

Passivhaus Development at Scale in the UK – An Overview

Ann-Marie Fallon
Associate Director
Perform+ Lead



Architecture + Consultancy



PEOPLE | PERFORM | PASSION

ARCHITYPE

Creative hubs UK wide

Edinburgh

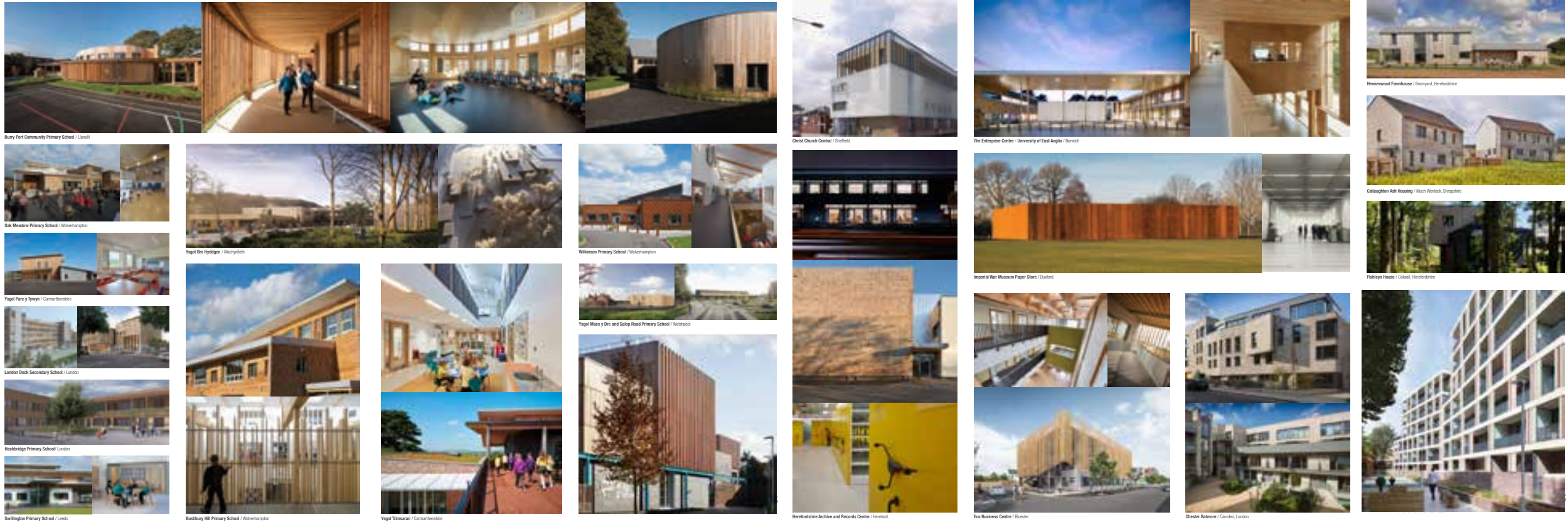
Hereford

London



40 years of sustainable design and data

Diversity of scale and sector new build Passivhaus over 15 years

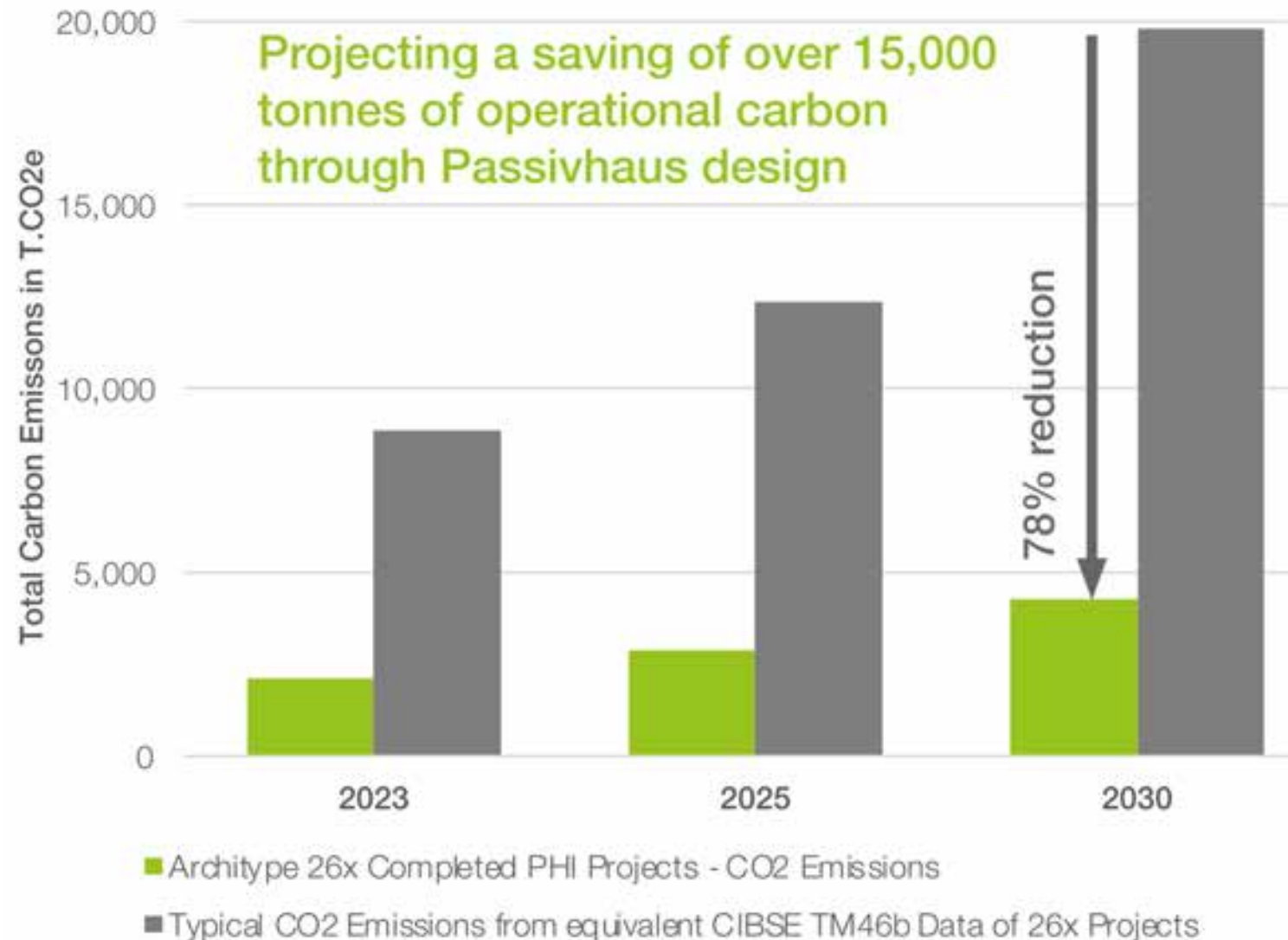


ARCHITYPE

Evidence based performance

Architype's accumulative societal impact

- Delivery of 198 certified Passivhaus homes and buildings
- 2 EnerPHit retrofits
- 11 Passivhaus schools
- 2 Passivhaus Plus projects
- 24+ Passivhaus designers
- 90% projects are Passivhaus



Enterprise Centre, University of East Anglia

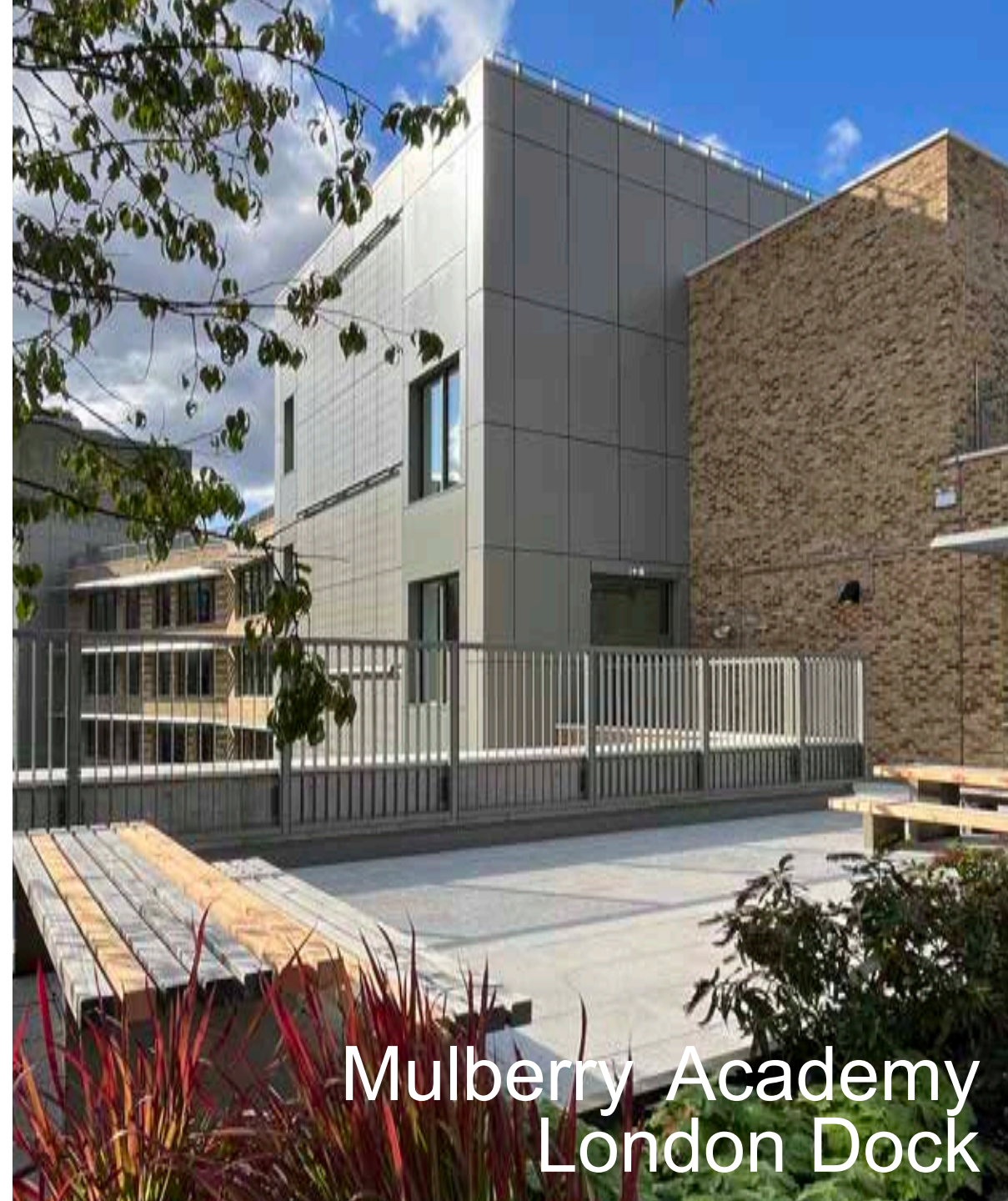




Harris Academy Sutton

Hackbridge Primary School





Mulberry Academy
London Dock



Bicester Eco Centre



Agar Grove



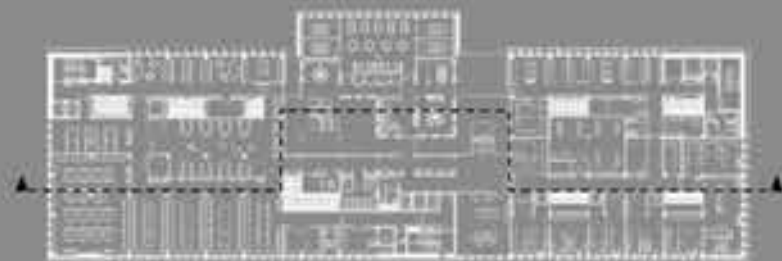
Agar Grove



Exeter University / UPP



- 1 – Chemistry Specialist Teaching
- 2 – Physics Specialist Teaching
- 3 – Event Space/ Collaboration Hub
- 4 – The Street
- 5 – Open-Box Research
 - Chemical Biology
 - Cell Culture and HTA
- 6 – Research Corridor



Warwick STEM



Imperial War Museums / Duxford



RIVERSIDE
PRIMARY SCHOOL

Riverside Primary School



Riverside Primary School

A photograph of a modern school ceiling. The ceiling is made of large, light-colored, textured panels. In the center, there is a large, rectangular skylight that allows natural light to enter. Below the skylight, there are several recessed rectangular light fixtures. The overall design is clean and minimalist.

