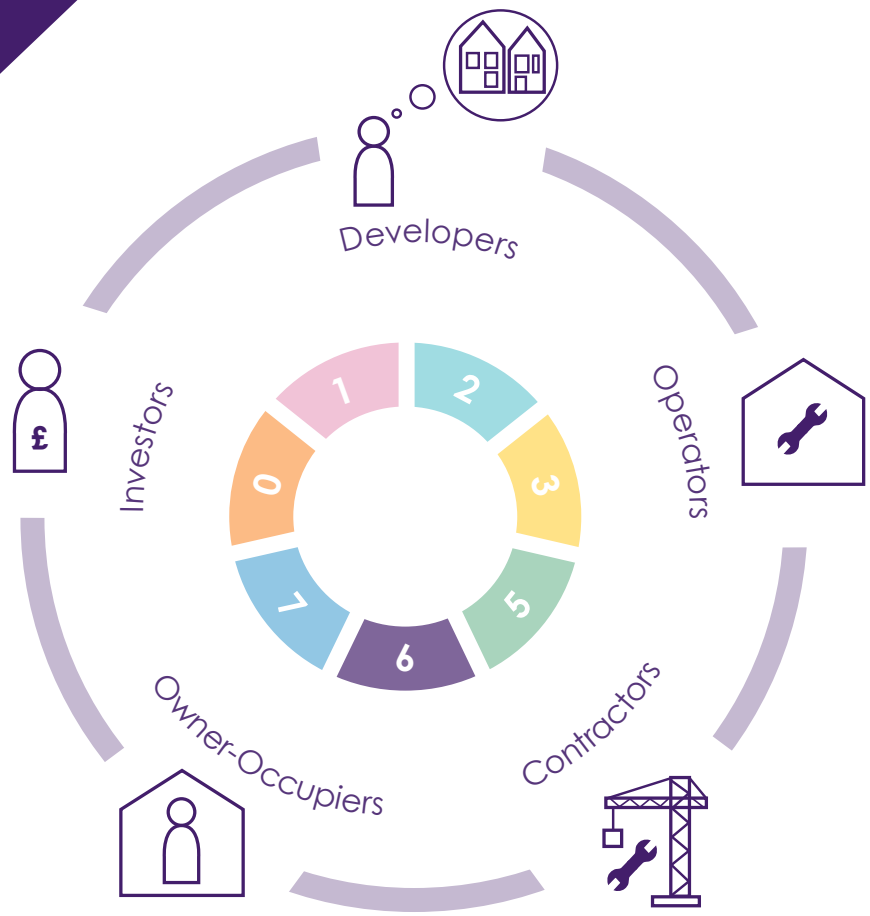
LETI Client Guide

for Net Zero Carbon Buildings



LETI

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About LETI

The London Energy Transformation Initiative (LETI) was established in 2017 to support the transition of London, and the wider United Kingdoms built environment to Net Zero Carbon.

We do this by:

- → **Publishing guidance** to support the built environment industry in tackling the climate emergency;
- → **Engaging with stakeholders** to develop a robust and rapid energy reduction approach, producing effective solutions to the energy trilemma of security, sustainability, and affordability;
- → **Working with local authorities** to create practicable policy to ensure the regulatory system is fit for purpose, placing verified performance at its core;
- → **Encouraging and enabling collaboration** within a large, diverse group of built environment professionals; and
- → **Providing technical advice to support exemplar development,** enabling leaders to deliver Net Zero Carbon buildings.

LETI is a diverse and dedicated network of over 1,000 built environment professionals who are working together to enable and enhance the vision to a Net Zero Carbon future. We are made up of developers, engineers, housing association professionals, architects, planners, academics, sustainability professionals, Contractors, Facilities managers and Local Authorities.

Over the last few years LETI has focused on providing guidance on defining what good looks like in the context of the climate emergency, publishing two key pieces of guidance, The Climate Emergency Design Guide and The Embodied Carbon Primer.

For more information on LETI, please see:
www.LETI.london

Contents

Executive Summary

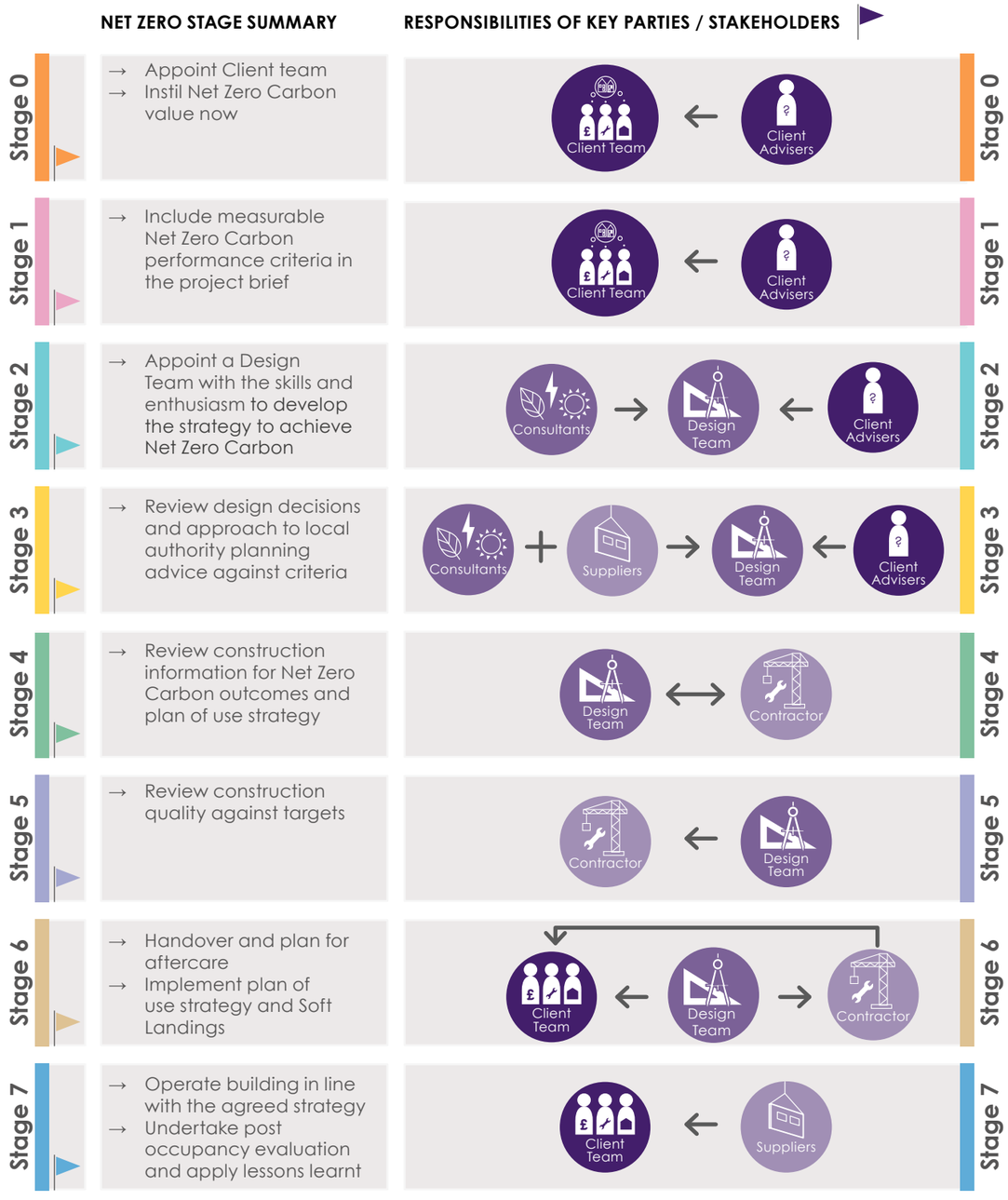
Amidst a backdrop of unprecedented and irreversible changes to our climate and an increasing number of climate change commitments, this guide will help construction client teams navigate their route to Net Zero Carbon development within a rapidly changing construction industry.

The future is Net Zero Carbon - in both retrofit of existing building stock and new construction. Any building not either operating at Net Zero Carbon performance or designed to be capable of this becomes an expensive liability for future generations.

The *LETI Client Guide for Net Zero Carbon Buildings* pulls together key findings and recommendations from numerous LETI publications, covering the ways in which the processes of briefing, design, procurement, construction, occupation, management and valuing of building development must change to fulfill this Zero Carbon vision. LETI recognise that client bodies and their funders remain at the centre of this process, capable of empowering or preventing this achievement through the wide number of stakeholders they engage with.

Throughout this guide, our recommendations are mapped against the RIBA plan of work, and identify both primary and secondary stakeholders involved in each and every decision.

It is our vision that this guide will help you as Clients, and your advisers, to create project value and avoid stranded assets and/or projects. It provides the missing front-end to the overall procurement process identified by the Construction Leadership Council's 'The Construction Playbook'.



KEY ACTIONS

Stage 0

- → Understand the need for the project. Do you need a new building? Evaluate options for retention and retrofit.
- → Set a thoughtful and thorough brief that includes long-term planning and future flexibility. Appoint a specialist to assist in the formation of the net zero brief, if required.
- → Evaluate lessons learnt from previous projects and Post Occupancy Evaluations (POEs), where applicable.
- → Establish the sustainability aspirations of the project and understand the implications of your decisions.
- → Ensure that the cost forecasts account for the sustainability aspirations of the project. Apply Whole Life Costing.
- → Investigate planing and/or government incentives.
- → Critique sites on suitability for Net Zero Carbon objectives.

Stage 1

- → Establish operational energy and embodied carbon targets and identify measurement tools. Translate the project's sustainability aspirations and specific building requirements into a fixed project brief.
- → Assess the risks that the chosen form of contract has on the project's Net Zero Carbon ambition and develop a procurement strategy that mitigates this risk. Set Net Zero Carbon design responsibilities.
- → Appoint specialist consultants to deliver a Net Zero Carbon building.
- → Gather site survey information and undertake micro-climate analyses to inform Net Zero Carbon strategy.
- → Undertake feasibility studies to test site viability and the surrounding environment for opportunities to maximise passive design, as well as biodiversity enhancement and water savings.

Stage 2

- → Communicate the Net Zero Carbon design intent to the wider Design Team.
- → Consult with stakeholder teams on future maintenance roles and responsibilities.
- → Consider how operational energy will contribute to the building's Whole Life Carbon. Develop a seasonal operational energy strategy, considering the impact of form, orientation and thermal mass on thermal performance, glazing proportions, airtightness and building physics.
- → Use embodied carbon assessment to inform decision making on material selection.

PROCUREMENT

- → Tender documents to be aligned with Net Zero Carbon criteria and sustainability outcomes.
- → Identify Net Zero Carbon risks and communicate to bidding Contractors.
- → Embed the requirements for Post Occupancy Evaluation (POE) in the project's procurement strategy.
- → Establish the criteria for selecting the Contractor. (This criteria should include assessment the Contractor's Net Zero Carbon skills/ability/ approach).
- → Highlight responsibilities under the building contract for construction quality.

Stage 3

- → Audit design against carbon targets. Identify and record performance risks to inform RIBA Stage 4 decisions and progress.
- → Use embodied carbon and carbon assessment/ modelling to test relative impacts of design options as part of whole life costs.
- → Submit Planning Application and include a Sustainability Strategy.
- → Ensure Employer's Requirements contain details of the Sustainability Strategy (if these are to be produced at this stage).

KEY ACTIONS

Stage 4

- → Agree carbon reduction targets and carbon reduction options in order to influence specifications.
- → Use embodied carbon and carbon assessment/ modelling to test relative impacts of design options as part of whole life costs. Record design changes and product substitutions that influence key performance criteria.
- → Review decisions relating to constructability and supply chain against Net Zero Carbon criteria.
- → Review substitutions of products and adjustments to design to ensure equivalency in embodied carbon impacts.
- → Highlight responsibilities under the building contract, for construction quality.
- → Embed requirements for commissioning in the tender documentation.

Stage 5

- → Identify a site based Net Zero Carbon champion/ manager and ensure all personnel fully understand the building's Net Zero Carbon strategy.
- → Ensure the Design Team engages with Contractors to reduce waste.
- → Allow time and fees for review of alternative products, and materials proposed by the Contractor against technical and performance standards and against Whole Life Carbon requirements.
- → Keep an updated 'Net Zero Carbon Risk Register' (refer to Table 3, page 23).
- → Undertake site inspections for fabric and services' installation quality assurance.
- → Undertake building systems' testing and fine-tune them as needed.
- → Undertake Whole Life Carbon assessment.

Stage 6

- → Deliver "As-Built" information pack as part of handover package, including operational carbon predictions, and Whole Life Carbon analysis.
- → Simplify building user guide and training, detailing energy-efficient operation of the building, for all occupants.
- → Train with the facilities' management team to learn about the building's low carbon operation, as well as its maintenance requirements to ensure the building maintains high performance in use.
- → Undertake seasonal commissioning and fine-tune building systems as needed.
- → Following one year of continuous operation, undertake a light touch Post Occupancy Evaluation (POE) of the building's performance against the targets set in the initial project brief, and those predicted during the design and construction process.
- → Declare Year one operational carbon emissions performance.

Stage 7

- → Identify the performance of the building against the original brief, together with the budget and scope for Post Occupancy Evaluation (POE) based on findings from the light touch POE in the RIBA Stage 6 and project particulars.
- → Implement findings of POE to fine-tune building systems and reduce the performance gap.
- → Compare predicted energy performance to actual energy performance of the building (from data obtained through the sub-meters).
- → Publish data and lessons learnt, where possible, to share knowledge throughout the project team and the wider industry in order to reduce the risk of performance gaps reoccurring in buildings.

(Throughout this Guide, Project Stages have been defined based on the RIBA Plan of Work 2020).

0

Introduction

0.0 Introduction

More than ever, the urgency of the climate and ecological crises means that there is greater pressure and expectation for all organisations to transform their value chains to mitigate risks, and harness opportunities that address their key impacts on the climate, natural and social systems.

By 2060, the world is expected to build and/or renovate over 230 billion m^2 of buildings[1]– adding the equivalent of Paris to the planet every single week. We must act now in collectively transforming the buildings we design, build, and occupy to be Net Zero Carbon.

Following on from the LETI Climate Emergency Design Guide and Embodied Carbon Primer, the LETI Client Guide for Net Zero Carbon Buildings has been produced to help Clients understand the value of Net Zero Carbon buildings, and how to specify Net Zero Carbon in their projects.

Drawing on insights gathered, from over 110 respondents, through the LETI Client Guide Survey (results of which are presented in Appendix 2), this guide focuses on what can be influenced, and how to target the most relevant items to practically implement a Net Zero Carbon commitment in projects. The target Clients considered for this guide include developers, investors, Contractors, operators, and owner/occupiers, whose strategic roles are presented in Table 1.

Client Types	RIBA Stage 0	RIBA Stage 1	RIBA Stage 2	RIBA Stage 3	RIBA Stage 4	RIBA Stage 5	RIBA Stage 6	RIBA Stage 7
Investor	X	X	X				X	
Developer	X	X	X	X	X	X	X	X
Contractor	Only if Design & Build Contract	Only if Design & Build Contract	Only if Design & Build Contract	Only if Design & Build Contract	Typically, only if Design & Build Contract	X	X	
Operators	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	X	X
Owner-Occupiers	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	Sometimes, & typically, only if Owner-Occupied	X	X

Table 1 - Client Types and their Involvement in various Project Stages*

(*Throughout this Guide, Project Stages have been defined based on the RIBA Plan of Work 2020).

0.1 Purpose of this Guide

The LETI Client Guide for Net Zero Carbon Buildings provides simple steps for Clients to understand and follow, in order to develop and deliver Net Zero Carbon projects.

Throughout this document, guidance is provided on common pitfalls and how to avoid them. To illustrate what is possible, case studies are included in Appendix 4, showcasing successful examples of embedded Net Zero Carbon objectives into project briefs.

1. **Section 1** of this guide highlights the value and benefits of a Net Zero Carbon project for each Client type mentioned in Table 1.
2. **Section 2** focuses on setting a Net Zero Carbon brief, the importance of stakeholders and the overall team's "buy-in" to achieve this objective.
3. **Section 3** delves into the interventions to be made, at each RIBA Plan of Work stage, to ensure that the Net Zero Carbon objective is integral to the procurement and the decision-making process.

The LETI Client Guide for Net Zero Carbon Buildings has been produced to share knowledge and experiences from across the industry, and to inspire everyone to deliver Net Zero Carbon buildings. It specifically focuses on the delivery of Net Zero Carbon building projects. However, it also recognises various, industry-wide commitments and pathways, such as BBP's Net Zero Carbon Pathway Framework, WorldGBC's Net Zero Carbon Buildings Commitment, and Science Based Targets, among others - that can help address Net Zero Carbon at an organisational level for Clients.

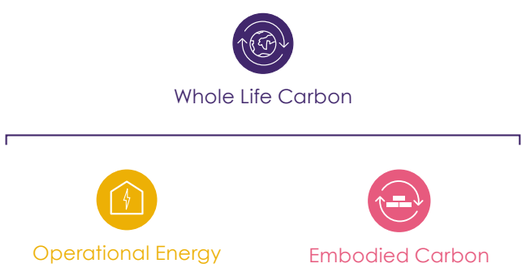
0.2 What does Net Zero Carbon mean?

The world of Net Zero Carbon can be confusing: the inconsistencies found between different approaches Clients apply to achieve Net Zero Carbon are a testament to the complexity of the challenge.

The first and the most important distinction to make is the difference between embodied and operational carbon. In the context of this guide, any reference to "Net Zero Carbon" refers to both net zero embodied and operational carbon, as defined by the WLCN/LETI Carbon Definitions (details of which are presented in Appendix 7, together with the LETI Whole Life Carbon One-Pager):

- → Embodied Carbon emissions are the total Greenhouse Gas (GHG) emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A1-A5, B1-B5, C1-C4).
- → Operational Carbon emissions are the Greenhouse Gas (GHG) emissions arising from all energy consumed (Module B6) by, and water supply and wastewater treatment (Module B7) for an asset in-use, over its life cycle.

(Please also refer to Appendix 1 for LETI Net Zero Carbon Operational Carbon One-Pager for the visual representation of net zero operational carbon).



0.3 The Industry View

Lack of knowledge and awareness is a key reason for Net Zero Carbon criteria not being included in project briefs.

