Whole of life carbon, scope 3, sustainability and the National Standard of Competency for Architects (NSCA)

Geronimo ADVISORY

Prof Philip Oldfield - UNSW

Dr Dominique Hes

Acknowledgment

Dominique Hes

Lands of the Yalukit-willam

Kulin Nation Naarm

Manameet season

Phil Oldfield

Bidjigal Land

CPD Questionnaire

- Attending this webinar live and submitting this form will qualify you for 1 hour formal CPD.
- Certificates will be sent to the email address used to complete this form, please ensure your name and contact details are correct.
- This form will close 24 hours after the webinar has commenced.
- Certificates will be issued within 1 week of the closure of the quiz.

https://forms.office.com/r/j6PiMUDYxd

ARBV Webinar Quiz - Whole of Life Carbon and the NSCA

run sheet

Introduction

Embodied carbon, whole of carbon and education

The latest on embodied carbon and zero carbon buildings

National Standard of Competency for Architects (NSCA) – thoughts on meeting them

Questions

Whole of life carbon / embodied carbon

https://www.architecture.com.au/embodied-carbon-curriculum

NB set to change

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Embodied carbon - why is it an issue

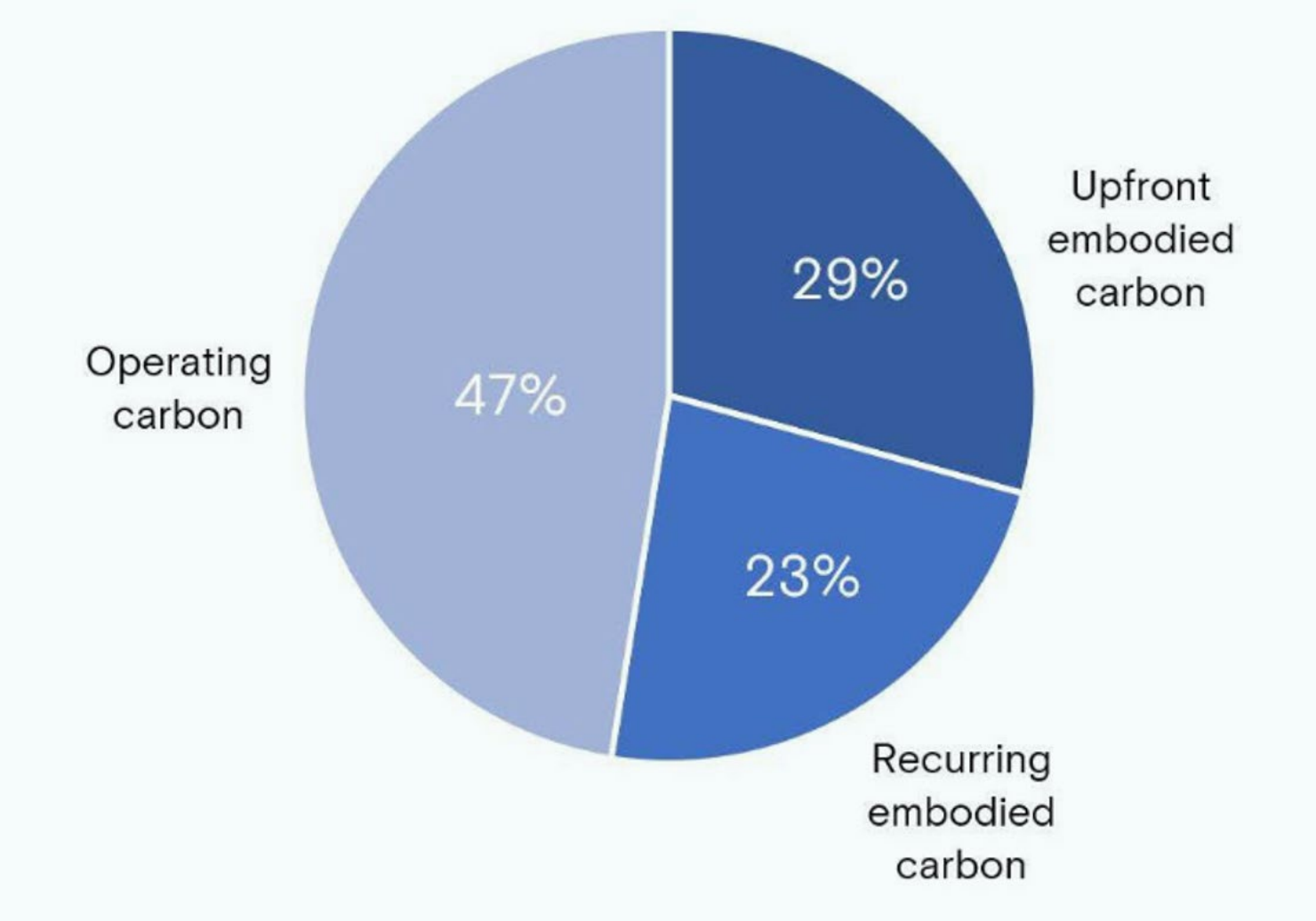
As we reduce the carbon intensity of electricity and get off gas

The materials we use have an impact on the total carbon

BUT - Need to balance carbon in materials with the capacity to create comfortable, long lasting, low energy consuming buildings – even if the energy is low carbon…

Embodied carbon - why is it an issue

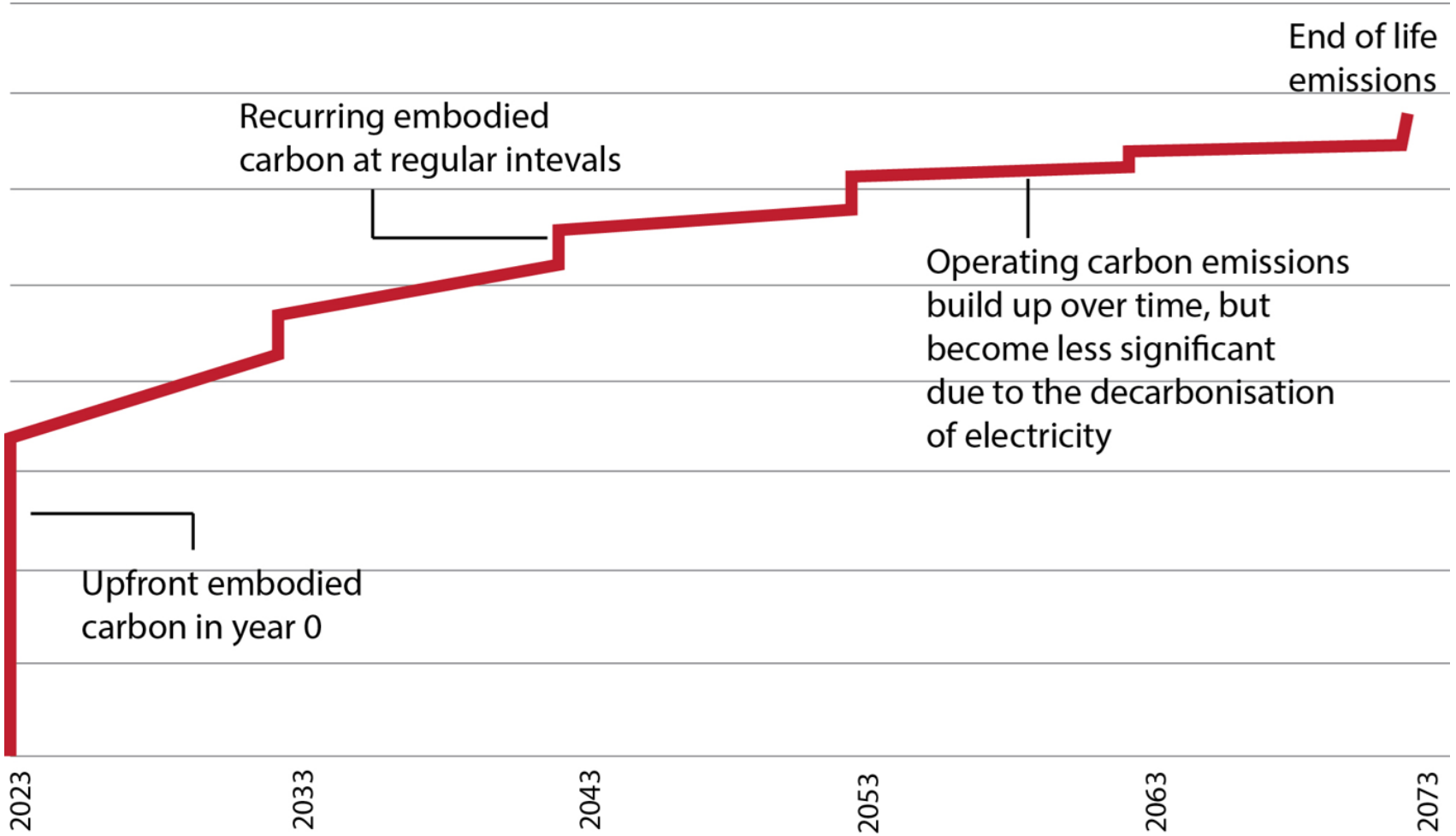
Life cycle carbon emissions of a typical detached house, Victoria, 2019 - 2050



Source: Schmidt et al. (2020). Quantifying Australia's life cycle greenhouse gas emissions for new homes

Embodied carbon - why is it an issue

If our electricity emissions decarbonise by 2050 (which we hope will happen)



Source: Philip Oldfield, Embodied Carbon in Buildings: AIA Acumen Note

DESIGNING OUT CARBON SUPPORT - FOCUS EMBODIED CARBON

5 STEPS FOR ARCHITECTS TO ADDRESS EMBODIED CARBON

As Antonio Guterres noted and COP27, "We are on a highway to climate hell with our foot still on the accelerator." In July 2023 as Europe burned, he said, "the era of global boiling has arrived" and we can only avoid the very worst "with dramatic, immediate climate action." How can architects take action and be part of the solution?

1. **Understand the why**
With the built environment contributing up to 37% of global emissions, architects have the opportunity and the responsibility to play an influential role in reducing emissions, especially those embodied in our buildings. This roadmap is here to help you urgently start on this journey to effectively contribute all you can and thereby make the best acknowledgement to Country and our First Nations people who ask us to join them as they care for Country.

2. **What is embodied carbon?**
To unpack this, it is important to understand the terminology; why embodied carbon is becoming an issue; the role materials have; and how embodied and whole life carbon are being considered in policy and regulation; and make yourself aware of the enabling mechanisms that are being developed to help make change happen. It is now time to think about what this could mean for your business and what you need to help you plan for the future that will involve this.

3. **Develop strategies to reduce**
To be able to develop the strategies that suit your practice, you will need to understand how, what, and when to measure; see how this could be a design opportunity through every stage of every project; and therefore, how your design processes will need to adapt. To help make this effective for your practice, have a sense for the many case studies, precedents and models that can help.

4. **Practice implementation**
To implement an embodied carbon strategy at your practice you will need to start measuring in house so you can develop a real understanding of what it means. With a support group, you can work out what and how this will be done. Developing a sustainability action plan for your practice, supported by reflecting on possible barriers to integrating embodied carbon in your work and how to resolve them, can help you positively address wide ranging practice issues. Spending time looking at embodied carbon as an innovation opportunity, strengthening your connection with your supply chain, and strategies for looking for alternative, regenerative, and living materials, will further enrich the way you can practice in the future.

5. **Growing and sharing**
This step is about celebrating, reviewing, continuing to experiment, improve and most importantly sharing with others, so you can contribute to providing the many shoulders the leaders of tomorrow will need to stand on.