“Our Passivhaus Primary school is simply stunning.

*Light, bright and airy bringing comfort and joy to the children and staff
of Riverside Primary.*

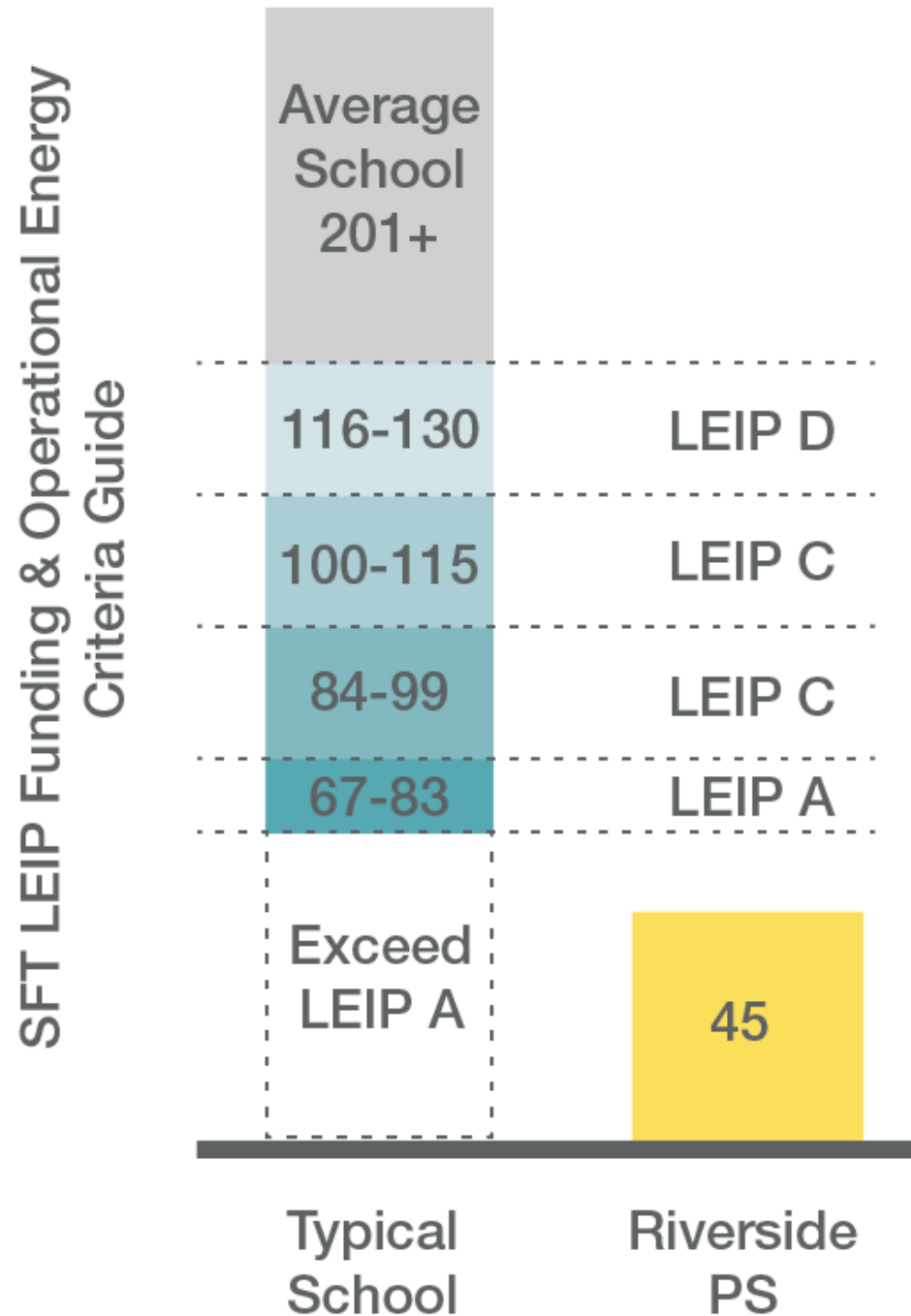
*We look forward to developing our creative learning and teaching
spaces and will treasure and respect the opportunities this building
and high-quality finish brings us.”*

Annabelle Burns, Riverside Primary, Perth and Kinross Council

Evidence based performance – Riverside Primary School

Learning Estate Investment Programme Scotland (LEIP)

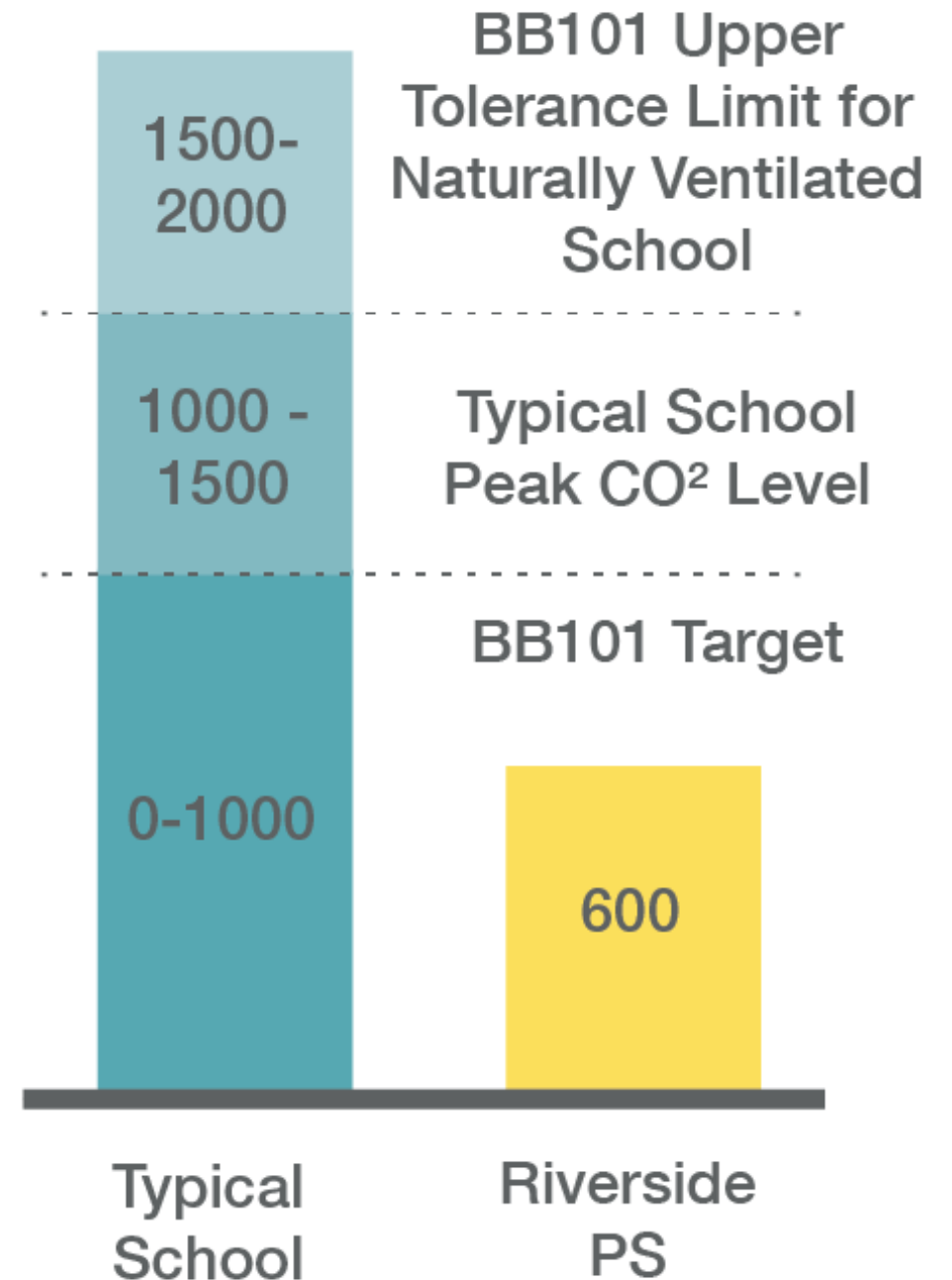
- Outcomes based capital funding model
- Energy Use Intensity bandings defines % of funding released over 25 year period.
- Other funding requirements now include an Upfront carbon metric limit
- Riverside exceeds top banding ensuring client receives 100% funding



Evidence based performance – Riverside Primary School

Indoor air quality monitoring

- Best indoor air quality in a UK primary school?
- Well below current BB101 ventilation regulations



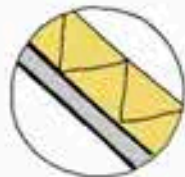
The wider challenges of retrofit



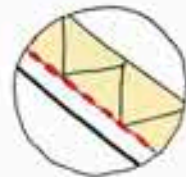
Form Factor



Orientation



Fabric Performance



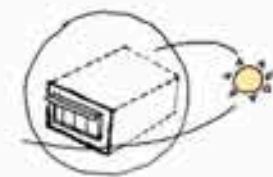
Airtightness



Ventilation Strategy



Window Design



Daylighting & Shading



Optional Renewables

The challenge of retrofit

80% of the buildings that will be here in 2050
already exist

The logo for RetroFirst is displayed on a solid green rectangular background. The word "RetroFirst" is written in a bold, black, sans-serif font. The letter "o" in "Retro" is white and contains a small black dot, resembling a stylized eye or a specific design element.

RetroFirst

A black metal signpost with a white rectangular panel is positioned on a sidewalk. The sign features a list of actions in a bold, black, serif font. The text is arranged in a vertical column. At the bottom left of the panel is a small logo for "1m♀" and at the bottom right is the attribution "- Pete Seeger". The background shows a street scene with trees and a person walking.