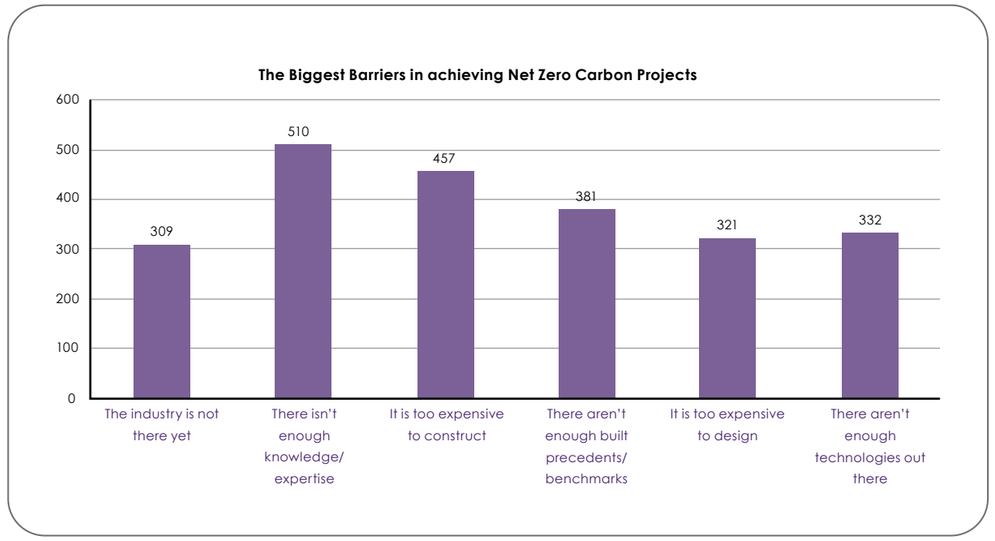
An online consultation (hereafter referred to as the LETI Client Guide Survey - results presented in full in Appendix 2) - was undertaken to identify both the interests and knowledge gaps that Clients experience with regards to Net Zero Carbon. This consultation helped inform the priority areas of this guide, which focuses on effective ways Clients can define and implement Net Zero Carbon briefs through practical steps and measurable outcomes.

A series of case studies have also been collated, as part of this Survey, to support the guidance offered in this guide. They are presented in Appendix 4 of this document.

The survey results, presented on Graph 1, indicate that lack of knowledge and awareness is a key reason for Net Zero Carbon criteria not being included in project briefs, and for Net Zero Carbon performance not to be targeted for projects.

To complement the previous guidance documents produced by LETI (the LETI Climate Emergency Design Guide, and the LETI Embodied Carbon Primer), and UKGBC (UKGBC Net Zero Carbon Buildings: A Framework Definition, and UKGBC Building the Case for Net Zero Carbon), among others, the LETI Client Guide for Net Zero Carbon Buildings has been produced to raise awareness on Net Zero Carbon, and to assist Clients in their Net Zero Carbon journey.

(*All resources referenced are briefly described within the List of Resources' Section).



Graph 1 - LETI Client Guide Survey Results - The biggest barriers in achieving and delivering Net Zero Carbon Projects

0.4 The Benefits & Value of Net Zero Carbon Outcomes

Net Zero Carbon buildings have benefits beyond addressing climate change mitigation; they can lower energy costs, improve energy security, create jobs,[2] and enhance health and wellbeing.

A number of these co-benefits are presented in various industry publications, such as the UKGBC's Capturing the Value of Sustainability[3] and JLL's The Impact of Sustainability on Value[4] reports.

It is essential to assess the value beyond cost implications, as Net Zero Carbon buildings can bring meaningful value over their life cycle.

As the UKGBC's Building the Case for Net Zero Carbon[5] report identifies, while initial capital costs of Net Zero Carbon buildings may be higher in some cases, such buildings also demonstrate increased value in terms of high rental premiums, lower tenancy void periods, likely lower life cycle, and operational costs, and increased reputational benefits, among others.

Tenants are also demanding Net Zero Carbon to align with their own individual and/or organisational commitments.

Table 2. summarizes some of the key benefits and value a Net Zero Carbon project can bring to Clients.

8 Key Benefits of Net Zero	Who benefits?
Long-term Resilience	Investor, Developer, Operators, Owner-Occupiers
Operational Running Costs	Operators, Owner-Occupiers
Legislative Compliance	Investor, Developer, Contractor, Operators, Owner-Occupiers
Reputation & Legacy	Investor, Developer, Contractor, Operators, Owner-Occupiers
Meeting Investor Demand	Investor, Developer
Meeting Tenant Demand	Operators, Owner-Occupiers
Employee Engagement & Productivity	Investor, Developer, Contractor, Operators, Owner-Occupiers
Capital Value	Investor, Operators, Owner-Occupiers

Table 2 - Eight Key Benefits of Net Zero Carbon, illustrating the range of benefits specific to each stakeholder type

The *LETI Client Guide Survey* has identified cost and the lack of awareness as the largest 'perceived' barrier to targeting and delivering Net Zero Carbon projects. This perception has a large impact on the business case for a Net Zero Carbon project, as well as its preliminary budget and identification of risks.

In their Building the Case for Net Zero Carbon[6] report, UKGBC argues that the capital cost increase of delivering a typical building (of 6.2% for office, and 3.5% for residential) to achieve the LETI, RIBA and UKGBC operational energy and carbon targets for 2025 is feasible, especially considering that "these costs will likely be offset by the value benefits, including increased rental premiums, lower tenancy void periods, lower offsetting costs, and lower operating/ life cycle costs"[7].

Historically, the success of construction projects has been measured in purely economic terms. However, increasingly both environmental and social objectives are becoming key elements in project briefs[8], as demonstrated by the Construction Industry Hub's 'Value Toolkit'[9]. This trend reflects a growing appreciation, amongst Clients, of a broader interpretation of 'value' in a building's outcomes.

Moreover, research increasingly shows leased office spaces, promising lower operating costs and healthier working environments, have been proven to command rental premiums up to 10% higher than equivalent buildings delivered to building regulations (and significantly lower vacancy rates)[10]. Trends also indicate lending institutions are awarding 'green premiums' when financing sustainability-led real estate projects[11].

Figure 1 - Capital Cost Increase to meet 2025 Targets (Source: Building the Business Case for Net Zero, UKGBC)

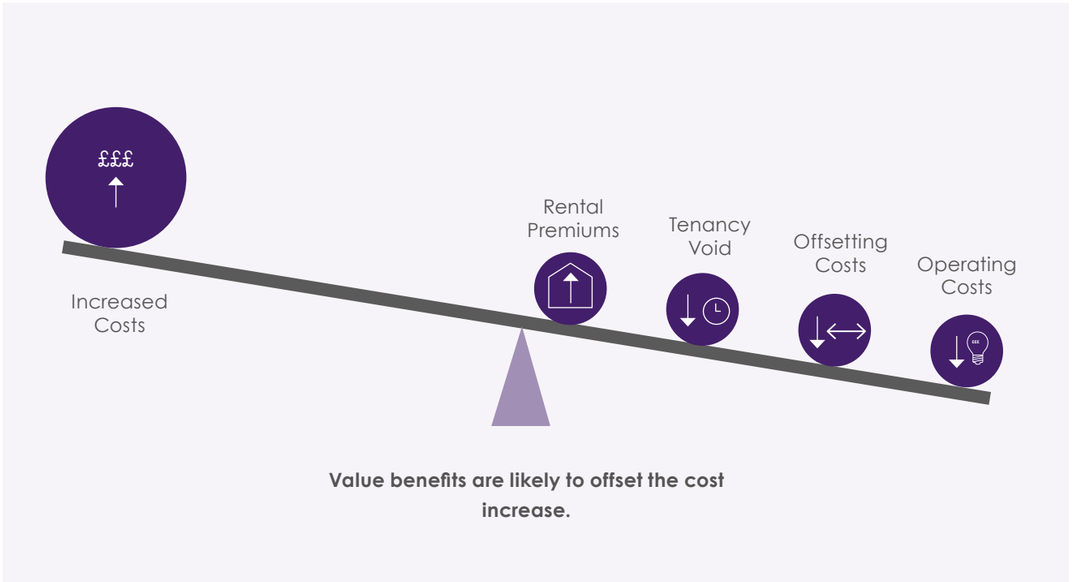


Figure 2 - Benefits of Net Zero Carbon

0.5 Life Cycle Costing

Life cycle costing should be used to inform decision-making, rather than a one-dimensional capital cost metric.

LETI strongly recommends that Clients use life cycle costing to assess projects. This method reviews costs during the development, construction and operational phases of a project. It is a more holistic approach, which encourages the cost to maintain, operate and decommission a building to be considered.

Capital cost studies alone often inflate the risks of Net Zero Carbon actions, whereas life cycle studies can highlight opportunities (for heating, lighting or equipment energy demand savings) throughout the whole life of a project. Additionally, monetary benefits through grants and subsidies for carbon savings can be accounted for.

A 'Net Zero Carbon Risk Register' (as presented in Table 3) can be included as part of briefing documentation to allow the Design Team to highlight decisions that impact the project's ability to achieve Net Zero Carbon; and shadow internal 'carbon pricing', which is a theoretical or assumed price per tonne of carbon to be considered in the business case[12].

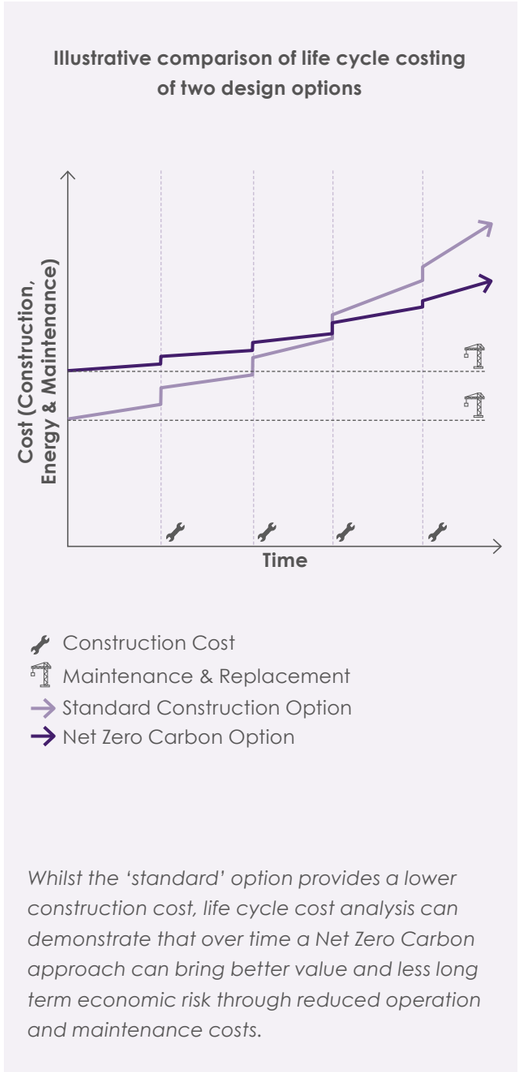


Figure 3 - Illustrative comparison of Life Cycle Costing

Risk	Probability	Impact	Actions Needed	Residual Risk Level
Net Zero Carbon Material Shortages	High	Delays to construction on site and critical path programme slipping increasing cost and project viability.	• Materials to be sourced as locally as possible • Net Zero Carbon supply chain to be started	Medium
Tender exceeding Budget	High	Value engineering may be needed which could result in Net Zero Carbon materials/production methods being negated.	• Life cycle costing to be used for decision-making • Net Zero Carbon necessities to be integrated into the project brief	Medium / Low
Lack of Net Zero Carbon Skills on Site	Medium	Reduced construction quality increases performance gap.	• Contractor selection to consider experience and willingness of Net Zero building skills	Medium / Low

Table 3 - Indicative 'Net Zero Carbon Risk Register'

1

Brief Development

1.0 Client Influence on Net Zero Carbon

Clients have a crucial influence over the economics, the technical ambition, and the team dynamics, in delivering Net Zero Carbon buildings.

Positive Client influence is possibly the most important aspect of delivering Net Zero Carbon projects, as Design Teams will not be able to deliver Net Zero Carbon projects unless it is defined as part of the Client brief. However, according to the LETI Client Guide Survey (in Appendix 2), only 31% of respondents recorded having a sustainability strategy for net zero operational and embodied carbon performance in place. Section 1 therefore, aims to guide Clients through defining a Net Zero Carbon strategy for their projects/portfolio.

1.1 Before the Brief: Stage 0 Strategic Definition

During Stage 0, Clients have the opportunity to set aspirational sustainability outcomes, and conduct a sustainability site appraisal.

Clients must formulate the Client requirements, along with the business case, preliminary project budget, and potential risks, before producing the brief. All the key Client team stakeholders should be involved in this process as soon as possible in order for the Client requirements and, consequently, the brief to reflect the Client's needs and (financial) capacity.

Sustainability outcomes should be a key part of the Strategic Definition, setting-out the Client's expectations for overall sustainability and carbon reduction. Net Zero Carbon should therefore, be set as a measurable and a clear target, defined specifically for the project, in parallel with research on relevant legislation and analysis (of previous relevant projects' Post Occupancy Evaluation (POE), if applicable). This provides a chance for the Client to set aspirational targets that will inspire others, and establish them as a leader both in their relevant field, and within the wider project team.

Site appraisal - the act of identifying opportunities and constraints for each potential site - also forms a crucial element in any Net Zero Carbon project. LETI has produced a checklist to aid this task (please refer to Appendix 3 for 'Site Appraisal Checklist for Net Zero Carbon & Sustainability', which is also referenced in Section 2 - Outcome 0.4).

Sites with existing buildings should seek to prioritise the retention of such buildings or parts of such buildings (e.g. foundation, structures, etc.), instead of assuming that demolition will take place. If re-use is not viable on-site, then all elements should be reused at their highest carbon value, where possible. A retrofit-first approach is a crucial component of a Net Zero Carbon built environment due to the emissions otherwise saved from new development. (Please refer to LETI's Retrofit Guide).

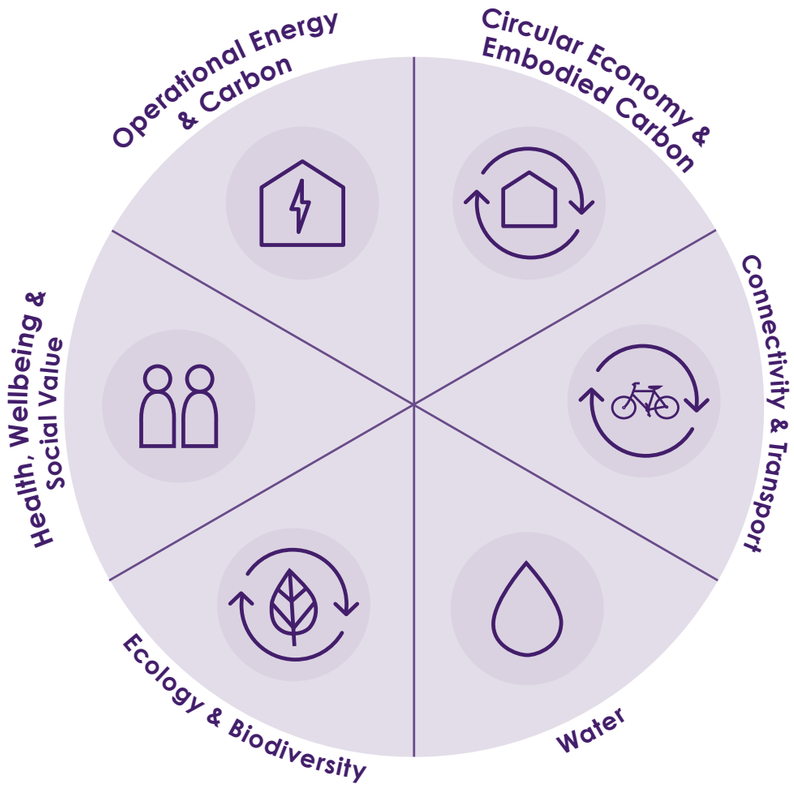


Figure 4 - Holistic Sustainability Criteria: Climate Framework

1.2 Brief Overview

The Net Zero Carbon elements of a Client's brief should be challenged by the Design Team and adjusted if necessary before sign off.

The project brief outlines a project's ambition through its stated goals and aspirations, and acts as a manifestation of the Client requirements.

The briefing process may start with a vision statement before developing an outline brief, and the appointment of a Design Team. The detailed brief should be developed with the Design Team, in an iterative process, to test the Client's intentions, the capacity of the site, the overall budget and the proposed timetable. (Reference: 'Creating Excellent Buildings: A Design guide for Clients' by CABE, and Managing the brief for Better Design).

(Although material re-use is often perceived to be unviable, early engagement of the Design Team can reduce risks and increase the viability of material re-use).

Building on the LETI Climate Emergency Design Guide, the creation of a clear project brief with stated performance goals and Net Zero Carbon targets is critical.

LETI recommends using four key principles for creating successful project briefs. (These are presented as the 'Elements of a Net Zero Carbon Brief' on Figure 5).

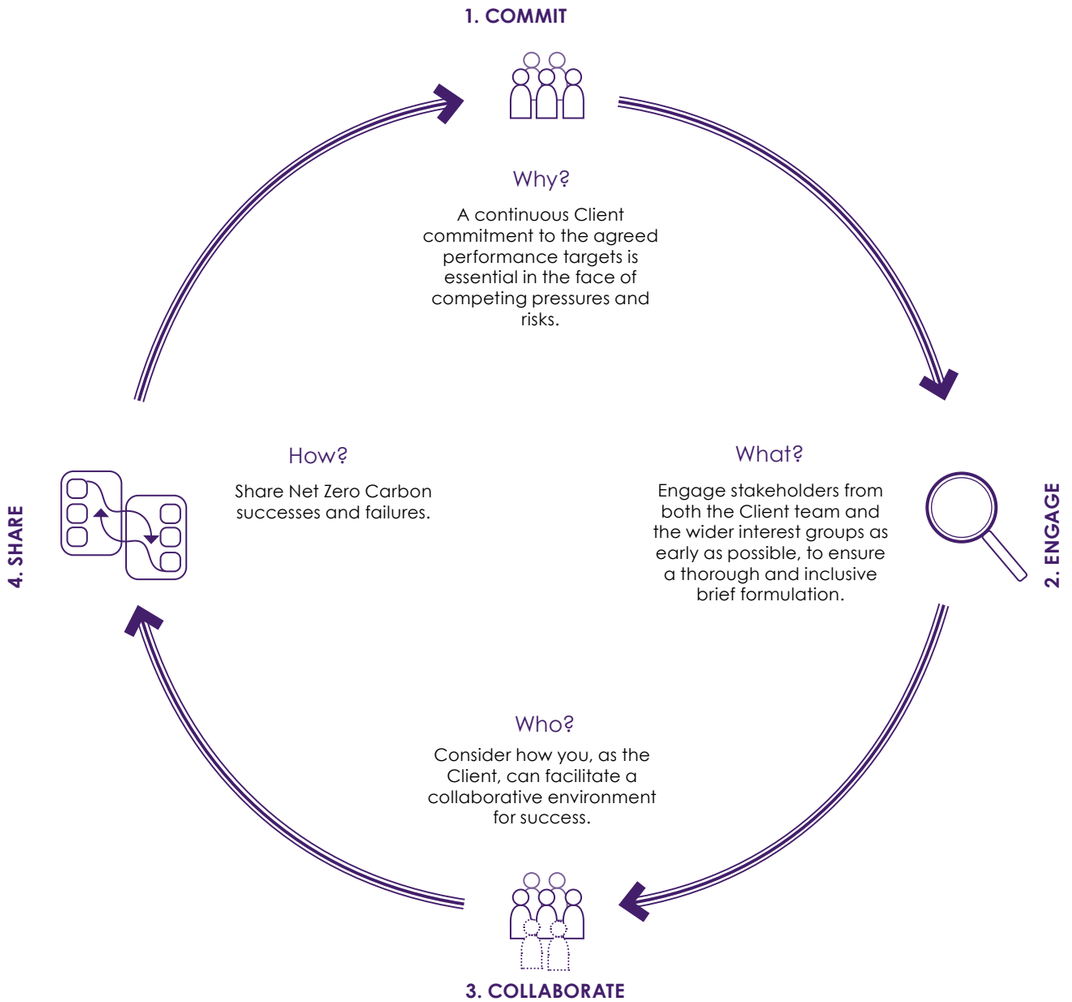


Figure 5 - Elements of a Net Zero Carbon Brief

1.3 Elements of a Net Zero Carbon Brief

Outcomes: Be explicit about the reason and value.

