KL&A Engineers & Builders

Evaluating the Cost, Carbon, and Energy Impacts of Different Structural Systems

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Adolfson & Peterson Construction

BSLC Binational Softwood Lumber Council

THINK WOOD

WOODWORKS Wood Products Council

Disclaimer: This presentation was developed by a third party and is not funded by WoodWorks or the Softwood Lumber Board.

Evaluating the Cost, Carbon, and Energy Impacts of Different Structural Systems

OUTLINE

1. Introduction to Platte Fifteen
2. Basics of embodied carbon
3. Measurement of embodied carbon: Life Cycle Assessment (LCA)
4. Comparative LCAs: Platte Fifteen in Timber, Steel, and Concrete
5. Comparative costs
6. Conclusions

Office / Retail
Type III-B over IA Construction
2 floors concrete below grade
1 floor concrete above grade
3 floors + roof in mass timber
Concrete cores

30’ x 30’ grid

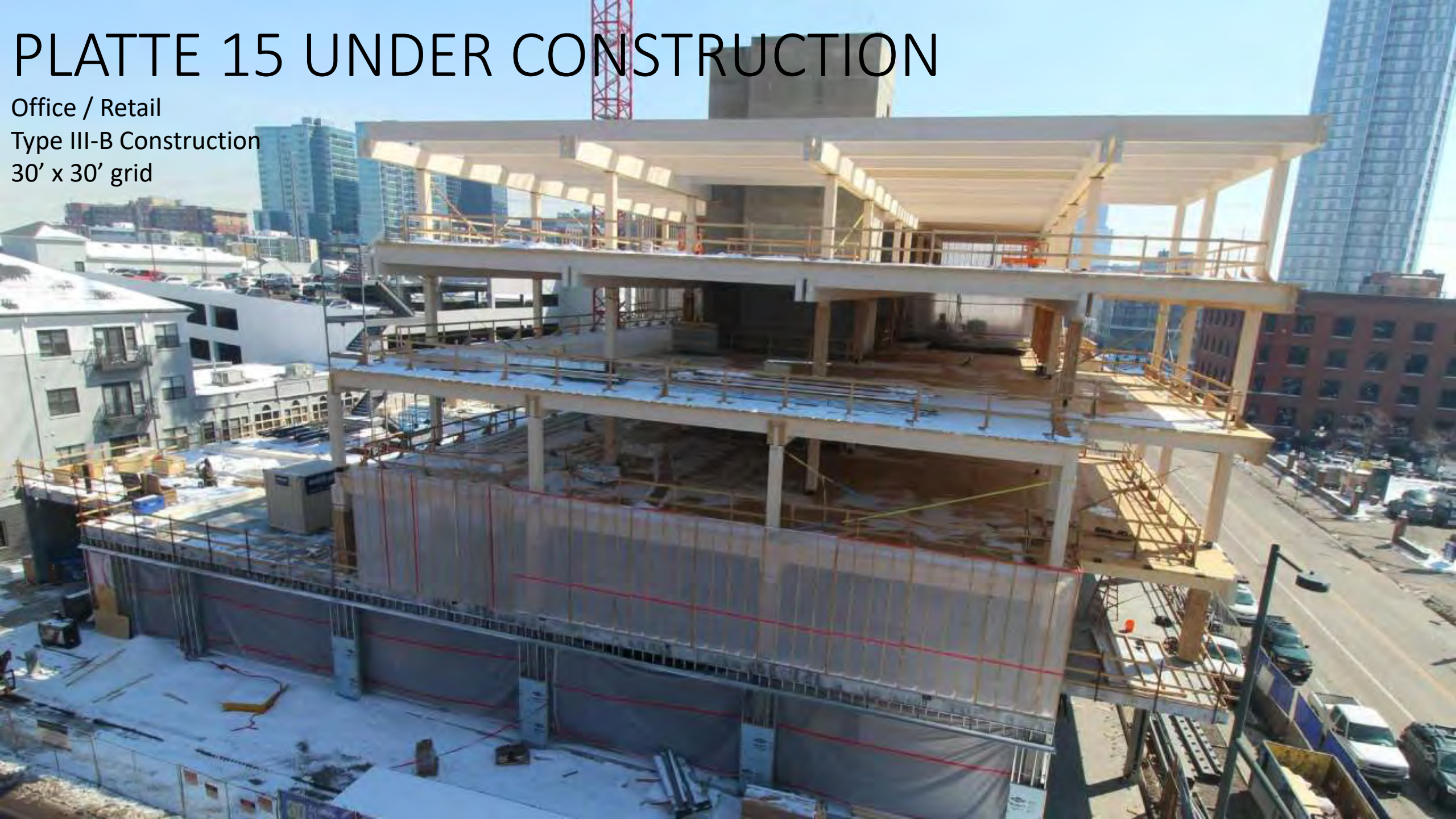
PLATTE FIFTEEN

PLATTE 15 UNDER CONSTRUCTION

Office / Retail
Type III-B Construction
30’ x 30’ grid

PLATTE 15 UNDER CONSTRUCTION

