PERFORM + ARCHITYPE

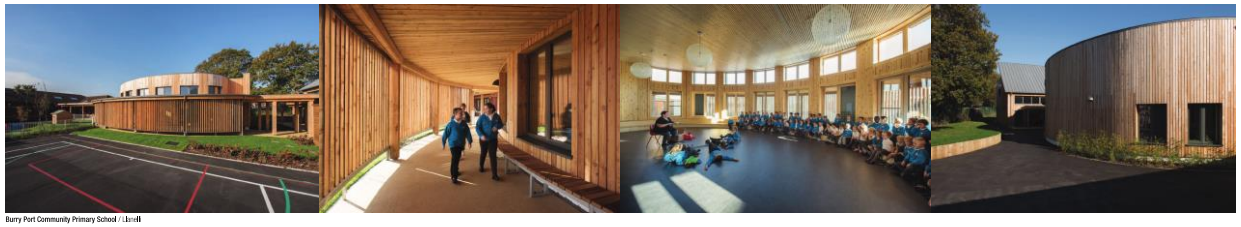
London | Hereford | Edinburgh

Regenerative design and Whole Life Carbon: Challenges beyond assessment

Ann-Marie Fallon

40 years of sustainable design and data

Diversity of scale and sector new build Passivhaus over 15 years


Burry Port Community Primary School / Llanelli


Oak Meadow Primary School / Wolverhampton


Ysgol Bro Hyddgen / Machynlleth


Wilkinson Primary School / Wolverhampton


Ysgol Parc y Tywyn / Carmarthenshire


Bushbury Hill Primary School / Wolverhampton


Ysgol Trimsaran / Carmarthenshire

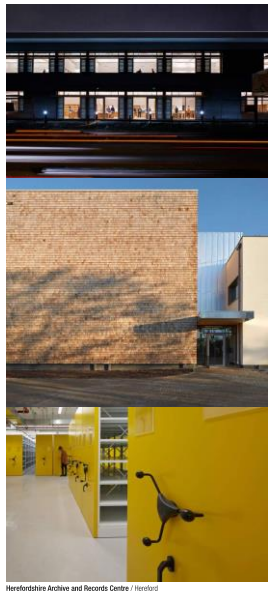

Ysgol Maes y Dre and Salop Road Primary School / Welshpool


London Dock Secondary School / London


Hackbridge Primary School / London


Swillington Primary School / Leeds


Christ Church Central / Sheffield


Herefordshire Archive and Records Centre / Hereford


The Enterprise Centre - University of East Anglia / Norwich


Imperial War Museum Paper Store / Duxford


Eco Business Centre / Bicester


Chester Balmore / Camden, London


Hennerwood Farmhouse / Bromyard, Herefordshire


Callaughton Ash Housing / Much Wenlock, Shropshire

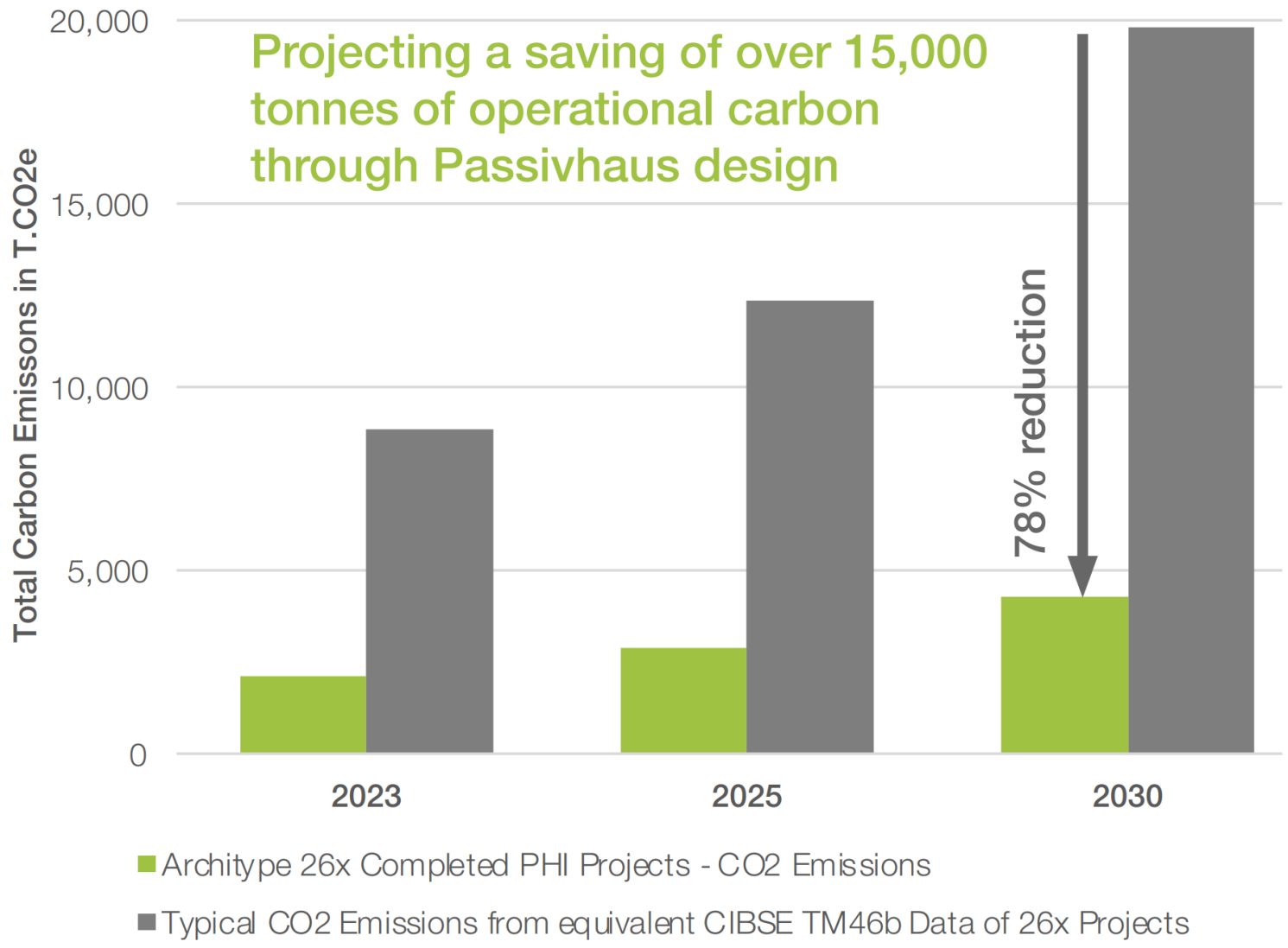

Fishleys House / Colwall, Herefordshire

ARCHITYPE

Evidence based performance

Architype's accumulative societal impact

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



Our sectors

- Residential
- Arts, culture and heritage
- Office and workspace
- Community
- Further Education
- Primary, Secondary and SEN
- Archives and passive stores

"The Architype team is professional, systematic and highly creative in approach. Our scheme is benefiting significantly from their approach to design and their collaborative working. I would have no hesitation in recommending them."

John French, Executive Director / Cambridge Institute for Sustainability Leadership


Durham
University


UNIVERSITY OF
OXFORD


UNIVERSITY OF
CAMBRIDGE


UNIVERSITY OF
EXETER


Letchworth
Garden City
Heritage Foundation


WARWICK
THE UNIVERSITY OF WARWICK


THE
ROYAL
PARKS


UNIVERSITY OF
BATH


University of
St Andrews


NATURAL
HISTORY
MUSEUM


upp


THE
PORTMAN
ESTATE

EDINBVRGH
THE CITY OF EDINBURGH COUNCIL

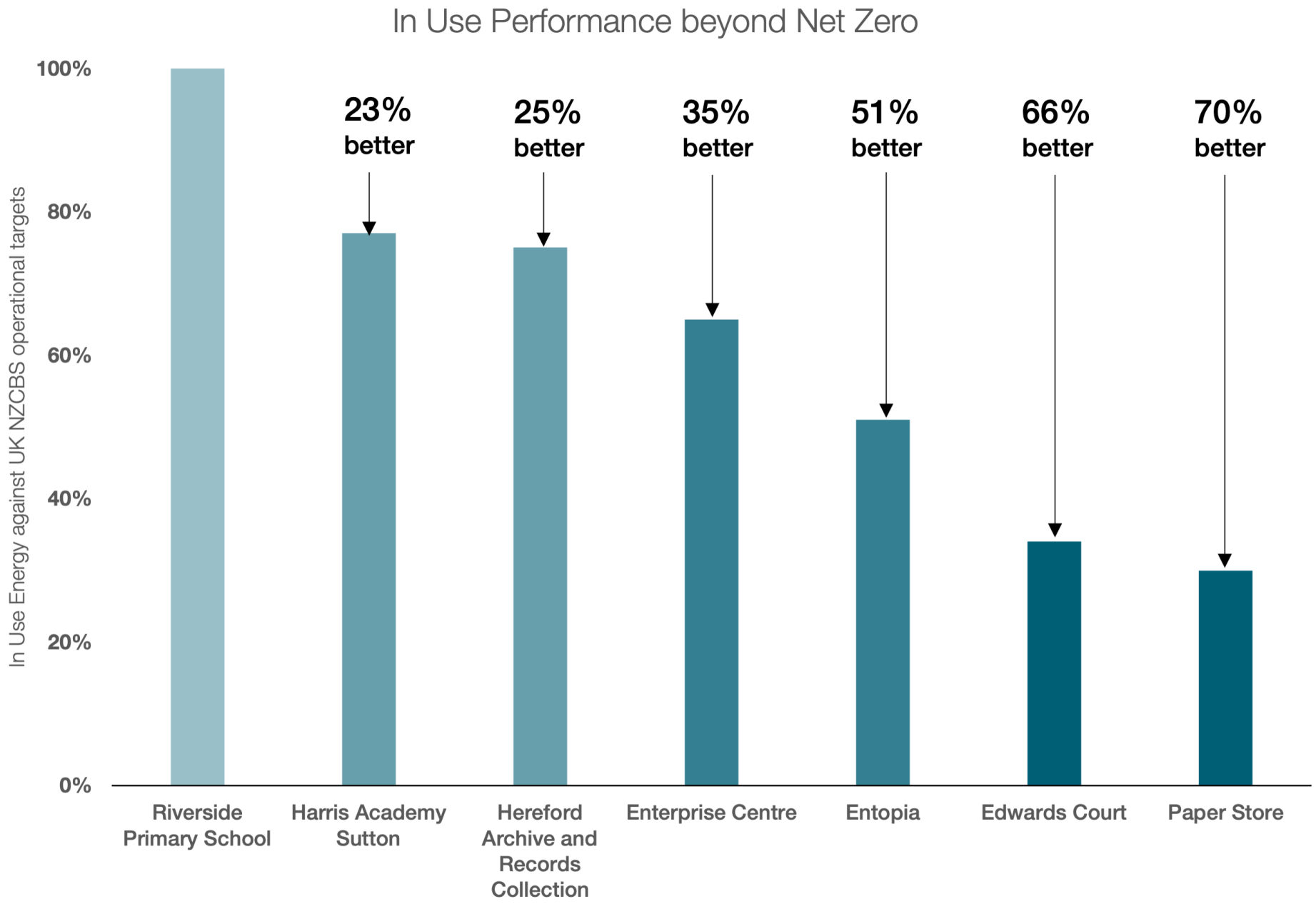

IWM
IMPERIAL
WAR
MUSEUMS


Hammerson

PERFORM+ Consultancy

- Environmental consultancy
- Solving the building performance gap
- Providing evidence for climate action
- Supporting excellence in sustainable design – no greenwashing
- 24% of our turnover

PERFORM+ Consultancy



PERFORM+ Consultancy

- Embodied and operational carbon analysis
- Passivhaus and EnerPHit design
- BIM to PHPP Coordination
- Wellbeing: temperature, light, CO_2
- Hygrothermal modelling (WUFI)
- Thermal Bridge Assessment