THESE STEPS ARE SUPPORTED WITH THE TOOL KIT, RESOURCES, LINKS AND HIGH-LEVEL INFORMATION THAT WILL UNDERPIN THE CURRICULUM WHICH WILL GO INTO MORE DEPTH BUILDING CAPACITY FOR ARCHITECTS TO IMPLEMENT THE APPROACHES OUTLINE IN THESE 5 STEPS

Outline and prep Slides	M1A - Why	M1B - Terms and concepts	M1C - Measuring
Activities Activity sheet	M2A - Calculations	M2B - Case Studies	M2C - Improving
Quizzes Tools	M3A - Practice	M3B - Innovation	

STEPS / ROADMAP
Do X, Y, Z, …

TOOL KIT
All the basics you will need

CURRICULUM
Learning and having a go

DEVELOPED BY

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Co-Chair, AIA NCASC
Chair AIA Environ Notes Group
Adviser, Evitat
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2022 AIA National Awards Jury
2021 EEC Energy Efficiency Champion
2021 AIA Leadership in Sustainability Prize Joint Winner

Amanda Sturgeon
BSc (Arch), M Arch
Power of Leadership

CEO Biomimicry Institute
CEO Built by Nature
CEO Living Futures Institute
Practice lead Regen Mott Macdonald

Visiting lecturer and professor University of Washington

Top Ten Women in Sustainability Award - Green Building & Design

Dr. Dominique Hes
BSc, Grad Dip Eng
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LCA engineer Netherlands
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Academic Sust Arch RMIT
Academic Sust Arch UniMelb
Research Principal BZE 2019-2020
Zero Carbon Arch Lead CoM 2021-23

NED and Chair Greenfleet 2017-23

FUNDING, SUPPORT, AND THANK YOU'S

Australian Government
Department of Climate Change, Energy, the Environment and Water

Australian Institute of Architects

UNSW SYDNEY

MECLA

Green Building Council Australia

fitzpatrick + partners

NABERS

Leanne Hardwicke
Ruth Nordstrom

Mitch Tobin
Suzanne Lavender
Felicity Wybrew

Carlos Flores (Nabers)

Monica Richter (MECLA)

Envirotecture

Davina Rooney

Jorge Chapa

Paul Reidy

Andy Marlow

Dr Phil Oldfield

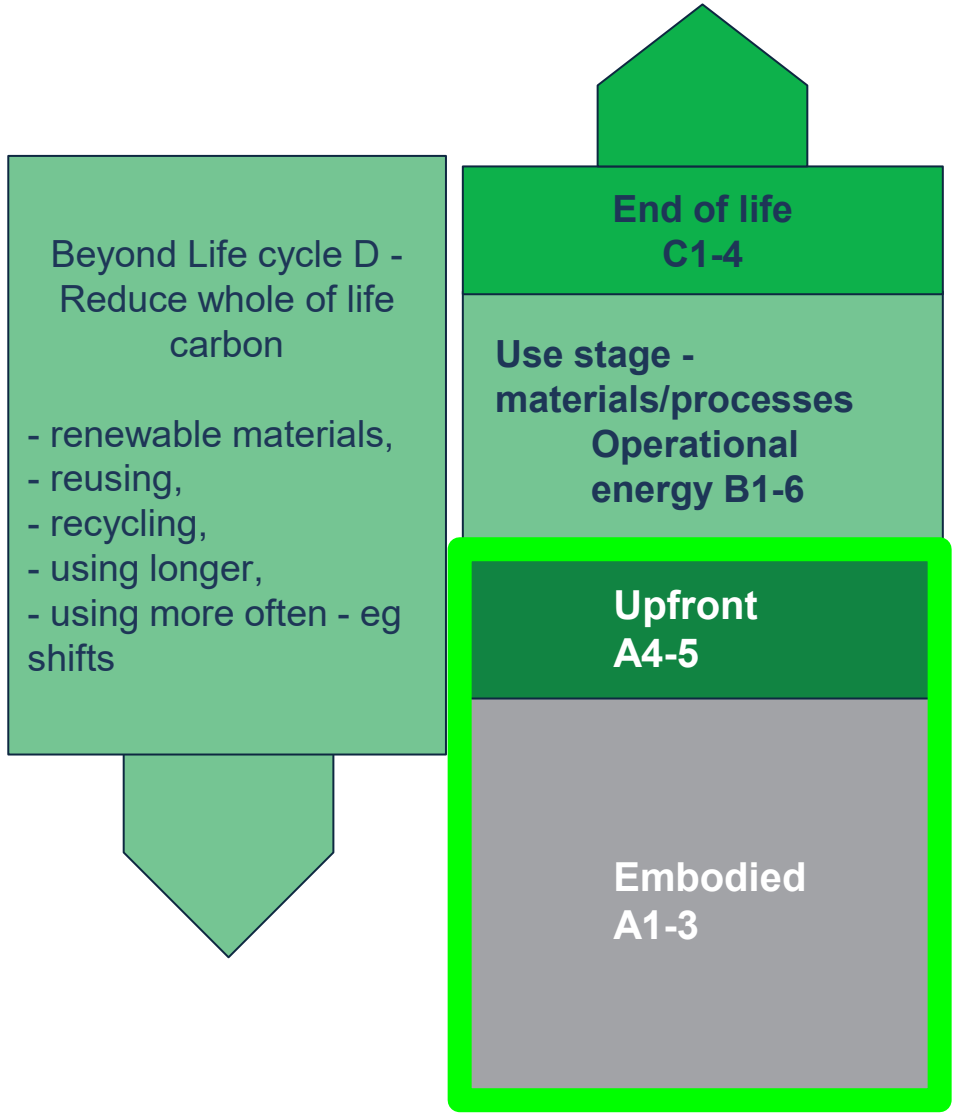
LC STAGES

Common terms useful as you will hear industry clients and regulators use these.

Life cycle carbon common terms:

- Embodied Carbon
- Upfront Carbon
- Use stage Carbon
- End of life Carbon

- Operational Carbon
- Beyond lifecycle



TERMINOLOGY

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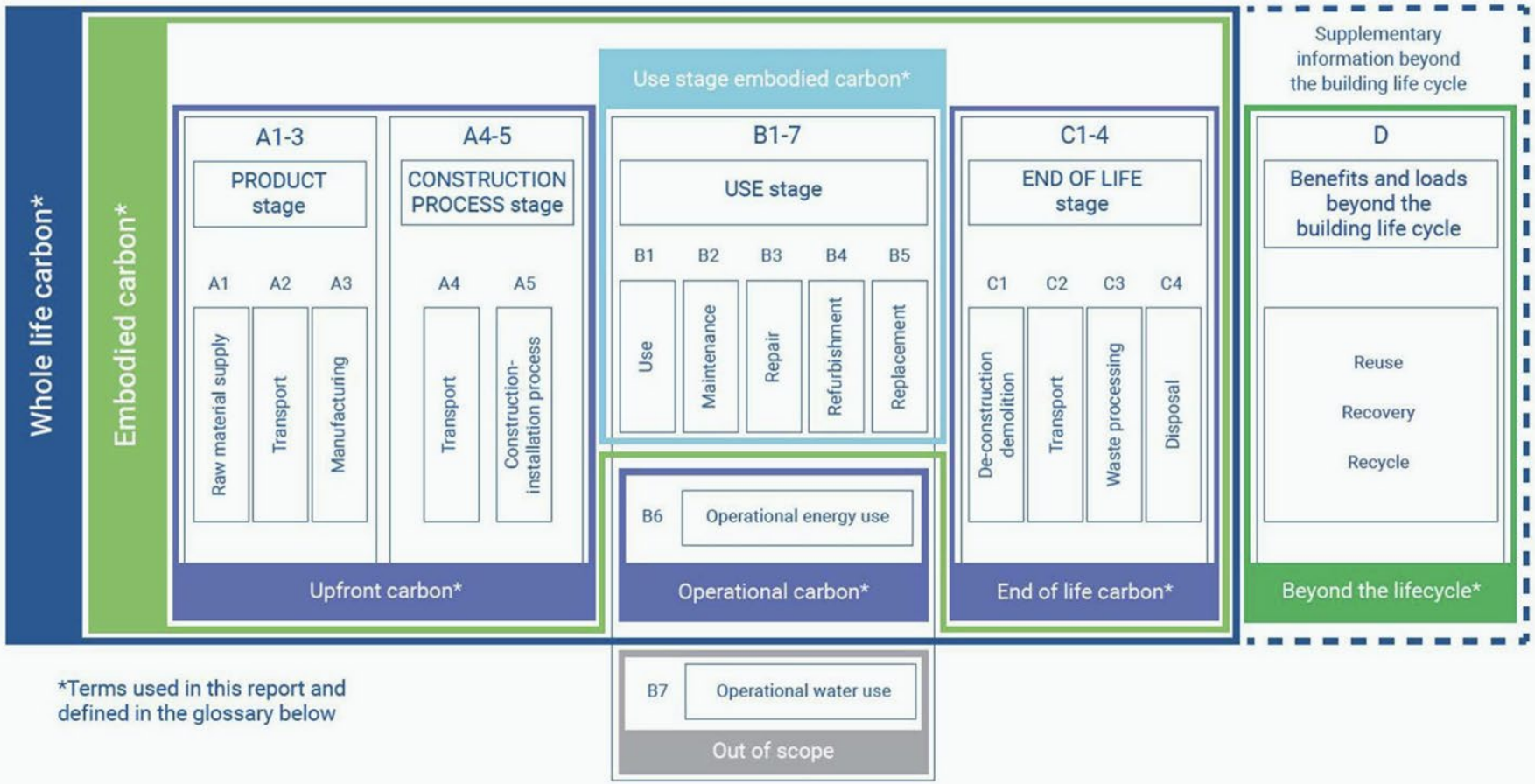

Figure 2. Life cycle stages and modules as defined by EN 15978:2011 (WorldGBC 2019). (Image: WorldGBC)

Image: Embodied carbon in buildings by Philip Oldfield, p3

TERMINOLOGY

Figure 2: Typical breakdown of construction upfront carbon in a new office building[6]

Image bottom: GBCA - A Practical Guide to upfront carbon reductions, page 10.

SCOPE 1 2 3

- Why different scopes
- Why they are important
- How they impact design

Definition (Philip Oldfield page 5)

- Scope 1 - released onsite - e.g. leaked gas & refrigerants
- Scope 2 - released offsite due to use of the building - e.g. burning coal to create electricity to run lights
- Scope 3 - indirect emissions from other sources - e.g. embodied carbon, waste sent to landfill, water treatment emissions, etc.

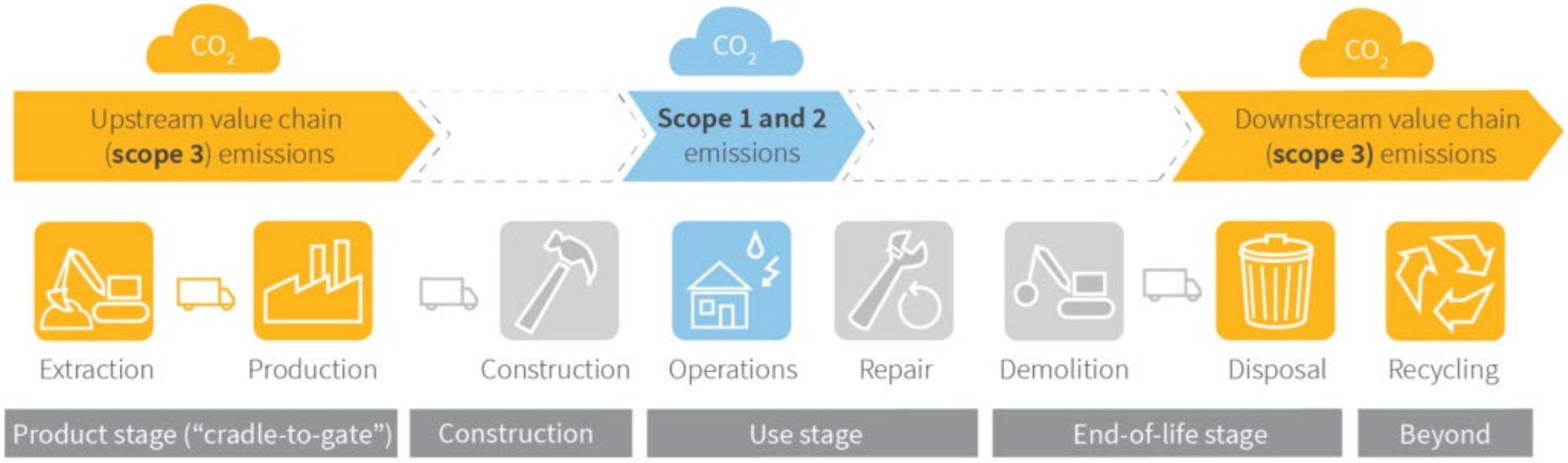

Image: https://carbonleadershipforum.org/targeting-net-zero-embodied-carbon/

How is Embodied carbon Measured

1. Measure the material quantities

- Use the bill of quantities or model take-offs.
- Examples: **m³ of concrete**, **kg of steel**, **m² of façade panels**.
- These represent the *physical amount* of each product used.

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- EFs come from **EPDs**, AusLCI, NABERS, or Green Star databases.
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- On-site energy use, waste, and construction processes.

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5. Express the result per m² GFA

- Industry standard normalisation: kg CO_2-e/m² GFA
- Allows comparison between buildings and benchmarks.