There can be a tendency for building design and construction projects to focus on cost rather than value, encouraging decisions to reduce cost, but undermining the project's ability to meet the agreed performance targets.

Clients should be explicit in the brief on the reasons behind specifying a Net Zero Carbon building and the corporate value it is anticipated to deliver, so that this value can be protected.

Goals: Include a measurable Net Zero Carbon requirement.

For the Net Zero Carbon target - defined at the beginning of a project - to become a reality, it must be measured throughout the life of a project (with iterative energy modelling and carbon assessments at various project stages; detailed carbon evaluation during construction, and with measured data in the actual building's in-use stage).

A Net Zero Carbon target should be identified and holistically evaluated with a multitude of other 'sustainability' criteria when designing, delivering and operating buildings, in order to avoid any unintended consequences. These sustainability criteria, defined in the Climate Framework by The Cross-Industry Action Group, and in the RIBA's Sustainable Outcomes Guide, include:

Human Factors
Focusing on health and wellbeing, user experience and social value[13]

Circular Economy
Focusing on resource efficiency, environmental, health impacts and overall amount of resources/materials, and waste

Energy & Carbon
Focusing on operational energy and Whole Life Carbon

Ecology & Biodiversity
Focusing on land use, biodiversity net gain and nature-based solutions[14]

Water
Focusing on water use and quality

Connectivity & Transport
Focusing on compactness of the development, walkability and low carbon transport

(from Climate Framework)

Descriptive elements of the brief may highlight an overall ambition for the project or the development, including objectives that touch on both environmental and social aspirations, such as a Local Authority's ambition to end fuel poverty.

Prescriptive elements of the brief should develop this aspiration into requirements, such as the need to deliver Passivhaus standards (please refer to Section 2, 'Net Zero Carbon Brief Structure/Checklist').

Clients have a key role in establishing the project ethos. In addition to having the project ethos defined; leadership, collaboration, and consistent knowledge and, as well as effective communication and evaluation of performance are essential in delivering a Net Zero Carbon building.

Responsibilities: Ensure everyone is aware of their influence/impact.

Everyone involved in a project has influence over whether or not a Net Zero Carbon requirement is achieved. This includes architects, structural engineers, building services engineers, controls engineers, cost consultants, property consultants, Contractors, commissioning engineers, facilities managers, tenants, etc. Many of these stakeholders are not always fully aware of their influence, and where their roles lie (please refer to Section 0.5 'Life Cycle Costing', the 'Net Zero Carbon Risk Register' on Table 3, page 23, and Section 1.3, 'Elements of a Net Zero Carbon Brief', Figure 5).

The Client should ensure a robust 'responsibility matrix' is created to accompany the project brief. This should highlight the roles and responsibilities each team has towards Net Zero Carbon objective - as iterated by the Design for Performance principles. In this approach, regular monitoring will inform and ensure the Net Zero Carbon targets are met throughout various project stages, and once the building is in use.

Clients should require every project role (including those of the sub-Contractors) to be briefed on their influence and responsibility for achieving that project's Net Zero Carbon requirement. Clients should also appoint a Life Cycle Assessment (LCA) consultant, and a Sustainability (Net Zero Carbon) Champion (who works very closely with the Project Manager).

Professionalism: Do it differently than how you may have done it before.

A 'business as usual' approach is no longer viable to deliver Net Zero Carbon buildings. Systemic change is required, with the Client and all stakeholders required to honour their professional and ethical obligations. Consultant teams must advocate for positive impact at all stages of decision-making, and become more confident at communicating the value proposition. A few examples that illustrate the scale of change specific to various disciplines, are presented in Appendix 8.

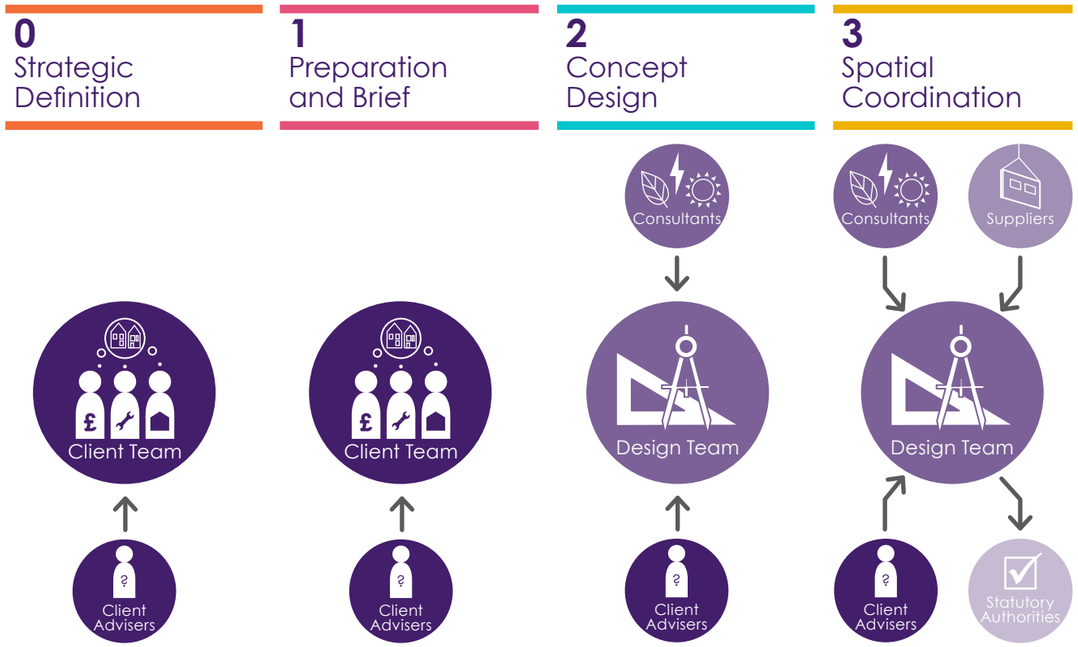
Choosing the best procurement form and delivery is critical[15], as risks need to be managed; merely passing them down the supply chain will inevitably lead to conflict, and unsuccessful outcomes.

In order to build Net Zero Carbon buildings, there needs to be a collaborative culture within the overall Project Team. There are a number of contracts that promote collaboration, such as PPC2000, TPC2005, NEC3 ECC, JCT Constructing Excellence with their Non-Bind Partnering Charter and Integrated Project Insurance (IPI) as supported by the Cabinet Office.

Additionally, the Better Buildings Partnership is currently developing a 'Design for Performance Contract', which aims to close the performance gap through continuous review at all project stages. Furthermore, Soft Landings should be anticipated from the start to help tune up the building in its early years.

Clients should ensure that Net Zero Carbon requirements are explicit, and embedded in all relevant documentation, contracts, and processes.

Figure 6 shows key parties and collaborations per project stage, in a conventional project, as well as a list of actions required to ensure that Net Zero Carbon targets are not jeopardized.

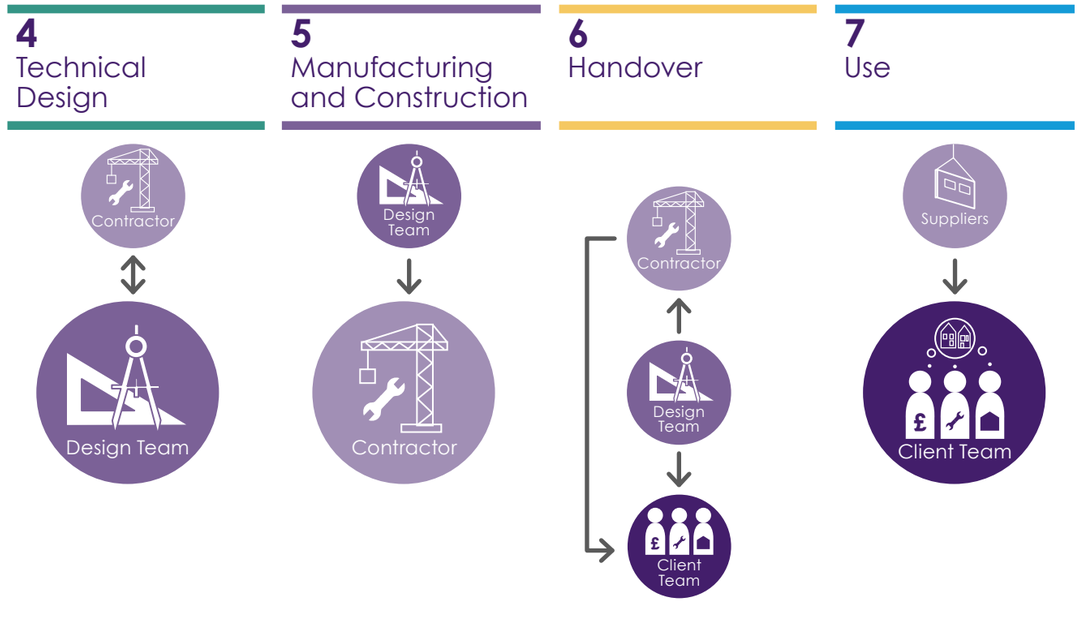


- → Client leadership team leads the vision for Net Zero Carbon and avoids delegating Net Zero Carbon responsibilities to others.

- → Designers are appointed at an appropriate time where their influence on matching the brief to their skillset is minimised.
- → Innovation incentives for Design Team are set.
- → Clear criteria for Client sign-off and implicators are set.

- → Ensure designers are given the fee and scope to develop alternative strategies to compare and contrast approaches (as opposed to defaulting to tried -and-tested).
- → Transparency and appropriate recording of the decision-making process are incorporated.

- → Design intent clearly communicated as Design Team widens.
- → Effective integration/ coordination between principles are implemented.
- → Clear communication with the procurement team (to instil low risk Net Zero Carbon) is set.
- → Single sourcing of equipment suppliers is established.



- → Contractor has a collaborative ethos.
- → Clear communication between the Design Team, the Contractor team and all the suppliers during detailed design, is set.
- → Sufficient oversight is in place when detail design responsibility is given to a specialist Contractor.

- → Site queries are addressed by the Design Team in a timely and complete manner.
- → Clear Net Zero Carbon leadership is established.
- → Site labour is skilled and motivated for the effort required for Net Zero Carbon.
- → True verification/ inspection is undertaken.

- → Design Team's focus is retained within the project with adequate fee / budget for Post Occupancy Evaluation (POE).

- → A good relationship between Facilities' Management Team and the equipment suppliers is established.

Figure 6 - Key Stakeholders and their Role in delivering Net Zero Carbon throughout each Project Stage

Who: Roles and Professions

There are particularly influential roles and professions in delivering a Net Zero Carbon development. Some obvious and familiar to a Client, some less so - and in these instances it is typically left for others to appoint. However, it is essential that a Client is explicit on the requirements of all the influential roles and professions along the supply chain to be aligned with the objective of a Net Zero Carbon building, if this objective is to be achieved in operation.

(The following is not an exhaustive, but rather an illustrative list to demonstrate the key profession influences that need alignment in a project).

Embodied Carbon

Operational Carbon

Both Operational & Embodied Carbon

Roles	Key Influence to align
Architect	→ Reducing embodied carbon through design choices, including materials specification, limiting basement area, avoiding large column grids, minimising transfer structures, etc. → Reducing energy demand through passive design with optimised orientation, form, shading, and Fabric-first approach (facade U-values, glazing, etc.) that minimises the need for heating, cooling, ventilation, and lighting. → Collaborating with the relevant Engineer/s in the project to integrate renewable energy generation and storage on-site (if feasible). → Collaborating with the relevant Engineer/s in the project to enable intuitive operation of building, so that appropriate, low energy use by occupants is obvious. (This is particularly important on mixed-mode buildings, which combine natural and mechanical systems).
Building Services Engineer	→ Prioritising efficient, low carbon building systems' design. → Integrating efficient operation across all operational scenarios, and not just during peak summer, winter, and 100% occupied hours. (This will require greater attention to building control systems). → Implementing intuitive operation, so that it is clear to both Facilities Managers, and the general building users how to appropriately and efficiently operate building systems. (Controls and BMS interfaces are notorious for not being clear). → Reducing risk of refrigerant leaks through selection of systems and specification of maintenance requirements.
Commissioning Engineer	→ Commissioning must ensure that building systems are not just achieving the specified temperatures and flow rates, but also operating and being controlled as designed, in order to deliver these efficiently.
Contractor	→ Ensuring that Contractor design responsibilities do not undermine a design's ability to achieve the required embodied and operational carbon performance.
Cost Consultant	→ Ensuring that value engineering does not rationalise designs in ways that undermine the ability of a building to perform as specified.
Facilities Manager	→ Requiring operation and maintenance of systems to ensure low carbon operation, with continuous performance monitoring and disclosure, as well as fine-tuning of building systems, and occupant behaviour, as needed. → Monitoring refrigerant leak detection consistently.

Occupant		→ Ensuring that fit-out, maintenance and operation of equipment are consistent with embodied and operational requirements (This includes tenant systems, such as terminal units that interact with central Landlord equipment).
Property Manager		→ Ensuring that facilities management contracts require that buildings are operated in accordance with the energy-efficient, low carbon design intent. (This goes beyond a common focus on planned, preventative maintenance, and responds to reactive calls). → Ensuring that tenancy contracts clearly identify tenant responsibilities with the potential to affect the efficient, low carbon operation of a building, and outline enforceable requirements on how these responsibilities must be executed.
		→ Ensuring that refurbishment and upgrades are in line with the set embodied and operational carbon requirements for the project, throughout the building's replacement cycles and life.
Project Manager		→ Ensuring that the wider project team is appropriately resourced with the right level of (Net Zero Carbon/ sustainability) expertise in place to deliver, assess, and monitor a project's performance (throughout the design stage) and also construction's progress (throughout the construction phase of a building).
Structural Engineer		→ Selecting low embodied carbon materials with overall structural efficiency optimised to enable deconstruction, and reuse of materials at the End-of-Life.
		→ Accounting for operational carbon when selecting/ specifying materials, as thermal properties of these materials can influence operational carbon performance of the building.
Client Adviser		→ Implementing initial discussions for project sustainability and carbon requirements. → Determining a project's vision, targets and objectives with relevant project team members (Employer's sustainability requirements/brief development should be input from specialists, when required). → Determining assessment methodology and accreditation/ certification measures with the relevant project team members → Socialising sustainability/Net Zero Carbon requirements amongst Client stakeholders/teams.
Transactional Agent		→ Clearly and well communicating property value, including project and reputational value to investors and tenants, as well as operational value (with increased productivity and lower operational costs). (It is acknowledged that commercial values are in a state of flux at the moment due to the nature of work during and after COVID-19 pandemic).

Table 4 - Roles and Professions

1.4 Client's Influence throughout a Project's Life Cycle

Findings from studies such as PROBE (Post Occupancy Review of Buildings and their Engineering) indicate that the actual performance of built projects is often up to 2.5 times more than it is anticipated at design stage of those projects[16]. To ensure the delivery of a Net Zero Carbon project, Net Zero Carbon should be set as a strategic objective at project inception, and its progress monitored throughout a project's life.

Targets, opportunities, and constraints should each be fixed at the project outset, making the Client requirements and the brief perhaps the most important aspects of the project, in terms of influencing Net Zero Carbon outcomes. This is further highlighted in this Section on Diagram 4 where the 'Role of the Client' is illustrated throughout the RIBA Plan of Work Stages.

Clients have a fundamental impact on facilitating a "*design for performance**" culture - including Design Team motivation, aspirations, marketing, in addition to aiding design coordination, construction culture, and site management. They also often have sole influence over budget management and business ethics; therefore, they can implement effective restrictions on the procurement of materials, and the scope of value engineering exercises.

Net Zero Carbon (both for operational and embodied) must be seen as a strategic objective and intended outcome from day one, and be appropriately communicated to the wider project team members (please refer to Section 1.3). The scale of influence, as presented on Figure 7 , the opportunities to intervene and thus, the ability to achieve Net Zero Carbon decrease as the project develops. However, it is still possible to achieve a Net Zero Carbon target even if it is set at a later RIBA Stage, as illustrated in Section 2.

Design for Performance is designing and delivering a project, based on measurable performance outcomes to ensure the design intent is achieved when the building is constructed[17].

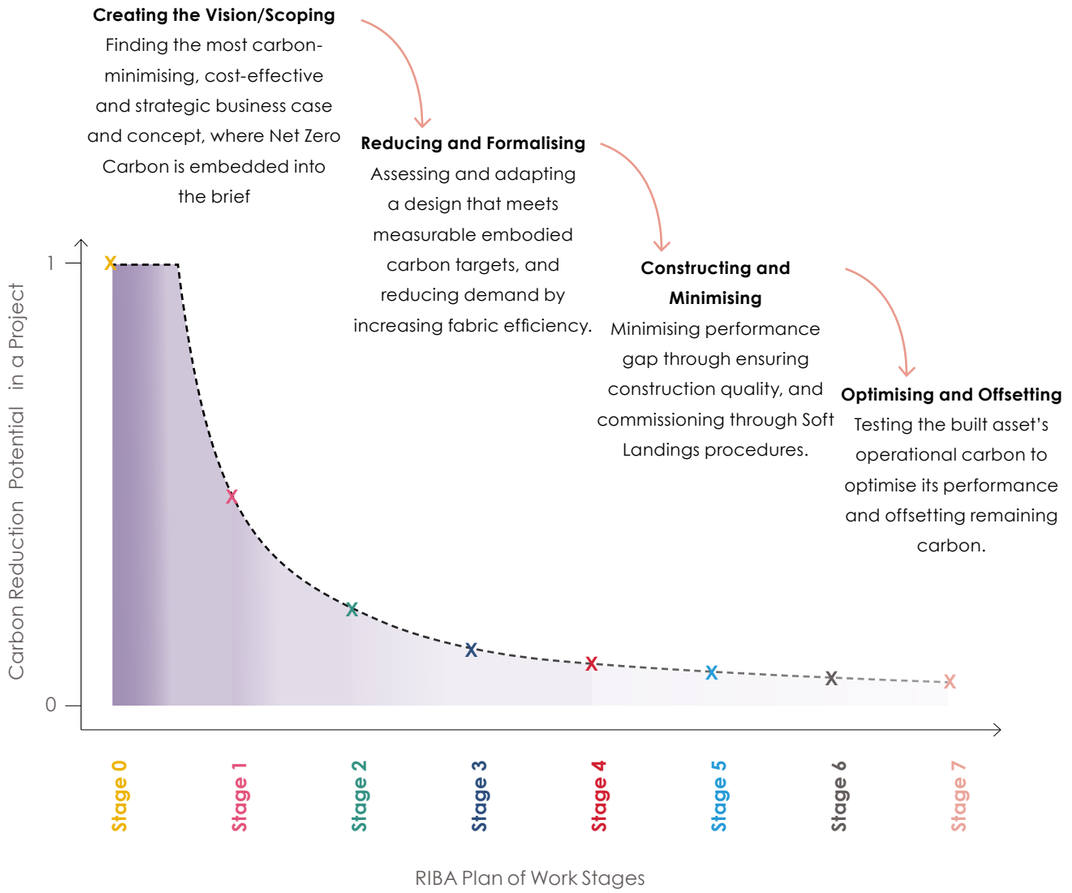


Figure 7 - Carbon Reduction Potential as Project Progresses

2

Implementation

2.0 Net Zero Carbon Brief Structure/Checklist

The following section outlines a detailed structure and accompanying checklist for Clients writing a new project brief and commission of a Net Zero Carbon building.

