Sustainability Design Guide

Part 1 – Introduction

REVISION SUMMARY

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CONTENTS

RELATIONSHIP WITH OTHER DOCUMENTS AND PROCEDURES 4
INTRODUCTION AND BACKGROUND 5
OVERARCHING OBJECTIVES 6
SUSTAINABILITY DESIGN GUIDE 7
Purpose of this Guide 7
Implementation Plan 7
How to use this Guide 7
DEFINITION OF TERMS 8
NET ZERO CARBON 9
OPERATIONAL ENERGY AND CARBON 10
EMBODIED CARBON AND CONSTRUCTION CARBON 11
NET ZERO EMBODIED CARBON 12
WHOLE LIFE NET ZERO CARBON 13

RELATIONSHIP WITH OTHER DOCUMENTS AND PROCEDURES

Relationship with other documents and procedures

This document is designed to complement The University of Exeter procedures, specifications, guidance, and templates. The contents and requirements are also reflected and embedded throughout relevant Estate Services documentation. The following University of Exeter sustainability documents, available via the University of Exeter website, are of particular relevance:

Environmental Sustainability Policy

Environment and Climate Emergency Policy Statement

Environment and Climate Emergency Working Group White Paper

Non-Exeter documents

The following external documents have also been used to inform specific targets and requirements, notably with regard to net zero carbon buildings:

United Nations – Sustainable development goals

UKGBC – Net Zero Carbon Buildings: A Framework Definition

LETI – Climate Emergency Design Guide

LETI – Embodied Carbon Primer

LETI – Client guide for Net Zero Carbon Buildings

RIBA 2030 Climate Challenge

RIBA Plan of Work 2020

RIBA Sustainable Outcomes Guide

RIBA Embodied and whole life carbon assessment

Passivhaus and EnerPHit Criteria

EuroPHit Guidance

RICS whole life carbon assessment for the built environment

UKGBC - Circular economy guidance for construction clients

INTRODUCTION AND BACKGROUND

The target audience for this Sustainability Design Guide are Project Managers, Design Teams and Contractors who will all be involved in developing University capital projects, providing the framework to achieve carbon zero on projects and deliver wider sustainability benefits.

This framework has been developed in response to The Environment and Climate Emergency (E&CE) Policy Statement (agreed March 2022) that declared all campus activities and operations shall have a carbon net zero impact and/or result in environmental gain by 2030.

This document is designed to cater for all Capital projects, with project teams encouraged to consider all carbon emissions associated with all scopes 1,2 and 3. This will have a significant impact by reducing the associated carbon emissions for the Universities overall carbon footprint.

The University of Exeter has an ongoing commitment to reducing carbon emissions that is continuously developing Low Carbon Commitment plan.

The University has now elected to promote the Passivhaus methodology to guide its projects and the design guidance in this document supports the delivery of the new framework change and summarises expectations.

OVERARCHING OBJECTIVES

The overall objective of this guide is to enable the implementation of carbon net zero as set out in the Environment and Climate Emergency Policy Statement.

Summary of Policy Goals and Timeline

Goal 1.

To be carbon neutral (net zero) for scope 1 and 2 emissions[1] by 2030 via a front-loaded approach.

Goal 2.

To ensure we have data analytics so that we can reduce scope 3 emissions-with a plan to reach net zero by 2030 publically communicated~~.~~

Goal 3.

To pursue a policy of 'environmental net gain' on our estates, and to use our research and education to deliver environmental net gain within region, country and across the globe.

Goal 4.

To be recognised as an Environment and Sustainability leader across the University sector, nationally and internationally by 2025, and first in the Russell Group Universities in key sustainability benchmarks.

[1] **Scope 1** emissions from sources that are owned or controlled (e.g., fuel combustion, company vehicles, fugitive emissions)
Scope 2 emissions linked to purchased electricity, heat & steam
Scope 3 all other indirect emissions (e.g., purchased goods & services, sold products, transportation (up & down stream) business travel, commuting, waste, investments, leased assets & franchises)

SUSTAINABILITY DESIGN GUIDE

Purpose of this Guide

This sustainability guide has been created to show a clear pathway for all parties whether it is a minor works project carried out by the maintenance team or a large new build scheme with a full design team.

The climate emergency commitment means that all decisions big and small will have a financial/carbon cost associated with them. The reason for this is because all decisions will have an impact on the overall carbon emissions which the University will need to account for.

It is important to note that projects will not be signed off if the design guide is not followed and a checklist process has been put in place to make sure this happens (throughout all RIBA design stages). If any derogations are required a full justification including the associated carbon and a life cycle costs assessment will be required to allow the university to make an informed decision.

Implementation Plan

The approach for achieving the University's Zero Carbon Target will guide decisions on the design and construction of new builds, the refurbishments and minor works that will be carried out on existing buildings and the phasing of the different projects. The overall University's Strategy will of course have to take account of the other concerns such as requirements for academic and student living spaces, maintaining the heritage of the properties and the cost of works. However, the Zero Carbon strategy will form a key part of this.

To achieve these zero-carbon targets, the University will adopt Whole Life Carbon (WLC) Assessments for all capital projects. The Passivhaus standard will be achieved on all new builds as a minimum and EuroPHit guidelines will be used to apply EnerPHit standards on all refurbishments and fitouts. All capital projects must aim for these standards.

As well as achieving reductions in energy consumption and the resulting carbon emissions through the implementation of the Passivhaus and Enerphit standards, the WLC Assessments must be executed to reduce the embedded carbon associated with scope 3 to help the University achieve net zero carbon by 2030.

These WLC Assessments enable understanding of the lifetime consequences of design decisions. This promotes durability, resource efficiency, reuse, and future adaptability, all of which contribute to life-time carbon reductions.

How to use this Guide

This document provides key Sustainability decisions and guidance for Carbon Net Zero design and compliance at each RIBA stage.

An example of what this looks like is shown below, the Project Team should follow the guidance by each RIBA stage to ensure nothing is missed.

The following sections will give a brief introduction to the Sustainability and Design categories to introduce the design and carbon recording processes that need to be followed to comply with this document.

	RIBA Stage 0: Strategic Definition
Outcome	**Confirm the Client Requirements**
Whole Life Carbon Assessment	
Biodiversity	
Net Zero Operational Energy	
Light and Daylight	
Thermal Comfort	
Indoor Air Quality	
Water	
Low and Zero Carbon Technologies	
Environmental Net Gains	
Carbon Reporting (measurement and verification)	

Description of RIBA Stage and desired outcome

Key Sustainability decisions and guidelines for Carbon Zero Design by category

Sustainability and Design categories for project

Figure 1: Example of Sustainability Design Guide format by RIBA Stage

DEFINITION OF TERMS

The University of Exeter Environment and Climate Emergency Policy Statement and Low Carbon Commitment express carbon reduction goals in terms of scope 1, 2, and 3 emissions.

Scope 1.

All Direct Emissions From the activities of an organisation or under their control. This includes fuel combustion on site, from owned vehicles and fugitive emissions. Examples include fleet vehicles, gas emissions from boilers and air-conditioning refrigerant leaks.

Scope 2.

Indirect Emissions From electricity purchased and used by the organisation. Emissions will be created during the production of the energy and eventually used by the organisation. Includes electricity from energy supplier to power computers, heating, and cooling.

Scope 3.

All Other Indirect Emissions From activities of the organisation but occur from sources that they do not own or control. This is usually the largest share of the carbon footprint, especially for the University sector, covering emissions associated with business travel, procurement, waste, and water.

Note

Scope 3 emissions account for the largest proportion of the universities carbon emissions. Although these emissions are also not in the university's full control as they are influenced by the current supply chain they are required to be addressed as part of the Guide. The preferred approach for scope 3 is to have a preferred supplier list that is broken down into three categories:

Category A: Suppliers that offer zero carbon products or services and can account for all their carbon emissions associated with their products or services.

Category B: Suppliers that can account for all their carbon emissions associated with their products or services.

Category C: Suppliers who cannot provide carbon information.

The idea being that when a choice needs to be made between two like for like products or services the category A suppliers would be the preferred choice. This would also need to be integrated into any Value Engineering or cost reduction process.

By having these categories, the University is not excluding any suppliers that we may need but giving them an incentive to improve the carbon reporting and carbon emissions compared to their competitors.

NET ZERO CARBON

This Sustainability Design Guide provides a framework for achieving Net Zero Carbon relevant to all capital project types and sizes, this framework addresses Scope 1 ,2 and 3 emissions for all building projects. For Scope 3 emissions the University is developing additional policy and strategies on how to monitor and report on the more difficult items such as procurement.

The design guide has been based on the UK Green Building Councils - Net Zero Carbon Buildings: A framework definition.

The framework definition:

- Define net zero carbon targets
- Reduce operational energy use
- Reduce construction impacts
- Increase renewable energy supply
- Account for any remaining residual carbon

  This process will use a whole life net zero carbon process to capture operational, embodied and end of life carbon.

Note

Scope 1 and Scope 2 emissions are within direct control of the University decision making processes, the prospect of reaching the 2030 net zero carbon target will only be achieved with Project Teams following the guidance in this document.

Scope 3 emissions are from indirect sources and heavily rely on the collaboration and cooperation of the University supply chains. The procurement of materials and products for capital projects will be undertaken following guidance in document link.

OPERATIONAL ENERGY AND CARBON

The source of most of the Scope 1 and Scope 2 emissions.

Harmful emissions associated with operational energy refers to the carbon dioxide and other greenhouse gases which are emitted as a result of the buildings energy use. This typically includes emissions associated with heating, hot water, cooling, ventilation, and lighting systems, as well as energy used for cooking and specialist equipment such as lifts.

Net zero operational carbon

A building with net zero operation carbon is achieved when a building's total annual net emissions equal zero, that is powered by renewable energy, and achieves a level of energy performance in-use in line with the UK's national climate change targets. Any further carbon impacts that cannot be achieved this way are finally balanced with additional carbon credits. This means that an operational carbon balance is met.

A net zero carbon building is highly energy efficient and powered from on-site and/or off-site renewable energy sources, with any remaining carbon balance offset.

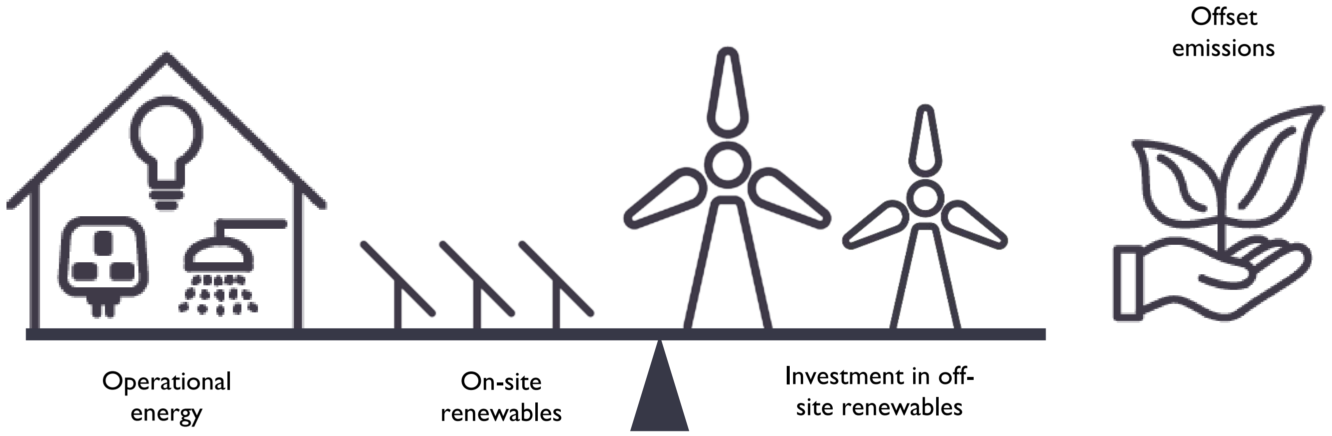


Figure 2: Net zero operational balance

EMBODIED CARBON AND CONSTRUCTION CARBON

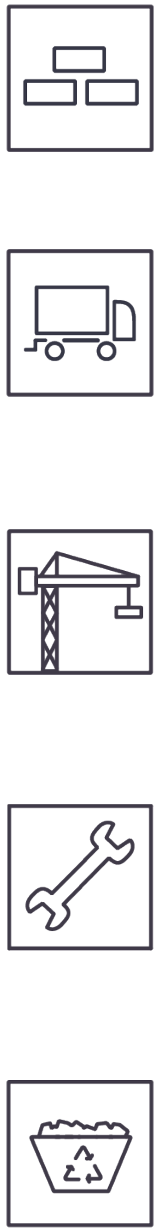
Products

Transport

Construction

Maintenance and Repairment

End of Life Disposal



Addressing the impacts of the carbon emissions related to the construction phase of a project is known as Embodied Carbon or Construction Carbon. This carbon is associated with the manufacturing and transportation process of materials used in the construction phase, and once the building has come to the end of its life, the material resources are potentially still available for re-use. Here we begin thinking of the project's whole life and consider the resources as a carbon store for future availability or disposal.

These are all considered to be Scope 3 emissions and are currently challenging to measure; however, a modelled assessment of impacts should still be carried out. This assessment is called a Whole Life Carbon Assessment and is valuable to inform early design decisions which aim to minimise the building's Whole Life Carbon impacts.

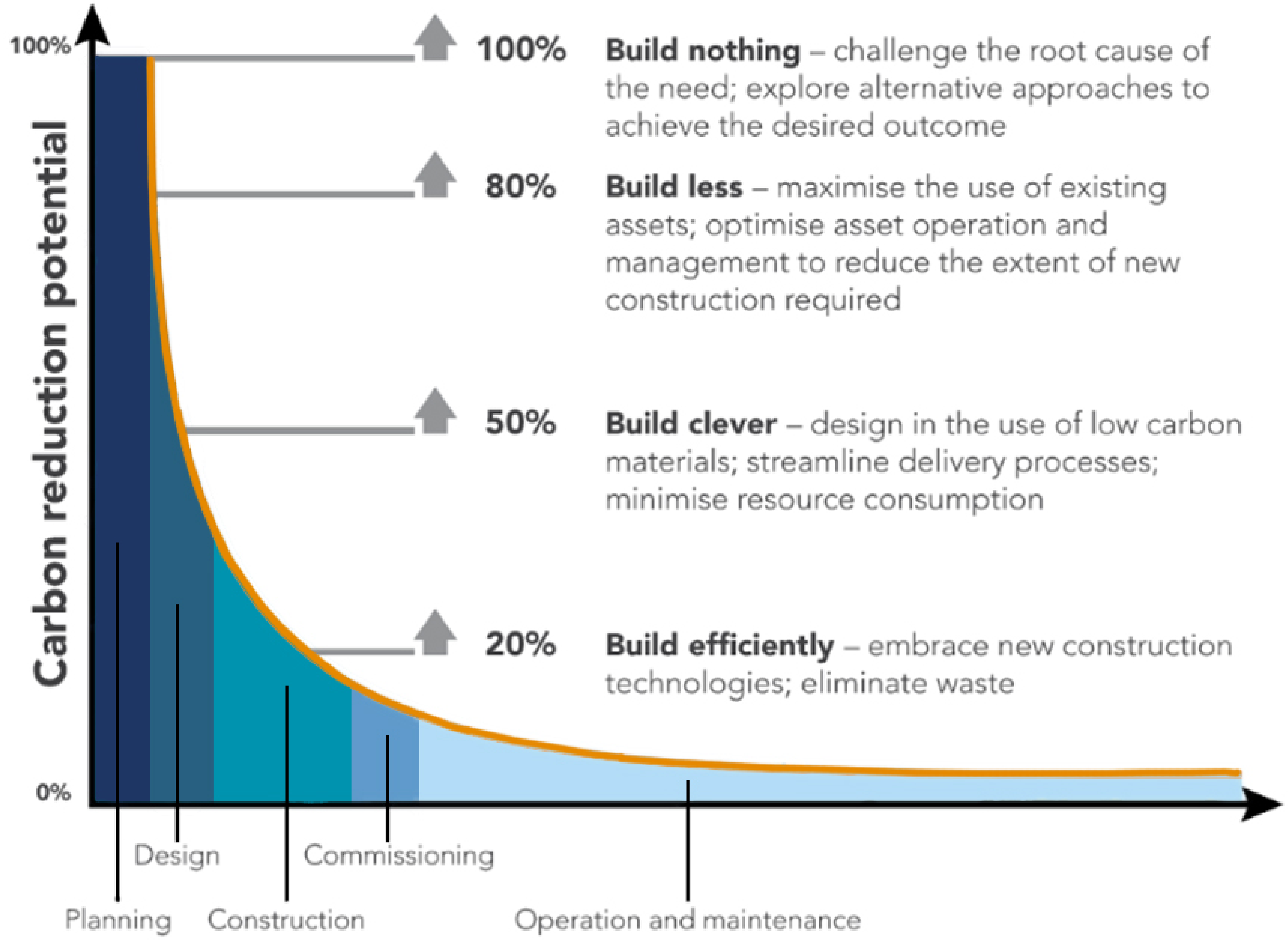
Embodied Carbon: The carbon emissions emitted producing a building's materials, their transport, and installation on site, as well as their disposal at end life.

NET ZERO EMBODIED CARBON

Projects aiming to achieve net zero carbon for construction should address all embodied impacts from the building's product and construction stages up to practical completion.

Updating The Whole Life Carbon Assessment throughout the project will help inform decisions to achieve Net Zero Carbon.

The residual carbon to be offset for Net Zero Carbon should be determined through the Whole Life Carbon assessment undertaken at the point of completion.



2.2 The embodied carbon impacts from the product and construction stages sould be measured and offset at practical completion.

Figure 3: Embodied carbon reduction potential at different stages of a building project

WHOLE LIFE NET ZERO CARBON

A building that is whole life net zero carbon meets the operational zero carbon balance and 100% of its construction materials and products are made up from re-used materials and the building is designed to disassemble such that materials and products can be re-used in future buildings.

In the future, when construction, transport and disassembly is carried out with renewable energy there will be zero carbon emissions associated with the embodied carbon.

Whole Life Net Zero Carbon for projects needs to be developed in detail over the next few years. At present, due to current limitations in the reporting of carbon from all stages of the lifecycle of materials and products used in construction, this approach is not expected to be delivered in full.

The Circular Economy principles and end-of-life material stages (Module D) are in development and will be adopted over the coming years.

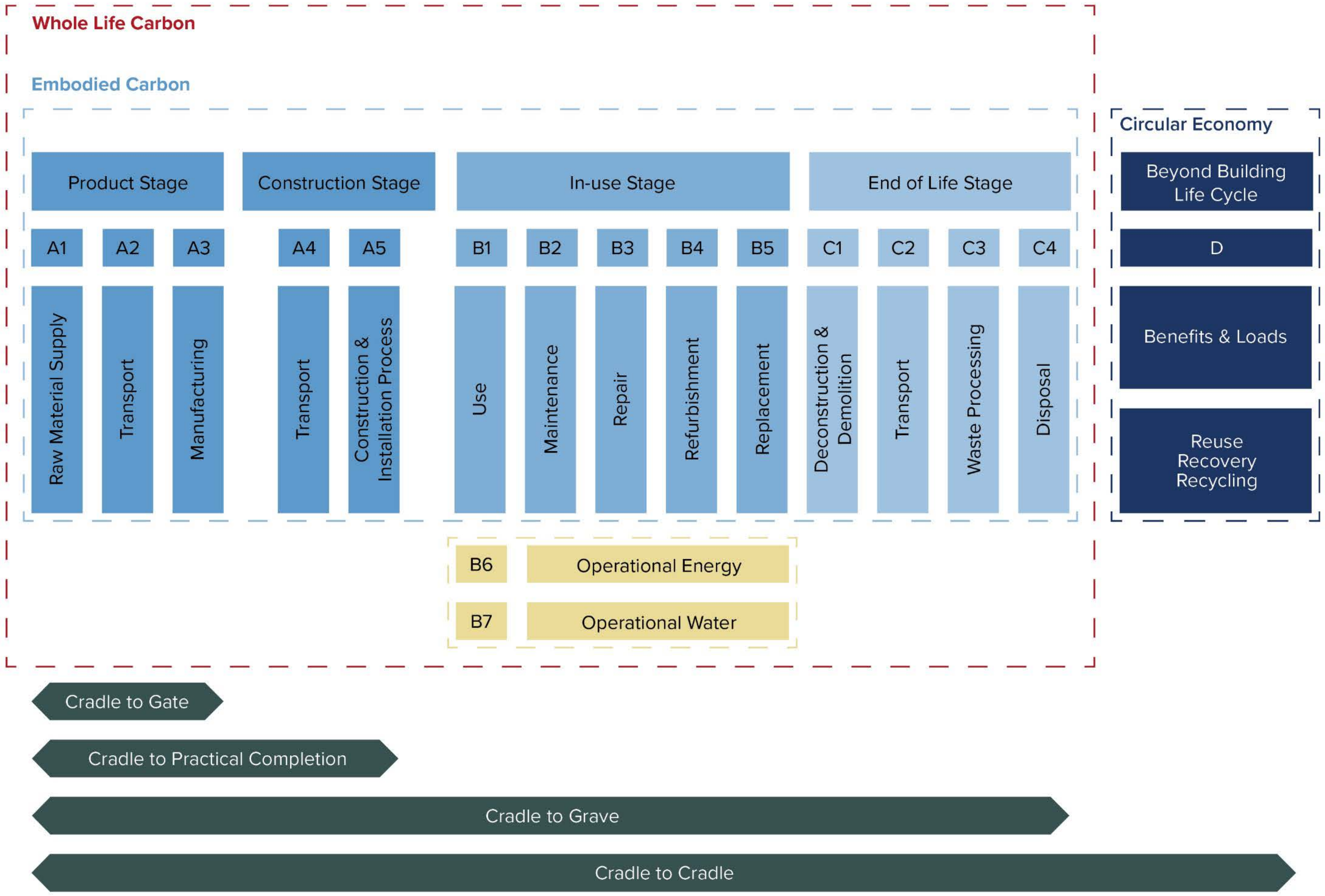


Figure 4: **shows the system boundaries for carbon accounting in the construction industry that will be used for Whole Life Carbon assessments**

Figure 5 shows the construction industry system boundaries for carbon accounting in an illustration that shows the material flow from cradle to cradle, with the idea that the circular economy will complete the material life cycle to achieve Whole Life Net Zero Carbon for projects.