EPD

Environmental Performance Data sheet

Source: international - https://www.environdec.com/library

Australasia - https://epd-australasia.com/

AUSTRALASIA EPD®

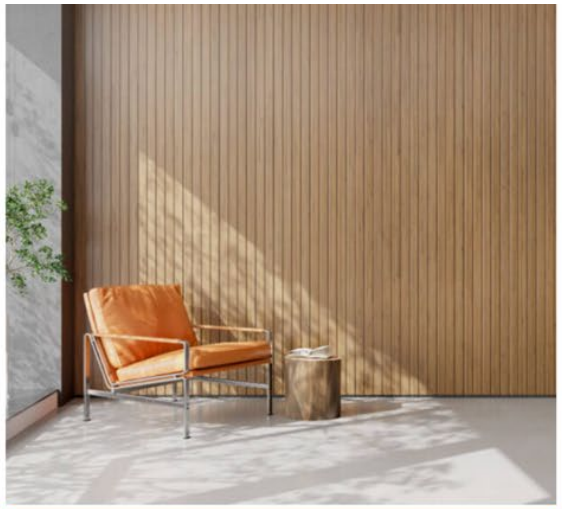
INTERNATIONAL EPD SYSTEM

ABOUT WHAT IS AN EPD? CREATE AN EPD EPD DATABASE CLIMATE DECLARATIONS NEWS & RESOURCES SUPPORT

Strand Woven Bamboo

HOUSE OF BAMBOO

EPD



Laminated Bamboo

HOUSE OF BAMBOO

EPD

Hynds Reinforced Concrete Pipes and Precast Products

HYNDS GROUP

EPD

EPD

Environmental Performance Data sheet

Source: international - https://www.environdec.com/library

Australasia - https://epd-australasia.com/

Table 5: Environmental indicators legend (EN 15804+A2)

Core indicators	Acronym	Unit
Climate change – total	GWP-total	kg CO_2 equivalent
Climate change – fossil	GWP-fossil	kg CO_2 equivalent
Climate change – biogenic	GWP-biogenic	kg CO_2 equivalent
Climate change – land use and land use change	GWP-luluc	kg CO_2 equivalent
Ozone layer depletion	ODP	kg CFC-11 equivalent
Acidification	AP	mol H^+ equivalent
Eutrophication aquatic freshwater	EP-freshwater	kg P equivalent
Eutrophication aquatic marine	EP-marine	kg N equivalent
Eutrophication terrestrial	EP-terrestrial	mol N equivalent
Photochemical ozone formation	POCP	kg NMVOC equivalent
Abiotic depletion potential – minerals and metals[2]	ADP minerals & metals	kg Sb equivalent
Abiotic depletion potential – fossil fuels[2]	ADP fossil	MJ, net calorific value
Water use[2]	WDP	m^3 world equivalent deprived

TOOLS

See also:

Source: AIA-CLF Embodied Carbon Toolkit for Architects - Carbon Leadership Forum

NABERS

- A **national rating tool** that measures and verifies **upfront embodied carbon** for new buildings and major refurbishments.
- Provides a **certified, comparable measure** of carbon intensity across similar building types.
- Uses **material, transport, and construction emissions** to calculate the rating.

A1–A5 life-cycle stages:

- A1 Raw material supply
- A2 Transport
- A3 Manufacturing
- A4 Transport to site
- A5 Construction

Optional whole-of-life calculation available in the calculator (B & C stages), but **only upfront emissions count toward the certified rating**

Main structural materials (concrete, steel, timber).

Major mechanical services and vertical transport.

As-built quantities

Emissions data:

- Prefer product-specific EPDs.
- Otherwise use NABERS national emissions factors database.

TOOLS

See also: https://www.nabers.gov.au/ratings/our-ratings/nabers-embodied-carbon

NABERS - how the rating works

Input material quantities + emissions factors.

Tool calculates **kg CO_2-e/m² GFA** for upfront embodied carbon.

Where benchmarking exists, a **1–6 Star rating** is issued:

- 3 Stars = Market average
- 4 Stars = High performance
- 5 Stars = Superior
- 6 Stars = Market leading

Key design levers

- **Material substitution** (low-carbon concrete, recycled steel, mass timber).
- **Structural efficiency** (span optimisation, modularity).
- **Reduced finishes** and **smarter façade systems**.
- **Transport & construction impacts** (local sourcing, prefabrication).

TOOLS

See also:
- GBCA upfront carbon calculator guide
https://www.gbca.org.au/get/resources/2156/794DF066980741905C78C3EE5A89D0C3

Source: AIA-CLF Embodied Carbon Toolkit for Architects - Carbon Leadership Forum

GBCA

Green Star's whole-of-life carbon framework sits across two major credit families in Green Star Buildings v1 / v1.1:

- (1) Upfront Carbon and (2) Life Cycle Impacts.
- These credits together address embodied, (3) operational, and end-of-life emissions across the building's full life cycle.

1. Upfront Carbon

Covers **cradle-to-practical-completion** embodied emissions.

- Requires a **minimum 10% reduction** in upfront carbon for certification.
- **20% and 40% reductions** earn additional points (3 and 6 points respectively).
- Focuses on materials, manufacturing, transport, and construction emissions.

2. LCA

A full Life Cycle Assessment (LCA) credit addressing impacts across all life-cycle stages (A1–C4, and sometimes D).

Awards points for demonstrating reduced whole-of-life environmental impacts.

Includes embodied carbon, operational ener*gy, water, and other impact* ***categories.***

TERMINOLOGY

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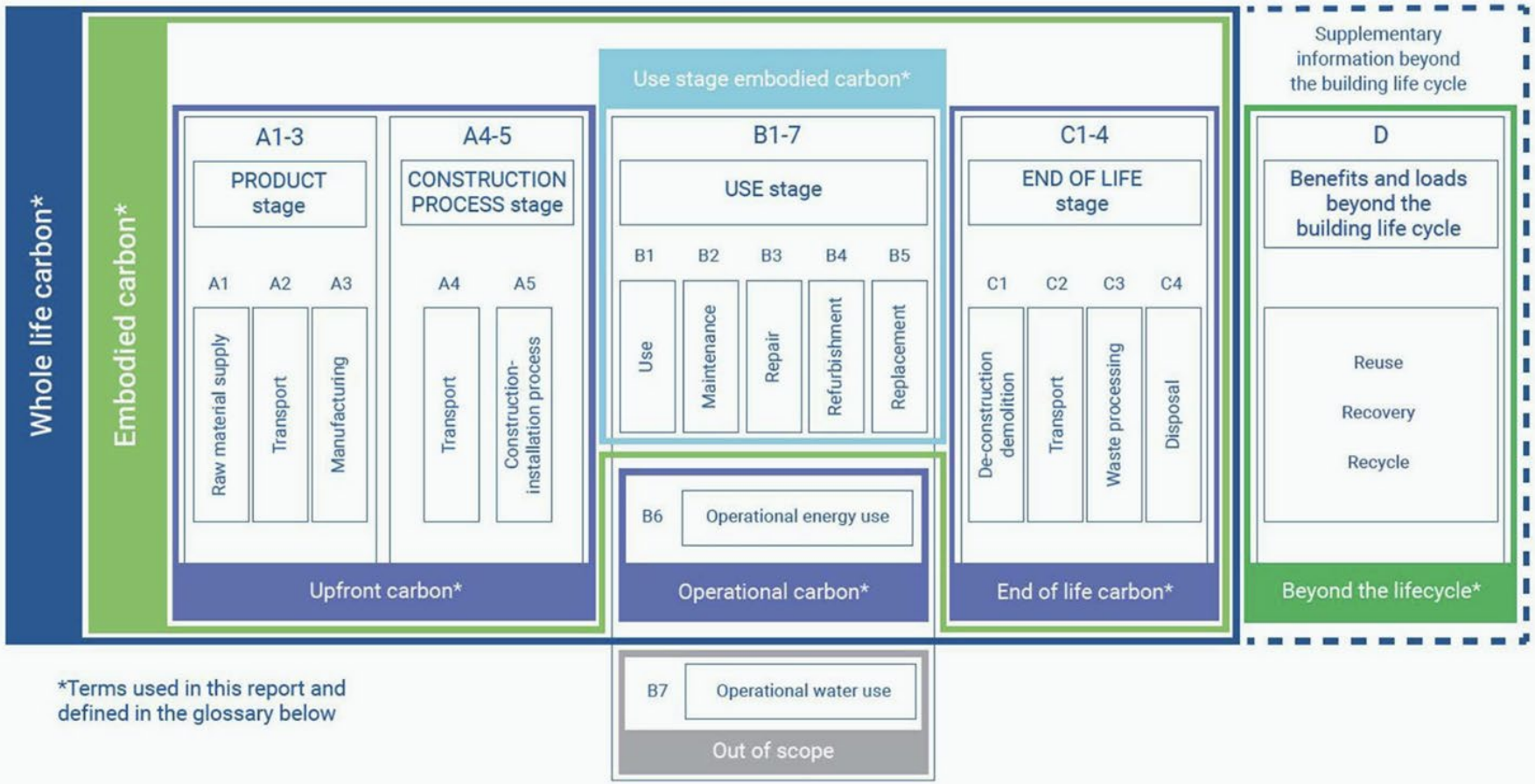

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GBCA

Credit / Pathway	Life-cycle stage	What it covers
Upfront Carbon	A1–A5	Materials, manufacturing, transport, construction emissions
Life Cycle Impacts	A1–C4 (+D)	Full LCA: embodied + operational + end-of-life
Climate Positive Pathway	B6	Operational energy emissions
Carbon Neutral Pathways	A1–A5 or B6	Optional certification for upfront or operational neutrality

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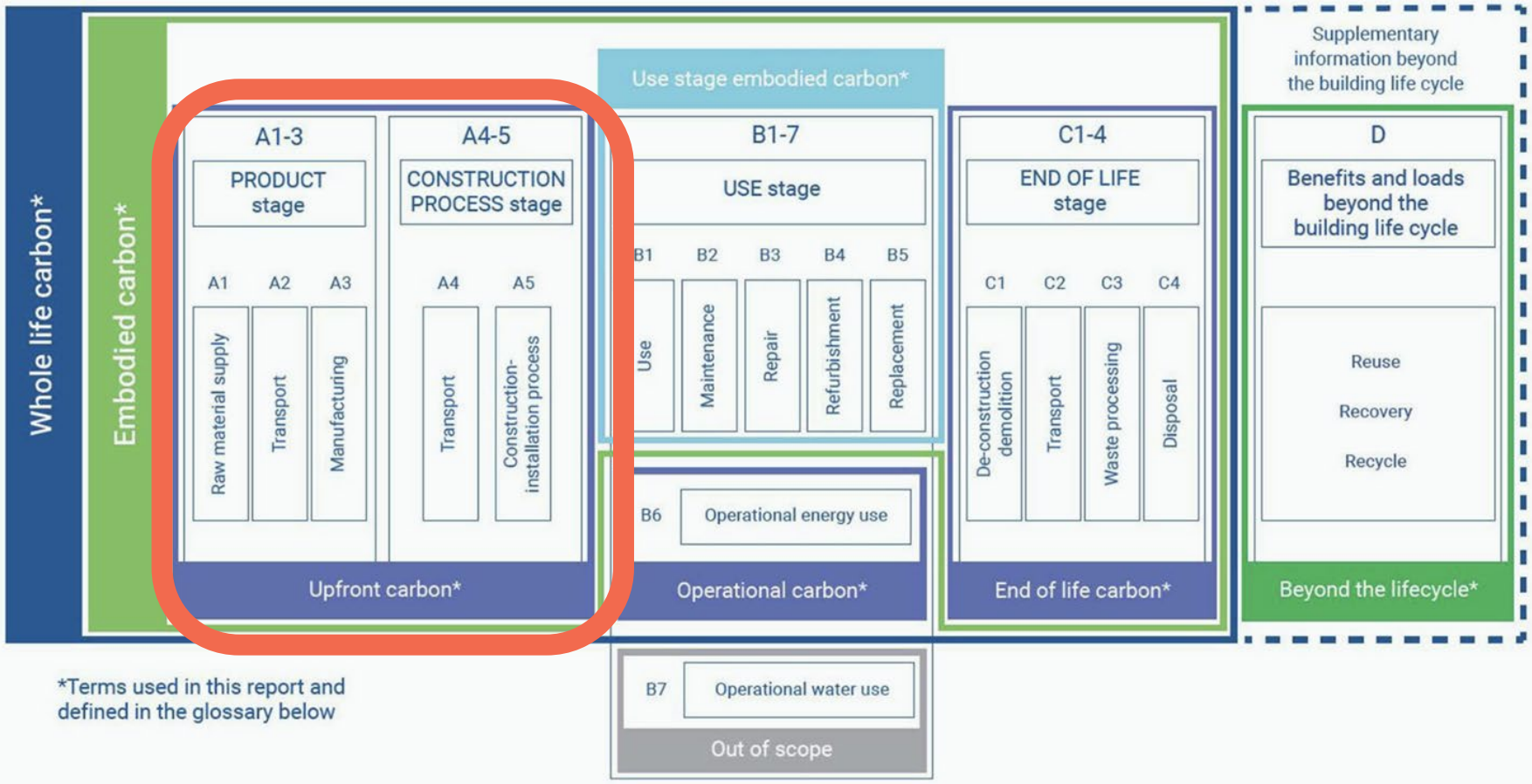