The brief sets out the Client's sustainability agenda in terms of:

- achieving a Net Zero Carbon building/ development **(WHY?),**
- setting out targets for embodied carbon and operational energy **(WHAT?),**
- defining a roadmap on how targets will be met, and tested during design, construction, and in-use stages of a project **(HOW?),** and
- outlining relevant, responsible parties **(WHO?)**.

The strategy to achieve the defined targets and the way such targets will be measured, will differ according to site constraints, Client requirements, user requirements, project budget, the climate, and data/ insights gathered from any previously conducted Post Occupancy Evaluation (POE).

Why?

Context & Objectives:
•Net Zero Carbon Value for Client
[Reference to Client's overall 'Sustainability Strategy', if applicable] (refer to Appendix 9 for the 'Additional Requirements for Net Zero Carbon').'

[Reference to the main brief for design vision, commercial objectives, etc.]

•'Site Appraisal for Net Zero Carbon Checklist' conducted at Stage 0 - Client Requirements (please refer to Appendix 3, and Section 2, Outcome 0.4)

How?

Assessment Methodology:
•Boundary of Assessment:
The building, the site, or part of a building

•Client sign-off procedure regarding Net Zero Carbon delivery.

•Starting point and frequency of calculation and measurement where not specified by the selected certification method

•Sustainability Assessment and Certification Methods (please refer to Appendix 5)

What?

Clear & Measurable Net Zero Carbon Brief Targets:
•Net Zero Operational Carbon (for targets, please refer to LETI Climate Emergency Design Guide)

•Net Zero Embodied Carbon (for targets, please refer to the Embodied Carbon Target Alignment document. For the time being, current best-practice performance for projects in the design phase is considered to be a C rating, while a B and above is considered a robust stretch target).

•Additional, wider 'sustainability' criteria to be considered for Human Factors, Ecology & Biodiversity, Water and Connectivity & Transport (for information, please refer to Appendix 6: Holistic Sustainability Criteria)

Who?

Roles & Responsibilities:
• Team collaborative ethos and sustainability specialists (where applicable)

• Include 'Net Zero Carbon Responsibility Matrix' for all the project consultants
[please refer to 'Roles & Professions' on Table 3, on page 15]

Figure 8 - Net Zero Carbon Brief Structure/Checklist

2.1 Client Role in Net Zero Carbon Procurement

This Section includes a series of tables outlining the Clients' role in the procurement of Net Zero Carbon buildings. Clients should review these tables at the start of a project, and throughout the relevant RIBA Stages, as the project develops. These tables are complementary to UKGBC's resource that addresses critical barriers and opportunities to overcome these in their 'Unlocking the Delivery of Net Zero Carbon Buildings'.

Stage 0: Strategic Definition

Whole Life Carbon thinking should start at the outset of a project at the RIBA Stages 0 and Stage 1.
The Brief should include the proposed scope of assessment in line with the RICS Whole Life Carbon Assessment for the Built Environment (2017).

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 0.1 **Understanding the Need:** Develop a set of activities and areas that need to be fulfilled by the project.	→ Identify a list of activities for the project, along with key interfaces those activities will require. → Work with Client Advisers who will be able to help you formulate your needs. → Create a long-term plan to ensure that future flexibility is enshrined within your ambitions. → Understand the areas of space you will need for your building, and how it compares to your current situation. → For larger organisations, talk to those, who will be using the new space(s) and explicitly understand their needs.	**Lead:** Client **Collaborators:** Client Adviser Architect End Users	→ Check that the spaces you already have could be suitable with minimal changes. (Organisational changes may enable a space to be reused/ shared for a new purpose). → Be frugal with space - this will not only save money, but also use less material than a large space would typically need. → Highly specific designs can preclude future flexibility, so think about how you may need to use your building in 5, 10 , 20 years. → Engaging with the End Users, where not the Client, is key to ensure early buy-in and it will pay dividends if their needs form a key part of the project brief.
Outcome 0.2 **Sustainability Aspiration:** Establish the sustainability vision of your project and understand the implications.	→ Establish the sustainability targets for the project, including operational energy, embodied carbon, and water use. → Consider a broader sustainability framework to target wider determinants of sustainability (please refer to Appendix 6 and Climate Framework). → Evaluate the impact of these targets on how you will operate the building → Where internal guidance on buildings exists, check they are not in conflict with the project aspirations.	**Lead:** Client **Collaborators:** Client Adviser Architect Sustainability Consultant	→ Targets should be set according to when the building will be finished and operated (rather than meeting the current standards). → Identify sustainability targets that align with the local area to enable easier consultation and planning. → Internal guidance may be based on a particular experience, so there may be resistance to be changed. → Some stretching operational energy targets may require significant changes to the way the building is operated. → Additional training may be needed to truly understand your sustainability options. (This would also be a good opportunity to improve your skills).
Outcome 0.3 **Feasibility and Budgeting:** Ensure that the cost forecasts include the indicative costs for the sustainability aspirations.	→ Use the sustainability aspirations to establish the predicted cost difference compared to a "standard" building. → Establish key areas of difference to provide context to the changes that may be needed. → Establish areas where optimisations and improvements can be designed-in to reduce costs. → Make a long-term financial case to establish if savings will be made due to the reduced operational costs. → Evaluate the best collaborative procurement routes for a net zero result and identify any associated risks.	**Lead:** Client **Collaborators:** QS Sustainability Consultant	→ Be careful that simple uplift factors are not applied due to unknown costs. (These can prevent a project going forward from the very start. Ensure QS has the relevant experience). → Ensure that overall project cost will be evaluated not only based on upfront but also based on the life of the building (i.e. when the building is occupied and running). → Get buy-in from the budget holder and build in contingency from the outset. → Subsidies and grants may be available, so check with authorities. → In large organisations, it can be useful to reflect the positive PR and business that Net Zero Carbon may bring.
Outcome 0.4 **Site Appraisal:** Assess the specific site constraints and opportunities, including any existing structure.	→ Identify a suitable site for development. → Establish the specific site constraints, including micro-climates, flood risk, contamination, and existing habitats that will significantly affect the appropriateness of the site. → Where there are existing structures, establish if they can be re-purposed for use (particularly evaluate the suitability of the structure).	**Lead:** Client **Collaborators:** Ecology Consultant Architects MEP Engineers Structural Engineers	→ Attention should be paid to site biodiversity and the development should aim to improve local biodiversity. → Removing site contaminants can be costly, but it should prioritised, in the spirit of regenerative design principles. → The lowest impact building is the one that already exists, so any existing structures should be investigated for ability to be retrofitted.

Stage 1: Preparation and Briefing

Whole Life Carbon thinking should start at the outset of a project at the RIBA Stages 0 and Stage 1.
The Brief should include the proposed scope of assessment in line with the RICS Whole Life Carbon Assessment for the Built Environment (2017).

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 1.1 **Operational Target and Methodology:** Translate the sustainability aspirations and specific building requirements into a fixed project target.	→ Examine benchmarks based on case studies for achievable operational energy targets. → Review broad targets (such as those defined by the LETI and/or RIBA 2030 Climate Challenge), and determine appropriateness for building use/type. → Establish a target based on the sector and type of the building. → Choose a methodology for prediction during design that includes all energy, such as CIBSE TM54, Design for Performance/NABERS UK, Display Energy Certificates, or Passivhaus. → Determine a hierarchy of passive principles, efficient systems and renewables to reduce the dependency on technology.	**Lead:** MEP Consultants Sustainability Team **Collaborators:** Client Architects Client Advisers	→ Benchmarks are based on existing buildings, and will not be identical to yours, so take the time to understand the difference between your needs and other buildings (particularly when it comes to occupancy profiles). → Ensure your target is measurable, so choose meter data (kWh) rather than carbon ($kgCO_2e$). → Do not use EPCs or Part L calculations - as indications of predicted energy use as they only include regulated energy, which is much lower than total energy consumption (i.e. regulated + unregulated). → On-site renewables will help the overall energy story, but aim for low energy passive design first, as it will outlast the renewable technology and provide a more robust solution for long-term.
Outcome 1.2 **Embodied Carbon Target and Methodology:** Translate the sustainability aspirations and specific building requirements into a fixed project target.	→ Examine benchmarks based on case studies for achievable embodied carbon targets. → Review broad targets (such as those defined by the LETI and/or RIBA 2030 Climate Challenge), and determine appropriateness for building use/type. → Establish a target based on the sector and type of the building. → Determine the boundaries of the analysis (e.g. building, landscaping, FF&E, infrastructure). → Ensure the analysis is compliant with BS EN15978. → Undertake preliminary life cycle analysis to understand an expected embodied carbon footprint.	**Lead:** Sustainability Team Architects Structural Engineers **Collaborators:** Client MEP Consultants Client Advisers	→ Establish the life cycle modules to be included, with Modules A1-3 representing Cradle-to-Gate, Modules A1-5 representing Cradle-to-Handover, and Modules A1-C4 representing Cradle-to-Grave. → It is important to set other targets, beyond embodied carbon, that also consider Circular Economy, material re-use, recycled content. → For non-domestic buildings, most of the embodied carbon emissions would come from the structure, so work with the engineers to find an efficient form/ structure (and avoid big structural spans, large grids and/or transfers). → For domestic buildings, a significant amount of the embodied carbon emissions would come from the facade. (Please refer to LETI Client Emergency Design Guide and Embodied Carbon Primer). → Carbon sequestration can be a complex issue, so do not rely on it to make a low carbon building.
Outcome 1.3 **Risk Mitigation:** Assess the risks that the chosen form of contract has on the project's Net Zero Carbon ambitions and develop a procurement strategy that mitigates this risk.	→ There is no 'Net Zero Carbon contract', but instead, it is the performance documents that accompany contracts at different stages, and these documents need to be transparent and rigorous. Employer's Requirements should establish absolute and measurable performance targets to be reviewed during the procurement process. → Establish additional cost risks associated with the sustainability aspirations and choose the best balance of risk vs. cost for the project.	**Lead:** Client Client Adviser **Collaborators:** QS Project Manager Facilities Manager (if known) Building Insurer	→ Contracts where Contractors are appointed early on (e.g. in Design & Build) can make it harder to achieve Net Zero Carbon, unless the contract includes a reward-based incentive, linked to RIBA Stage 6 for the final operation of the building.

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 1.4 **Specialist Consultant Appointment:** Engage a specialist consultants to deliver a Net Zero Carbon Building.	→ Establish the required specialist reports and investigations. → Establish which specialist energy/sustainability consultants are required to deliver a Net Zero Carbon Building. → Determine the RIBA Plan of Work stages, where specialist reports must be delivered and ensure these are captured in the programme, as well as Consultant scope. → Prepare briefs and appointment documents for specialist Consultants → Create a 'Net Zero Carbon Risk Register' (please refer to Table 3, page 23) to enable the "golden thread" of performance to be referred to throughout the project.	**Lead:** Client Client Adviser Accountable Person **Collaborators:** Design Team (if appointed)	→ Sometimes Design Teams will resist needing to develop specialist skills or Clients won't prioritise hiring Net Zero Carbon design consultants. → When conducting feasibility studies and budget estimations, ensure the person/organisation conducting the estimation is skilled in Net Zero Carbon delivery, and is not adding a 'margin-of-the-unknown' in an attempt to have the requirement removed, so that the project is within their skillset. → Ensure the Client understands the extent of the required additional services from the sustainability consultant. → The 'Net Zero Carbon Risk Register' (please refer to Table 3, page 23) needs ownership within the Design Team, and it should be kept up-to-date throughout the construction and post-handover.
Outcome 1.5 **Climatic Design Strategies:** Define seasonal, passive design strategies to reduce energy.	→ Site information will need to include a micro-climate analysis to identify any challenges that need to be mitigated, or opportunities that can be exploited by the environmental design strategy. (It might be more cost effective to procure this analysis early on, and have it included in the brief, so that Design Teams can bid while in possession of the information they need in order to develop effective strategies).	**Lead:** Architect **Collaborators:** Sustainability Consultant	→ Passive principles and Fabric-first approach should be the starting point in any given project. → Over-reliance on renewables and/or other forms of offsets should be avoided.
Outcome 1.6 **Site Appraisal:**	→ Assess the project's environment (site, climate, etc.) and identify opportunities to maximise passive design. → Identify the possibility of re-use of the entire or a part of the building. → Always prioritise brownfield sites in site selection, and avoid greenfield sites. → Assess proximity to public transport, where appropriate. → Examine potential for water recycling and rainwater harvesting. → Identify opportunities to increase biodiversity on- and off-site. → Enable connection to external spaces, daylight and high air quality. → Identify opportunities for placemaking and enhancing existing successful social structures, as well as neighbourhood/community patterns of the project area.	**Lead:** Architect **Collaborators:** Structural Engineer MEP Engineer	→ Consider structural reuse for piling, foundations, basements and frame, if it can be used, to save on embodied carbon emissions. → Be mindful of adopting rigid design codes/standards that do not allow reuse.

Stage 2: Concept Design

RIBA Stage 2 sets a project's Architectural Concept in line with the Site Information and the Project Brief, including the Spatial Requirements. During this Stage, Regular Design Reviews are used to obtain comments from the Client and other Project Stakeholders and the design is iterated in response. Any Project Brief Derogations are agreed, or the Project Brief is adjusted to align with the Architectural Concept.

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 2.1 **Whole Life Carbon Consideration - Operational Energy:** Consider how the operational energy of the design contributes to the Whole Life Carbon of the building.	→ Develop an operational energy strategy considering the impact of form and orientation and thermal mass on thermal performance, glazing proportions, air tightness and building physics. Develop seasonal energy strategies for the site considering opportunities for passive systems, the impact of the complexity of controls and management on energy consumption, comfort and occupation satisfaction. → Carry out sufficient energy and other modelling to test and refine the Architectural Concept. → TM54 and Passivhaus PHPP could be used to predict energy in use requirements at early design stage and tracked through the Plan of Works.	**Lead:** Whole Life Carbon Assessor **Collaborators:** Design Team (Client, Lead Designer, Architect, MEP Engineer, Structural Engineer)	→ Allow sufficient time at Stage 2 to explore and test various design options (feasibility studies), and carry out a Site Appraisal and research precedents. → Ensure Consultant scopes and fees are aligned to allow for early Whole Life Carbon considerations. The Architecture, Structure and MEP all impact one another and their integration should be considered at an early stage, rather than trying to "shoe horn" strategies into a design concept that has already been fixed. Roles should be defined clearly in the Responsibility Matrix. → Client should decide how innovative they are prepared to be, in order to achieve Net Zero Carbon and appoint the Design Team/Specialist Consultants accordingly, so that they can draw from experience and precedents, as well as insights from Post-occupancy Evaluations (POEs).
Outcome 2.2 **Whole Life Carbon Consideration - Embodied Carbon:** Consider how the embodied carbon of the design contributes to the Whole Life Carbon of the building.	→ Review the embodied carbon and carbon of materials and construction processes in the context of the building's lifespan and operational strategy. → Minimise high embodied carbon materials, paying particular attention to the structure and envelope. → Prioritise low carbon and recycled materials. → Avoid inefficient/wasteful use of materials. → Design out waste where possible. → Carry out embodied carbon assessment of proposed construction materials. At early design stages and in the absence of detailed information, the ICE database can be used to develop a generic early study on embodied carbon. → Facilitate structural engineer to propose efficient structural layout and grid as in many instances these can have more benefit than material choices.	**Lead:** Whole Life Carbon Assessor **Collaborators:** Design Team (Client, Lead Designer, Architect, MEP Engineer, Structural Engineer)	→ Set project targets according to when the building will be finished and operated, rather than the current standards. → Identify sustainability targets that align with the local area, to enable easier consultation and planning. → Internal guidance may be based on particular experiences, so there may be resistance for change. → Deliver additional training, as needed, to truly understand your sustainability options, and it would be a good opportunity to improve your skills. → Some of the stringent operational energy targets may require significant changes to the way the building is operated.
Outcome 2.3 **Sustainability Actions + Assessment:** Be mindful of time frames for appointments and actions for specific sustainability Consultants and assessment tools	→ Some sustainability assessment tools require actions at Stage 2. For example, if undertaking BREEAM 2018, a Life Cycle Assessment must be submitted at Stage 2 (BREEAM MAT 01), and this would already be determined at the project briefing stage. → Holistically understand the requirements and interrelation, as well as effect of Net Zero Carbon on design.	**Lead:** BREEAM Assessor/Appropriate Certified Assessor relevant to the chosen Sustainability Tool **Collaborators:** Design Team	→ Ensure that the chosen target is appropriate to the type of project. → The type of assessment tool used will be chosen as part of the briefing process at Stage 1, and its requirements will need to be properly integrated into the design process throughout.
Outcome 2.4 **Pre-planning Advice:** Seek Pre-planning application advice and prepare for Outline Planning, if applicable.	→ Pre-planning application advice should be obtained (on the suitability of the initial proposal) from a planning adviser, or the relevant planning department. → Outline planning can also be submitted, if applicable. → Production of the Pre-planning Application report/Outline Planning by the Design Team.	**Lead:** Planning Consultant **Collaborators:** Design Team (Client, Lead Designer, Architect, MEP Engineer, Structural Engineer)	→ If Outline Planning is to be submitted, note that Local Planning Authorities may have sustainability requirements, such as enhanced regulatory requirements or assessment methods. For example, the London Plan states that the submission should be accompanied by an Energy Strategy to demonstrate how the Client will minimise the development's carbon emissions. This effort will require input from the entire Design Team to show how the Whole Life Carbon considerations are incorporated into the project.