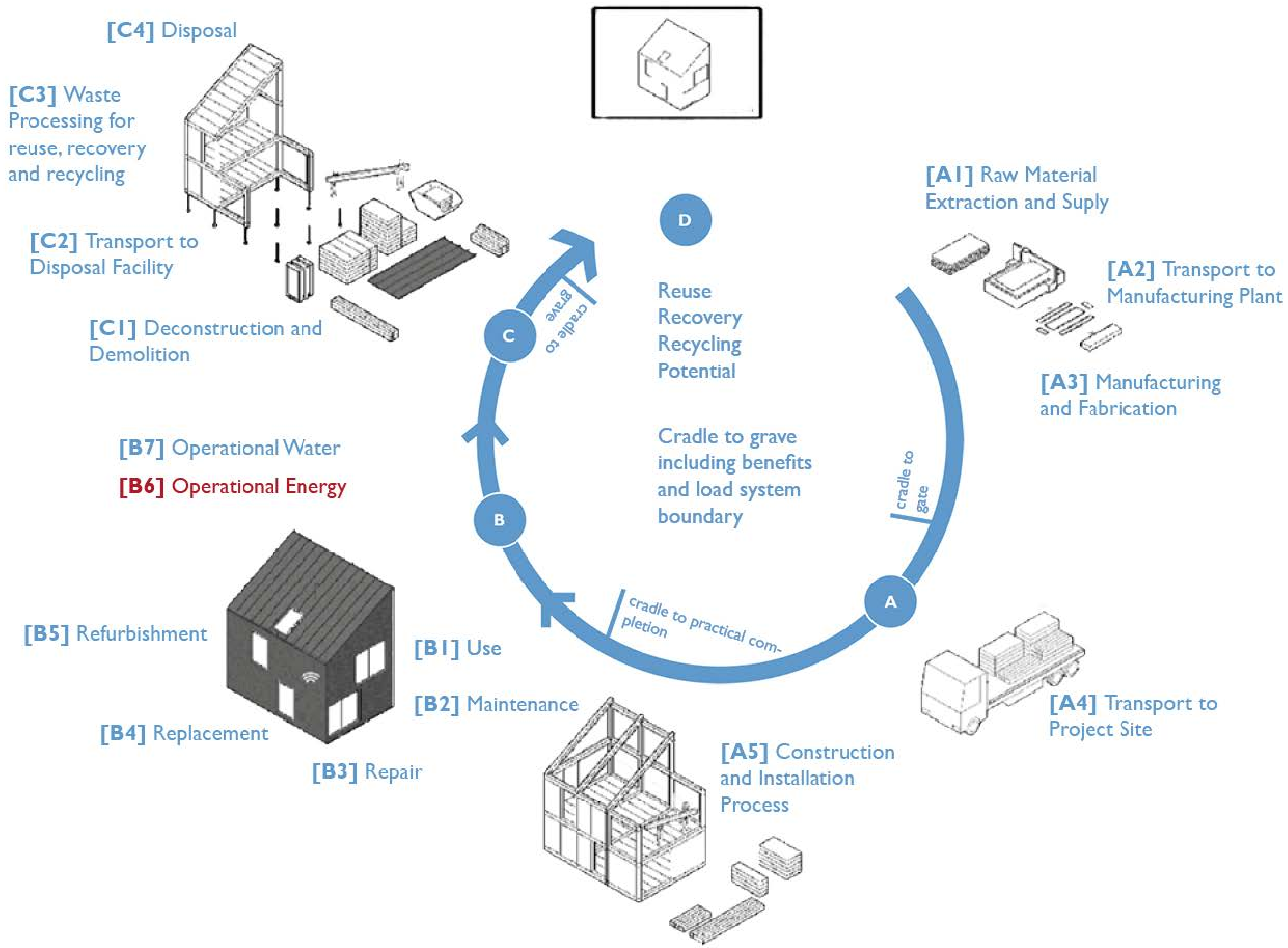


Figure 5: Illustration of carbon system boundaries for construction life cycle assessment

Sustainability Design Guide

Part 2 – Sustainability Measures

REVISION SUMMARY

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Part 2 Draft	Oliver Fuller		24.05.21
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CONTENTS

INTRODUCTION 18
DESIGN TOPICS TO BE CONSIDERED AT EACH RIBA STAGE 19
RIBA STAGES CHECKLIST FOR PROJECT IMPLEMENTATION 20
WHOLE LIFE CARBON ASSESSMENT 21
WHOLE LIFE CARBON REPORTING TEMPLATE 24
LIFE CYCLE COST ANALYSIS 28
WHOLE LIFE NET ZERO CARBON EMISSIONS 29
NET ZERO OPERATIONAL ENERGY 30
NET ENVIRONMENTAL GAIN - BIODIVERSITY 32
SKA RATING 35
WELLNESS 37
LIGHT AND DAYLIGHT 38
THERMAL COMFORT 39
SUMMER COMFORT CRITERIA 41
WINTER COMFORT CRITERIA 41
INDOOR AIR QUALITY 42
WATER 44
WATER CONSUMPTION 45
MATERIALS 46
LOW AND ZERO CARBON TECHNOLOGIES 47
ENVIRONMENTAL NET GAIN – RESIDUAL CARBON 48
Part 1: Residual Carbon from Operational Energy 48
Part 2: Residual Carbon from Embodied Carbon 49
CARBON REPORTING 50
SOFT LANDINGS 51
CIRCULAR ECONOMY 53

INTRODUCTION

Part 2 of the sustainability guide provides the descriptions and guidance for the **key sustainability measures** that will need to be implemented as part of any proposed project.

Part 2 needs to be read in conjunction with Part 1 of the sustainability design guide as well as the relevant new build, refurbishment, and minor works Parts of the sustainability guide.

DESIGN TOPICS TO BE CONSIDERED AT EACH RIBA STAGE

The following sections identify the descriptions and guidance for the key sustainability measures that need to be implemented. The table adjacent shows an overview of the sustainability measures identified.

Whole Life Carbon Assessment	Page 21	Guidance on conducting whole life carbon assessments
Whole Life Carbon Reporting Template	Page 24	Whole life carbon reporting template to be used
Life Cycle Costing	Page 28	
Whole Life Carbon Net Zero Emissions	Page 29	
Net Zero Operational Energy	Page 30	Guidance on net zero operational energy using Passivhaus framework
Net Environmental Gain (Biodiversity)	Page 32	Guidance on targets for net environmental gain (Biodiversity)
SKA Rating	Page 35	
Wellness	Page 37	
Light and Daylight	Page 38	Guidance on high performance design criteria
Thermal Comfort	Page 39	Guidance on high performance design criteria
Indoor Air Quality	Page 42	Guidance on high performance design criteria
Water	Page 44	Guidance water use and associtaed performance design criteria
Materials	Page 46	
Low and Zero Carbon Technologies	Page 47	Guideance on achieving net zero operational energy with LZC technologies
Environmental Net Gain - Residual Carbon	Page 48	Details on the residual carbon fund, investment and project suitability
Carbon Reporting (measurement and verification)	Page 50	Guidance on carbon reporting
Soft Landings	Page 51	Guidance on soft landings framework and post occupancy evaluation
Circular Economy	Page 53	Guidence on circular economy methodology

RIBA STAGES CHECKLIST FOR PROJECT IMPLEMENTATION

Following the introductory sections above there is a mandatory checklist process for Project Teams to follow to ensure all Sustainability Guidelines are followed. These are captured in Parts 3,4 and 5 of the sustainability guide.

There is a checklist process for:

- New Build
- Refurbishments or fit outs greater than £500k (this is construction cost inclusive of VAT)
- Refurbishment or fit outs less than £500k (this is construction cost inclusive of VAT)
- (minor works)

<table>
<tr><td>Design checklists by RIBA Stages for New Builds</td><td>Part 3</td><td>Design checklists for Project Teams to follow
<table>
<tr><td></td><td>RIBA Stage 0: Strategic Definition</td></tr>
<tr><td>Outcome</td><td>Confirm the client requirements</td></tr>
<tr><td>Whole Life Carbon assessment</td><td></td></tr>
<tr><td>Biodiversity</td><td></td></tr>
<tr><td>Net Zero Operational Energy</td><td></td></tr>
<tr><td>Light and Daylight</td><td></td></tr>
<tr><td>Thermal Comfort</td><td></td></tr>
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<tr><td>Environmental Net Gain</td><td></td></tr>
<tr><td>Carbon reporting (measurement and verification)</td><td></td></tr>
</table>
</td></tr>
<tr><td>Design checklists by RIBA Stages for Refurbishment projects greater than £500k (this is construction cost inclusive of VAT)</td><td>Part 4</td><td></td></tr>
<tr><td>Design checklists by RIBA Stages for Refurbishment projects less than £500K (this is construction cost inclusive of VAT) (minor works)</td><td>Part 5</td><td></td></tr>
</table>

WHOLE LIFE CARBON ASSESSMENT

A Whole Life Carbon (WLC) assessment is becoming an essential tool for addressing a buildings carbon impact throughout its lifecycle. The system boundaries for construction materials and products in the whole life carbon assessment are summarised in the adjacent diagram (Figure 1):

All projects will need to carry-out a whole life carbon assessment as described in this section.

This will allow the University to make informed decisions throughout the design process and understand their operational carbon as well as the embodied carbon.

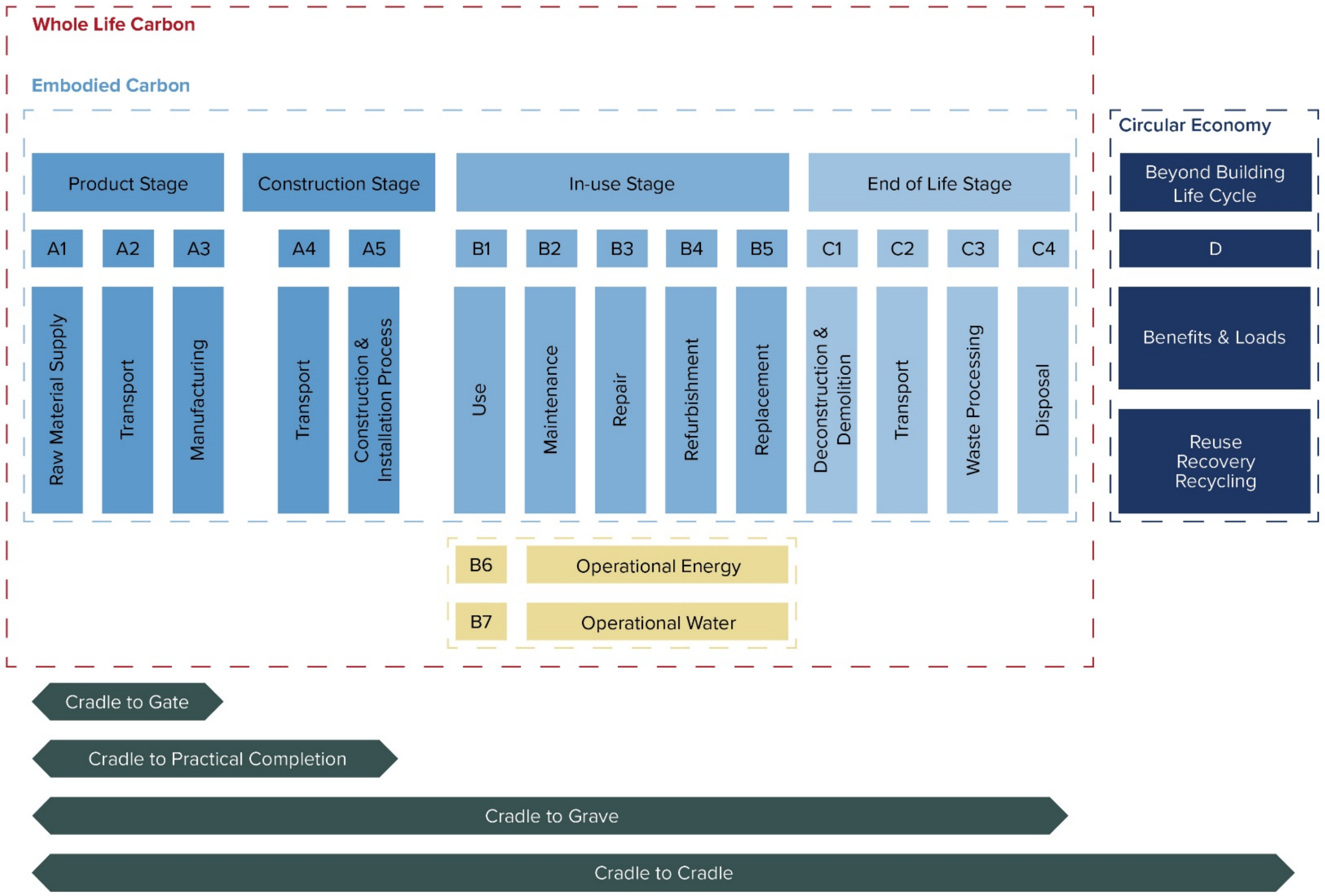


Figure 6: Whole life carbon modules for carbon accounting – cradle to grave[2]

Construction products and processes:	Modules A1 – A5	Building Construction
Maintenance, repair and refurbishment:	Modules B1 - B5	Building Operation
Operational energy and water consumption:	Modules B6 - B7	Building Operation
Demolition, waste and disposal:	Modules C1 - C4	End of Life
Carbon savings from material re-use:	Module D	Beyond the lifecycle

[2] LETI – Climate Emergency Design Guide

Summary of factors influencing the WLC assessment:	
Spatial boundaries	The assessment should cover all works relating to the proposed building and its intended use, including its foundations, external works within the site and all adjacent land associated with its typical operations.
Physical characteristics	All items within the project's cost plan/bill of quantities or equivalent information should be included.
Assumed building life span (reference study period)	For comparability purposes, the life expectancy of all building types is assumed to be 60 years.
Life cycle assessment (LCA)	LCA is fundamental to a Whole Life Carbon assessment. It can be summarised as "a systematic set of procedures for compiling and examining the inputs and outputs of materials and energy, and the associated environmental impacts directly attributable to the functioning of a building throughout its life cycle" (ISO 14040: 2006).
Floor area measurement	This should be in accordance with the RICS property measurement standards
Quantities measurement	Material quantities should follow from the project cost plan/bill of quantities (BoQ), the BIM model or be estimated from drawings. These should be in accordance with the RICS property measurement standards (2015) and the BCIS Elemental Standard Form of Cost Analysis.
Units of measurement to be reported	WLC should be reported using $kgCO_2e$ or suitable multiples thereof, e.g., tCO_2e
Embodied carbon data sources	The availability of accurate data on the carbon cost of materials and systems is a rapidly evolving area. Typically, Environmental Product Declarations (EPDs) are used. These are provided for an increasing number of products by the manufacturer and cover a range of data including the embodied carbon. EPDs are developed in accordance with a number of standards including BS EN 15804 and various ISO standards (see RICS PS for further detail). EPD data has been collated into databases by various providers, which generally charge for access.

Definitions and abbreviations
Operational carbon is the emissions associated with heating, cooling and lighting of a building, i.e., the emissions associated with the using of a building or space.
Embodied carbon is the carbon footprint of a material or product. It considers how many greenhouse gases (GHGs) are released throughout the supply chain and will be measured from cradle to site (final use).
Whole life carbon is the combination of carbon from operational energy related emissions and embodied carbon over the life of the building, usually taken as 60 years.
Life cycle assessment is a cradle-to-grave or cradle-to-cradle analysis technique to assess carbon emissions associated with all the stages of a product's life, which is from raw material extraction through materials processing, manufacture, distribution, and use.
Environmental Product Declaration, **or EPD**, is a document which transparently communicates the environmental performance or impact of any product or material over its lifetime and is used to provide data for life cycle assessments and whole life carbon assessments.

Recommended tools
A suitable software tool needs to be proposed. This is to be a database tool for design of low impact buildings and provides information to support project cost, embodied carbon, and energy performance decisions. The main objective is that it provides design stage analysis that allows the LETI embodied carbon reporting tool to be fully populated. All proposed WLC tools will need to be approved by the University Project Manager.
LETI – Embodied Carbon Reporting tool. Carbon Alignment | LETI

Key documents
RICS whole life carbon assessment for the built environment
RIBA Embodied and whole life carbon assessment
CIBSE TM65: Embodied carbon in building services: A calculation methodology

WHOLE LIFE CARBON REPORTING TEMPLATE

The LETI embodied carbon reporting template adjacent needs to be completed covering all modules (A-D) using the carbon data from the proposed LCA carbon reporting tool.

This must be agreed no later than RIBA Stage 1 of the project.

Embodied Carbon per Module per Element ($kgCO_2e/m^2$, GIA)

		A1-3	A1-3 (Sequestered)	A4	A5	B1-3	B4&5	C1-4	D
Demolition	Toxic Material Treatment								
	Major Demolition Works								
Facilitating Works	Temporary/ Enabling Works								
	Specialist Ground works								
Substructure	Substructure								
Superstructure	Frame								
	Upper Floors								
	Roof								
	Stairs and Ramp								
	External Walls								
	Windows and External Doors								
	Internal Walls and Partitions								
	Internal Doors								
Finishes	Wall Finishes								
	Floor Finishes								
	Ceiling Finishes								
FF&E	FF&E (Fixed)								
	FF&E (non-fixed)								
Building Services	Building Services								
	Refrigerant Leakage								
	Renewable Electricity Generation								
Prefabricated Buildings	Pre-fab Building Units								
Work to Existing Building	Minor Demolition and Alterations								
External Works	External Works								
	TOTAL	0	0	0	0	0	0	0	0

Figure 7: Whole Life Carbon Assessment reporting template [3]

[3] LETI Reporting Template

Preferred Scope

The scope of reporting requirements for WLC assessments, are clearly defined in the table adjacent:

Carbon reporting tools are rapidly improving, and more and more data is becoming available to help with this process.

If supplier data is not available, then secondary data should be used such as average data (Emission estimates for goods and services using industry data or national average data) and spend data (Emissions estimates from data on the economic value of goods and services purchased).

All projects will need to achieve the preferred scope.

The preferred requirements for whole life carbon assessment:		
Building parts to be included	Facilitating works (all) Substructure (all) Superstructure (all) Finishes Fittings, furnishings and equipment Services (MEP) Prefabricated Buildings and Building Units Work to Existing Building External Works	
Project life stages to be included	Product stage	[A1 – A3]
	Construction process stage	[A4 – A5]
	Use stage	[B1 – B5]
	End of Life stage	[C1 – C4]
Assessment timing	At design stage – prior to technical design	

Embodied Carbon Targets

All projects should follow the LETI embodied carbon target alignment measurement methodology which forms part of the LETI embodied carbon reporting template.

Upfront Carbon

Is the embodied carbon involved in the project up to the end of construction phase.

All projects should achieve a minimum target of an A rating for upfront carbon (see adjacent table).

The University's target is currently in line with the latest LETI published targets for Upfront Carbon for a project designed in 2030.

Embodied Carbon

All projects should achieve a minimum whole life embodied carbon target of a B rating (see adjacent table).

The University's target is currently in line with the latest RIBA 2030 challenge standards (published in 2021).

Embodied carbon benchmarks and targets are a developing knowledge area; it is anticipated that as the quantity of more accurate and detailed information becomes available target figures may be updated It may also become relevant to refine and provide an increased number of typology specific targets.

The University's targets shall be updated for future projects.