**If it can't be
reduced, reused,
repaired, rebuilt,
refurbished,
refinished, resold,
recycled or
composted,
then it should
be restricted,
redesigned
or removed
from production.**

1m♀

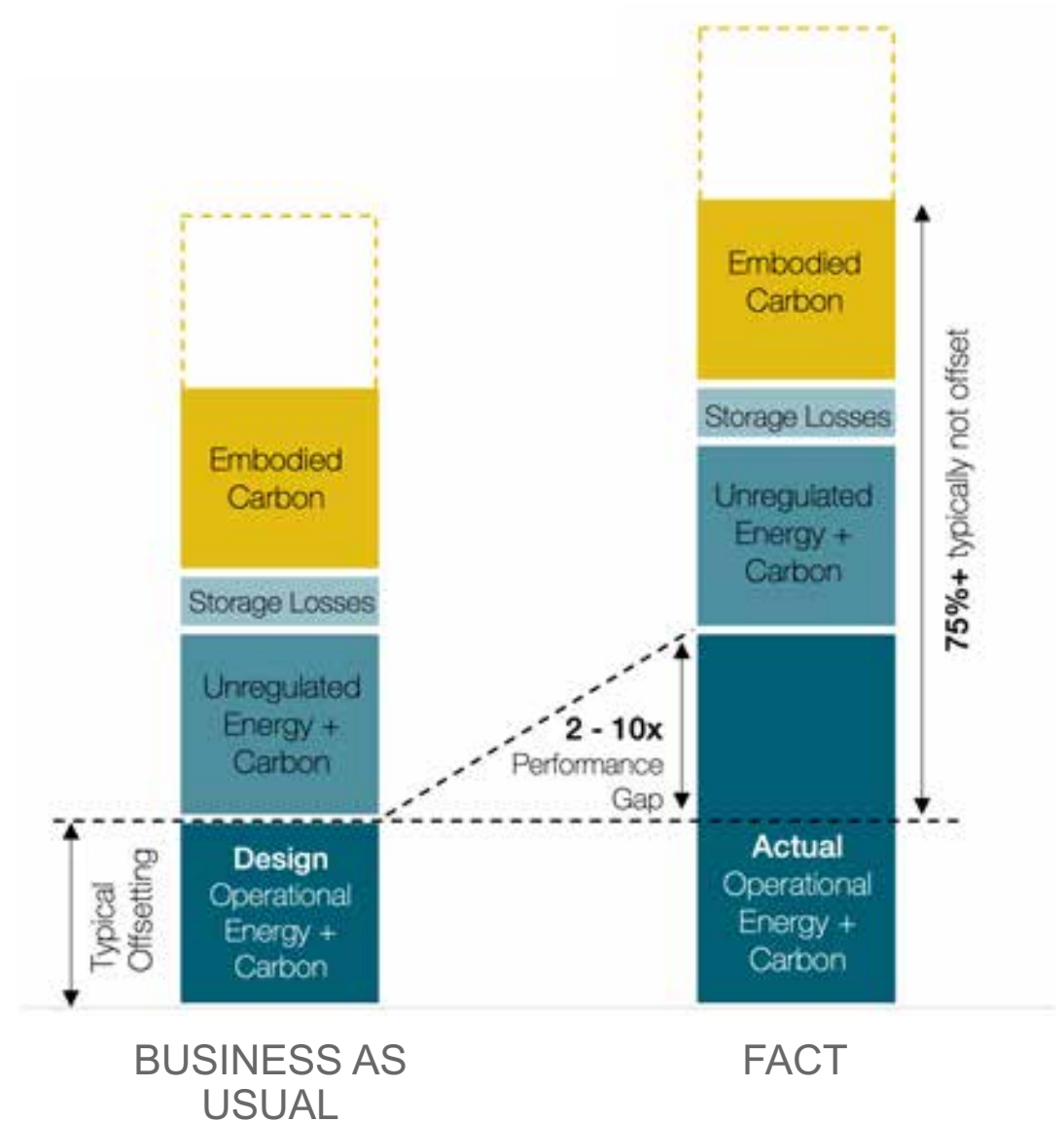
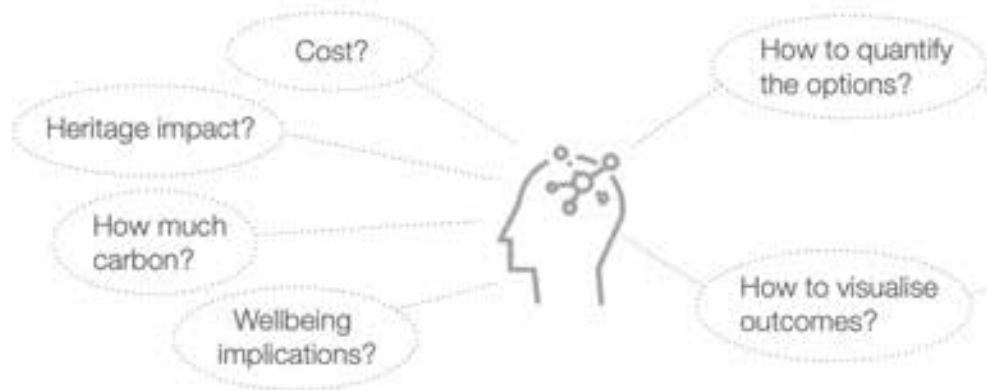
- Pete Seeger

The reality of decarbonisation

Business as Usual 'Net Zero'

Common Issues

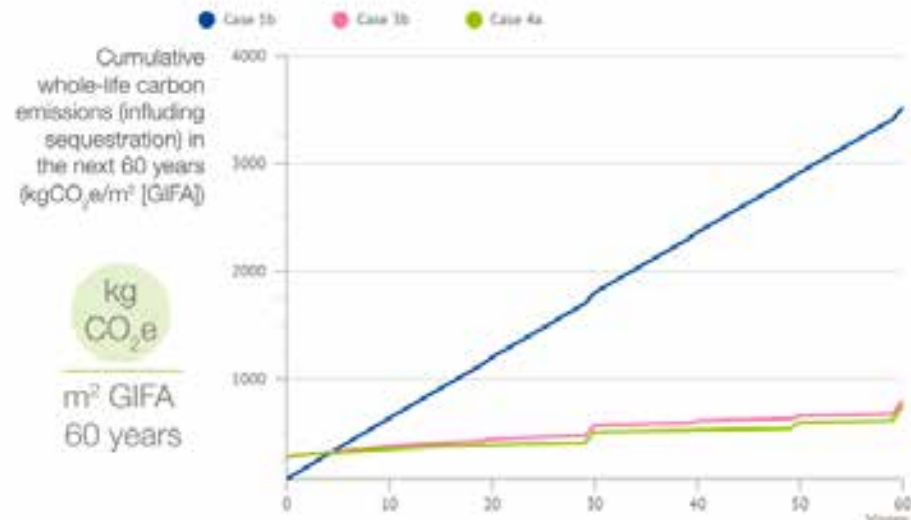
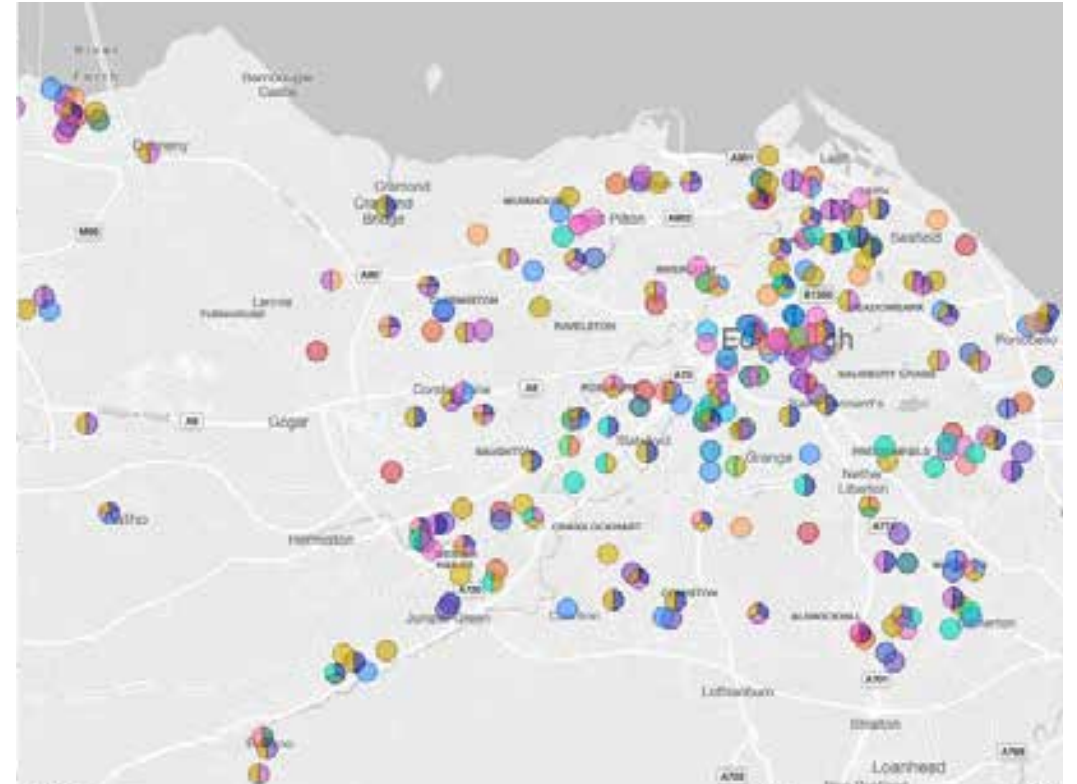
- Too high level to be useful
- Strategies based on unsubstantiated assumptions on existing assets
- Risks not sufficiently identified and mitigated
- No roadmap to delivery / briefing & contracts poor
- Performance gaps



Decentralised Estates

City of Edinburgh Council

- 300+ assets
- Energy via on site (boilers) or via grid
- Varied use type, age, condition, statutory status
- Where to start?
- What is best practice in estate management?



Whole estate graphs

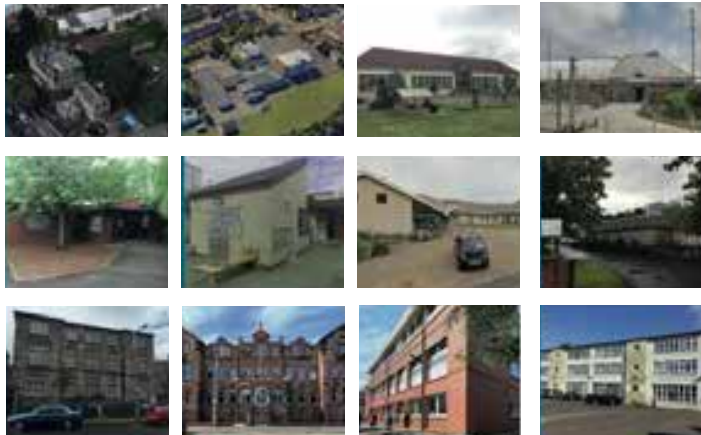
Taking a deeper dive

Building Study Process

Scottish Local Authority Retrofit Delivery Forum

- 35+ building studies complete for 7 local authorities across Scotland
- Outcomes shared between Local Authorities via discussion forum including BE-ST and HSE
- Studies cover a wide range of archetype buildings, schools, offices, pools

Edinburgh – Initial 12 building study



East Ayrshire



Hub East Central



Renfrewshire



Midlothian



Moray



Perth and Kinross



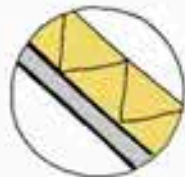
The Entopia Building A Retrofit Exemplar



