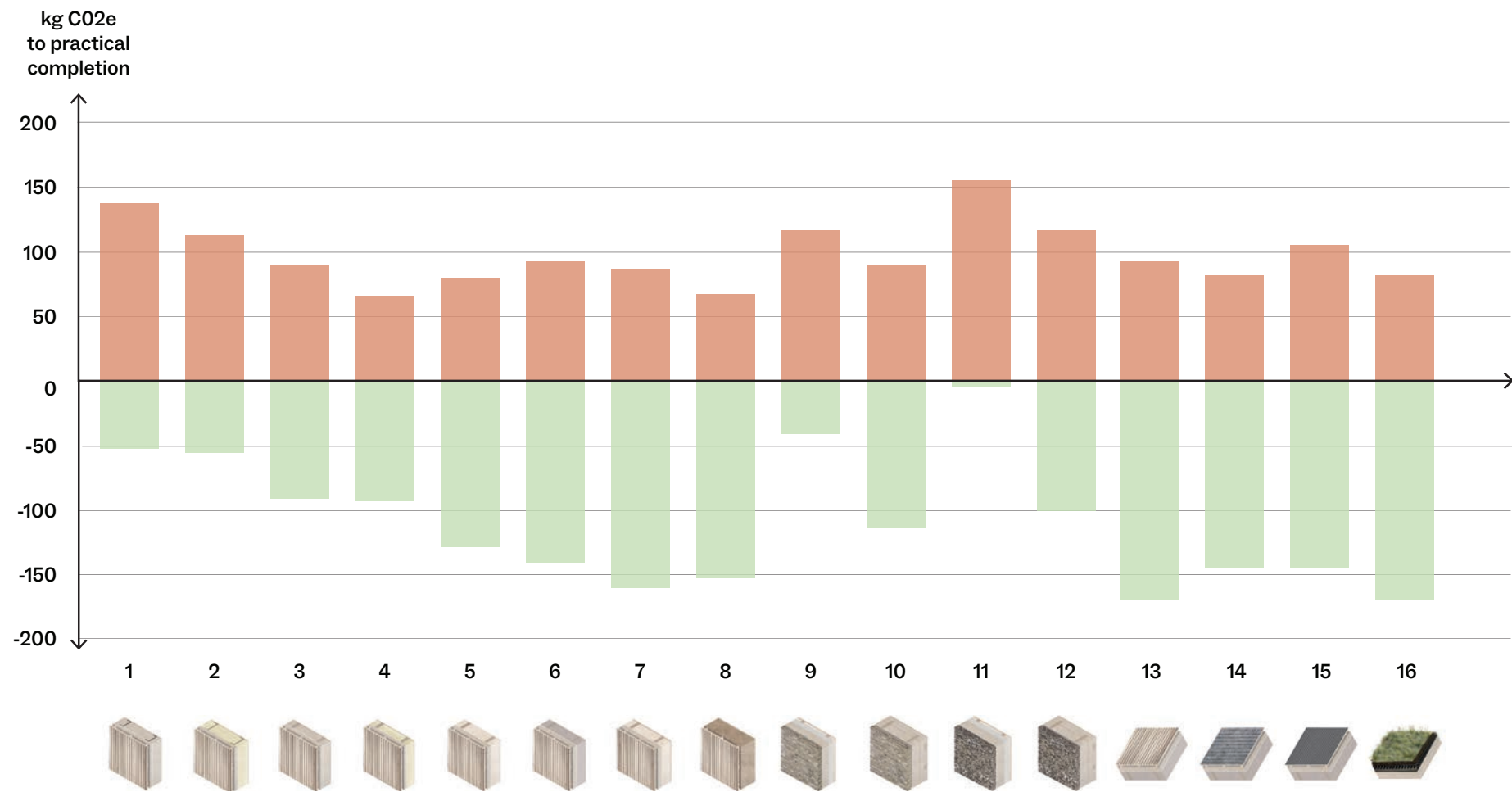
Different wall build ups were tested by first establishing a baseline ‘business as usual’ build up which subsequent tests were based on.

Studio Bark then looked at making individual changes to build ups, including cladding, insulation and structural options, which in turn fed into design development and materials choices.

Material Choices

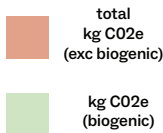
Informed by the study, the project aims to use natural materials and build ups where possible to reduce embodied carbon and increase sequestered carbon.

The entire house is proposed to be constructed of a timber frame, with flint block cladding to the ground floor and stained timber cladding to the first floor. Corrugated metal sheet roofing will be used for greater durability, alongside areas of flat green roof.