Further information on the above: Carbon Alignment | LETI

Upfront Carbon, A1-5 (exc. sequestration)

	Band	Office	Residential	Education	Retail	
	A++	<100	<100	<100	<100	
	A+	<225	<200	<200	<200	
Exeter Target →	A	<350	<300	<300	<300	LETI 2030 Design Target
	B	<475	<400	<400	<425	
Current industry 'good design' →	C	<600	<500	<500	<550	LETI 2020 Design Target
	D	<775	<675	<625	<700	
Current industry standard for 'average design' →	E	<950	<850	<750	<850	
	F	<1100	<1000	<875	<1000	
	G	<1300	<1200	<1100	<1200	

Embodied Carbon, A1-5, B1-5, C1-4 (inc. sequestration)

	Band	Office	Residential	Education	Retail	
	A++	<150	<150	<125	<125	
	A+	<345	<300	<260	<250	
	A	<530	<450	<400	<380	
Exeter Target →	B	<750	<625	<540	<535	RIBA 2030 Built Target
	C	<970	<800	<675	<690	
	D	<1180	<1000	<835	<870	
	E	<1400	<1200	<1000	<1050	
	F	<1625	<1400	<1175	<1250	
	G	<1900	<1600	<1350	<1450	

All values in $kgCO_2e/m^2$ (GIA)

Whole Life Carbon Assessments: Guidance by module (A-B)	
Modules A1-A3: Product Stage	The product stage carbon emissions of the different construction elements should be calculated by assigning suitable embodied carbon factors derived from acceptable data sources, for example EPDs provided by the manufacturer.
Module A4: Transport emissions (factory gate to site)	This requires assessing the likely transport types and the associated emissions attributable to the products being transported from factory to site. These should be updated at Practical Completion to paint a more accurate picture.
Module A5: Construction/ installation emissions	The carbon emissions from all on-site activities and plant accommodation should be covered. Appropriate allowances for site waste should be made. The site waste rates for the different materials should be estimated. Initial estimates should be replaced with evidence-based site monitoring data provided by the contractor at Practical Completion.
Module B1: In use emissions	This covers the release of greenhouse gas from products and materials (e.g., refrigerants, paints, carpets) during the normal operation of the building.
Module B2: Maintenance emissions	The carbon emissions of all maintenance activities, including cleaning, should be taken into account, encompassing the carbon impacts from energy and water use associated with them.
Modules B3-B4: Repair and replacement emissions	This stage involves any emissions arising from the repair and replacement of relevant building components in line with sensible scenarios developed from the LCA. These should capture all emissions associated with the supply of new products (as in A1-A5 above). It should be noted that for consistency it is assumed that repair and replacement are 'like for like'.
Module B5: Refurbishment emissions	The detailed LCA should incorporate any known refurbishment scenarios going forward. This would cover a planned future extension or change to the building.
Module B6: Operational energy use	This should cover regulated energy consumption as per Part L, including heating, cooling, ventilation, domestic hot water, lighting and auxiliary systems as projected over the life cycle of the project (excluding during maintenance, repair, replacement and refurbishment). It should also include building related systems such as lift machinery or security systems. All energy generating units such as solar thermal panels, wind turbines, gas boilers, combined heat and power (CHP) and heat pumps should be included within the calculation.
Module B7: Operational water use	All carbon emissions relating to operational water consumption, both supply and waste, throughout the life cycle of the building should be included.

Whole Life Carbon Assessments: Guidance by module (C-D)	
Module C1: Deconstruction emissions	This module includes all emissions associated with dismantling a building that has reached the end of its life.
Module C2: Transport Emissions	This refers to transport emissions arising from removing redundant material from the building site and taking it to a disposal site.
Module C3: Waste processing emissions	Module C3 is directly linked to Module D and represents the carbon cost of processing redundant materials for repurposing, reuse or recycling. C3 represents the carbon cost to bring the materials to the 'out-of-waste' state, whereas D represents the potential benefit. For example, removing mortar from a brick would be covered under C3, whilst the benefit of the brick reuse would be shown under D.
Module C4: Disposal emissions	This includes any emissions arising from the disposal of materials to landfill or incineration.
Module D: Reuse, recovery, and recycling stage	This module is likely to become increasingly important in building design and WLC assessments

LIFE CYCLE COST ANALYSIS

To allow the university to make informed decisions during the design process it is critical that life cycle costing is carried out.

The life cycle cost analysis needs to be calculated over a 60-year period unless it can be justified that a shorter time period is more applicable.

The analysis needs to include for:

- Capital cost.
- Operational running costs.
- Maintenance costs.
- Replacement costs.
- Residual carbon cost.

WHOLE LIFE NET ZERO CARBON EMISSIONS

The project will be Whole Life Net Zero Carbon when the amount of carbon emissions associated with a building's embodied and operational impacts over the life of the building, including its disposal, are zero or negative. Therefore, a circular economy approach must be adopted and building materials should follow a cradle-to-cradle life cycle.

Projects looking to achieve Whole Life Net Zero Carbon Emissions will have to record Module D in WLC assessments.

As mentioned in Part 1 of the sustainability guide the University have set the following carbon targets (see adjacent image) which need to be adhered to.

NET ZERO OPERATIONAL ENERGY

New Build projects will need to achieve Passivhaus Certification as a minimum, as part of achieving Net Zero Carbon operational energy.

Refurbishment projects will achieve EnerPHit Certification as a minimum, as part of achieving Net Zero Carbon operational energy.

Passivhaus Standard

Passivhaus is the best current methodology that focuses on a fabric first approach to minimise operational energy. Passivhaus is the most suitable framework to deal with the issue regarding performance gap between designed and in-use building operational energy.

Passivhaus Classic

Passivhaus Plus (includes renewable targets

Passivhaus Premium(includes renewable targets

For detailed definitions: [The new Passive House Classes [ ] (passipedia.org)]

EnerPHit Standard

The EnerPHit standard sets a slightly different standard requirement for refurbishment projects where full Passivhaus Standards cannot be met. It is a high standard and

These Standards should be achieved as a minimum to reduce on-site energy demand and minimise the scale of low and zero carbon technology provision required to meet net zero carbon.

For Low and Zero Carbon technology provision guidance, see relevant section.

Any residual carbon associated with operational energy at the end of these design measures must be balanced. Refer to residual carbon section for further details.

Design Standard
Passivhaus and EnerPHit Criteria

Definitions and abbreviations
The specific space heating demand is the total energy required to heat the building for a year. It is measured in kilowatt-hours (kWh) per metre squared (m2) of treated floor area per year.
Specific primary energy renewable demand: Primary Energy (PE), the previous evaluation criteria, included not only the energy content of the raw material but also the losses from distribution, conversion and delivery to the end-user. So, PE is distinguished from energy used in the building (final energy), measured by the utility's gas or electric meter on the building. Similarly, for Primary Energy Renewable (PER), where the energy is supplied solely by renewable energy (RE) sources, all losses are included, although now the most notable losses are through storage. The calculations are based on climate data from various sources; the resulting PER factors describe how much more renewable energy must be supplied in order to cover the final energy consumed at the building.
Specific Renewable Energy Generation is renewable energy produced either on the site or offsite by newly built renewable energy facilities owned by the building owner including a fractional share in a community-owned renewable energy production facility.
Airtightness is the measurement of how much air leaks through the fabric of a building (e.g., through the floor, walls, and roof). To test the airtightness of a building it must be pressurised and depressurised, giving an accurate basis for comparison with other buildings. Airtightness is the number of air changes per hour of the total building volume (n50).* This must be tested at pressurisation and depressurisation of 50 pascals (50Pa).
EnerPHit Retrofit Plan (ERP) is a document for building owners. It includes a well-thought-out overall concept for stepwise retrofits. This takes into account important interrelations between different energy saving measures. Thus, an optimal final result can securely be obtained over all steps with manageable effort. The ERP output from PHPP creates the basic structure of the retrofit plan.
EuroPHit is an information source for *EnerPHit Standard* applied knowledge and provides good information on the often overlooked yet critical area of step-by-step refurbishments.

Recommended tools
PHPP Is the Passive House Planning Package, one of the most powerful design tools available for designing low energy buildings. The PHPP makes use of numerous tested and approved calculations to yield a building's heating, cooling and primary energy demand.
DesignPH is a plugin for popular 3D design software Google SketchUp, allowing interactive and graphically oriented input interface for PHPP. Developed by the Passivhaus Institute to provide a 3D modelling interface that works together with PHPP.

Key documents
Passivhaus and EnerPHit Criteria EuroPHit Guidance

Performance Criteria	
➢	Aim to achieve Net Zero Carbon Operational Energy.
➢	New Build projects will achieve Passivhaus Classic Certification at a minimum with Passivhaus Classic Criteria compliance
➢	Refurbishment projects and fit outs will achieve EnerPHit Pre-Certification at a minimum via an EnerPHit Retrofit Plan, leading to full certification on completion

Key Appointments
Certified Passivhaus/EnerPhit designer Passivhaus Certifier (from RIBA Stage 2 or 3)

NET ENVIRONMENTAL GAIN - BIODIVERSITY

Delivering environmental net gain means taking steps to mitigate the high potential impact of many major development projects on our site's biodiversity.

Taking an environmental net gain approach to development has many benefits, including:

- Supporting biodiversity by mitigating against climate change and flood risk, improving air and water quality, and improving quality of life.
- Delivering benefits efficiently, for example both achieving a development goal and increasing resilience.
- Saving time and money by avoiding the risks of costly and lengthy appeals processes due to environmental concerns
- Being a positive approach that ensures losses of high value biodiversity are minimised and mitigated while also providing opportunities to enhance natural capital. This also represents a 'least regrets' option as biodiversity loss is hard to reverse.

This means that:

- All capital projects should leave the environment in a measurably better state compared to the pre-development baseline.
- Natural capital frameworks and analysis should be used in decision making.
- Project teams should follow the mitigation hierarchy (**Figure 3**) when delivering environmental net gain by:
  1. Avoiding impacts as far as possible
  2. Minimising unavoidable impacts
  3. As a last resort, compensating for unavoidable losses wherever the greatest benefits can be delivered, either locally or nationally, first considering compensating for losses within the development footprint.

Our Biodiversity Strategy for Exeter Campuses follows these guiding principles:

1. Preserve and enhance existing landscapes and habitats.
2. Identify specialist measures to protect vulnerable species.
3. Zero green waste to landfill.
4. Work plans to incorporate sympathetic tree and hedgerow management.
5. New and upgraded planting schemes.
6. Continue to review non-sustainable peat use
7. Encourage engagement with biodiversity on campus.
8. Watercourse management (Streatham Campus)

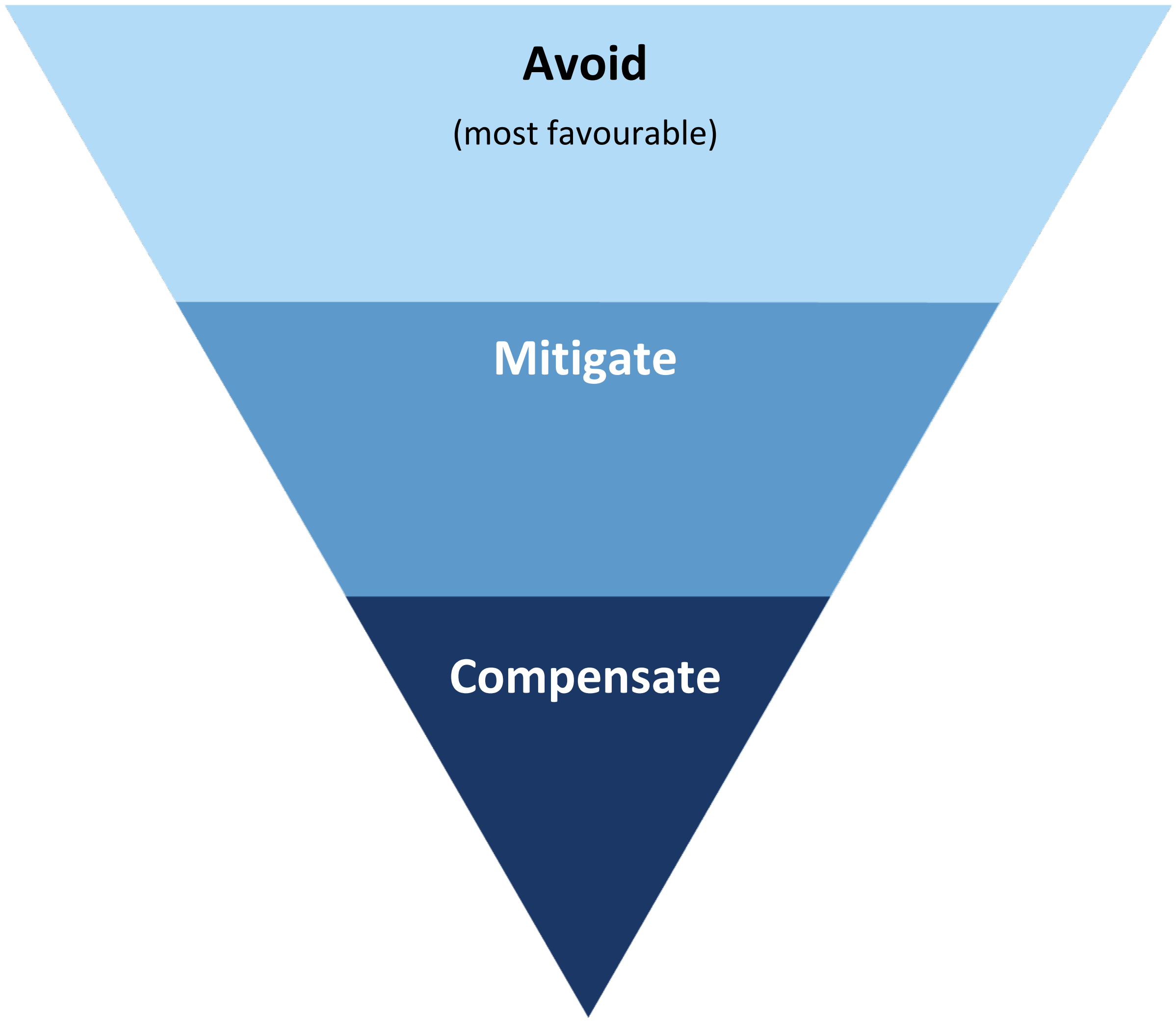


Figure 8: Biodiversity mitigation hierarchy

Design Standard

Natural England Biodiversity Metric

The Biodiversity Metric provides a way of measuring and accounting for biodiversity losses and gains resulting from development or land management change.

Designed to provide developers, ecologists, planners, and other interested parties with means of assessing changes in biodiversity value (losses or gains) brought about by development or changes in land management. The metric is a habitat-based approach to determining a proxy biodiversity value.

BREEAM criteria for Land Use and Ecology

The criteria and methodology used by BREEAM's ecology issues recognise good and best practice processes that can help achieve the Government and industry aspiration to meet environmental net gain; 'development that leaves biodiversity in a better state than before, and an approach where developers work with local governments, wildlife groups, landowners and other stakeholders in order to support their priorities for nature conservation.'

LE04 provides a way to quantify biodiversity change, including biodiversity net-gain, which is based on the industry-recognised Defra Biodiversity Metric.

BREEAM 2018 New Constructions (non-domestic buildings)

- LE01 Site selection (2 credits)
- LE02 Ecological risks and opportunities (2 credits)
- LE03 Managing impacts on ecology (3 credits)
- LE04 Ecological change and enhancement (4 credits)
- LE05 Long term ecological management and maintenance (2 credits)

Definitions and abbreviations

Biodiversity is defined as 'the variability among living organisms from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part'.

Environmental Net Gain is an approach to development, and/or land management, that aims to leave nature in a measurably better state than beforehand. All new developments must consider the environmental impact of the proposed scheme and ensure that post-development biodiversity is left in a state better than it was before, for example, providing more natural habitat than there was existing prior to development.

Recommended tools

DEFRA Biodiversity Metric

BREEAM Ecological Risk Evaluation Checklist (LE02)

BREEAM, CEEQUAL and HQM Ecology Calculation Methodology – Route 2 (LE04)

Key documents

Applying Biodiversity Metric 2.0

BREEAM 2018 New Constructions (non-domestic buildings)

Performance Criteria	
➢	Minimum 10% gain required calculated using Biodiversity Metric, with a view to exceed this & approval of net gain plan
➢	The design should aim to score as many credits as possible under each BREEAM objective
➢	'Protected' status to be designated to highly biodiverse areas on site, ensuring they cannot be lost to future development
➢	Map of biodiversity features (currently in progress) to guide location of future developments. The map will include location of species e.g., bats / badgers, and key biodiverse areas
➢	Any planting for new developments must be conducted in collaboration with grounds staff to ensure the appropriate native species are selected for the location
➢	Establish a 5-meter minimum development buffer to protect retained hedgerows
➢	Consult with grounds to include nest boxes / bricks in all new builds as standard e.g., swift and bee bricks, bat boxes, to ensure new builds have some value to wildlife
➢	Install green / living walls for both new builds and existing buildings to improve biodiversity, insulation, air quality, and provide statement green aesthetics on campus

Key Appointments
Qualified ecologist who is experienced in undertaking calculations required for Biodiversity Metric and BREEAM compliance

SKA RATING

SKA is a dynamic assessment tool designed to allow occupiers to benefit from the highest level of sustainability for building spaces. It has been specifically developed to measure the sustainability performance of fit-outs, rather than the base build.

One of the key features of the SKA Rating is its flexibility. It enables a design team to select the topics that are relevant and which they are able to influence through product selection or improvement of a process

Each project must identify their good practice measures from the SKA rating tool and target achieving a **Gold SKA rating.**

The system uses a concept known as gateway measures. The gateway measures are aimed at ensuring that a high rating cannot be achieved without carrying out the most effective measures. It also prevents design teams from getting a good score by just targeting the easiest measures. This is designed to incentivise projects to install matters that will have the greatest benefit.

To obtain a Gold Ska rating, 75% of these must be achieved. In addition to this, any 12 out of the top 15 ranked measures (from the gateway pool) within the scope of the project must also be achieved for a Gold Ska rating to be awarded.

A SKA assessor will then ensure the correct metrics are used at each of the three stages (see below) and the highest possible rating is achieved.

Design Stage

Good practise measures in scope are identified

Environmental performance standards for how the project is delivered are set, in terms of waste management and energy in use.

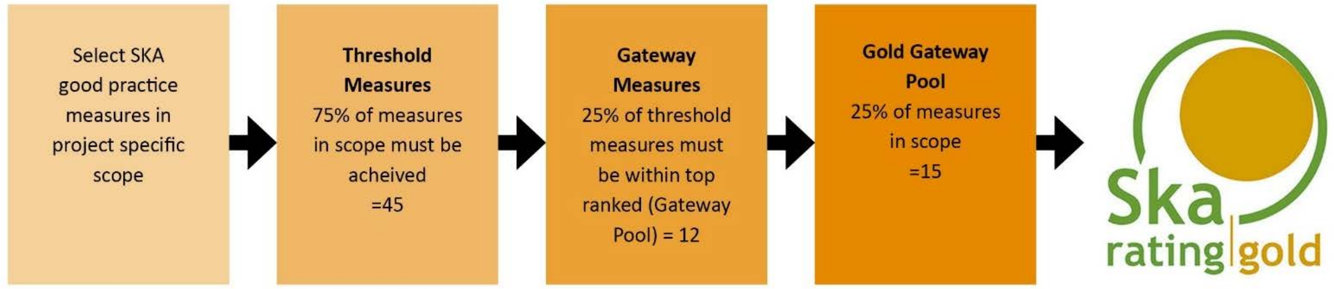
If the specification demonstrates the proposed measures are likely to be achieved, they will be reflected in an indicative rating.

Handover Stage

Evidence from operation and maintenance manuals and other sources is gathered to prove what has been specified and delivered and that the performance benchmarks have been achieved.

Occupancy stage assessment

There is an option to review how well a fit out has performed in use against its original brief one year following completion.



Design Standard
Each project must identify their good practice measures from the SKA Rating and target achieving a Gold SKA Rating.

Definitions and abbreviations
Good Practice Measures (GPM) are criteria used by SKA assessment. Each good practice measure is outlined in a datasheet explaining the criteria that need to be achieved, including the rationale behind the measure and guidance on how to achieve it.
Gateway Measures are important from a sustainability perspective. To ensure the design team do not target the easiest measures, the project has to achieve a number of the highest ranked measures in scope in order to score. These are known as gateway measures.

Recommended tools
SKA Rating online tool

Key documents
None

Performance Criteria	
➢	The SKA score is ranked in three thresholds: bronze, silver and gold. The design will target a **Gold SKA rating.**

WELLNESS

Buildings should be developed with people's health and wellness at the centre of design. The WELL Building

Standard takes a holistic approach to health in the built environment, addressing behaviour, operations and design.

WELL is a performance based system for features of the built environment that impact human health and wellbeing, through the following features:

- Air
- Water
- Nourishment
- Light
- Fitness
- Comfort
- Mind

Each feature is designed to address issues that impact the health, comfort, or knowledge of occupants. Designers should look to enhance each feature with their designs.

Examples of the concepts and typical enhancements are demonstrated in the diagram.

The following features of the WELL Standard have a performance specification to be achieved by Exeter University developments.

See table below for equivalent sections within this Design Guide:

WELL category	Design Guide chapter
Daylight	Light and daylight
Thermal comfort	Summer and winter comfort criteria
Air	Indoor air quality
Water	Water and water consumption
Materials	Materials

- VOC levels
- Controls during construction phase
- Air-quality

Materials

- Controls on materials and cleaning products used

Mind

- Education and support for employees

Water

- Testing of water quality
- Potential filtering requirements

- Shading and minimum standards for light

- Maximum noise levels and sound barriers
- Sound mapping

Movement

- Ergonomic workspaces
- Encouraging stair or corridor use

Thermal Comfort

- Summer and Winter comfort
- Dehumidification to achieve

- Promoting education and stakeholder engagement

Nourishment

- Standards to promote healthier diets

Innovation

- Innovation that goes above and beyond the requirements

LIGHT AND DAYLIGHT

Daylight access shall be demonstrated through spaces receiving daylight directly or indirectly that enhances the visual environment. The level of daylight access provided shall take into account the activities in the space.