Stage 3: Spatial Coordination

RIBA Stage 3 is fundamentally about testing and validating the Architectural Concept, to make sure that the architectural and engineering information prepared at Stage 2 is spatially coordinated before the detailed information required to manufacture and construct the building is produced at Stage 4.

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 3.1 **Audit & Risks:** Audit design against operational energy target.	→ Assess coordinated Consultant information developed at Stage 2 against the architectural design to ensure there is a spatially coordinated scheme, in line with the operational energy strategy. → Identify and record performance risks to inform Stage 4.	**Lead:** Whole Life Carbon Assessor **Collaborators:** Design Team (Client, Lead Designer, Architect, MEP Engineer, Structural Engineer)	→ Go beyond checklists and analyse/model designs realistically (with likely use estimations, rather than over optimistic assumptions). → Involve the entire Design Team in the coordination process to ensure consistent alignment.
Outcome 3.2 **Embodied Carbon Assessment:** Use embodied carbon assessment/ modelling to test relative impacts of design option,s as part of whole life costs.	→ Whole Life Carbon assessment should be prepared using the material descriptions and quantities in the project's cost plan, and the anticipated energy use over the building's life. As the project progresses, this indicative baseline carbon budget should be updated with actual material/product selection, together with the evolving environmental strategy. → Continue to research materials/product alternatives, and maintain a table of detailed design options and their respective impacts on the carbon budget in order to enable the Design Team to choose low carbon options. → Ensure appointment of Specialist Consultants, where required (e.g. Façade Engineer). → Identify and record performance risks to inform Stage 4.	**Lead:** Whole Life Carbon Assessor **Collaborators:** Design Team Specialist Consultants Cost Consultants	→ Lifespan of materials and adaptability/maintainability are critical in assessing holistic/full embodied carbon picture of a building. → Note that single-sourcing suppliers will increase costs as tender process is not effective. → Creating an accurate Bill of Materials (BoM) without BIM can be tricky, and is often the easiest way to plug into Life Cycle Analysis (LCA) software. (*Note:* check the Bill of Materials (BoM) for errors).
Outcome 3.3 **Planning Application:** Submit Planning Application.	→ Submit Planning Application, and include Sustainability, Energy and Circular Economy Statements. → Benchmark against planning case studies (of similar building types) within the project's borough, and in line with the local planning authority context.	**Lead:** Planning Consultant **Collaborators:** Design Team (Client, Lead Designer, Architect, MEP Engineer, Structural Engineer)	→ Note that various Planning Authorities may have sustainability requirements, such as enhanced regulatory requirements or assessment methods. For example, the London Plan provides guidance on what should be included in the energy assessment, following the 'Be Lean', 'Be Clean', 'Be Green' energy hierarchy approach. → The building should be aiming at a higher standard than the planning and the building control authority set as a minimum.
Outcome 3.4 **Employer's Requirements:** Prepare Employer's Requirements.	→ Ensure the Employer's Requirements contain details of the Sustainability, Energy and Circular Economy Statements, if these are to be produced at Stage 3.	**Lead:** Client **Collaborators:** Sustainability Consultant Architect	→ The sustainability strategy should have been prepared at the beginning of Stage 2, as it frames the design and also requires development for planning submission, typically on large projects. → Don't leave this until the design is finalised.
Outcome 3.5 **Soft-Landings & Procurement Strategy:** Embed the requirements for Post-Occupancy Evaluation (POE) in the Procurement Strategy.	→ Ask FM team to feedback on design and contract for evaluation. → Consult with potential suppliers & specialist sub-Contractors. → Consult with End Users and the building maintenance/management team.	**Lead:** Client **Collaborators:** QS Cost manager MEP Consultant Architect	→ Ensure that the tender includes carrying out of full handover requirements' and post occupancy checks, including checks to be made at the end of the defects period and beyond. → After occupancy, it is essential to know whether the building is performing as designed.

Stage 4: Technical Design

RIBA Stage 4 incorporates design details and all the key sustainability strategies into the project's drawings and specifications, for tender and procurement. It is important for the tender documentation to ensure that the competing Contractors understand the project's Whole Life Carbon requirements, the goals, as well as the process for delivering and monitoring carbon reduction during construction.

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 4.1 **Performance Targets & Specifications:** Implement embodied carbon and operational energy targets, as well as a list of carbon reduction options to influence specifications.	→ Ensure requirements and targets for Whole Life Carbon are clear and prescriptive in the project specifications and tender documentation, at the start of procurement process. → Ask for improvements options around embodied carbon and operational energy targets, and request embodied carbon and operational energy questions to be included on tender return forms.	**Lead:** Client **Collaborators:** Design Team	→ Ensure there is good communication between the Design Team and Contractor Team/Suppliers during detailed design. → Contractor's Procurement Team can exploit loopholes in performance specification, if not sufficiently detailed, and this team can underestimate the level of Net Zero Carbon skills required of labour. → Well communication with the procurement team is essential, so that it can become easier for them to chose Net Zero Carbon (with a lower risk). → Client's Procurement Team can fail to embed Life Cycle Costing (LCC) into the tender documents.
Outcome 4.2 **Embodied Carbon Assessment:** Use embodied carbon assessment/ modelling to test relative impacts of design options, as part of whole life costs.	→ Ensure that the technical design elements align with the operational carbon target, using detailed modelling (such as PHPP or CIBSE TM54). → Record design changes that influence the energy use, including changes to occupancy patterns, as well as building elements. → Identify options to further reduce operational energy requirements.	**Lead:** Sustainability Consultant **Collaborators:** MEP Architects Contractor Sub-Contractors Client	→ Window opening mechanisms may not be able to open as wide as initially planned, so ensure that any natural ventilation implications are properly measured. → Detailed duct and pipework layouts may push up fan and pump power requirements during operation. → Late changes to the design brief, particularly changing the use of rooms, can have a significant impact on the building's energy performance. → Work with sub-Contractors to ensure that they are aware of the importance of their work against the operational energy targets.
Outcome 4.3 **Embodied Carbon & Specifications:** Assess design against embodied carbon targets. Ensure specifications include embodied carbon of materials.	→ Request that Design Team continues numerical analysis and uses material guides to optimise material specification. → Ensure Whole Life Carbon budget is updated by the Life Cycle Analysis (LCA) Specialist and included in the design development. → Review the list of carbon reduction options. → Update 'Net Zero Carbon Risk Register' (please refer to Table 3, page 23).	**Lead:** Life Cycle Assessment Specialist **Collaborators:** QS Client Design Team	→ Request a Life Cycle Analysis (LCA) for any value engineering options. → Contractor's Procurement Team can fail to understand performance issues. → Allow time for design to be completed to optimise elements and to minimise design error which collectively can lead to potential waste on site (i.e. costing embodied carbon). This applies to Contractor design items also, and their integration into the main design. (Refer to the 'Get It Right' Initiative's design guide for improving value by reducing design error).
Outcome 4.4 **Life Cycle Analysis:** Request a list of suitable low carbon suppliers for Life Cycle Analysis.	→ LCA Specialist to send pre-procurement RFI to suppliers to collect carbon data in order to provide supplementary information for supplier selection. Review returned RFIs and analyse the environmental credentials of procurement options.	**Lead:** Life Cycle Assessment Specialist **Collaborators:** Design Team Client Successful Contractor and their chosen Suppliers	→ Contractor's Procurement Team will focus on capital costs only. (Ensure long-term, operational costs are also considered to 'sell the Net Zero Carbon ambition). → Single-sourcing equipment suppliers (but not novating or free issue).
Outcome 4.5 **Commissioning:** Embed requirements of commissioning in the tender documentation.	→ Develop Building Management Systems' (BMS) protocols. → Contractor Team to demonstrate compliance with holistic sustainability outcomes (please refer to Appendix 6).	**Lead:** MEP Engineer **Collaborators:** Contractor Team	→ Ensure that detailed design responsibility is given to Specialist Contractor with sufficient independent oversight.

Stage 5: Manufacturing and Construction

RIBA Stage 5 is when the actual carbon impacts of the construction process needs to be monitored against the Stage 3 carbon budget, taking into account any evolution of the scheme during tender and procurement. It is recommended to have reporting intervals of 3-6 months during construction, as it help ensure the delivery of the project requirements (Source: RIBA Sustainable Outcomes Guide).

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 5.1 **Data Collection:** Gather of data for the construction stage analysis.	→ Identify site-based Net Zero Carbon Champion/Manager. → Ensure Design Team engages with the Contractor to reduce waste. → Allow time and fees for review of alternative products and materials proposed by the Contractor against technical and performance standards and against Whole Life Carbon requirements. → Request review of numerical data throughout the construction phase to prepare for post completion analysis. → Programming and logistics (including off-site) Toolbox Talks – Health, Safety & Sustainability, to ensure all current and new personnel fully understand the Net Zero Carbon strategy. → Keep 'Net Zero Carbon Risk Register' updated (please refer to Table 3, page 23). → Undertake fabric installation quality assurance. → Undertake services' installation quality assurance. → Start the Commissioning process. → Test and fine-tune building systems which can be complex and often subject to time & budget issues.	**Lead:** Main Contractor **Collaborators:** Net Zero Carbon Champion/ Manager Design Team	→ Allow for in the budget, identify an appropriately trained airtightness manager, and schedule airtightness testing through construction. → Check insulation continuity through construction. → Site queries may not be addressed by Design Team in a timely and complete manner which can cause delays. → Ensure there is clear and comprehensive installation details provided. → Ensure there is a clear Net Zero Carbon leadership during construction. → Ensure site labour is skilled and motivated for the effort required to deliver a Net Zero Carbon building. → Ensure the Design Team has adequate role (responsibility, fee and time) to not only cover site queries, but also be on-site to help the Client safeguard the building's construction as intended.
Outcome 5.2 **Achievement of Carbon Targets:** Achieve the agreed carbon reduction targets.	→ Request review of numerical data throughout the construction phase to prepare for post completion analysis. → Undertake Whole Life Carbon Assessment. → Prepare for the final certification. → Prepare the Building Manual. → Share success with the Client, Contractor, Design Team and all the key Stakeholders.	**Lead:** Main Contractor **Collaborators:** Net Zero Carbon Champion / Manager Design Team	→ Ensure monitoring is in place to verify auditable environmental credentials and construction carbon data, at regular intervals, throughout construction. → Avoid having a 'tick-box' culture, and embrace true verification inspection. → Ensure defects' list inspector has Net Zero Carbon awareness. → Poor information and documentation management can lead to incomplete certification/s and a poor maintenance plan.

Stage 6: Handover

RIBA Stage 6 should include a post-practical completion final review of the building information, with a final assessment of the Whole Life Carbon impacts of the completed project (which should be included within the Building Manual. (Light touch Post Occupancy Evaluation (POE) might include a more thorough account of operational carbon use) (Source: RIBA Sustainable Outcomes Guide).

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 6.1 **As Built Information:** Issue As Built Information.	→ Deliver "As Built" information pack as part of handover package, including operational carbon predictions, and Whole Life Carbon analysis. → Update all drawings and specifications to as built information, representing any changes that occurred during construction. → Review and update the operational carbon predictions for the building based on the as built performance, including air-tightness, changes to control strategy/occupancy patterns, and substitution of equipment. → Review and update embodied carbon and Whole Life Carbon analyses based on actual building construction.	**Lead:** Main Contractor **Collaborators:** Sub-Contractors Design Team	→ Update the as built information as it becomes available, not at end of construction. → Ensure BIM model includes updates from all Sub-Contractors. → Ensure changes are carried through all the project/building documentation. → Ensure that it is clear in the contracts, who is responsible for as built drawings. If it is meant to be the Design Team, they need to have a full site role to know what is actually built.
Outcome 6.2 **Building User Guide:** Develop a simply building user guide, detailing energy efficient operation of the building, for all occupants including training.	→ Convert the complex control strategy into an intelligible, short, diagrammatic guide that all occupants can understand. → Train End Users to show how the building operates and provide opportunity for questions. → Train Facilities Management Team to detail low carbon operation of the building and necessary maintenance to ensure continuing high performance.	**Lead:** Main Contractor **Collaborators:** M&E Engineers Architectural Design Team Facilities Manager	→ Ensure time is left for the training with the End Users and that this forms a part of the Employer's Requirements. → Ensure to have a Building User Guide and do not only rely on the building logbook or O&M manual for relevant information.
Outcome 6.3 **Seasonal Commissioning:** Undertake seasonal commissioning to align building systems with operational characteristics (both occupant and building characteristics).	→ Commissioning Manager to arrange and oversee periodic re-commissioning of the M&E services in each season, to identify deviations from expected behaviour and fine-tune the control systems to reduce energy use, while also maintaining building performance.	**Lead:** Commissioning manager **Collaborators:** Sub-Contractors Facilities Management Team	→ Program in seasonal commissioning sessions at point of handover to ensure they are undertaken. → Ensure Sub-Contractors are obliged to return to the building to assist with systems included within the seasonal commissioning. → Allow enough time for seasonal commissioning. → Verify accuracy of metering and sub-metering.
Outcome 6.4 **Building Performance Targets' Review:** Initial review of building performance against targets set in brief.	→ Following one year of operation/occupancy, undertake a light touch Post Occupancy Evaluation (POE) in the building to evaluate its performance against the targets set-out in the initial project brief and those predicted during the design and construction processes (including energy, maintenance, indoor environmental quality and occupant satisfaction). → Host a post-project review with the Client and the Design Team to discuss the findings of the POE and the overall project delivery.	**Lead:** Client **Collaborators:** Design Team Main Contractor Building Occupants	→ Create a no-blame culture to ensure that Post Occupancy Evaluation (POE) findings can be shared for everyone to learn from. → Findings can be used within contractual disputes.

Stage 7: Use

RIBA Stage 7 should include a Post Occupancy Evaluation (POE) process, which takes into account of all Whole Life Carbon impacts. This should include the actual performance of the building's environmental systems; the fabric's physical performance with respect to durability and fitness for purpose and an assessment of the maintenance regimes for both. (Source: RIBA Sustainable Outcomes Guide).

OUTCOME	ACTIONS	RESPONSIBILITY	WATCHPOINTS
Outcome 7.1 **Building Performance Identification:** Identify the performance of the building against the original project brief.	→ Identify budget and scope for Post Occupancy Evaluation (POE) based on findings from light touch POE in Stage 6 and project particulars. (The scope should be based on targets set in the initial brief and those monitored during the design process, as well as aspects that will be relevant to future projects, such as occupant behaviour or performance of innovative systems). → Appoint POE Team, including time for a member from each of the Design Team to attend a meeting. → For POE Team, provide access to building systems and occupants to undertake their services. → POE to identify gaps in the building's performance and recommend interventions to reduce this performance gap. → Having resisted making changes during the construction period, there should be a reassessment of the Client's needs (which may well have changed) and alterations made, as necessary.	**Lead:** Client **Collaborators:** Design Team Main Contractor Building Occupants Post Occupancy Evaluation (POE) Team Client Advisers	→ Stage 7 may not included in typical procurement and may need to be under a separate appointment to maintain PI cover. → Findings can be used within contractual disputes.
Outcome 7.2 **Performance Gap Reduction:** Reduce any performance gap between monitored and targeted performance of the building.	→ Use the recommendations within the POE analysis to establish a plan of works to reduce the performance gap. → Undertake the required works to reduce the performance gap. → Update the Building User Guide and logbooks and provide additional training on the changes, as required.	**Lead:** Client **Collaborators:** Post Occupancy Evaluation (POE) Team	→ Establish a budget for consequential works arising from the Post Occupancy Evaluation (POE) from the outset, to simplify undertaking of small activities. → Carbon should be included in the cost-benefit analysis of reducing the performance gap.
Outcome 7.3 **Lessons Learnt Dissemination:** Publish a lessons learnt report to share findings within the wider industry.	→ Share findings from the POE, either good or bad, to reduce the likelihood of recurrence. (Creating Net Zero Carbon buildings requires sharing findings across the industry in order to create a collective knowledge). → Create a POE report, and establish a no-blame culture for sharing knowledge and findings, along with suggestions for improvements, where necessary.	**Lead:** Client **Collaborators:** Post Occupancy Evaluation (POE) Team	→ Produce the POE report using neutral language to ensure all parties agree to publication. → Don't compare your building to unrealistic building performance targets.

3

Conclusion

3.0 Conclusion

The LETI Client Guide for Net Zero Carbon Buildings recognizes the key role that Clients play in ensuring that all their projects are Net Zero Carbon or 'Net Zero Carbon enabled'. This requires Client leadership in from the very beginning of a project where the Client's influence is the greatest. The successful delivery of a net zero project, and operation of a building at Net Zero Carbon requires Clients to set the brief right, and then to consistently monitor the project's, and the team's progress throughout that project's life.

This guide builds around LETI's four Elements of a Net Zero Carbon Brief: Engage, Collaborate, Commit and Share, identifying key players and their roles, as the project develops, through the RIBA Plan of Work stages.

Following this Conclusion, there are eight Appendices that provide further, detailed information on some of the key areas this guide covers in its main body.

We know responding to the climate and biodiversity emergency is difficult, as we are all learning how to design and procure projects differently. One of the exciting consequences is that we are learning how buildings can perform in the way that they are designed to, minimising the risk of these built environments becoming a liability to future generations. In this manner, we can ensure that energy is not wasted, whole life costs are reduced and buildings' value will be continuously enhanced.

We hope that this guide can both enlighten and empower you to help realise a Zero Carbon future.

Your feedback would be most welcome.

Please provide us with comments and any recommendations for the continued improvement of this guide, so that it gives future Clients more of what you found you needed.