Build-ups Key

- 1. Timber cladding - Steel frame - PIR - Gypsum
- 2. Timber cladding - Steel frame - Mineral Wool - Gypsum
- 3. Timber cladding - Timber frame - PIR - Gypsum
- 4. Timber cladding - Timber frame - Mineral Wool - Gypsum
- 5. Timber cladding - Timber frame - Sheepswool - Clay
- 6. Timber cladding - Timber frame - Wood Fibre - Clay
- 7. Timber cladding - Timber frame - Hemp Wool+CSB - Clay
- 8. Timber cladding - Modular Straw - Clay
- 9. Reclaimed brick - Blockwork - PIR - Gypsum
- 10. Reclaimed brick - Timber frame - Wood Fibre - Clay
- 11. Flint - Blockwork - PIR - Gypsum
- 12. Flint - Timber frame - Wood Fibre - Clay
- 13. Timber Clad Roof
- 14. Slate Roof
- 15. Corrugated Sheet Metal Roof
- 16. Green Roof



Results

The graph to the right (top) shows the upfront carbon for Chalkstream House. The green ‘negative’ bars show the **biogenic carbon** which is sequestered within the materials at product stage. **Biogenic carbon is significant within Chalkstream House**, with the extensive use of natural biogenic construction types. For the whole life cycle of the building, we assume that most of the carbon locked-up within the materials will be re-released into the atmosphere at the end of life stage (C); except where recycling or reuse is likely to keep this carbon locked-up within materials.

At practical completion, Chalkstream House will have locked-up 319 tonnes of CO2e - the equivalent carbon impact of almost 1.5 million miles driven in a car¹, or 323 round trip flights from London to New York.²

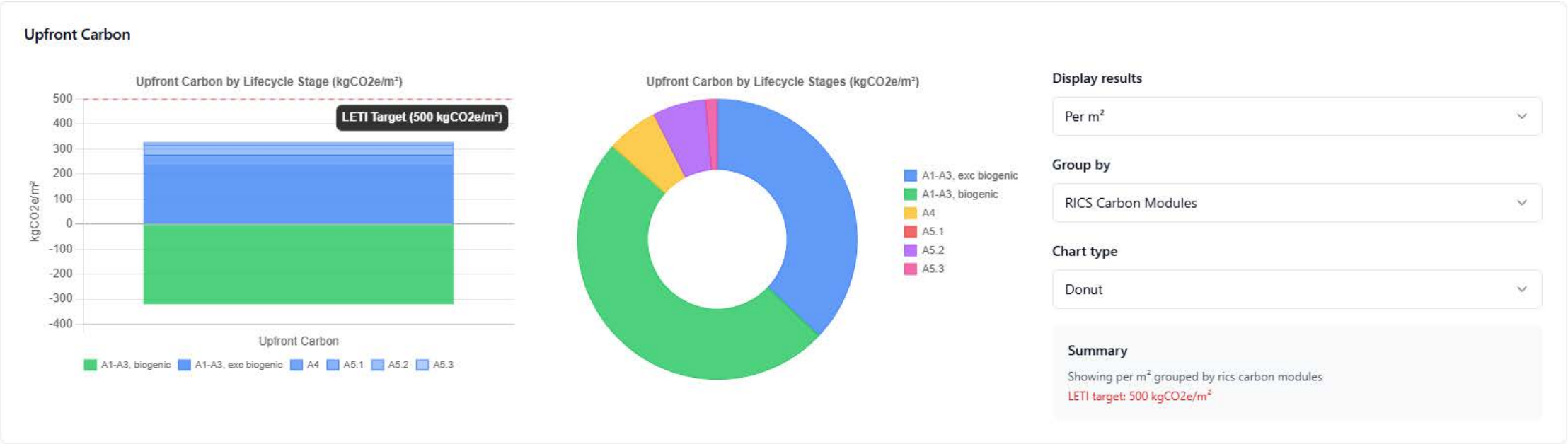
The graph on the bottom shows the whole life cycle carbon picture for Chalkstream House, broken down according to the three modules: A (upfront carbon), B (in-use stage) and C (end of life stage).