Design Standard
'Education and Skills Funding Agency (ESFA) Annex 2E (2019)', Section 3 – Daylight

Definitions and abbreviations
Daylight Autonomy (DA) is the percentage of time that a point in a space can expect to achieve or exceed an illuminance threshold (typically 300 lux) from daylight alone. Spatial Daylight Autonomy sDA (300/50%) defines the percentage of the task plane which receives at least 300 lux, for at least 50% of the annual occupied hours, i.e., the percentage of the task plane which can achieve a DA of 50%
Useful Daylight Illuminance (UDI-a) measured as 100~3000 lux, is the annual occurrence of illuminance, at a point in a space, within the range 100~3000 lux, measured across the task plane, during occupied hours. The final UDI result is taken as an average of the results across the task plane.

Recommended tools
Any tool that provides the required lighting measurements: • Spatial Daylight Autonomy (sDA) • Useful Daylight Illuminance (UD)

Performance Criteria	
➢	Compliance with 'Education and Skills Funding Agency (ESFA) Annex 2E (2019)', Section 3 – Daylight.
➢	Useful Daylight Illuminance (UDI) used to measure human daylight benefit and 80% of occupied spaces to achieve 80% score
➢	Spatial Daylight Autonomy (sDA) used to measure energy benefit of daylight, with occupied spaces scoring 300lux-50%-50%

THERMAL COMFORT

Passive design should be used to reduce the peak internal temperatures that can be experienced on hot summer days. Detailed dynamic thermal modelling will be essential to ensure the risks to providing an appropriate environment for staff and students are understood.

Design Standard
CIBSE TM52: The Limits of Thermal Comfort: Avoiding Overheating in European Buildings
CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017)
Weather files to be used for overheating analysis: Current weather: Plymouth_DSY1_2020High90, Plymouth_DSY2_2020High90 & Plymouth_DSY3_2020High90 Future weather: Plymouth_DSY1_2050High90, Plymouth_DSY2_2050High90 & Plymouth_DSY3_2050High90 Plymouth_DSY1_2080High90, Plymouth_DSY2_2080High90 & Plymouth_DSY3_2080High90

Definitions and abbreviations
Overheating is the phenomenon of excessive or prolonged high temperatures resulting from internal or external high gains, which may have adverse effects on comfort, health, or learning activities.
Test Reference Year (TRY) is set of weather data used for building energy simulations, is composed of 12 separate months of data each chosen to be the most average month from the collected data. The TRY is used for energy analysis and for compliance with the UK Building Regulations (Part L).
Design Summer Year (DSY) is a single continuous year used for simulations rather than a composite one made up from average months. The DSY is used for overheating analysis.
There are now 3 DSYs available per location, representing summers with different types of hot events for overheating analysis: **DSY1:** Moderately warm summer **DSY2:** Short, intense warm spell **DSY3:** Long, less intense warm spell

Recommended tools
Any thermal dynamic modelling package that uses the approved weather files.

Key documents
CIBSE TM52: The Limits of Thermal Comfort: Avoiding Overheating in European Buildings CIBSE TM59: Design methodology for the assessment of overheating risk in homes (2017) Soft Landings Framework 2018 (BG 54/2018) – for post occupancy evaluation of thermal comfort experienced by building occupants

SUMMER COMFORT CRITERIA

Designers should use future weather files (2050) and investigate different Design Summer Year (DSY) scenarios to decide the most appropriate weather data to test the building performance against.

Assumptions and diversity for occupant numbers, heat generating equipment and operational hours must be realistic, clearly agreed with occupants and documented.

Performance Criteria for buildings without comfort cooling	
➢	Designs tested against CIBSE TM59/TM52, within overheating limits for current and future weather files
➢	Test building adaptivity for future weather files 2050 and 2080, allowing future cooling connection and plant space allocation in M&E design. This allowance is acceptable for future scenarios but should not influence day 1 plant unless significant change is expected within 10 years.

Performance Criteria for buildings with comfort cooling	
➢	Spaces shall meet the following metrics as defined by BS EN ISO 7730: 1. PMV in range +/-0.5 2. PPD<10% PMV is predicted mean vote and is used in comfort criteria PPD is percentage people dissatisfied and is also used in comfort criteria

WINTER COMFORT CRITERIA

Passive design promotes the use of natural ventilation and cold draughts in winter make it much less likely that occupants will open the windows. Therefore, a cold draught criterion must be included in the natural ventilation modelling.

Performance Criteria for winter comfort	
➢	Internal surface temperatures >17degC at design external winter temperature
➢	Avoidance of cold draughts: air supplied >15degC at height of 1.5m from floor

INDOOR AIR QUALITY

Indoor air quality (IAQ) is a complex subject with a wide range of variables, including occupancy levels, external air quality, air filtration, fresh air supply rates and pollutant sources within the building among other factors.

The ESFA guideline BB101 contains wide-ranging guidance for IAQ, based on extensive research, and is a suitable single-source standard for IAQ. It contains standards and targets for a wide range of educational building usage types, which should be adhered to carefully to ensure good IAQ for University building occupants. While not a complete picture, CO_2 levels in parts per million (PPM), is a suitable proxy for good air quality overall.

Design Standard
BB 101: Ventilation, thermal comfort and indoor air quality 2018

Definitions and abbreviations
Natural ventilation is where the driving force behind these ventilation systems is wind and the thermal stack effect. They can involve: Opening windows Opening dampers Roof stacks
Mechanical ventilation systems are fan driven, there are two types: Centralised systems which have supply and extract Room based systems which have supply and extract

Recommended tools
Any approved dynamic simulation software

Key documents
UK Building Regulations Part F: Ventilation BB 101: Ventilation, thermal comfort and indoor air quality 2018 WHO Guidelines for indoor air quality

Performance Criteria for naturally ventilated buildings (Please note these are above and beyond the requirement set out in BB101)	
➢	Daily average CO_2 levels of less than 1000ppm during the occupied period
➢	Maximum concentration should not exceed 1500ppm for more than 20 consecutive minutes per day
➢	(New Build) natural ventilation system design to target CO_2 levels of less than 1000ppm throughout the year

Performance Criteria for mechanically ventilated buildings	
➢	Daily average CO_2 levels of less than 1000ppm during the occupied period
➢	Maximum concentration should not exceed 1500ppm for more than 20 consecutive minutes per day

WATER

Water management is a significant aspect of the net zero carbon design and projects should go as far as possible to minimise water use.

Considerable care and attention should be given to the design and specification of rainwater harvesting systems and systems providing boiling and chilled potable water. Significant issues and costs to the University can occur from poor design of these systems.

Design Standard
BREEAM 2018 New Constructions (non-domestic buildings) WAT01 Water Consumption (5 credits) WAT02 Water Monitoring (1 credit)

Definitions and abbreviations
Greywater recycling is the appropriate collection, treatment and storage of domestic wastewater (which is defined as that discharged from kitchens, baths or showers, laundry rooms and similar) to meet a non-potable water demand in the building, e.g., WC flushing, or other permissible non-potable use on the site of the assessed building
Potable water is water suitable for human consumption that meets the requirements of Section 67 (Standards of Wholesomeness) of the Water Industry Act 1991(166) is referred to as 'wholesome water'
Non-potable water is any water other than potable water, also referred to as unwholesome water (BS 8525)
Rainwater Recycling is the appropriate collection and storage of rainwater run-off from hard outdoor surfaces to meet a non-potable water demand in the building, e.g., WC flushing, or other permissible non-potable use on the site of the assessed building.

Recommended tools
BREEAM WAT 01 Calculator (2018)

Key documents
BREEAM 2018 New Constructions (non-domestic buildings)

Performance Criteria	
➢	BREEAM 2018 Wat 01: Water consumption (min 3 credits; 40% improvement) Use the BREEAM Wat 01 calculator to assess the efficiency of the domestic water-consuming components. All components must meet a minimum of level 4 or 5.
➢	BREEAM 2018 Wat 02: Water monitoring (1 credit)
➢	Boreholes, Rainwater and Grey Water harvesting must be investigated as part of the design

WATER CONSUMPTION

Table 1 outlines the consumption performance levels, by component type, used in BREEAM 2018 Calculator. These levels of efficiency have been steered by a range of published sources of information and reflect robust levels of typical, good, best and exemplary practice. All projects are required to meet levels 4 and 5 as a minimum.

Table 1: Water efficiency consumption levels by component type (from BREEAM 2018 Calculator used for New Builds)

Component	Performance levels (quoted numbers are minimum performance required to achieve the level)						
	Base	1	2	3	4	5	Units
WC	6	4.5	4	3.75	3.5	1.5	Effective flush volume (litres)
Wash-hand basin taps	10	8	6	5	4	3	litres/min
Showers	12	10	8	6	5	3.5	litres/min
Baths	200	180	160	140	120	100	litres
Urinal (2 or more urinals)	7.5	6	3	1.5	0.75	0	litres/bowl/ hour
Urinal (1 urinal only)	10	8	7	6	5	5	litres/bowl/ hour
Greywater and rainwater system	0%	0%	0%	25%	50%	75%	% of WC or urinal flushing demand met using recycled non-potable water
Kitchen tap: kitchenette	10	8	7	6	5	5	litres/min
Kitchen taps: restaurant (pre-rinse nozzles only)	10.3	9	8.3	7.3	6.3	6	litres/min
Domestic sized dishwashers	17	13	13	12	11	10	litres/cycle
Domestic sized washing machines	90	60	50	40	35	30	litres/use
Waste disposal unit	17	17	0	0	0	0	litres/min
Commercial sized dishwashers	8	7	6	5	4	3	litres/rack
Commercial or industrial sized washing machines	14	12	10	7.5	5	4.4	litres/kg

MATERIALS

Designers must consider the impact on the environment when selecting materials (e.g. avoid over-specifying the use of cement).

Exeter University encourages all designers to use materials in accordance with the RICS **SKA Rating** assessment tool.

Furthermore, designers shall also take into account a life cycle perspective, regarding the choice of material (i.e. from cradle to end-of-life or preferably cradle-to-cradle).

To support our sustainability commitments, design teams should follow the principles below:

- Consider the source of materials – locally sourced is preferable.
- Consider the reputational risks associated with extraction activities.
- Consider the embodied carbon of materials selected – as this will be recorded in WLC assessment.
- Minimise waste on and off site.
- Plan for the reuse of materials produced as part of the construction phase.
- Make use of reused or recycled content in construction materials.
- Use materials with ease of repair, maintenance and end-of-life dismantling in mind.
- Minimise the use of toxic and/or polluting materials in the design.
- Be able to report environmental impact, recycled content and embodied carbon materials.
- Materials supply to comply with all applicable legislation throughout its supply chain.

Design Standard
Use materials that meet specification and have low environmental impact. Designs should be based on the principles of the Circular Economy, which is “restorative and regenerative by design, and which aims to keep products, components and materials at their highest utility and value at all times”

Definitions and abbreviations
SKA Rating is a dynamic assessment tool designed to allow occupiers to benefit from the highest level of sustainability
Good Practice Measures (GPM) are criteria used by SKA assessment. Each good practice measure is outlined in a datasheet explaining the criteria that need to be achieved, including the rationale behind the measure and guidance on how to achieve it.
Gateway Measures are important from a sustainability perspective. To ensure the design team do not target the easiest measures, the project has to achieve a number of the highest ranked measures in scope in order to score. These are known as gateway measures.

Recommended tools
SKA Rating online tool

Key documents
None

Performance Criteria	
➢	The design will target all appropriate good practice measures for materials in the SKA Rating.

LOW AND ZERO CARBON TECHNOLOGIES

Project Specific Low and Zero Carbon Technologies

Low and Zero Carbon (LZC) Technologies is the term for heat and energy providing technologies that emit low levels of carbon or no net carbon emissions. The feasibility of the following technologies should be explored at a minimum for every project:

- Ground Source Heat Pumps (GSHP)
- Air Source Heat Pumps (ASHP)
- Water Source Heat Pumps (WSHP)
- Biomass Boilers
- Combined Heat and Power (CHP)
- PV
- Solar Hot Water
- Wind Turbines
- Hydropower
- hydrogen
- Battery storage

LZC technologies need to be used alongside the Passivhaus/EnerPHit design standards and frameworks to achieve Net Zero Operational Energy.

Site Wide Specific Low and Zero Carbon Technologies

Project specific LZC should be reviewed in conjunction with site wide LZC to ensure integration into the Campus wide approach.

Site wide LZC are not permitted to be used to offset project specific Carbon emissions.

Design Standard
All projects, of any size should aim to maximise the potential to utilise on-site low and zero carbon technologies to meet the net zero carbon targets.

Definitions and abbreviations
Low and zero carbon technologies (LZC) is the term given to technologies that emit low levels of carbon emissions, or no net carbon emissions. The incorporation of these technologies is more effective with buildings with a highly energy efficient fabric after heat demand and heat loss have been reduced to a minimum.
Specific Renewable Energy Generation is renewable energy produced either on the site or offsite by newly built renewable energy facilities owned by the building owner including a fractional share in a community-owned renewable energy production facility

Recommended tools
PHPP software

Key documents
None

Performance Criteria	
➢	Aim to achieve or go beyond Net Zero Carbon Operational Energy. Passivhaus Plus or Premium (if applicable) Maximise the use of LZCT’s as part of the development/project

ENVIRONMENTAL NET GAIN – RESIDUAL CARBON

The development plan should maximise efforts to remove carbon emissions associated with the building, however, after all efforts have been deployed there may still be some residual carbon emissions. The quantity of residual carbon emissions expected should be calculated and monitored.

Part 1: Residual Carbon from Operational Energy

Any carbon emissions associated with operational energy not met by on-site Zero Carbon generation should be met by an investment into the **Residual Carbon Fund,** to be paid as a single sum after Practical Completion.

The investment into the Residual Carbon Fund shall be equal to **£150 per tonne of residual carbon** from operational energy **over a timeframe of 30 years** and shall be reinvested into university sustainability projects, minor works and small refurbishments that result in further University carbon reductions, leading to **Environmental Net Gain from residual carbon.**

Environmental net gain schemes that allow for offsetting of residual carbon must be done first on-site (including other locations on the University Campus) and must be in addition to existing schemes to avoid the risk of double accounting.

Design Standard
Investment into Residual Carbon Fund =

Price of carbon associated with operational energy (from non-renewable sources)	£150 per tonne
Timeframe	30 years

= Residual Carbon from operational energy (tonnes) x £150 x 30 years

Definitions and abbreviations
Environmental Net Gain is an approach to development, that aims to leave nature in a measurably better state than beforehand. All new developments must consider the environmental impact of the proposed scheme and ensure that post-development carbon emissions are neutral or left in a state better than it was before, for example, providing excess Solar PV for onsite renewable energy generation to other sources.
Residual Carbon Fund is an investment scheme that is controlled by The University and is used to provide resources to Sustainability projects that reduce the carbon emissions of The University.

Part 2: Residual Carbon from Embodied Carbon

In line with E&CE Goal 2, Scope 3 emissions should be reduced by 100% by 2030. This will require collection of data via Whole Life Carbon assessments.

- Any carbon associated with embodied carbon will require a similar investment into the Residual Carbon Fund to achieve **Environmental Net Gain.**
- Any carbon from schemes for Environmental Net Gain funded by **Part 1: Residual Carbon from Operational Energy** cannot be double counted for residual carbon from embodied carbon.

A carbon price for residual carbon from embodied carbon is shown below.

Design Standard	
Investment into Residual Carbon Fund =	
Price of carbon associated with embodied carbon Module A Module B Module C	£150 per tonne
Timeframe	30 years
= Residual Carbon from embodied carbon (tonnes) x £150 x 30 years	

CARBON REPORTING

Carbon reporting is a crucial element in understanding and recording the associated carbon emissions that's needs to consider scope 1,2 and 3

During all stages of the project carbon will be reported via the use of Whole life carbon assessment methodology and reporting.

Once the project enters the construction phase metering and monitoring will be required to capture real life data.

During Stage 5 the contractor will need to monitor items such as:

- Water use
- Energy use
- Waste
- Recycling
- Transport

These requirements will need to be included in the tender documentation by the design team.

Once the project is complete metering and monitoring procedures will need to be in place to allow the building performance, energy consumption and carbon to be captured and compared back to the design stage PHPP model and whole life carbon assessment. This is captured as part of the soft landings requirements.

Design Standard
Whole life carbon assessment and reporting during RIBA design stage 1-4

Definitions and abbreviations
Carbon Reporting is the term used for measuring and recording the CO_2 emissions produced by activities and processes associated with the project.

Recommended tools
A suitable software tool needs to be proposed. This is to be a database tool for design of low impact buildings and provides information to support project cost, embodied carbon, and energy performance decisions. The main objective is that it provides design stage analysis that allows the LETI embodied carbon reporting tool to be fully populated.
PHPP software
LETI – Embodied carbon template

Key documents
RICS whole life carbon assessment for the built environment
RIBA Embodied and whole life carbon assessment
LETI Embodied carbon reporting template
CIBSE TM65: Embodied carbon in building services: A calculation methodology

Performance Criteria	
➢	Passivhaus or EnerPHit standards Embodied carbon targets as set out under the Net Zero Carbon Emissions section Net zero carbon for all new build schemes

SOFT LANDINGS

The Soft Landings Framework is a six-phase approach to help the project team focus more on the client's needs throughout the project, to smooth the transition into use and to address issues that post-occupancy evaluation has shown to be widespread. It is not just about better commissioning, fine-tuning and handover.

Soft Landings should be used for all projects irrespective of their type and size, it allows for a full programme of post-occupancy evaluation that the project team can use to improve a buildings performance and make it sustainable over the long term.

Design Standard
Soft Landings

Recommended tools
Soft Landings Guides

Key documents
Soft Landings Framework 2018 (BG 54/2018)
Soft Landings Guides

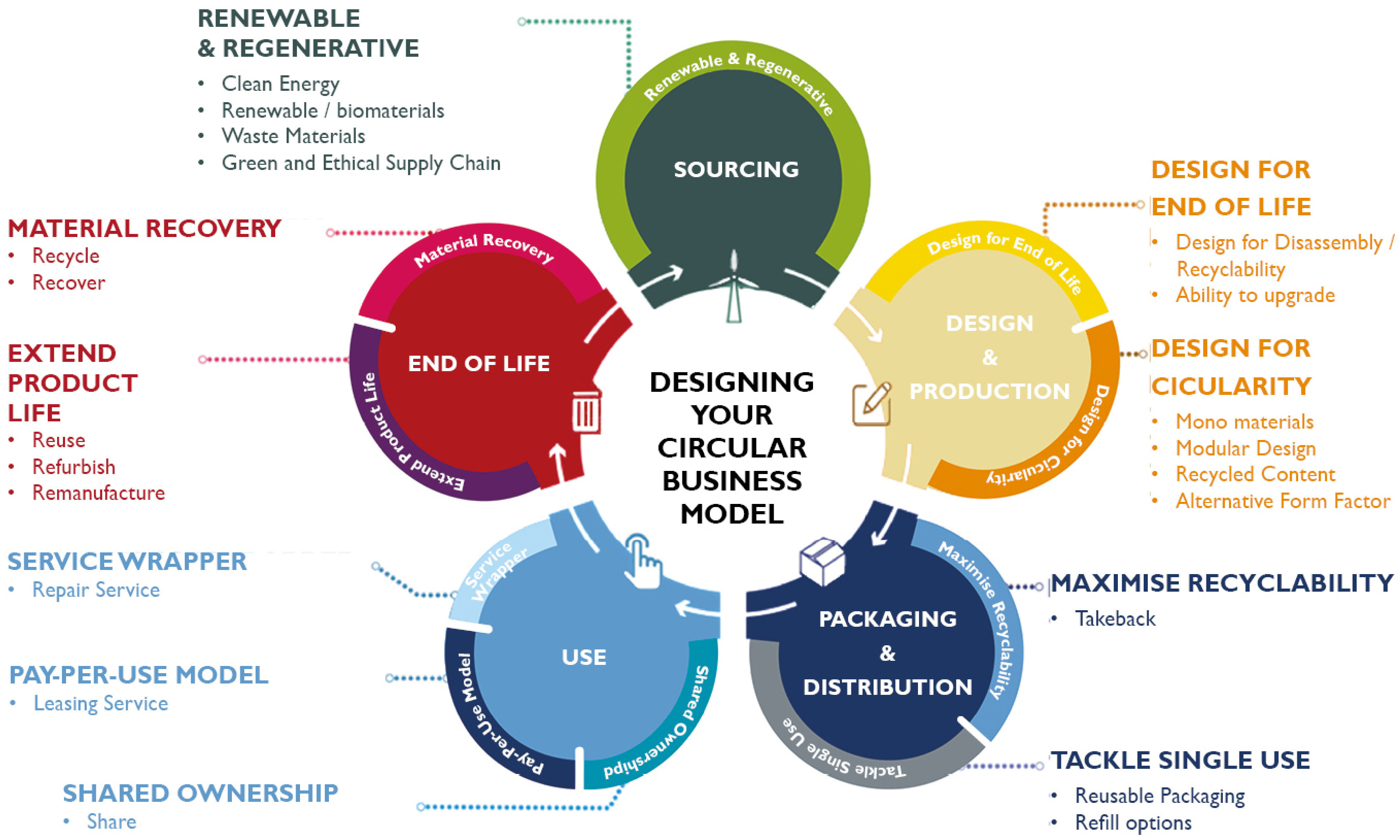
Performance Criteria	
➢	A Soft Landings champion is nominated by the client to promote the project's success criteria throughout the project. Soft Landing lead(s) are identified on the project team side to support the Soft Landings champion.