Performance data from completed projects is also gratefully received for sharing with industry within the next iteration of this guide.

https://www.leti.london/clientguide

Section 0

1 Architecture 2030 (https://architecture2030.org/new-buildings-operations/)
2 WorldGBC: From Thousands to Billions (https://www.worldgbc.org/news-media/thousands-billions-coordinated-action-towards-100-net-zero-carbon-buildings-2050)
3 UKGBC: Capturing the Value of Sustainability (https://www.ukgbc.org/ukgbc-work/capturing-value-sustainability-2/)
4 JLL: The Impact of Sustainability on Value (https://www.jll.co.uk/en/trends-and-insights/research/the-impact-of-sustainability-on-value)
5 UKGBC: Building the Case for Net Zero Carbon (https://www.ukgbc.org/wp-content/uploads/2020/09/Building-the-Case-for-Net-Zero_UKGBC.pdf)
6 UKGBC: Building the Case for Net Zero Carbon (https://www.ukgbc.org/wp-content/uploads/2020/09/Building-the-Case-for-Net-Zero_UKGBC.pdf)
7 UKGBC: Building the Case for Net Zero Carbon (https://www.ukgbc.org/wp-content/uploads/2020/09/Building-the-Case-for-Net-Zero_UKGBC.pdf)
8 Forbes: The Remarkable Rise of ESG (https://www.forbes.com/sites/georgkell/2018/07/11/the-remarkable-rise-of-esg/?sh=61dc530c1695)
9 Construction Innovation Hub 'Value Toolkit' (https://constructioninnovationhub.org.uk/new-toolkit-signals-shift-towards-value-based-decision-model/)
10 JLL: Green offices more likely to bring in rent premium, less likely to sit empty (https://www.edie.net/news/6/JLL--Green-offices-more-likely-to-bring-in-rent-premium--less-likely-to-sit-empty/)
11 Property lenders are moving towards awarding a 'green premium' for ESG-led real estate burrowing (https://www.savills.co.uk/insight-and-opinion/savills-news/300973/property-lenders-moving-towards-awarding-a--green-premium--for-esg-led-real-estate-borrowing)
12 What is shadow carbon pricing? (https://www.ebrd.com/news/2019/what-is-shadow-carbon-pricing.html)

Section 1

13 UKGBC Framework for Defining Social Value (https://www.ukgbc.org/wp-content/uploads/2021/02/Framework-for-Defining-Social-Value.pdf)
14 UKGBC Nature-based Solutions to the Climate Emergency (https://www.ukgbc.org/wp-content/uploads/2020/08/Nature-based-solutions-to-the-climate-emergency.pdf)
15 Procurement and Building Performance, Julie Godefroy (https://irp-cdn.multiscreensite.com/b29d1e5a/files/uploaded/00-JG-Reading%20Conference-Procurement%20and%20Building%20Performance-rev02-CLEAN.pdf)
16 CarbonBuzz, PROBE (https://www.carbonbuzz.org/index.jsp#performancegap)
17 BBP Design for Performance (https://www.betterbuildingspartnership.co.uk/sites/default/files/media/attachment/BBP_Design%20for%20Performance_A%20new%20approach%20to%20deliver%20energy%20efficient%20offices_0.pdf)

Section 2

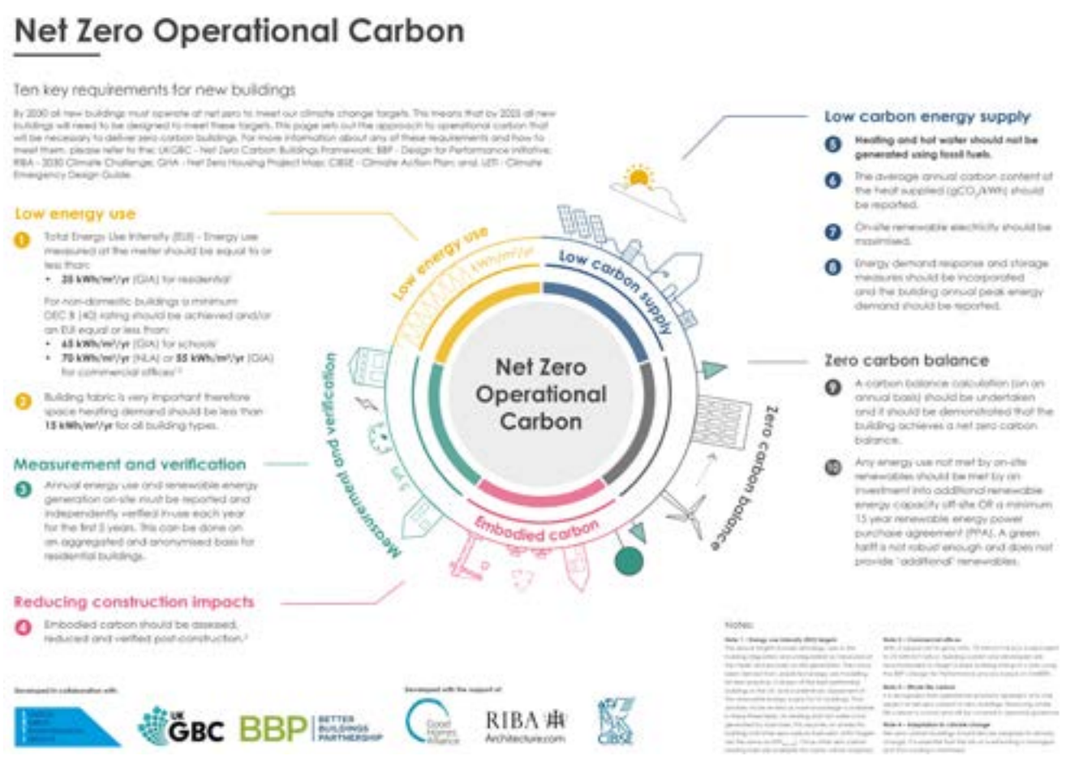
18 UKGBC Framework for Defining Social Value

A

Appendix

A1: LETI One Pager Summary

LETI has produced a one-pager document that explains all the key features of net zero operational carbon buildings. This one-pager document should be read in tandem with the LETI Whole Life Carbon One-Pager document that illustrates the concept of Whole Life Carbon with graphics that explain the measurement scopes, key terminology, an example building cycle and guidance on reducing emissions.



A2: LETI Client Guide Survey Results

An online consultation has been undertaken to establish what Clients are most interested in regards to Net Zero Carbon. The results have helped to inform priority areas that this Guide focuses on - to help Clients effectively define Net Zero Carbon briefs, and translate the objectives identified in their briefs into practical steps as well as outcomes.

The profile of the 110 survey respondents predominantly included built environment professionals (architects, engineers, etc.) making up 55% of all the respondents. Developers were the second largest group of respondents (with 25%), followed by Contractors (7%), Owner-Occupiers (6%) and investors (5%) (figure A2.1). Although the survey has been in half, responded by the built environment professionals, we understand that Clients often rely on built environment professionals to help them define and/or refine their (original) project briefs.

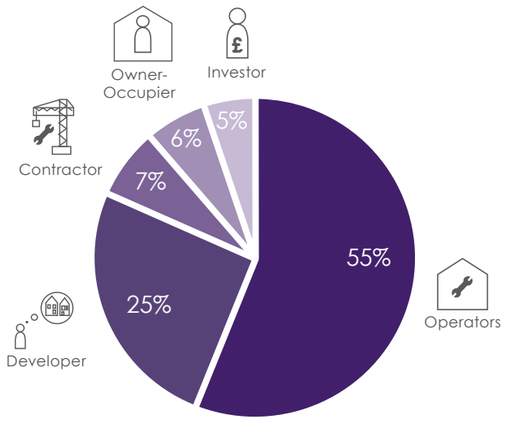


Figure A2.1 - The Breakdown of the Client Profile of Respondents

The survey results indicate that lack of knowledge and awareness is a key reason for Net Zero Carbon criteria not being included in project briefs, and for Net Zero Carbon performance not to be targeted for projects.

→ The survey highlighted that 40% of respondents do not know how to include Net Zero Carbon criteria in their project briefs with those who do, predominantly (>60%) relying on the local initiatives and industry benchmark documents (such as the LETI Climate Emergency Guide, the UKGBC's Net Zero Carbon Buildings: A Framework Definition, the UKGBC Delivery Guidance for Net Zero Carbon Buildings, and the Embodied Carbon: Practical Guide, BBP's Net Zero Carbon Pathway Framework, BBP's Real Estate Environmental Benchmark, and BBP's Design for Performance Initiative, as well as others) to help build an effective Net Zero Carbon project brief (figure A2.2). Global initiatives and commitments, including but not limited to, the UN 2030 Sustainable Development Goals and the Paris Agreement are among the other, main resources the respondents refer to in order to identify key performance indicators for their projects (and briefs).

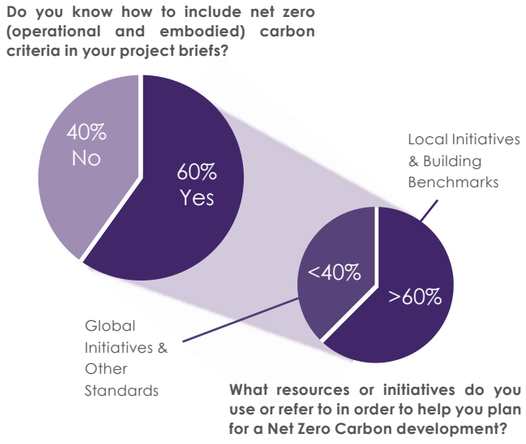


Figure A2.2 - Percentage of respondents that know how to include Net Zero Carbon criteria in their projects and breakdown of their resources

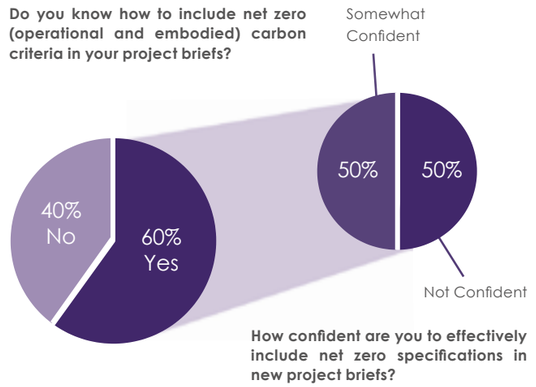


Figure A2.3 - Percentage of respondents that know how to include Net Zero Carbon criteria in their projects and their level of confidence in including net zero specifications

→ 60% of respondents know how to include Net Zero Carbon criteria in their project briefs, but their level of confidence in appropriately detailing the specific requirements and defining the effective stakeholder group (consultants and Contractors) is not aligned (figure A2.3). Seeing the 50% of respondents not feeling confident in this regard, concludes that further guidance is needed to help the industry effectively transition to a Net Zero Carbon world.

→ Less than 40% of respondents do not currently have a plan in place to achieve Net Zero Carbon performance in all of their projects/portfolio, and those who do, predominantly (45%) have a clear Net Zero Carbon operational carbon target (and a roadmap), but none with the same clarity for embodied carbon performance (figure A2.4).

→ **Case Studies:** To help raise awareness with demonstrable examples, 44% of respondents would value case studies (of built and/or renovated projects) demonstrating how Net Zero Carbon performance can be achieved in practical terms (figure A2.5).

→ **Project Briefs:** 20% of respondents believe that maximising value is the most important criterion when formulating a project brief.

→ Remaining within the originally determined time frames (both for the design and construction stages of a project) have been identified as the second most important criterion, followed by organisational reputation - to be seen as 'a leader of sustainable movement/climate action', and to be able to maximise the letting of the building/project (figure A2.6).

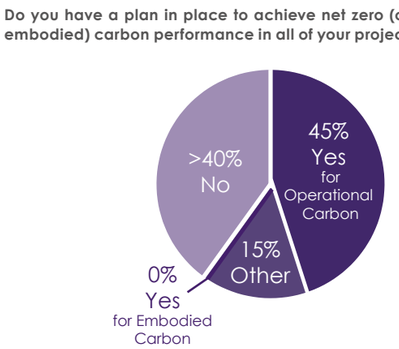


Figure A2.4 - Percentage of respondents that currently have a plan to achieve Net Zero Carbon performance in all of their projects

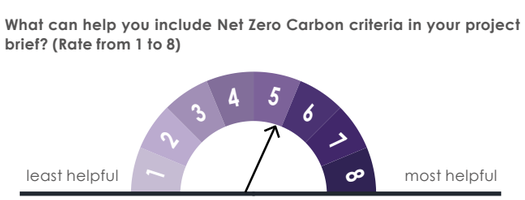
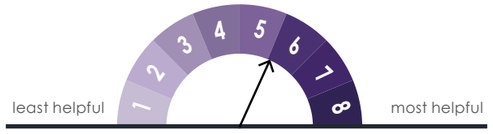


Figure A2.5 - Survey question on what could enable Clients to include Net Zero Carbon criteria in their projects

What are the most important criteria for you, when formulating a project brief? (Rate from 1 to 8)



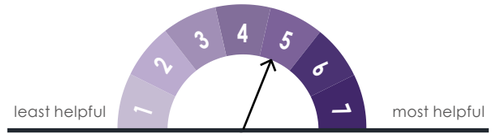
- ☐ Maximising net lettable project area
- ☐ Minimising upfront/capital cost
- ☐ Minimising operational cost (throughout the building's life cycle (including maintenance))
- ☐ Project's design timeline
- ☐ Project's construction timeline
- ☐ Reputation (e.g. the most innovative, the most sustainable project, etc.)
- ☐ Maximising occupant/End User satisfaction
- ☐ Other

Figure A2.6 - Survey question on what could enable Clients to include Net Zero Carbon criteria in their projects

→ **Enablers:** 24% of respondents believe that a Net Zero Carbon Guide would be most helpful in enabling them to deliver Net Zero Carbon projects (figure A2.7). Understanding how Net Zero Carbon projects align with existing certifications such as BREEAM, LEED and others, as well as clearly outlining the roles and responsibilities (in the delivery of Net Zero Carbon buildings) at each RIBA Stage, are deemed the most valuable guidance the industry can offer (to Clients) to accelerate the transition to Net Zero Carbon built environments.

→ **Barriers:** Fewer than 20% of respondents see lack of (advanced) technologies and the likely increase in the overall (capital) investment (for Net Zero Carbon projects) as key barriers for specifying and achieving Net Zero Carbon performance in buildings. Limited number of built precedents and accurate industry benchmarks (for various building uses), as well as overall lack of knowledge across the buildings and construction industry have also been identified as key challenges for delivering built environments that achieve Net Zero Carbon performance (figure A2.9).

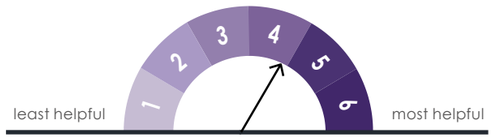
What could help you deliver Net Zero Carbon projects? (Rate from 1 to 7)



- ☐ Understanding how to effectively formulate a Net Zero Carbon project brief
- ☐ Understanding the overall upfront cost compared to a project that is currently just meeting Part L
- ☐ Understanding the overall operational cost compared to a project that is currently just meeting Part L
- ☐ Understanding the specific actions (required for the delivery of a Net Zero Carbon project)at each RIBA Stage
- ☐ Understanding the roles and responsibilities of all the stakeholders (in the delivery of a Net Zero Carbon project) at each RIBA Stage
- ☐ Understanding how a Net Zero Carbon project aligns with existing certifications, such as BREEAM, LEED, etc.
- ☐ Other

Figure A2.7 - Survey question on what could enable Clients deliver Net Zero Carbon projects

What do you think are the barriers to achieving Net Zero Carbon targets in projects? (Rate from 1 to 6)



- ☐ It is too expensive to design.
- ☐ It is too expensive to construct.
- ☐ The industry is not there yet.
- ☐ There aren't enough technologies out there.
- ☐ There isn't enough knowledge/expertise.
- ☐ There aren't enough built precedents / benchmarks.

Figure A2.8 - Survey question on what could hinder Clients from including Net Zero Carbon criteria in their projects

A3: Net Zero Carbon & Sustainability Site Appraisal Checklist

Operational Carbon

- [ ] **Assess micro-climate**
  - → Rainfall
  - → Sunlight
  - → Wind
  - → Temperature
- [ ] **Assess opportunities for passive design**
  - → Orientation
  - → Optimise glazing for passive heating and overheating
  - → Local green and blue infrastructure to neutralise urban heat island effect
- [ ] **Understand the existing context and infrastructure**
- [ ] **Assess opportunities for renewable technologies**
  - → Opportunity for heat recovery for heat pumps (water, ground, sewerage, etc.)
  - → Opportunity for renewable energy generation including wind, solar, hydro
  - → Opportunities for sharing heat with local buildings
  - → Opportunities for micro-grids with battery storage, electric vehicle connection

Embodied Carbon & Circular Economy

- [ ] **Possibility of re-rue of whole of part of the existing building and infrastructure**
  - → Survey of existing buildings, material and infrastructure on site
- [ ] **Avoid sites requiring soil stabilisation and deep foundation**
  - → Site survey of ground conditions

Connectivity & Transport

- [ ] **Access proximity to public/low carbon transport and pedestrian/cycle routes**
  - → Proximity
  - → Extent of network
- [ ] **Planning restrictions on density of development**
  - → Proposed development to be dense enough to promote walking and cycling
  - → Density not to be harmful to existing biodiversity

Ecology & Biodiversity

- [ ] **Identify opportunities to increase biodiversity on- and off-site**
  Audit of existing ecology and ecosystems
- [ ] **Always prioritise brownfield sites in site selection**

Water

- [ ] **Examine risk of site to flooding**
- [ ] **Assess opportunities for Sustainable Urban Drainage solutions (SuDS)**
- [ ] **Examine potential for grey water recycling, rainwater harvesting, on-site black water cleansing**

Social Value

- [ ] **Connection to external spaces**
- [ ] **Site air quality**
- [ ] **Daylighting**
- [ ] **Proximity to nature / green spaces**
- [ ] **Site noise levels**
- [ ] **Identify opportunities for placemaking and enhancing existing successful social structures, as well as neighbourhood / communities patterns of the area**
- [ ] **Access opportunities for meanwhile use**

A4: Case Studies

Case Study 01: Here + Now

Project Summary

Two existing HQ style office buildings, within a former Microsoft campus, in need of substantial refurbishment and repositioning. The buildings will also include a gym, cafés, outdoor cinema and outdoor working.

The project has extremely high Environmental, Social, Corporate Governance (ESG) credentials. The aim is to refurbish the buildings in the most sustainable way possible considering carbon consumption at every stage of the development.

Location
Thames Valley Park, Reading
Building use
Office
Status
Under construction
GEA
23,226m^2
No. storeys
5 storeys (including basement)
Type
Refurbishment
Key team members
V7, Hoare Lea, Element 4

Net Zero Brief

The buildings must achieve Net Zero Carbon from a whole life cycle perspective i.e. both embodied and operational carbon over 15 year timeframe.

Brief defined at:
RIBA Stage 1
Net Zero target set by:
The Client
Benchmarks & guidance to identify targets & metrics:
BREEAM Outstanding, FitWel 3*, EPC B
Operation vs. embodied / Whole Life Carbon: Whole life Net Zero Carbon i.e. life cycle embodied carbon & net zero in operation.
Benchmarks and certification schemes:
Existing certifications/rating schemes (BREEAM Outstanding)
Carbon offsetting:
Offsetting embodied carbon in order to achieve net zero through woodland planting.
Net zero brief formulation:
Brief developed to whole life Net Zero Carbon following discussion of project scope and initial brief with market leading sustainability consultants.

Design Team

Design Team selection:
Hoare Lea were appointed to review the embodied carbon and operational carbon consumed and then report a pathway to net zero. Element 4 were appointed to manage the ESG strategy. LHS were appointed to run the buildings and were given a clear brief to acquire renewable energy.

Criteria for Design Team selection:

1. Experience on delivering Net Zero Carbon projects in the UK.
2. Expert knowledge on Net Zero Carbon.
3. Delivering Net Zero Carbon projects in general.
4. Industry leadership and engagement on Net Zero Carbon*.
5. 'Public' commitments and declarations on Net Zero Carbon.

Delivery

Specification/procurement to reduce embodied carbon:
Yes
Ensure delivery of Net Zero:

- ☑ Defined Net Zero Carbon brief.
- ☑ Appointed knowledgeable / experienced Design Team at early design stage.
- ☑ Appointed specialist consultant/s in the project.
- ☑ Allocated time and budget (for the Design Team) to include additional assessments for Net Zero Carbon.