Industry Benchmarks

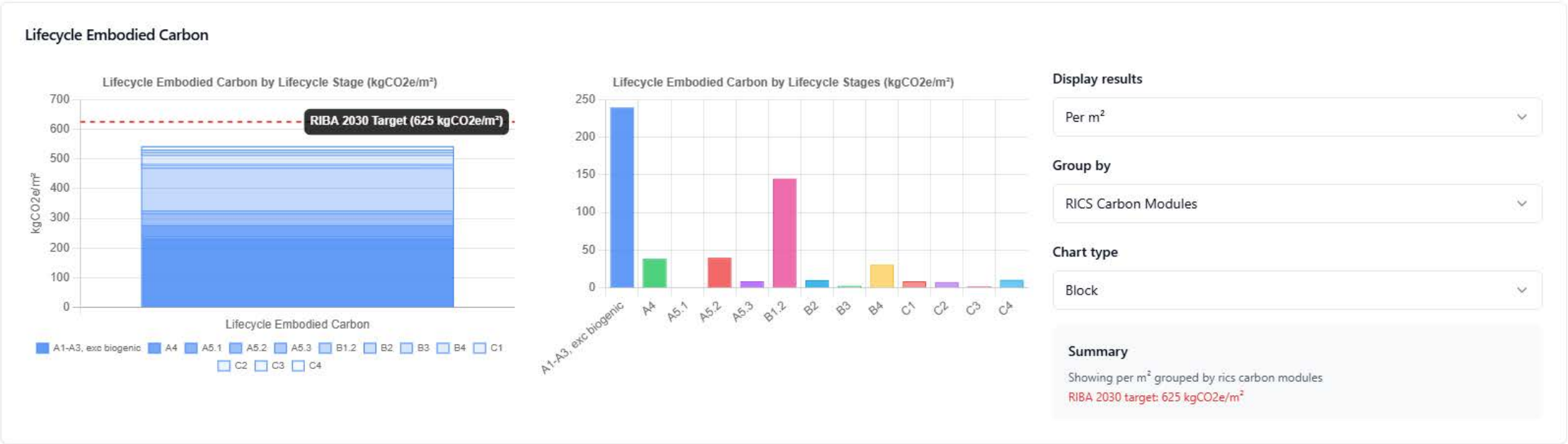
The embodied carbon over lifecycle for Chalkstream House is 543 kgCO2e/m2.

This is an **exemplar project for carbon negative design** in the UK, surpassing the industry benchmarks:

- RIBA Business As Usual - 1200 kgCO2e/m2
- RIBA 2025 - 800 kgCO2e/m2
- RIBA 2030 - 625 kgCO2e/m2



A1-A5 Upfront Carbon:
Non-biogenic - 326 kgCO2e/m²
Biogenic - -320 kgCO2e/m²



Use Stage B (excl. B6 and B7) + End of Life Stage C:
217kgCO2e/m²

Total Embodied Carbon Over Lifecycle:
543kgCO2e/m²

1 - <https://www.openco2.net/en/co2-converter>
2 - [theguardian.com/environment/ng-interactive/2019/jul/19/carbon-calculator-how-taking-one-flight-emits-as-much-as-many-people-do-in-a-year](https://www.theguardian.com/environment/ng-interactive/2019/jul/19/carbon-calculator-how-taking-one-flight-emits-as-much-as-many-people-do-in-a-year)

Tree Planting

In order to consider the entire Chalkstream House proposal holistically, alongside a Whole Lifecycle Assessment for the building we are to also consider the on-site carbon drawdown effect of trees planted as part of the scheme.

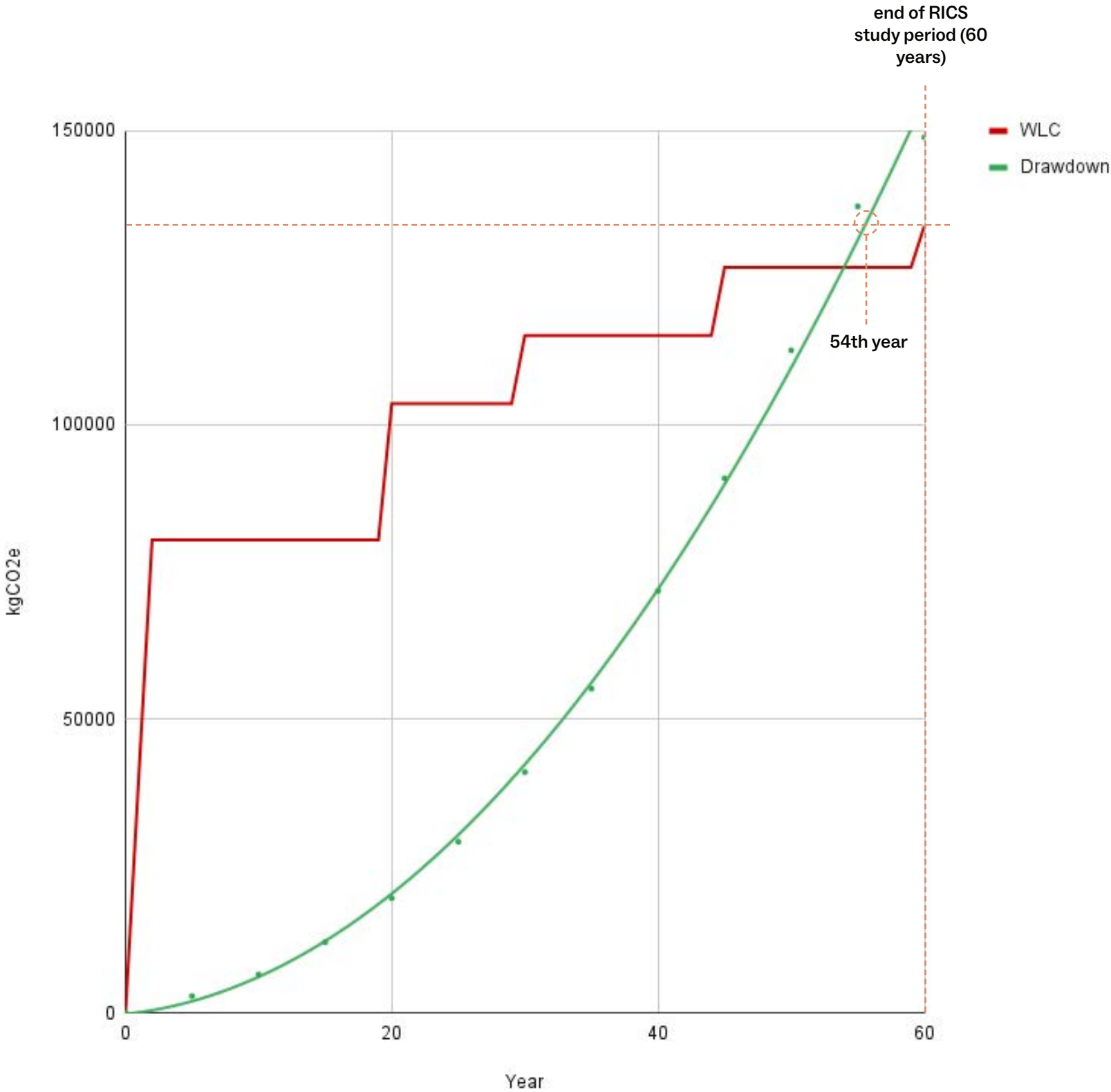
This is based upon the planting of 25 new trees upon practical completion, in a split mix of fast, medium and slow growing species, with a majority of fast growing.