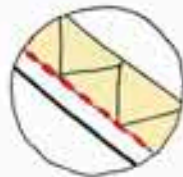
Form Factor



Orientation



Fabric Performance



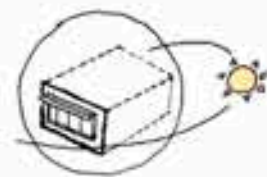
Airtightness



Ventilation Strategy



Window Design



Daylighting & Shading



Optional Renewables

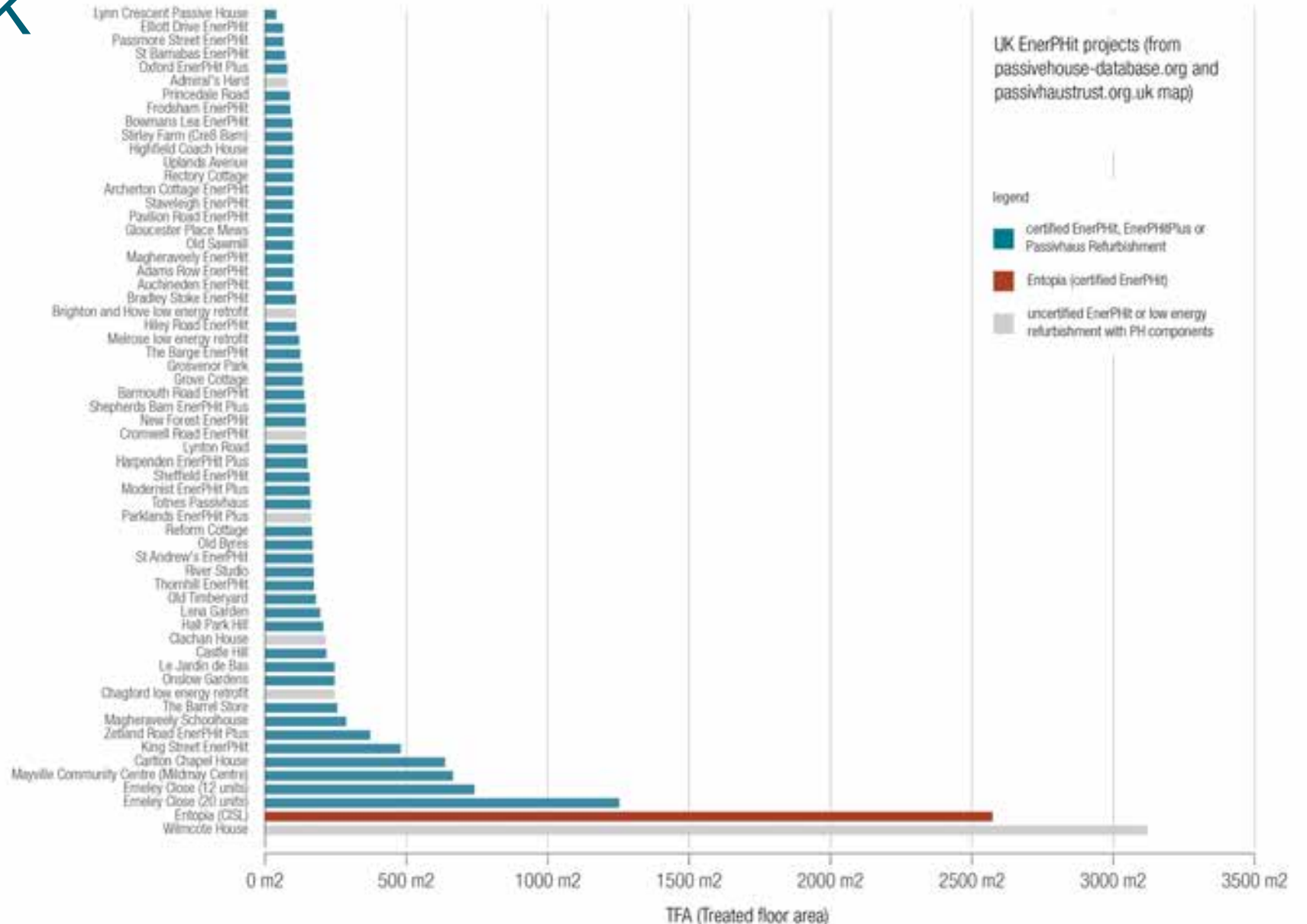
Why Entopia is important

- Exemplar large scale retrofit blueprint
- Successfully demonstrates an approach that can be used on existing buildings including heritage
- Open knowledge sharing



EnerPHit in the UK

- Mainly domestic-scale at present
- Entopia is the largest certified EnerPHit in UK
- The lowest embodied carbon EnerPHit in the UK







Before

- Originally built in 1939 as a telephone exchange
- Photo from BT Archives of a Cambridge telephone exchange – may not be 1 Regent Street, but gives sense of original use



Before

- Most recent use before CISL acquired the building was as offices for Cambridge Assessment
- Previous refurbishment in 1998
- Dark interior due to windows being partially covered by dropped ceiling

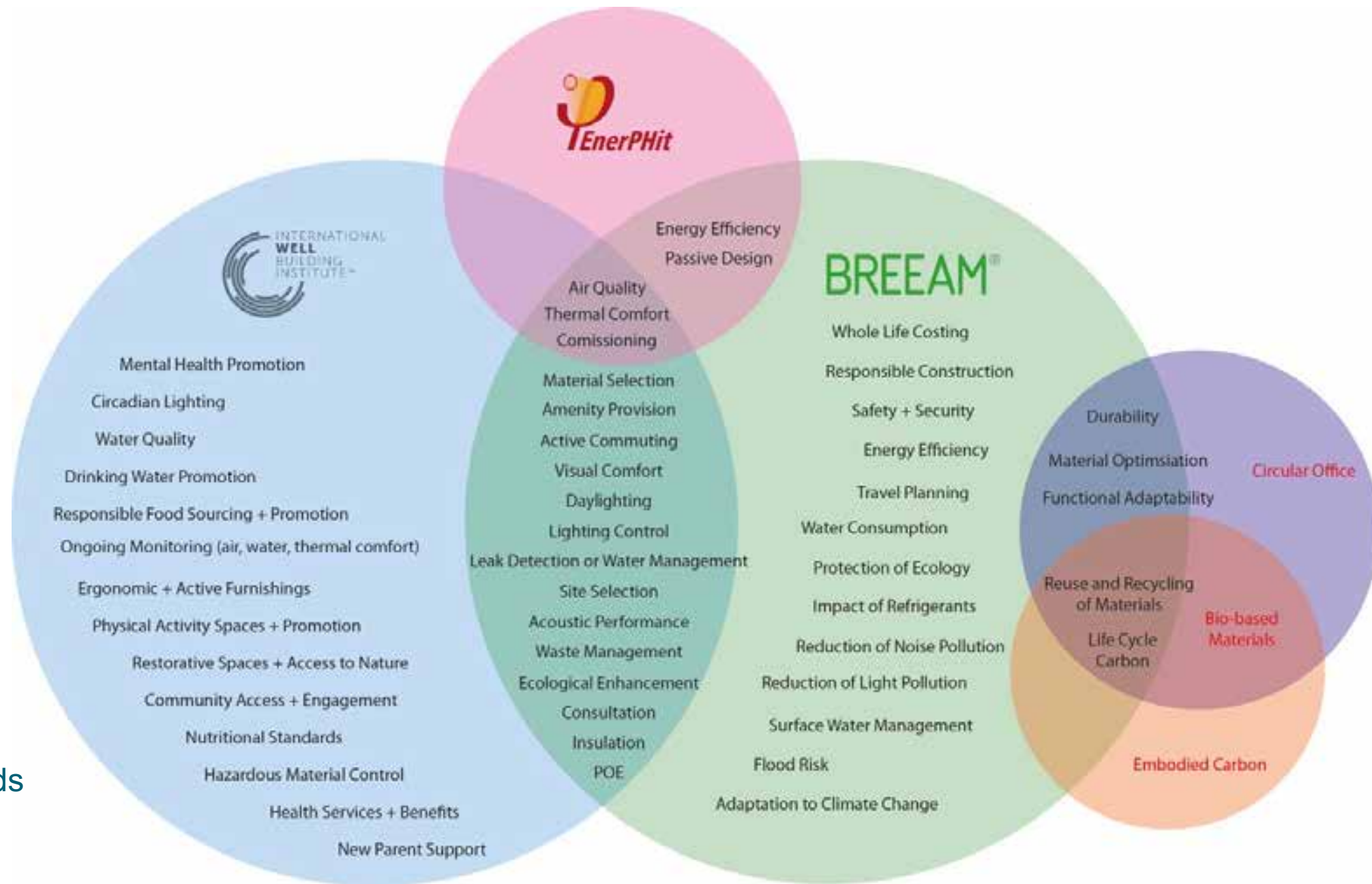




Before



Brief



- Ambitious and challenging brief
- Overlap between different standards
- Consistent client commitment and advocacy

Design team

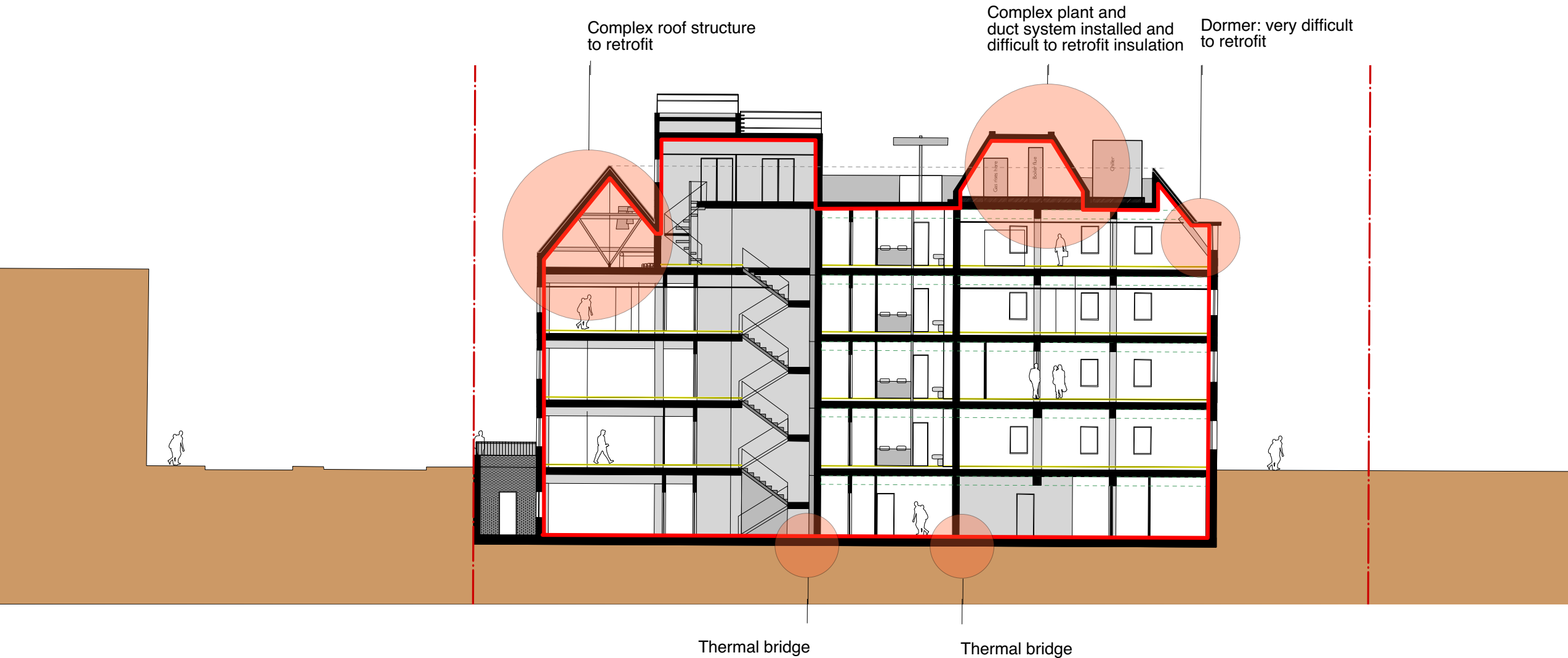
- Initial design team developed scheme to Stage 3, including planning permission, and retained client-side
- ISG-lead design team developed design through to practical completion
- Mead Consulting – Passivhaus Certifier