Summary of Soft Landings six-phases	
Inception and briefing	Soft Landings can help to establish client requirements and associated success criteria which are better informed by performance outcomes in use on previous projects. It also commits those joining the design and construction team to follow through after handover. It advises the team to begin allocating responsibilities for ongoing reviews of design intent and anticipated performance, and to prepare for the other Soft Landings related activities required.
Design	Soft Landings advises to review performance targets as the project progresses and inevitable challenges are encountered. Based on these reviews, performance targets can be set and/or revised.
Construction	Soft Landings requires the team to be fully aware of the project's success criteria. It also requires the facilities manager and the end users' representatives to be much more closely involved in the project, especially in the decisions which affect operation and management of the delivered building.
Pre-handover	Soft Landings helps the team prepare to deliver the building and its systems in a better state of operational readiness. It also helps to ensure the facilities manager has the knowledge and ability to maintain, control and manage the building.
Initial aftercare	When the occupants begin to move in, Soft Landings advises for the aftercare team to have a designated workplace in the building and be available at known times to explain to the end users how their building is supposed to work and to answer questions They should also undertake or organise any necessary troubleshooting and finetuning. Both before and after handover, the design and building team will work closely with client, end users and facilities manager to share experiences and smooth the transition into use.
Extended aftercare and POE	Soft Landings asks the project team to monitor performance and evaluate it against the identified performance targets and to deal with any problems and queries. The project team are also advised to incorporate independent POE (such as occupant satisfaction surveys as well as technical and energy performance surveys), and to discuss, act upon and lean from the outcomes. Achievements and lessons learned should then be carried back to inform the industry and its clients.

CIRCULAR ECONOMY

The following 'Designing your circular business model' diagram illustrates where the opportunities for change lie within the circular economy model. The diagram adjacent explores 5 key opportunities areas that should be considered and discussed throughout the RIBA design stages for all projects.

- Sourcing
- Design and production
- Packaging and distribution
- Use
- End of life



Design Standard
LETI circular economy (coming soon)
UKGBC Circular Economy How-to Guide: Reusing products and materials in built assets.

Definitions and abbreviations
Circular Economy - A circular economy employs reuse, sharing, repair, refurbishment, remanufacturing and recycling to create a closed-loop system, minimising the use of resource inputs and the creation of waste, pollution and carbon emissions

Recommended tools
A suitable software tool needs to be proposed. This is to be a database tool for design of low impact buildings and provides information to support project cost, embodied carbon, and energy performance decisions. The main objective is that it provides design stage analysis that allows the LETI embodied carbon reporting tool to be fully populated.

Key documents
Embracing-the-circular-economy-in-your-business.pdf
UKGBC Circular Economy How-to Guide: Reusing products and materials in built assets.

Performance Criteria	
➢	Please see embodied carbon performance targets.

Sustainability Design Guide

Part 3 – New Build

REVISION SUMMARY

Issue	Document prepared		
	Name	Signature	Date
Part 3 Draft	Oliver Fuller		24.05.21
Part 3	Oliver Fuller		02.07.21
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CONTENTS

INTRODUCTION 58
RIBA SUSTAINABILITY MEASURES CHECKLIST 59
RIBA Stage 0 59
RIBA Stage 1 61
RIBA Stage 2 64
RIBA Stage 3 67
RIBA Stage 4 71
RIBA Stage 5 74
RIBA Stage 6 77
RIBA Stage 7 79

INTRODUCTION

This document should be read in conjunction with Part 1 and part 2 of the sustainable design guide.

Below is a stage-by-stage project checklist for the sustainability design measures as described and covered in Part 1 and 2 of the sustainability design guides.

RIBA Stage 0 is critical in defining the brief that is taken forward into the project. For all new build project's, it is expected that all the sustainability measures will be included. Any derogations will need to be clearly explained and signed off by the client at the end of each RIBA stage.

An Excel template for the below checklist is available which contains additional columns for tracking, assigning responsibility and adding additional comments. This is to be used as a key tracker document throughout the design process. All consultants and contractors should ask for a copy of this document to allow them to accurately allow for the requirements specified.

RIBA SUSTAINABILITY MEASURES CHECKLIST

RIBA Stage 0

	**RIBA Stage 0: Strategic Definition**
Outcome	▫ Confirm the client requirements and define the brief.
Whole Life Carbon assessment	▫ Confirm that WLC assessments will be required on the project.
Environmental Net Gain - Biodiversity	▫ Confirm that a net biodiversity gain will be targeted on the project.
Net Zero Operational Energy and Passivhaus	▫ Confirm Net Zero Carbon operation will be targeted on the project. ▫ Confirm that Passivhaus will be targeted on the project and confirm what level is to be achieved (Classic, Plus or Premium).
SKA Rating	▫ Confirm the SKA Rating will be applied on this project.
Light and Daylight	▫ Confirm the targets for natural daylight that will be required.
Thermal Comfort	▫ Confirm the targets for thermal comfort that will be required.
Indoor Air Quality	▫ Confirm the targets for indoor air quality that will be required.
Water	▫ Confirm targets for water consumption and what measurement will be required.
Materials	▫ Confirm targets for fit-out and construction materials will be required
Low and Zero Carbon technologies	▫ Confirm the requirement for low or zero carbon technologies will be required on the project. ▫ Confirm if the wider site should be looked at to offer further opportunities for Low or Zero carbon technologies.

Environmental Net Gain – Residual Carbon	☐ Confirm that residual carbon offsetting can only take place once all other measures have been met. ☐ Confirm that a residual carbon fund will be set up for the project for operational carbon. ☐ Confirm that a residual carbon fund will be set up for both operational and embodied carbon.
Carbon reporting (measurement and verification)	☐ Confirm that carbon reporting is required for the project and template that is to be used.
Soft Landings	☐ Confirm Soft Landings will be applied on the project.
Circular Economy	☐ Confirm circular economy opportunities will be reviewed and applied to the project.
Other	☐ Has the project been run past the relevant academics to encourage engagement and to identify potential collaborations? ☐ Confirm if projects will be linked to academic research or studies. ☐ Review integration with University of Exeter Heat Decarbonisation Strategy

RIBA Stage 1

	**RIBA Stage 1: Preparation and Briefing**
Outcome	▫ Project Brief approved by the client and confirmed that it can be accommodated on site.
Gateway	▫ RIBA Stage 0 signed off.
Whole Life Carbon assessment	▫ Appoint a WLC assessment champion or appoint a separate assessor if not available within the core design team already. ▫ The scope of the WLC Assessment is decided, ideally all modules (A,B,C and D) should be covered and over all RIBA stages. ▫ Refer to UKGBC (2017). Embodied carbon: developing a client brief.
Environmental Net Gain - Biodiversity	▫ Appoint a qualified ecologist who is experienced in undertaking calculations required for Biodiversity Metric and gathering evidence for BREEAM credits.
Net Zero Operational Energy and Passivhaus	▫ Appoint a certified Passivhaus consultant/designer to be dedicated to the project (if not already within the design team). ▫ Carry out initial massing studies. These must include consideration of Passivhaus i.e., form factor and orientation, to help minimise the costs of achieving Passivhaus classic, plus, or premium.
SKA Rating	▫ Agree whether professional certification will be necessary for SKA Rating ▫ Identify good practice measures in scope to be achieved
Light and Daylight	▫ Appoint architect and/or M&E consultant with understanding of façade design for natural daylight, and capability in the use of the tool Climate-Based Daylight Modelling (CBDM). See required targets as set out in Part 2 of the sustainability design guide for detail. ▫ Identify site and client brief constraints as they relate to solar access and natural light. ▫ Consider options around massing and position of building(s) for optimal solar access. ▫ Ensure that the design team is fully briefed regarding well daylit buildings, and with regard for avoiding either over or under-glazing of facades.

Thermal Comfort	- Appoint M&E consultant with expertise in dynamic thermal modelling. - Identify site and client brief risks as that relate to opening window restrictions, solar access and glazing area. - Establish the space usage types intended for the project and identify areas with high internal gains. - Consider options around masing and positioning of building to avoid major overheating risks in spaces with high internal gains. - Ensure the design team is fully briefed regarding the overheating risks and with regard for avoiding over glazing of facades. - Start early discussions on construction types, light weight v's heavy weight with exposed thermal mass. - Identify potential acoustic restraints that are applicable for the project.
Indoor Air Quality	- Establish the range of space usage types intended for the project and agree which Air Quality Standards will apply to the building (Such as BB101). - Agree likely concept-level servicing strategies for each usage type, in principle. - Issue any necessary guidance to the design team regarding site massing issues. *e.g., if a usage type is intended to be entirely naturally ventilated, then building plan depth will need to be limited accordingly, and floor-to-floor heights may need to increase to allow sufficient ventilation flow to the rear of spaces.* - Establish the nature of the site in terms of external air quality, and if necessary, commission an air quality survey. *Understanding prevailing wind direction is also important if there are nearby sources of pollution – e.g., a busy road. Output from either desk or site studies should be used to guide the likely principles of ventilation design incorporated in later stages of the project.*
Water	Identify water supply to site.
Materials	Ensure materials targets are within SKA Rating scope
Low and Zero Carbon technologies	- Identify suitable options for renewable and low carbon technologies which offer real benefit in terms of carbon reduction and running costs. - As a minimum, consider the following technologies: - District or community heating - Heat pumps (air, ground water or other, as appropriate) - Solar PV - Wastewater heat recovery - Identify any other suitable technologies or new innovations for further investigation.

	Note: As electrical energy will be a major element of the building's carbon emissions, Solar PV is a key technology for achieving carbon reduction. This should be considered in decisions over form and orientation of the building to provide adequate unshaded areas suitable for PV panels.
Environmental Net Gain – Residual Carbon	☐ Confirm what carbon factors that are to be used for the project. ☐ Confirm the residual fund carbon price for operational and embodied carbon.
Carbon reporting (measurement and verification)	☐ Identify key targets and performance criteria that will feed into the carbon reporting requirements moving forward.
Soft Landings	☐ Identify a client-side Soft Landings champion. ☐ Roles and responsibilities of each stakeholder in relation to Soft Landings have been identified. ☐ Chain of command should be identified, and the decision-making protocols should be agreed. ☐ Ideally a Soft Landings lead should be identified on the Project Team side. ☐ Soft Landings leaders to arrange a stakeholder workshop should be arranged to gather thoughts with a review of lesson learned from similar previous projects. ☐ Workshop outcomes should be recorded and implemented during project. ☐ Project success criteria should be defined, each success criterion should have an evaluation method associated with it. ☐ Intermediate evaluation workshops have been planned for. ☐ Soft Landings gateways have been created.
Circular Economy	☐ Client workshop to discuss and review any circular economy opportunities that could influence the design and approach taken. ☐ Refer to the 5 key areas as highlighted in part 2 of the sustainability guide
Other	☐ Workshop on integration with University of Exeter Heat Decarbonisation Strategy

RIBA Stage 2

	**RIBA Stage 2: Concept Design**
Outcome	▫ Concept approved by client and aligned to project brief.
Gateway	▫ RIBA Stage 1 signed off.
Whole Life Carbon assessment	▫ WLC analysis of design options for major built systems (structure, cladding, mechanical etc.). ▫ Estimate for the building's proposed embodied carbon performance calculated. ▫ Different construction approaches should be explored.
Environmental Net Gain - Biodiversity	▫ Early-stage analysis and feasibility into achieving a positive increase in net biodiversity.
Net Zero Operational Energy and Passivhaus	▫ Develop outline strategies for air tightness and insulation. ▫ Carry out initial PHPP modelling to establish fabric performance requirements. ▫ Establish appropriate glazing fractions for each elevation, checking for overheating risk where required. ▫ MVHR strategy local v's centralised.
SKA Rating	▫ Develop design that meets criteria of good practice measures
Light and Daylight	▫ Concept designs to be tested against daylight standards using early-stage tools, and informal reporting used to record progress towards targets. ▫ Consider solar shading, window size and position, and other key factors affecting solar access, view, glare avoidance etc. ▫ Carry out full CBDM in line with targets that have been set using analysis on a selection of rooms to guide overall building massing and elevation design. If there are risks to daylight compliance, then consider a whole-building model to guide the façade design before Planning applications are submitted. ▫ Consider room depths and begin to plan arrangement of spaces for EML scoring if targeting the Preferred Standard.

Thermal Comfort	▫ Develop strategy for controlling summertime overheating, prioritising passive measures including orientation, natural ventilation, thermal mass, and solar shading. ▫ Glazing fractions should be carefully considered for each space and should typically be less than 25% of façade area unless effective shading can be provided. Potential for overheating in the spring and autumn should also be considered for highly glazed spaces, when the lower sun can reduce the effectiveness of shading, while external temperatures are too low for natural ventilation. *Careful consideration needs to be taken based on how the potential heat network is distributed throughout the buildings. Ideally shared vertical risers with as limited as possible horizontal distribution runs would be the preferred solution to reduce heat losses from the distribution pipework. Corridors, circulation spaces and risers should have controlled ventilation to avoid unwanted heat build-up. The distribution losses in these areas must be included as part of the thermal comfort analysis and must not be ignored. The use of ambient loops should also be considered.* *Initial thermal modelling may be necessary for sample spaces to demonstrate that proposed façade and ventilation strategies are able to deliver within overheating limits.*
Indoor Air Quality	▫ During concept design overarching ventilation strategy by space usage should be firmed up, and pre-Planning architectural treatments of facades agreed in line with this. *e.g., the incorporation of natural ventilation louvres in the façade treatment if required, or careful sizing of windows for natural ventilation. Space may be required for mechanical systems that are required to ensure good IAQ, and these may well be visible if roof mounted and hence a Planning issue.* ▫ Any uncertainty about external air quality at the proposed site should be resolved at this stage.
Water	▫ Complete early-stage analysis and feasibility study into the viability of boreholes, rainwater and grey water harvesting based on whole life cycle methodology.
Low and Zero Carbon technologies	▫ Carry out feasibility study of suitable renewable and low carbon technologies for site. ▫ Base on realistic building total energy consumption and loads (to be taken from PHPP modelling). ▫ Estimate capital costs for each technology. ▫ Calculate energy and carbon savings. ▫ Financial analysis including Internal Rate of Return (IRR) and Payback against a baseline*, utilising agreed fuel and maintenance costs and inflation rates. ▫ Initial plant room sizing, careful consideration of riser locations and routes and other practical implications including maintenance. ▫ Carry out feasibility study of suitable renewable and low carbon technology opportunities for wider site. *Note: The baseline would normally be a building with gas boilers for heating and hot water, and no renewable energy systems.* *Note: When using heat pump technology, the GWP for the type of refrigerant needs to be considered and clearly stated.*
Environmental Net Gain – Residual Carbon	▫ Identify and report on the predicted residual carbon based on the stage 2 design options. ▫ Calculate and report the financial residual fund payment that would be required to help inform the decision-making process.
Carbon reporting (measurement and verification)	▫ Workshop to discuss metering and monitoring strategy to allow accurate monitoring of carbon emissions and energy use pre and post construction.
Soft Landings	▫ Soft landings workshop.

	□ Insights from previous lessons learnt are collected from design team members. □ As new organisations such as specialist subcontractors or end users become involved in the project, they should be instructed in the Soft Landings procedures and their roles in them. □ Success criteria and performance targets have been revisited and readjusted where needed. □ Changes to success criteria and/or performance targets and any other important information have been recorded and communicated with the project team.
Circular Economy	□ Carryout a client and design team workshop to discuss opportunities. □ Identify and log circular economy options following workshop.
Other	□ Workshop on integration with University of Exeter Adaptive Estates Strategy □ Workshop on integration with University of Exeter Heat Decarbonisation Strategy

RIBA Stage 3

	**RIBA Stage 3: Developed Design - Spatial Coordination**
Outcome	☐ Architectural and engineering information spatially coordinated.
Gateway	☐ RIBA Stage 2 signed off.
Whole Life Carbon assessment	☐ A carbon assessment should be prepared using the cost plan's material descriptions and quantities. (This will be indicative but will form the baseline carbon budget and will be a granular analysis of the project's WLC cost in as much detail as can be provided by the design team). ☐ A table of detailed options and their respective impacts on the carbon budget should be prepared to enable the design team to choose low carbon and preferably cost neutral options. *Note: Planning applications may require WLC assessments in the future.*
Environmental Net Gain - Biodiversity	☐ BREEAM credit analysis and confirmation of achieving the applicable credits. Carryout a workshop to review the proposed options to allow the strategy to be confirmed and signed off by the University.
Net Zero Operational Energy and Passivhaus	☐ Establish strategies for air tightness and insulation (this may drive towards a construction system). ☐ Thermal bridge workshop with architect and structural engineer. ☐ Develop the MVHR strategy, considering centralised v's local plant, distribution strategy, intakes, and exhausts. ☐ Initial hot water distribution calculations in PHPP. ☐ Initial U-value calculations. ☐ Identification of all thermal bridge junction types. ☐ Thermal bridge calculations for a selection of the most important junctions. ☐ Definition of airtightness testing requirements for contractor.

	▫ Engage with Certifier to clarify any unusual certification parameters. Carry out PHPP modelling including: o TFA calculated based on proposed layouts o Proposed glazing (including shading factors) o Mechanical ventilation (using proposed design flow rates) o Identify any significant thermal bridges and estimate impact o Carry out overheating analysis (see Thermal Comfort) o Architect to develop key 1:5 details, identifying strategy for air tightness and insulation. Review for buildability o Initial thermal bridging calculations on key details as required o Provide enough information for Certifier's initial check ▫ If contractor is appointed at this stage produce a Passivhaus specification document identifying Passivhaus requirements and the contractor responsibilities.
SKA Rating	▫ Assess whether design has met good practice measures identified and project has an indicative rating of gold certification
Light and Daylight	▫ Complete a whole-building CBDM model and score it against the targeted daylight criteria. ▫ Submit an interim compliance report detailing findings, and any corrective measures needed in the design. *Note: Challenges with daylight can usually be resolved through careful manipulation of window size and shading levels, but room depth is also a key criterion.*
Thermal Comfort	▫ Carry out dynamic thermal modelling for the whole building according to the CIBSE TM59 (accommodation) and TM52 (offices and other spaces) methodologies to test and verify the proposed design. ▫ Confirm and report on risks of cold drafts effecting the ventilation strategy. *The following CIBSE Design Summer Year (DSY) weather data must be used for assessing overheating risk, based on the UKCIP09 climate change scenarios.* o *2020 conditions: Plymouth 2020s High emissions scenario 90th percentile* o *2050 conditions: Plymouth 2050s Medium emissions scenario 90th percentile* o *2080 conditions: Plymouth 2080's Medium emissions scenario 90th percentile* *The thermal model should accurately represent the proposed building in terms of geometry, shading, glazing areas, constructions, and internal gains. Note that windows and doors should only be modelled as opening when external temperatures are sufficient to avoid cold draughts (as required by Passivhaus comfort criteria).* ▫ Demonstrate using the modelling that overheating limits described in CIBSE TM52/59 are not exceeded for the current weather file (2020) based on DSY 1, 2 and 3. ▫ As a minimum, demonstrate future adaptivity of the building design can meet the TM59/52 limits when tested against the future weather file (2050 and 2080) using DSY 1,2 and 3 for each. For the preferred standard, the proposed building design should be TM52/59 compliant for the future weather file.

	▫ The results of the modelling must be presented to the University to help them assess the risk of design decisions and consider level of future proofing and flexibility in the design that may be required for the future. *The modelling should be carried out in coordination with the architectural design, particularly in respect of the planning submission.*
Indoor Air Quality	▫ MEP Consultant and architect should work together to begin to produce a coordinated ventilation strategy in line with IAQ ambitions for the project. ▫ MEP consultant to confirm that the modelling shows that the carbon dioxide levels are within the requirements as per BB101 criteria. ▫ Report to describe how the ventilation strategy would adapt or cope with a COVID/pandemic scenario. *This should include details such as suitably sized risers for ventilation ductwork, and more detailed window and louvre designs on the façade with a sufficient free area for both winter and summer IAQ. There is overlap here with Thermal Comfort, and the design should be optimised with both these human health issues in mind.*
Water	▫ BREEAM credit analysis and confirmation of achieving the credits: o BREEAM 2018 WAT01: Water Consumption (5 credits) o BREEAM 2018 WAT 02: Water Monitoring (1 credit) ▫ Carryout a workshop to review proposed water fittings and systems to allow the strategy to be confirmed and signed off by the University.
Low and Zero Carbon technologies	▫ Finalise strategy for renewable and low carbon technologies. ▫ Plant and distribution space to be confirmed and incorporated into plans. ▫ Update calculations carried out at Stage 2 with new modelling data and information from specialist installers to predict financial and carbon performance. ▫ Consider the visual impact of external plant or equipment and ensure it is captured for purposes of planning application.
Environmental Net Gain – Residual Carbon	▫ An estimate of the residual carbon associated with the building's operational energy should be calculated for the lifespan of the building. ▫ An estimate of the embodied carbon associated with the building's construction should be calculated for the lifespan of the building. ▫ Environmental net gains schemes that allow for offsetting residual carbon should be identified. ▫ The investment into the Residual Carbon fund should be calculated to be paid as a single sum after practical completion of the project.
Carbon reporting (measurement and verification)	▫ Confirm the proposed metering and monitoring strategy to allow accurate monitoring of carbon emissions and energy use pre and post construction. ▫ Make sure whole life carbon assessment has been carried out and is being reported. ▫ If tendering for a contractor at stage 3 make sure monitoring and metering requirements during construction are clearly specified along with any specific KPIs.
Soft Landings	▫ Design reviews and reality checking workshops to be held. Reviews are best undertaken when options are relatively clear, allowing discussion to be focused.