**For example involvement in the LETI, UKGBC, CIBSE, RIBA, etc. efforts on Net Zero Carbon.*

Case Study 02: UWE SAP3 Phase 1

Project Summary

The first phase of the project will provide 900 bedrooms to the UWE Frenchay campus, as well as communal and study spaces for the wider campus.

UWE have set a target to be Net Zero Carbon by 2030. In line with this aspiration, the project is targeting Passivhaus Classic certification, and includes CO_2 air source heat pumps for hot water production, and solar PV. The resulting operational energy and carbon emissions are predicted to be over 75% lower than a conventional equivalent building.

Location
Bristol
Building use
University student accommodation
Status
RIBA Stage 4 (tender)
GEA
28,265m^2
No. storeys
6
Type
New build
Key team members
QODA Consulting, Stride Treglown, Curtins, Amber Management, JLL

Net Zero Brief

Minimum standard: Net Zero Carbon 'ready' - energy strategy will deliver Net Zero Carbon by 2030. Preferred standard: Design achieves Net Zero Carbon and delivered in practice within 3 years of operation.

Brief defined at:
RIBA Stage 0
Net Zero target set by:
The Client
Benchmarks & guidance to identify targets & metrics:
Passivhaus Classic standard, LETI, RIBA
Shadow price on carbon:
Included in reporting as £60/tonne, but was not very impactful on design decisions.
Operation vs. embodied / Whole Life Carbon:
Net Zero in operation.
Benchmarks and certification schemes:
Client ambition of Net Zero Carbon by 2030 and certified Passivhaus projects.
Carbon offsetting:
PPAs to ensure that the remaining energy demand can be met by Net Zero Carbon sources.
Operational targets:
Space heating Passivhaus target - 15kWh/m^2/yr
Primary Energy Renewable - 90kWh/m^2/yr
Operational energy (excluding renewables) will be 45-56kWh/m^2/yr*
Net zero brief formulation:
The brief was defined before the project started, then refined from Stages 1 to 2 when the predicted performance was established, i.e. Net Zero Carbon on site was not feasible, even with a larger budget, due to the limited roof space (from 6-storey massing). So, renewable energy through a PPA will be purchased to achieve net zero.

Design Team

Design Team selection:
The project was tendered to a number of architect-led Design Teams in line with the University's tendering process. QODA were specifically selected for their team as Sustainability and Passivhaus consultants, to address the operational energy and carbon emissions targets set in the project brief. MEP consultant with capability in energy modelling to CIBSE TM54. Certified Passivhaus Design/ Consultant (CEPH).

Carbon reporting and reduction integrated into the Design Team's scope of services:
Operational energy reporting.

Criteria for Design Team selection:
1. Team's industry leadership and engagement on Net Zero Carbon.
2. Team's previous experience on delivering net Net Zero Carbon projects in general.
3. Team's expert knowledge on Net Zero Carbon.

Delivery

Specification/procurement to reduce embodied carbon:
Partly, he embodied carbon of the structure was considered in the choice of structural frame.

Ensure delivery of Net Zero:
☑ Defined Net Zero Carbon brief.

☑ Appointed specialist consultant/s in the project.

**This does not sit with any of the main LETI or RIBA building categories, as student accommodation is intrinsically more energy intensive than residential schemes (35kWh/m2/yr LETI target).*

Case Study 03: Positive House

Project Summary

The Home of 2030 design competition invited professional teams from the housing industry to design the homes of the future. The design ideas had to be low carbon, age-friendly homes, meeting the highest standards of design, including highly energy efficient building fabric and energy systems (to meet Net Zero Carbon target). The Positive House, which is a regenerative project, i.e. absorbing more carbon than emitting over its life, was shortlisted as one of the 6 finalists.

Location
East Midlands
Building use
Residential
Status
Competition/not built
GEA
2ha
No. storeys
2-3
Type
New build
Key team members
The Positive Collective: Changebuilding, Perpendicular Architecture and Humblebee

Net Zero Brief

Low Environmental Impact – applying technology and construction techniques that will deliver net zero emissions and high quality outcomes, reduced fuel bills and improved occupant health. Energy and systems efficiencies, including low carbon technologies, which substantially reduce energy demand in line with the Government's net zero emissions target.

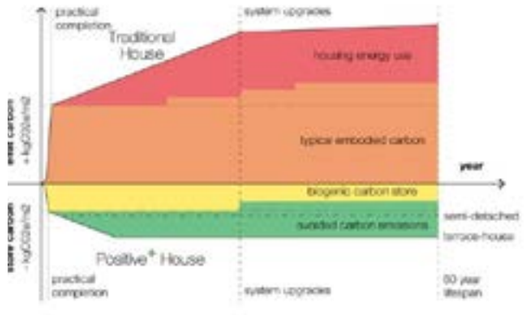
Brief defined at:
RIBA Stage 0 (Competition Stage)
Net Zero target set by:
The UK Government
Benchmarks, guidance, targets & metrics:
PHPP was used for modelling operational carbon. Embodied carbon was evaluated with and without carbon sequestration in timber products. Targets based on industry guidelines and benchmarks.
Operation vs. embodied / Whole Life Carbon: Whole life Net Zero Carbon, i.e. life cycle embodied carbon and net zero in operation.
Carbon offsetting:
Offsetting any carbon that is released at the end of the useful life of every component by managing UK home-grown forests.

Design Team

Design Team selection:
Sustainability experts with good collaboration skills.

Carbon reporting and reduction integrated into the Design Team's scope of services:
Yes.

Criteria for Design Team selection:
1. Team's expert knowledge on Net Zero Carbon.
2. Team's previous experience on delivering Net Zero Carbon projects in general.
3. Team's industry leadership and engagement on Net Zero Carbon*.
4. Team's previous experience on delivering Net Zero Carbon projects in the UK.
5. Team's own 'public' commitments / declarations on Net Zero Carbon.



Delivery

Specification/procurement to reduce embodied carbon:
Yes, most materials are biogenic, carbon-storing materials, including optimised balloon frame CLT and woodfibre insulation. The concrete slab was specified with increased GGBS proportion.

Ensure delivery of Net Zero:
☑ Appointed knowledgeable / experienced Design Team at early design stage.

☑ Allocated time and budget (for the Design Team) to include additional assessments for Net Zero Carbon.

How would the team approach the project differently now:
1. Adopt a 'shadow price' on carbon to better inform design options and decisions, based on cost and environmental performance.
2. Expand the typical scope of design / consultant team to include additional assessments to demonstrate Net Zero Carbon 'compliance'.
3. Embed Post Occupancy Evaluation (POE) as a service to ensure Net Zero Carbon is achieved in actual building's operational performance.

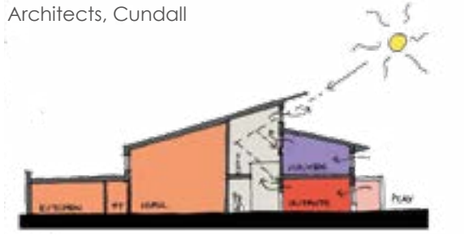
**For example involvement in the LETI, UKGBC, CIBSE, RIBA, etc. efforts on Net Zero Carbon.*

Case Study 04: Circular Twin

Project Summary

Circular Twin is a digital twinning project based on an original scheme delivered in 2017. The Circular Twin project's objective is to show that the whole life cost of a Net Zero Carbon building is not greater from the baseline (existing built asset). Utilising the full potential of digital twinning and BIM, and against the same functional requirements informing contemporary UK school design. By applying lessons learnt from past projects, challenging business as usual for all project stakeholders and enabling vertical collaboration through the supply chain, the project aims to align with the 2030 scenario set by the RIBA 2030 Climate Challenge.

Location
Digital twinning project based on Morgan Sindall's MySchool design.
Building use
Education (Primary School)
Status
Under design
GEA
2,658 m^2
No. storeys
2
Type
New build
Key team members
Scape, Morgan Sindall, HLM Architects, Lungfish Architects, Cundall



Net Zero Brief

Brief defined at:
RIBA Stage 0
Net Zero target set by:
The Client
Net Zero Carbon brief formulation:
The brief was defined in collaboration with the Design Team and definitive targets for the project were established.
Benchmarks, guidance, targets & metrics:
RIBA 2030 Climate Challenge
Shadow price on carbon:
Yes, £32/tCO_2e to £64/tCO_2e.
Operation vs. embodied / Whole Life Carbon:
Whole life Net Zero Carbon, i.e. life cycle embodied carbon and net zero in operation.
Embodied carbon targets:
500kgCO_2e/m^2 GIA, 40% reduction, A1-A5, B4, C2-C4.
Operational carbon targets:
55 kWh/m^2/yr (GIA).
Carbon offsetting:
British woodland creation is the basis for the offsetting cost range (c £50/tCO_2e).

**1For example involvement in the LETI, UKGBC, CIBSE, RIBA, etc. efforts on Net Zero Carbon.*

**2Within the Design Team time and budget was allocated to include additional assessments for Net Zero Carbon (in-house carbon assessment tool called CarboniCa which measures whole life cycle carbon at practical completion and during occupancy.*

Design Team

Design Team selection:
Spearheaded by Scape, the project team has been selected based on their collective 100+ years of experience in successfully delivering projects in the education sector, coupled with their credential in sustainable design.

Carbon reporting and reduction integrated into the Design Team's scope of services:
Yes, both operational and embodied carbon reporting.

Criteria for Design Team selection:
1. Team's expert knowledge on Net Zero Carbon.
2. Team's industry leadership and engagement on Net Zero Carbon*[1].
3. Team's previous experience on delivering Net Zero Carbon projects in the UK.
4. Team's own 'public' commitments / declarations on Net Zero Carbon.
5. Team's previous experience on delivering Net Zero Carbon projects in general.

**3 Lessons included:*
- → *Early supply chain engagement and involvement in strategic design decisions.*
- → *Design-out carbon through design.*
- → *Shortlisting and selection of applicable technologies that minimise both embodied carbon and operational energy.*
- → *Creation of clear brief and buy-in from all stakeholders.*

Delivery

Specification/procurement to reduce embodied carbon:
A methodology was developed for an early vertical collaboration with all elements of the supply chain, which heavily influenced the design decisions that were made.

Ensure delivery of Net Zero:

- ☑ Appointed knowledgeable / experienced Design Team at early design stage.
- ☑ Allocated time and budget (for the Design Team) to include additional assessments for Net Zero Carbon*[2].
- ☑ Applied lessons learnt from a previous Net Zero Carbon project into this case study*[3].

How would the team approach the project differently now:
1. Expand the typical scope of design / consultant team to include additional assessments to demonstrate Net Zero Carbon 'compliance'.
2. Engage specialist consultant/s to help formulate the (net zero) brief.
3. Engage Design Team at the RIBA Stage 0 to help formulate the (net zero) brief.
4. Embed Post Occupancy Evaluation (POE) as a service to ensure Net Zero Carbon is achieved in actual building's operational performance.
5. Adopt a 'shadow price' on carbon to better inform design options and decisions, based on cost and environmental performance.
6. Engage the design / consultant team during the RIBA Stage 1.

Case Study 05: Woodstock North

Project Summary

A master plan for 430 Passivhaus homes. Each home will have an Air Source Heat Pump, thermal store and PV solar panels. Parking barns will remove cars from the public realm, and provide electric car charging from solar panels, leaving the focus on pedestrians and cycle usage. There are extensive green areas for play and community use, food growing and SuDS.

Location
Oxfordshire
Building use
Private residential
Status
Planning submitted in January 2021
No. storeys
3
Type
New build
Key team members
Pollard Thomas Edwards , Blenheim Estates

Net Zero Brief

PTE suggested the net zero target and provided a full architectural and sustainable deign service of Passivhaus design, overheating assessments and BRE daylight and sunlight assessments. The seamless integration of the environmental approach into the design mitigates the risk of the costly changes to specification and coordination later in the process to achieve certification.

Brief defined at:
RIBA Stage 3
Net Zero target set by:
Suggested by the Architect, agreed with the Client
Benchmarks, guidance, targets & metrics:
Certified Passivhaus, Net Zero Carbon operational (LET definition), low embodied carbon – calculated as 360 $kgCO_2/m^2$. Targeting all environmental and health metrics in the RIBA 2030 challenge. The Design Team advocated the use of Passivhaus as the benchmark for the scheme based on previous experience and built evidence.
Operation vs. embodied / Whole Life Carbon: Net zero in operation.
Operational carbon targets: 35$kWh/m^2.yr$ (as per LETI guidance).
Embodied carbon targets: 360$kgCO_2/m^2$ (Upfront)

Design Team

Design Team selection:
The Design Team was made up of architects and sustainable design specialists from the PTE Knowledge Hub team. During the design process an additional sustainability specialist with a lot of energy use experience was hired to join the team.

Carbon reporting and reduction integrated into the Design Team's scope of services:
Yes. Proposed by PTE as part of their design proposal.

Criteria for Design Team selection:
1. Team's previous experience on delivering Net Zero Carbon projects in general.
2. Team's previous experience on delivering Net Zero Carbon projects in the UK.
3. Team's industry leadership and engagement on Net Zero Carbon*[1].
4. Team's expert knowledge on Net Zero Carbon.
5. Team's own 'public' commitments / declarations on Net Zero Carbon.

*[1]*For example, involvement in the LETI, UKGBC, CIBSE, RIBA, etc. efforts on Net Zero Carbon.*

Delivery

Ensure delivery of Net Zero:
- ☑ Defined Net Zero Carbon brief.
- ☑ Appointed knowledgeable / experienced Design Team at early design stage.
- ☑ Appointed specialist consultant/s in the project.
- ☑ Applied lessons learnt from a previous Net Zero Carbon project into this case study*[1].

How would the team approach the project differently now:
1. Engage the design / consultant team during the RIBA Stage 1
2. Embed Post Occupancy Evaluation (POE) as a service to ensure Net Zero Carbon is achieved in actual building's operational performance.
3. Engage specialist consultant/s to help formulate the (net zero) brief.
4. Adopt a 'shadow price' on carbon to better inform design options and decisions, based on cost and environmental performance.
5. Expand the typical scope of design / consultant team to include additional assessments to demonstrate Net Zero Carbon 'compliance'.
6. Engage Design Team at the RIBA Stage 0 to help formulate the (net zero) brief.

*[1] *'Passivhaus fabric lead approach is really important to achieve net zero from a good baseline. Without Passivhaus, we would need additional technologies to achieve net zero.'*

Case Study 06: Knights Park

Project Summary

Eddington is a new neighbourhood to the north-west of Cambridge. The new neighbourhood includes new homes, community facilities, a primary and nursery school, health centre, hotel, supermarket and shops. Knights Park includes 249 homes.

Location
Eddington, Cambridge
Building use
University student accommodation
Status
Completed in 2020
GEA
25,000m^2
No. storeys
2-5
Type
New build
Key team members
Pollard Thomas Edwards & Alison Brooks (Architects), Hill (Developer), DW Pointer & Partners (M&E), Baily Garner (Sustainability).

Net Zero Brief

The scope was to achieve Net Zero Carbon in operation to meet Code for Sustainable Homes Level 5.

Brief defined at:
RIBA Stage 2
Net Zero target set by:
The Client
Net Zero Carbon brief formulation: Net zero formed as part of Client's briefing document.
Benchmarks & guidance to identify targets & metrics:
Code for Sustainable Homes level 5, Net Zero Carbon operational is required a part of ENE01. Fabric first approach with Passivhaus principles used for guidance (not certified).
Embodied Carbon:
Code for Sustainable Homes level 5 – low embodied carbon materials.
Operational targets:
Net Zero Carbon (PV panels to provide 100% regulated energy demand on site).

Design Team

Design Team selection:
A specialist sustainability consultant was appointed to support the Design Team and ensure the delivery.

Carbon reporting and reduction integrated into the Design Team's scope of services:
Yes.

Cri**teria for Design Team selection:**
1. Team's industry leadership and engagement on Net Zero Carbon*.
1. Team's own 'public' commitments / declarations on Net Zero Carbon.
1. Team's previous experience on delivering Net Zero Carbon projects in the UK.
2. Team's expert knowledge on Net Zero Carbon.
2. Team's previous experience on delivering Net Zero Carbon projects in general.

[1]For example, involvement in the LETI, UKGBC, CIBSE, RIBA, etc. efforts on Net Zero Carbon.

Delivery

Ensure delivery of Net Zero:
☑ Defined Net Zero Carbon brief.

☑ Appointed specialist consultant/s in the project.

How would the team approach the project differently now:
1. Engage specialist consultant/s to help formulate the (net zero) brief.
2. Engage Design Team at the RIBA Stage 0 to help formulate the (net zero) brief.

A5: Sustainability Assessment & Certification Methods

Operational Energy & Carbon

LETI Targets

→ Residential Total EUI = 35 kWh/m² /yr (GIA)
→ Schools Total EUI = 65 kWh/m² /yr (GIA)
→ Commercial Offices Total EUI = 55 kWh/m² /yr (GIA)
→ Space Heating EUI = 15 kWh/m²/yr

Assessment Certification & Process Tools

→ BREEAM
→ CIBSE TM22
→ CIBSE TM54
→ Green Star (AUS)
→ Home Quality Mark (BRE)
→ LEED
→ Living Building Challenge
→ Guidance & Reference
→ Passivhaus
→ RIBA Plan for Use
→ Soft Landings

Guidance & Reference

→ LETI Climate Emergency Design Guide
→ LETI Whole Life Carbon One Pager
→ Unlocking the Delivery of Net Zero Carbon Buildings - UKGBC
→ Net Zero Carbon Buildings: A Framework Definition - UKGBC
→ TCPA Practical Guides - Guide 4: Master Planning for Net-zero Energy
→ The Building System Carbon Framework - WBCSD
→ Responsible Retrofit Guidance Wheel - STBA
→ Net Zero Carbon Pathway Framework - BBP
→ Building the Case for Net Zero:
→ A Feasibility Study into the Design, Delivery and Cost of New Net Zero Carbon Buildings - UKGBC
→ Whole Life Carbon Assessment for the Built Environment - RICS

Circular Economy & Embodied Carbon

LETI Residential Targets

→ 2020 design target (for buildings designed in 2020) a C rating should be achieved. (<500 $kgCO_2/m^2$ upfront embodied carbon and <800 $kgCO_2/m^2$ total embodied carbon)
→ 2030 design target (for buildings designed in 2030) an A rating should be achieved. (<300 $kgCO_2/m^2$ upfront embodied carbon and <450 $kgCO_2/m^2$ total embodied carbon)

→ For more typologies see https://www.leti.london/carbon alignment

Assessment Certification & Process Tools

→ BREEAM
→ Green Star (AUS)
→ Home Quality Mark (BRE)
→ LEED
→ Living Building Challenge
→ RIBA Plan for Use
→ Soft Landings

Guidance & Reference

→ LETI Embodied Carbon Primer
→ LETI Embodied Carbon Target Alignment
→ LETI Embodied Carbon One Pager
→ LETI Whole Life Carbon One Pager
→ Low Carbon Refurbishment: 10 Ways to reduce Embodied Carbon Emissions - OneClick LCA
→ Circular Economy Actor and Resource Map - UKGBC
→ Circular Economy in the Built Environment - ARUP
→ Design for a Circular Economy Primer - Mayor of London

Connectivity & Transport

Targets

→ 0 kgCO_2e/km per person/yr for the travel of occupants and visitors within the site, or from site to a local transport, retail and/or community hub (as applicable)
→ All developments design to be connected to smart technology to manage peak loads and close the performance gap.