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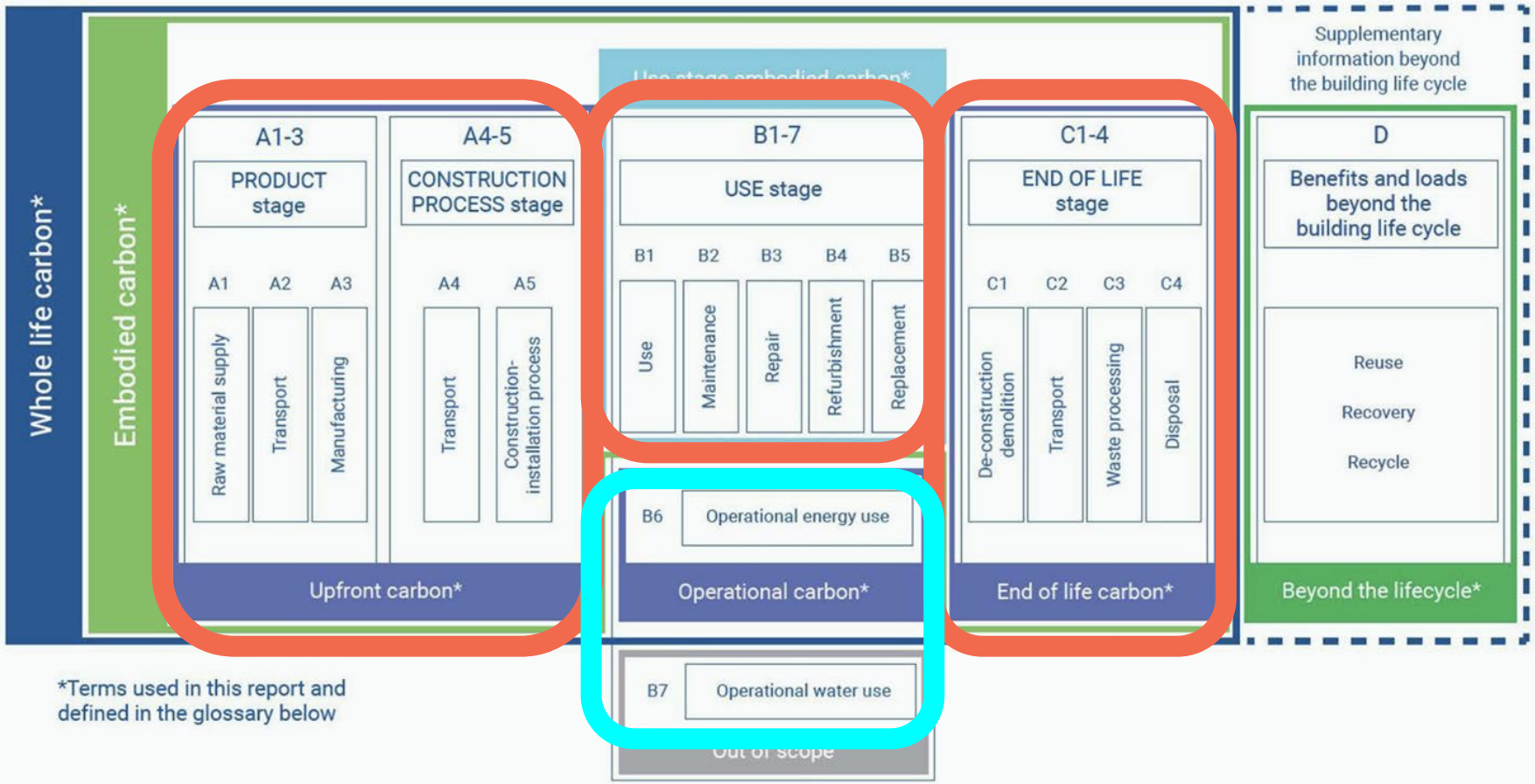

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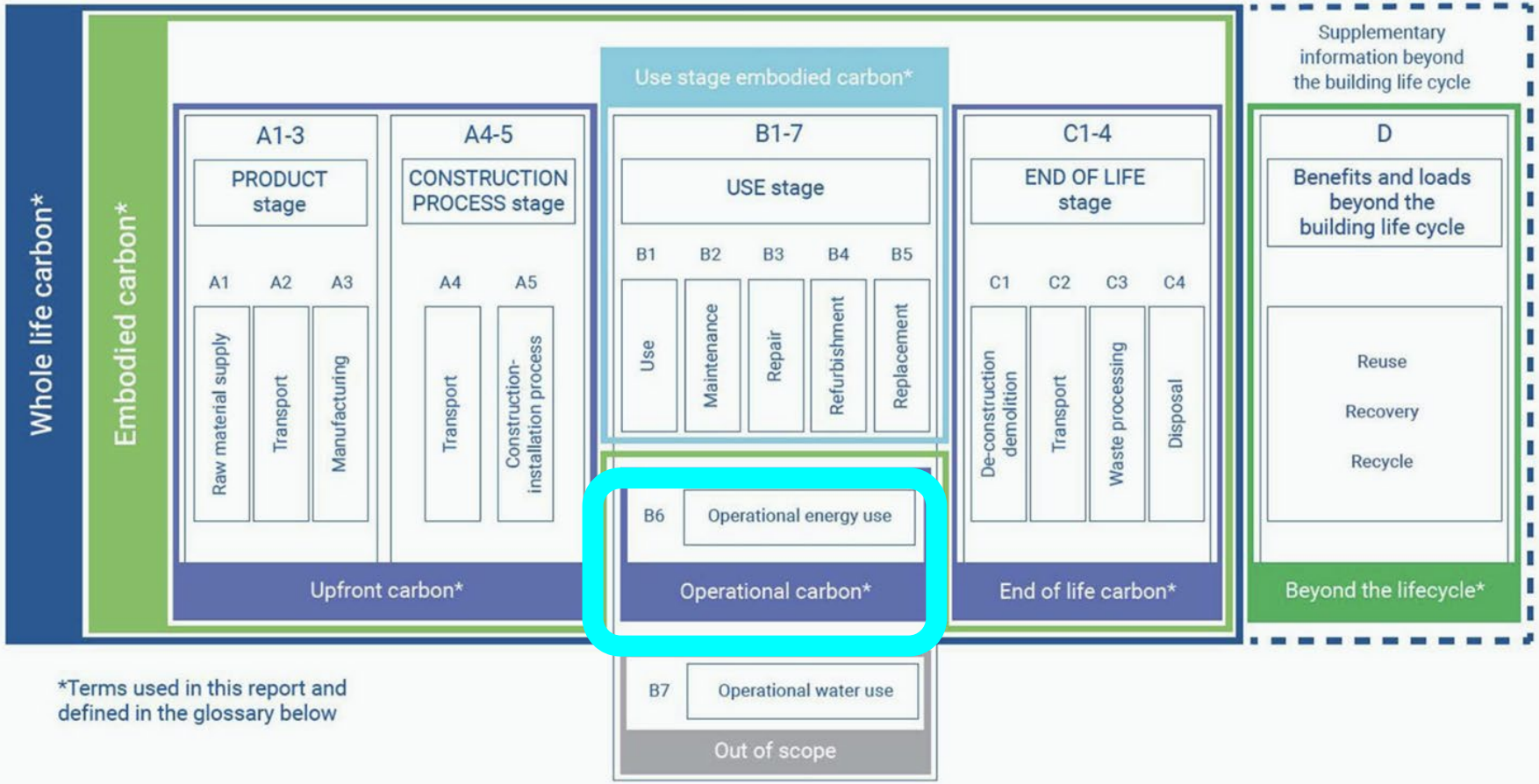

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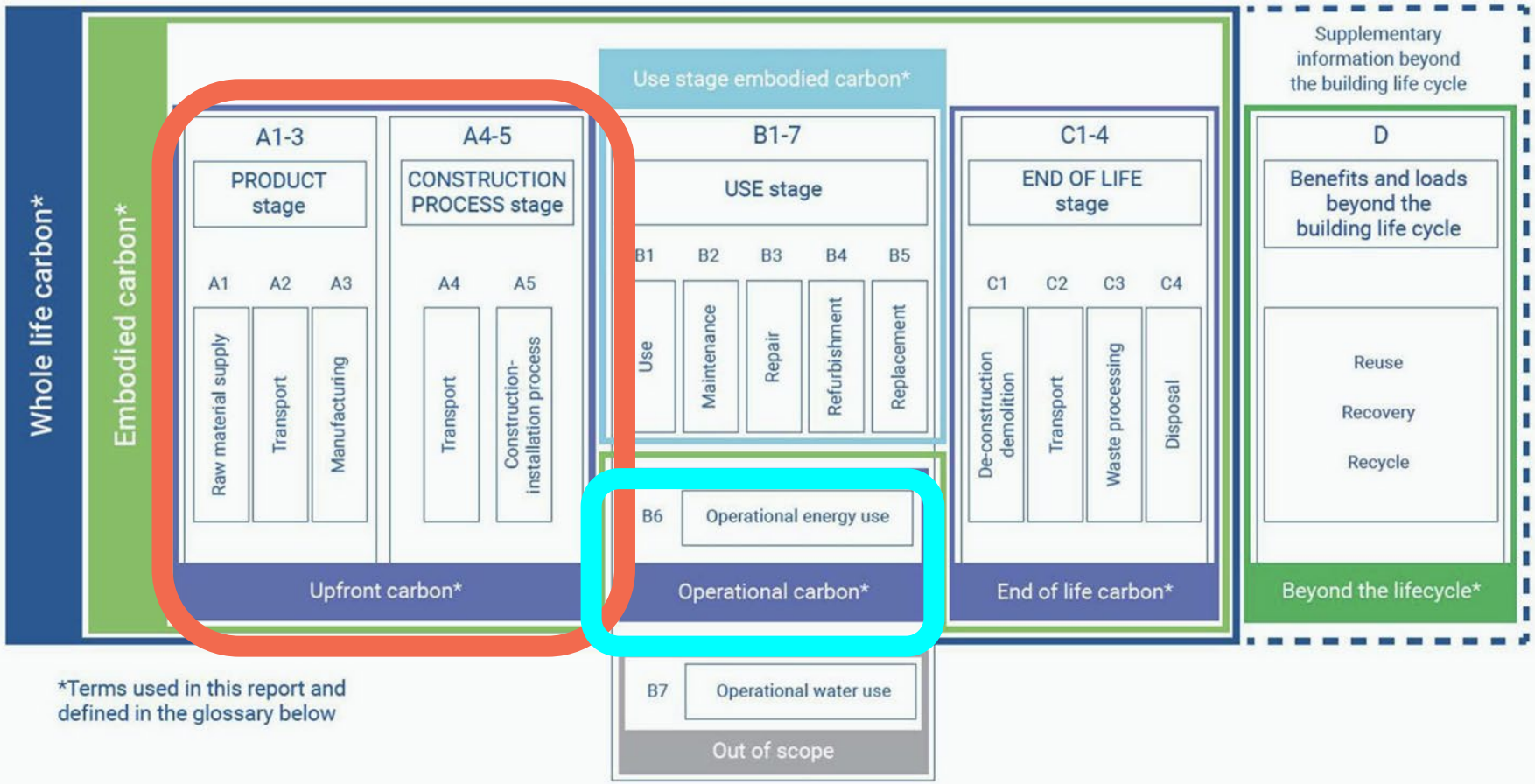

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TOOLS

See also:
- Philip Oldfield page 8

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Source: AIA-CLF Embodied Carbon Toolkit for Architects - Carbon Leadership Forum

Common tools used in Australia

Design tools:

- eTool + RapidLCA
- Fitzpatrick and Partner's Embodied Carbon Calculator App
- OneClick
- Tally (now tallyLCA)
- The Footprint Calculator
- Carbon trace

Data tools - EPD and other LCA/DATA tools:

- GaBi
- SimaPro
- EPIC
- OneClick LCA Planetary
- EC3

- NABERS

RESOURCES

RESOURCES PROVIDED

1. The Embodied Carbon Toolkit
2. The Embodied Carbon Roadmap
3. Recordings of modules
4. Online Outline of Curriculum and self paced run-sheet
5. Online Activity Sheets
6. Online Quizzes
7. Acronyms and Terminology

https://www.architecture.com.au/embodied-carbon-curriculum

NB set to change

The latest on whole of life carbon

Prof Phil Oldfield

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How low can we go?