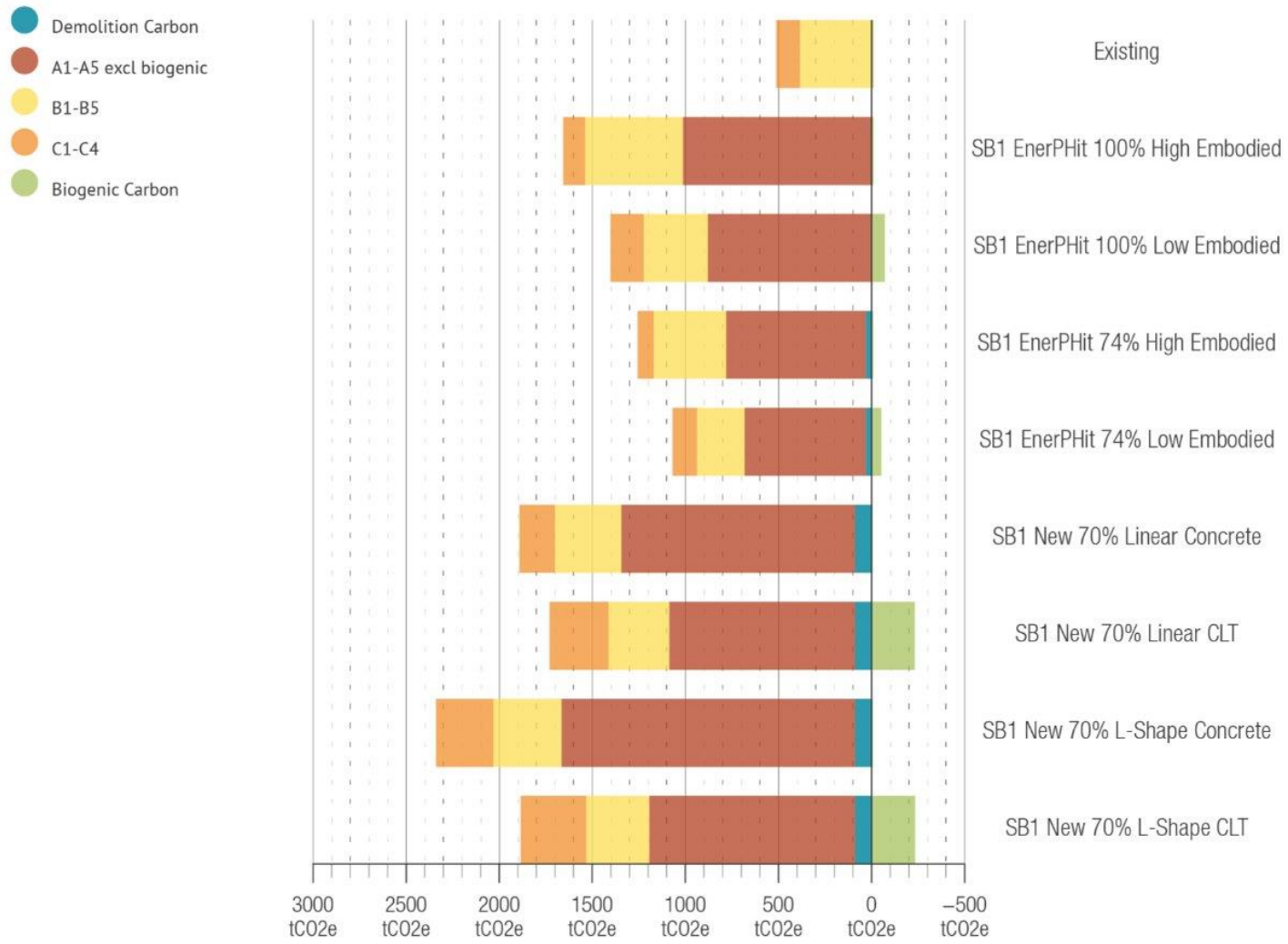


Fig.72 Embodied Carbon over the next 60 years, tonnes CO2e - SB1

Regenerative Design – Our Approach

Architypes approach

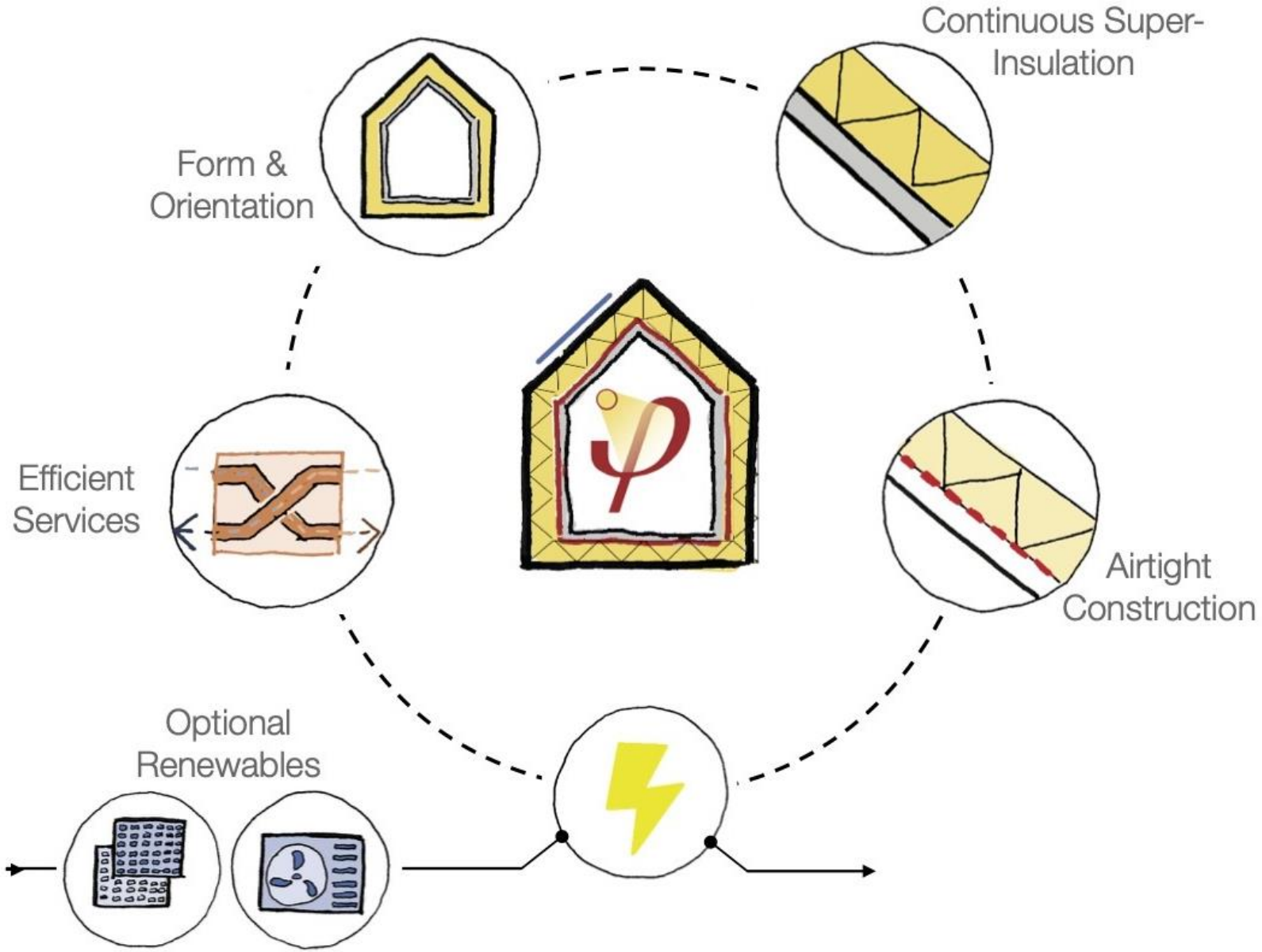
Passivhaus as design methodology

- Energy
- Comfort/health
- Design and site quality verification process

Architypes approach

Passivhaus as design methodology

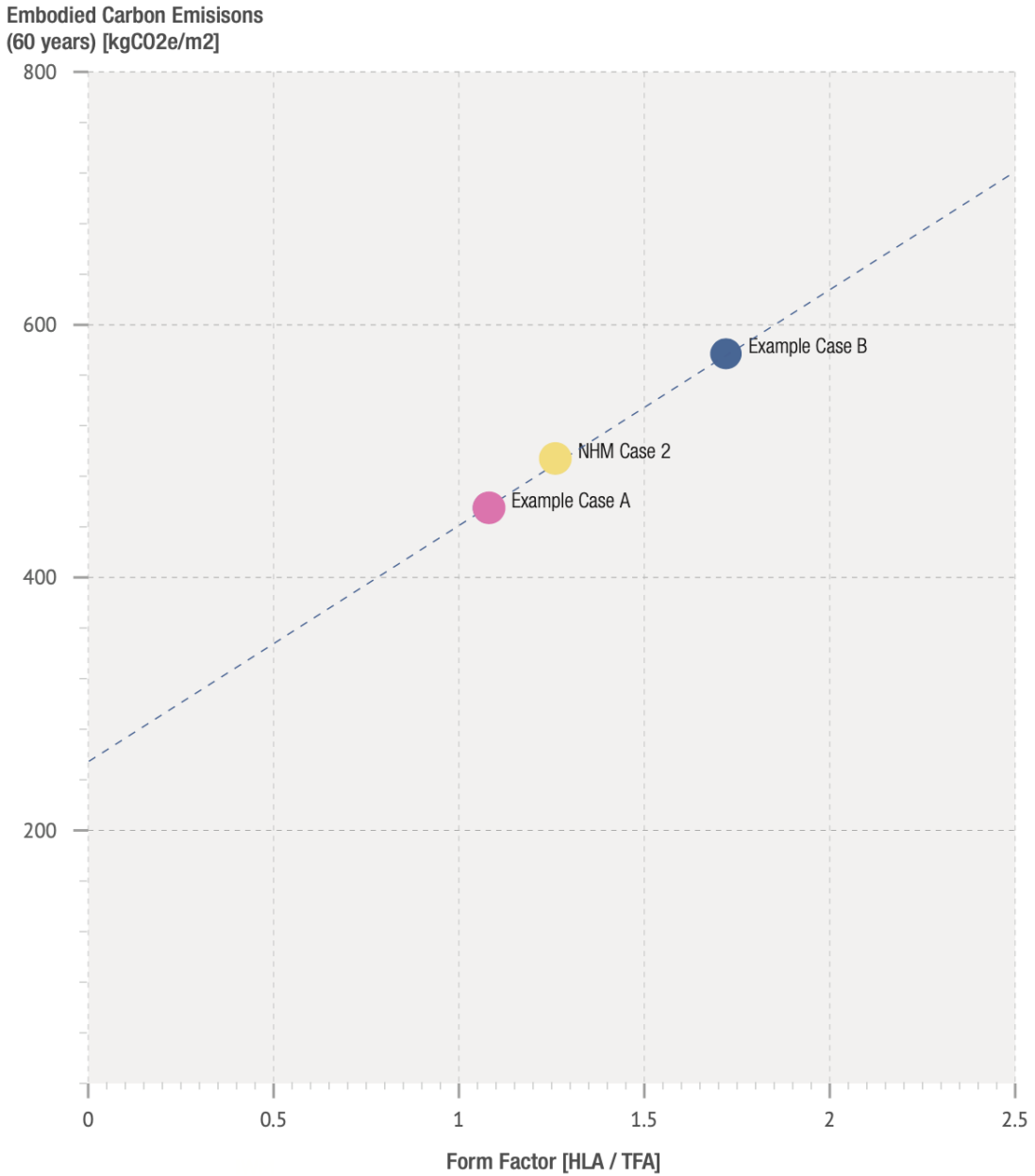
- Iterative design approach
- Design for spatial & material sufficiency



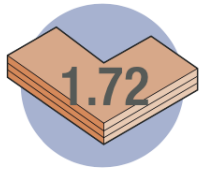
Architypes approach

Passivhaus as design methodology

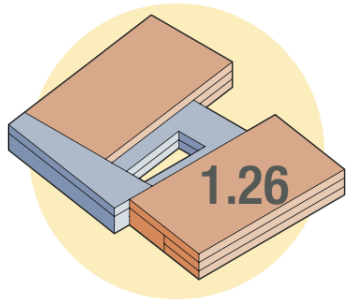
- Form factor is significant in whole life carbon assessment
- Form factor < 2: cost per m2 same as building regulations?!