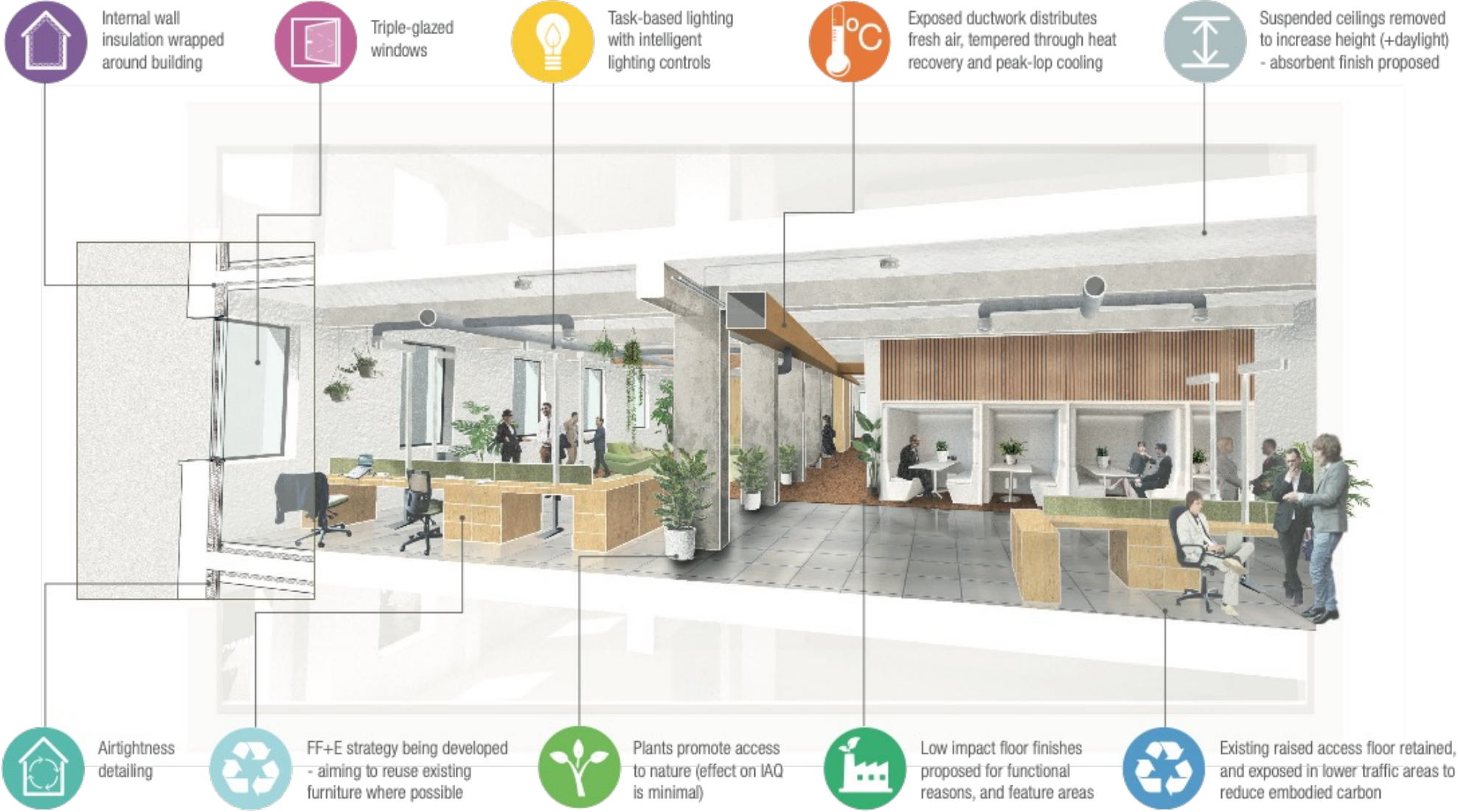
Collaborative Workshops



Initial strategy



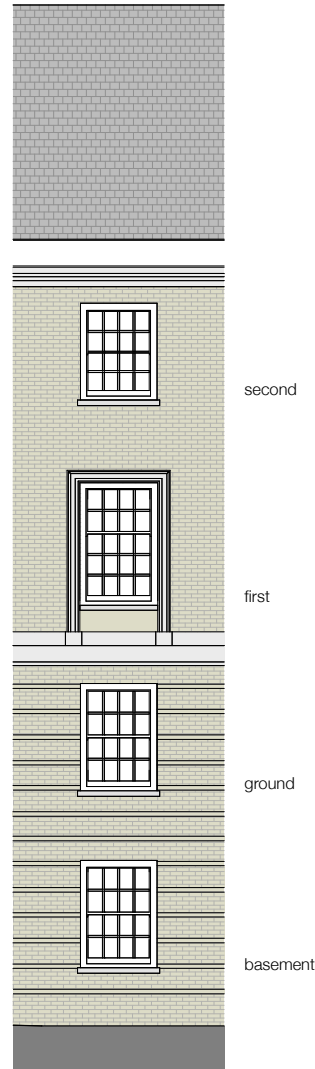
Developed strategy



Windows



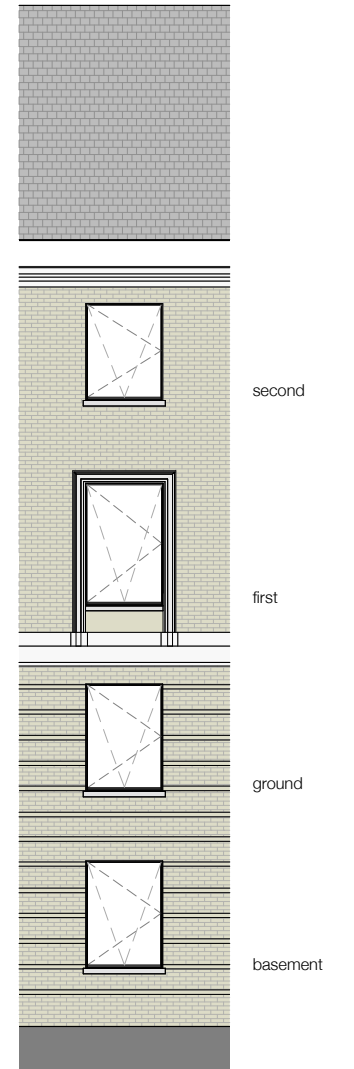
3D View - Existing Window Bay



Elevation - Existing Window Bay
1:100



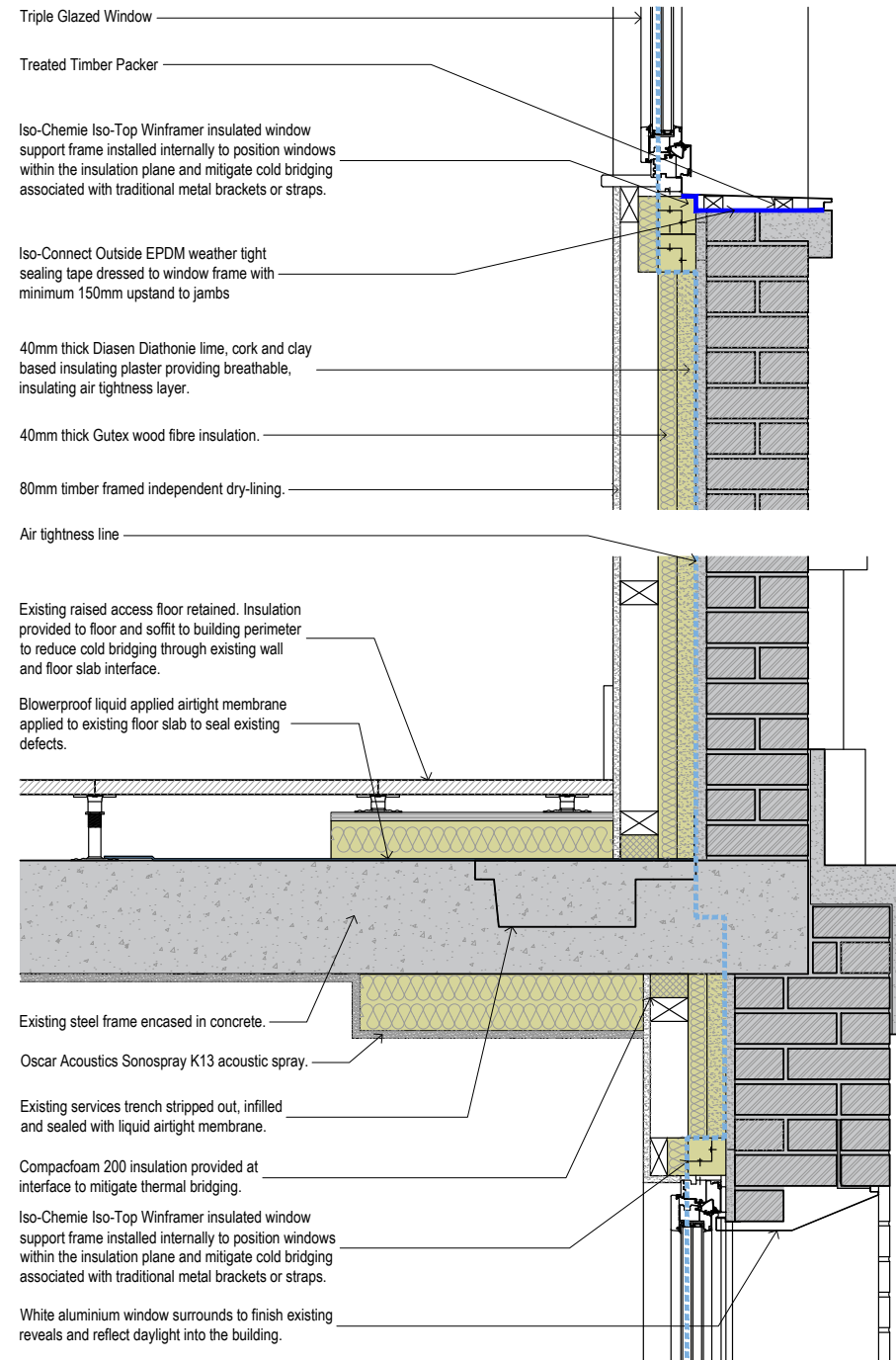
3D View - Proposed Window Bay



Elevation - Proposed Window Bay
1:100

Detail development

- Detailed modelling of thermal bridges and moisture risks
- Development of detail to include 40mm Diathonite insulating render and 40mm Gutex woodfibre board to minimise embodied carbon and manage moisture








EnerPHit certification



- ISG team achieved impressively low air leakage rate - 1.33 m³/(h.m²)@50Pa or 0.605 ach@50Pa


Certificate

Certified retrofit
'EnerPHit Classic'
(Climate zone: Cool-temperate)



Mead:
Energy &
Architectural
Design Ltd.


Authorised
by:



Passive House
Institute
Dr. Wolfgang Feist
64283 Darmstadt
Germany

The Entopia Building

1 Regent Street, CB2 1GG Cambridge, United Kingdom/ Britain



Certified
Retrofit
Passive House Institute

| classic | plus | premium |

Client	University of Cambridge Greenwich House, Madingley Road
Architect	Archtype / Feilden and Mawson
Building Services	Max Fordham LLP / BDP Ltd
Energy Consultant	Max Fordham LLP
Main Contractor	ISG Ltd

Buildings retrofitted to the EnerPHit Standard offer excellent thermal comfort and very good air quality all year round. Due to their high energy efficiency, energy costs as well as greenhouse gas emissions are extremely low.