The numerical workings behind this calculation can be seen in the appendix. It is assumed that the number of trees on site do not alter over the 60 year study period.

In order for Chalkstream House to be considered Whole Life Zero Carbon, it needs to sequester and offset more carbon than it produces over a set period, which as specified by the RICS guidelines is 60 years.

The breakeven point for ‘tipping the scales’ of Chalkstream House to a Whole Life Zero Carbon development is an 54 years, as shown in the left graph, 6 years faster than the RICS requirement for Whole Life Zero Carbon schemes.

After this breakeven point Chalkstream House becomes carbon negative, and any carbon sequestered by the trees planted will contribute to North Hertfordshire’s vision for net zero.



Graph showing embodied carbon and on-site carbon drawdown (445 trees) over lifecycle, with breakeven point of 54 years

Net Zero Embodied Carbon

A ‘Net Zero Embodied Carbon’ asset is one where the sum total of GHG (greenhouse gases) emissions and removals over an asset’s life cycle (Modules A0-A5, B1-B5 and C1-C4) are minimized, which meets local carbon targets or limits (e.g kgCO2e/m2), and with additional ‘offsets’, equals zero.

- LETI definition

Net Zero Operational Carbon

A ‘Net Zero Operational Carbon – Energy’ asset is one where no fossil fuels are used, all energy use (Module B6) has been minimized, meets the local energy use target or limit (e.g. kWh/ m2/a) and all energy use is generated on- or off- site using renewables that demonstrate additionality. Direct emissions from renewables and any upstream emissions are ‘offset’.

- LETI definition

When the amount of carbon dioxide emissions associated with building operations on an annual basis is reduced (highly energy efficient and fully powered from on-site and/or off-site renewable energy sources) to a level that is consistent with reaching net zero at the global or sector level in 1.5°C pathways. Any residual emissions that remain unfeasible to eliminate should be neutralised through carbon removals.

- World Green Building Council definition

Net Zero Whole Life Carbon

A ‘Net Zero (whole life) Carbon’ Asset is one where the sum total of all asset related GHG emissions, both operational and embodied, over an asset’s life cycle (Modules A0-A5, B1B8, C1-C4) are minimized, which meets local carbon, energy and water targets or limits, and with residual ‘offsets’, equals zero.

- LETI definition

When, in addition to net zero operational carbon, upfront carbon and other embodied carbon across the building lifecycle is reduced to a level that is consistent with reaching net zero at the global or sector level in 1.5°C pathways. Any residual emissions that remain unfeasible to eliminate should be neutralised through carbon removals.

- World Green Building Council definition

A net zero embodied carbon building is where carbon dioxide emissions relating to the materials and fabric of the building themselves have been reduced to meet local targets. Any residual emissions must be offset in order to equal zero.

The total embodied carbon over lifecycle of Chalkstream House is 543kg/m2. This surpasses the RIBA 2030 challenge benchmark of 625kg/ m2. Tree planting helps to offset the remaining carbon.

A net zero operational carbon building needs to have energy efficient measures in place and be 100% fully powered by on-site and/or off-site renewable energy. In addition to this, carbon dioxide emissions need to be reduced in line with local targets, and any residual emissions need to be offset.

PV panels will generate the majority of Chalkstream House’s energy, with the remainder coming from an off-site renewable energy provider. Annually, the house will generate more energy than it requires. The house’s total EUI has been reduced to 32.65kWh/m2/yr to surpass LETI targets.