Assessment Certification & Process Tools

→ BREEAM
→ Green Star (AUS)
→ LEED
→ Living Building Challenge
→ RIBA Plan for Use
→ Soft Landings

Water

Targets

40% reduction in potable water use/person/day
Domestic Potable Water Use:
→ 2020 - < 110 l/p/day
→ 2025 - < 95 l/p/day
→ 2030 - < 75 l/p/day
Non-Domestic Potable Water Use:
→ 2020 - < 16 l/p/day
→ 2025 - < 13 l/p/day
→ 2030 - < 10 l/p/day

Assessment Certification & Process Tools

→ BREEAM
→ Green Star (AUS)
→ LEED
→ Living Building Challenge
→ RIBA Plan for Use
→ Soft Landings

Ecology & Biodiversity

LETI Targets

→ Net Positive Species
→ Urban Greening Factor on all New Sites: 0.3 for Non-domestic and 0.4 for Residential

Assessment Certification & Process Tools

→ BREEAM
→ Green Star (AUS)
→ Home Quality Mark (BRE)
→ LEED
→ Building with Nature
→ Living Building Challenge
→ RIBA Plan for Use
→ Soft Landings

Guidance & Reference

→ Nature-based Solutions to the Climate Emergency: The Benefits to Business and Society - UKGBC
→ Spatial Planning INstruments and the Environment (SPINE) - OECD
→ BREEAM Biodiversity Credits - BRE
→ Urban Green Factor - Mayor of London
→ Urban Greening for Biodiversity Net Gain: A Design Guide - Mayor of London
→ Practical How-to Guide: Understanding Green Infrastructure at Different Scales - Barker, A., Clay, G., Morrison, R. et al, University of Manchester
→ Making the Case for Green Infrastructure: Lessons from Best Practice - UKGBC
→ Developing and Implementing a Green Infrastructure Strategy - UKGBC

Human Factors
Good Health & Wellbeing

Targets

→ Overheating: 25-28 °C maximum for 1% of Occupied Hours
→ Daylighting: > 2% average Daylight Factor, 0.4 Uniformity
→ CO_2 levels: < 900 ppm
→ Total VOCs: < 0.3 mg/m^3
→ Formaldehyde: < 0.1 mg/m^3
→ Open windows within 7m

Assessment Certification & Process Tools

→ BREEAM
→ BUS Methodology
→ CIC Design Quality Indicators
→ Green Star (AUS)
→ Home Quality Mark (BRE)
→ LEED
→ CIBSE TM59 and CIBSE TM52
→ Living Building Challenge
→ Leesman Index
→ NABERS
→ Passivhaus
→ WELL Building Standard
→ RIBA Plan for Use
→ Soft Landings

Human Factors
Sustainable Cities & Communities

Assessment Certification & Process Tools

→ BREEAM
→ Green Star (AUS)
→ Home Quality Mark (BRE)
→ LEED
→ Living Building Challenge
→ RIBA Social Value Toolkit
→ RIBA Plan for Use
→ Soft Landings

Guidance & Reference

→ LEED ND
→ Well Community
→ BREEAM Communities
→ RIBA Social Value Toolkit

Human Factors
Sustainable Life Cycle

Targets

→ Operation costs per area (£/m^2) compared with the return on investment value created by the project, (including rental value, building value and social value)

Assessment Certification & Process Tools

→ LEED
→ Living Building Challenge
→ RIBA Social Value Toolkit
→ RIBA Plan for Use
→ Soft Landings

A6: Holistic Sustainability Criteria

Underpinned by the UN Sustainable Development Goals for 2030, and developed in consultation with over 530 individuals, and currently supported by more than 90 international organisations, the Climate Framework Initiative is a trans-disciplinary effort aiming to unite buildings and construction industry, as well as academia for upskilling and building collective capacity for climate action.

A key output of this Initiative is a shared curriculum framework, outlining all the core concepts - described in detailed topics (pages 14-17) - to be considered and embraced in order to holistically and effectively mitigate adverse impacts of climate change.

Throughout this Guide, the Climate Framework topics have been adopted and referenced to defined the holistic sustainability criteria for the built environment.

The RIBA Sustainable Outcomes Guide is additionally referenced to bring in the various targets and strategies that the project teams should consider and implement in order to deliver on holistic outcomes.

Human Factors

Circular Economy

Energy & Carbon

Ecology & Biodiversity

Water

Connectivity & Transport

(Overarching Topics of the Climate Framework)

A7: Carbon Definitions

The 'Carbon Definitions for the Built Environment, Buildings and Infrastructure' provides a common set of definitions that has been developed by the Whole Life Carbon Network (WLCN) in collaboration with LETI to align definitions, scopes, measurement methodologies and targets.

Whole Life Carbon =
Operational Carbon + Embodied Carbon

A8: The Scale of Change needed for Net Zero Carbon Buildings

The scale of change needed, from each discipline, to deliver a systemic change across the design and delivery of Net Zero Carbon buildings are summarised here.

Architects must design buildings in line with Net Zero Carbon requirements - they must understand the impact their decisions have, for design and specifications, on operational and embodied carbon. In particular, architects must understand the relevance of climate responsive design, and the role of form and orientation play in minimising overheating and reducing the need for mechanical cooling. Their decisions on complex facade designs with a lot of surface area, large grid spans, and basements would also influence embodied carbon outcome of a building as projects that include these would demand a relatively high carbon facade and structural designs.

Structural engineers must advocate for Net Zero Carbon structural design - one that promotes the benefits of retrofit, and reuse of existing materials, harnesses low carbon materials, and identifies 'lean' design principles (including appropriate safety margins and reducing sacrificial finishes).

Building services engineers must ensure that Net Zero Carbon in design is followed through to completion. They must provide passive and active design guidance, design out unnecessary equipment, effectively manage peak demand, and ensure building operation is fully communicated to occupants upon completion.

Cost consultants must embrace life cycle cost analysis, rather than using simple capital cost estimates. They must communicate cost alongside value, helping manage risks and deliver affordable Net Zero Carbon buildings.

Contractors and construction managers must work with the Design Team and the Client to avoid unilateral product substitution: establishing electrical supply early to reduce the need for diesel generators for instance, can significantly minimise a project's on-site carbon emissions.

Facilities managers should contribute to the design process to ensure that it is operable and maintainable, and that building elements can be replaced without undue disruption.

Landscape architects should contribute to the design process to ensure that landscape design enhances biodiversity, reduces outdoor water use, and contributes to the overall outdoor/indoor comfort by meaningfully integrating planting to support passive design principles of that building/project.

Occupants should learn how to best use the building, and would be advised to consult with the design and construction teams before making major changes (i.e. fit-outs or operational changes to building systems, for instance).

(As part of their briefs, Clients can specify a "Occupant/Tenant Design and User Guidelines" to help raise awareness on the building's various features, and how it is intended to be used. Smart meters and data sharing of a building's in-use performance can additionally help inform occupants live on whether the building is appropriately operated/used).

A9: List of Resources

LETI Climate Emergency Design Guide provides an overview of how new buildings need to be designed to meet the UK's climate change targets.

LETI Embodied Carbon Primer offers supplementary guidance (to what is provided within the LETI Climate Emergency Design guide) on embodied carbon reduction strategies and calculations.

UKGBC Net Zero Carbon Buildings: A Framework Definition outlines an overarching framework for implementing key strategies and metrics within businesses, as well as policy to accelerate the transition to a Net Zero Carbon built environment.

UKGBC Building the Case for Net Zero Carbon presents a feasibility study of design, delivery and cost of new, Net Zero Carbon residential and commercial buildings in the UK.

UKGBC Unlocking the Delivery of Net Zero Carbon Buildings

A new book "Energy / People / Buildings: Making sustainable architecture work" by Kimpian, Hartman and Pelsmakers (RIBA 2021) promotes the use of a 'Building Performance Register' "to track all the elements of a building that impact energy performance at key milestones of a project, and [to demonstrate] how these milestones are going to be achieved, unaffected by value-engineering".

To help with measuring and recording performance at each stage in the process, a free to download "Building Performance Evaluation Guide" has been produced by Julie Godefroy and Susie Diamond (with the Good Homes Alliance for Wood Knowledge Wales) with a simple one-page summary 'Client Sheet'.

The Construction Leadership Council (CLC) has recently published "The Construction Playbook", which aims to transform public procurement, and is fully endorsed by the UK Government (i.e. BEIS).

Pinsent Masons produced two reports as part of its 'collaborative construction' research, concluding that decisive leadership and an overhaul of contractual structures, procurement processes and behaviours are crucial to embracing collaborative practices and resultant industry efficiency.

A10: Definitions

Biogenic Carbon: Emissions are those that originate from biological sources such as plants, trees, and soil.

Carbon Factor: It is the factor that is applied to electricity that is consumed by buildings, to understand that carbon emissions associated with the electricity use. The carbon factor of the UK grid changes throughout the day and the seasons depending on how much renewable energy is being generated.

Carbon Sequestration: A natural or artificial process by which carbon dioxide is removed from the atmosphere and held in solid or liquid form, e.g. reforestation or, in the built environment through using timber.

Circular Economy: A Circular Economy is an industrial system that is restorative or regenerative by intention and design. It replaces the linear economy and its 'End-of-Life' concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals and aims for the elimination of waste through the design of materials, products, systems

Cradle-to-Cradle: Goes beyond 'cradle to grave' and conforms more to the model of the Circular Economy. In a cradle to cradle model products would be designed in a way so that at the end of their initial life they can be readily reused, or recycled, and therefore avoid landfill altogether. [1]

Cradle-to-Gate: A boundary condition associated with embodied carbon, carbon footprint and LCA studies. It considers all activities starting with the extraction of materials from the earth (the cradle), their transportation, refining, processing and fabrication activities until the material or product is ready to leave the factory gate. See also embodied carbon. [1]

Cradle-to-Grave: A boundary condition associated with embodied carbon, carbon footprint and LCA studies. It includes the cradle to site results but also includes the GHG emissions associated with the in use of the material or product (maintenance) and the End-of-Life (disposal, reuse, recycling). [1]

Embodied Carbon (EC): The 'Embodied Carbon' emissions of an asset are the total GHG emissions and removals associated with materials and construction processes throughout the whole life cycle of an asset (Modules A1-A5, B1-B5, C1-C4). [2]

Embodied carbon (EE): The total primary energy consumed (e.g. in MJ) from direct and indirect processes associated with the production of a product or system. This is considered within the boundaries of cradle-to-gate.

Energy Budget: A specific target for Energy Use Intensity (EUI) that LETI believe developments must not exceed in order to achieve Net Zero Carbon, as demonstrated through archetypes. See also top-down modelling.

Energy Use Intensity (EUI): The Energy Use Intensity (EUI) is an annual measure of the total energy consumed in a building. LETI believes that setting an EUI requirement for new buildings is fundamental to meeting our climate change targets. It is a good indicator for building performance as the metric is solely dependent on how the building performs in-use; rather than carbon emissions, which also reflect the carbon intensity of the grid.

EUI is a metric that can be estimated at the design stage and very easily monitored in-use as energy bills are based on kWh of energy used by the building. This metric can be used to compare buildings of a similar type, to understand how well the building performs in-use. It includes all of the energy consumed in the building, such as regulated energy (heating, hot water, cooling, ventilation, and lighting) and unregulated energy (plug loads and equipment e.g. kitchen white goods, ICT/AV equipment). It does not include charging of electric vehicles.

Fossil Fuel: A natural fuel such as petroleum, coal or gas, formed in the geological past from the remains of living organisms. The burning of fossil fuels by humans is the largest source of emissions of carbon dioxide,

Life Cycle Assessment: A multi-step procedure to quantify carbon emissions (embodied and operational) and other environmental impacts (such as acidification and eutrophication) through the life stages of a building. The EN15978 standard is typically used to define the different life cycle stages A1-3 ('Cradle-to-Gate'), A1-3 + A4-5 ('Cradle-to-Practical Completion of Works'), B1-5 ('Use'), C1-4 ('End-of-Life'), D ('Supplemental'), In the case of Whole Life Carbon, an LCA assesses greenhouses gas emissions measured in carbon dioxide equivalent to also include Global Warming Potential (GWP). Thus the use of predicted CO_2 data across the Life Cycle Stages relevant to the particular development allows comparisons of different options in relation to impact on Whole Life Carbon as well as demonstrating that a certain level of carbon emission reductions have been met at design stage.[3]

Net Zero Embodied Carbon: A 'Net Zero Embodied Carbon' asset is one where the sum total of GHG emissions and removals over an asset's life cycle (Modules A1-A5, B1-B5 and C1-C4) are minimized, meets local carbon targets* (e.g.kgCO_2e/m^2), and with additional 'offsets', equals zero. [2]

Net Zero Carbon - Operational Energy: A 'Net Zero Carbon – Operational Energy' asset is one where no fossil fuels are used, all energy use (Module B6) has been minimized, meets the local energy use target (e.g. kWh/m^2/yr) and all energy use is generated on- or off- site using renewables that demonstrate additionality. Any residual direct or indirect emissions from energy generation and distribution are 'offset'. [2]

Net Zero Upfront Carbon: A 'Net Zero Upfront Carbon' asset is one where the sum total of GHG emissions, excluding 'carbon sequestration', from Modules A1-A5 is minimized, meets local carbon targets* (e.g.kgCO_2e/m^2), and with additional 'offsets', equals zero. [2]

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 A1-A5, B1-B7, C1-C4) are minimized, meet local carbon*, energy and water targets, and with residual 'offsets', equals zero.[2]

*Use the Embodied Carbon Target Alignment document to target a rating. For the time being current best-practice performance for projects in the early design phase is considered to be a C rating, while a B and above is considered a robust stretch target.

Offsetting: Offsetting is the process of compensating for the remaining carbon emissions balance by contributing, usually financially, towards solutions to reduce emissions elsewhere. Typically, this is put in practice by establishing carbon offset funds which then invest in renewable energy and other carbon reduction measures. See Appendix 10 of the LETI Embodied Carbon Primer for more information.

Operational Carbon ($kgCO_2e$): 'Operational Carbon – Energy' (Module B6) is the GHG emissions arising from all energy consumed by an asset in-use, over its life cycle. [2]

Performance Gap: This term refers to the discrepancy between energy predictions at design stage, compared to in-use energy consumption of buildings.

Post-Occupancy Evaluation (POE): Post-occupancy evaluation is the process of obtaining feedback on a building's performance in use after it has been built and occupied. By accurately measuring factors such as building use, energy consumption, maintenance costs and user satisfaction, POE allows for a process of continuous improvement in the construction industry.[4]

Renewable Energy: Renewable energy technologies use natural energy sources to generate electricity and/or heating/cooling. Sources include solar, wind, wave, marine, hydro, etc..

Soft Landings Framework: The term Soft Landings refers to a strategy designed to make an easy transition from the construction to occupation phases of a project with the overriding aim of realising optimal operational performance. It's all about narrowing the performance gap between design intent and operational outcomes that can emerge at any stage in a construction project. [5]

Upfront Embodied Carbon: 'Upfront Carbon' emissions are the GHG emissions associated with materials and construction processes up to practical completion (Modules A1-A5). Upfront carbon excludes the biogenic carbon sequestered in the installed products at practical completion.[2]

U-Value: the rate of transfer of heat through a structure (which can be a single material or a composite), divided by the difference in temperature across that structure. The units of measurement are $W/m^2.K$.

Whole Life Carbon (WLC): 'Whole Life Carbon' emissions are the sum total of all asset related GHG emissions and removals, both operational and embodied over the life cycle of an asset including its disposal (Modules: A1-A5; B1-B7 (plus B8 and B9 for Infrastructure only); C1-C4). Overall Whole Life Carbon asset performance includes separately reporting the potential benefit from future energy recovery, reuse, and recycling (Module D).[2]

References:

1 www.circularecology.com

2 Improving Consistency in Whole Life Carbon Assessment and Reporting; Carbon Definitions for the Built Environment, Buildings and Infrastructure (https://www.leti.london/carbonalignment)

3 Athena, Sustainable Material Institute Definition

4 RIBA POE Primer (https://www.architecture.com/-/media/gathercontent/post-occupancy-evaluation/additional-documents/ribapoebpeprimerpdf.pdf)

5 NBS (www.thenbs.com)

A11: Abbreviations

BBP	Better Buildings Partnership
BIM	Building Information Modelling
BMS	Building Management System
BRE	Building Research Establishment
BREEAM	Building Research Establishment Environmental Assessment Method
BUS	Building Use Studies
CABE	Chartered Association of Building Engineers
CIBSE	Chartered Institution of Building Services Engineers
CLT	Cross Laminated Timber
CO_2	Carbon Dioxide
COP	Coefficient of performance
DEC	Display Energy Certificate
EC	Embodied Carbon
EPC	Energy Performance Certificate
ESG	Environmental, Social, and Governance
EUI	Energy Use Intensity
EoL	End-of-Life
FF&E	Furniture, Fixtures, and Equipment
FSC	Forest Stewardship Council
GHG	Greenhouse Gases
GIA	Gross Internal Area
GLA	Greater London Authority
GWP	Global Warming Potential
HQ	Headquarters
IPI	Integrated Project Insurance
LCA	Life Cycle Assessment
LETI	London Energy Transformation Initiative
MEP	Mechanical, Electrical and Public Health
MVHR	Mechanical Ventilation with Heat Recovery
NABERS	National Australian Built Environment Rating System
NBS	National Building Specification
O&M	Operation and Maintenance
PHPP	Passivhaus Planning Package
PI	Professional Indemnity
POE	Post Occupancy Evaluation
PV	Photovoltaic Panels
QS	Quantity Surveyor
RFI	Request for Information
RIBA	Royal Institute of British Architects
RICS	Royal Institute of Chartered Surveyors
SuDS	Sustainable Urban Drainage
UKGBC	United Kingdom Green Building Council
UN	United Nations
WorldGBC	World Green Building Council
WLC	Whole Life Carbon
WLCN	Whole Life Carbon Network
ZC	Net Zero Carbon

A12: Acknowledgements

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This is a climate emergency.

More than ever, the urgency of the climate and ecological crises means that there is greater pressure and expectation for all organisations to transform their value chains to mitigate risks, and harness opportunities that address their key impacts on the climate, natural and social systems.

Following on from the LETI Climate Emergency Design Guide and Embodied Carbon Primer, the LETI Client Guide for Net Zero Carbon Buildings has been produced to help Clients understand the value of Net Zero Carbon buildings, and how to specify Net Zero Carbon in their projects.

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