Decarbonising the Campus Retrofit to EnerPHit standard

John Thornberry

22 June 2023

PICK EVERARD | Deliver better together.

Deliver better together.

John Thornberry

Sustainability Consultant
Pick Everard

Contents

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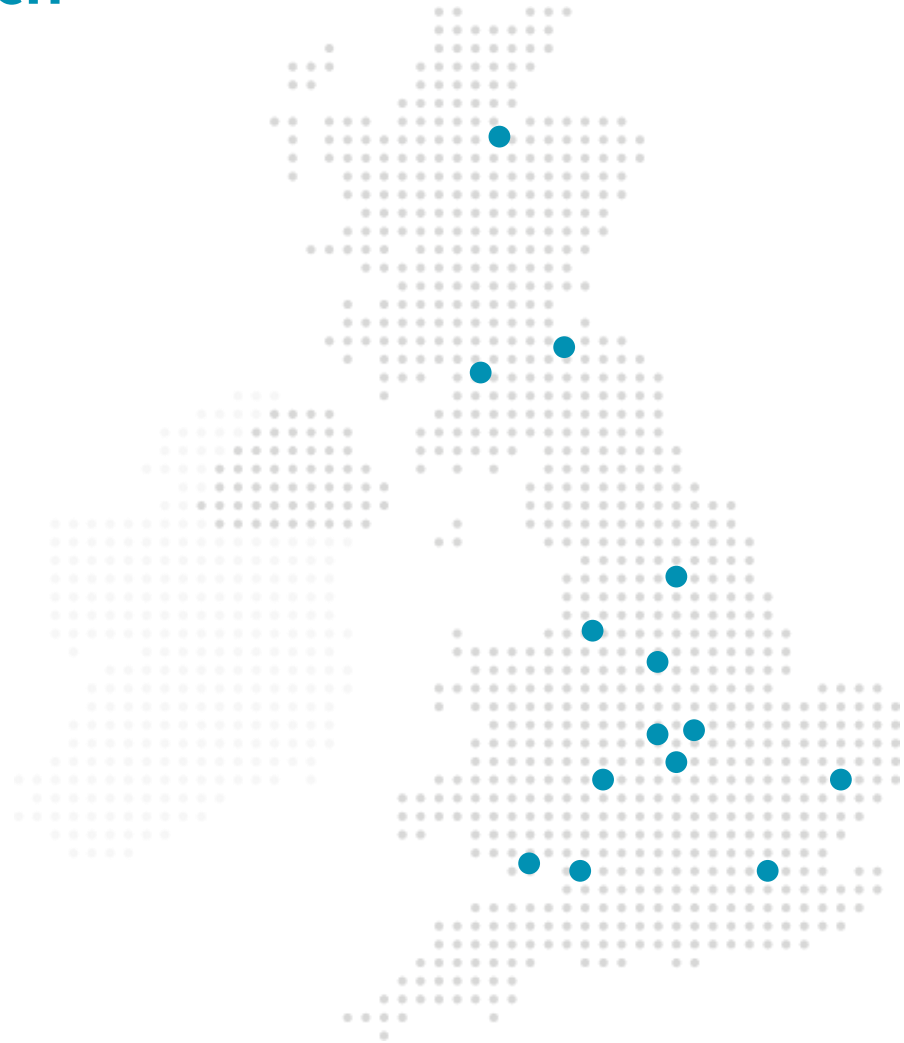
National business with a joined up approach

15

UK offices

- Leicester
- London
- Birmingham
- Bristol
- Bristol (Design Studio)
- Bury St Edmunds
- Cardiff
- Derby
- Edinburgh
- Glasgow
- Inverness
- Leeds
- Manchester
- Nottingham
- Sheffield



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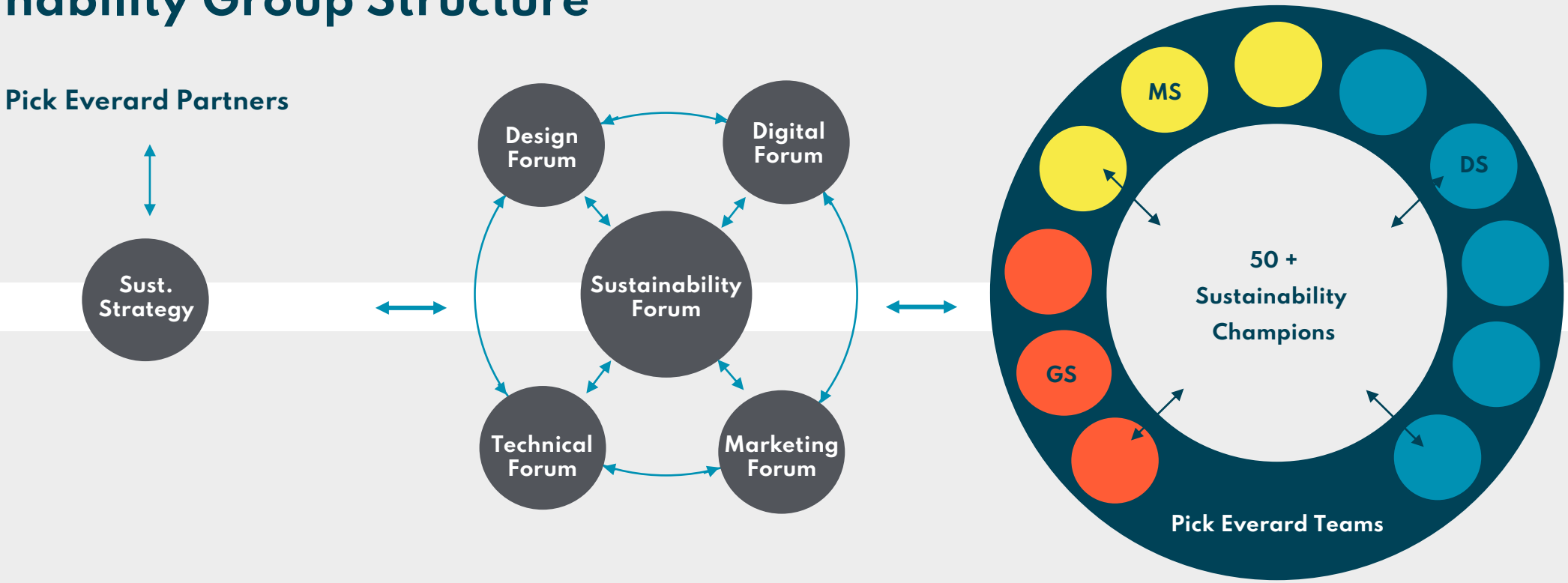
Sustainability Group Structure



SUSTAINABILITY STRATEGY GROUP

Focus Practice Net Zero
Carbon Performance
Outputs Strategy, Policies & Priorities

SUSTAINABILITY FORUM GROUP

Focus Business Integration
Outputs Implementation actions

SUSTAINABILITY CHAMPIONS GROUP

Focus Cultural Change
Outputs Discipline/ Team actions

Pick Everard's carbon footprint challenge (practice & projects)

2019-20 ~1450 tCO2 (75% from commuting and business travel)

2020-21 ~ 500 tCO2 (Covid! ~750 tCO2 if Working From Home included)

2021-22 ~1190 tCO2

Our projects - by far and away our largest impact (though 'not accountable' for !)

approximately 50 times greater than our own carbon footprint.

e.g. ((40 kgCO2/m2/y x 60y/project + 800kgCO2/m2) x 1000m2 x 1000 projects/y) / 60y = 53,333 tCO2/y

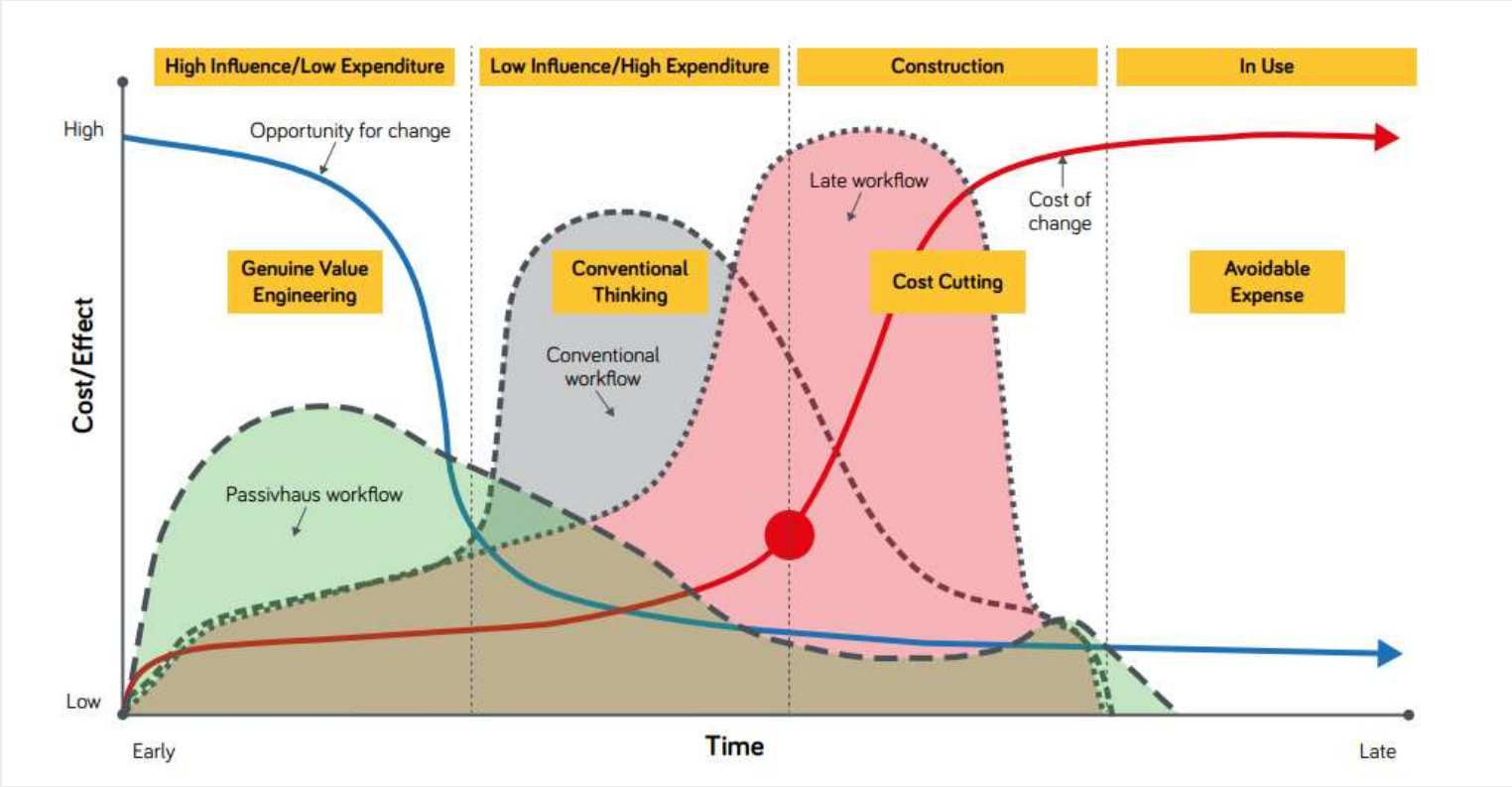
2022 CIBSE building performance awards- shortlisted
Consultancy over 300 employees

2022 NEC Sustainability and Climate Resilience
Award of the Year

Sustainability Timing in Projects

Relationship between sustainability opportunity & cost

Greatest opportunity & least cost impact → Lowest opportunity & highest cost impact



Credit - Inspired by Boyd Paulson, 1976

Project Stages 0-2 | Project Stages 3-4 | Project Stages 5-6 | Project Stage 7

Importance of Retrofit

Existing Building stock

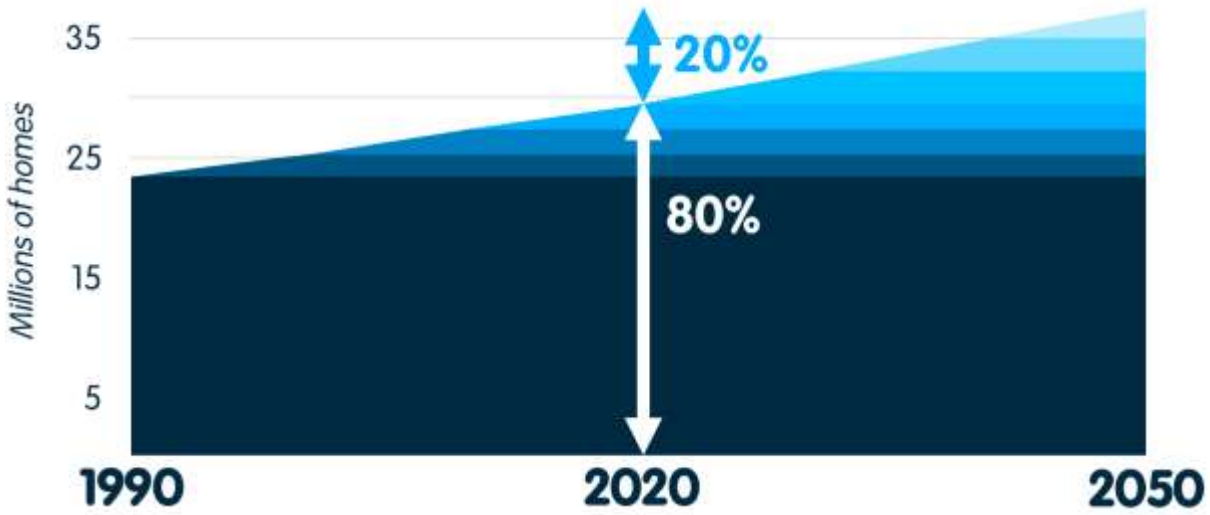


Image Source: Passivhaus Trust Retrofit Position Paper v2, Jan 2022

How low should be go

30%

Shallow Retrofit

Reduced carbon emissions
Large renewable demand
Large peak demand
More grid storage required
Little change in energy bills
Limited health benefits
Sub-optimal heat pump performance

75%

Deep Retrofit

Reduced carbon emissions
Reduced renewable energy demand
Reduced peak load
Less grid storage required
Significantly lower energy bills
Improved health & comfort
Effective heat pumps

EnerPHit approach

Retrofitting to Passivhaus Certification

ENERPHIT CERTIFIED

PHPP Software Assessment - Building by Building

Passive House Planning Package – EnerPHit version - A sophisticated Excel PHPP Assessment Tool

Developed and updated from over 30 years of use

Design & Certification Process

Certified Passivhaus Designer professional needed through ALL project stages.

EnerPHit Certification

by 3rd Party independent PHI Registered Certifier

1. Initial design — *Design check before Planning*
2. Finished Design — *Pre-construction review before start on site*
3. Building Completion Certification — *After commissioning*

EnerPHit comparison

Passivhaus Certification for Retrofit

- A space heating and cooling demand of **25kWh/m2.year** (compared to the Passivhaus standard of 15kWh/m2.year)

Criteria	Passivhaus Classic new build	EnerPHit	AECB Retrofit	LETI Retrofit (Guidance)*
Space heating demand	≤ **15** kWh/m²year	≤ **20**, **25** or **30** kWh/m²year *or circa 20-60 for component approach*	≤ **50** kWh/m²year *with exemption up to 100*	≤ **50** kWh/m²year *exemption up to 60 with an exemplar target of ≤ **25***
Primary energy renewable (PER) / energy use intensity (EUI)	PER ≤ **60** kWh/m²year	PER ≤ **71** kWh/m²year *(Cool Temperate)* PER ≤ **65.5** kWh/m²year *(Warm Temperate)*	*Not specified - fabric only*	EUI ≤ **50** kWh/m²year *exemption up to 60 with an exemplar target of ≤ **40**. With grid storage losses included these become ≤ 65 with exemption up to 70***
Primary energy demand	≤ **135** kWh/m²year	≤ **135** kWh/m²year + (QH − 15) * 12	*Not specified but direct electric & new gas boilers are only allowed by exception*	*Not specified*
Airtightness n50	≤ **0.6** ach @ 50Pa	≤ **1.0** ach @ 50Pa	≤ **2.0** ach @ 50Pa	≤ **2.0** ach @ 50Pa *exemption up to 3 with an exemplar target of ≤ **1.0** ach @50pa*
Summer overheating	Max **10%** > 25°C	Max **10%** > 25°C	Max **10%** > 25°C	*Not specified*
Surface temperature (inc. windows)	> **17°C**	> **17°C**	> **17°C**	*Not specified*
Surface temperature coefficient	Cool-temperate **0.7** fRsi*** Cold **0.75** fRsi Warm **0.65** fRsi	Cool-temperate **0.7** fRsi Cold **0.75** fRsi Warm **0.65** fRsi	>**0.75** fRsi	*Not specified*
Ventilation	**30** m³/hrperson	**30** m³/hrperson	**30** m³/hrperson	*MVHR specified rate m³/hrperson not specified*
How is this standard demonstrated?	**PHPP**	**PHPP**	**PHPP**	**PHPP** or simplified elemental approach

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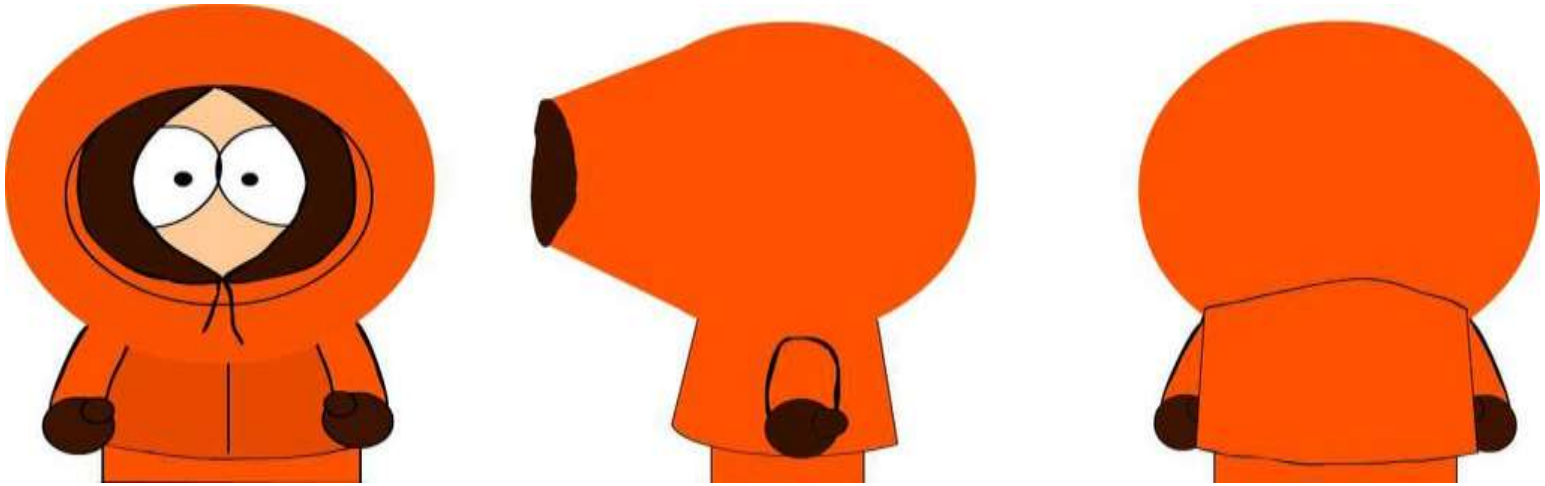
EnerPHit Principles

1

Fabric First



2

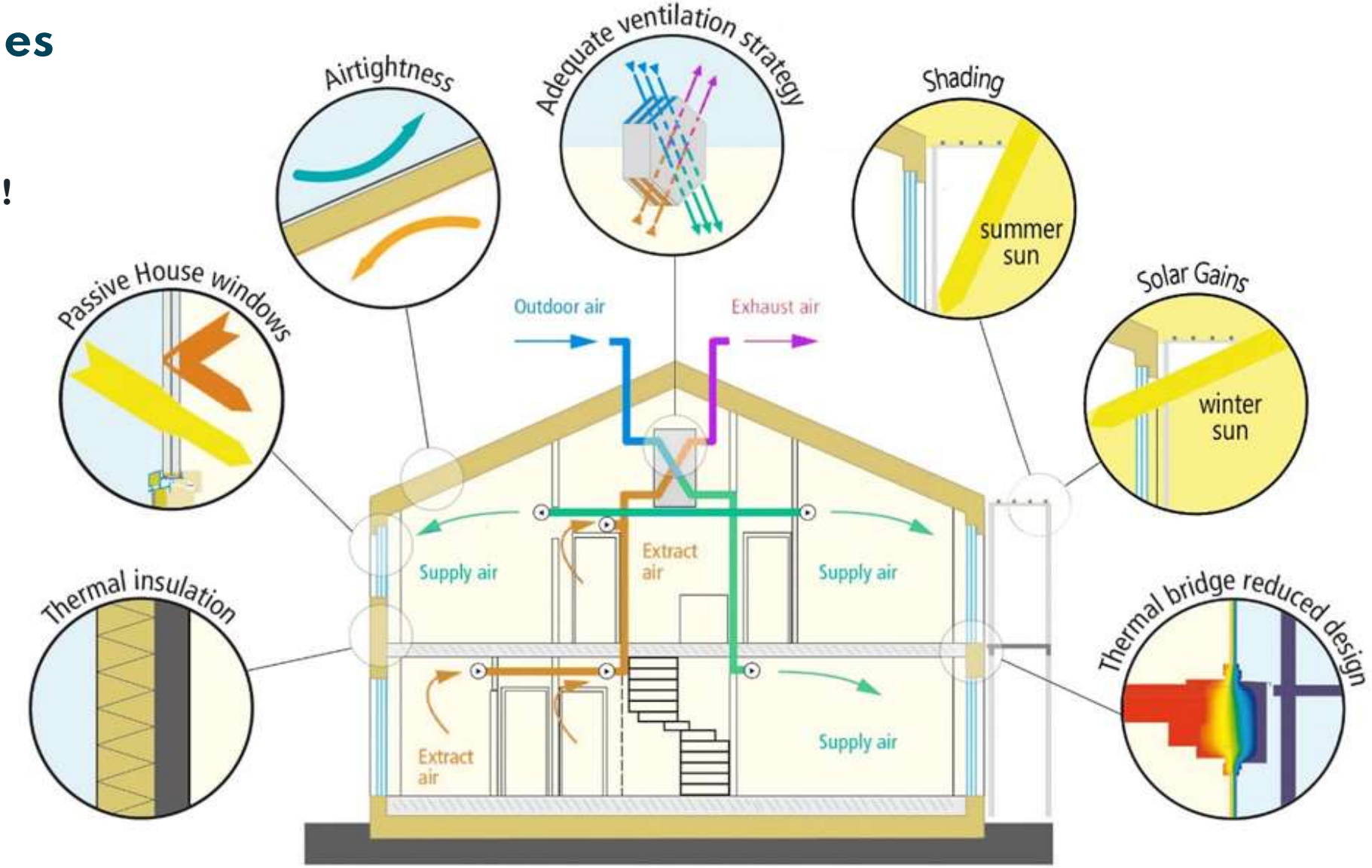
Technology Second

EnerPHit Principles

Not just about energy !