	☐ The client should provide the facilities manager, or those responsible for the ongoing management and maintenance of the building, with a view to start planning their long-term building management plan. ☐ Review servicing budget and models predicting annual running costs of building, including water and energy consumption. ☐ Success criteria and performance targets have been revisited and readjusted where needed. ☐ Changes to success criteria and/or performance targets and any other important information have been recorded and communicated with the project team.
Circular Economy	☐ Confirm circular economy opportunities to be taken forward to detailed design.
Other	☐ Confirm Heat Decarbonisation Strategy opportunities to be taken forward to detailed design

RIBA Stage 4

	**RIBA Stage 4: Technical Design**
Outcome	◻ All design information required to manufacture and construct the project completed.
Gateway	◻ RIBA Stage 3 signed off.
Whole Life Carbon assessment	◻ Low carbon choices made during Stage 3 are now integrated into the detailed drawings, specifications, and tender documentation. ◻ Suppliers assessed for their ability to provide relevant information with respect to fabrication methodology, factory location, energy use type, treatment of waste etc. ◻ Carbon budget updated and included within the tender documentation. ◻ Tender documentation ensures that the competing contractors understand the WLC requirements, the goals and process of delivering and monitoring carbon reductions during construction. ◻ Process needs to be tailored to engage with, but not burden, the supply chain.
Environmental Net Gain - Biodiversity	◻ Carry out the detailed design and provide comprehensive specification referring to the BREEAM credits to make sure these are captured by the contractor.
Net Zero Operational Energy and Passivhaus	◻ Final junction detailing demonstrating buildability for airtightness and insulation continuity. ◻ Review of airtightness line on each drawing and identification of airtightness requirements for service penetrations. ◻ Detailed construction build-ups with associated U-value calculations. ◻ Detailed build-ups of all external elements including thickness and conductivity of all materials. ◻ Thermal bridge workshop to review thermal bridge lengths and psi-values. ◻ Detailed thermal bridge calculations to determine psi-values for all junctions. ◻ MVHR layout including duct distribution and measurement of length of intake and exhaust ducts for all systems.

	▫ Detailed specifications of all key Passivhaus products including windows, doors, airtightness membranes, tapes, and seals, MVHR units etc. ▫ Produce Passivhaus specification identifying all Passivhaus requirements and contractor responsibilities. ▫ Liaison with Passivhaus certifier for pre-construction design check. ▫ Architect to develop comprehensive set of 1:5 details, to be reviewed for air tightness and insulation buildability. ▫ If not using certified products or systems, check performance data in detail. ▫ Detailed PHPP modelling including: o Proposed fabric constructions and products (glazing, MVHR) o Thermal bridges o Primary energy assessment- appliances, building services o Review proposed products including: • Glazing • Insulation • Building services • MVHR selections
SKA Rating	▫ Assess whether design has met good practice measures identified and project has an indicative rating of gold certification
Light and Daylight	▫ Incorporate any changes into the whole-building model and ensure that overall compliance is achieved. ▫ Detail position of workstations, desks etc. for compliance with WELL Building requirements to achieve L03 and related credits. ▫ Agree room finishes and specify average surface reflectance required.
Thermal Comfort	▫ The building design should be monitored for changes which could impact on overheating risk, and the thermal model updated as required. Areas with excessive overheating risk should be resolved prior to tender.
Indoor Air Quality	▫ Thermal model should be used to assess predicted IAQ outcomes based on agreed design (this assessment is not the same as a Part L compliance model and required the designers to model predicted occupancy and air flows from the real design). It is recommended that full thermal model for assessing overheating conditions is used. ▫ Internal surface finishes should be considered in detail, to avoid or minimise off-gassing and minimise associated VOC levels within the occupied spaces.
Water	▫ Carry out the detailed design and provide comprehensive specification referring to the BREEAM credits to make sure these are captured by the contractor.

Low and Zero Carbon technologies	▫ Incorporate renewable and low carbon systems into M&E detailed design. ▫ Consult with suppliers and installers to ensure that plant spaces and hydraulic designs are suitable for contractor design elements.
Environmental Net Gain – Residual Carbon	▫ Refine estimate of the residual carbon associated with the building's operational energy for the lifespan of the building. ▫ Refine estimate of the embodied carbon associated with the building's construction for the lifespan of the building. ▫ Environmental net gains schemes that allow for offsetting residual carbon should be confirmed. ▫ The refined investment into the Residual Carbon fund should be calculated to be paid as a single sum after practical completion of the project.
Carbon reporting (measurement and verification)	▫ If tendering for a contractor at this stage, make sure monitoring and metering requirements during construction are clearly specified along with any specific KPIs. ▫ Metering and monitoring requirements should be captured as part of the MEP detailed design package. ▫ Whole life carbon to be reported based on detailed design information (this will also inform the residual fund calculations).
Soft Landings	▫ Ongoing design reviews and reality checking workshops are held. ▫ The client should ensure that the requirements of Soft Landings are thoroughly written into the scope of the contract. *BSRIA Guide BG45 can assist with tender documentation.* ▫ Success criteria and performance targets have been revisited and readjusted where needed. ▫ Changes to success criteria and/or performance targets and any other important information have been recorded and communicated with the project team.
Circular Economy	▫ Circular economy opportunities captured with in the detailed design.
Other	▫ Heat Decarbonisation Strategy opportunities captured with in the detailed design.

RIBA Stage 5

	**RIBA Stage 5: Manufacturing and Construction**
Outcome	▫ Manufacturing, construction, and commissioning completed.
Gateway	▫ RIBA Stage 4 signed off.
Whole Life Carbon assessment	▫ Actual carbon impacts of the construction process to be monitored against the carbon budget and any agreements made on completion of the tender process. ▫ Reporting at regular intervals of construction, as appropriate for project size and scope. ▫ Reporting consists of interim updates to the carbon budget based on actual data from site activities, including transport movements and waste disposal.
Environmental Net Gain - Biodiversity	▫ Site inspections and review to make sure the measures are being implemented.
Net Zero Operational Energy and Passivhaus	▫ Contractor to meet all requirements as set out in the contractor specification and requirements document. Such as: o low energy construction workshops on-site o Site manager and team training on construction quality requirements covering insulation and airtightness o Preparation of Passivhaus toolbox talk material for site team inductions o Regular Passivhaus construction quality assurance site visits (depending on the size of the scheme – at least six) combined with regular visits o Preparation of associated Passivhaus construction quality assurance site visits reports and feedback to construction team highlighting key actions required o Develop existing site quality tracker in include Passivhaus items and update regularly o Leak finding airtightness tests o airtightness test pre-completion o Compile site evidence and issue to Certifier o Stage 5 PHPP model of each building leading to the final 'as built' PHPP model

	▫ Check compliance against Passivhaus requirements. ▫ Liaison with Passivhaus certifier for construction check. ▫ Review contractor's submittals for products and systems. ▫ Witnessing of final air pressure test.
Light and Daylight	▫ Ensure that glazing specification in particular is delivered as designed. ▫ Internal finishes should match those specified in the design, with finishes selected to achieve the aggregate surface reflectance.
Thermal Comfort	▫ Review contractor submittals for products and systems such as glazing. In particular, ensure that glazing g-values are as required by the thermal model.
Indoor Air Quality	▫ Monitor all construction work to ensure that ventilation systems, both natural and mechanical, are built to specification, and control systems correctly provisioned to ensure simple operation.
Water	▫ Site inspections to make sure the measures are being implemented.
Low and Zero Carbon technologies	▫ Monitor installation of renewable and low carbon technologies to ensure compliance with design. ▫ Witness commissioning and ensure controls are correctly set up.
Environmental Net Gain – Residual Carbon	▫ Environmental net gains schemes that allow for offsetting residual carbon should be agreed with client team. ▫ The investment into the Residual Carbon fund should be agreed with client team.
Carbon reporting (measurement and verification)	▫ On-site construction related energy use to be reported as per tender specification document. ▫ On-site reporting to be reviewed against key KPIs that have been targeted.
Soft Landings	▫ The construction team have been informed about the project's success criteria and the client's needs. ▫ The construction team have been made aware of their roles and responsibilities in relation to Soft Landings. ▫ All changes have been checked against the project's success criteria to ensure they would not affect them. ▫ All changes have been recorded and communicated with the project team. ▫ Plans have been made (both in terms of programme and resources) for the commissioning and handover periods.
Circular Economy	▫ Has the contractor implemented the circular economy opportunities?

Other	- Has the contractor implemented Heat Decarbonisation Strategy opportunities

RIBA Stage 6

	**RIBA Stage 6: Handover**
Outcome	□ Building handed over, Aftercare initiated, and Building Contract concluded.
Gateway	□ RIBA Stage 5 signed off.
Whole Life Carbon assessment	□ Post Project Completion a final review of the 'as built' information should be undertaken and a final assessment of the WLC impacts of the completed project produced. □ The final version of the WLC assessment to be included within the O&M manual. □ The final assessment to be compared to the initial carbon budgets and lessons to be learned identified.
Environmental Net Gain - Biodiversity	□ Make sure a maintenance and management plan are in place to make sure both new and existing biodiversity measures continue to thrive.
Net Zero Operational Energy and Passivhaus	□ Issue final Passivhaus Certification evidence to Certifier. □ Participate in client training, particularly for MVHR. □ Provide simple instructions for user at building handover. □ Passivhaus plaque and Certificate.
SKA Rating	□ Evidence from operation and maintenance manuals is gathered to prove that the performance benchmarks have been achieved. □ SKA Rating is confirmed
Light and Daylight	□ Check that building occupants are able to operate glare prevention measures such as blinds or external shades, and that operation of artificial lighting systems is straightforward and optimised for both human health and energy efficiency. □ Consider post-occupancy evaluation of satisfaction levels and monitoring of natural and artificial lighting levels (see Soft Landings section).
Thermal Comfort	□ As part of the soft landings handover requirements a simple user guide should be provided which covers the ventilation/heating and cooling strategy that has been put in place to provide a comfortable environment for the end user.
Indoor Air Quality	□ Mechanical ventilation systems must be carefully commissioned, including measurement of flow rates of exhaust and intakes, and balancing of supply and extract systems. □ Filter replacement must be scheduled, or BMS alarm systems set up to ensure that filters are changed regularly and IAQ maintained. □ Ideally some post-occupancy measurements of IAQ should be carried out to confirm that design intent is delivered in operation.
Water	□ Monitor and validate the systems to make sure they are set up and working as designed.
Low and Zero Carbon technologies	□ Participate in client training. □ Ensure all systems are operating as intended and maintenance schedules agreed.

	▫ Any innovative systems, or first-time systems must be closely monitored.
Environmental Net Gain – Residual Carbon	▫ Investment into the Residual Carbon fund should be paid as a single sum.
Carbon reporting (measurement and verification)	▫ Annual energy use and renewable energy generation on-site must be reported and independently verified in-use each year for the first 5 years.
Soft Landings	▫ The facilities team has been fully trained and has enough knowledge about the building and how it works. ▫ All the guides necessary for the operation of the building have been completed and are available. ▫ A maintenance contract is in place. ▫ A migration plan has been developed and is ready to be followed. ▫ A suitable workplace has been prepared for the aftercare team.

RIBA Stage 7

	**RIBA Stage 7: Use**
Outcome	▫ Building used, operated, and maintained efficiently.
Gateway	▫ RIBA Stage 6 signed off.
Whole Life Carbon assessment	▫ Review as part of soft landings appraisal.
Environmental Net Gain - Biodiversity	▫ Review as part of soft landings appraisal.
Net Zero Operational Energy	▫ Review as part of soft landings appraisal.
SKA Rating	▫ Complete post occupancy assessment stage
Light and Daylight	▫ Review as part of soft landings appraisal.
Thermal Comfort	▫ Review as part of soft landings appraisal.
Indoor Air Quality	▫ Review as part of soft landings appraisal.
Water	▫ Review as part of soft landings appraisal.
Low and Zero Carbon technologies	▫ Review as part of soft landings appraisal.
Environmental Net Gain – Residual Carbon	▫ Review as part of soft landings appraisal.
Carbon reporting (measurement and verification)	▫ Report on energy and carbon use and compare to as designed PHPP model.

Soft Landings	▫ The aftercare team have been available on site to support the end users. ▫ The aftercare team provided initial support to the facilities team to ensure they have a good understanding of the building and how to control and manage it. ▫ The aftercare team dealt with emerging issues and carried out fine-tuning when needed. ▫ Lessons learned have been captured and disseminated to the project team. ▫ The facilities management team, with the support of the aftercare team when needed, has logged relevant performance data. ▫ Post Occupancy Evaluation reviews have been carried out. ▫ The aftercare team, with the support of the facilities manager, has addressed issues identified after the first performance evaluation and Post Occupancy Evaluation reviews. ▫ Changes due to fine-tuning and other necessary activities have been recorded. ▫ Communication to the end users has been completed. ▫ End of year reviews have been completed. ▫ Lessons learned have been recorded and passed to the relevant teams. ▫ The facilities team can manage and control the building without referring back to the project team. ▫ Post Occupancy Evaluation. ▫ Review and cost analysis with QS/Cost Consultant. ▫ Hold a ‘Lessons Learnt’ Workshop at 6 months post Practical Completion and issue report. ▫ Performance review of data from active building. ▫ Satisfaction Survey at 12 months post Practical Completion. ▫ Building Performance Evaluation at 18 months post Practical Completion. ▫ Review of Operation and Maintenance Costs lead by client. ▫ Final report with everything above documented.
Circular Economy	▫ Review as part of soft landings appraisal.

UNIVERSITY OF EXETER

OUR EFFECT

Sustainability Design Guide

Part 4 – Refurbishment

REVISION SUMMARY

Issue	Document prepared		
	Name	Signature	Date
Part 4 Draft	Oliver Fuller		24.05.21
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CONTENTS

INTRODUCTION 84
REFURBISHMENTS >£500K 85
Net Zero Carbon goal and methodology 85
EnerPHit RETROFIT PLAN (ERP) 86
RIBA SUSTAINABILITY MEASURES CHECKLIST 87
RIBA Stage 0 87
RIBA Stage 1 89
RIBA Stage 2 92
RIBA Stage 3 95
RIBA Stage 4 99
RIBA Stage 5 102
RIBA Stage 6 105
RIBA Stage 7 107

INTRODUCTION

This document should be read in conjunction with Part 1 and part 2 of the sustainable design guide.

Below is a stage-by-stage project checklist for the sustainability design measures covered in Part 2 of the sustainability design guide.

RIBA Stage 0 is critical in defining the brief that is going be taken forward into the project. Any derogations will need to be clearly explained and signed off by the client at the end of each stage.

An **Excel template** for the below checklist is available which contains additional columns for tracking, assigning responsibility and adding additional comments. This is to be used as a key tracker document throughout the design process.

REFURBISHMENTS >£500K

Net Zero Carbon goal and methodology

All refurbishment projects should have the ambition to target zero carbon operational energy.

Where possible, refurbishment projects should first look to achieve Passivhaus Certification as part of net zero carbon operational energy goal.

Most refurbishments projects will struggle to achieve full passivhaus requirements and therefore as a minimum should look to achieve the EnerPHit standard.

All Refurbishment projects (>£500k - this is construction cost inclusive of VAT) will target EnerPHit Certification and will include the development of a retrofit plan to 2050.

Whole Life Carbon assessment are still required and will be used to record embodied carbon related to each phase of the design.

Main Objective
Net Zero Carbon operational energy and net environmental gain

Or

Method to achieve goal. Where the Passivhaus framework cannot be applied in a major refurbishment approach, the EnerPHit Standard for existing buildings should be applied.

Refurbishment with the EnerPHit Standard uses Passivhaus components for all relevant structural elements to achieve extensive improvements with respect to thermal comfort, structural integrity, cost-effectiveness, and energy requirements.

EnerPHit certification is only possible for buildings for which modernisation to the Passivhaus Standard for New Builds would be uneconomical or impossible in practical terms due to the existing building characteristics or building substance.

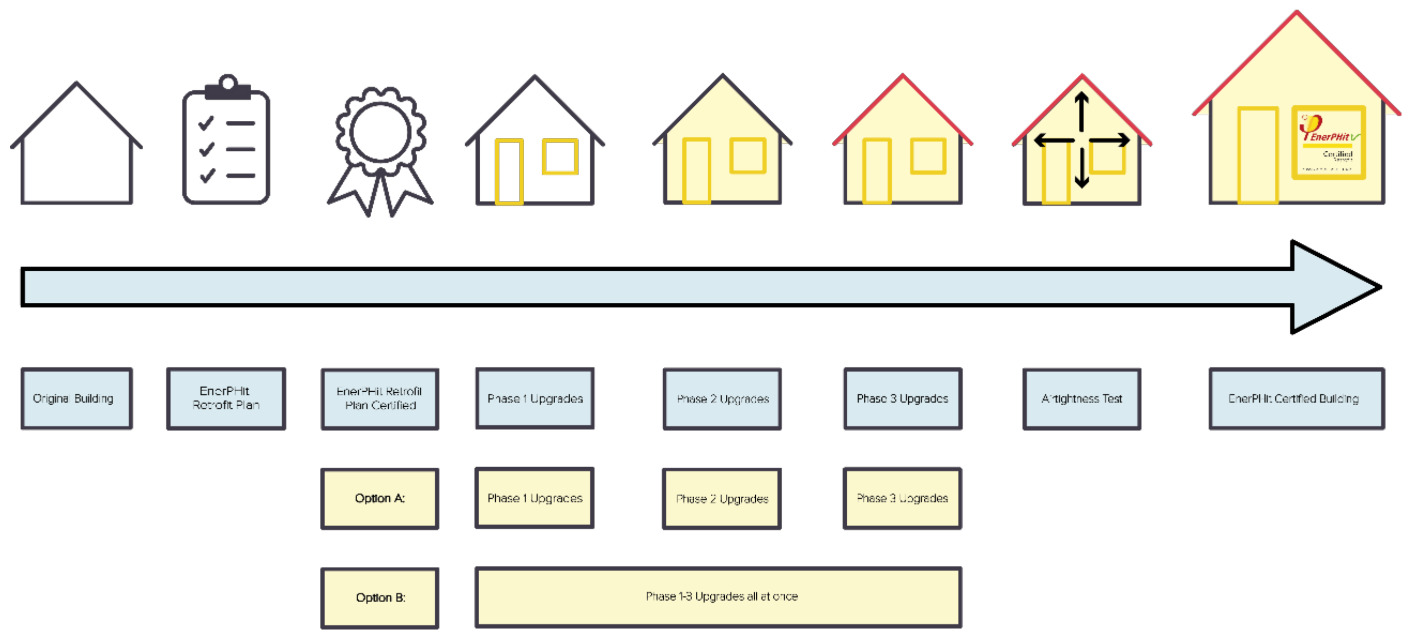
Stepwise retrofit

If EnerPHit Certification cannot be achieved within a single phase of design, then a Retrofit Plan is required that will show a pathway to Certification for the building. Ideally both options are provided to the client during RIBA Stage 0-2 so they can make an informed decision.

Pre-Certification

The preparation of a comprehensive EnerPHit Retrofit Plan (ERP) is required.

Once approved, the ERP will allow a pre-certificate, providing a detailed pathway for the University and design team to achieve the EnerPHit Standard.



EnerPHit RETROFIT PLAN (ERP)

If energy retrofits are carried out in several individual consecutive steps, then preparation of a comprehensive ERP up to 2050 is required.

This plan aims to give a feasible opportunity for the University to apply the Passivhaus methodology in a step-by-step approach to the building, whilst using the EnerPHit standard. Its aim is to implement individual retrofit measures before 2050. For this approach to be successful a full overview of the project from start to completion must be undertaken, this not only ensures high levels of energy efficiency are achieved but also keep costs to a minimum.

A Passivhaus Certifier will confirm the ERP meets all the required criteria and a coherent retrofit plan exists.