A net zero whole life carbon building, therefore, needs to be net zero operational carbon, but also needs to reduce embodied carbon through material considerations. Any residual emissions left after undertaking reductions in both of these can be neutralised through offsetting.

Chalkstream House is therefore net zero whole life carbon as it satisfies both net zero embodied carbon and operational carbon requirements. The residual emissions leftover are offset through on-site tree planting, which neutralises the emissions by the 54th year - before the end of the 60 year life cycle.

Promoting Biodiversity

	Gold Standard	Evidence
Ecological Surveys and Assessments	In addition to Silver level requirements: Ensure habitats are evidenced in photographs, and the local context of the site is shown in relation to features beyond the site / wider ecological networks / LNRS	See Supporting Document - EcIA
	[Silver] In addition to bronze level requirements: Ensure surveys include a review of existing sources of information such as the Hertfordshire Environmental Records Centre, MAGIC or any other appropriate resource	See Supporting Document - EcIA
	[Silver] Ensure that an assessment of additional features within the site but beyond compensation for species affected is included in the species assessment	See Supporting Document - EcIA
	[Bronze] Carry out and submit a habitat survey to enable metric baselines to be completed, including quadrant survey (where necessary) to demonstrate UK Habitats. The survey should be undertaken in line with best practice (e.g. timing and age) and identify Priority/ irreplaceable habitats (BS42020)	See Supporting Document - EcIA
	[Bronze] A species assessment and follow-up surveys should be completed and submitted according to recommendations required to enable determination – i.e. no outstanding surveys	PEA recommended further reptile and botany survey only. See Supporting Document - EcIA
Arboriculture Assessment (where trees are impacted by the proposal)	In addition to Silver level requirements: Retain all existing trees on site	No trees impacted by proposal - all retained
	[Silver] In addition to bronze level requirements: Retain any high value tress onsite (Category A/B or other highest value trees)	No trees impacted by proposal - all retained
	[Bronze] Submit a survey of all trees on site, identifying trees of value and potential impacts on offsite trees	No trees impacted by proposal

	Gold Standard	Evidence
Biodiversity Net Gain (BNG) (all development except BNG exempt developments)	In addition to Silver level requirements: Submit a plan showing that 20% BNG is achieved, either all onsite or 10% onsite plus 10% offsite (e.g. contributing to the Hertfordshire LNRS)	See Supporting Document - BNG Metric - Despite being a self-build exemption, 33.27% BNG has been achieved in Habitat Units onsite.
	[Silver] In addition to bronze standard requirements: Ensure 10% BNG is achieved onsite	Superseded by above
	[Silver] Provide on plot ecological enhancements to support wildlife (housing for bats, birds, bees, hedgehog holes in fences etc.)	Page 37
	[Bronze] Ensure the Statutory Metric or Small Sites Metric (SSM) is completed and submitted showing baseline value and demonstrate how the mitigation hierarchy has been applied	See Supporting Document - BNG Metric
	[Bronze] Submit a plan showing that habitat proposals achieve at least 10% BNG	Superseded by above
	[Bronze] Submit a Habitat Management and Monitoring Plan (HMMP) showing how BNG significant habitats are to be managed and monitored	N/A - Scheme is BNG exempt
Ecological buffers	In addition to Silver level requirements: Ensure the scheme includes enhancements to national and/or local sites and other habitats seeking to limit impacts of development and positively contribute to existing habitats	See Supporting Document - EcIA
	[Silver] In addition to bronze standard requirements: Ensure the scheme includes a 12m buffer adjacent to LWS and species rich hedgerows	Page 37
	[Bronze] Ensure the scheme takes account of Natural England’s Standing Advice for ancient woodland and veteran trees to provide a 15m buffer in these areas	N/A
	[Bronze] Ensure the scheme includes a 12m buffers for SSSIs	N/A
	[Bronze] Ensure the scheme includes a 10m riparian zone buffer alongside watercourses, where applicable	12m buffer provided from ditch to north. Page 37

Habitat Enhancements

- Wildflower overseeding of grassland, contributing to the 'B-Lines' project
- Flowering lawn within the domestic garden area
- Green roofs with native planting
- New trees, shrubs and scrub
- Orchard planting
- New ponds and swale
- All existing hedgerows retained and managed
- 33.27 % BNG in Habitat Units on site

Small-Scale Species Enhancements

Small scale species enhancements will be made in line with the ecologist's recommendations:

- 1 1no. integrated bat box within south-facing side of chimney, positioned at least 5m above ground level.
- 2 1no. swift box within northern elevation, at least 5m above ground level.
- 3 Habitat pile using woody cut material from vegetation clearance, approx. 2m x 1m x 0.5m.
- 4 1no. invertebrate box on retained tree within proposed shrub habitat.



2



4



1



3



Scope & Guidance

The scope of the lighting strategy is to demonstrate how artificial lighting is designed so that it is limited in light spill to vegetation, and subsequently limited in the impact on local wildlife, and more specifically local bat populations.