What's the lowest embodied carbon office we can build?

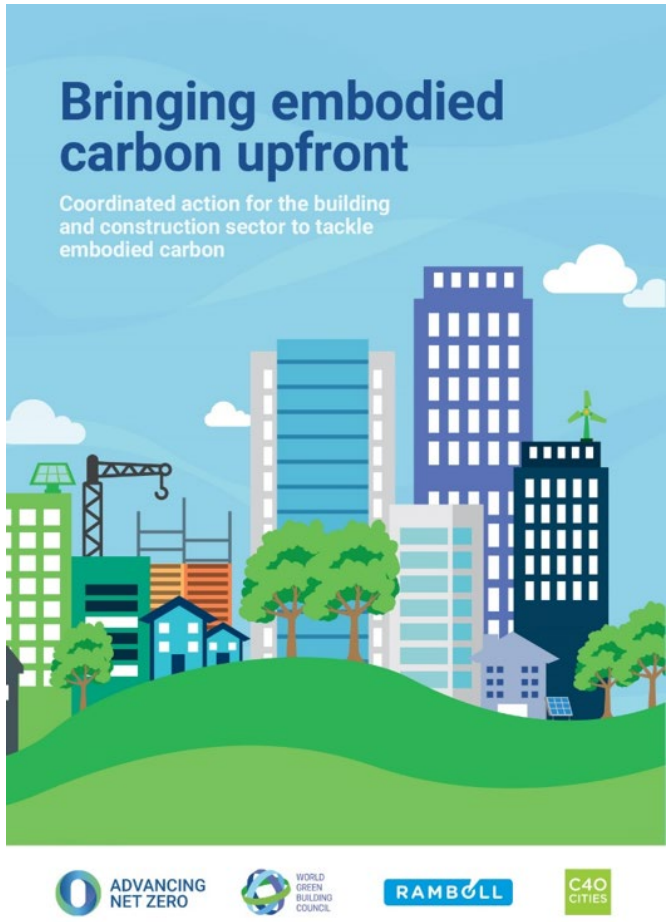
Research team

William Craft, *UNSW*
Philip Oldfield, *UNSW*
Gerard Reinmuth, *Terroir / UTS*
Damien Hadley, *Cantilever*
Scott Balmforth, *Terroir*
Anh Nguyen, *Terroir*

UNSW SYDNEY
UTS
TERROIR
Australian Government | Business
business.gov.au

How low can we go?

Global targets



2030 Targets

- All new buildings, must be net zero operational carbon
- All new buildings, infrastructure and renovations will have at least 40% less embodied carbon

2050 Targets

- All new and existing buildings must be net zero operational carbon
- All new buildings, infrastructure and renovations will have net zero embodied carbon

Source: https://worldgbc.org/advancing-net-zero/whole-life-carbon-vision/

1. What magnitude of embodied carbon reductions is possible for an office building in Australia and what materials and systems influence this? **[PC10, PC31, PC53]**

2. How can embodied carbon methodologies and data sources influence the measurement and scale of these reductions? [**PC45, PC60]**

3. What is net zero embodied or whole of life carbon? Can it be achieved today? **[PC35]**

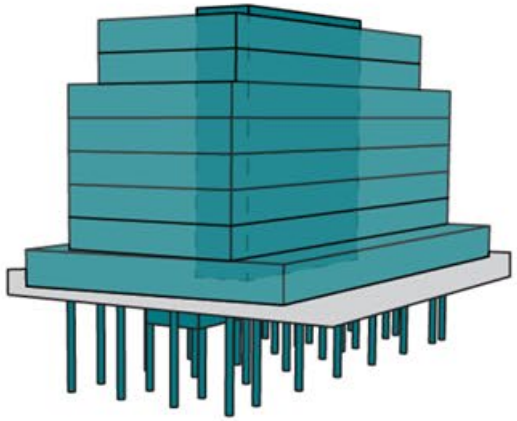
Concrete

Engineered Timber

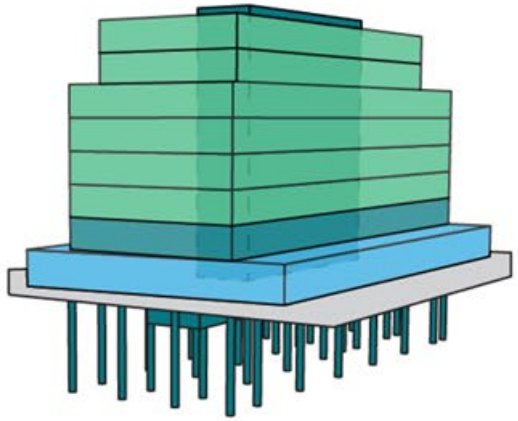
Lightweight Timber Frame

Adaptive Reuse

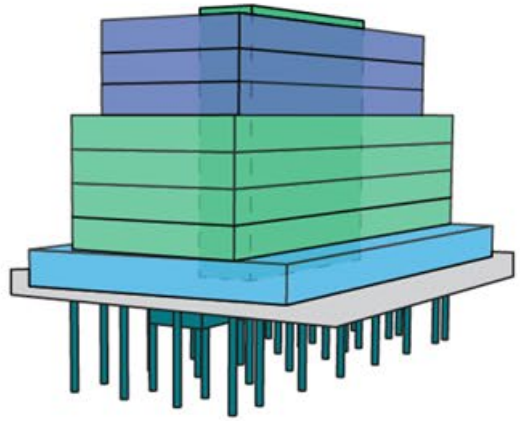
TY



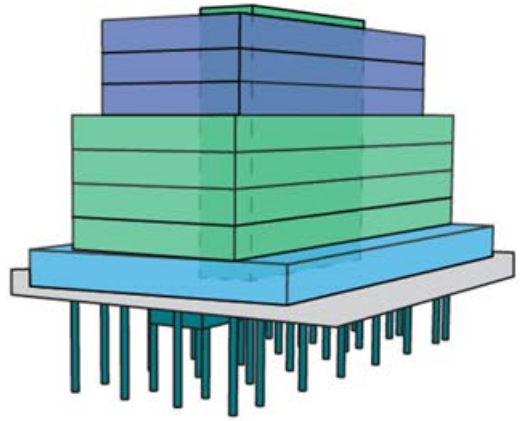
BP



ST / ST-R

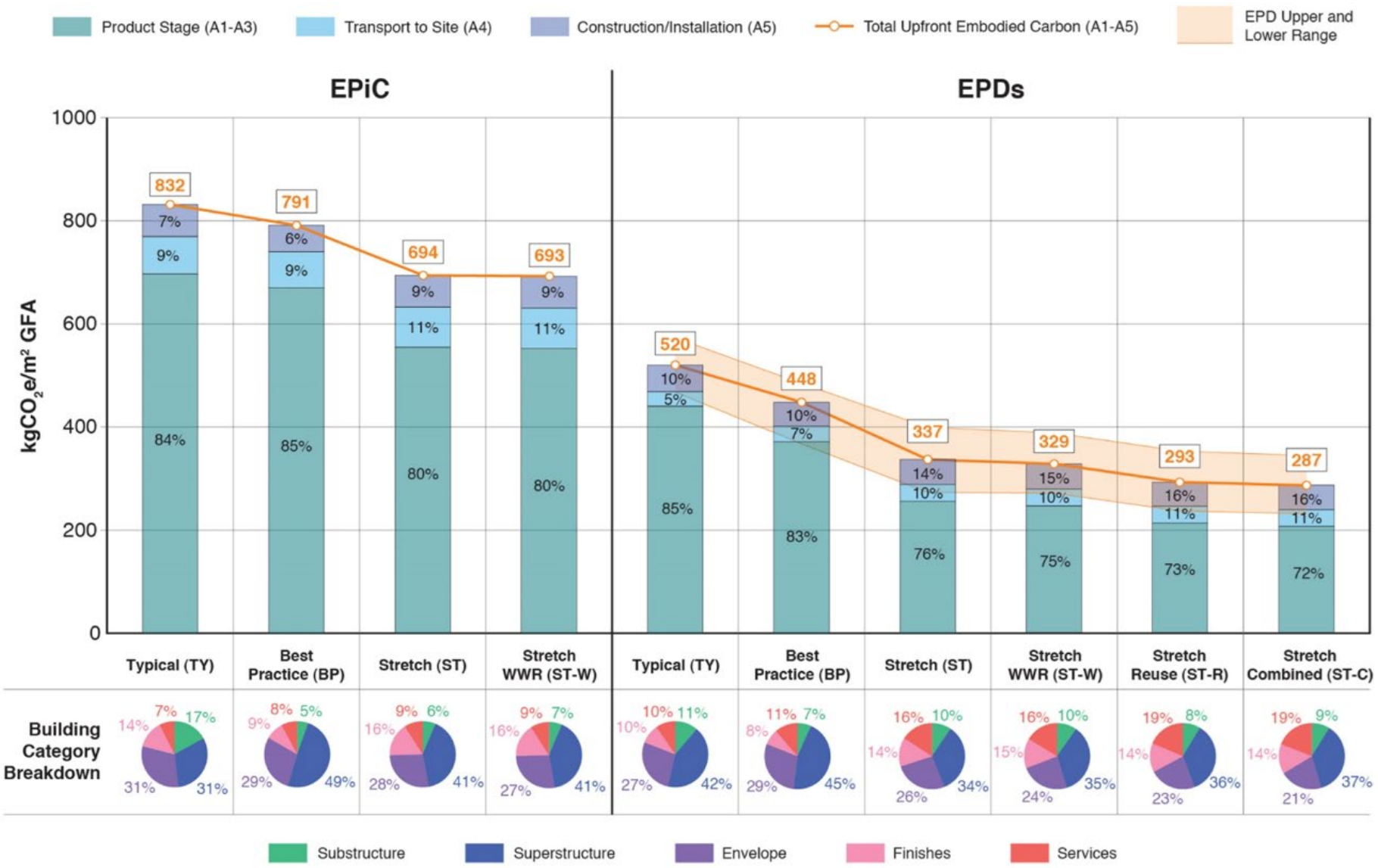


ST-W / ST-C



How low can we go?

Upfront embodied emissions (A1-A5)



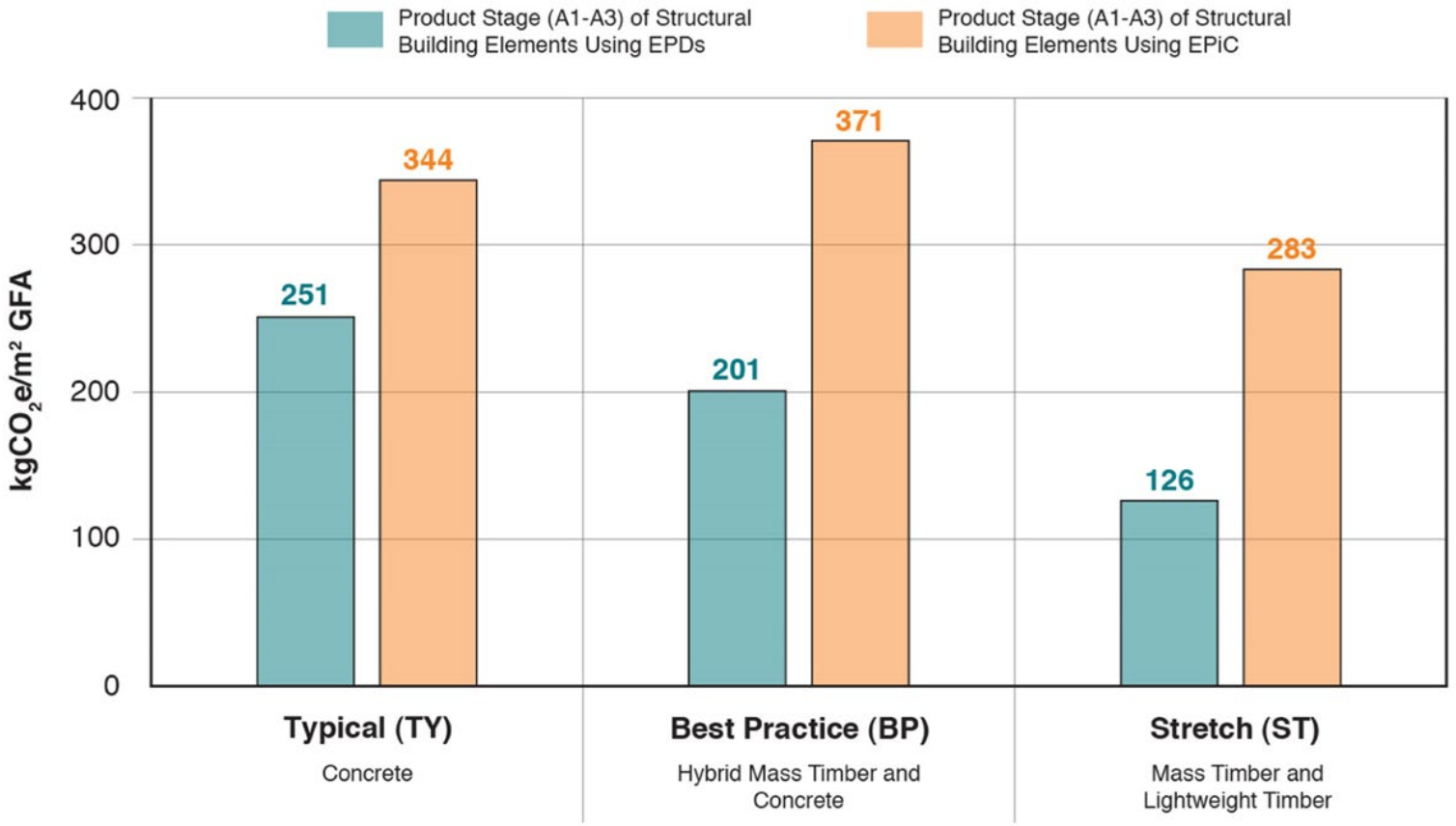
Upfront results using EPiC were 60-111% higher as compared to EPDs