Thermal Comfort

Air Quality



Passivhaus & EnerPHit comparison

Technical Criteria

RIBA Academy

Criteria	Passivhaus Limiting Value	EnerPHit Limiting Value	Comfort Related	Energy Related
Airtightness	0.6 air changes per hour @50Pa	1 air changes per hour @50Pa	✔	✔
Internal surface temperatures	> 17°C at all times	> 17°C at all times if possible	✔	
Summer overheating	Less than 10% of the year > 25°C	Less than 10% of the year > 25°C	✔	
Ventilation	30m³ of fresh air per person per hour	30m³ of fresh air per person per hour	✔	
Heating Demand	<15 kWh/m².year	<25 kWh/m².year <20 kWh/m².year London	✔	✔
Primary energy (PE)	<135 kWh/m².year	<135 kWh/m².year some leeway allowed		✔
or Primary energy renewable (PER)	<60 kWh/m².year	<60 kWh/m².year some leeway allowed		✔

EnerPHit starting criteria

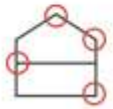
U-Values

At Stage 2, the U-values targeted are:

- Ext Walls/Roof 0.12 W/m2 .K
- Windows 0.8 W/m2 .K
- Ground floor 0.1 W/m2 .K
- Ext Door 1.0 W/m2 .K
- Exposed Soffit 0.13 W/m2 .K

High levels of insulation

Airtight building fabric



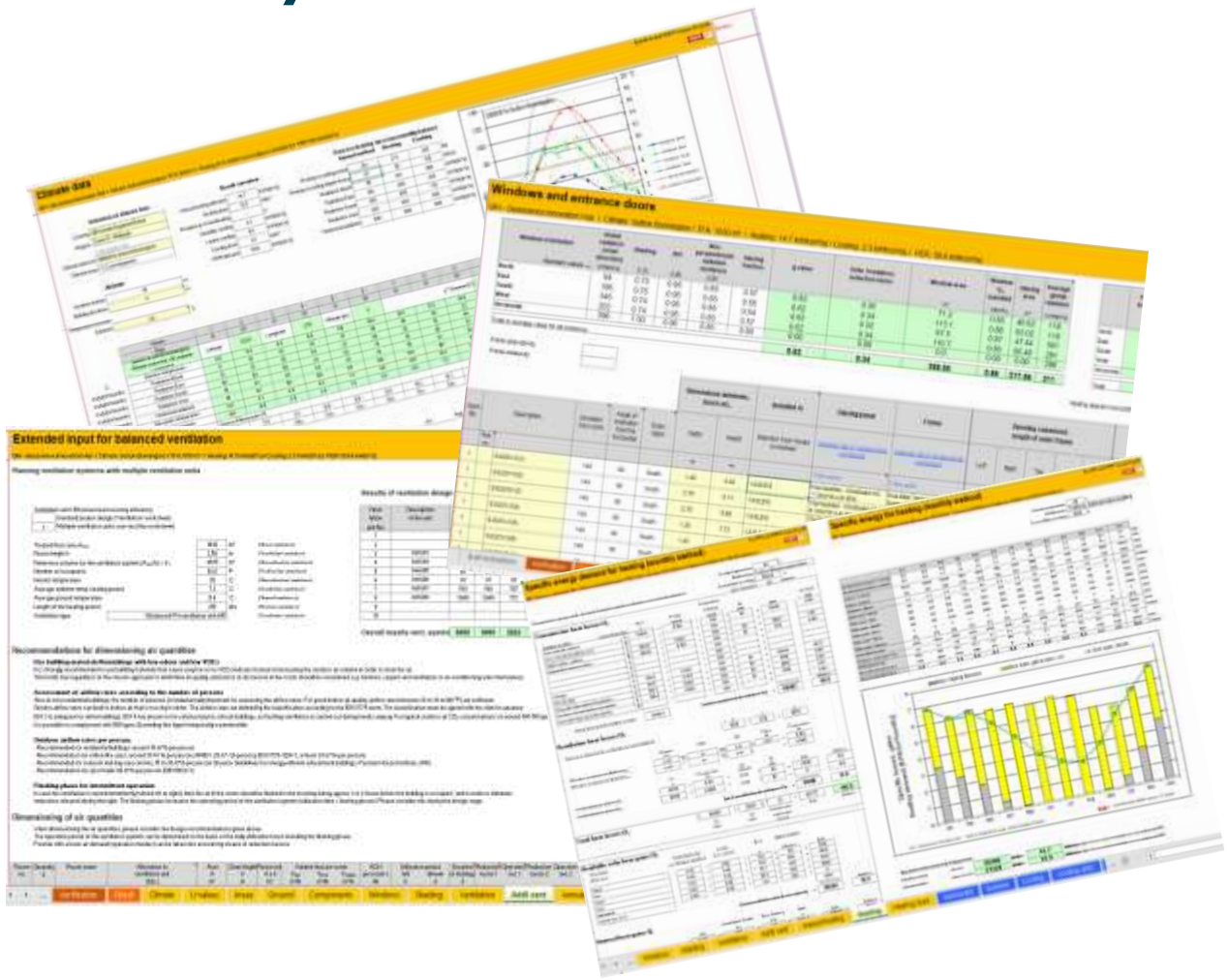
Reduced thermal bridges

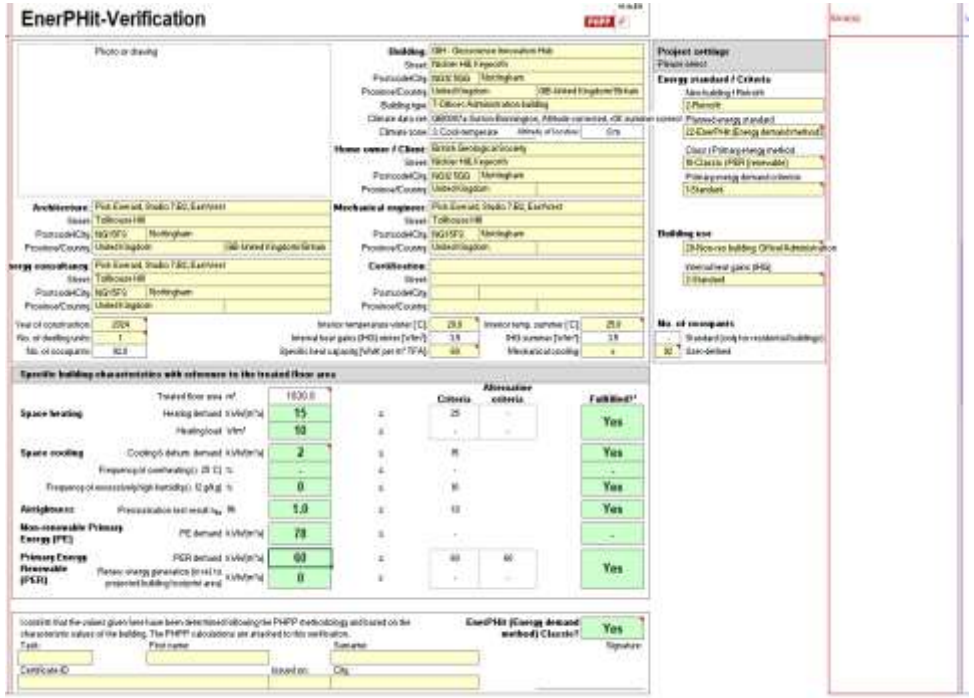
High performance triple glazed windows

Efficient background mechanical ventilation with heat revocery (MVHR)

Accurately predicted energy use modelling using the Passive House Planning Package (PHPP)

PHPP Analysis

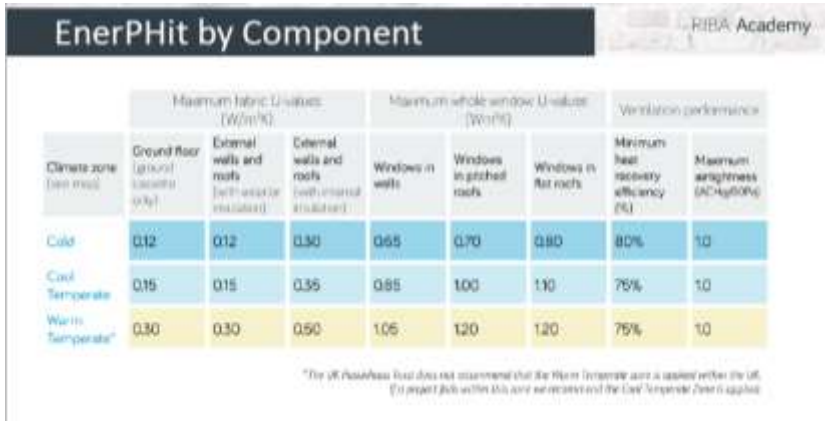




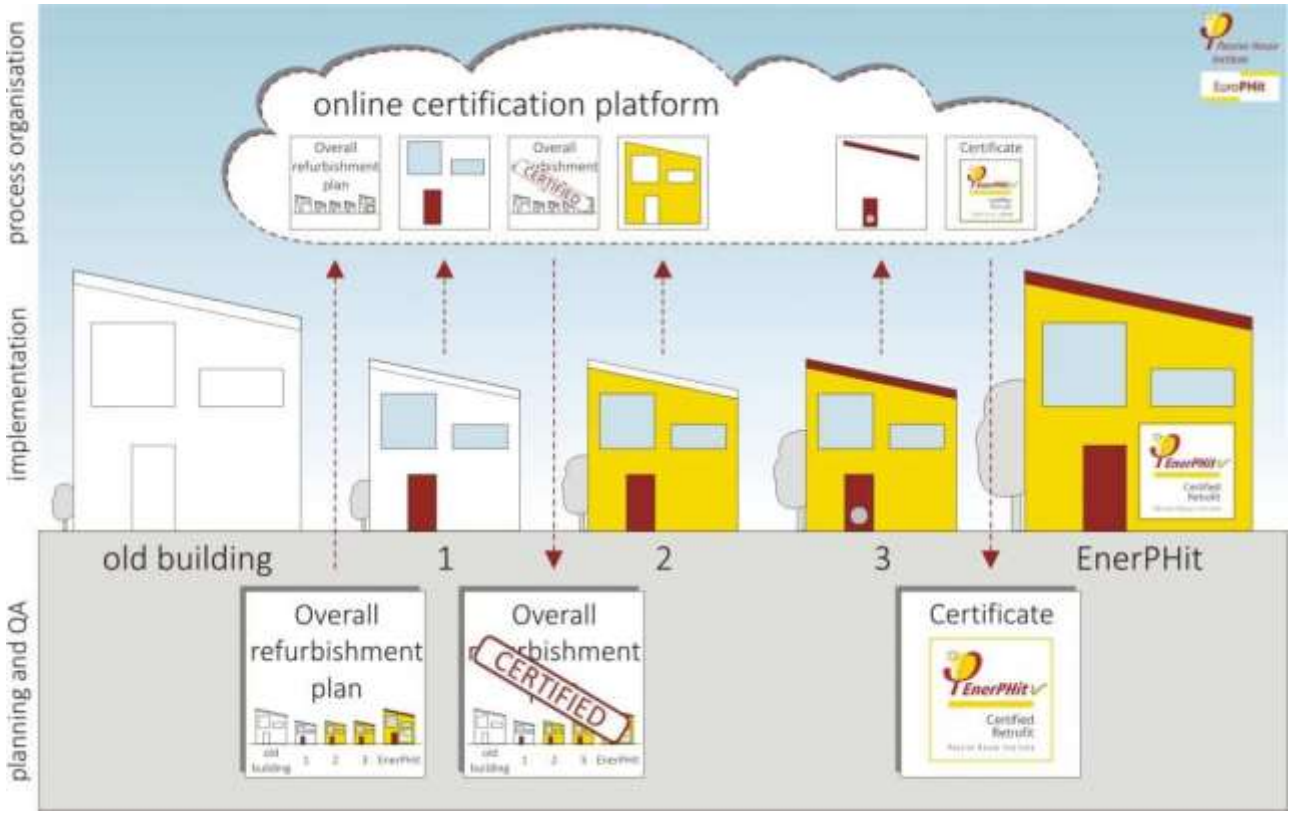
EnerPHit Certification Process

Energy Demand Method

Component Method



Step by Step



Super Insulation / Airtightness and Moisture Balance

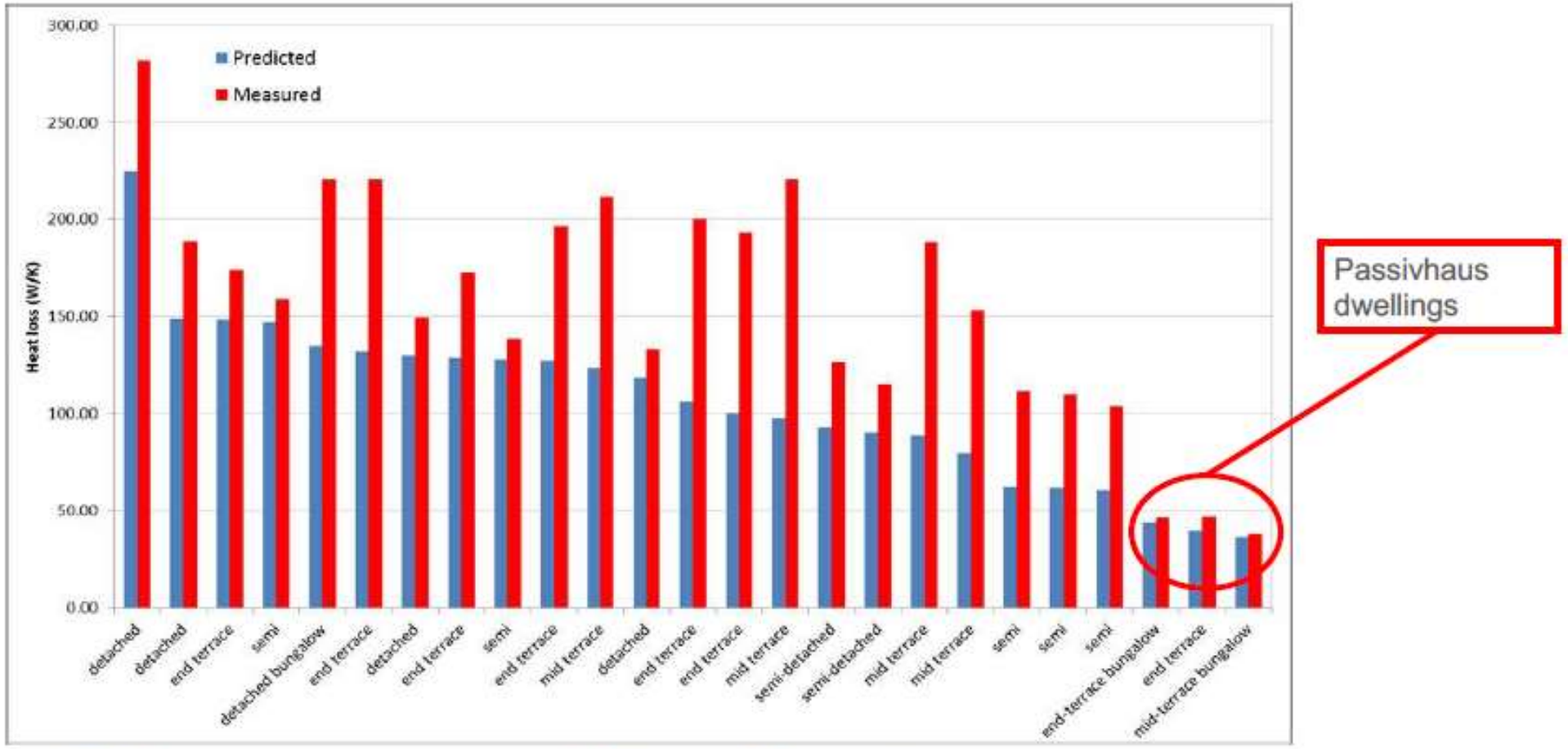
WUFI Dewpoint Calculations

Get expert input

Reduce the Thermal Bridges

- Continuous insulation
  Gaps are a problem
- Identify and address the thermal weak points
- Watch Structure & Services penetrations
- Problem-solving detailing

Performance Gap



Coheating tests. Source: Centre for the Built Environment, Leeds Metropolitan University

Case Study - British Geological Survey (GBS)

Keyworth Campus, Nottingham

Natural Environment Research Council (NERC)

Client's perspective on importance of sustainability and decarbonisation

'Supported by the UKRI Environmental Sustainability Strategy, NERC's ambition is to be **a leader in environmental sustainability** for the sector, setting out what we will do to enhance and recognise where we are making **a positive environmental contribution**, while minimising environmental harm.

By **2040** we aspire to be **'net-zero' for our entire research undertaking**, which includes reducing and mitigating all carbon emissions from our owned operations. We have written 'net-zero' broadly, looking beyond carbon and ensuring our wider environmental contribution and adaptation to climate change is a positive one'

Nigel Parfitt, Senior Estates Officer, Major Programmes Team

Natural Environment Research Council, UK Research and Innovation

NERC Carbon Footprint

Magnetic Observatories

Scientific exploration, sample collection and research

The British Geological Survey is a world-leading geological survey and global geoscience organisation, focused on public-good science for government and research to understand earth and environmental processes.