The strategy aims to provide specific light installation prescriptions in accordance with current guidance issued by the Bat Conservation Trust(BCT)and Institute of Lighting Professionals (ILP): Guidance Note 08/23: Bats and Artificial Lighting at Night.

In the absence of any designations from the LPA, it is assumed that the site lies within Environmental Zone E2 as prescribed by the ILP. The lighting will be designed in accordance with this.

Impact of Development on Bats

The Preliminary Ecological Appraisal concluded that whilst two trees were identified as having one PRF-I each, it was determined that these features were not in occupation by bats through visual inspection and thus the value of the site for bats roosting in trees is negligible.

The existing cow shed structure was inspected and also found to be negligible for bat roosting potential due to a lack of suitable roosting features.

However, the site is highly likely to be predominantly used for commuting and foraging purposes by relatively common bat species. The boundary hedgerows were found to afford potential flight corridors and foraging opportunities, however, given that the site is isolated and the hedgerows do not extend into surrounding arable land, the site was deemed at being a Lower value at the Parish level for foraging and commuting bats.

Artificial lighting proposed to be installed in association with the proposed development should therefore focus on limiting artificial light pollution over the boundary hedgerows to retain and protect the existing dark corridors.

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town / City centres with high levels of night-time activity

Mitigation & Sensitive Design

Dark Buffers

The proposal will be located within the 12m ecological buffer zone as dictated by the LPA.

Luminaire Specifications

All luminaires will be specified in accordance with the Bats and Artificial Lighting at Night guidance:

Internal Lighting

- Internal lighting will all be LED lightsource
- Recessed LEDs will be used where in close proximity to windows to reduce glare and spill.
- All light sources will be set back a minimum of 1m from windows.

External Lighting

- Limited to low lux level with no upwards illuminance - no greater than a 3-lux average illuminance with a maximum horizontal illuminance of 0.6 uniformity (subject to appropriate maintenance factors).
- Lamps that minimise UV emissions or use UV filters.
- Warm LED sources, 2700K or less
- Peak wavelengths higher than 550nm
- Negligible or zero Upward Light Ratio, and with good optical control
- No light output above 90° and/or no upward tilt
- Limited installation with lighting on the entrance porch, carport area, and external ground floor terraces only.
- No high powered security lights.
- No lighting outside of the residential curtilage.

Sensitive Site Configuration

Windows have been minimised where they are closer to the 12m buffer edge. Hard landscaping is kept to a minimum, reducing the risk of reflection and scatter.

Physical Screening

Key windows which are closer to buffer edges will feature angled timber louvres externally to help reduce direct light spill.

New scrub is also proposed close to the house to increase connectivity of habitats and to provide additional screening of the house from the boundaries.

Dimming and Part-Night Lighting

External lights will be on a PIR sensor with a timeclock or photocell to ensure that movement only triggers the light during a set window of hours, or during certain months.

Lights will also be switched to allow these to be permanently turned off during certain hours to avoid unnecessary light spill (e.g. midnight to 06:00am).

External lighting response will be maintained for 1-2 minutes if necessary.



Outdoor recessed LED downlights



Figure 5 - Outdoor Wall Light - Integrated LED Downlight to illuminate door entrances and garage area.



Figure 6 - Surface mounted outdoor LED lights to provide low level illumination on garden pathways and courtyard areas.

External Design



Internal Design



Conserving Water

	Gold Standard	Evidence
<i>Residential development</i>	Ensure that water consumption can meet the target of < 75 lpppd (RIBA 2030 Climate Challenge)	Page 43

Minimising Water Use

The proposal implements a number of different measures to minimise water use and reduce water waste. These include the following:

Rainwater Harvesting

A rainwater harvesting butt will be used to collect rainwater for watering the garden.

Any additional water required can be taken from the attenuation pond, rather than tap water.



Example:
Geberit Delta Dual
Flush Concealed
Cistern with 4/2.6L
cup



Example:
Logis M31 Single
lever kitchen mixer
260 EcoSmart, single
spray mode

Water Efficient Fittings

- Low-flow and high efficiency fittings and fixtures will be used throughout the house to reduce water waste.
- All toilets will be installed with a 4/2.6L dual flush system.
 - Water saving shower heads will be used to keep flow rates below 6L per minute, in line with RIBA 2030 targets.
 - Taps will be installed with a standard flow rate of 6L per minute, with flow limiters to further reduce this to 4L per minute in bathrooms as per 2030 RIBA targets.
 - An efficient washing machine will be installed using around 7L per kg of dry load.
 - An efficient dishwasher using between 9-11L per full load.

Water labelling schemes will also be used to help in choosing appliances.

Future efficiencies can be made by removing baths and replacing these with showers and/ or wetrooms.