Using EPiC data, a 17% embodied carbon saving was possible

Using EPDs, a 45% embodied saving was possible

How low can we go?

The impact of different data sources on embodied carbon outcomes



A concrete structure is better using EPiC, but a timber structure is better using EPDs!

The example of glulam

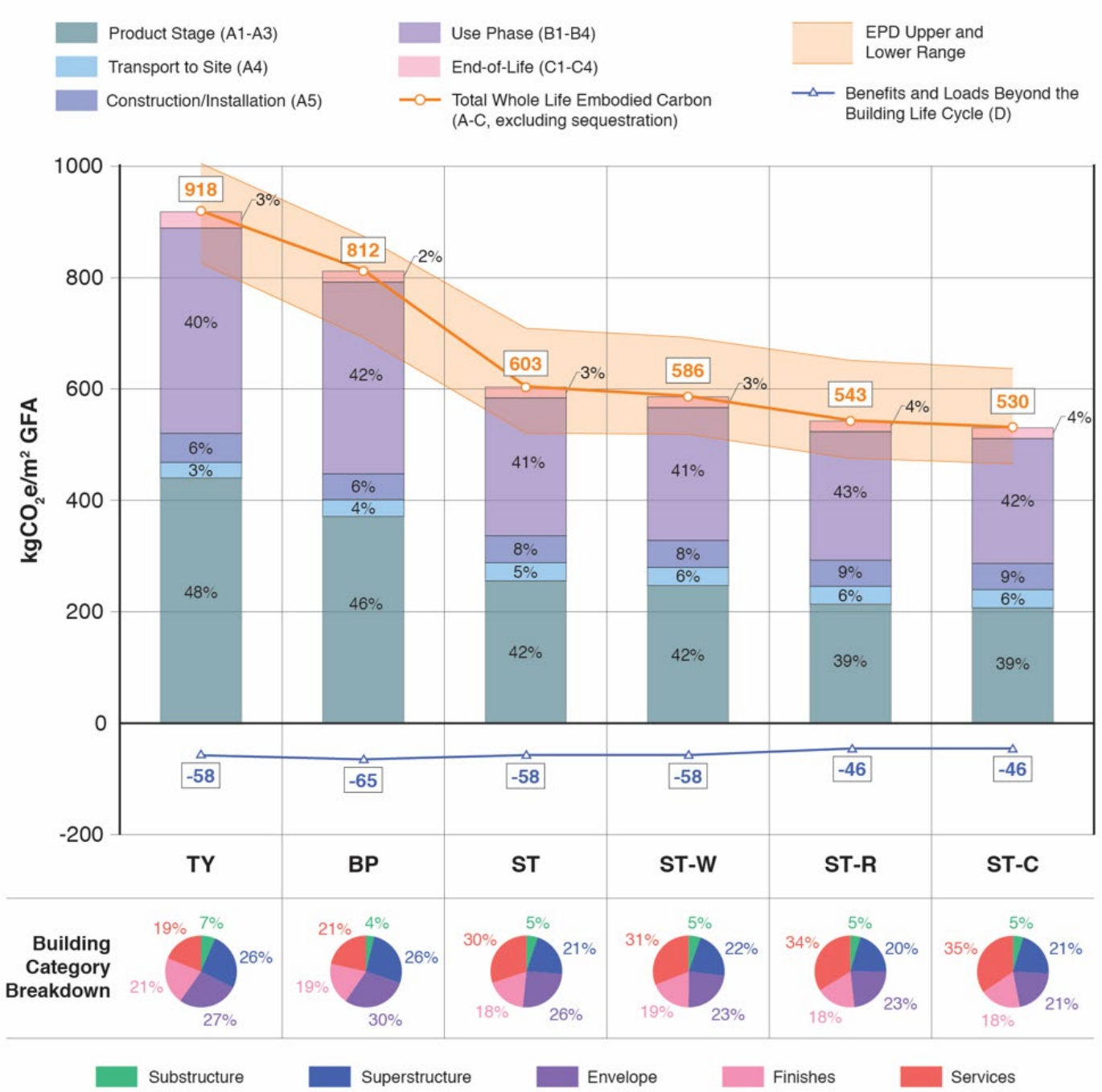
- 1,718 $kgCO_2e/m^3$ in EPiC
- 200–400 $kgCO_2e/m^3$ in EPDs

How low can we go?

Whole of life embodied emissions (A-D)

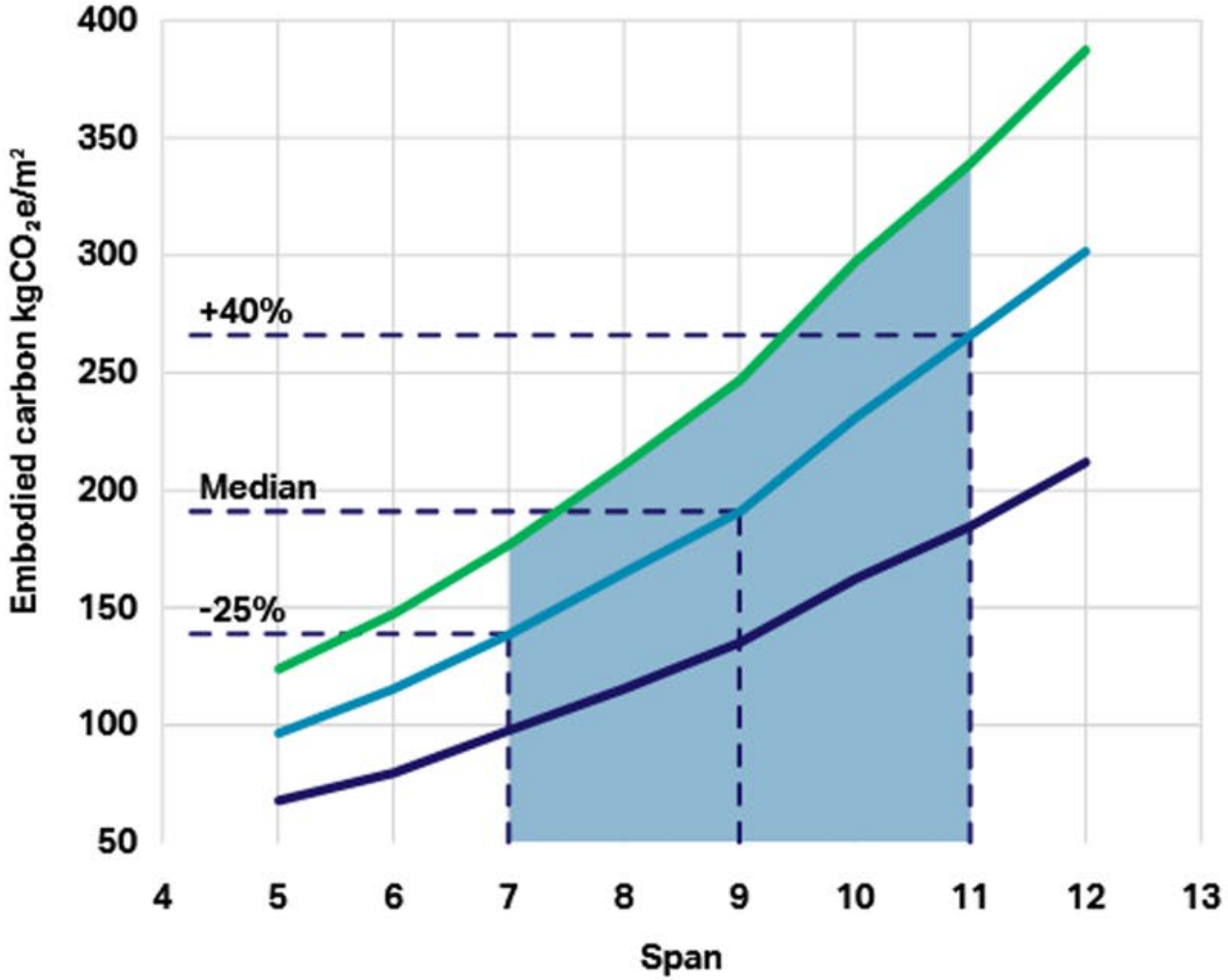
- It is possible to reduce whole of life embodied carbon by up to 45%

- Switching to timber *and* reducing the column grid is highly effective (from 6 x 9 to 3.6 x 6)



How low can we go?

Impact of span on structural embodied carbon



World values

General values

Low carbon values

Carbon factor ($kgCO_2e/kg$)	Concrete	Steel reinforced
World values	0.19	1.95
General values	0.15	1.5
Low carbon values	0.12	0.76

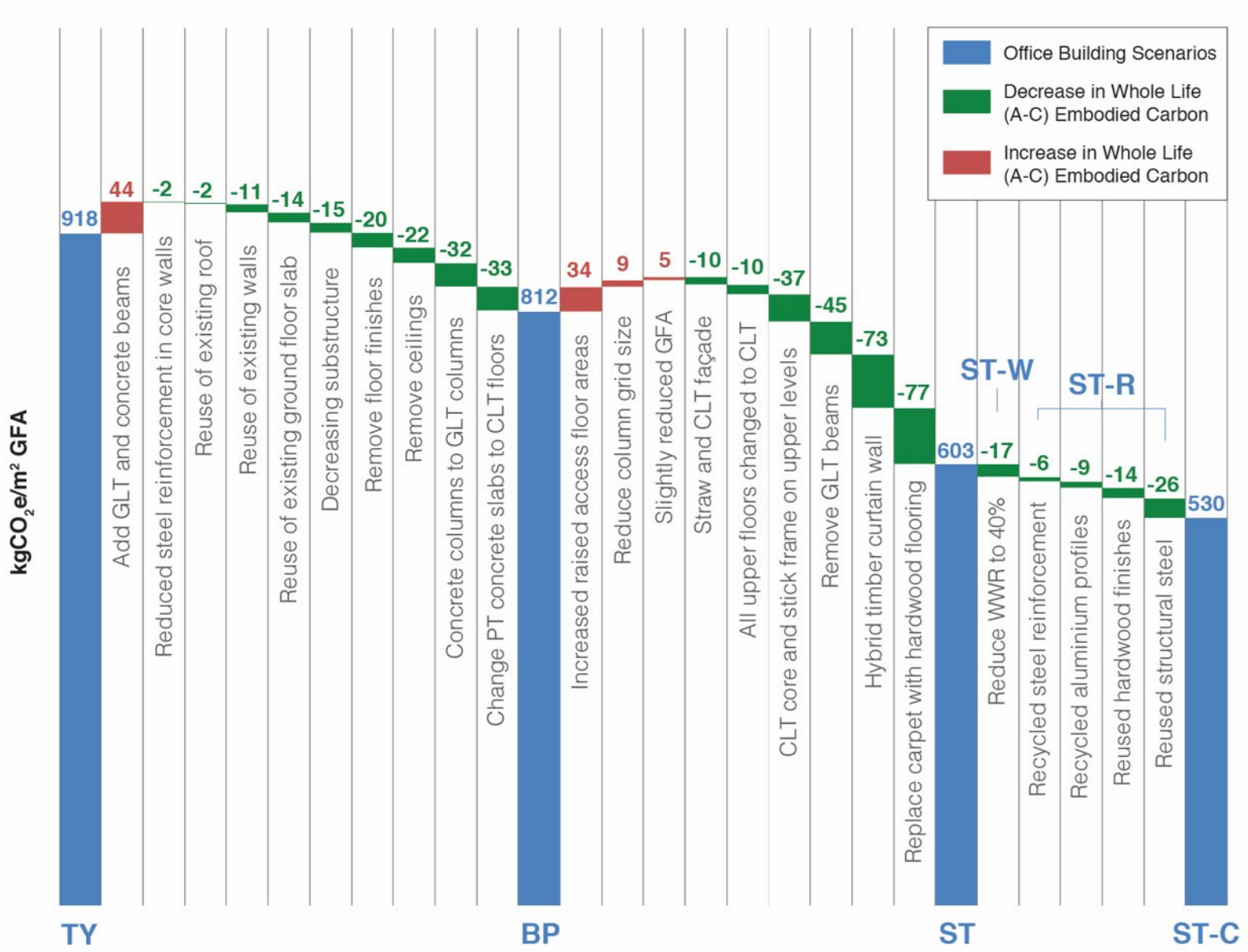
Source: WBCSD & Arup (2023). Net-zero buildings: Halving Construction Emissions Today

How low can we go?