> Our vision:
> **To be a leading and trusted provider of geological data and knowledge to meet the societal need for a sustainable future.**

British Geological Survey
Keyworth Campus

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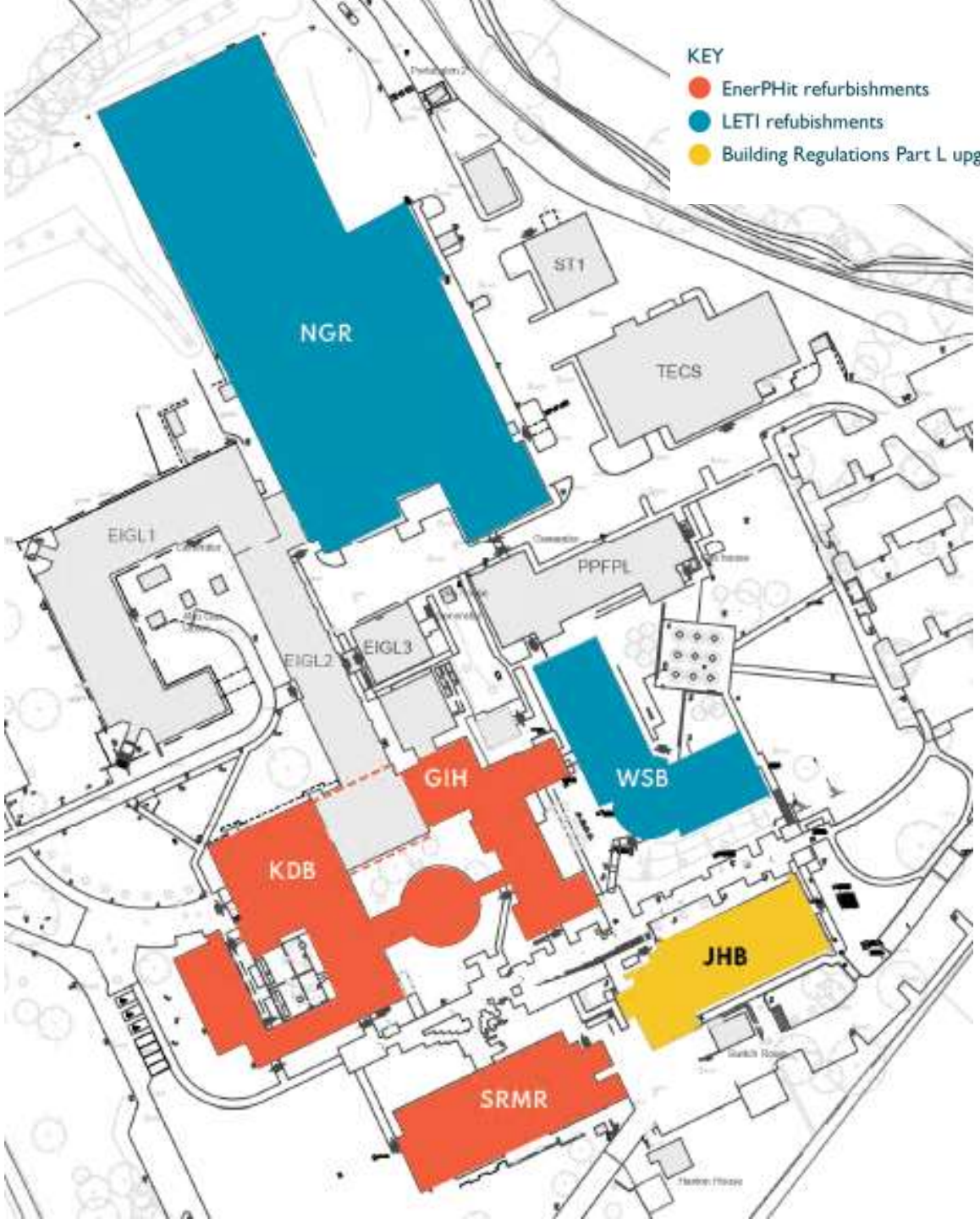
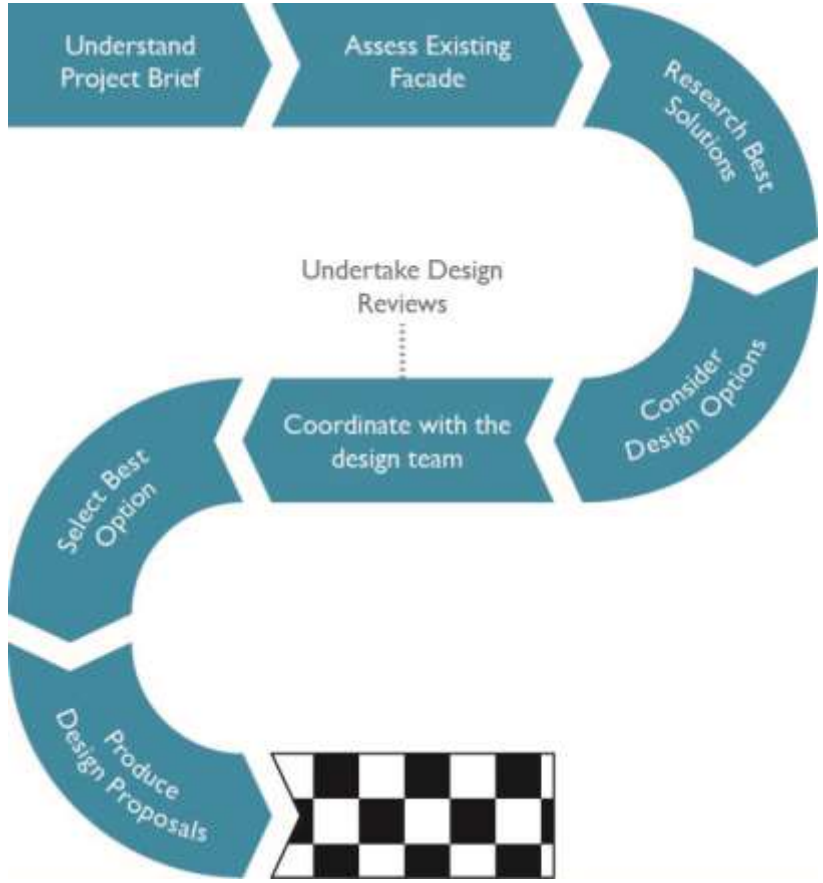
British Geological Survey
Keyworth Campus Task Order 32



British Geological Survey
Keyworth Campus Task Order 32

- Testing the Brief
- Decarbonisation Road Map
- Optioneering
- Envelope Assessment
- Coordination
- Wider Considerations



British Geological Survey
Existing campus issues

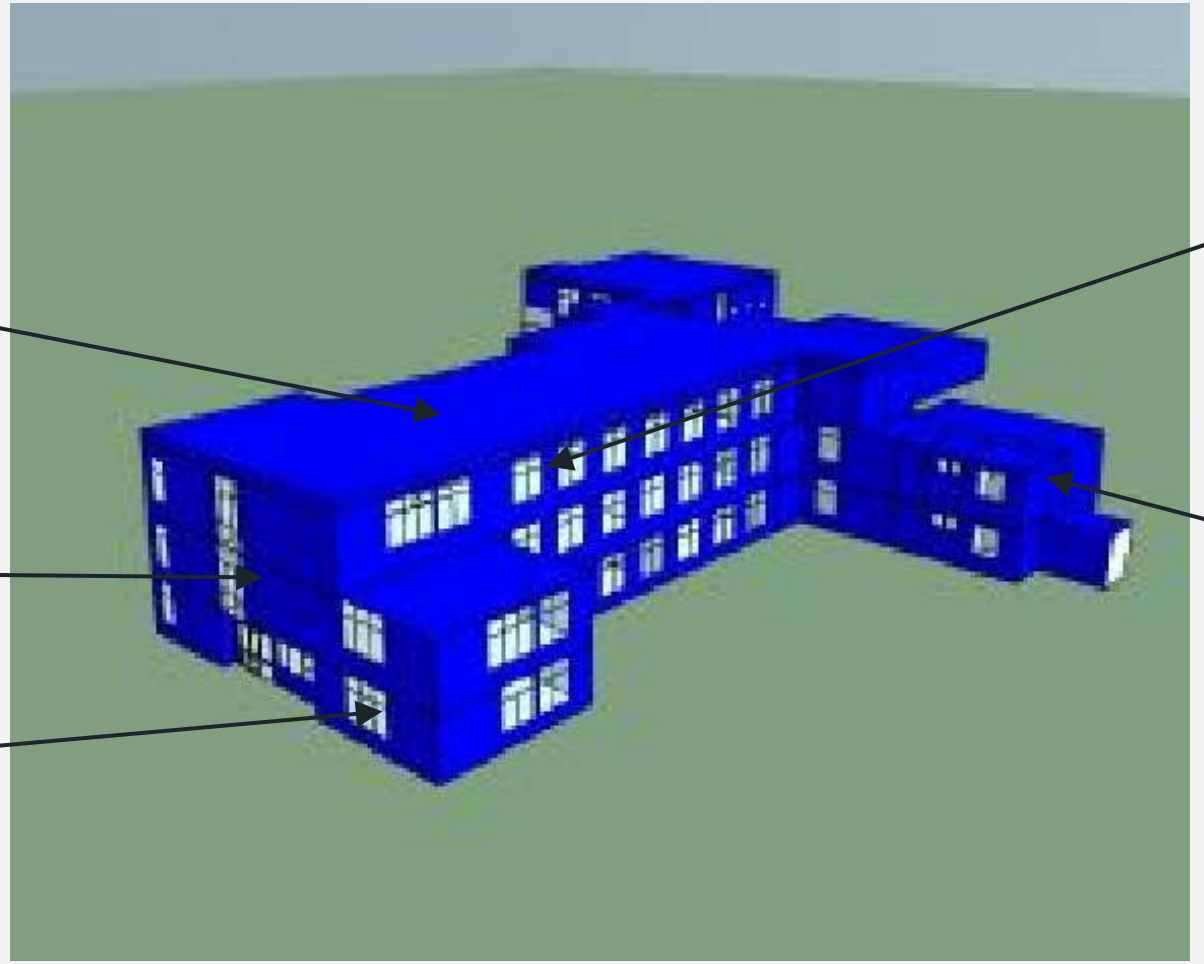
- Need to Decarbonise the campus
- Limitations on campus infrastructure
- Maintenance & operational energy costs
- Under-utilisation of accommodation
- Capitol Funding availability
- Thermal Comfort issues – cold, draughts
- Internal Overheating and Glare issues
- Biodiversity & Ecology
- Future needs
- Working in an occupied site

Review of existing building fabric - GIH Building

ROOF
Concrete deck.
Mineral felt
90mm insulation

FLOOR
Concrete deck.
Mineral felt
90mm insulation

WINDOWS
Aluminium framed double glazed with approximately 20mm cavity. Kawneer system.



EXTERNAL WALL TYPE 1
5-10mm retro fitted fibre reinforced render system.
103mm brickwork external skin.
60mm cavity with full fill mineral fibre insulation.
103mm brickwork internal skin
20mm plaster finish

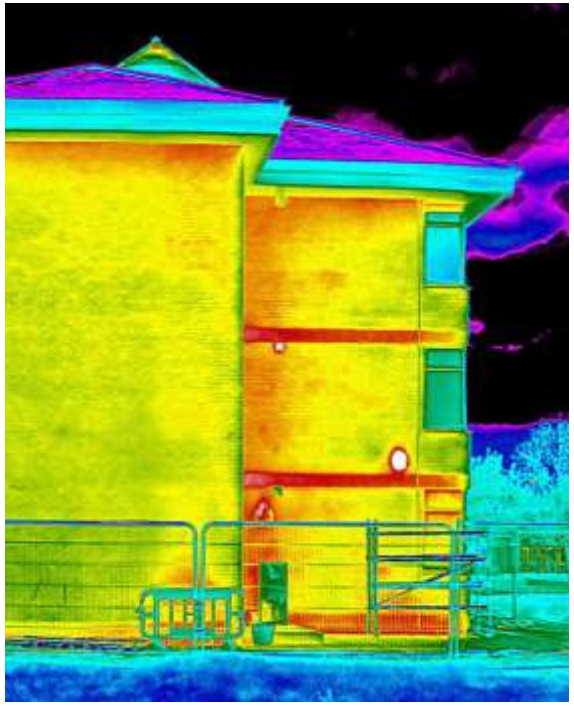
Solid Concrete lintols below windows with glass infill. Lintols approximately 250mm thick with plaster finish internally have been clad with 18mm thick horizontal sections of Cedar cladding 40mm timber battens on breather membrane.

EXTERNAL WALL TYPE 2
103mm brickwork external skin.
60mm cavity with full fill mineral fibre insulation.
103mm brickwork internal skin
20mm plaster finish

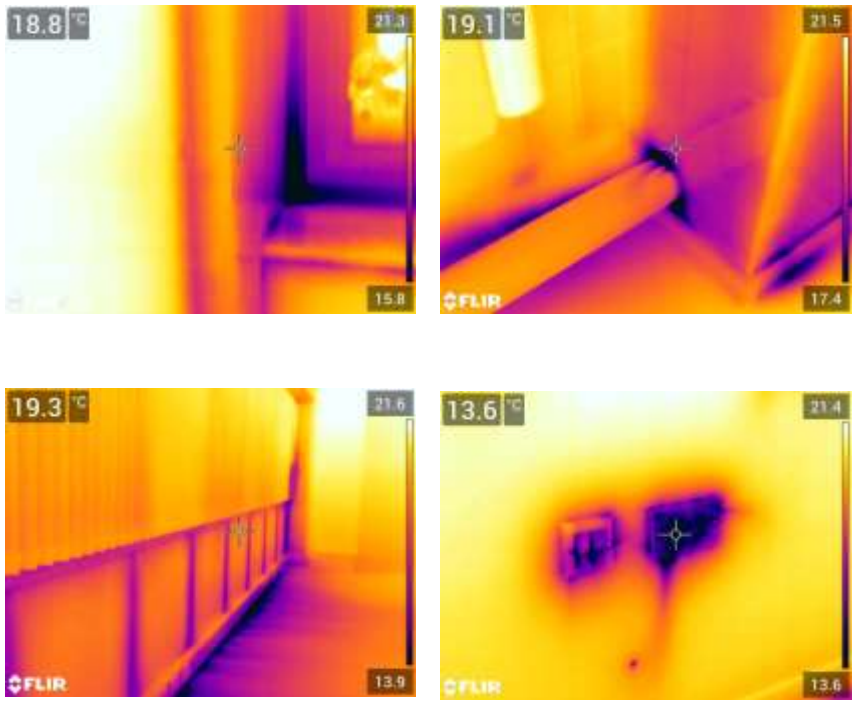
Solid Concrete lintols below windows with glass infill. Lintols approximately 250mm thick with plaster finish internally

Investigation

comprehensive surveys of existing conditions



Thermography



Cold Bridge Assessment

Air-tightness

Evaluation of sustainability criteria

OPTION 01 2021 UK BUILDING REGULATIONS

Option Overview	Accreditations
MINIMUM Baseline requirement, aiming for 30% carbon reduction from 2013 regulations. Relates to all newbuild and extended Residential & Non-residential buildings.	• Part L - Conservation of Fuel & Power • Part 0 - Overheating

Benefits

Increased fabric U values, to the lowest passable new-build standard.

Minimum airtightness, assessed with basic air test process.

Basic calculation of thermal bridging only.

Basic overheating assessment, without detailed modelling.

Weaknesses

Latest Building Regs. far lower than LETI Zero Carbon or EnerPHit metrics.

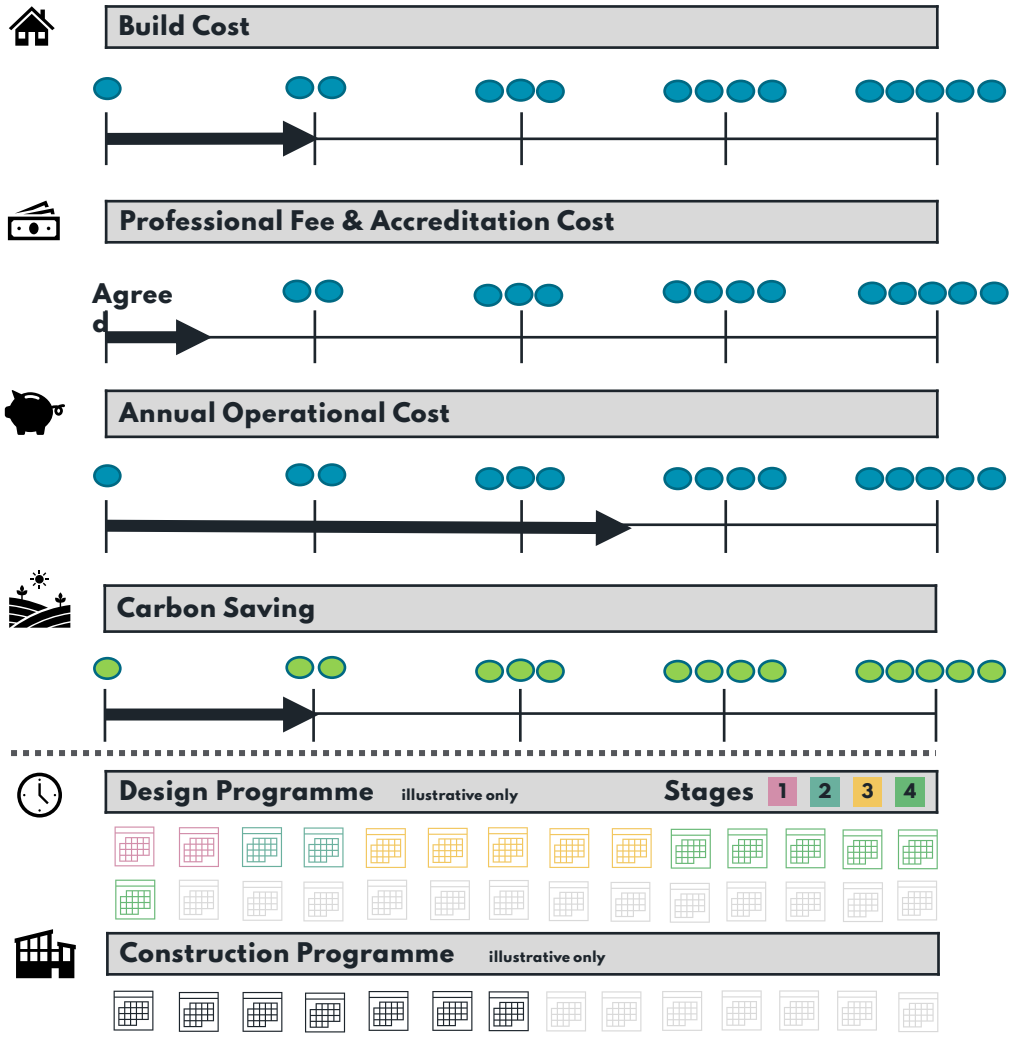
Poor futureproofing- this standard very likely to be superseded by improved standard requirements within next 5 years.

Limited assistance in the site-wide ambition to reach Net Zero Carbon in operation.

Lower 'building performance' – not rigorously tested- and nominal inspection process., so buildings not usually constructed to meet design standard, giving lower building 'performance' in use.

Does not address broader wellbeing, transportation, ecological pupil concentration educational benefits.

INDICATIVE PROJECT IMPACTS



Evaluation of sustainability criteria

OPTION 01 2021 UK BUILDING REGULATIONS

DESIGN CRITERIA

Fabric U-values (W/m2.K)- minimum

Walls	0.26	(non-domestic)
Floor	0.18	
Roof	0.16	(0.18 flat roofs)
Windows & Rooflights	1.6 / 2.2	(non-domestic - double glazing)
Ext. Doors	1.6	

Fabric efficiency measures - minimum

Air tightness m3/h. m2@50Pa	< 8.0
Thermal bridging of element U value	25%
G-value of glass	n/a

Process

Regulatory minimum requirement (B. Regs):	Yes
Certified - by independent 3rd party:	**No**
Timing - project stage when initiative needs to be implemented:	From Stage 1
Physically Tested & recorded during construction:	**No** (basic air test)
Inspected during construction:	Yes (sampled only)

Performance Gap

LARGE GAP:

- Compliance based on NCM pre-set activity templates that don't necessarily follow the building operation patterns and loads.
- Only regulated energy is accounted in the energy and emissions calculations.
- Embodied carbon is not part of the Part L assessment.

On-site Renewables

Not mandatory. Required depending Building Emission Rates.

Evaluation of sustainability criteria

OPTION 02 LETI - NET ZERO CARBON (RETROFIT STANDARD)

Option Overview	Accreditations
Provision of a range of design criteria aiming to provide Net Zero Carbon in operation. Number of design solutions to achieve this, but set criteria.	• No formal accreditation, just an uncertified assessment & claim.

Benefits

Much increased U values over Part L, with limited glazed openings per façade.

Gas-free plant.

Defined space heating demand- **25** to 50 kWh(m2a), giving lower energy costs.

Increased Air-tightness over Part L.

Includes an Embodied carbon target.

Medium 'building performance' – not tested or certified.

Weaknesses

LETI glazed areas not always compatible with existing buildings.