Lower form factor is better:



Example Case B: 3,000m² L-shaped plan



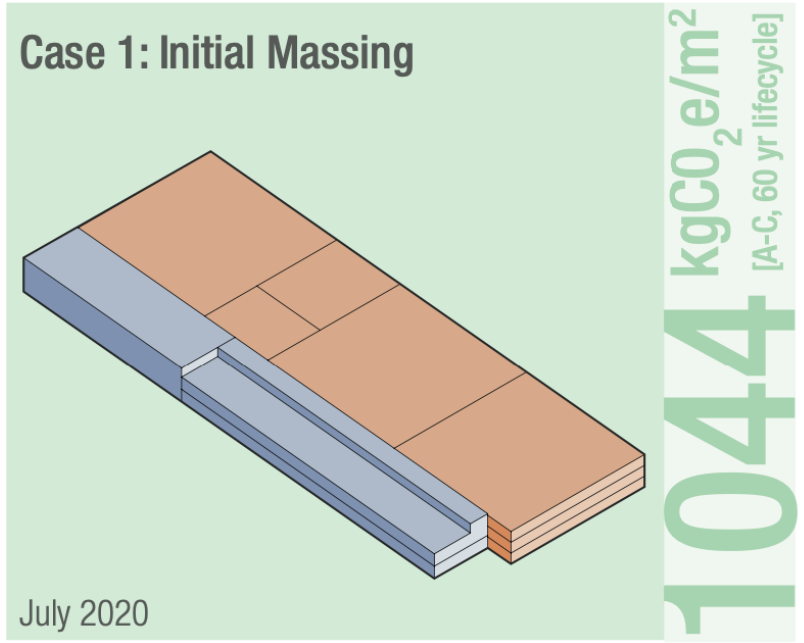
NHM Case 2 [current]: 30,000m² to current massing

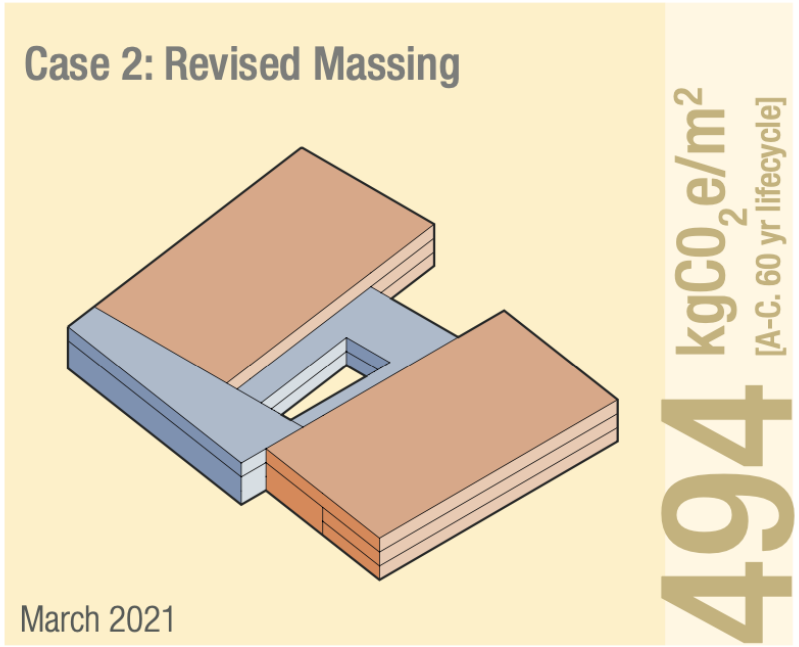
Example Case A: 30,000m² rectangular plan

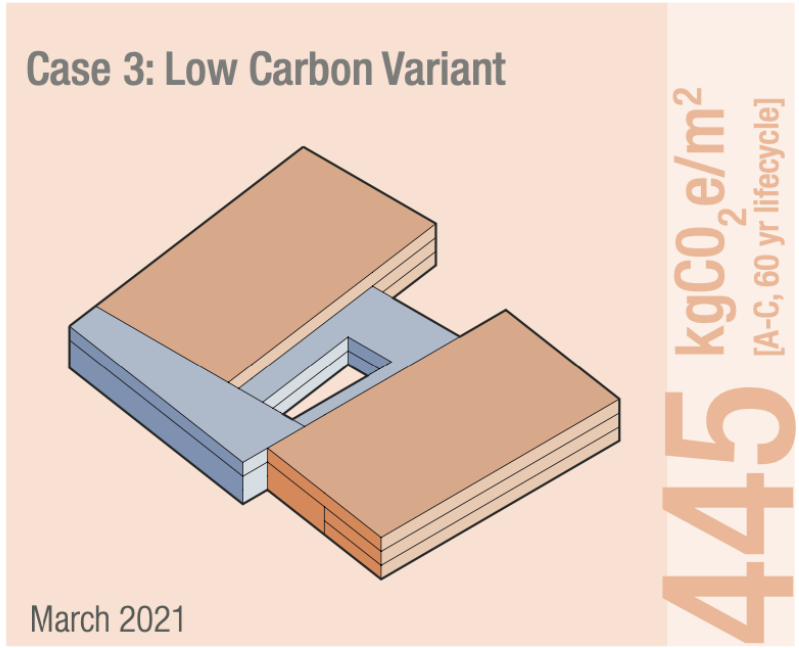
Architypes approach

Passivhaus as design methodology

- Material choice & form factor combined can give significant results







Architypes approach

Passivhaus as design methodology

- Demand reduction first
- Design for sufficiency in materials
- THEN offset remaining emissions

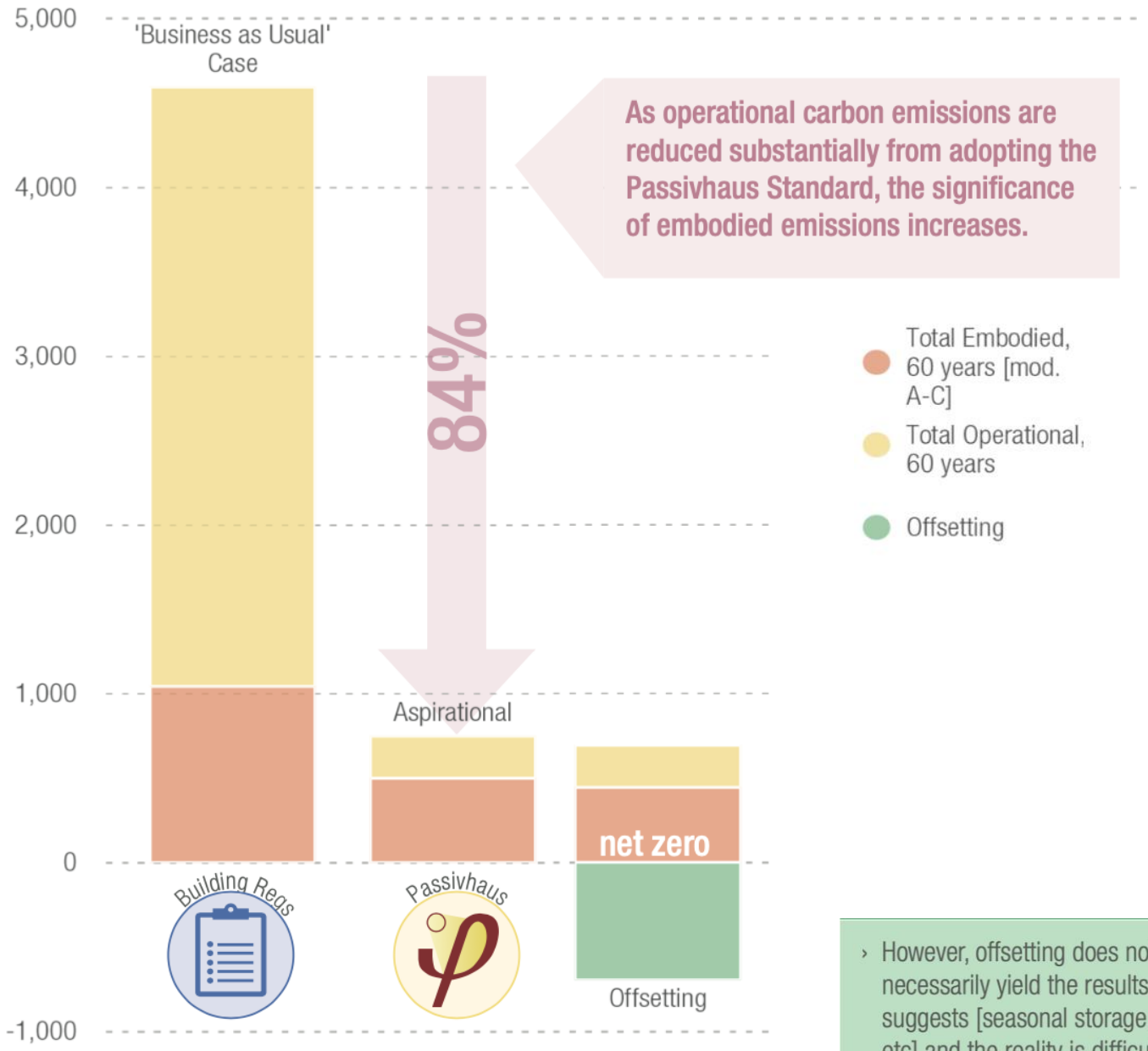
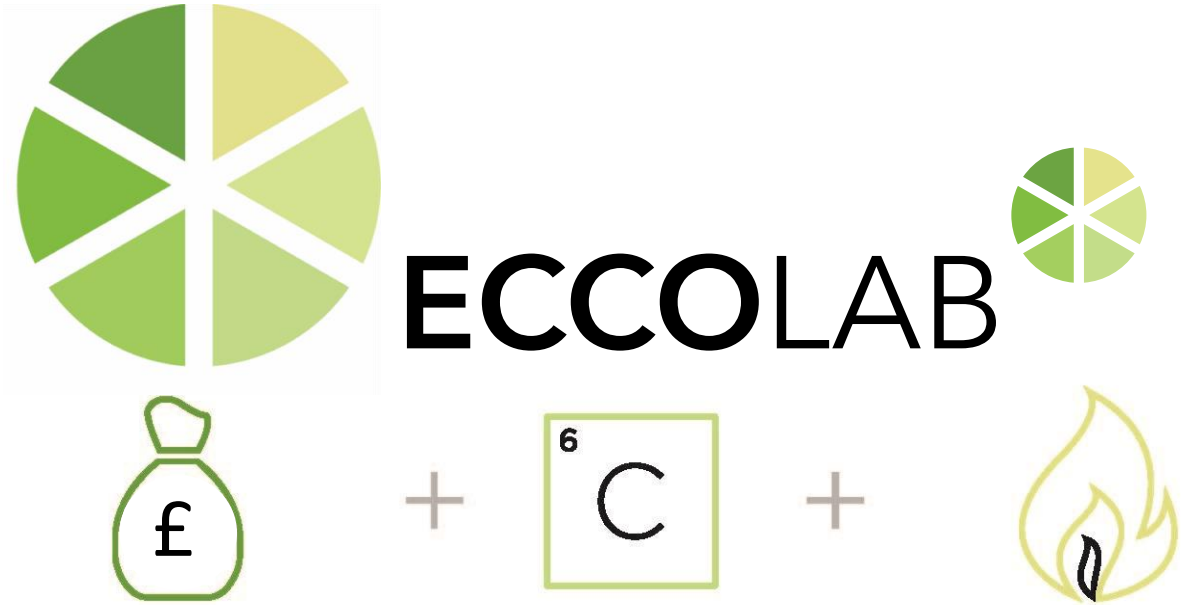


Fig. 19 / Lifecycle Emissions comparison

› However, offsetting does not necessarily yield the results it suggests [seasonal storage, etc] and the reality is difficult to quantify.

Source: LETI Embodied Carbon Primer

Life cycle analysis



Capital & Lifecycle Cost Model

£

Energy & Services Model

kWh

Embodied Carbon Model

CO_2e

Certification

✓

Materials Library

EPD

Optioneering

✓

Rapidly and simultaneously optimise the Energy, Cost, and Carbon of a project's lifecycle