Most effective strategy is removing the carpet – think recurring embodied carbon!

Second most effective strategy is switching to hybrid timber curtain wall

Third most effective strategy is switching to timber and reducing column span

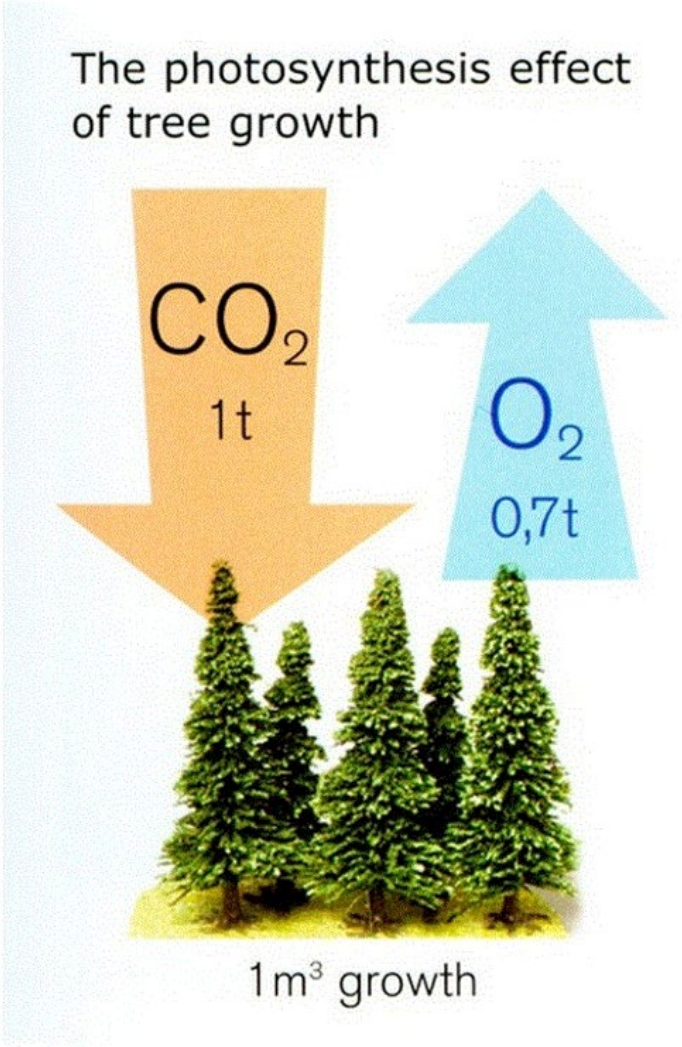


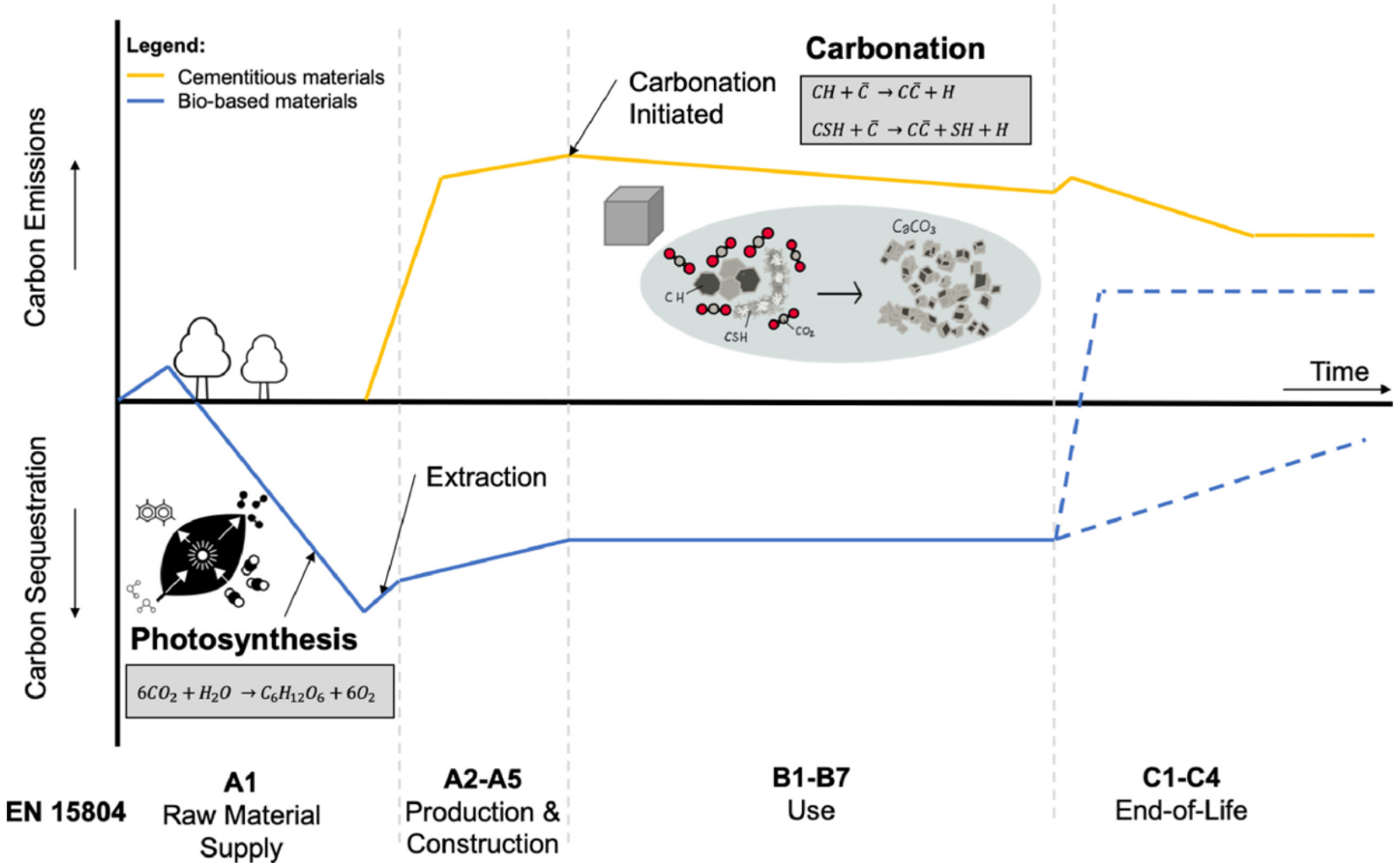
How low can we go?

Can we get down to net zero embodied carbon?

How low can we go?

Can we get down to net zero embodied carbon?





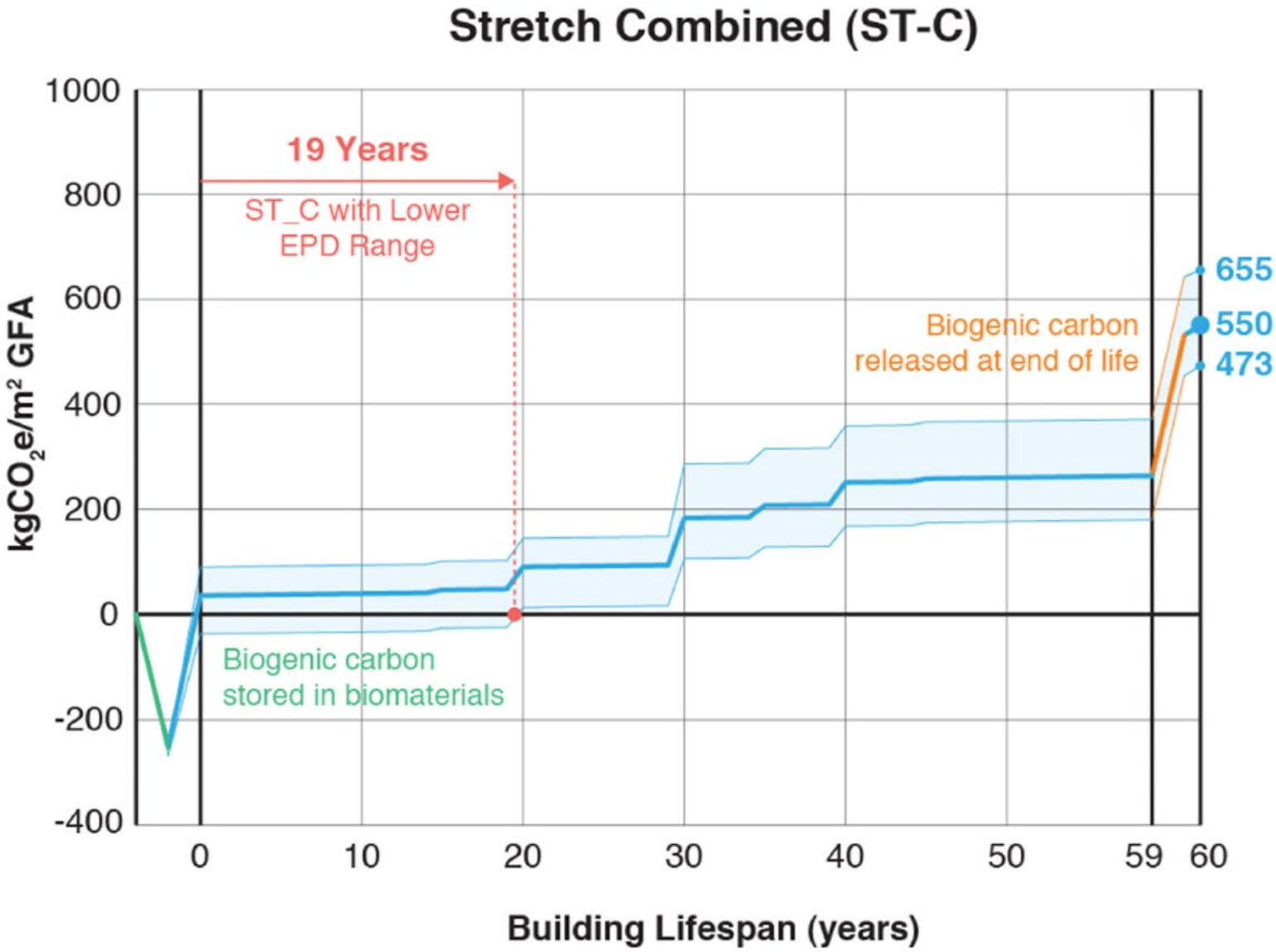
Source: Arehart *et al.* (2021). Carbon sequestration and storage in the built environment, *Sustainable Production and Consumption,* pp. 1047-1063

How low can we go?

Can we get down to net zero embodied carbon?

It's possible to achieve **temporal net zero embodied carbon** for up to 19 years using "creative accounting"

But can lead to **perverse outcomes** – increasing CLT thickness from 250mm to 500mm increases A1-A5 upfront emissions, but would expand temporal net zero carbon for 39 years.