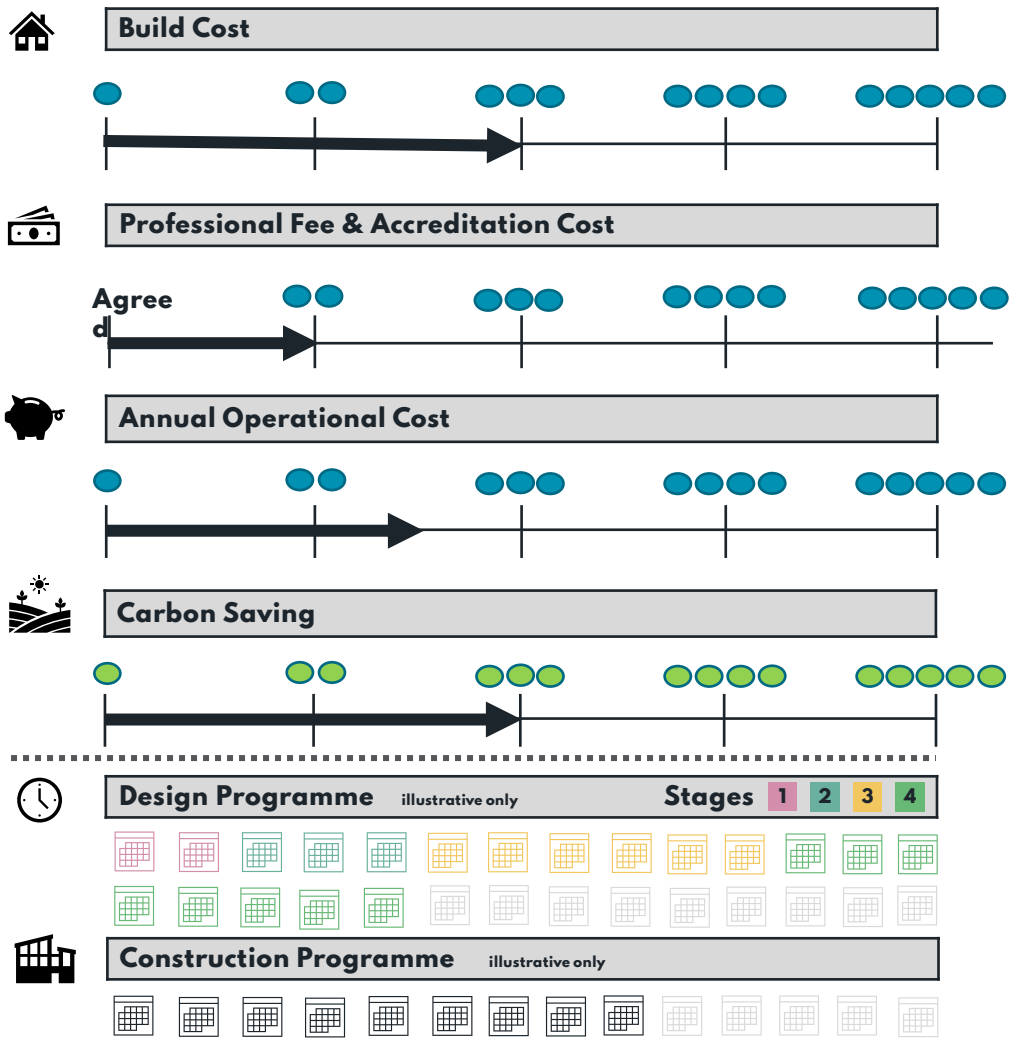
Can't take into account 'form factor' and orientation with existing buildings.

Reliant on extent of renewable on-site electricity generation.

Not independently inspected in construction or certified – meaning actual built performance normally 30% less than design criteria.

Not necessarily providing increased internal air quality or heat recovery, so limited impact on student learning & thermal comfort.

INDICATIVE PROJECT IMPACTS



Evaluation of sustainability criteria

OPTION 02 LETI - NET ZERO CARBON (RETROFIT STANDARD)

DESIGN CRITERIA 'Unconstrained retrofit' (cool temperate climate)

Fabric U-values (W/m2.K)- minimum

Walls	0.18
Floor (solid)	0.15
Roof	0.12
Windows & Rooflights	1.0 (triple glazing)
Ext. Doors	0.8

Fabric efficiency measures - minimum

Air tightness	< 2.0 (m3/h. m2 @50Pa)
Thermal bridging	0.01w/m.K
G-value of glass	n/a

Process

Regulatory minimum requirement (B. Regs):	Yes
Certified - by independent 3rd party:	**No**
Timing - project stage when initiative needs to be implemented:	From Stage 1
Physically Tested & recorded during construction:	**No**
Inspected during construction:	**No**

Performance Gap

MEDIUM GAP:

- Taking into account the expected use of the building (Schedule of occupancy, extended occupancy, activities, equipment)
- Calculate all the unregulated loads
- Half hourly metering and energy consumption data disclosure for benchmarking.
- Energy storage (batteries or thermal storage)
- Focus on reducing embodied carbon

On-site Renewables

40% of roof area

Evaluation of sustainability criteria

OPTION 03 ENERPHIT CERTIFIED
(RETROFIT PASSIVHAUS)

Option Overview	Accreditations
Internationally recognised 'gold standard' for energy efficient building design. Independent certification. Uses higher quality materials & construction to ensure building performance in use.	• Certified Passivhaus standard. • Additional Passivhaus Plus & Premium options.

Benefits

High 'building performance' accreditation – which is tested and certified.

High quality filtered air environment – improves staff concentration.

Very high levels of thermal comfort.

90% plus heat recovery of exhaust air.

Defined space heating demand- **25 kWh**(m2a), giving lower energy costs.

Increased Air-tightness over Part L. & NZC.

Weaknesses

Needs early project stage integration and earlier design, specification, analysis (using PHPP software) & co-ordination.

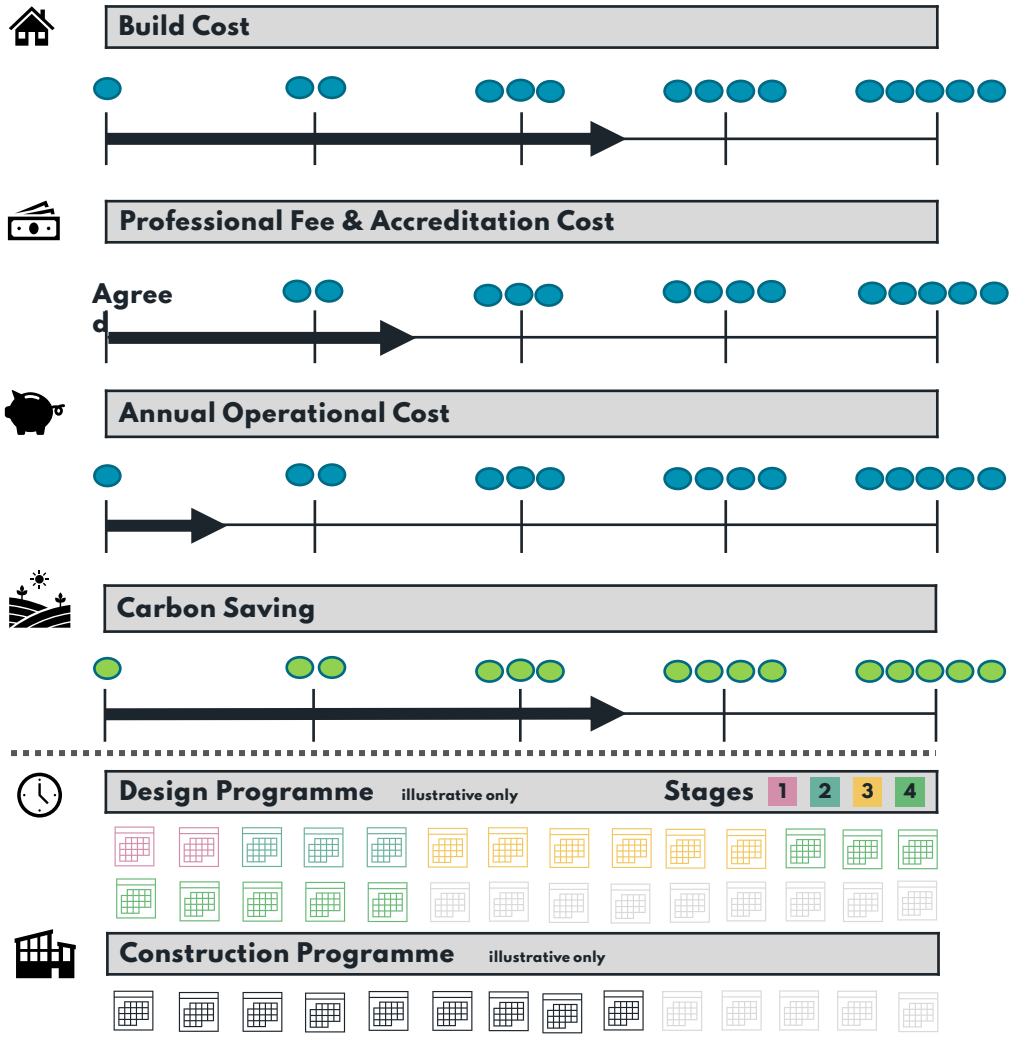
Can't take into account 'form factor' and orientation with existing buildings.

Increased cost from Part L, as use of higher quality materials and construction rigor.

Doesn't deliver all the benefits if not Certified.

Doesn't yet address Embodied energy- new version under development.

INDICATIVE PROJECT IMPACTS



Evaluation of sustainability criteria

OPTION 03 ENERPHIT CERTIFIED (RETROFIT PASSIVHAUS)

Design Criteria – (using Cert. Component approach)
Typical values, as project specific calculation in PHPP programme

Fabric U-values (W/m2.K)- minimum

Walls	< 0.15
Floor	< 0.15
Roof	< 0.12
Windows & Rooflights	0.85 (triple glazing)
Ext. Doors	0.80

Fabric efficiency measures - minimum
(using Cert. Component approach)

Air tightness	< 1.0 (ac/h @50Pa)
Thermal bridging	0.01 W/mK
G-value of glass	0.5

Performance Gap

LOW – ZERO GAP:
Monitored against accredited performance process

Further options for additional benefits
– reducing payback period

On-site Renewables

Maximise renewables so that 70% of the roof is covered

Process

Regulatory minimum requirement (B. Regs):	Yes
Certified - by independent 3rd party:	Yes
Timing - project stage when initiative needs to be implemented:	From Stage 1
Physically Tested & recorded during construction:	Yes
Inspected during construction:	Yes

OPTION 03 **ENERPHIT CERTIFIED**
(RETROFIT PASSIVHAUS)

EnerPHit Benefits

- Minimised energy consumption.
- Avoidance of building defects that can lead to mould growth.
- Excellent standards of thermal comfort.
- Minimised energy bills.
- High standard of indoor air quality, filtered to remove airborne allergens.
- High Acoustic isolation levels.
- Design for changing climate weather patterns and combatting 'overheating'.
- Optimised lifecycle costs.
- High levels of satisfaction by the building user/owner.
- Addresses the 'Performance Gap'; the difference between planned performance criteria in the design and the tested built reality of what is really achieved.
- Demonstratable method of communicating the client's sustainability ethos and ambition.

The intensive monitoring of Certified Passivhaus buildings by the Passivhaus Institute over the last 30 years has clearly demonstrated and validated the quality assurance requirements of the standard.

Reference: PHI – Claiming the Passivhaus Standard

OPTION 03 **ENERPHIT CERTIFIED**
(RETROFIT PASSIVHAUS)

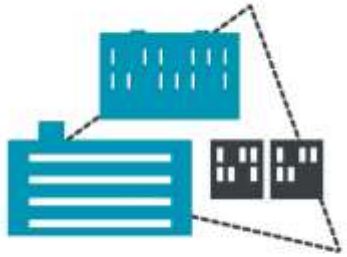
EnerPHit Delivery
CONSTRUCTION QUALITY

CERTIFICATION a 'proper job'
Outlay now is 'money well spent'

Build **exactly** what is designed

- No deviation
- No 'fudging'
- No substitution
- Additional Inspection to ratify

Holistic sustainability approach

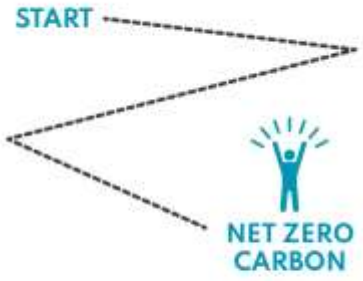


Audit of existing campus

Improve the building fabric

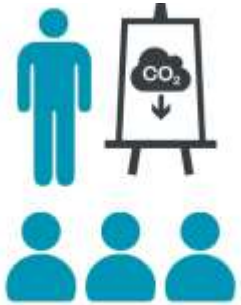
Renewable energy sources

Biodiversity net gain



Net Zero Roadmap

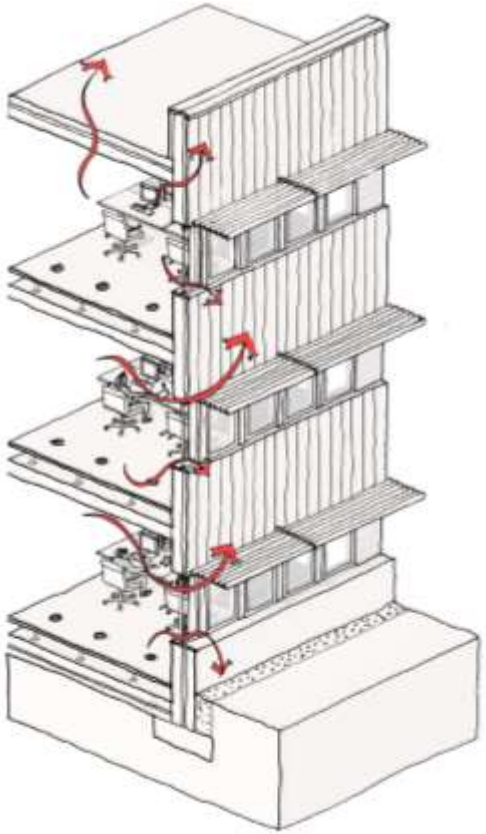
Reduce operational carbon



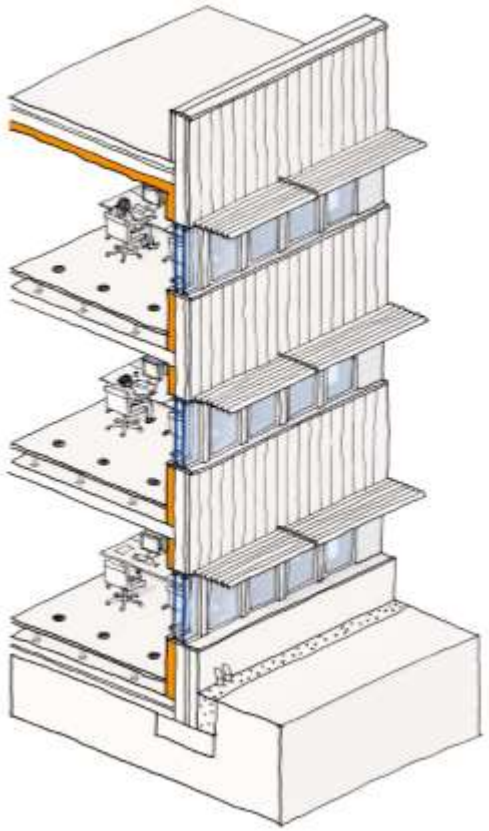
Education and climate change

Renewable heating

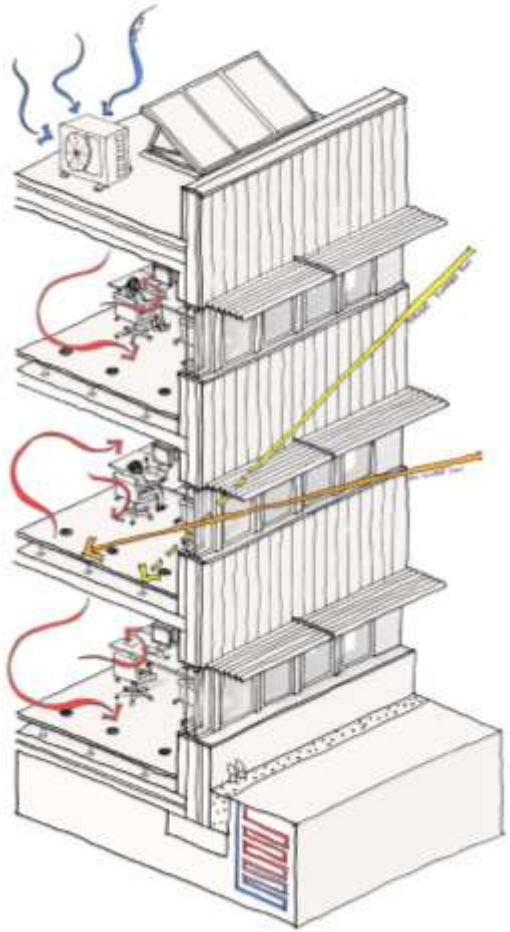
Holistic sustainability approach



Existing: Assessment of 1960s Buildings



Proposal: Fabric upgrade:
New Airtightness and Insulation



Proposal: Renewables and upgraded systems to improve comfort

Observed Workplace Trends

Employees have greater choice

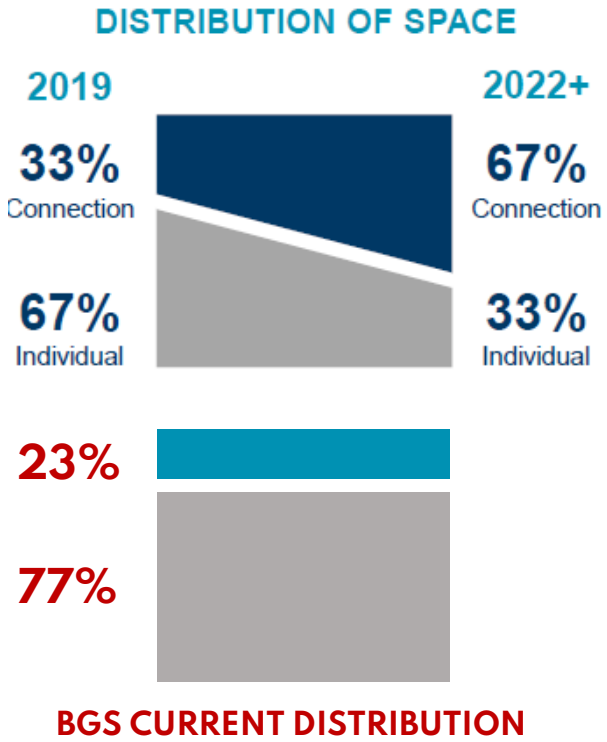
73% open to new jobs if unsatisfied

Flexibility (2nd only to compensation)

80% want flexibility where they work

94% want flexibility in when they work

Significant changes in how the office is apportioned (workplace/support)



BGS CURRENT DISTRIBUTION

Use of the office has changed for many employees

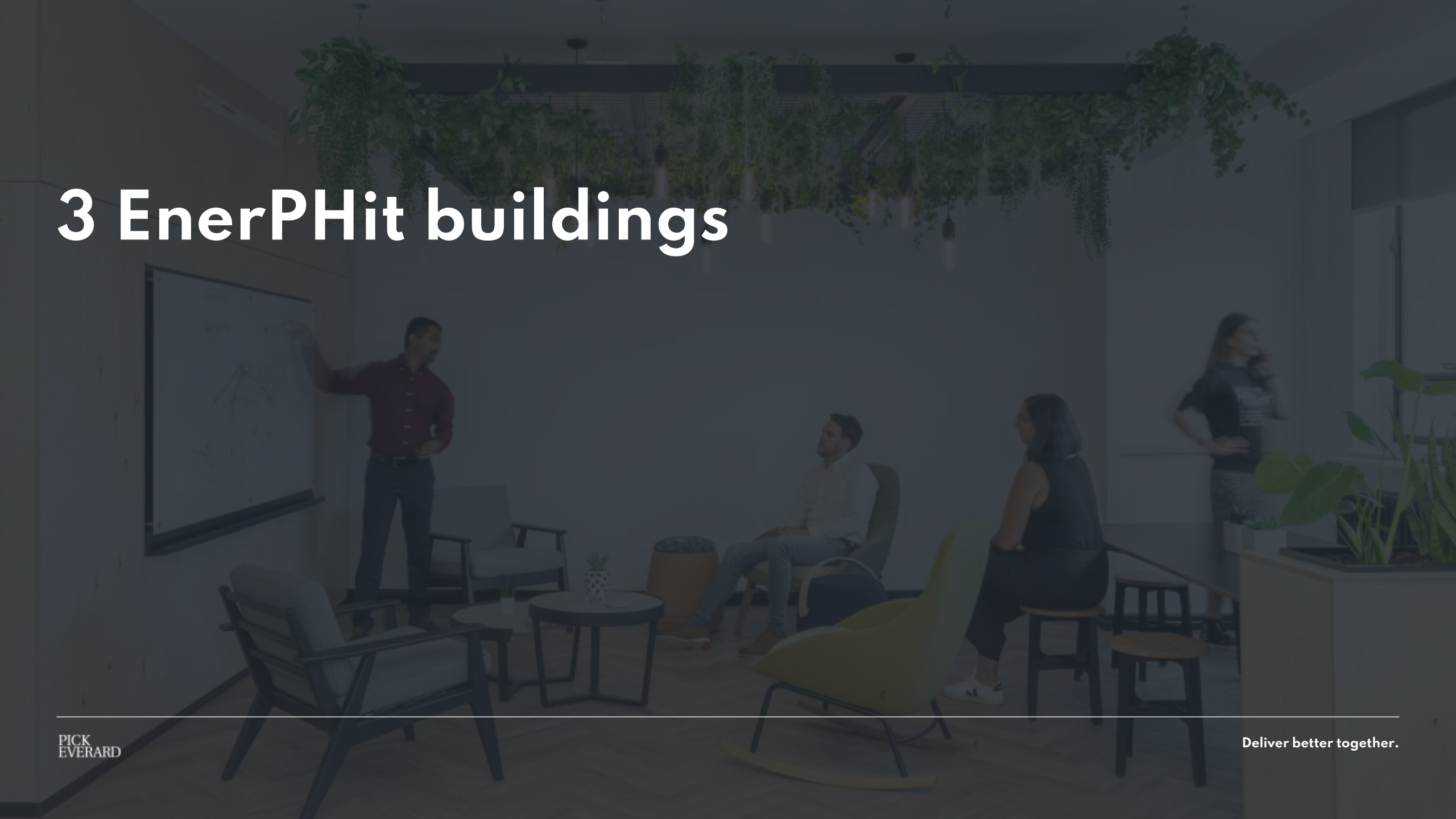
Credit: Cushman & Wakefield | Total Workplace