The design of the above-mentioned building meets the criteria defined by the Passive House Institute for modernization to the 'EnerPHit Classic' standard:

Building quality		This building	Criteria	Alternative criteria
Heating	Heating demand [kWh/(m ² a)]	24	≤ 25	-
	Cooling + dehumidification demand [kWh/(m ² a)]	0	≤ 15	-
	Frequency of overheating (> 25 °C) [%]	-	≤ 10	-
Airtightness	Pressurization test result (n ₅₀) [1/h]	0.6	≤ 1.0	-
Renewable primary energy (PER)	PER-demand [kWh/(m ² a)]	65	≤ 75	75
	Generation (reference to ground area) [kWh/(m ² a)]	17	≥ -	-
Component quality				
	Building envelope to ambient air (U-value) [W/(m ² K)]	0.28	≤ -	-
	Building envelope to ground (heat loss/load) [kWh/(m ² a)]	9.54	≤ -	-
Windows/Exterior doors (U _{w,installed}) [W/(m ² K)]	Glazing (g-value) [-]	0.57	≥ -	-
	Glazing/shading (max. solar load) [kWh/(m ² a)]	138	≤ -	-
	Ventilation (effect. heat recovery efficiency) [%]	83	≥ -	-

The associated certification booklet contains more characteristic values for this building.

London
11.07.2022
Certifier: Kym Mead, MEAD Ltd

www.passivehouse.com
35486-35511_MEAD_EP_20220714_KM







Reused lights

- ISG sourced from CAT A fit out in London, and persuaded the original manufacturer to test and honour the remaining warranty period
- Lights adapted to be hung suspended, with additional LED strip for uplight



Reused steels

- ISG procured secondhand steel section from Cleveland Steel, who acquired the sections from a Marvel film set
- Original documentation made reuse straightforward
- 3.79 tonnes reused, saving an estimated 2,000 kgCO₂e



Reused reception desk

- Sourced by ISG from the Copyright Building, London
- Removed in 2021 and taken back to original manufacturer's workshop to be stored and adjusted
- Lower wheelchair accessible added and linear bench seats created from excess desk length

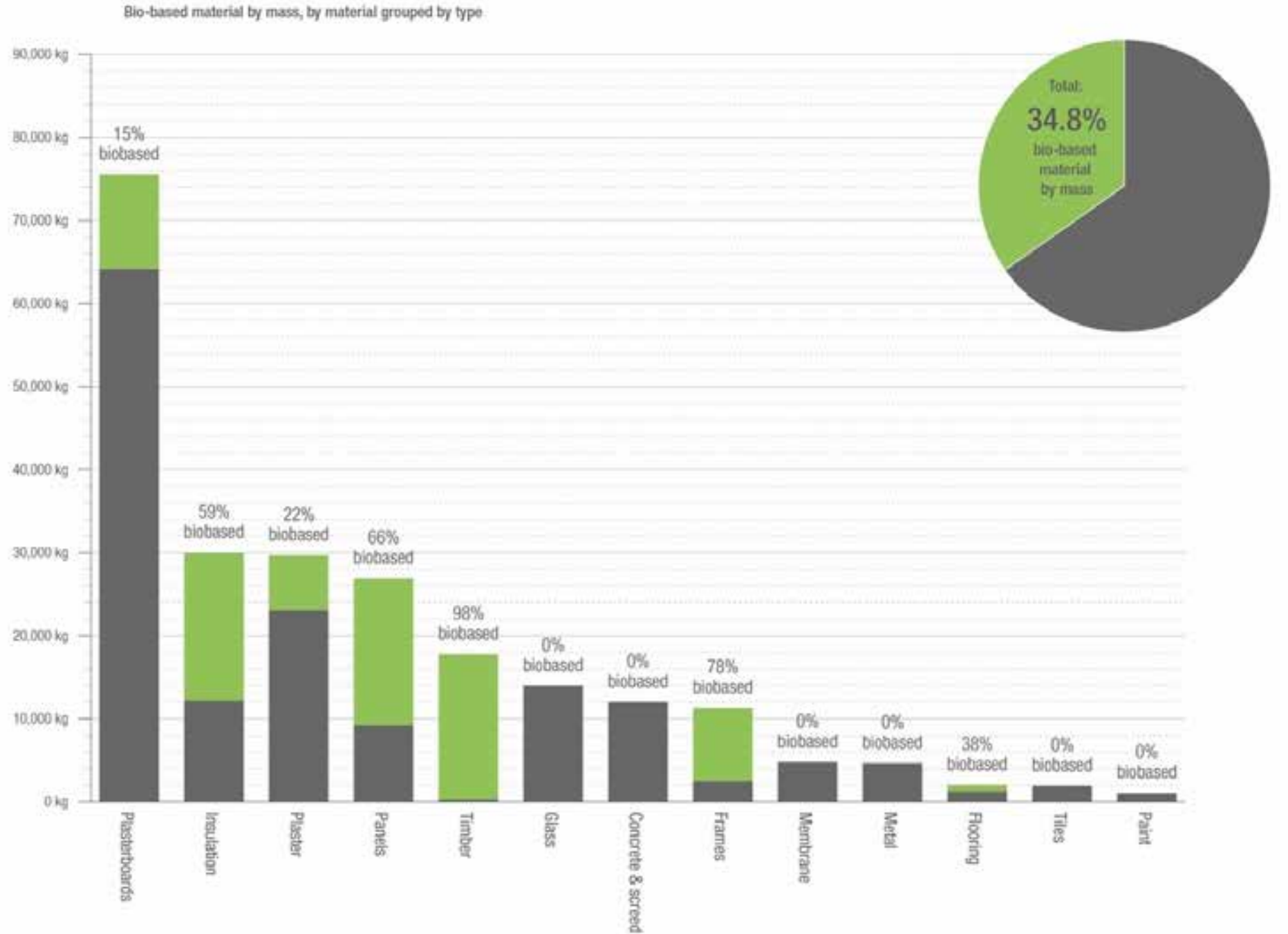


Kintsugi Repair

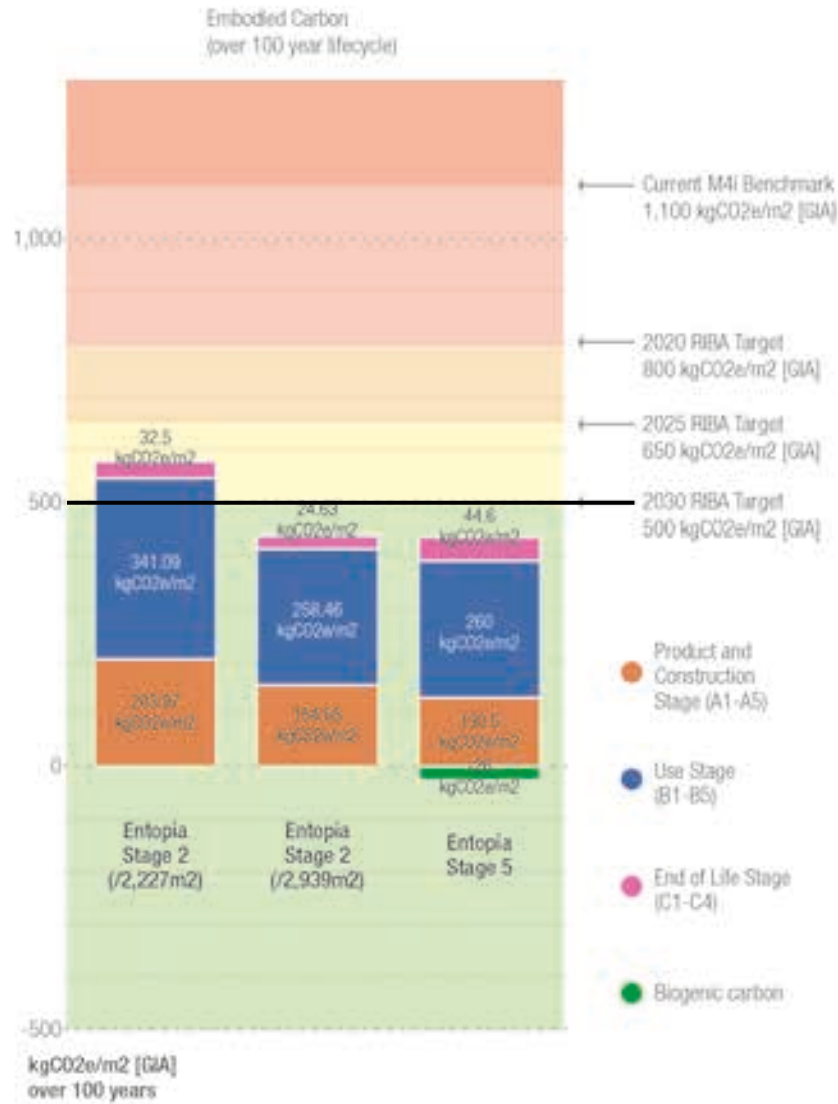
- Travertine stone top cracked during removal and repaired in the spirit of the Japanese Kintsugi technique
- Breakage and repair treated as part of the history of the object - to be celebrated rather than hidden
- Manufacturer now designing for disassembly