Example:
Hansgrohe Crometta
Set 100 (1-jet, 6 l/min
green)



Example:
LG F4X1009NWK
Freestanding
Washing Machine,
9kg Load, 50L per
cycle (5.6L/kg)



Example:
Bristan Eco Flow
Limiter 4L Per
Minute for Basin Tap
Chrome ECOTAP4



Example:
Bosch Series 6
SMV6ZCX10G
Fully Integrated
Dishwasher, 9L per
cucle

Incorporating Sustainable Drainage

	Gold Standard	Evidence
SuDS scheme All development	In addition to silver level requirements: Ensure the scheme achieves better than greenfield (pre-development) run-off rates	See Supporting Document - Drainage Strategy
	Ensure that the scheme does not discharge to combined sewers	Surface water to discharge to on site pond for attenuation into existing watercourse and ditch.
	Ensure the scheme achieves Wst 05 Exemplary BREEAM credit.	See Supporting Document - Drainage Strategy
	[Silver] In addition to bronze level requirements: Ensure the SuDS strategy is in accordance with DEFRA's non-statutory SuDS technical standards	See Supporting Document - Drainage Strategy
	[Silver] Ensure the SuDS strategy also addresses the 4 pillars of SuDS. The scheme must also include SuDS planters, tree pits and rain gardens	See Supporting Document - Drainage Strategy
	[Silver] Ensure the scheme achieves Wst 05 BREEAM credit	As above
	[Bronze] Submit a SuDS strategy and maintenance plan approved by SAB ensuring that surface water run-off is managed as close to its source as possible and the scheme will not increase downstream flood risk. Strategy to include a climate change allowance	See Supporting Document - Drainage Strategy
	[Bronze] Ensure that discharge to a combined sewer is avoided unless all other discharge options (infiltration, watercourse, surface water sewer) have been exhausted first, as per the discharge hierarchy	As above
	[Bronze] Ensure that the scheme achieves greenfield run-off rates unless this is demonstrably not feasible in which case a minimum of 50% reduction will be required. Brownfield sites will need to achieve run-off rates as close to greenfield as possible	As above

Appendices

Appendices:

- A. SmallCarbon® Lifecycle Calculations**
- B. SmallCarbon® Lifecycle Results**
- C. Drawdown Calculation Sheet**

Quantities

Projects

Chalkstream House

Version 1

Version 1

Chalkstream House • A270

Create Version

Overview

Quantities

Calculation

Results

Build-ups

Materials

Build-ups

Manage building elements and their associated build-ups

Add Build-up

Build-ups (16)

Actions	Build-up Name	Building Element	Associated Build-up	Width (m)	Length (m)	Area (m²)	Mass (kg)	A1-A3, exc biogenic (kgCO2e)	A1-A3, biogenic (kgCO2e)	Notes
	Flint Walls	External walls (above ground)	A270 - Flint Wall	0.00	0.00	177	15,162.00	3,564.78	-13,908.48	
	Timber Walls	External walls (above ground)	A270 - Timber Cladding Wall	0.00	0.00	161	8,605.61	3,165.10	-13,154.18	
	Polycor Walls	External walls (above ground)	A270 - Polycor Brick Wall	0.00	0.00	17.7	5,235.52	851.62	-1,335.46	
	Corrugated Metal Roof	Roof	A270 - Corrugated Metal Roof	0.00	0.00	137.5	7,432.56	4,184.68	-10,171.01	
	Green Roof	Roof	A270 - Green Roof	0.00	0.00	48	6,650.98	1,215.02	-2,937.02	
	Roof Terrace	Roof	A270 - Roof Terrace	0.00	0.00	20	1,892.08	671.04	-2,379.88	

Calculation Sheet

Projects

Chalkstream House

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Create Version

Overview

Quantities

Calculation

Results

Bill of Quantities

Combined view of all materials and build-ups

Bill of Quantities (150 items)

Search...

View

VCL	Vapour Control Layer (VCL) Membrane	2.3 Roof	6.00	17.16	-0.12	0.89	--	--	0.00	--	--	--	--	--
Plywood Deck	Timber Plywood (Including Carbon Storage)	2.3 Roof	182.70	123.68	-294.14	2.14	--	--	12.06	--	--	--	--	--
Insulated Rafters	Woodfibre Flexible Insulation	2.3 Roof	170.00	87.72	-258.74	25.14	--	--	0.73	--	--	--	--	--
VCL	Vapour Control Layer (VCL) Membrane	2.3 Roof	6.00	17.16	-0.12	0.89	--	--	0.00	--	--	--	--	--
Fermacell Board	Fermacell Board	3.3 Ceiling finishes	295.00	62.54	-71.68	43.63	--	--	0.01	--	--	--	--	--
Clay Plaster	Clay Plaster	3.3 Ceiling finishes	77.50	4.42	-0.70	0.38	--	--	0.00	--	--	--	--	--
Child item	Timber Softwood	2.3 Roof	322.98	83.32	-500.60	3.78	--	--	0.74	--	--	--	--	--
Paint finish	Oil-based Paint	2.6 Windows and external doors	19.50	60.30	-1.41	0.23	--	--	0.00	--	--	--	--	--

SmallCarbon®
Beta version

Studio Bark
member

Home

Library

Materials

Build-ups

Projects (5)

+

> A282 Between The T...