Landscape & Biodiversity

Design needs:

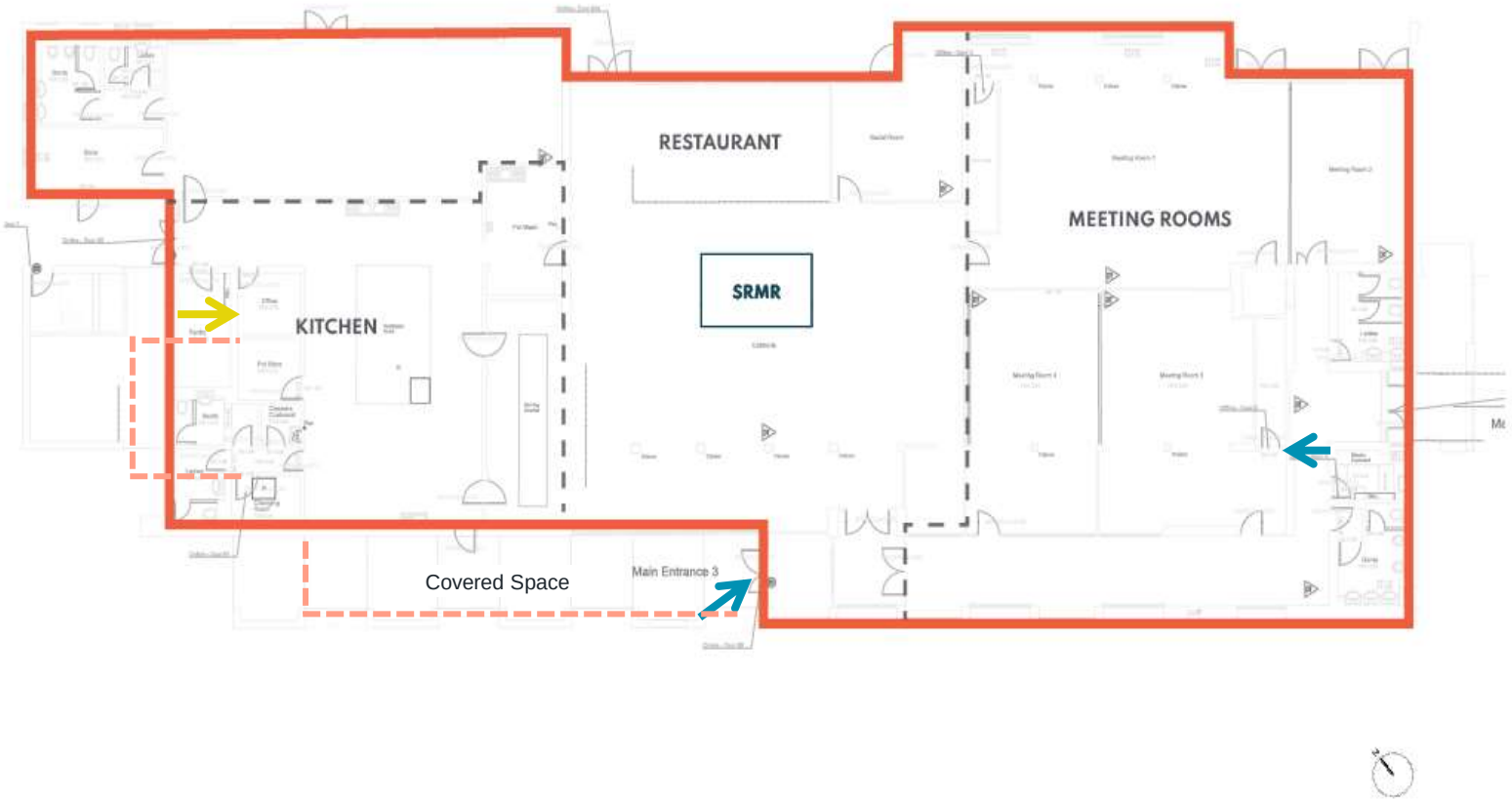
- **GSHP** – Boreholes, manifolds & associated pipework, areas agreed with Building Services Engineer to avoid existing habitats. Exact locations to be determined.
- **ASHP** - to the north-east of NGR building
- **Temporary modular buildings** - the size and locations to be determined
- **BNG** – Planning stipulates % gain for Biodiversity Net Gain required. Applications approved from November require 10% gain.
  Current 'worst case scenario' BNG score
  0.45% gain for habitats & 65.70% gain for hedgerows. Based on all habitats in GSHP areas destroyed & reinstated.
  Ecologist confirms 10% gain possible if all medium & large trees are retained.
- **BREEAM** - Land Use & Ecology Credits. Appointment of Suitably Qualified Ecologist - confirmed design is in line with requirements and who will provide evidence.

3 EnerPHit buildings



SRMR

SRMR


RESTAURANT
MEETING ROOMS
SRMR
KITCHEN
Covered Space
Main Entrance 3

SRMR

Opportunities

- If the roof plant is decommissioned large PV zone is available
- New internal wall lining creates new airtightness line
- Reinstate existing rooflights
- Upgrade to building elements: walls, roof, floor
- Upgrade to building components: windows and doors etc.
- Consideration of T037 to bring kitchen ventilation requirements aligned with EnerPHit requirements.

Constraints

- Single Storey – Large surface area (form factor)
- Catering strategy required prior to stage 3 commencement
- Early within the design programme, becomes a showcase for further EnerPHit developments
- Canopy to sit outside of the thermal line

EnerPHit-Verification

10.4a EN

PHPP

Photo or drawing

Building:	British Geological Survey - SRMR Building		
Street:	Nicker Hill		
Postcode/City:	NG12 5GG	Keyworth	
Province/Country:	Nottingham		GB-United Kingdom/ Britain
Building type:	7-Office | Administration building		
Climate data set:	GB0007a-Sutton Bonnington, Altitude corrected		
Climate zone:	3: Cool-temperate	Altitude of location:	65 m
Home owner / Client:	British Geological Survey		
Street:	Nicker Hill		
Postcode/City:	NG12 5GG	Keyworth	
Province/Country:	Nottingham		GB-United Kingdom/ Britain
Architecture:	Pick Everard		
Street:	The Generator Building, Counterslip		
Postcode/City:	BS1 6BX	Bristol	
Province/Country:	Bristol		GB-United Kingdom/ Britain
Mechanical engineer:	Pick Everard		
Street:	Halford House, Charles Street		
Postcode/City:	LE1 1HA	Leicester	
Province/Country:	Leicester		GB-United Kingdom/ Britain
Energy consultancy:	Pick Everard		
Street:	Halford House, Charles Street		
Postcode/City:	LE1 1HA	Leicester	
Province/Country:	Leicester		GB-United Kingdom/ Britain
Certification:			
Street:			
Postcode/City:			
Province/Country:			

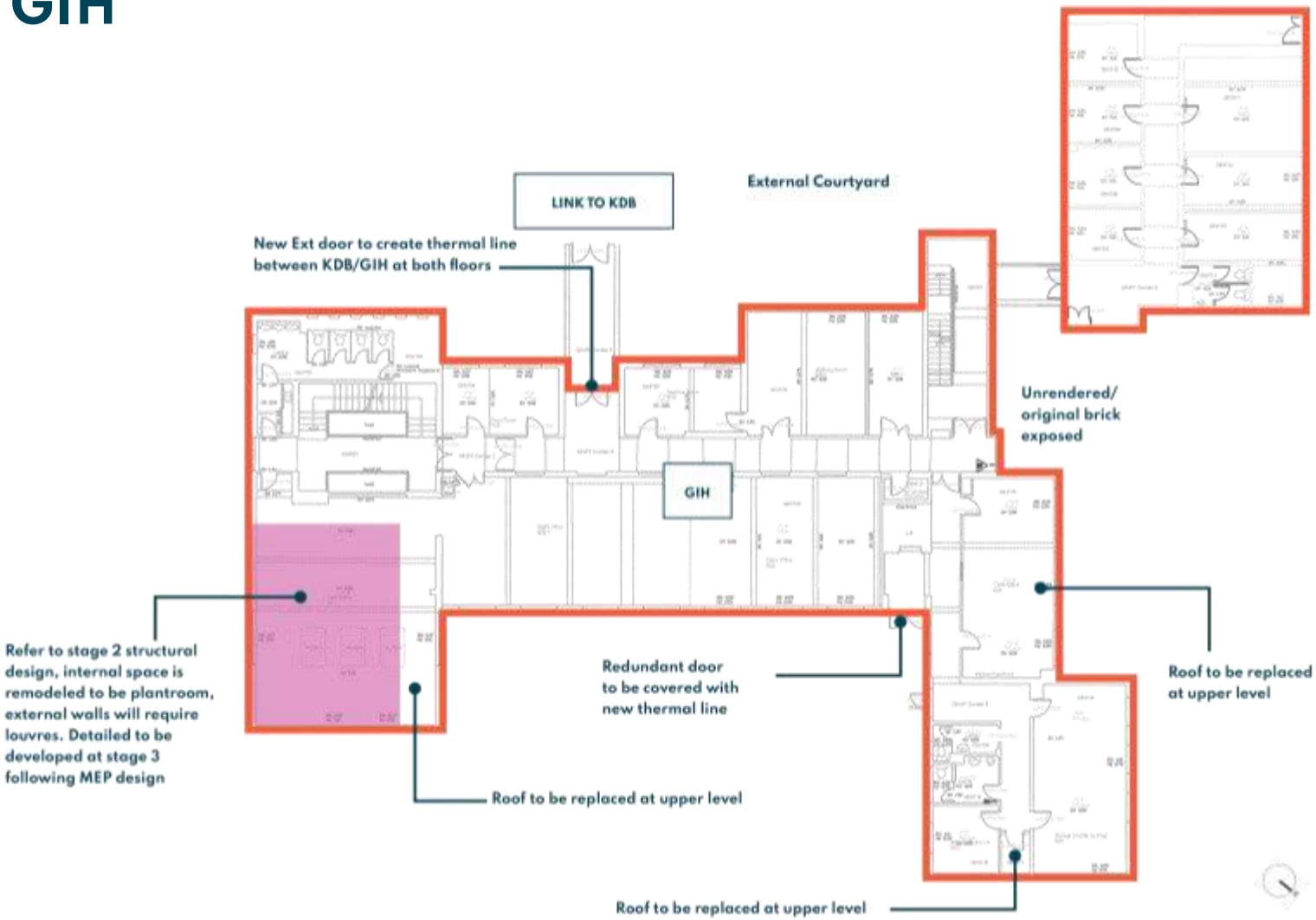
Year of construction:	2025	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	3.5	IHG summer [W/m²]:	3.5
No. of occupants:	200.0	Specific heat capacity [Wh/K per m² TFA]:	60	Mechanical cooling:	

Specific building characteristics with reference to the treated floor area — 1 error message(s) in 'Check' worksheet'

					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	772.7				
Space heating	Heating demand	kWh/(m²a)	25	≤	25	-	Yes
	Heating load	W/m²	13	≤	-	-	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	-	≤	-		-
	Frequency of overheating (> 25 °C)	%	0	≤	10		Yes
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	20		Yes
Airtightness	Pressurisation test result n_{50}	1/h	1.0	≤	1.0		Yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	22	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	18	≤	76	76	Yes
	Renew. energy generation (in rel. to projected building footprint area)	kWh/(m²a)	0	≥	-	-	


GIH

GIH


LINK TO KDB
External Courtyard
New Ext door to create thermal line between KDB/GIH at both floors
Unrendered/ original brick exposed
GIH
Refer to stage 2 structural design, internal space is remodeled to be plantroom, external walls will require louvres. Detailed to be developed at stage 3 following MEP design
Redundant door to be covered with new thermal line
Roof to be replaced at upper level
Roof to be replaced at upper level
Roof to be replaced at upper level

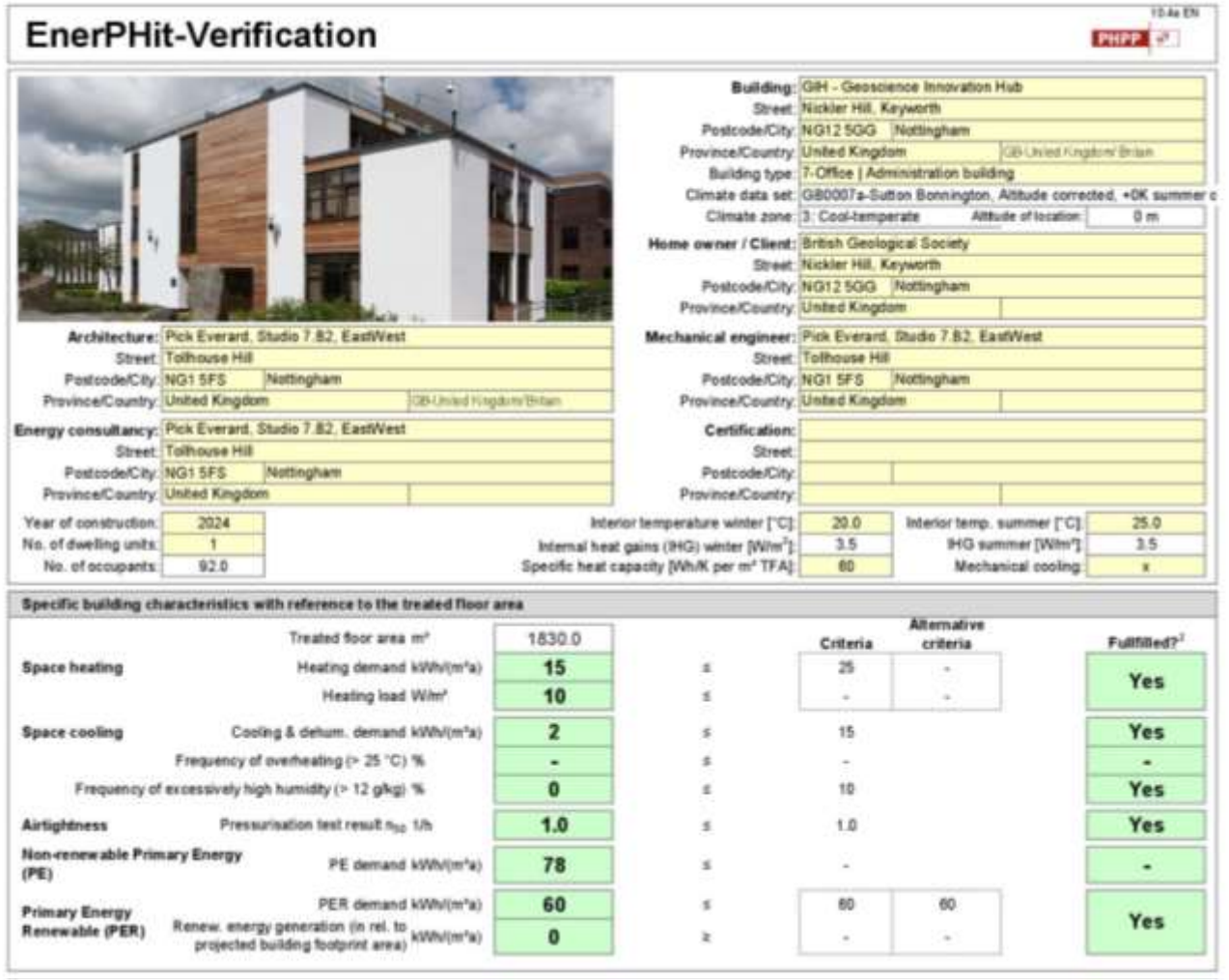
GIH

Opportunities

- Could achieve EnerPHit
- Upgrade to building elements: walls, roof, floor
- Upgrade to building components: windows and doors etc.
- KDB and GIH to look upgraded as one

Constraints

- Additional survey information required to complete PHPP for stage 3
- Stepped roofs will all require insulation and re-roofing
- Further CCTV drainage survey to determine if RWP are re-usable
- Potential new plant room required, TBC at stage 3



EnerPHit-Verification

PHPP 10.4a EN

Building:	GIH - Geoscience Innovation Hub
Street:	Nickler Hill, Keyworth
Postcode/City:	NG12 5GG Nottingham
Province/Country:	United Kingdom
Building type:	7-Office | Administration building
Climate data set:	GB0007a-Sutton Bonnington, Altitude corrected, +0K summer c
Climate zone:	3: Cool-temperate Altitude of location: 0 m
Home owner / Client:	British Geological Society
Street:	Nickler Hill, Keyworth
Postcode/City:	NG12 5GG Nottingham
Province/Country:	United Kingdom
Architecture:	Pick Everard, Studio 7.B2, EastWest
Street:	Tollhouse Hill
Postcode/City:	NG1 5FS Nottingham
Province/Country:	United Kingdom
Mechanical engineer:	Pick Everard, Studio 7.B2, EastWest
Street:	Tollhouse Hill
Postcode/City:	NG1 5FS Nottingham
Province/Country:	United Kingdom
Energy consultancy:	Pick Everard, Studio 7.B2, EastWest
Street:	Tollhouse Hill
Postcode/City:	NG1 5FS Nottingham
Province/Country:	United Kingdom
Certification:	
Street:	
Postcode/City:	
Province/Country:	

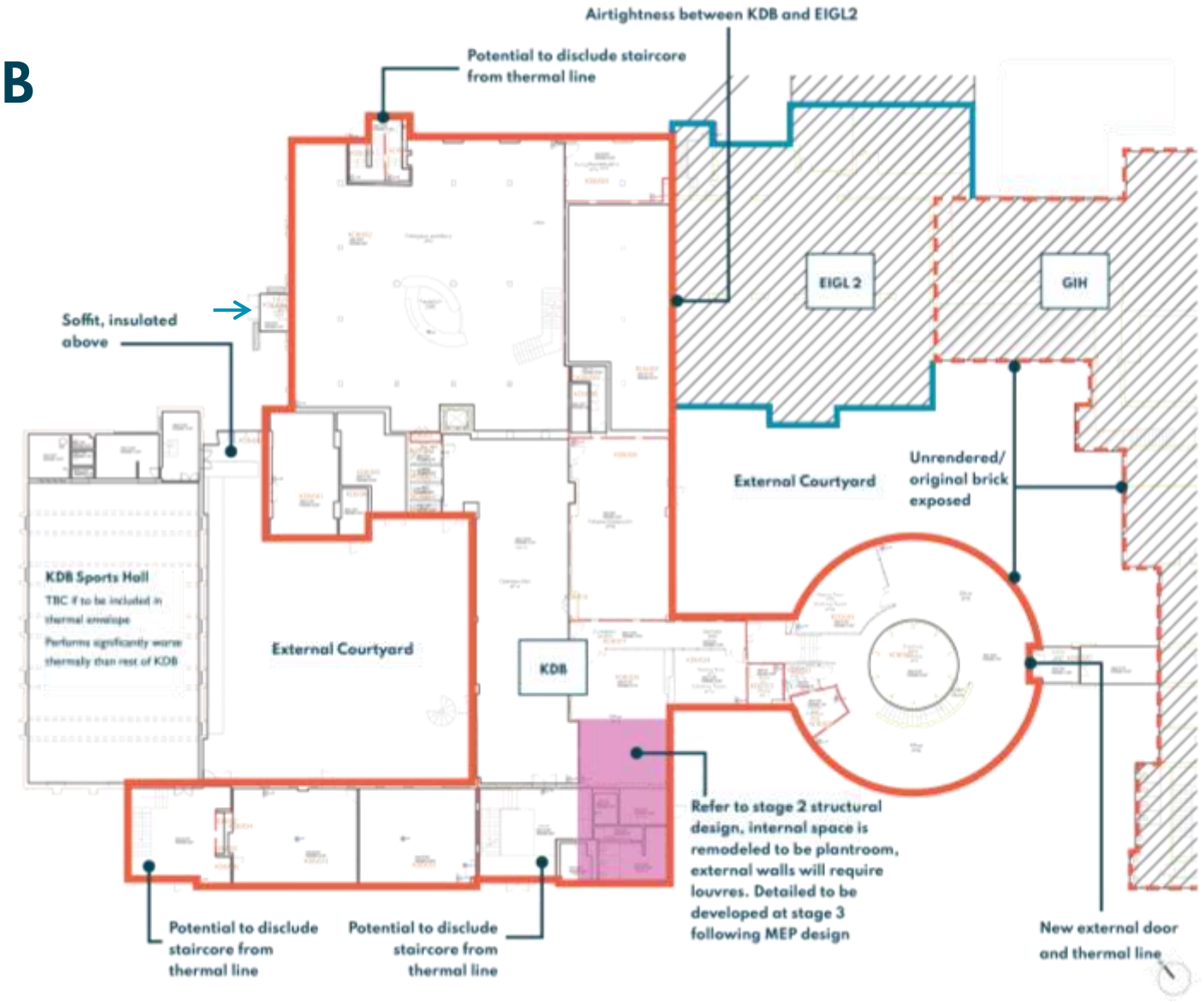
Year of construction:	2024	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	3.5	IHG summer [W/m²]:	3.5
No. of occupants:	92.0	Specific heat capacity [Wh/K per m² TFA]:	60	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area