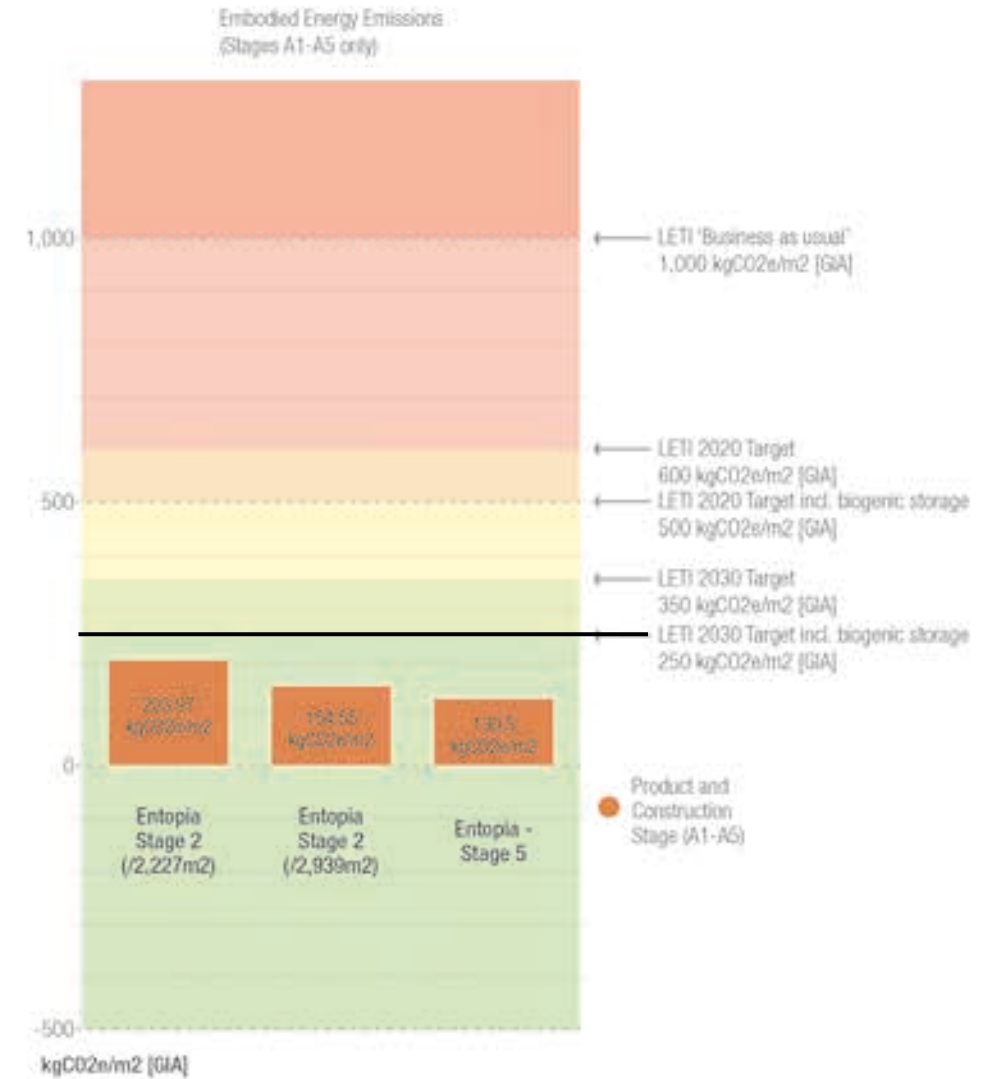
Bio-based materials



Embodied carbon

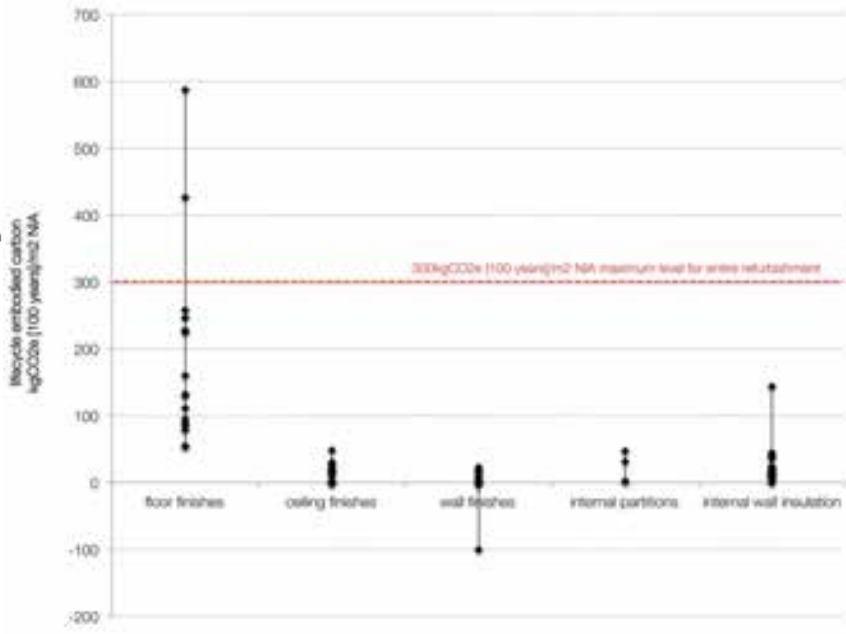
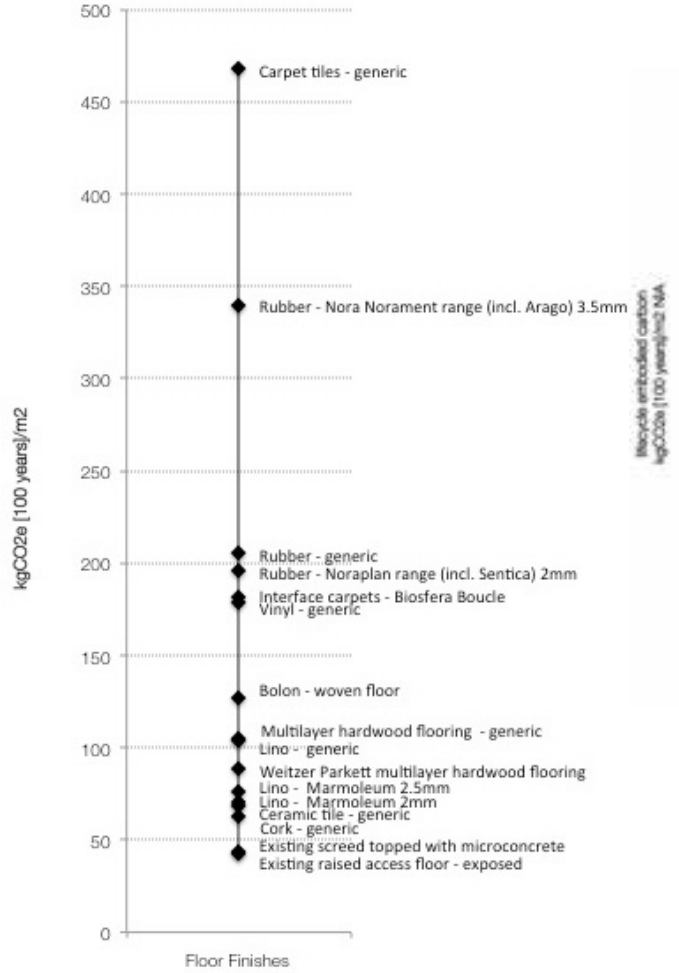


Lifecycle embodied carbon



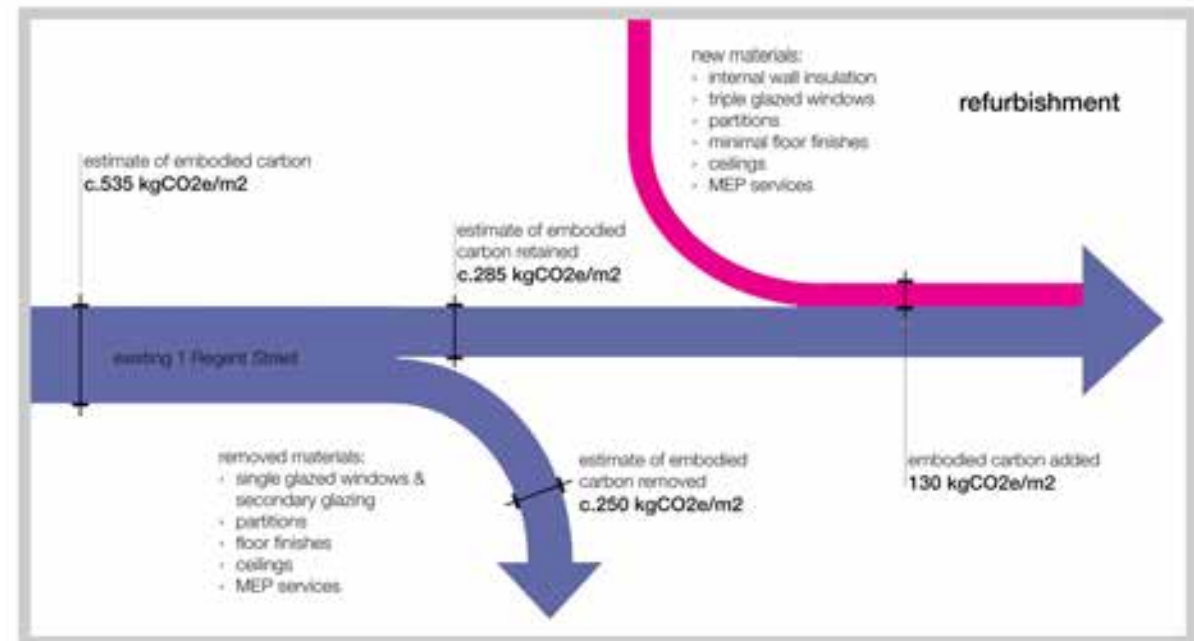
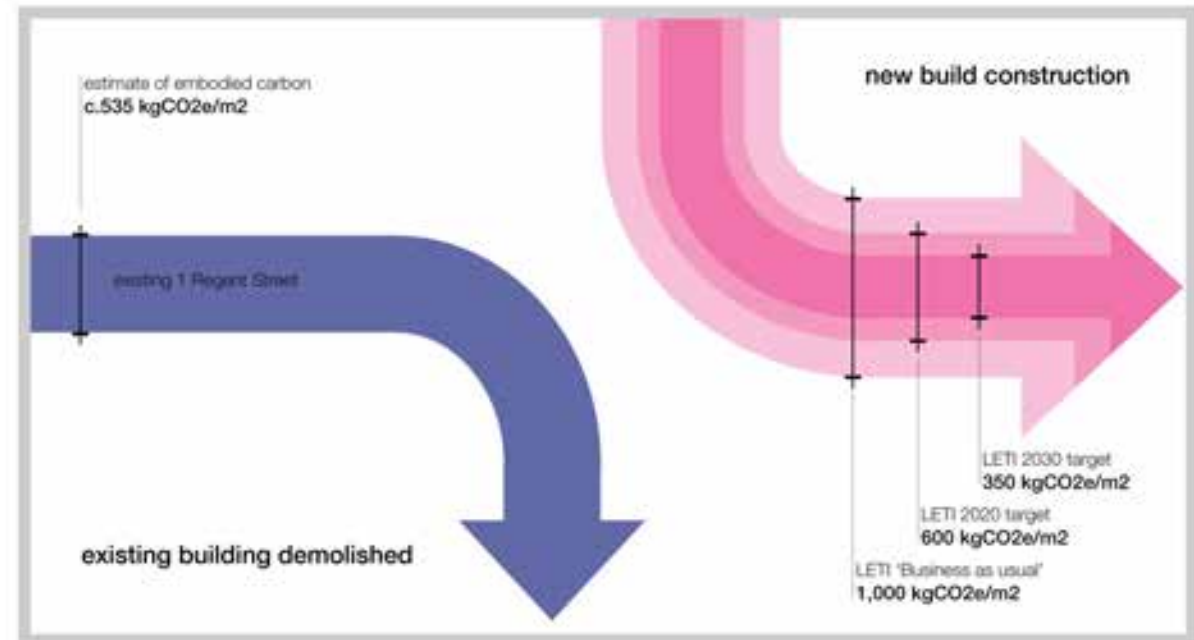
Upfront carbon

Floor finishes – carbon & cost benefit



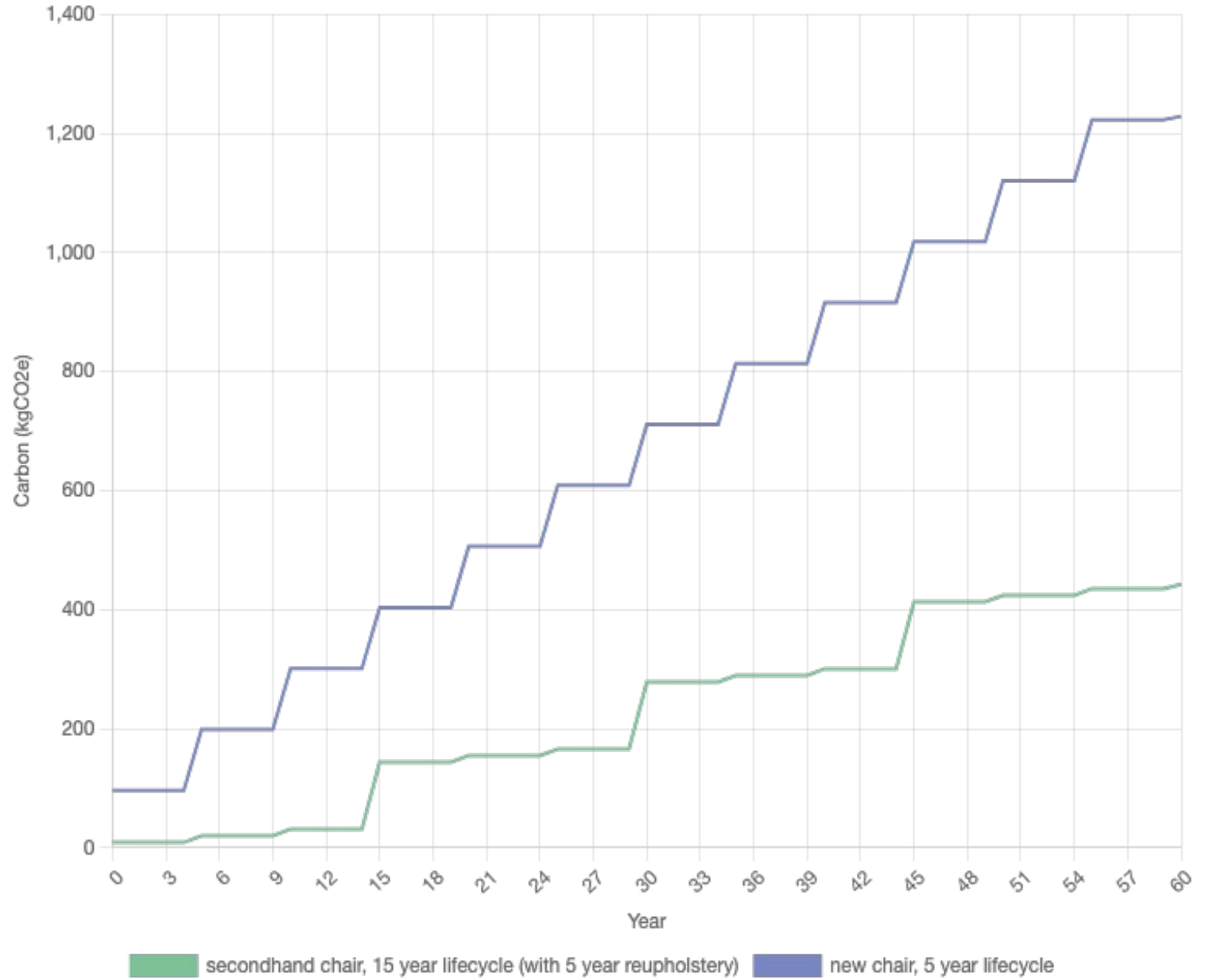
Embodied carbon

- Comparison between a 'demolish and build new' scenario, and the retrofit of Entopia
- Embodied carbon of retrofit is significantly lower