1. Large reductions of embodied carbon are possible… but *just* switching to ‘low-carbon’ materials alone can have a modest impact

1. Modelling challenges occur around appropriate data sources, measuring the future decarbonisation of materials and how to factor in carbon storage

1. ‘Temporal net zero embodied carbon’ is possible… but relies on creative carbon accounting (not always good!)

National Standard of Competency for Architects

environmental sustainability, life cycle assessment and whole life carbon performance criteria

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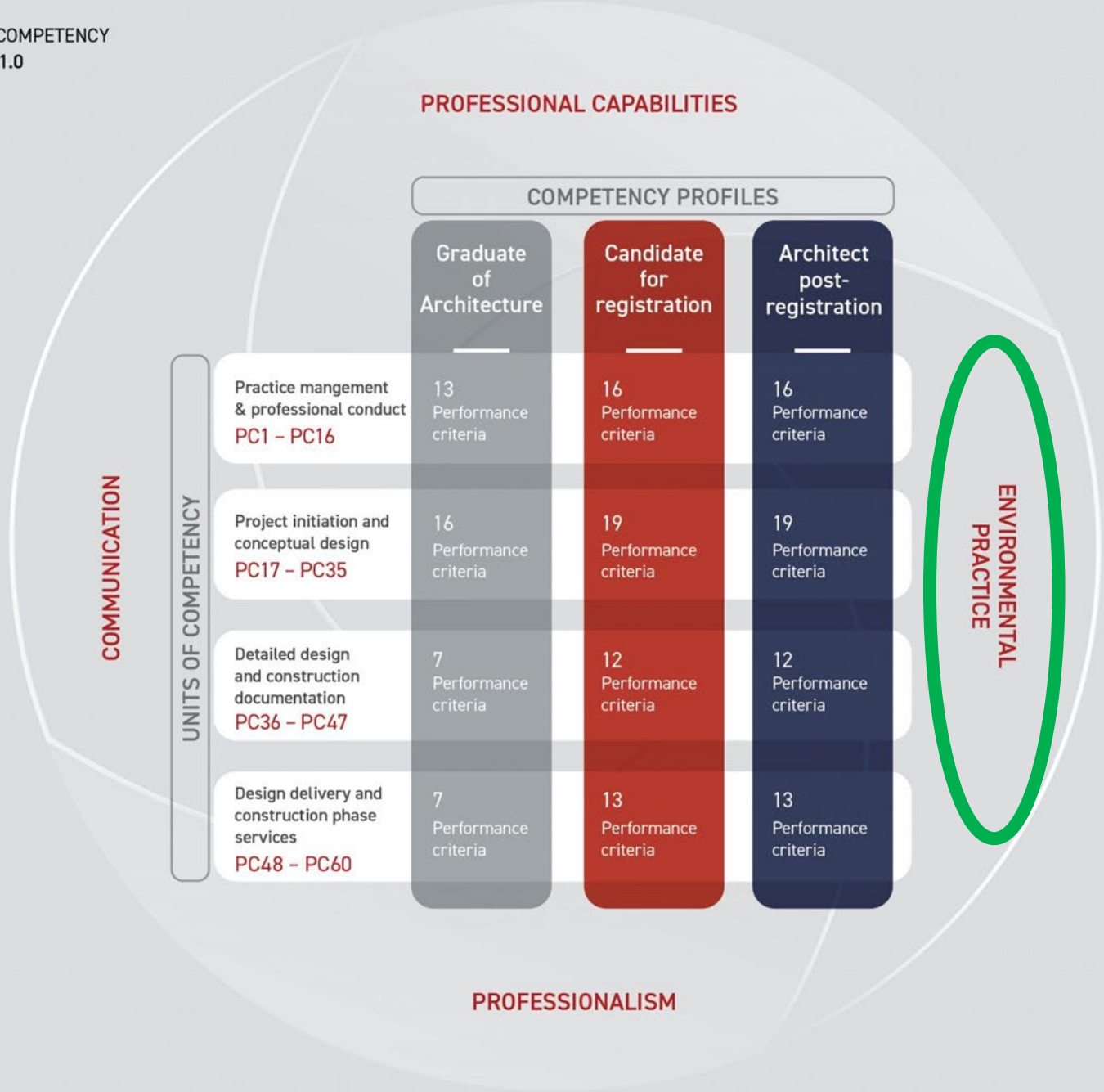

PROFESSIONAL CAPABILITIES
COMPETENCY PROFILES
Graduate of Architecture
Candidate for registration
Architect post-registration
UNITS OF COMPETENCY
Practice mangement & professional conduct
PC1 – PC16
13 Performance criteria
16 Performance criteria
16 Performance criteria
Project initiation and conceptual design
PC17 – PC35
16 Performance criteria
19 Performance criteria
19 Performance criteria
Detailed design and construction documentation
PC36 – PC47
7 Performance criteria
12 Performance criteria
12 Performance criteria
Design delivery and construction phase services
PC48 – PC60
7 Performance criteria
13 Performance criteria
13 Performance criteria
COMMUNICATION
ENVIRONMENTAL PRACTICE
PROFESSIONALISM

ENVIRONMENTAL PRACTICE

Environmental practice capabilities encompass a holistic approach to creating and caring for living environments. This includes the ability to understand, analyse and assess the impacts of design decisions and delivery processes on the natural and built environment, to care for Country and community, to minimise carbon impact, and to support the transition to a carbon-neutral built environment.

This includes

- Minimising the impact on, and use of, limited natural resources, recognising their inherent value, and prioritising design for a circular economy and longevity.
- Demonstrating an ethical, service-oriented commitment to the responsible care for Country, the environment and regenerative design.
- Promoting health, integrating accessibility for all, and respecting the diversity of culture, gender and experience in our communities.
- Understanding and integrating relevant design principles and technological applications to support the transition to a carbon-neutral built environment.

Minimise carbon impact

Carbon neutral

Holistic

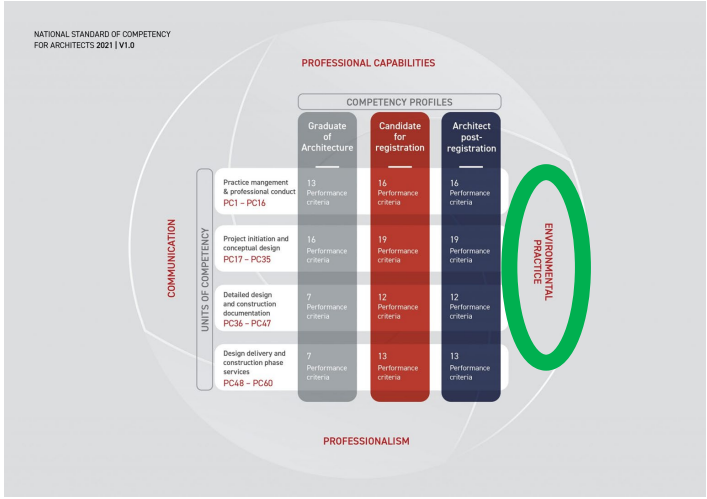
Understand and analyse impacts

Resources – circular and longevity

Env Sustainability

The NSCA frames sustainability as a **core ethical** and professional responsibility of architects, tied to custodianship of Country and the transition to a carbon-neutral built environment.

Foundational in all aspects



Environmental Practice

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Lifecycle Carbon– PC31

Understand the full whole of life impact of your building, not just carbon.

PC 31	Be able to identify, analyse and integrate information relevant to environmental sustainability – such as energy and water consumption, resources depletion, waste, embodied carbon and carbon emissions – over the lifecycle of a project.

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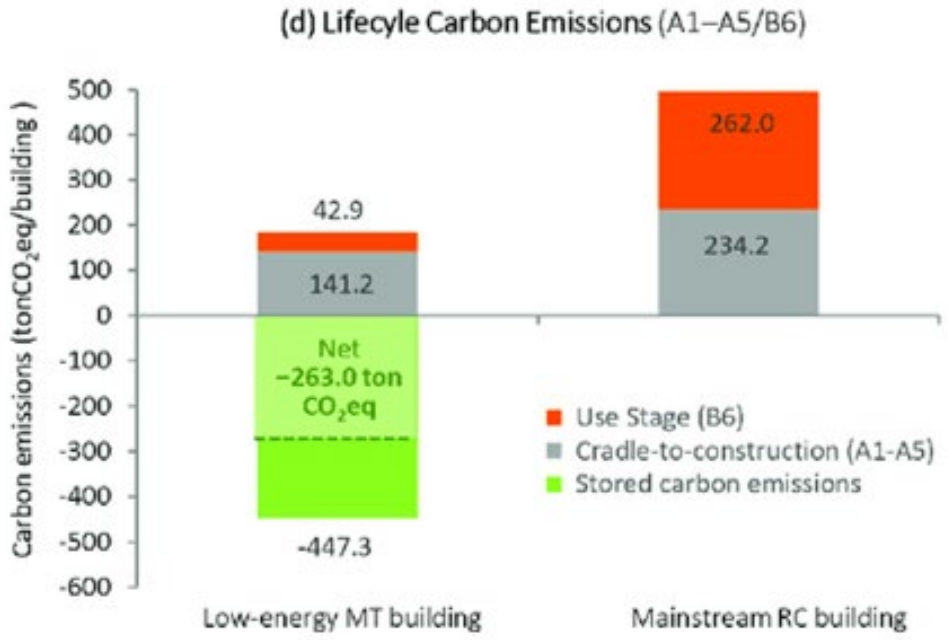
Lifecycle Carbon– PC31

Understand the full whole of life impact of your building, not just carbon.

Simple materials that are recyclable or reusable

Reduced material pallet

Use bio-based materials that actually sequester carbon – biogenic carbon



Whole of life Carbon – PC35

Understand the full whole of life impact of your building, not just carbon.

PC 35	Understand the operational and embodied carbon implications of chosen materials, components and systems.	Be able to assess operational and embodied carbon implications of materials, components, construction systems and supply chains (including transport) to achieve net zero whole life carbon when developing design concepts. This includes integrating relevant consultant expertise and advising on the impact of chosen materials, components and systems on carbon outcomes.

Understand the operational and embodied carbon implications of chosen materials, components and systems.

EPD is your friend

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Do the AIA course

EPD is your friend

Understand the terminology

Understand the tools

Build trusted partnership and understandings with consultants

Whole of life Carbon – PC35

Understand the full whole of life impact of your building, not just carbon.

Use an ideation or analysis tool to understanding the implications of design decision on whole of life.

Best whole of life impact, while providing the aesthetic, comfort, function and longevity outcomes.

Life Cycle Assessment and Carbon – PC 45

Understand the full whole of life impact of your building, not just carbon.

PC 45	Understand processes for selecting materials, finishes, fittings, components and systems, based on consideration of quality and performance standards, the impact on Country and the environment, and the whole life carbon impact of the project.	Be able to nominate and integrate quality and performance standards with regard to selected materials, finishes, fittings, components and systems, considering the impact on Country and the environment, and the whole life carbon impact of the project. This includes integrating life cycle assessments and other expertise and advice from consultants.

EPD is your friend

Red list / Declare products

Natural / bio based products

Life cycle assessment gives you all impact not just carbon, work with your supplier of LCA to understand what you need to know – eutrophication maybe not, but toxicity probably yes.

Life Cycle Assessment PC 53

Understand the full whole of life impact of your building, not just carbon.

	of differing contractual relationships.
PC 53	Be able to provide advice to clients on the impact of a selected procurement method on cost, time, life cycle implications and quality control during the construction phase.

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Life Cycle Assessment PC 53

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PC 53	Be able to provide advice to clients on the impact of a selected procurement method on cost, time, life cycle implications and quality control during the construction phase.

When what you specified gets costed out ensure there is a trail of justification and implications to operational, quality and longevity performance.

Different delivery methods and construction methods will have different quality and operational implications.
Integrate life cycle costing with life cycle impacts – bringing the opex and capex together can be hard

Life Cycle Assessment PC 60

Understand the full whole of life impact of your building, not just carbon.

PC 60	Apply appropriate methodologies for undertaking post occupancy evaluations and life cycle assessment where required under terms of engagement.

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Life Cycle Assessment PC 60

Understand the full whole of life impact of your building, not just carbon.

PC 60	Apply appropriate methodologies for undertaking post occupancy evaluations and life cycle assessment where required under terms of engagement.

Full life cycle includes impact on nature, materials stock, climate, water, waste, toxicity, and much more.

Simple, local, natural, recyclable or reusable.

ARBV Webinar Quiz - Whole of Life Carbon and the NSCA

THANK YOU
QUESTIONS

Geronimo ADVISORY

Prof Philip Oldfield

Dr Dominique Hes