				Criteria	Alternative criteria	Fulfilled?
	Treated floor area m²	1830.0				
Space heating	Heating demand kWh/(m²a)	15	≤	25	-	Yes
	Heating load W/m²	10	≤	-	-	
Space cooling	Cooling & dehum. demand kWh/(m²a)	2	≤	15		Yes
	Frequency of overheating (> 25 °C) %	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg) %	0	≤	10		Yes
Airtightness	Pressurisation test result n_{50} 1/h	1.0	≤	1.0		Yes
Non-renewable Primary Energy (PE)	PE demand kWh/(m²a)	78	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m²a)	60	≤	60	60	Yes
	Renew. energy generation (in rel. to projected building footprint area) kWh/(m²a)	0	≥	-	-	


KDB

KDB


Airtightness between KDB and EIGL2
Potential to disclude staircore from thermal line
EIGL 2
GIH
Soffit, insulated above
External Courtyard
Unrendered/ original brick exposed
KDB Sports Hall
TBC if to be included in thermal envelope
Performs significantly worse thermally than rest of KDB
External Courtyard
KDB
Refer to stage 2 structural design, internal space is remodeled to be plantroom, external walls will require louvres. Detailed to be developed at stage 3 following MEP design
Potential to disclude staircore from thermal line
Potential to disclude staircore from thermal line
New external door and thermal line

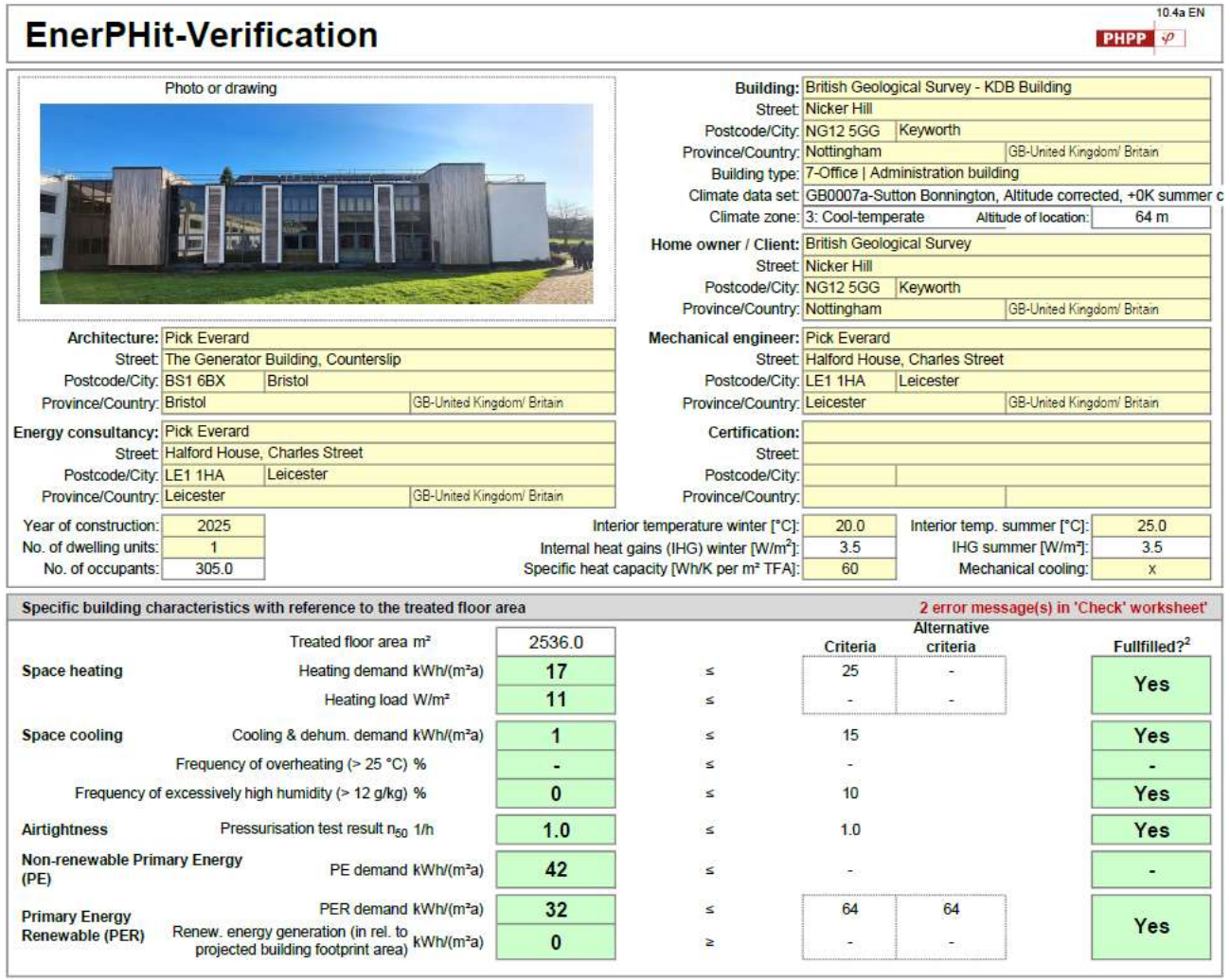
KDB

Opportunities

- Could achieve EnerPHit
- Potential for public-facing visitor building to be extremely sustainable in terms of operation
- Showcase building for BGS Keyworth
- Upgrade to building elements: walls, roof, floor
- Upgrade to building components: windows and doors etc.
- Utilise the sports hall during phasing as storage

Constraints

- Complicated geometry (such as rotunda)
- Lots of existing curtain walling, doors and windows that will need replacing
- Additional survey information required to complete PHPP for stage 3
- Large rooflight required on Rotunda



EnerPHit-Verification — 10.4a EN — PHPP

Photo or drawing

Building:	British Geological Survey - KDB Building		
Street:	Nicker Hill		
Postcode/City:	NG12 5GG	Keyworth	
Province/Country:	Nottingham	GB-United Kingdom/ Britain	
Building type:	7-Office | Administration building		
Climate data set:	GB0007a-Sutton Bonnington, Altitude corrected, +0K summer c		
Climate zone:	3: Cool-temperate	Altitude of location:	64 m
Home owner / Client:	British Geological Survey		
Street:	Nicker Hill		
Postcode/City:	NG12 5GG	Keyworth	
Province/Country:	Nottingham	GB-United Kingdom/ Britain	

Architecture:	Pick Everard		
Street:	The Generator Building, Counterslip		
Postcode/City:	BS1 6BX	Bristol	
Province/Country:	Bristol	GB-United Kingdom/ Britain	
Energy consultancy:	Pick Everard		
Street:	Halford House, Charles Street		
Postcode/City:	LE1 1HA	Leicester	
Province/Country:	Leicester	GB-United Kingdom/ Britain	

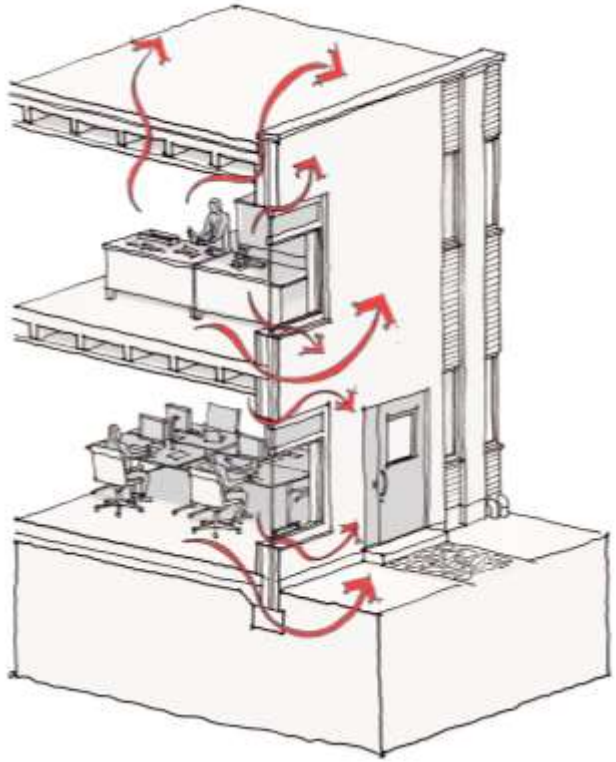
Mechanical engineer:	Pick Everard		
Street:	Halford House, Charles Street		
Postcode/City:	LE1 1HA	Leicester	
Province/Country:	Leicester	GB-United Kingdom/ Britain	
Certification:			
Street:			
Postcode/City:			
Province/Country:			

Year of construction:	2025	Interior temperature winter [°C]:	20.0	Interior temp. summer [°C]:	25.0
No. of dwelling units:	1	Internal heat gains (IHG) winter [W/m²]:	3.5	IHG summer [W/m²]:	3.5
No. of occupants:	305.0	Specific heat capacity [Wh/K per m² TFA]:	60	Mechanical cooling:	x

Specific building characteristics with reference to the treated floor area — 2 error message(s) in 'Check' worksheet'

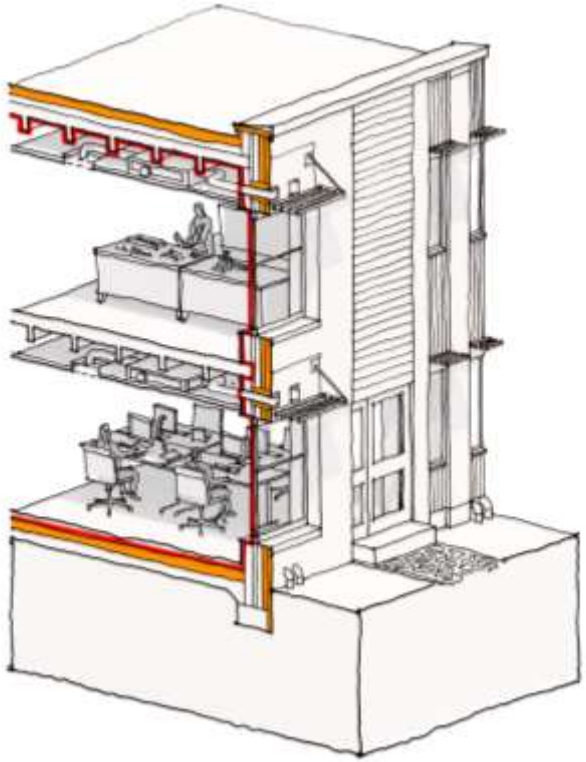
					Criteria	Alternative criteria	Fullfilled?[2]
	Treated floor area	m²	2536.0				
Space heating	Heating demand	kWh/(m²a)	17	≤	25	-	Yes
	Heating load	W/m²	11	≤	-	-	
Space cooling	Cooling & dehum. demand	kWh/(m²a)	1	≤	15		Yes
	Frequency of overheating (> 25 °C)	%	-	≤	-		-
	Frequency of excessively high humidity (> 12 g/kg)	%	0	≤	10		Yes
Airtightness	Pressurisation test result n_{50}	1/h	1.0	≤	1.0		Yes
Non-renewable Primary Energy (PE)	PE demand	kWh/(m²a)	42	≤	-		-
Primary Energy Renewable (PER)	PER demand	kWh/(m²a)	32	≤	64	64	Yes
	Renew. energy generation (in rel. to projected building footprint area)	kWh/(m²a)	0	≥	-	-	

Fabric Upgrade



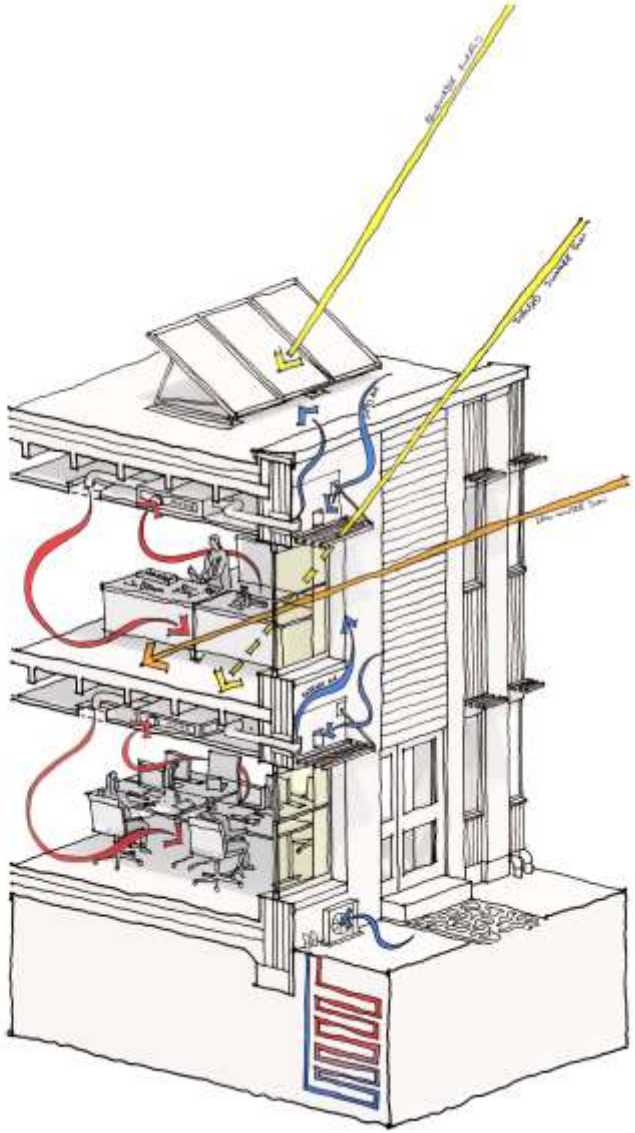
Existing

Assessment of 1960's Buildings



Proposal

New Airtightness and Insulation



Proposal

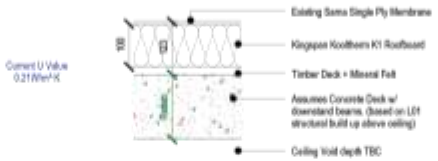
Upgraded systems and Renewables to improve comfort

PICK EVERARD

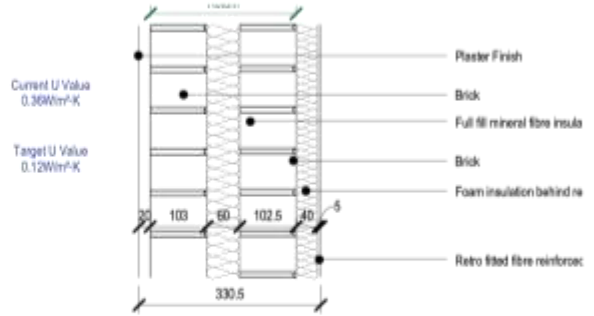
Fabric Upgrade – Stage 2 Detailing strategies

Existing Ground Typical Floor Detail

Existing Roof Typical Detail Scenario 1

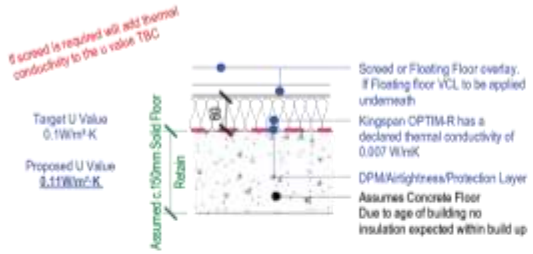


Existing Wall Typical Detail Scenario 1



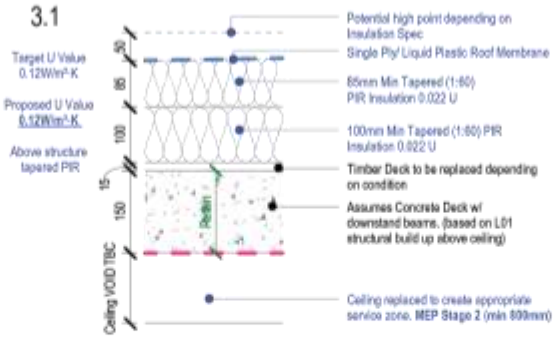
Proposed Ground Floor Detail

(Option 1)



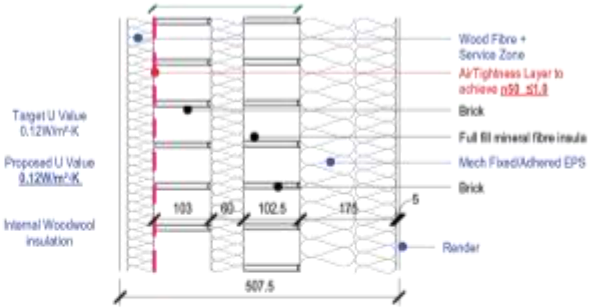
Proposed Roof Detail Scenario 1

(Option 3.1)



Proposed Wall Detail Scenario 1

(Option 1)



PICK EVERARD

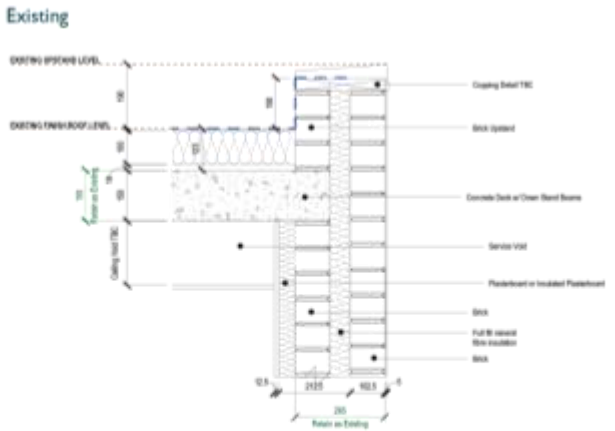
Ground Floor

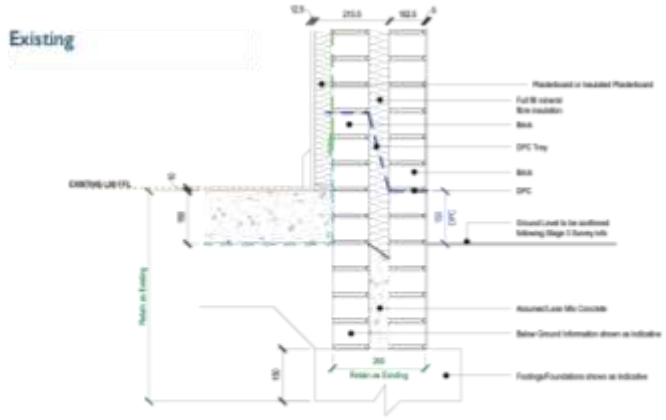
Roof

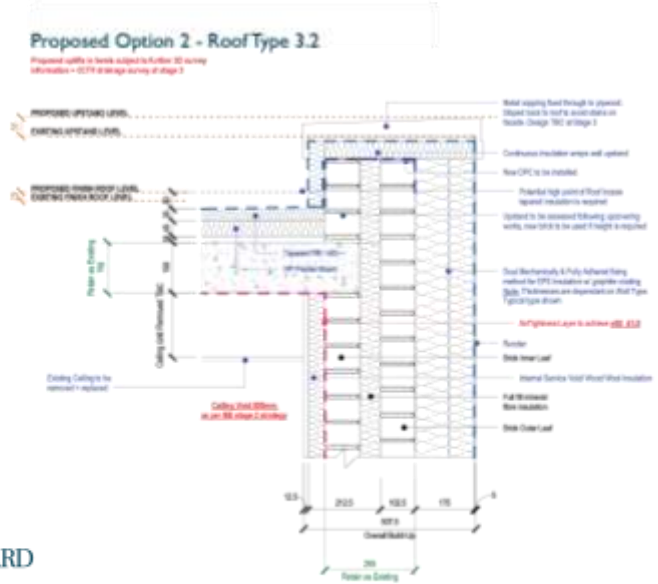
External Wall

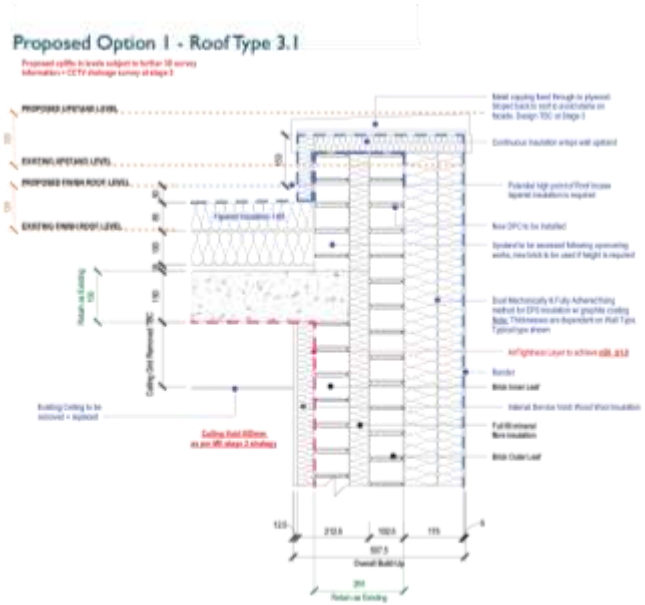
Fabric Upgrade – Stage 2 Detailing strategies