Whole life carbon – challenges beyond assessment

Challenges beyond assessment

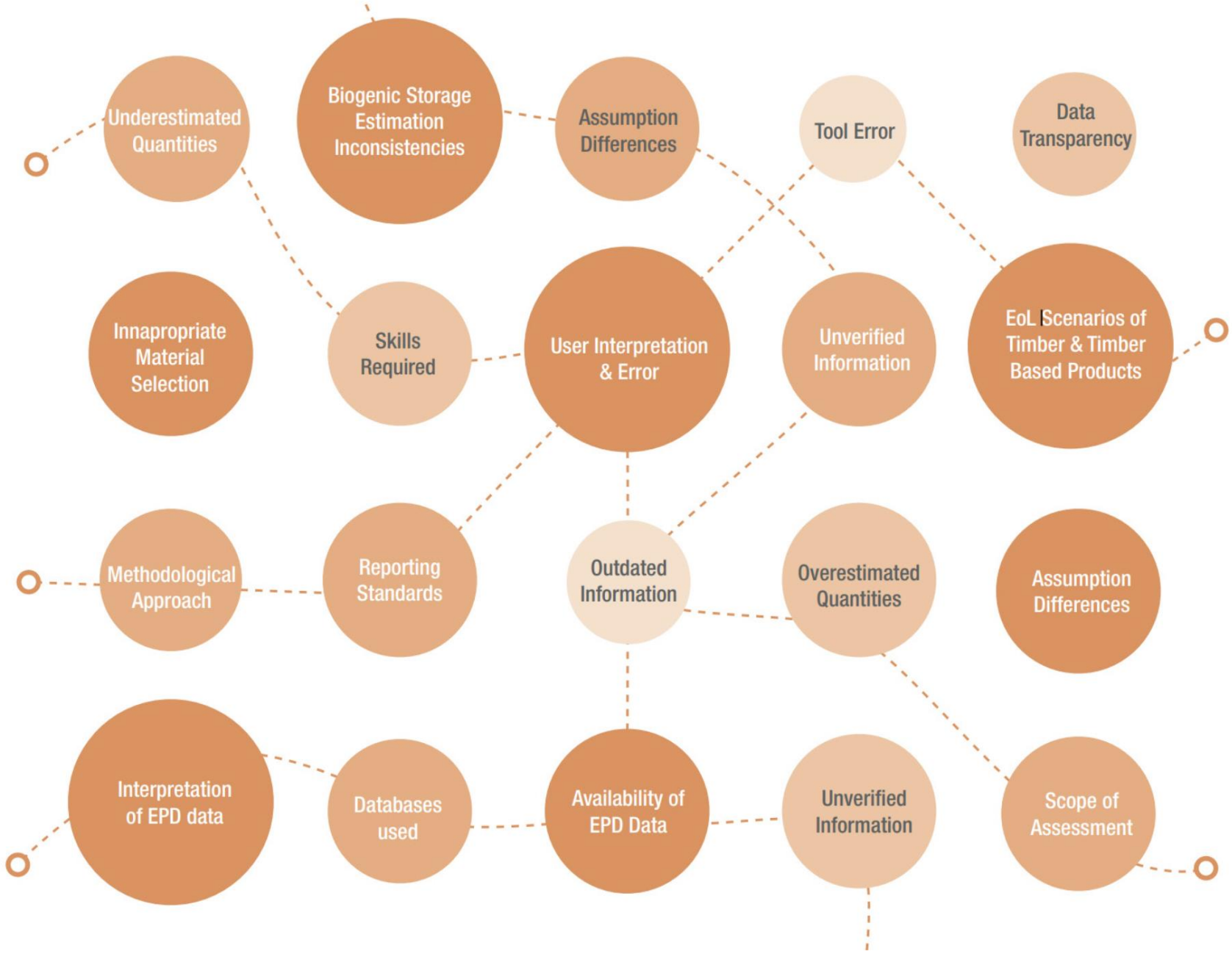
Some factors outside of assessment control:

- Assessment tools and their availability
- Structural material choice
- Services over a building life
- Renewables end of life of physical components
- Materials scarcity - example
- Fitted furniture FFE and finishes

Assessment tools and availability

Requires expert Knowledge to navigate well

- Interpretation
- Data availability
- Verified information
- Biogenic storage inconsistencies



Life cycle analysis

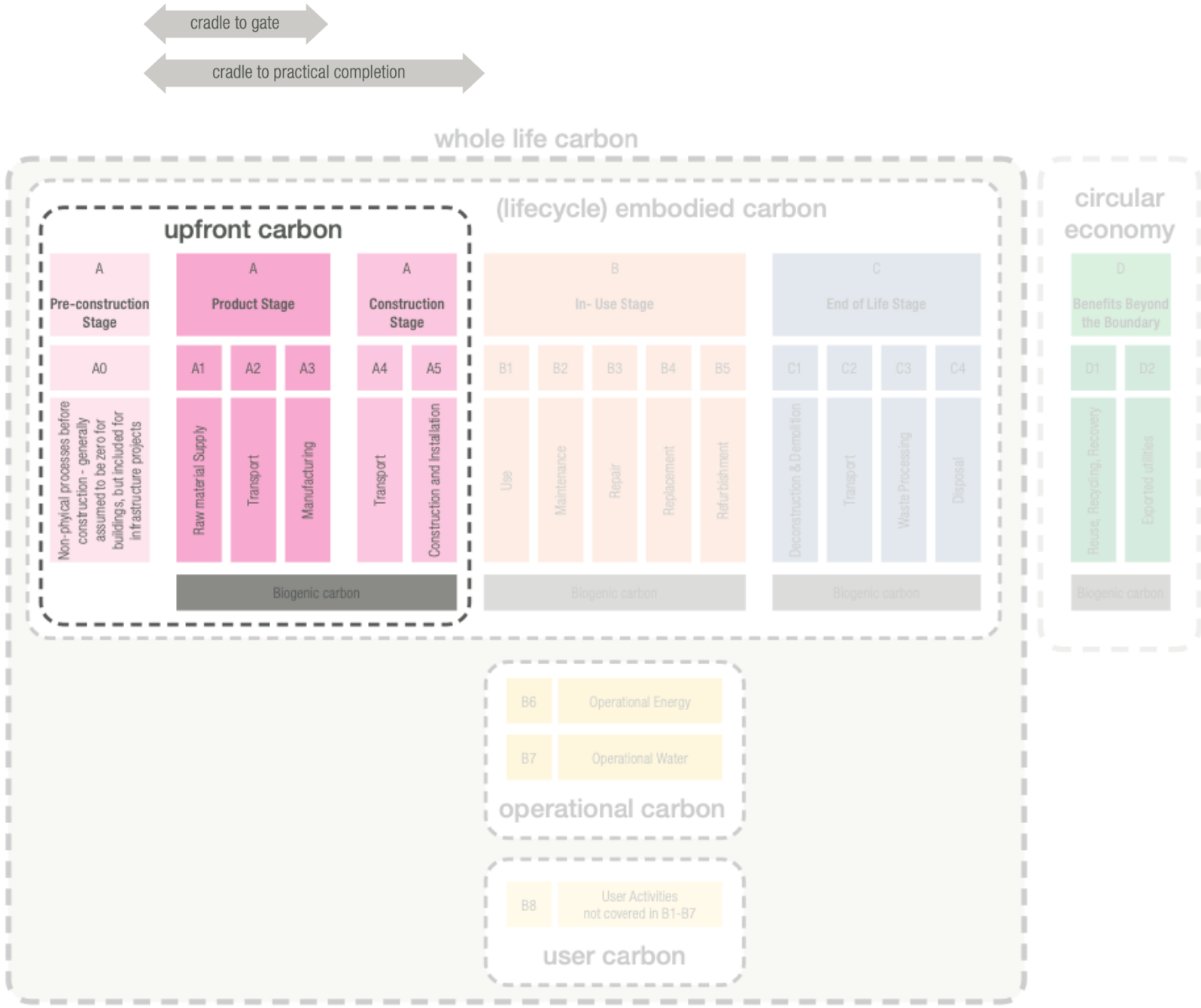
Assessment Scope

Typically, the scope can be:

Upfront carbon

- Emissions from materials/construction processes up to practical completion
- Modules A1-A5
- Sequestration excluded and reported separately*

**RICS UK guidance*



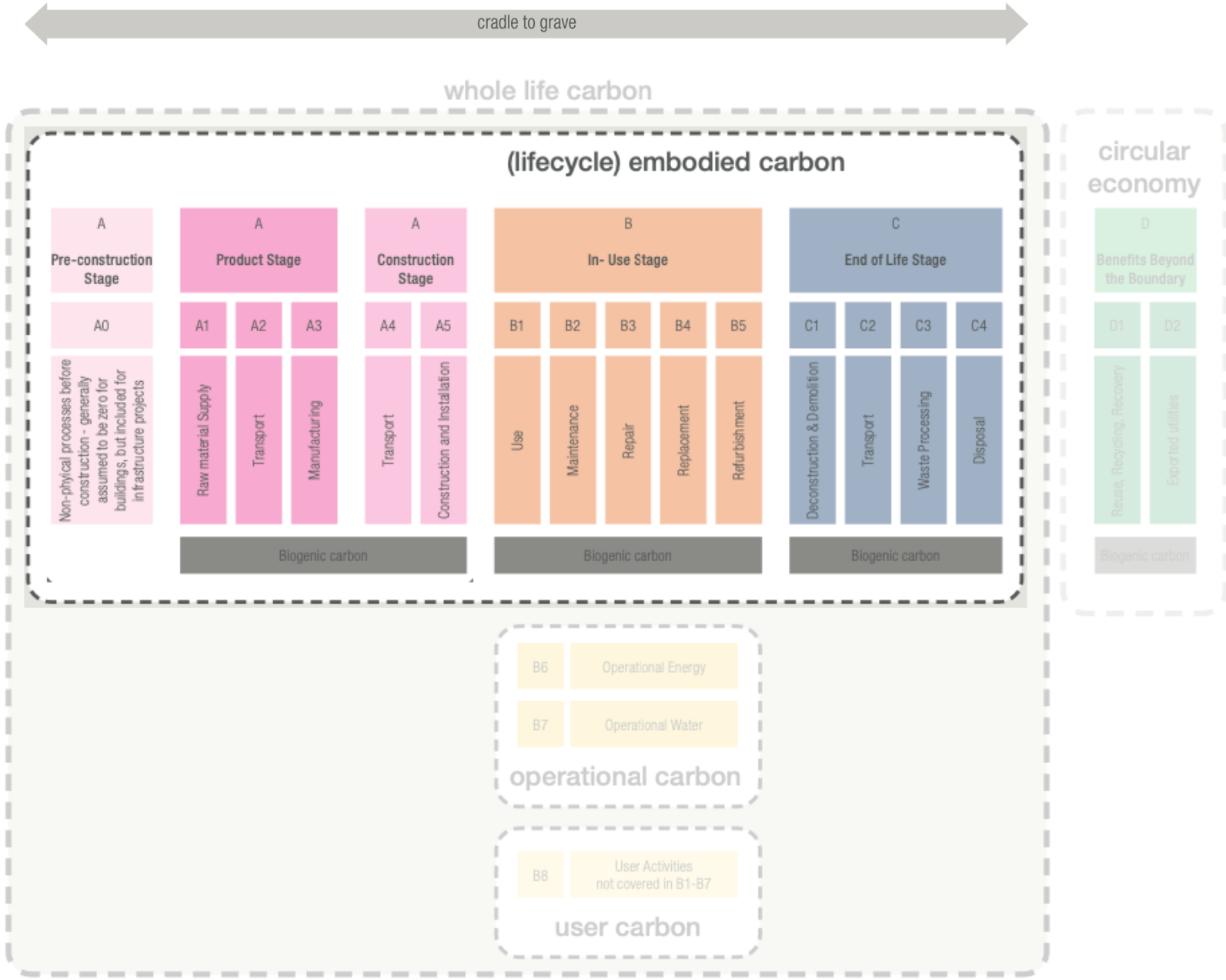
Assessment Scope

Or:

Life cycle embodied carbon

- GHG emissions & removals from materials/processes throughout the whole life cycle of an asset
- Modules A1-A5,B1-5,C1-4
- Sequestration included only when fairly accounted in end of life emissions*

**RICS UK guidance*



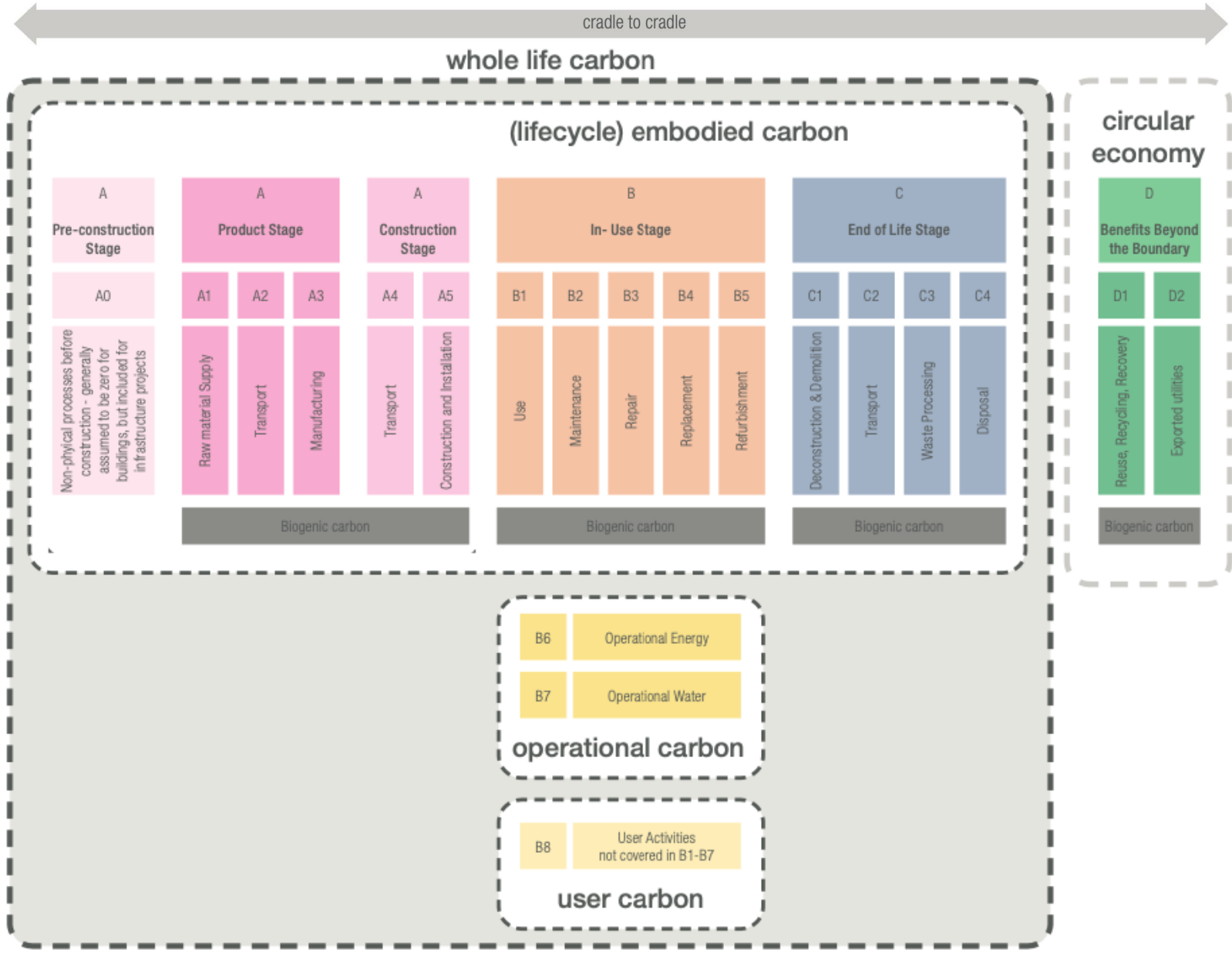
Assessment Scope

Or:

Whole life carbon

- Modules A0-5, B1-7, C1-4 including operational & biogenic carbon
- Separately report the benefits or loads from future energy/material recovery (D1,D2)

**RICS UK guidance*



Assessment Scope - Circularity

< 10% of journey from linear to circular in UK

- 90% of UK material use from virgin sources
- 80% of these materials are extracted from abroad
- Context should impact material decision making now

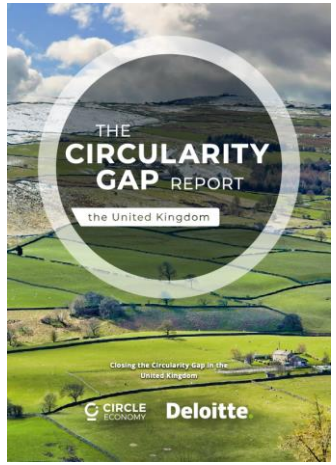
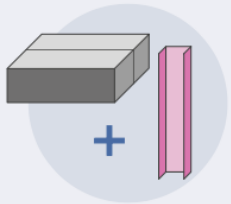


Figure two shows the full picture of circular and non-circular materials that make up the UK's Circularity Gap.

https://www.circularity-gap.world/united-kingdom

Material choice

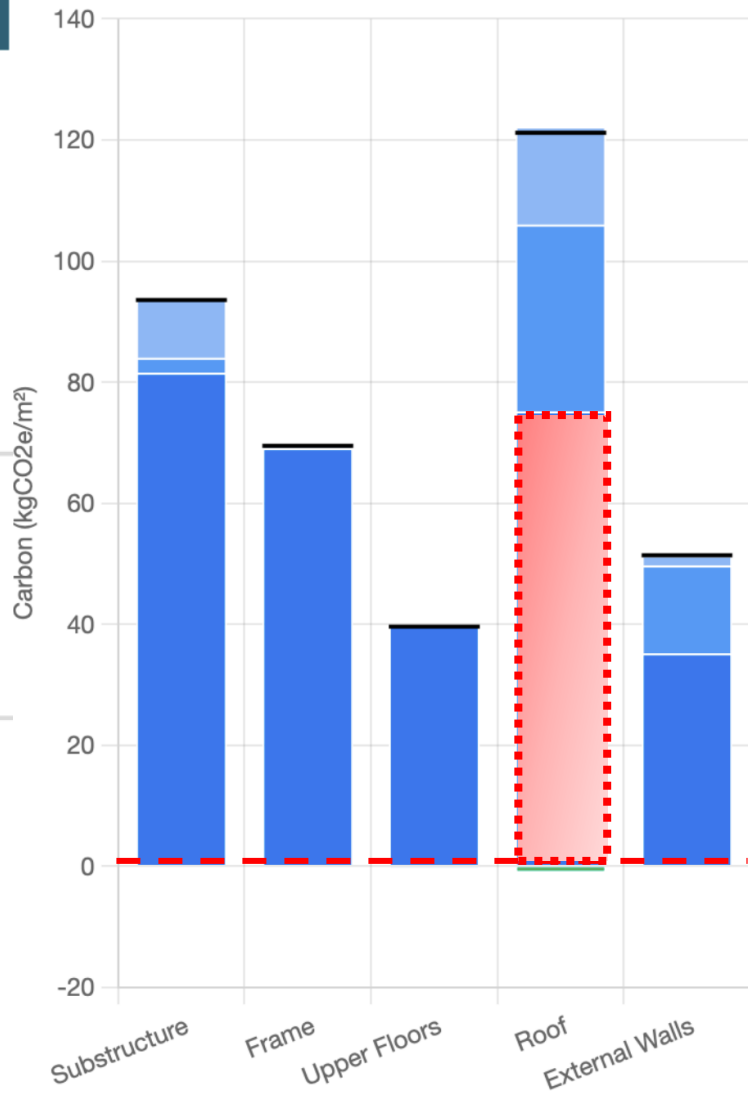
Option 1A:
Current Design*
Steel Frame & Metal Partitions



Steel Frame with Precast Concrete Floors & SFS Infill on Concrete Raft

440
kgCO₂e/m²
[A1-A5]

751
kgCO₂e/m²
[A-C. 60 yr lifecycle]



Option 2A:
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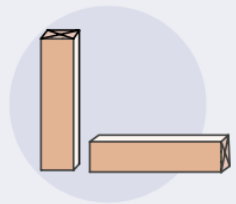
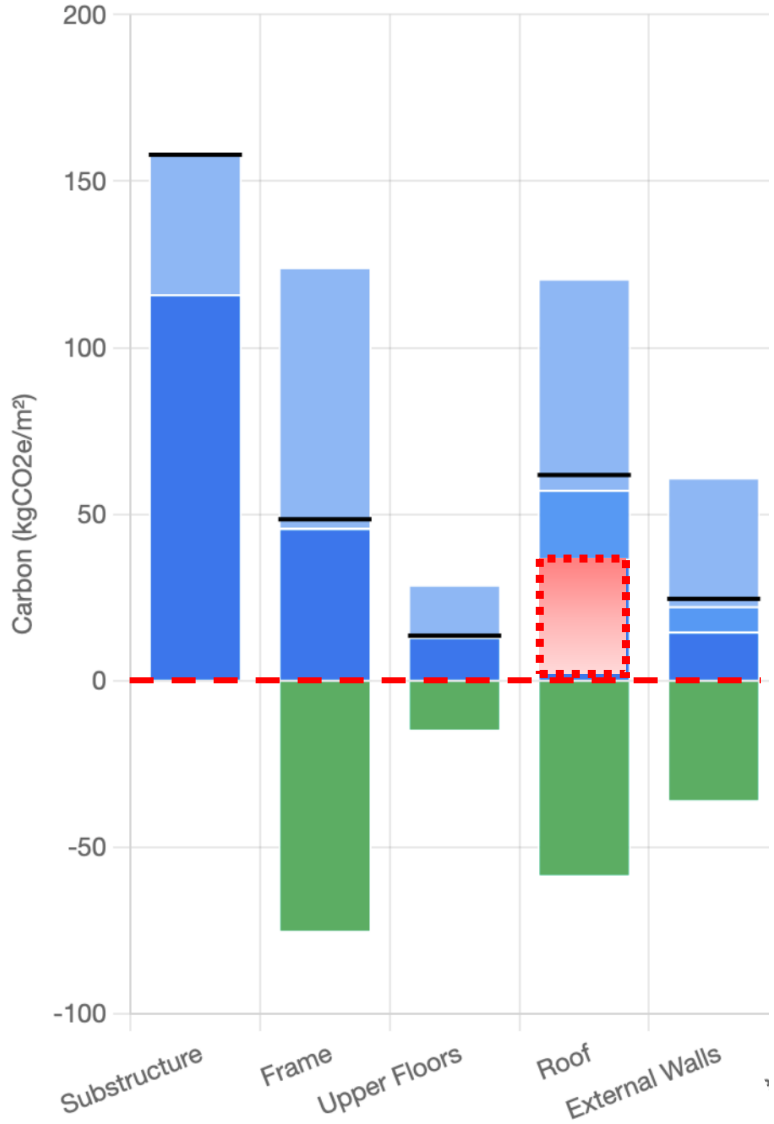
Timber Frame & Metal Partitions



Timber Frame on Concrete Raft.

362
kgCO₂e/m²
[A1-A5]

670
kgCO₂e/m²
[A-C. 60 yr lifecycle]



A1-5 Upfront Carbon
B1-5 Use Embodied Carbon
C1-4 End-of-Life
A1-3 Product (Sequestered)
NET (Including sequestration)

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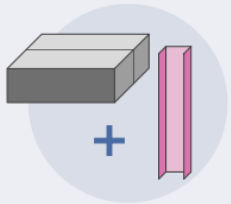

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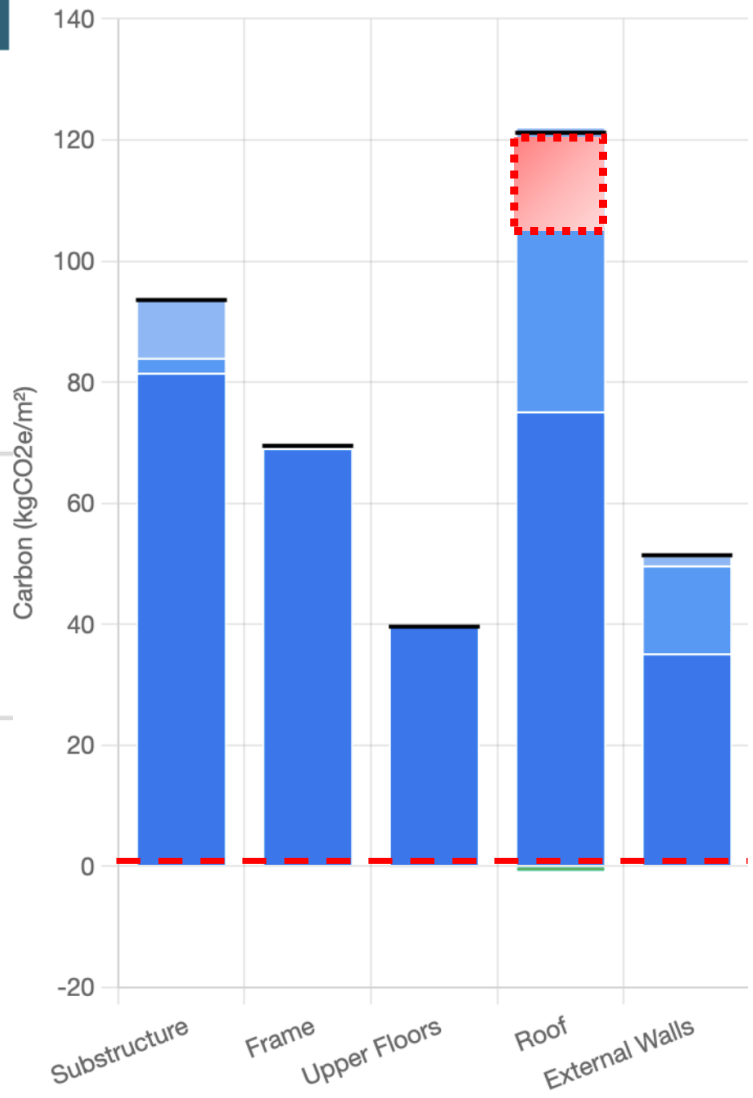

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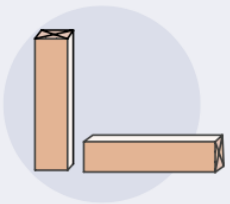