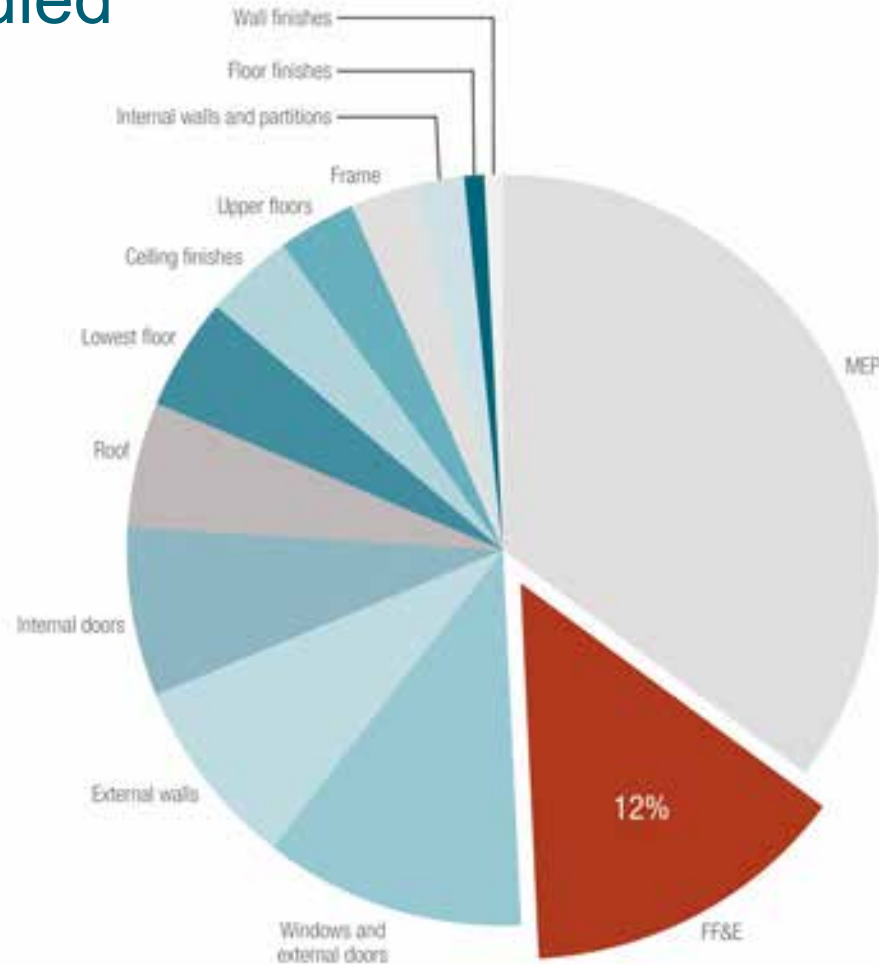


Note: Embodied carbon figures are for building life cycle Stages A1-A5. Figures for 1 Regent Street and LETI targets include substructure, superstructure, internal finishes and MEP. Figures for 1 Regent Street are from Stage 5 design (May 22 update).

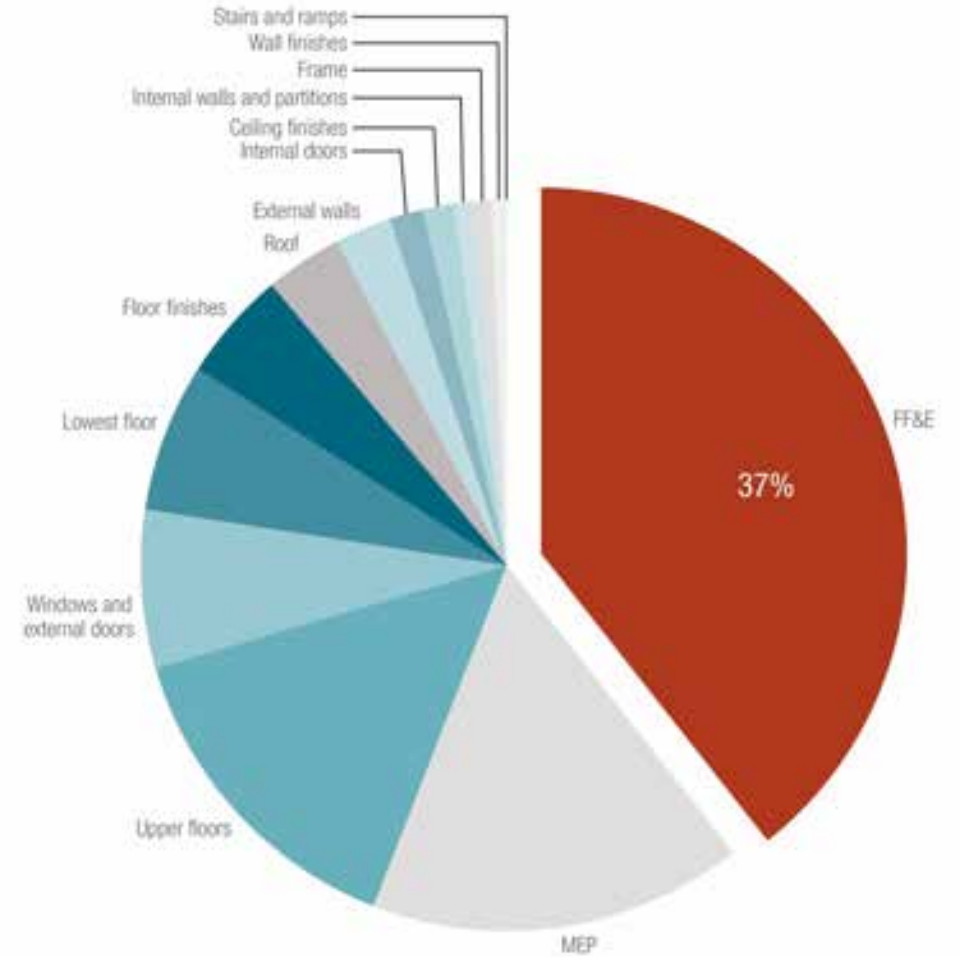
FF&E embodied carbon



FF&E embodied carbon



Upfront carbon

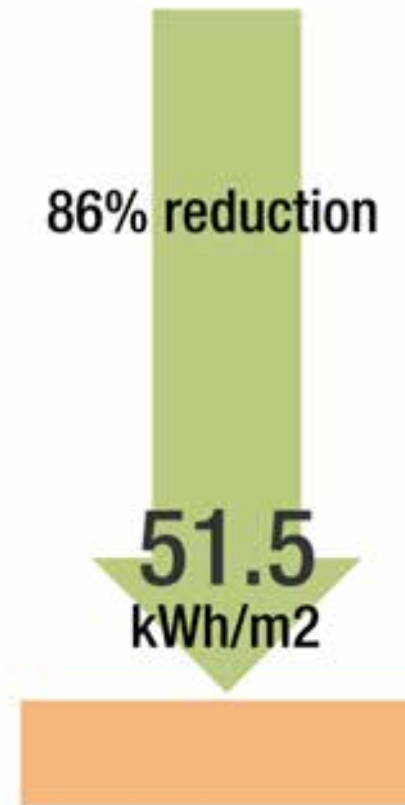


Lifecycle embodied carbon

Entopia In-use performance – saving £100,000 a year in costs



pre-retrofit EUI

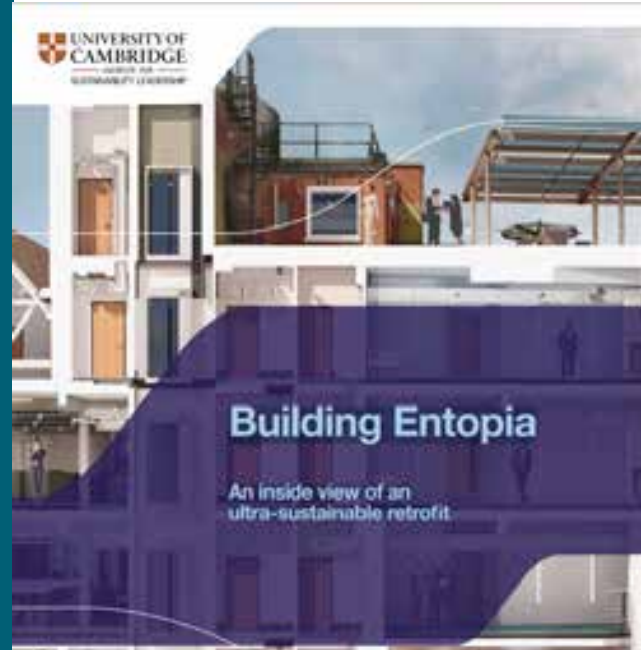


post-retrofit EUI

The lived experience



Sharing lessons learnt



Exchange of purpose
Architype and Feilden + Mawson's retrofit of a 1930s telephone exchange into the Entopia Building for the Cambridge Institute for Sustainability Leadership has exemplified environmental credentials. But are they at the expense of its character and design?

Wendy Lee Robinson
Retrofitting and Reuse
Wendy Lee Robinson

The building's original purpose was to house the Cambridge Telephone Exchange, a landmark of the city's architectural heritage. The building's original purpose was to house the Cambridge Telephone Exchange, a landmark of the city's architectural heritage. The building's original purpose was to house the Cambridge Telephone Exchange, a landmark of the city's architectural heritage.





ENTOPIA BUILDING



Flame R Flame R Flame R Flame R Flame R Flame R Flame R Flame R Flame R Flame R
THIS IS NOT AN ORDINARY PROJECT.

BUT IT NEEDS TO BE.

The time is now.

Together we can be extraordinary. Together we can build a better world.

#BuildingChange | #Entopia | @CSL_Cambridge



ARCHITYPE

THANK YOU

ARCHITYPE

London | Hereford | Edinburgh

Ann-Marie Fallon

Associate Director & Perform+ Lead

Ann-Marie.fallon@architype.co.uk 0131 285 2600

www.architype.co.uk