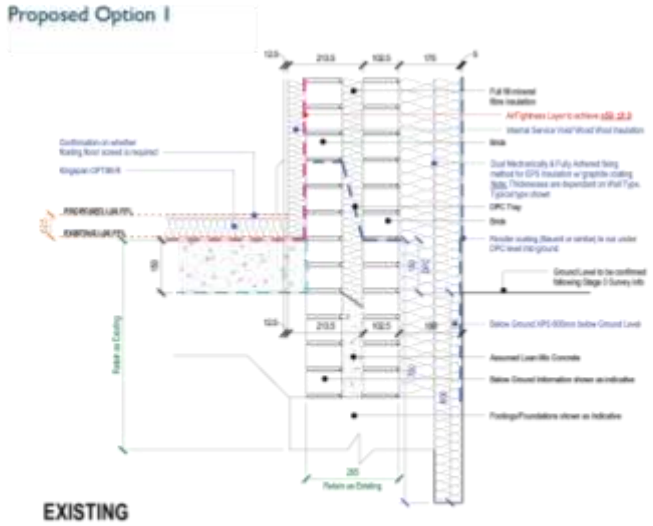
- Additional insulation to exterior, parapet and foundations
- Internal airtightness line











PICK EVERARD

3 LETI Refurbishment buildings

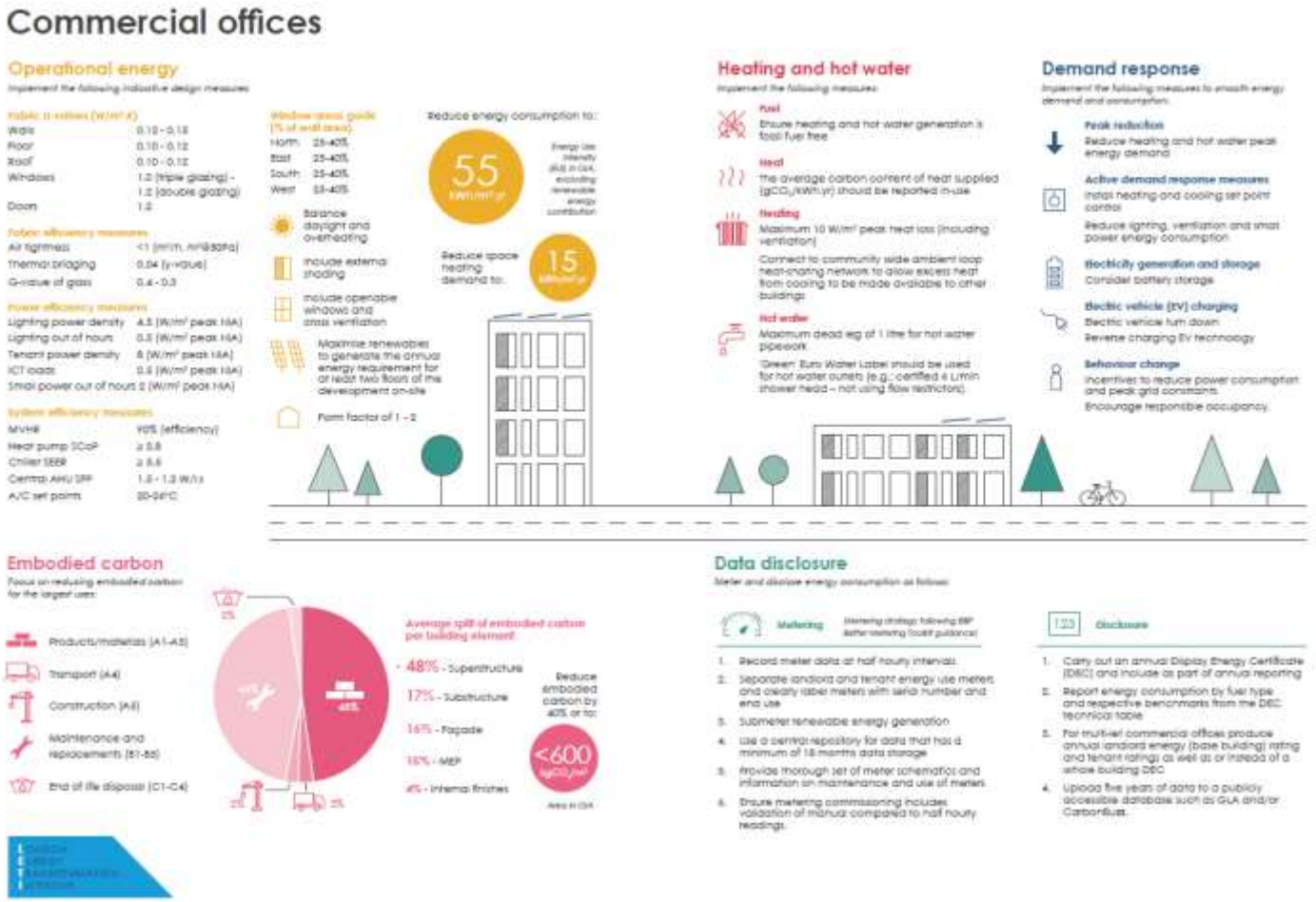
LETI

Low Energy Transformation Initiative
(Retrofit Design Guide)

U-Values:
Stage 2 the U-values targeted are:

- Walls 0.15 W/m2 .K
- Roofs 0.12 W/m2 .K
- Floors 0.15 W/m2 .K
- Windows 0.8 W/m2 .K
  1.2 W/m2 double glazed (commercial new build)
  1.0 W/m2 triple glazed (commercial new build)

- Airtightness 1.0 ach@50Pa



JHB

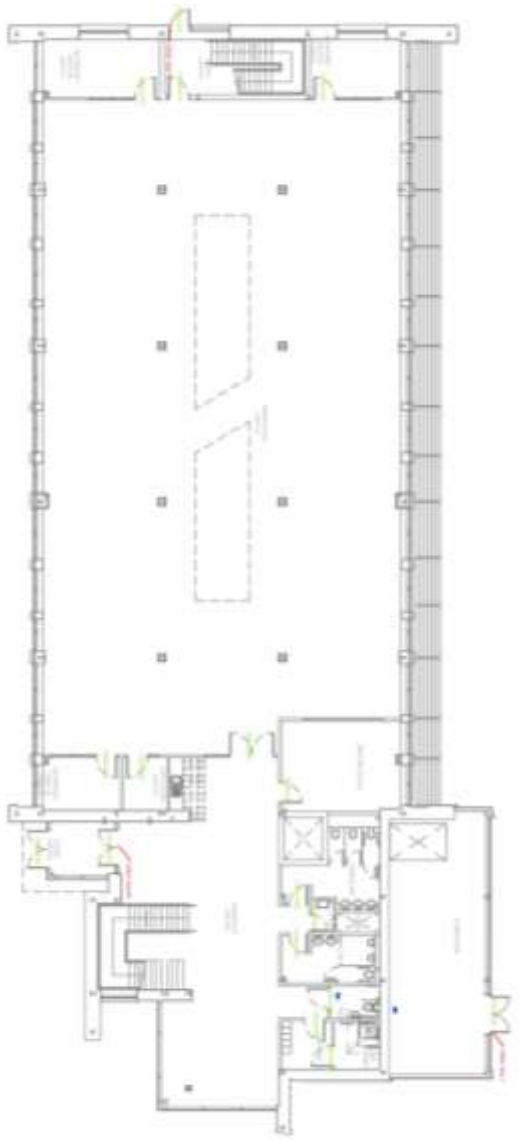
Opportunities

- Performs to Part L opportunities to upgrade to LETI.
- Newest building within TO32 project.
- Potential to include secondary glazing.
- Potential to upgrade Roof to LETI standards.

MAIN OFFICE					
Section	Current U-Value (W/m^2K)	Part L Refurbishment (W/m^2K)		LETI U-Value ($W/m2K$)	
Roof	0.14	0.18		0.10 - 0.12	
Walls	0.12	0.30		0.12 - 0.15	
Windows	1.8*	1.6		1.0 (Triple) 1.2 (Double)	
Curtain Wall	1.8*				
Floor	0.14	0.25		0.10 - 0.12	
Doors	N/A	1.6		1.2	
Air tightness	7.4	8.0**		1.0	

* Denotes assumed values

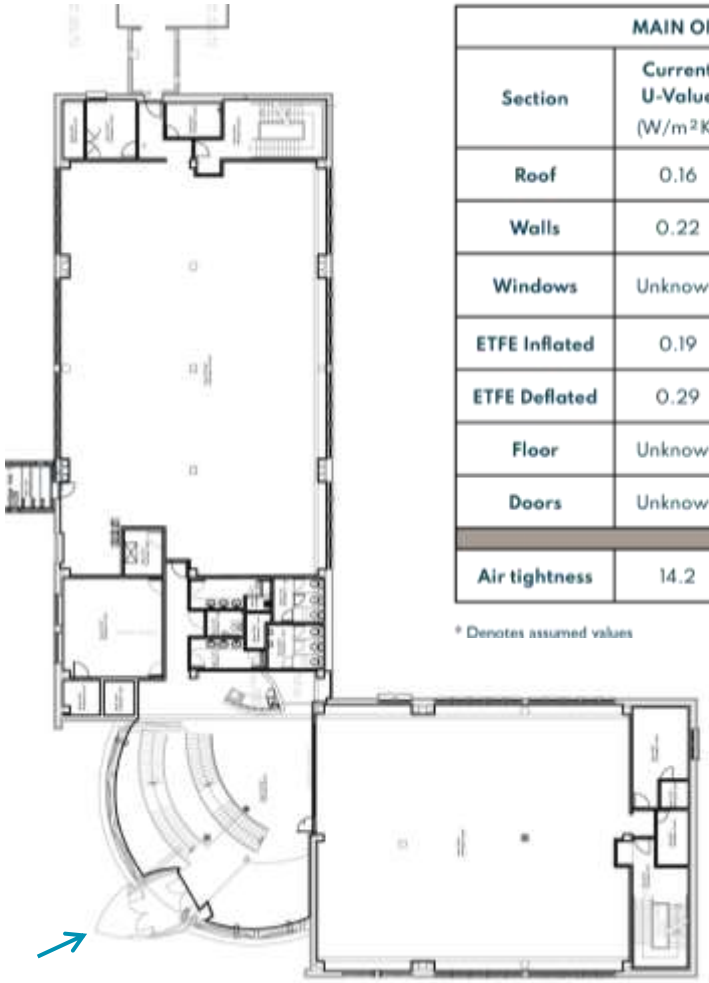
** Denotes new build requirements



WSB

Opportunities

- Upgrade to LETI standard.
- Introduce secondary glazing internally.
- Reduce overheating risk in the entrance lobby.
- Chance to improve the Airtightness.
- Internal wall lining allows for internal insulation to improve U-Value.
- Less intrusive internal works.
- ETFE atrium to be improved with a ventilation opening.



MAIN OFFICE			
Section	Current U-Value (W/m^2K)	LETI U-Value (W/m^2K)	
Roof	0.16	0.10 - 0.12	
Walls	0.22	0.12 - 0.15	
Windows	Unknown	1.0 (Triple) 1.2 (Double)	
ETFE Inflated	0.19	0.10 - 0.12	
ETFE Deflated	0.29	0.10 - 0.12	
Floor	Unknown	0.10 - 0.12	
Doors	Unknown	1.2	
Air tightness	14.2	1.0	

* Denotes assumed values

WSB

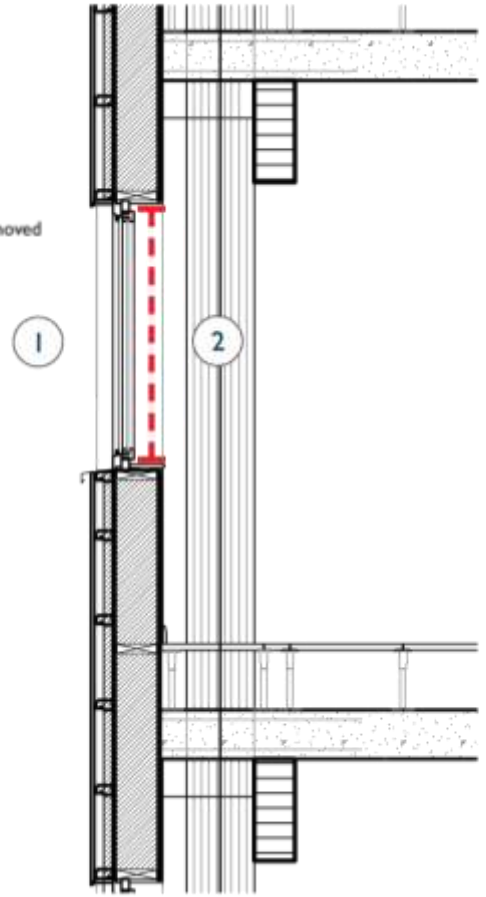
KEY

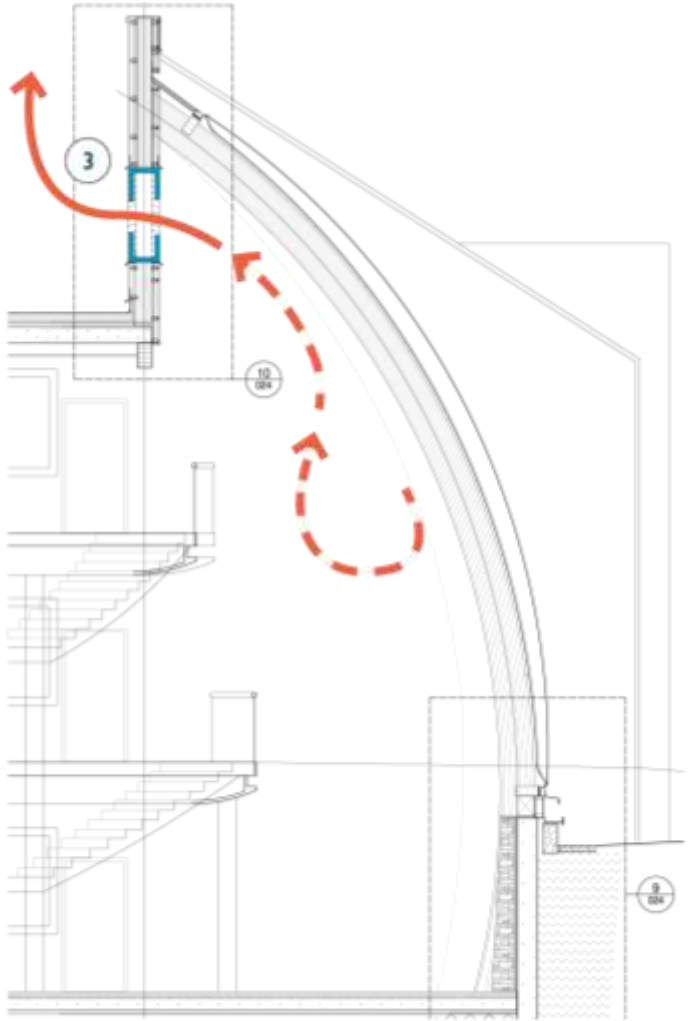
Upgrade 02

1. New window
2. Existing secondary secondary glazing removed

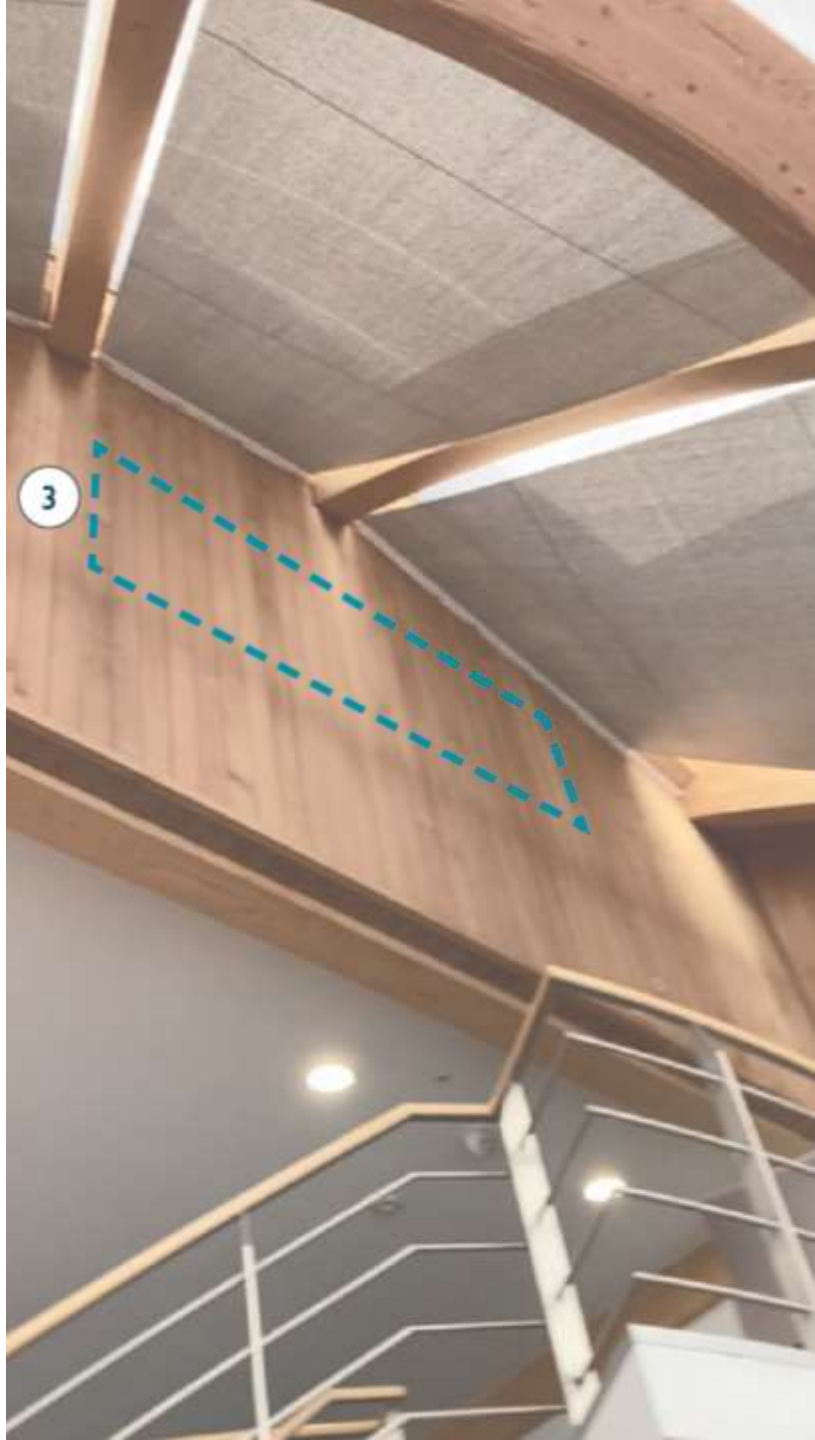
Upgrade 03

3. Proposed ventilation opening





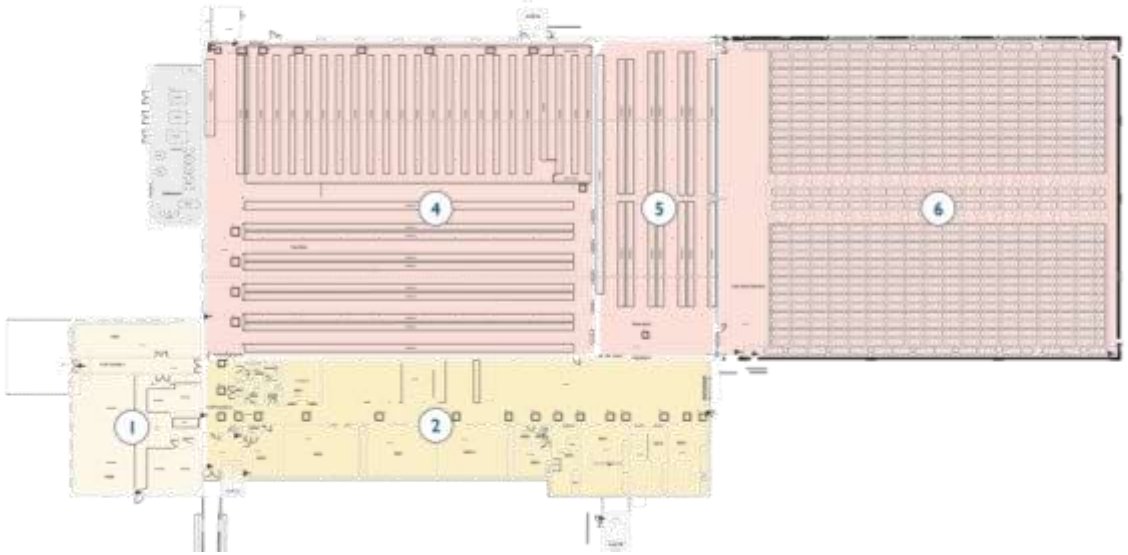
Proposed atrium section diagram



NGR - Store

KEY

1. Archive
2. Examination Area
3. Office / Archive
4. Tray Store (older building)
5. NIREX Store
6. Core Store (newer extension)