- The ERP is compiled through the PHPP tool and requires information on:
- Qualities Quality of components before and after the refurbishment
- Recommendations for component connections
- Intended dates to carry out retrofit steps
- Investment costs and energy costs for all steps

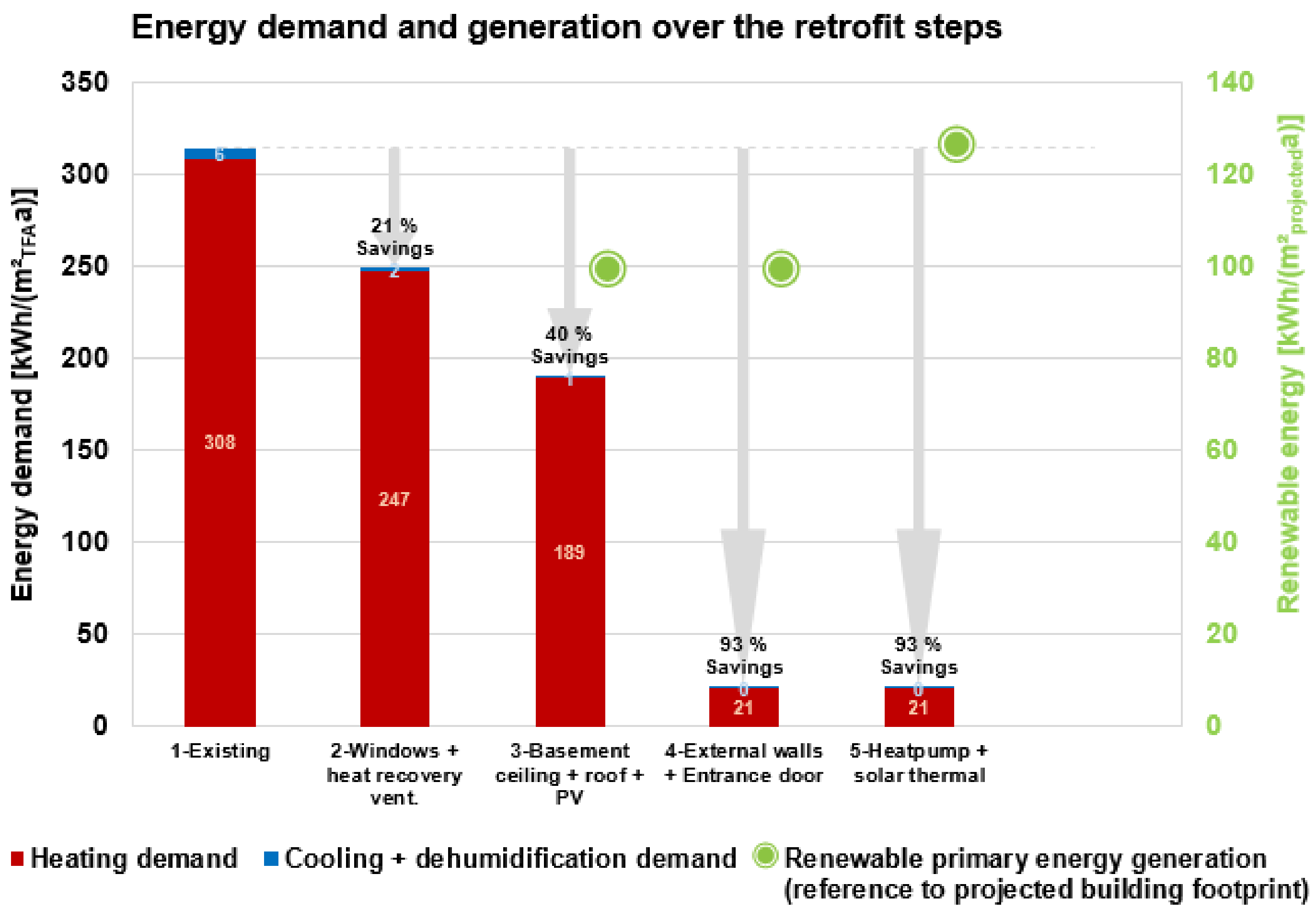


Figure 9: Example overview chart from EnerPHit Retrofit Plan

Efficiency parameters and corresponding results are automatically transferred from the PHPP into the ERP, all that needs to be done is entry of information regarding schedule, costs recommendation for each of the retrofit steps. By doing so it is possible to provide a comprehensive document to the client so that they can better understand the specific concepts and the potential of the retrofit process.

Sequential retrofitting of components

Entering improvement of building components is straightforward, beginning with a variant for the existing building, probably with poor insulation, poor window performance, ventilation by windows and old heating systems or distribution concepts.

PHPP offers a wide range of parameters which have been predefined to be calculated as parameters automatically. In the PHPP tool include the improved parameters of components, for example, insulation layers or improved quality of windows. Other parameters such as shading, ventilation concepts, heating, or cooling systems, can also be adapted using pre-defined entries.

Other parameters can be entered in the user-defined section if not available as automatic selections.

Sequential retrofitting of building parts / section

Entering retrofitted building parts or extensions is also possible, it can be used to record extensions of buildings, or adding/demolition of building components (e.g., the insertion of a window into a wall during a retrofit step).

RIBA SUSTAINABILITY MEASURES CHECKLIST

RIBA Stage 0

	**RIBA Stage 0: Strategic Definition**
Outcome	☐ Confirm the client requirements
Whole Life Carbon assessment	☐ Confirm that WLC assessments will be required on the project. ☐ Confirm the embodied carbon targets for the project.
Environmental Net Gain - Biodiversity	☐ Confirm that a net biodiversity gain will be targeted on the project.
Net Zero Operational Energy and Passivhaus/EnerPHit	☐ Confirm Net Zero Carbon operation will be targeted on the project ☐ Will the project target full Passivhaus certification and confirm what level is to be achieved (Classic, Plus, or Premium)? ☐ Will the project target EnerPHit certification
SKA Rating	☐ Confirm the SKA Rating will be applied on this project.
Light and Daylight	☐ Confirm targets for natural daylight will be required
Thermal Comfort	☐ Confirm targets for thermal comfort will be required
Indoor Air Quality	☐ Confirm targets for indoor air quality will be required
Water	☐ Confirm targets for water consumption and measurement will be required
Materials	☐ Confirm targets for fit-out and construction materials will be required
Low and Zero Carbon technologies	☐ Confirm that residual carbon offsetting can only take place once all other measures have been met.

	▫ Confirm that a residual carbon fund will be set up for the project for operational carbon. ▫ Confirm that a residual carbon fund will be set up for both operational and embodied carbon.
Environmental Net Gain – Residual Carbon	▫ Confirm that residual carbon offsetting can only take place once all other measures have been met. ▫ Confirm that a residual carbon fund will be set up for the project for operational carbon. ▫ Confirm that a residual carbon fund will be set up for both operational and embodied carbon.
Carbon reporting (measurement and verification)	▫ Confirm that carbon reporting is required for the project and template that is to be used.
Soft Landings	▫ Confirm Soft Landings will be applied on the project
Circular Economy	▫ Confirm circular economy opportunities will be reviewed and applied to the project.
Other	▫ Has the project been run past the academics to encourage engagement and to identify potential collaborations? ▫ Confirm if projects will be linked to academic research or studies. ▫ Are there fabric and MEP condition survey reports available? ▫ Review integration with University of Exeter Heat Decarbonisation Strategy

RIBA Stage 1

	**RIBA Stage 1: Preparation and Briefing**
Outcome	▫ Project Brief approved by the client and confirmed that it can be accommodated on site
Gateway	▫ RIBA Stage 0 signed off
Whole Life Carbon assessment	▫ Appoint a WLC assessment champion or appoint a separate assessor if not available within the core design team already. ▫ The scope of the WLC Assessment is decided, ideally all modules (A,B,C and D) should be covered and over all RIBA stages. ▫ Refer to UKGBC (2017). Embodied carbon: developing a client brief.
Environmental Net Gain - Biodiversity	▫ Appoint a qualified ecologist who is experienced in undertaking calculations required for Biodiversity Metric and gathering evidence for BREEAM credits.
Net Zero Operational Energy and Passivhaus/EnerPHit	▫ Appoint a certified Passivhaus/EnerPHit consultant/designer to be dedicated to the project. (if not already within the design team) ▫ Initial massing studies for consideration of Passivhaus i.e., form factor and orientation, to help review feasibility and the costs of achieving Passivhaus or EnerPHit on this project. ▫ Initial surveys of building fabric to identify opportunities or risks for EnerPHit
SKA Rating	▫ Agree whether professional certification will be necessary for SKA Rating ▫ Identify good practice measures in scope to be achieved
Light and Daylight	▫ Appoint architect and/or M&E consultant with understanding of façade design for natural daylight, and capability in the use of the tool Climate-Based Daylight Modelling (CBDM) ▫ Identify site and client brief constraints as they relate to solar access and natural light. ▫ Consider options around massing and position of building(s) for optimal solar access.

	▫ Ensure that the design team is fully briefed regarding well daylit buildings, and with regard for avoiding either over or under-glazing of facades.
Thermal Comfort	▫ Appoint M&E consultant with expertise in dynamic thermal modelling ▫ Identify site and client brief risks as they relate to solar access and glazing area. ▫ Establish the space usage types intended for the project and identify areas with high internal gains. ▫ Consider options around masing and positioning of building to avoid major overheating risks in spaces with high internal gains. ▫ Ensure the design team is fully briefed regarding the overheating risks and with regard for avoiding over glazing of facades. ▫ Identify potential acoustic restraints that are applicable for the project.
Indoor Air Quality	▫ Establish the range of space usage types intended for the project and agree which Air Quality Standards will apply to the building (such as BB101). ▫ Agree likely concept-level servicing strategies for each usage type, in principle. ▫ Issue any necessary guidance to the design team regarding site massing issues *e.g., if a usage type is intended to be entirely naturally ventilated, then building plan depth will need to be limited accordingly, and floor-to-floor heights may need to increase to allow sufficient ventilation flow to the rear of spaces.* ▫ Establish the nature of the site in terms of external air quality, and if necessary, commission an air quality survey. *Understanding prevailing wind direction is also important if there are nearby sources of pollution – e.g., a busy road. Output from either desk or site studies should be used to guide the likely principles of ventilation design incorporated in later stages of the project.*
Water	▫ Identify water supply to site
Materials	▫ Ensure materials targets are within SKA Rating scope
Low and Zero Carbon technologies	▫ Identify suitable options for renewable and low carbon technologies which offer real benefit in terms of carbon reduction and running costs. ▫ As a minimum, consider the following technologies: o District heating (especially for DHW demand) o Heat pumps (air, ground water or other, as appropriate) o Solar PV o Wastewater Heat Recovery (can significantly reduce hot water demand in student accommodation) ▫ Identify any other suitable technologies or new innovations for further investigation.

	Note: As electrical energy will be a major element of the building's carbon emissions, Solar PV is a key technology for achieving carbon reduction. This should be considered in decisions over form and orientation of the building to provide adequate unshaded areas suitable for PV panels.
Environmental Net Gain – Residual Carbon	☐ Confirm what carbon factors that are to be used for the project. ☐ Confirm the residual fund carbon price for operational and embodied carbon.
Carbon reporting (measurement and verification)	☐ Identify key targets and performance criteria that will feed into the carbon reporting requirements moving forward
Soft Landings	☐ Identify a client-side Soft Landings champion. ☐ Roles and responsibilities of each stakeholder in relation to Soft Landings have been identified. ☐ Chain of command should be identified, and the decision-making protocols should be agreed. ☐ Ideally a Soft Landings lead should be identified on the Project Team side. ☐ Soft Landings leaders to arrange a stakeholder workshop should be arranged to gather thoughts with a review of lesson learned from similar previous projects. ☐ Workshop outcomes should be recorded and implemented during project. ☐ Project success criteria should be defined, each success criterion should have an evaluation method associated with it. ☐ Intermediate evaluation workshops have been planned for. ☐ Soft Landings gateways have been created.
Circular Economy	☐ Client workshop to discuss and review any circular economy opportunities that could influence the design and approach taken. ☐ Refer to the 5 key areas as highlighted in part 2 of the sustainability guide
Other	☐ Workshop on integration with University of Exeter Heat Decarbonisation Strategy

RIBA Stage 2

	**RIBA Stage 2: Concept Design**
Outcome	◻ Concept approved by client and aligned to project brief
Gateway	◻ RIBA Stage 1 signed off
Whole Life Carbon assessment and Passivhaus	◻ WLC analysis of design options for major built systems (structure, cladding, mechanical etc.) ◻ Estimate for the building's proposed embodied carbon performance calculated.
Environmental Net Gain - Biodiversity	◻ Early-stage analysis and feasibility into achieving a positive increase in net biodiversity
Net Zero Operational Energy and Passivhaus/EnerPHit	◻ Develop outline strategies for air tightness and insulation. ◻ Surveys of the existing fabric to establish risks and opportunities for EnerPHit if not already carried out ◻ Carry out initial PHPP modelling to establish existing building performance. ◻ Produce an EnerPHit retrofit plan for the project. ◻ Review of existing glazing fractions for each elevation, checking for overheating risk where required.
SKA Rating	◻ Develop design that meets criteria of good practice measures
Light and Daylight	◻ Concept designs to be tested against daylight standards using early-stage tools, and informal reporting used to record progress towards targets. ◻ Consider solar shading, window size and position, and other key factors affecting solar access, view, glare avoidance etc. ◻ Carry out full CBDM analysis on a selection of rooms to guide overall building massing and elevation design. If there are risks to daylight compliance, then consider a whole-building model to guide the façade design before Planning applications are submitted. ◻ Consider room depths and begin to plan arrangement of spaces for EML scoring if targeting the Preferred Standard.

Thermal Comfort	▫ Develop strategy for controlling summertime overheating, prioritising passive measures including orientation, natural ventilation, thermal mass, and solar shading. ▫ Glazing fractions should be carefully considered for each space and should typically be less than 30% of façade area unless effective shading can be provided. Potential for overheating in the spring and autumn should also be considered for highly glazed spaces, when the lower sun can reduce the effectiveness of shading, while external temperatures are too low for natural ventilation. *Careful consideration needs to be taken based on how the potential heat network is distributed throughout the buildings. Ideally shared vertical risers with as limited as possible horizontal distribution runs would be the preferred solution to reduce heat losses from the distribution pipework. Corridors, circulation spaces and risers should have controlled ventilation to avoid unwanted heat build-up. The distribution losses in these areas must be included as part of the thermal comfort analysis and must not be ignored.* *Initial thermal modelling may be necessary for sample spaces to demonstrate that proposed façade and ventilation strategies are able to deliver within overheating limits.*
Indoor Air Quality	▫ During concept design overarching ventilation strategy by space usage should be firmed up, and pre-Planning architectural treatments of facades agreed in line with this. *e.g., the incorporation of natural ventilation louvres in the façade treatment if required, or careful sizing of windows for natural ventilation. Space may be required for mechanical systems that are required to ensure good IAQ, and these may well be visible if roof mounted and hence a Planning issue.* ▫ Any uncertainty about external air quality at the proposed site should be resolved at this stage.
Water	▫ Complete early-stage analysis and feasibility study into the viability of boreholes, rainwater and grey water harvesting based on whole life cycle methodology.
Materials	▫ Ensure materials selection is within SKA Rating scope
Low and Zero Carbon technologies	▫ Carry out feasibility study of suitable renewable and low carbon technologies for site ▫ Base on realistic building total energy consumption and loads (ideally taken from PHPP modelling) ▫ Estimate capital costs for each technology. ▫ Calculate energy and carbon savings. ▫ Financial analysis including Internal Rate of Return (IRR) and Payback against a baseline*, utilising agreed fuel and maintenance costs and inflation rates. ▫ Initial plant room sizing, careful consideration of riser locations and routes and other practical implications including maintenance. ▫ Carry out feasibility study of suitable renewable and low carbon technology opportunities for wider site *Note: The baseline would normally be a building with gas boilers for heating and hot water, and no renewable energy systems.*
Environmental Net Gain – Residual Carbon	▫ Identify and report on the predicted residual carbon based on the stage 2 design options. ▫ Calculate and report the financial residual fund payment that would be required to help inform the decision-making process.
Carbon reporting (measurement and verification)	▫ Workshop to discuss metering and monitoring strategy to allow accurate monitoring of carbon emissions and energy use pre and post construction.
Soft Landings	▫ Soft landings workshop.

	☐ Insights from previous lessons learnt are collected from design team members. ☐ As new organisations such as specialist subcontractors or end users become involved in the project, they should be instructed in the Soft Landings procedures and their roles in them. ☐ Success criteria and performance targets have been revisited and readjusted where needed. ☐ Changes to success criteria and/or performance targets and any other important information have been recorded and communicated with the project team.
Circular Economy	☐ Carryout a client and design team workshop to discuss opportunities. ☐ Identify and log circular economy options following workshop.
Other	☐ Workshop on integration with University of Exeter Heat Decarbonisation Strategy

RIBA Stage 3

	**RIBA Stage 3: Spatial Coordination**
Outcome	▫ Architectural and engineering information spatially coordinated
Gateway	▫ RIBA Stage 2 signed off
Whole Life Carbon assessment	▫ A carbon assessment should be prepared using the cost plan's material descriptions and quantities. (This will be indicative but will form the baseline carbon budget and will be a granular analysis of the project's WLC cost in as much detail as can be provided by the design team). ▫ A table of detailed options and their respective impacts on the carbon budget should be prepared to enable the design team to choose low carbon and preferably cost neutral options. ▫ Different construction/cladding approaches should be explored. *Note: Planning applications may require WLC assessments in the future*
Environmental Net Gain - Biodiversity	▫ BREEAM credit analysis and confirmation of achieving the applicable credits. Carryout a workshop to review the proposed options to allow the strategy to be confirmed and signed off by the University.
Net Zero Operational Energy and Passivhaus/EnerPhit	▫ Establish strategies for air tightness and insulation (this may drive towards a construction system) ▫ Detailed building surveys including local intrusive survey work where required to establish existing fabric build ups and condition ▫ Thermal bridge workshop for structural engineer ▫ Develop the MVHR strategy, considering centralised v's local plant, distribution strategy, intakes, and exhausts. ▫ Initial hot water distribution calculations in PHPP ▫ Initial U-value calculations ▫ Identification of all thermal bridge junction types

	▫ Thermal bridge calculations for a selection of the most important junctions ▫ Definition of airtightness testing requirements for contractor ▫ Initial moisture risk assessments on proposed build ups, with specialist input where required. ▫ Carry out PHPP modelling including: o TFA calculated based on proposed layouts o Proposed glazing (including shading factors) o Mechanical ventilation (using proposed design flow rates) o Identify any significant thermal bridges and estimate impact o Carry out overheating analysis (see Thermal Comfort) o Architect to develop key 1:5 details, identifying strategy for air tightness and insulation. Review for buildability. o Provide enough information for Certifier's initial check. ▫ If contractor is appointed at this stage produce a Passivhaus/EnerPHit specification document identifying Passivhaus/EnerPHit requirements and the contractor responsibilities.
SKA Rating	▫ Assess whether design has met good practice measures identified and project has an indicative rating of gold certification
Light and Daylight	▫ Complete a whole-building CBDM model and score it against all daylight criteria. ▫ Submit an interim compliance report detailing findings, and any corrective measures needed in the design. *Note: Challenges with daylight can usually be resolved through careful manipulation of window size and shading levels, but room depth is also a key criterion.*
Thermal Comfort	▫ Carry out dynamic thermal modelling for the whole building according to the CIBSE TM59 (accommodation) and TM52 (offices and other spaces) methodologies to test and verify the proposed design. ▫ Confirm and report on risks of cold drafts effecting the ventilation strategy. *The following CIBSE Design Summer Year (DSY) weather data must be used for assessing overheating risk, based on the UKCIP09 climate change scenarios.* ▫ *2020 conditions: Plymouth 2020s High emissions scenario 90th percentile* ▫ *2050 conditions: Plymouth 2050s Medium emissions scenario 90th percentile* ▫ *2080 conditions: Plymouth 2080's Medium emissions scenario 90th percentile* *The thermal model should accurately represent the proposed building in terms of geometry, shading, glazing areas, constructions, and internal gains. Note that windows and doors should only be modelled as opening when external temperatures are sufficient to avoid cold draughts (as required by Passivhaus comfort criteria).* ▫ Demonstrate using the modelling that overheating limits described in CIBSE TM52/59 are not exceeded for the current weather file (2020) based on DSY 1, 2 and 3.

	□ As a minimum, demonstrate future adaptivity of the building design can meet the TM59/52 limits when tested against the future weather file (2050 and 2080) using DSY 1,2 and 3 for each. For the preferred standard, the proposed building design should be TM52/59 compliant for the future weather file. □ The results of the modelling must be presented to the University to help them assess the risk of design decisions and consider level of future proofing and flexibility in the design that may be required for the future. *The modelling should be carried out in coordination with the architectural design, particularly in respect of the planning submission.*
Indoor Air Quality	□ MEP Consultant and architect should work together to begin to produce a coordinated ventilation strategy in line with IAQ ambitions for the project. □ MEP consultant to confirm that the modelling shows that the carbon dioxide levels are within the requirements as per BB101 criteria. □ Report to describe how the ventilation strategy would adapt or cope with a COVID/pandemic scenario. *This should include details such as suitably sized risers for ventilation ductwork, and more detailed window and louvre designs on the façade with a sufficient free area for both winter and summer IAQ. There is overlap here with Thermal Comfort, and the design should be optimised with both these human health issues in mind.*
Water	□ BREEAM credit analysis and confirmation of achieving the credits: □ BREEAM 2018 WAT01: Water Consumption (5 credits) □ BREEAM 2018 WAT 02: Water Monitoring (1 credit) □ Carry out a workshop to review proposed water fittings and systems to allow the strategy to be confirmed and signed off by the University.
Materials	□ Assess whether material selection agrees with SKA Rating
Low and Zero Carbon technologies	□ Finalise strategy for renewable and low carbon technologies. □ Plant and distribution space to be confirmed and incorporated into plans. □ Update calculations carried out at Stage 2 with new modelling data and information from specialist installers to predict financial and carbon performance. □ Consider the visual impact of external plant or equipment and ensure it is captured for purposes of planning application.
Environmental Net Gain – Residual Carbon	□ An estimate of the residual carbon associated with the building's operational energy should be calculated for the lifespan of the building. □ An estimate of the embodied carbon associated with the building's construction should be calculated for the lifespan of the building. □ Environmental net gains schemes that allow for offsetting residual carbon should be identified. □ The investment into the Residual Carbon fund should be calculated to be paid as a single sum after practical completion of the project.
Carbon reporting (measurement and verification)	□ Confirm the proposed metering and monitoring strategy to allow accurate monitoring of carbon emissions and energy use pre and post construction.