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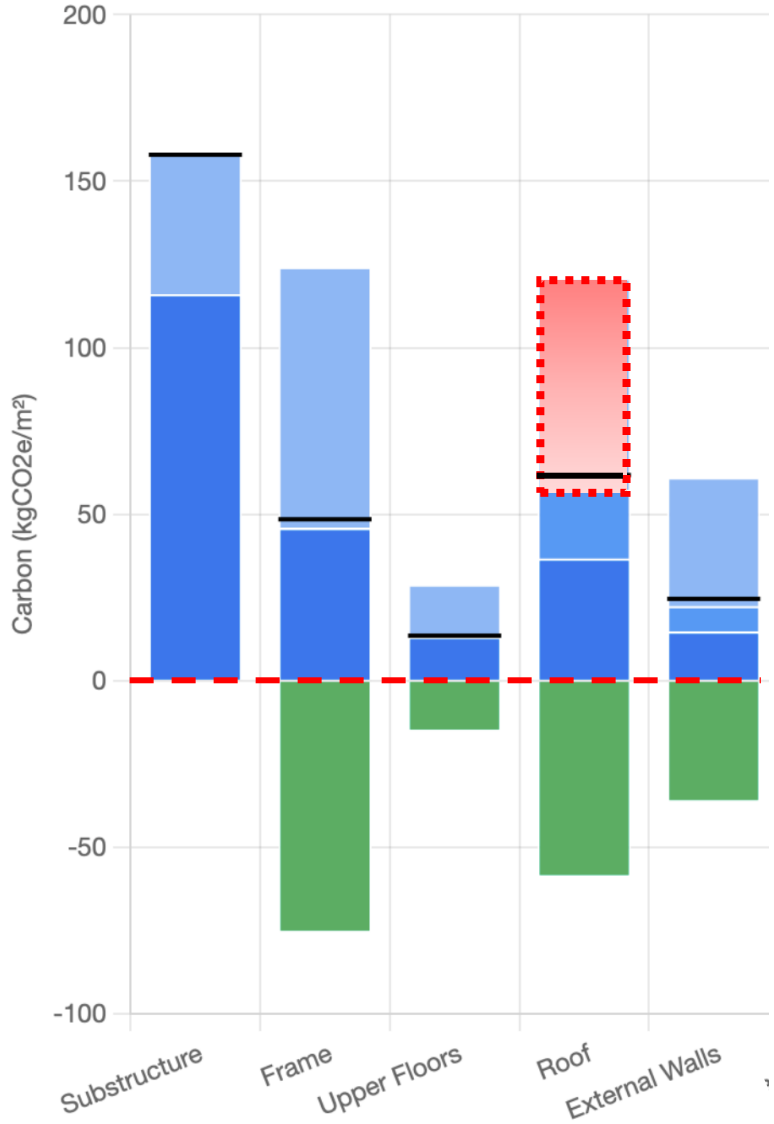

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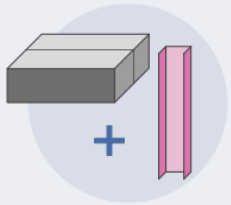

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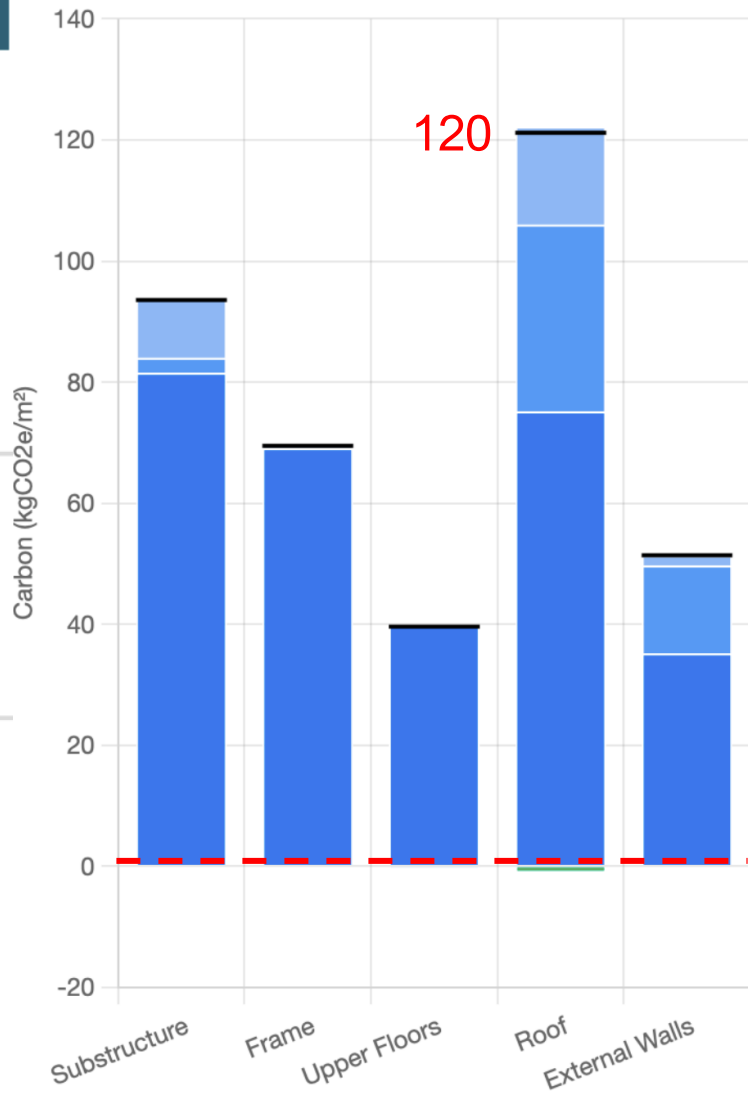

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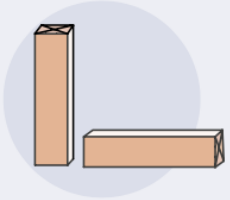

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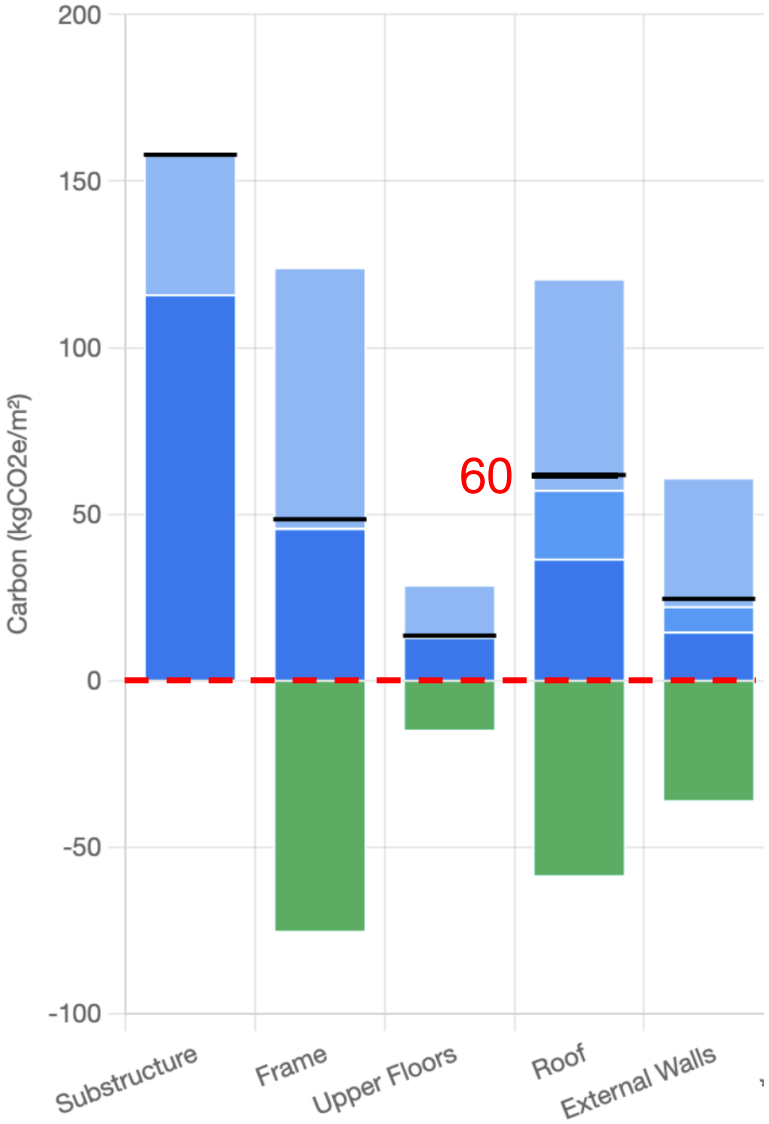

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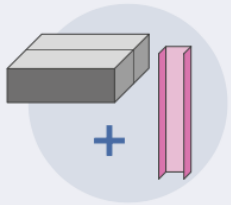

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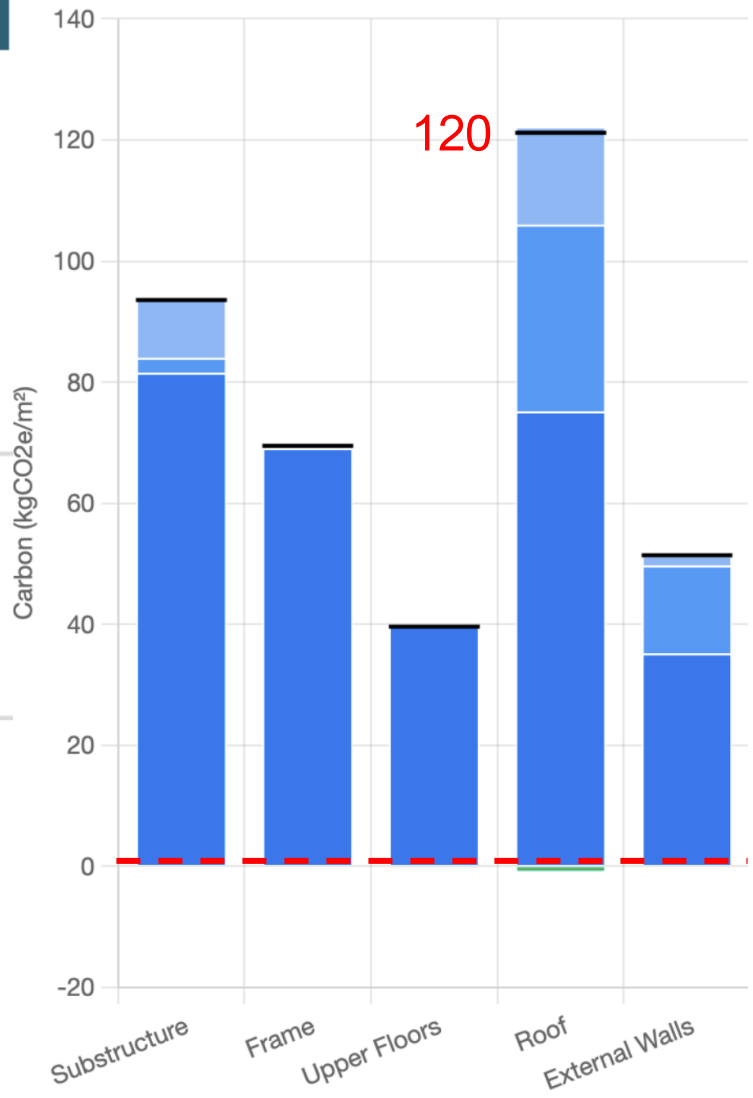

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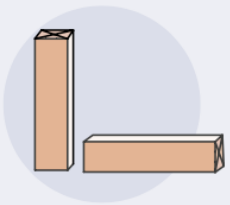

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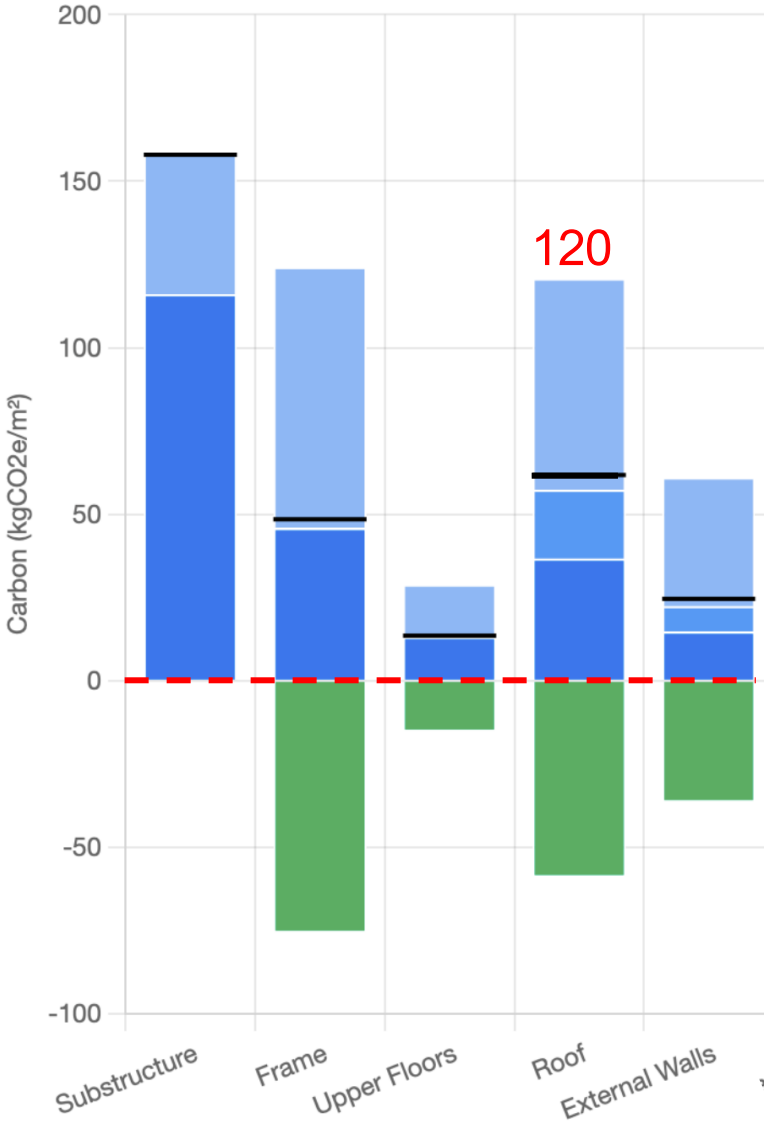