> Tester

> RIBA test

> Nest House

> A270 - Chalkstream ...

Version 1

Did you know?
You can compare build-ups or materials to each other?

Compare

OverviewQuantitiesCalculationResults

Summary Results

Total Carbon

Scenario	Upfront Carbon A1-A3 + A4 + A5.1 + A5.2 + A5.3	Embodied Carbon over Lifetime Upfront + B1.2 + B2 + B3 + B4 + C1 + C2 + C3 + C4	Operational Carbon B6 + B7
Non-decarbonised, non-biogenic	80445	133849	1280
Non-decarbonised, biogenic	-78856	-78856	0
Decarbonised, non-biogenic	80445	131900	640
Decarbonised, biogenic	-78856	-78856	0

Module Categories

Total Carbon

Scenario	Upfront Carbon A1-A3 + A4 + A5.1 + A5.2 + A5.3	Use Stage B1.2 + B2 + B3 + B4	Operational B6 + B7	End of Life C1 + C2 + C3 + C4
Non-decarbonised, non-biogenic	80445	46372	1280	7032
Non-decarbonised, biogenic	-78856	0	0	0
Decarbonised, non-biogenic	80445	46372	640	5082
Decarbonised, biogenic	-78856	0	0	0

RICS Lifecycle Stages

Total Carbon

Scenario	A1-A3 kgCO₂e	A4 kgCO₂e	A5.1 kgCO₂e	A5.2 kgCO₂e	A5.3 kgCO₂e	B1.2 kgCO₂e	B2 kgCO₂e	B3 kgCO₂e	B4 kgCO₂e	B6 kgCO₂e	B7 kgCO₂e	C1 kgCO₂e	C2 kgCO₂e	C3 kgCO₂e	C4 kgCO₂e
Non-decarbonised, non-biogenic	59047	9485	0	9774	2138	35734	2444	638	7557	1251	28	2130	1769	541	2592
Non-decarbonised, biogenic	-78856	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Decarbonised, non-biogenic	59047	9485	0	9774	2138	35734	2444	638	7557	626	14	1065	885	541	2592
Decarbonised, biogenic	-78856	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Slow	Moderate	Fast		Slow	Moderate	Fast		Slow	Moderate	Fast			
													TOTAL (KgCO2e)	
Age	Carbon absorption (KgCO2) - cumulative total				Number of				Total sequestration					Years
1	5	8	11		2	2	8		10	16	88		114	1
5	22	39	63		2	2	8		44	78	504		626	5
10	60	115	192		2	2	8		120	230	1,536		1,886	10
15	119	237	403		2	2	8		238	474	3,224		3,936	15
20	199	409	706		2	2	8		398	818	5,648		6,864	20
25	303	634	1106		2	2	8		606	1,268	8,848		10,722	25
30	433	916	1611		2	2	8		866	1,832	12,888		15,586	30
35	589	1258	2225		2	2	8		1,178	2,516	17,800		21,494	35
40	772	1663	2954		2	2	8		1,544	3,326	23,632		28,502	40
45	984	2132	3801		2	2	8		1,968	4,264	30,408		36,640	45
50	1225	2668	4771		2	2	8		2,450	5,336	38,168		45,954	50
55	1496	3274	5868		2	2	8		2,992	6,548	46,944		56,484	55
60	1799	3951	7097		2	2	8		3,598	7,902	56,776		68,276	60
Age	Carbon absorption (KgCO2) - cumulative total				Number of				Total sequestration					Years
5	22	39	63		1	2	10		22	0	630		652	5
10	60	115	192		1	2	10		60	230	1,920		2,210	10
15	119	237	403		1	2	10		119	474	4,030		4,623	15
20	199	409	706		1	2	10		199	818	7,060		8,077	20
25	303	634	1106		1	2	10		303	1,268	11,060		12,631	25
30	433	916	1611		1	2	10		433	1,832	16,110		18,375	30
35	589	1258	2225		1	2	10		589	2,516	22,250		25,355	35
40	772	1663	2954		1	2	10		772	3,326	29,540		33,638	40
45	984	2132	3801		1	2	10		984	4,264	38,010		43,258	45
50	1225	2668	4771		1	2	10		1,225	5,336	47,710		54,271	50
55	1496	3274	5868		1	2	10		1,496	6,548	58,680		66,724	55
60	1799	3951	7097		1	2	10		1,799	7,902	70,970		80,671	60
65	1799	3951	7097		1	2	10		1,799	7,902	70,970		80,671	65
Age	Slow	Moderate	Fast											Years
1+	2	2	8										2,836	5
5+	1	2	10										6,509	10
													12,013	15
													19,495	20
													29,097	25
													40,941	30
													55,132	35
													71,760	40
													90,911	45
													112,678	50
													137,155	55
													148,947	60