	☐ Make sure whole life carbon assessment has been carried out and is being reported. ☐ If tendering for a contractor at stage 3 make sure monitoring and metering requirements during construction are clearly specified along with any specific KPIs
Soft Landings	☐ Design reviews and reality checking workshops to be held. Reviews are best undertaken when options are relatively clear, allowing discussion to be focused. ☐ The client should provide the facilities manager, or those responsible for the ongoing management and maintenance of the building, with a view to start planning their long-term building management plan. ☐ Review servicing budget and models predicting annual running costs of building, including water and energy consumption. ☐ Success criteria and performance targets have been revisited and readjusted where needed. ☐ Changes to success criteria and/or performance targets and any other important information have been recorded and communicated with the project team.
Circular Economy	☐ Confirm circular economy opportunities to be taken forward.
Other	☐ Confirm Heat Decarbonisation Strategy opportunities to be taken forward to detailed design

RIBA Stage 4

	**RIBA Stage 4: Technical Design**
Outcome	▫ All design information required to manufacture and construct the project completed.
Gateway	▫ RIBA Stage 3 signed off
Whole Life Carbon assessment	▫ Low carbon choices made during Stage 3 are now integrated into the detailed drawings, specifications, and tender documentation. ▫ Suppliers assessed for their ability to provide relevant information with respect to fabrication methodology, factory location, energy use type, treatment of waste etc. ▫ Carbon budget updated and included within the tender documentation. ▫ Tender documentation ensures that the competing contractors understand the WLC requirements, the goals and process of delivering and monitoring carbon reductions during construction. ▫ Process needs to be tailored to engage with, but not burden, the supply chain.
Environmental Net Gain - Biodiversity	▫ Carry out the detailed design and provide comprehensive specification referring to the BREEAM credits to make sure these are captured by the contractor
Net Zero Operational Energy and Passivhaus/EnerPHit	▫ Final junction detailing demonstrating buildability for airtightness and insulation continuity ▫ Review of airtightness line on each drawing and identification of airtightness requirements for service penetrations ▫ Detailed construction build-ups with associated U-value calculations ▫ Detailed build-ups of all external elements including thickness and conductivity of all materials ▫ Thermal bridge workshop to review thermal bridge lengths and psi-values ▫ Detailed thermal bridge calculations to determine psi-values for all junctions. ▫ MVHR layout including duct distribution and measurement of length of intake and exhaust ducts for all systems.

	▫ Detailed specifications of all key Passivhaus products including windows, doors, airtightness membranes, tapes, and seals, MVHR units etc. ▫ Produce Passivhaus specification identifying all Passivhaus requirements and contractor responsibilities. ▫ Liaison with Passivhaus certifier for pre-construction design check ▫ Architect to develop comprehensive set of 1:5 details, to be reviewed for air tightness and insulation buildability. ▫ If not using certified products or systems, check performance data in detail ▫ Detailed PHPP modelling including: o Proposed fabric constructions and products (glazing, MVHR) o Thermal bridges o Primary energy assessment- appliances, building services o Review proposed products including: o Glazing o Insulation o Building services o MVHR selections
SKA Rating	▫ Assess whether design has met good practice measures identified and project has an indicative rating of gold certification
Light and Daylight	▫ Incorporate any changes into the whole-building model and ensure that overall compliance is achieved. ▫ Detail position of workstations, desks etc. for compliance with WELL Building requirements to achieve L03 and related credits. ▫ Agree room finishes and specify average surface reflectance required.
Thermal Comfort	▫ The building design should be monitored for changes which could impact on overheating risk, and the thermal model updated as required. Areas with excessive overheating risk should be resolved prior to tender.
Indoor Air Quality	▫ Thermal model should be used to assess predicted IAQ outcomes (this assessment is not the same as a Part L compliance model and required the designers to model predicted occupancy and air flows from the real design). It is recommended that full thermal model for assessing overheating conditions is used. ▫ Internal surface finishes should be considered in detail, to avoid or minimise off-gassing and minimise associated VOC levels within the occupied spaces.
Water	▫ Carry out the detailed design and provide comprehensive specification referring to the BREEAM credits to make sure these are captured by the contractor

Materials	☐ Ensure material selection agrees with scope of SKA Rating
Low and Zero Carbon technologies	☐ Incorporate renewable and low carbon systems into M&E detailed design. ☐ Consult with suppliers and installers to ensure that plant spaces and hydraulic designs are suitable for contractor design elements.
Environmental Net Gain – Residual Carbon	☐ Refine estimate of the residual carbon associated with the building's operational energy for the lifespan of the building. ☐ Refine estimate of the embodied carbon associated with the building's construction for the lifespan of the building. ☐ Environmental net gains schemes that allow for offsetting residual carbon should be confirmed. ☐ The refined investment into the Residual Carbon fund should be calculated to be paid as a single sum after practical completion of the project.
Carbon reporting (measurement and verification)	☐ If tendering for a contractor at this stage, make sure monitoring and metering requirements during construction are clearly specified along with any specific KPIs ☐ Metering and monitoring requirements should be captured as part of the MEP detailed design package. ☐ Whole life carbon to be reported based on detailed design information (this will also inform the residual fund calculations).
Soft Landings	☐ Ongoing design reviews and reality checking workshops are held. ☐ The client should ensure that the requirements of Soft Landings are thoroughly written into the scope of the contract. *BSRIA Guide BG45 can assist with tender documentation.* ☐ Success criteria and performance targets have been revisited and readjusted where needed. ☐ Changes to success criteria and/or performance targets and any other important information have been recorded and communicated with the project team.
Circular Economy	☐ Circular economy opportunities captured with in the detailed design.
Other	☐ Heat Decarbonisation Strategy opportunities captured with in the detailed design.

RIBA Stage 5

	**RIBA Stage 5: Manufacturing and Construction**
Outcome	▫ Manufacturing, construction, and commissioning completed.
Gateway	▫ RIBA Stage 4 signed off
Whole Life Carbon assessment	▫ Actual carbon impacts of the construction process to be monitored against the carbon budget and any agreements made on completion of the tender process. ▫ Reporting at regular intervals of construction, as appropriate for project size and scope. ▫ Reporting consists of interim updates to the carbon budget based on actual data from site activities, including transport movements and waste disposal.
Environmental Net Gain - Biodiversity	▫ Site inspections and review to make sure the measures are being implemented
Net Zero Operational Energy and Passivhaus/EnerPHit	▫ Contractor to meet all requirements as set out in the contractor specification and requirements document. Such as: o low energy construction workshops on-site o Site manager and team training on construction quality requirements covering insulation and airtightness o Preparation of Passivhaus toolbox talk material for site team inductions o Regular Passivhaus construction quality assurance site visits (depending on the size of the scheme – at least six) combined with regular visits o Preparation of associated Passivhaus construction quality assurance site visits reports and feedback to construction team highlighting key actions required o Develop existing site quality tracker in include Passivhaus items and update regularly o Leak finding airtightness tests o airtightness test pre-completion o Compile site evidence and issue to Certifier o Stage 5 PHPP model of each building leading to the final 'as built' PHPP model

	☐ Check compliance against Passivhaus requirements ☐ Liaison with Passivhaus certifier for construction check ☐ Review contractor's submittals for products and systems. ☐ Witnessing of final air pressure test
Light and Daylight	☐ Ensure that glazing specification in particular is delivered as designed. ☐ Internal finishes should match those specified in the design, with finishes selected to achieve the aggregate surface reflectance.
Thermal Comfort	☐ Review contractor submittals for products and systems such as glazing. In particular, ensure that glazing g-values are as required by the thermal model.
Indoor Air Quality	☐ Monitor all construction work to ensure that ventilation systems, both natural and mechanical, are built to specification, and control systems correctly provisioned to ensure simple operation.
Water	☐ Site inspections to make sure the measures are being implemented
Materials	☐ Ensure site materials comply with SKA Rating
Low and Zero Carbon technologies	☐ Monitor installation of renewable and low carbon technologies to ensure compliance with design. ☐ Witness commissioning and ensure controls are correctly set up.
Environmental Net Gain – Residual Carbon	☐ Environmental net gains schemes that allow for offsetting residual carbon should be agreed with client team. ☐ The investment into the Residual Carbon fund should be agreed with client team.
Carbon reporting (measurement and verification)	☐ On-site construction related energy use to be reported as per tender specification document. ☐ On-site reporting to be reviewed against key KPIs that have been targeted.
Soft Landings	☐ The construction team have been informed about the project's success criteria and the client's needs. ☐ The construction team have been made aware of their roles and responsibilities in relation to Soft Landings. ☐ All changes have been checked against the project's success criteria to ensure they would not affect them. ☐ All changes have been recorded and communicated with the project team.

	☐ Plans have been made (both in terms of programme and resources) for the commissioning and handover periods.
Circular Economy	☐ Has the contractor implemented the circular economy opportunities?
Other	☐ Has the contractor implemented Heat Decarbonisation Strategy opportunities

RIBA Stage 6

	**RIBA Stage 6: Handover**
Outcome	□ Building handed over, Aftercare initiated, and Building Contract concluded.
Gateway	□ RIBA Stage 5 signed off
Whole Life Carbon assessment	□ Post Project Completion a final review of the 'as built' information should be undertaken and a final assessment of the WLC impacts of the completed project produced. □ The final version of the WLC assessment to be included within the O&M manual. □ The final assessment to be compared to the initial carbon budgets and lessons to be learned identified.
Environmental Net Gain - Biodiversity	□ Make sure a maintenance and management plan is in place to make sure both new and existing biodiversity measures continue to thrive.
Net Zero Operational Energy and Passihaus/EnerPHit	□ Issue final Passivhaus Certification evidence to Certifier □ Participate in client training, particularly for MVHR. □ Provide simple instructions for user at building handover □ Passivhaus plaque and Certificate
SKA Rating	□ Evidence from operation and maintenance manuals is gathered to prove that the performance benchmarks have been achieved. □ SKA Rating is confirmed
Light and Daylight	□ Check that building occupants are able to operate glare prevention measures such as blinds or external shades, and that operation of artificial lighting systems is straightforward and optimised for both human health and energy efficiency. □ Consider post-occupancy evaluation of satisfaction levels and monitoring of natural and artificial lighting levels (see Soft Landings section).
Thermal Comfort	□ As part of the soft landings handover requirements a simple user guide should be provided which covers the ventilation/heating and cooling strategy that has been put in place to provide a comfortable environment for the end user.

Indoor Air Quality	◻ Mechanical ventilation systems must be carefully commissioned, including measurement of flow rates of exhaust and intakes, and balancing of supply and extract systems. ◻ Filter replacement must be scheduled, or BMS alarm systems set up to ensure that filters are changed regularly and IAQ maintained. ◻ Ideally some post-occupancy measurements of IAQ should be carried out to confirm that design intent is delivered in operation.
Water	◻ Monitor and validate the systems to make sure they are set up and working as designed.
Materials	◻ Review as part of SKA Rating
Low and Zero Carbon technologies	◻ Participate in client training. ◻ Ensure all systems are operating as intended and maintenance schedules agreed. ◻ Any innovative systems, or first-time systems must be closely monitored.
Environmental Net Gain – Residual Carbon	◻ Investment into the Residual Carbon fund should be paid as a single sum.
Carbon reporting (measurement and verification)	◻ Annual energy use and renewable energy generation on-site must be reported and independently verified in-use each year for the first 5 years.
Soft Landings	◻ The facilities team has been fully trained and has enough knowledge about the building and how it works. ◻ All the guides necessary for the operation of the building have been completed and are available. ◻ A maintenance contract is in place. ◻ A migration plan has been developed and is ready to be followed. ◻ A suitable workplace has been prepared for the aftercare team.

RIBA Stage 7

	**RIBA Stage 7: Use**
Outcome	▫ Building used, operated, and maintained efficiently
Gateway	▫ RIBA Stage 6 signed off
Whole Life Carbon assessment	▫ Review as part of soft landings appraisal
Environmental Net Gain - Biodiversity	▫ Review as part of soft landings appraisal
Net Zero Operational Energy	▫ Review as part of soft landings appraisal
SKA Rating	▫ Complete post occupancy assessment stage
Light and Daylight	▫ Review as part of soft landings appraisal
Thermal Comfort	▫ Review as part of soft landings appraisal
Indoor Air Quality	▫ Review as part of soft landings appraisal
Water	▫ Review as part of soft landings appraisal
Materials	▫ Review as part of SKA Rating
Low and Zero Carbon technologies	▫ Review as part of soft landings appraisal
Environmental Net Gain – Residual Carbon	▫ Review as part of soft landings appraisal

Carbon reporting (measurement and verification)	☐ Report on energy and carbon use and compare to as designed PHPP model.
Soft Landings	☐ The aftercare team have been available on site to support the end users. ☐ The aftercare team provided initial support to the facilities team to ensure they have a good understanding of the building and how to control and manage it. ☐ The aftercare team dealt with emerging issues and carried out fine-tuning when needed. ☐ Lessons learned have been captured and disseminated to the project team. ☐ The facilities management team, with the support of the aftercare team when needed, has logged relevant performance data. ☐ Post Occupancy Evaluation reviews have been carried out. ☐ The aftercare team, with the support of the facilities manager, has addressed issues identified after the first performance evaluation and Post Occupancy Evaluation reviews. ☐ Changes due to fine-tuning and other necessary activities have been recorded. ☐ Communication to the end users has been completed. ☐ End of year reviews have been completed. ☐ Lessons learned have been recorded and passed to the relevant teams. ☐ The facilities team can manage and control the building without referring back to the project team. ☐ Post Occupancy Evaluation ☐ Review and cost analysis with QS/Cost Consultant ☐ Hold a ‘Lessons Learnt’ Workshop at 6 months post Practical Completion and issue report. ☐ Performance review of data from active building. ☐ Satisfaction Survey at 12 months post Practical Completion. ☐ Building Performance Evaluation at 18 months post Practical Completion. ☐ Review of Operation and Maintenance Costs lead by client. ☐ Final report with everything above documented.
Circular Economy	☐ Review as part of soft landings appraisal

Sustainability Design Guide

Part 5 – Minor Works

REVISION SUMMARY

Issue	Document prepared		
	Name	Signature	Date
Part 5 Draft	Oliver Fuller		24.05.21
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CONTENTS

MINOR WORKS REQUIREMENTS (<500K) 112
Introduction 112
KEY OBJECTIVES 113
RIBA SUSTAINABILITY MEASURES CHECKLIST 114
RIBA Stage 0-4 114
RIBA Stage 1-4 116
RIBA Stage 5-6 117

MINOR WORKS REQUIREMENTS (<500K)

Introduction

This document has been put together to capture the sustainability requirements for all projects that fall under minor works (which covers any projects <£500k - this is construction cost inclusive of VAT).

Minor works projects can vary and there is no one fit all solution that can be applied.

Minor work will be the most common projects and for the University to meet its carbon reduction commitments it is vital that these are not excluded and overlooked.

This document sets out a process to tackle this and requires the applicable projects to go through a process of identifying potential opportunities, implementing the opportunities, and recording the data.

The sustainability measures checklist provided in this document takes you through this process and is to be completed and used as an ongoing tracker for all minor works projects.

KEY OBJECTIVES

All minor works projects should take a positive approach to achieving a net environmental gain however big or small the project is.

The following list covers the key categories that should be assessed and reviewed for every project which is also captured in the checklist in the next section:

1. Achieve a Net environmental gain through:
    a. Carbon reduction (operational and embodied)
    b. Net Biodiversity gain
    c. Reduced water use
    d. Increased health and wellbeing
    e. Reduced waste
2. Circular economy model and approach.
3. Record and capture data.

RIBA SUSTAINABILITY MEASURES CHECKLIST

RIBA Stage 0-4

	**RIBA Stage 0: Design and Tender**
Outcome	☐ Confirm the client requirements, brief and targets
Embodied Carbon assessment	☐ Confirm that embodied carbon information will be captured as part of the minor works
Environmental Net Gain - Biodiversity	☐ Do the minor works provide opportunity for net biodiversity gain
Net Zero Operational Energy	☐ Do the minor works provide opportunity for reducing operational energy
SKA Rating	☐ Do the minor works provide opportunity for SKA good practice measures to be applied and followed
Light and Daylight	☐ Do the minor works provide opportunity for improving natural daylight
Thermal Comfort	☐ Do the minor works provide opportunity for improving thermal comfort conditions.
Indoor Air Quality	☐ Do the minor works provide opportunity for improving Indoor air quality
Water	☐ Do the minor works provide opportunity for reducing water consumption
Materials	☐ Do the minor works provide opportunity for reducing environmental impact of materials
Low and Zero Carbon technologies	☐ Do the minor works provide opportunity for Low or Zero carbon technologies
Environmental Net Gain – Residual Carbon	☐ Are there available funds in the residual carbon fund to support additional carbon saving measures that would otherwise not happen as part of the minor works project
Carbon reporting (measurement and verification)	☐ Confirm that carbon reporting is required for the project and provide excel template.
Soft Landings/Post occupancy evaluation	☐ Would soft landings or post occupancy evaluation be required based on the project type
Circular Economy	☐ Confirm circular economy opportunities will be reviewed and applied to the project.
Other	☐ Do the minor works provide the opportunity to move away from fossil fuels?

	☐ Has the associated building been assessed as part of the decarbonisation masterplan? ☐ Are there fabric and MEP condition survey reports available? ☐ Does the minor works project effect the external envelope of the building? ☐ Are the minor works part of the maintenance plan

RIBA Stage 1-4

	**RIBA Stage 1-4: Design**
Outcome	☐ Project Brief approved by the client and confirmed that it can be accommodated on site
Gateway	☐ RIBA Stage 0 signed off
Embodied Carbon assessment	☐ To be captured and recorded in dedicated minor works embodied carbon spreadsheet.
Environmental Net Gain - Biodiversity	☐ TBC as part of RIBA stage 0 review
Net Zero Operational Energy	☐ TBC as part of RIBA stage 0 review
SKA Rating	☐ TBC as part of RIBA stage 0 review
Light and Daylight	☐ TBC as part of RIBA stage 0 review
Thermal Comfort	☐ TBC as part of RIBA stage 0 review
Indoor Air Quality	☐ TBC as part of RIBA stage 0 review
Water	☐ TBC as part of RIBA stage 0 review
Materials	☐ TBC as part of RIBA stage 0 review
Low and Zero Carbon technologies	☐ TBC as part of RIBA stage 0 review
Environmental Net Gain – Residual Carbon	☐ TBC as part of RIBA stage 0 review
Carbon reporting (measurement and verification)	☐ Captured as part of the embodied carbon assessment
Soft Landings	☐ TBC as part of RIBA stage 0 review
Circular Economy	☐ Workshop to run a review and identify circular economy opportunities

RIBA Stage 5-6

	**RIBA Stage 5-6: Construction and handover**
Outcome	☐ Manufacturing, construction, and commissioning completed.
Gateway	☐ RIBA Stage 1-4 signed off
Embodied Carbon assessment	☐ TBC as part of RIBA stage 0 and 1-4 review
Environmental Net Gain - Biodiversity	☐ TBC as part of RIBA stage 0 and 1-4 review
Net Zero Operational Energy	☐ TBC as part of RIBA stage 0 and 1-4 review
SKA Rating	☐ TBC as part of RIBA stage 0 and 1-4 review
Light and Daylight	☐ TBC as part of RIBA stage 0 and 1-4 review
Thermal Comfort	☐ TBC as part of RIBA stage 0 and 1-4 review
Indoor Air Quality	☐ TBC as part of RIBA stage 0 and 1-4 review
Water	☐ TBC as part of RIBA stage 0 and 1-4 review
Materials	☐ TBC as part of RIBA stage 0 and 1-4 review
Low and Zero Carbon technologies	☐ TBC as part of RIBA stage 0 and 1-4 review
Environmental Net Gain – Residual Carbon	☐ TBC as part of RIBA stage 0 and 1-4 review
Carbon reporting (measurement and verification)	☐ TBC as part of RIBA stage 0 and 1-4 review
Soft Landings	☐ TBC as part of RIBA stage 0 and 1-4 review
Circular Economy	☐ TBC as part of RIBA stage 0 and 1-4 review