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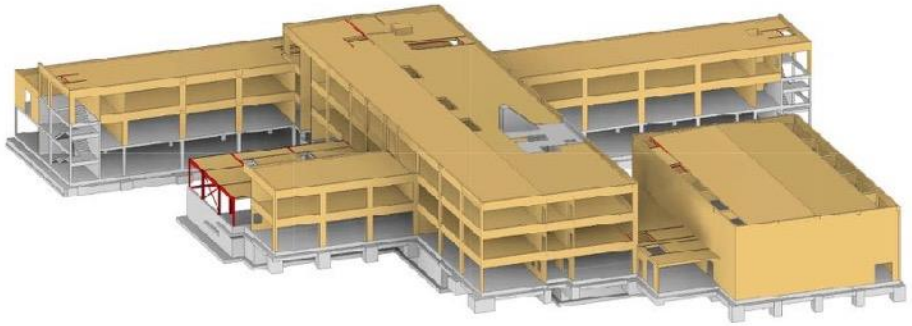


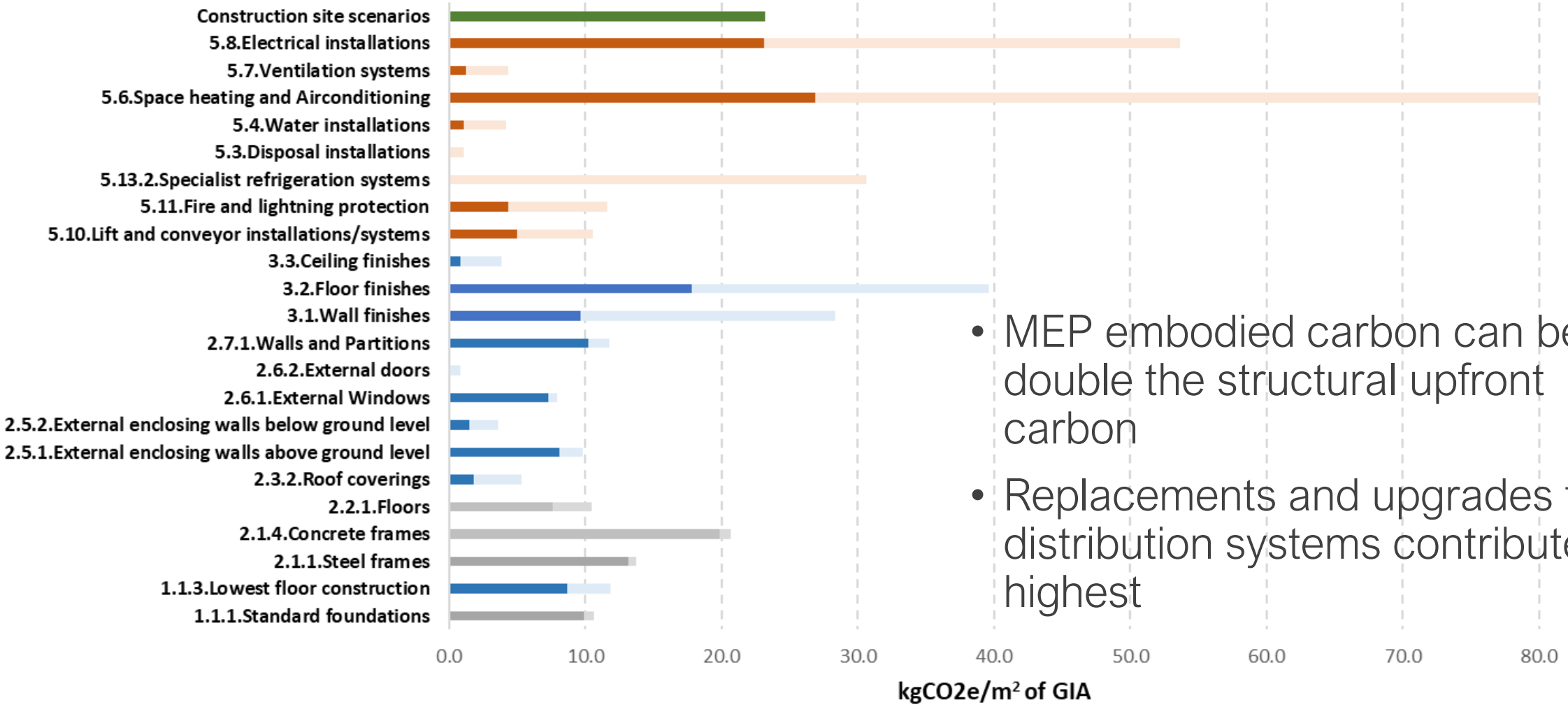
ARCHITYPE

CONSTRUCTION

DE-CONSTRUCTION

Services

Services

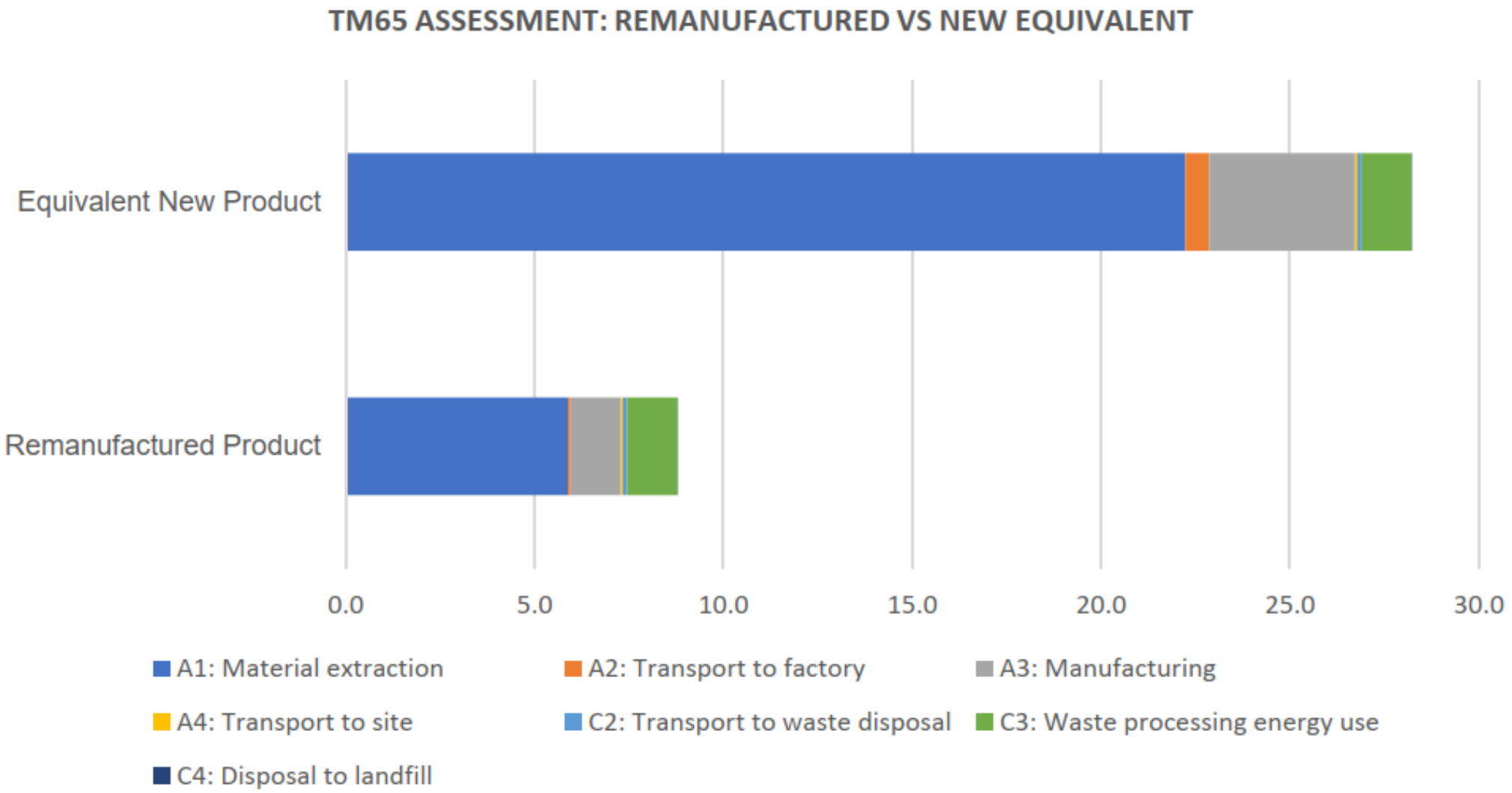


- MEP embodied carbon can be double the structural upfront carbon
- Replacements and upgrades to distribution systems contribute the highest

MAX FORDHAM

Services

Global resource consumption has tripled in the last 50 years
Resource efficiency of what we have in the system is key



MAX FORDHAM

Renewables at end of life

No global solutions for end of life of renewable components

- 1st PV recycling plant in 2023 Grenoble France globally
- Wind nacelles re-use/ recycle potential – maintaining value of materials in circular economy

Solar panels - an eco-disaster waiting to happen?

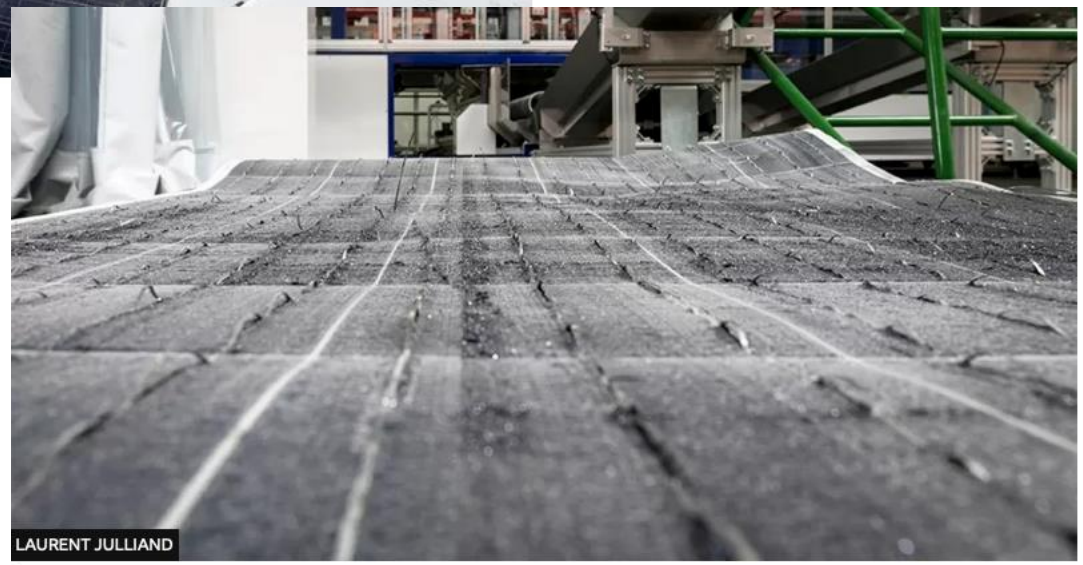
3 days ago

Climate change

The world's first wind turbine blade bridge was erected in 2021 in Szprotawa River in western Poland. Photo: Anmet

By Daniel Gordon

The Climate Question podcast, BBC Sounds



Solar panels are delaminated in order to recover precious materials

Materials scarcity

https://www.unep.org/news-and-stories/story/problem-our-dwindling-sand-reserves#:~:text=Sand%20is%20the%20foundation%20of,the%20collapse%20of%20coastal%20defences.