ARCHIVE		
Section	Current U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	2.66	0.10 - 0.12
Walls	0.67	0.12 - 0.15
Windows	1.4 - 1.8	1.2 (Double)
Floor	Unknown	0.10 - 0.12
Doors	Unknown	1.2
Air tightness	Unknown	1.0

MAIN OFFICE / EXAMINATION AREA		
Section	Current U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	0.35	0.10 - 0.12
Walls	0.34 / 2.6	0.12 - 0.15
Windows	1.4 - 1.8	1.2 (Double)
Floor	1.2	0.10 - 0.12
Doors	Unknown	1.2
Air tightness	Unknown	1.0

TRAY STORE		
Section	Current U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	0.34	0.10 - 0.12
Walls	0.50	0.12 - 0.15
Windows	1.4 - 1.8	1.2 (Double)
Floor	0.3	0.10 - 0.12
Doors	Unknown	1.2
Air tightness	Unknown	1.0

CORE STORE		
Section	Current U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	0.25	0.10 - 0.12
Walls	0.35	0.12 - 0.15
Windows	2.2	1.2 (Double)
Floor	0.08	0.10 - 0.12
Doors	2.2	1.2
Air tightness	8.8	1.0

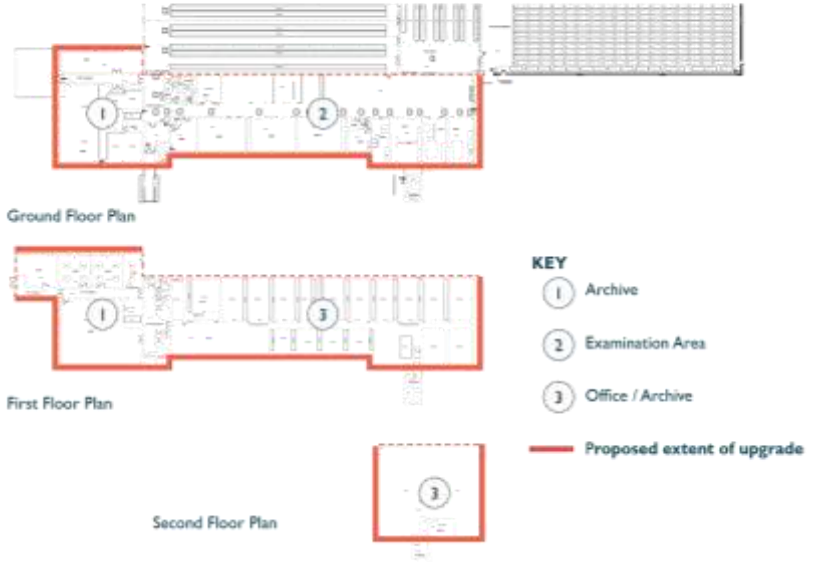
NGR - Offices

Opportunities

- Upgrade to LETI standard
- Improve the visitor aspect for students and academics

Challenges

- No specific LETI guidance for archive/ storage facilities
- Large building with multiple uses/ phases



ARCHIVE		
Section	Current U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	2.66	0.10 - 0.12
Walls	0.67	0.12 - 0.15
Windows	1.4 - 1.8	1.2 (Double)
Floor	Unknown	0.10 - 0.12
Doors	Unknown	1.2
Air tightness	Unknown	1.0

ARCHIVE		
Section	Proposed U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	0.12	0.10 - 0.12
Walls	0.13	0.12 - 0.15
Windows	1.0	1.0 (Triple)
Floor	Unknown	0.10 - 0.12
Doors	1.2	1.2
Air tightness	Improved	1.0

MAIN OFFICE / EXAMINATION AREA		
Section	Current U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	0.35	0.10 - 0.12
Walls	0.34 / 2.6	0.12 - 0.15
Windows	1.4 - 1.8	1.2 (Double)
Floor	1.2	0.10 - 0.12
Doors	Unknown	1.2
Air tightness	Unknown	1.0

MAIN OFFICE / EXAMINATION AREA		
Section	Proposed U-Value (W/m²K)	LETI U-Value (W/m²K)
Roof	0.12	0.10 - 0.12
Walls	0.13	0.12 - 0.15
Windows	1.0	1.0 (Triple)
Floor	1.2	0.10 - 0.12
Doors	1.2	1.2
Air tightness	Improved	1.0

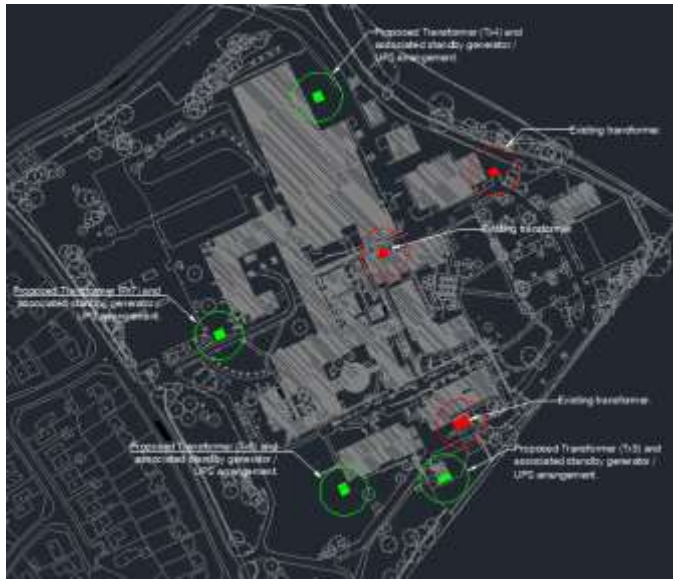
Campus Infrastructure

Electrical Impact of De-carbonisation

Existing Site Electrical Infrastructure

Current electrical infrastructure includes 3 No. 1MVA HV transformers providing distribution across the site.

The Authorised Supply Capacity (ASC) allocated by National Grid is currently 900kVA. This provides sufficient capacity for the site including the on-site developments in terms of ASHP installations for the TECS building and Publication store.



Short Term National Grid Works

Short term work requires a marginal increase to the incoming electrical supply providing a capacity of 1150kVA.

BGS have chosen to utilise this to;

- deploy the installation of Ground Source Heat Pumps.
- replace the existing gas kitchen cooking equipment with electric versions.
- extend the provision of electric vehicle charging outlets.

Long Term National Grid Works

Long term programme of electrical works will require development of both the on-site and off-site High Voltage electrical infrastructure in order to facilitate the complete de-carbonisation proposals of the project.

This long-term upgrade element of works will be a significant development for the BGS site and National Grid, which is estimated to be a three year programme and will achieve a capacity of circa 3563kVA.

Existing Site Plant & Equipment

Reference	Plantroom Location	Plant equipment	Locations served	Locations served detail
1	Energy Centre / GIH Plantroom	Ideal Evomax 100kW Boiler		Serves Data Centre via AHU coils and NGR underfloor heating circuit
2	TECS	ASHPs		Serves TECS building
3	JHB	Packaged 55kW CHP, Calorifier		Serves JHB and SRMR plantroom
4	WSB	DHWS Plant		Serves WSB domestic hot water (heating circuit to domestic water from PPFPL)
5	PPFPL	2No. Ideal IMAX Xtra EL545 520kW boilers, 2No. GMS CS U 500 calorifiers		Serves WSB Heating and domestic hot water service, PPFPL and EIGL3 heating and domestic hot water service
6	SRMR	3No. Ideal IMAX Extra EL 395 gas fired boiler 399kW, Calorifier		Serves SRMR, KDB, GIH and JHB
7	EIGL1	Strebel S AF 260 gas fired boiler 200-300kw , 2No. EVOCU calorifiers		Serves EIGL1 and 2
8	NGR	2No. Ideal Imax Xtra EL 545 550kW, 1No. Ideal Viceroy GT boiler, 2No. EVOCU calorifiers		Serves NGR

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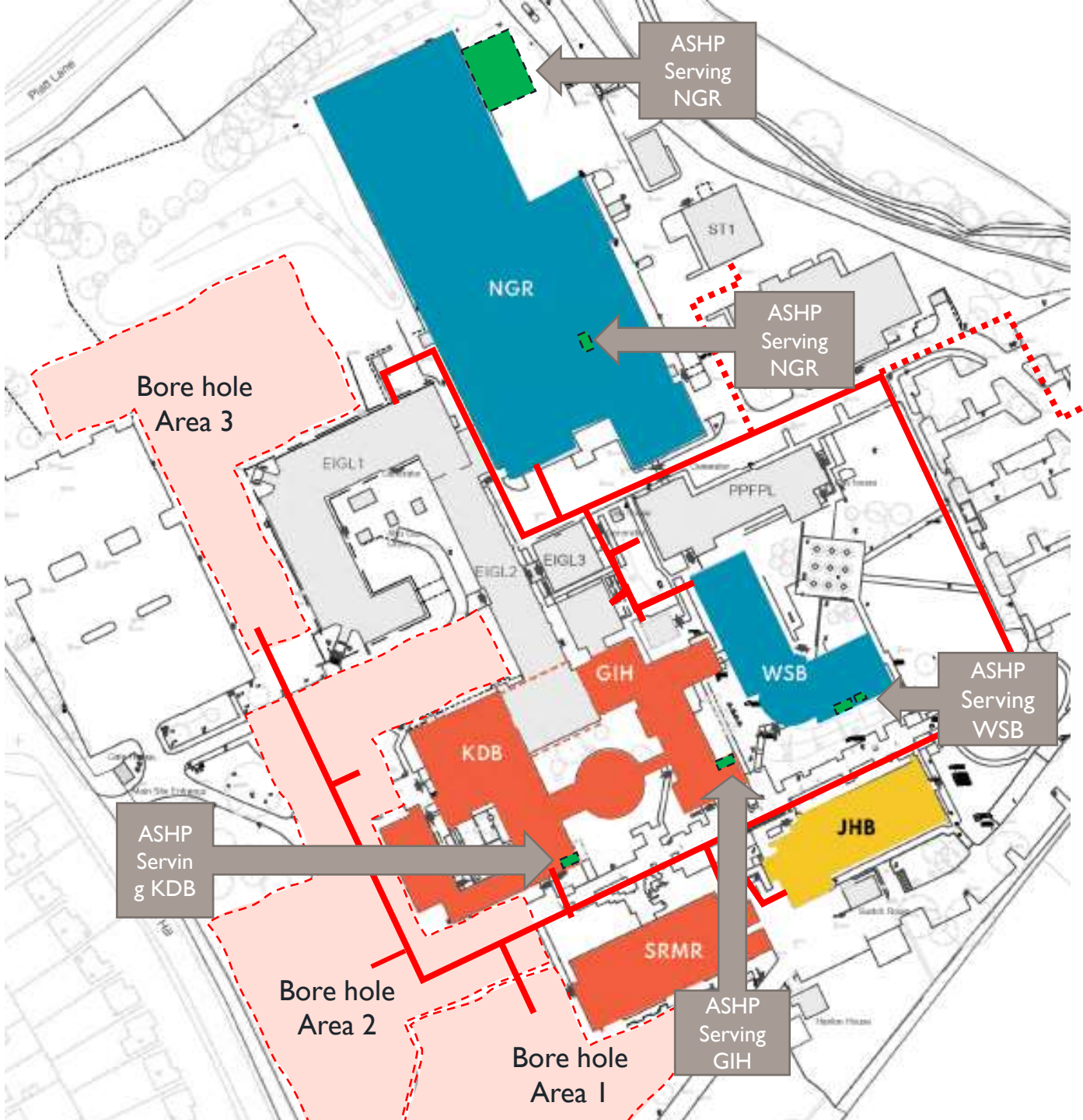
Proposed Technologies Implementation

GSHP implementation

Area Ref.	Ground area (m2)	No. of Boreholes	Electrical Load (kVA)	Peak Heat Load (kW)
1	6993	30	107	261
2	6271	43	256	527
3	4172	33	131	363

Legend

- Bore Hole Array
- Air Source Heat Pump
- Indicative future ambient loop Network



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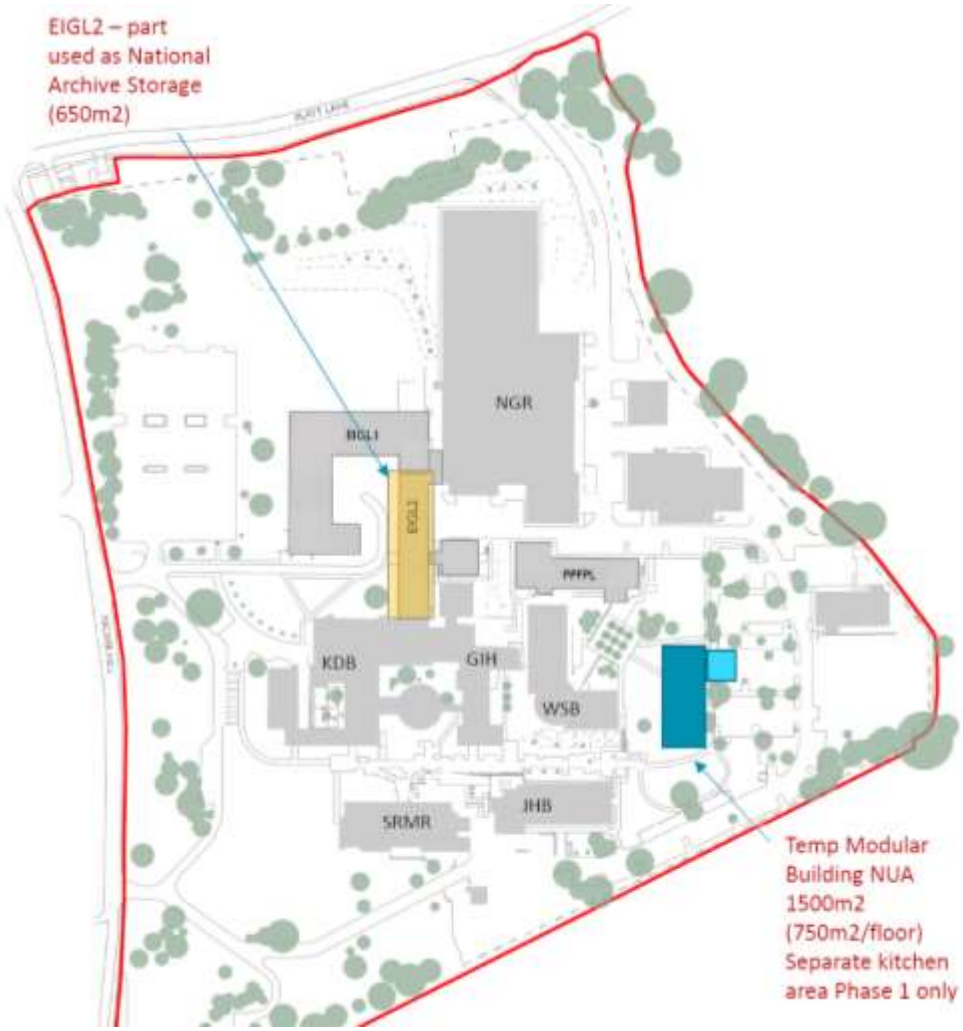
Phasing the Works

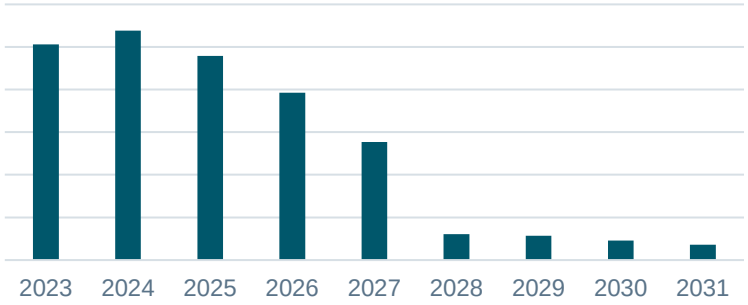
Considerations

- On / off-site storage
- Opportunities to utilise partner organisations sites
- Temporary off-site working to reduce decant requirements
- Multi-functional use of modular accommodation

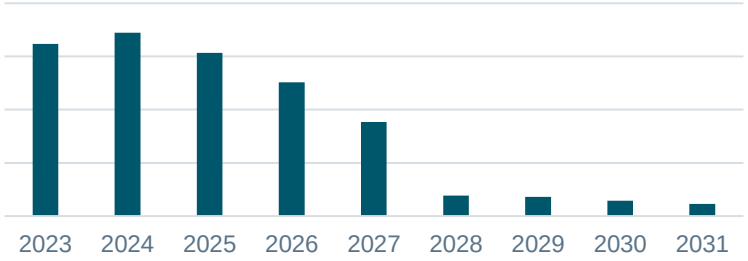


Proposed Reduction in CO2 emissions

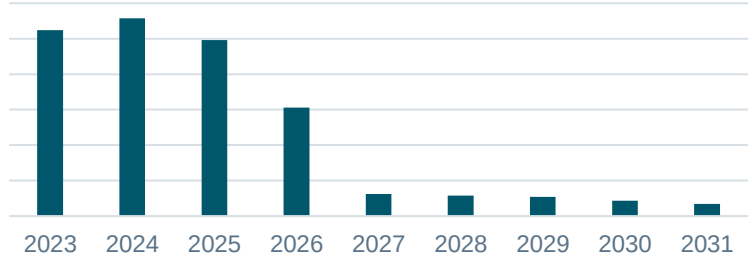
GIH regulated tonnes CO2 emissions



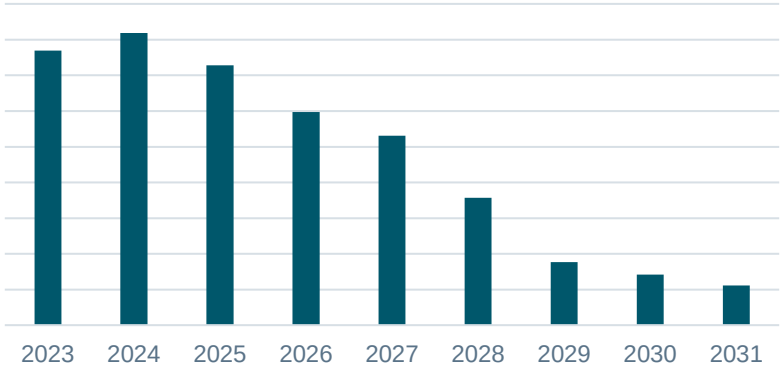
KDB regulated tonnes CO2 emissions



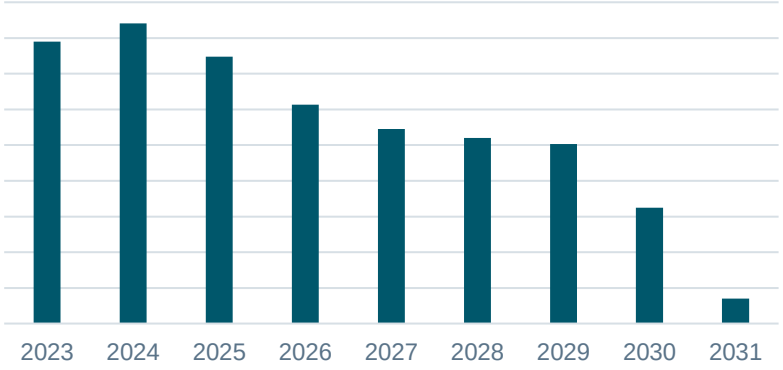
SRMR regulated tonnes CO2 emissions



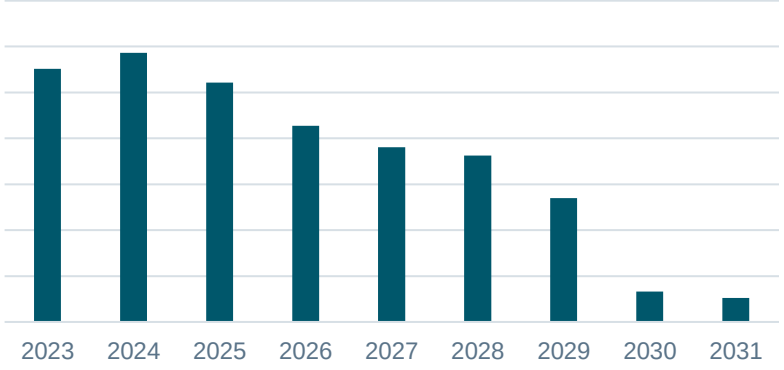
JHB regulated tonnes CO2 emissions



NGR regulated tonnes CO2 emissions



WSB regulated tonnes CO2 emissions



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Proposed Reduction in CO2 emissions

Reduction	BER (kgCO2/m2)	Primary (kWh/m2/y)	Asset rating EPC
GIH	-76%	-61%	-108
KDB	-76%	-61%	-106
SRMR	-75%	-63%	-80
JHB	-47%	-24%	-30
NGR	-73%	-52%	-126
WSB	-69%	-49%	-34
Combined	-73%	-54%	-92

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Review

Key Considerations in Decarbonising the Campus

- Establish the Sustainability objectives
- Tackle the whole site
- Wider holistic sustainability approach
- Explore options and pathways to achieve this
- Plan for the best achievable
- Go for Certification
- Plan for implementation
- Review & Evaluate

Questions