Material scarcity

Glass & components within frames for performance

- Replacement rates
- Industry incentives to refurbish components
- Future of components as hire purchase items?
  (Zero waste Scotland)

FF & E

Fittings furniture & equipment

- Generally, not modelled in whole life carbon assessments
- Major impact
- Entopia EnerPHit – Up to 40% of whole life carbon over 100 years even with re-used elements

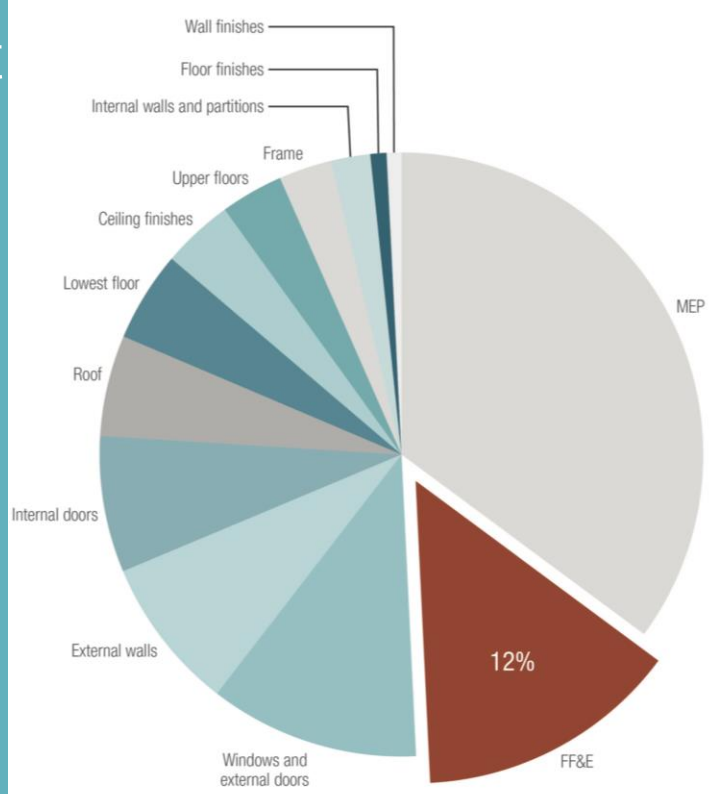


Fig. 11 / FF&E upfront carbon (A1-5) in red, compared with different elements of the building fabric

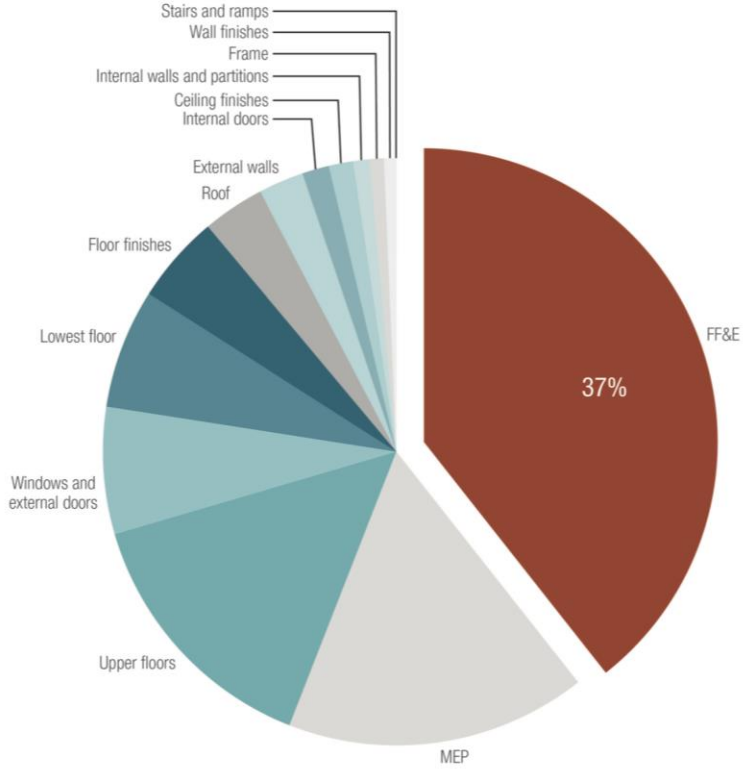


Fig. 12 / FF&E embodied carbon (A1-5, B1-5 and C1-4 over 100 years) in red, compared with different elements of the building fabric

Finishes

Floor finishes example

The Enterprise Centre
University of East Anglia UK

- Concrete floor chosen for longevity over timber floor

Finishes

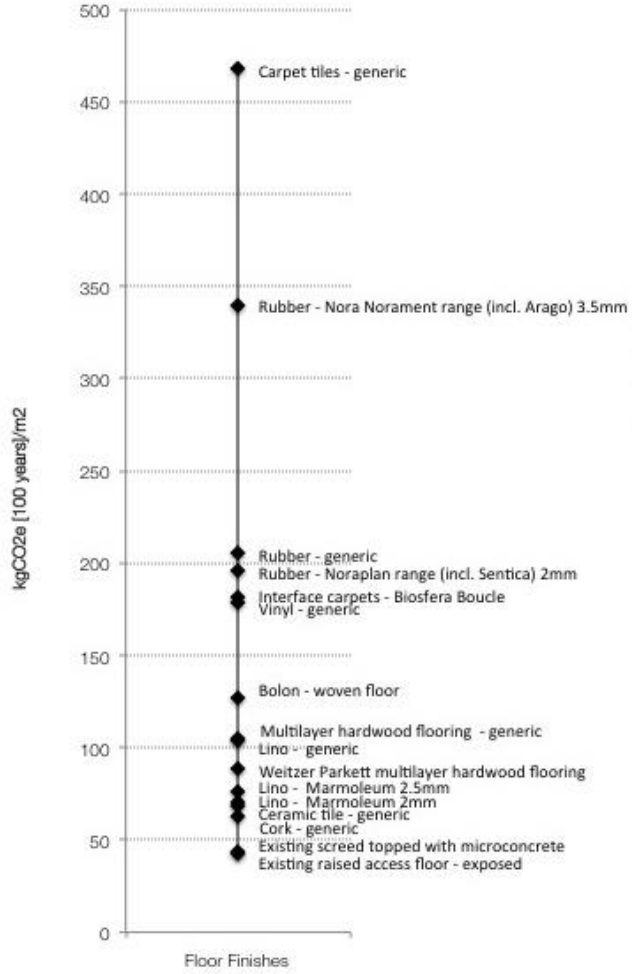
Floor finishes example

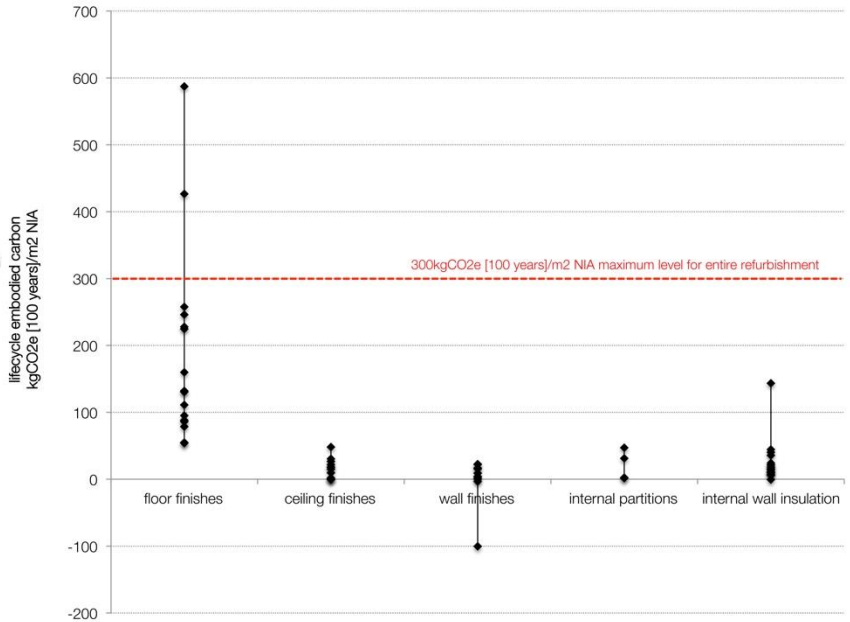
The Enterprise Centre
University of East Anglia UK

- Concrete floor chosen for longevity over timber floor
- Timber assessment excluded biogenic storage on a 15-year replacement rate for heavy trafficked area

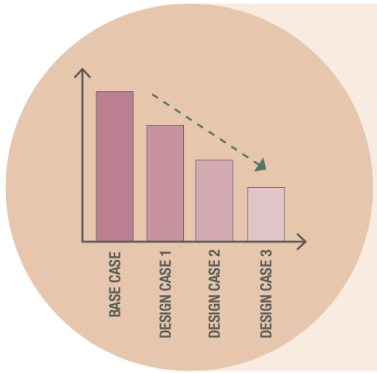
Finishes

Entopia example



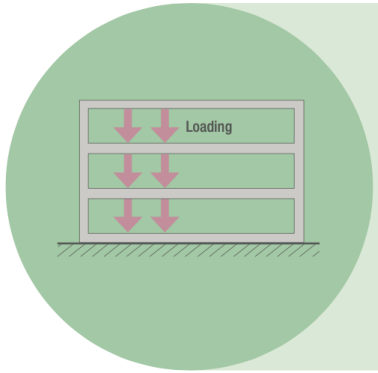


Regenerative Design and Whole Life Carbon – Conclusions



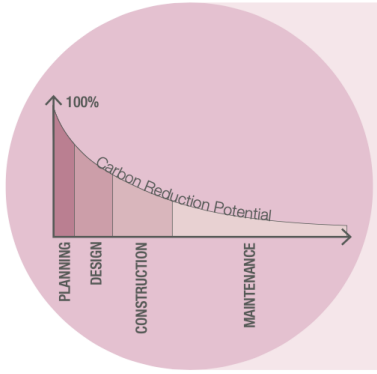
1. Use LCA Analysis as a Design Tool

- Appoint a Lifecycle Carbon Assessment [LCA] specialist or design team member for whole life carbon assessments moving forward. This should be in the form of iterative assessments at key design stages.
- Avoid seeing the analysis as a 'tick-box' exercise, instead use the tool to inform key design decisions.
- There are several standards which should be met when carrying out LCA analysis, this includes the RICS Professional Statement on Whole Life Carbon.



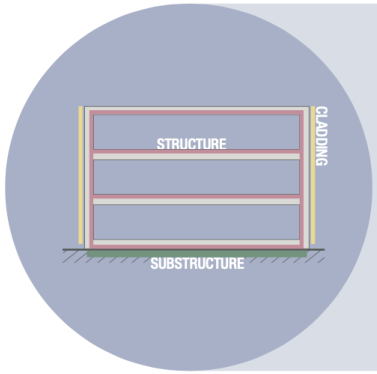
2. Build Light and Wise

- Whilst we can track and reduce the impacts of Embodied Carbon, the best principle is to only build what is necessary, with as little material as possible.
- Optimising structure at very early stage is essential for understanding where the greatest reductions can be achieved in structural design optimisation.



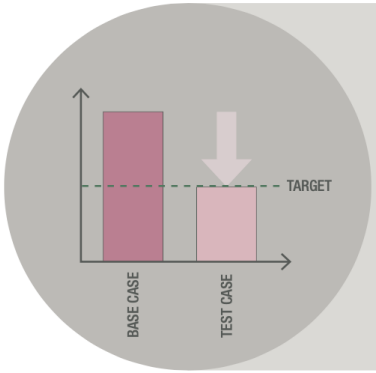
3. Early Assessment = Greater Reduction Potential

- The earlier embodied carbon is considered, the greater the ability to reduce it.
- Whilst many design elements have not been developed yet, it is important to assess the impact of these elements at early stage to understand the 'carbon consequences'.
- A carbon policy including Embodied and Operational Carbon for C&BRP should be agreed, with requirements for reducing Upfront and Embodied Carbon included in project briefs.



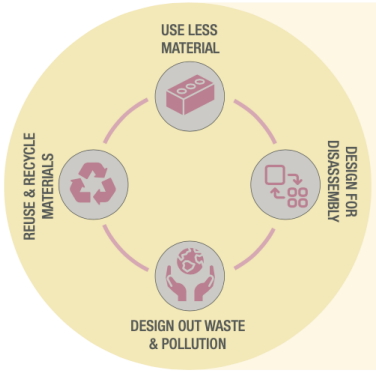
4. Focus on Carbon Hotspots

- Approximately 50% of main carbon impacts will be typically down to a small number of key elements.
- Elements such as foundations and structure will represent the biggest contribution to Embodied Carbon, largely due to the 'quantity' of material required.
- Therefore, focus on these main elements for replacements with lower carbon materials or further optimisation, to achieve significant reductions.



5. Set Achievable Reduction Targets

- Benchmarks are a useful way to check performance, however careful targets should be used to ensure useful and comparable data.
- We recommend that each new iteration of the model should be compared to the previous carbon studies for this project, with the aim of reducing where possible, and accounting for any increases (eg from increased scope, or greater detail).



6. Aim for a Circular Economy Principles

- Design for disassembly where possible, so that elements could be reused or recycled in the future, supporting a circular economy.
- Assess whether existing or recycled materials local to the site could be used, in full or in part, in the design.


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 | @CISL_Cambridge

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