Office / Retail
Type III-B Construction
30’ x 30’ grid



PLATTE 15 UNDER CONSTRUCTION

50+ ft panels
span five 10 ft bays

PLATTE 15 UNDER CONSTRUCTION

PLATTE 15 UNDER CONSTRUCTION

PLATTE 15 UNDER CONSTRUCTION

PLATTE 15 UNDER CONSTRUCTION

2,000 sf / day
with 6-8 laborers

PLATTE 15

Photo Credit: JC Buck

PLATTE 15

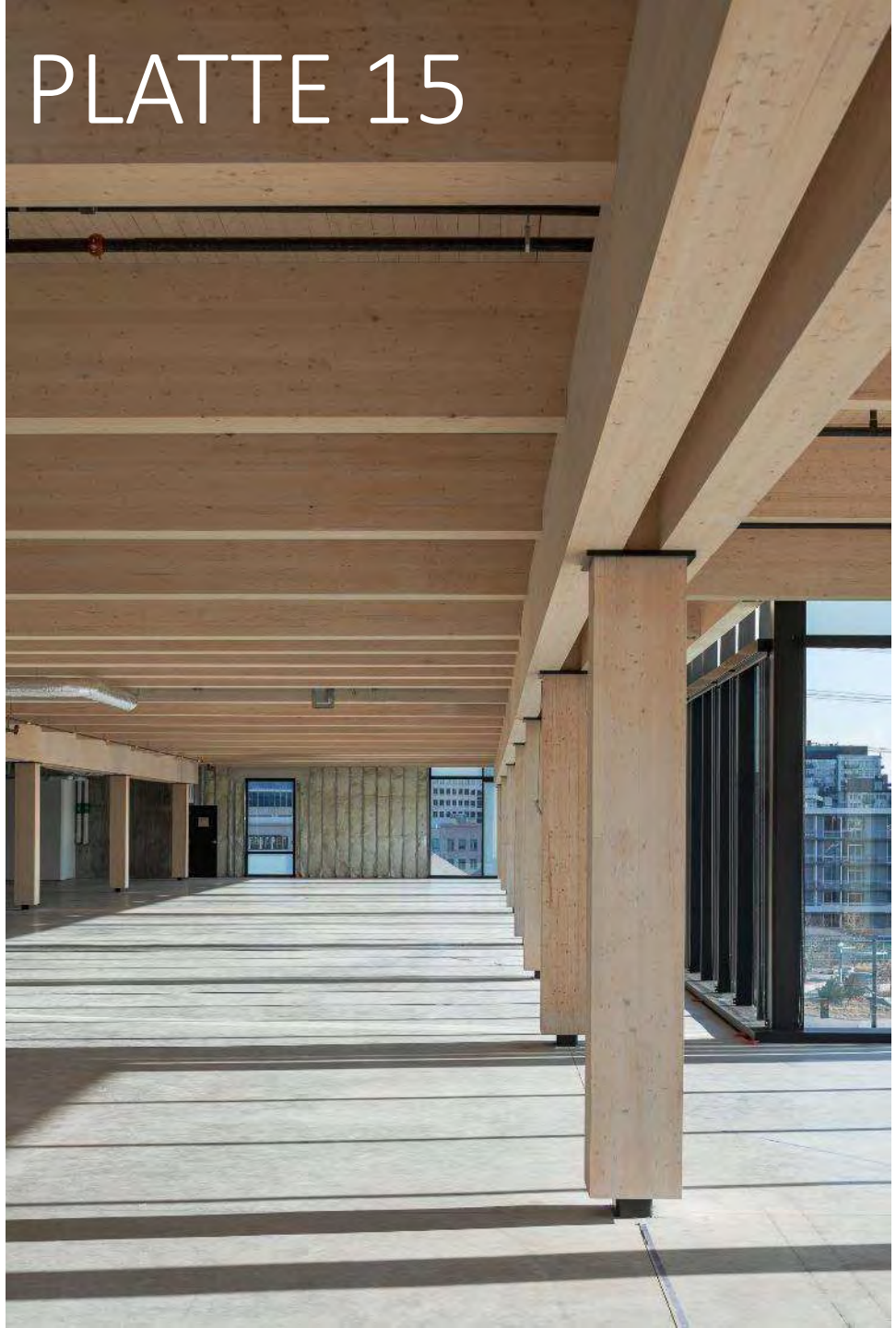


Photo Credit: JC Buck

PLATTE 15

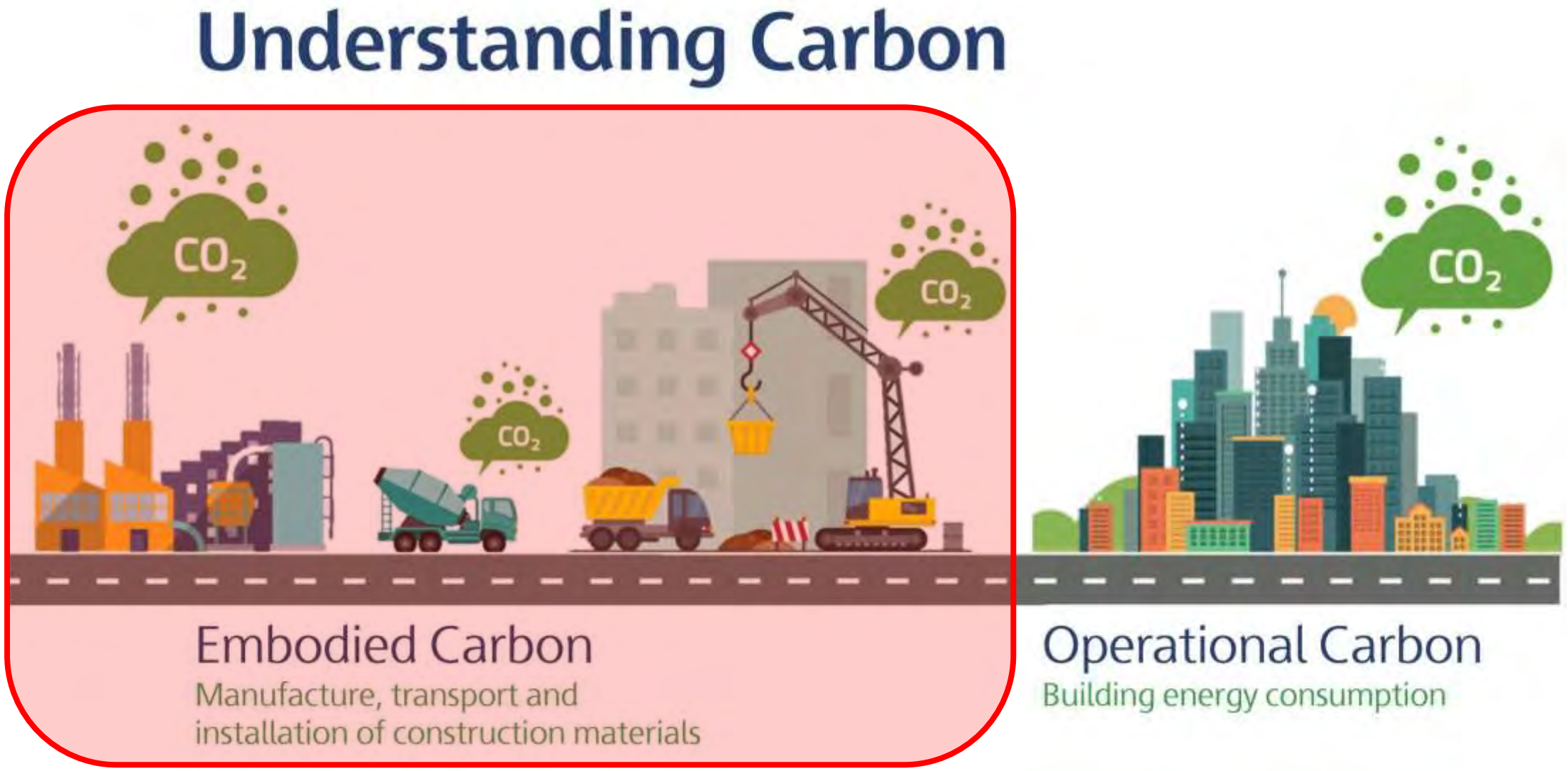
Photo Credit: JC Buck

PLATTE 15

Photo Credit: JC Buck

PLATTE FIFTEEN

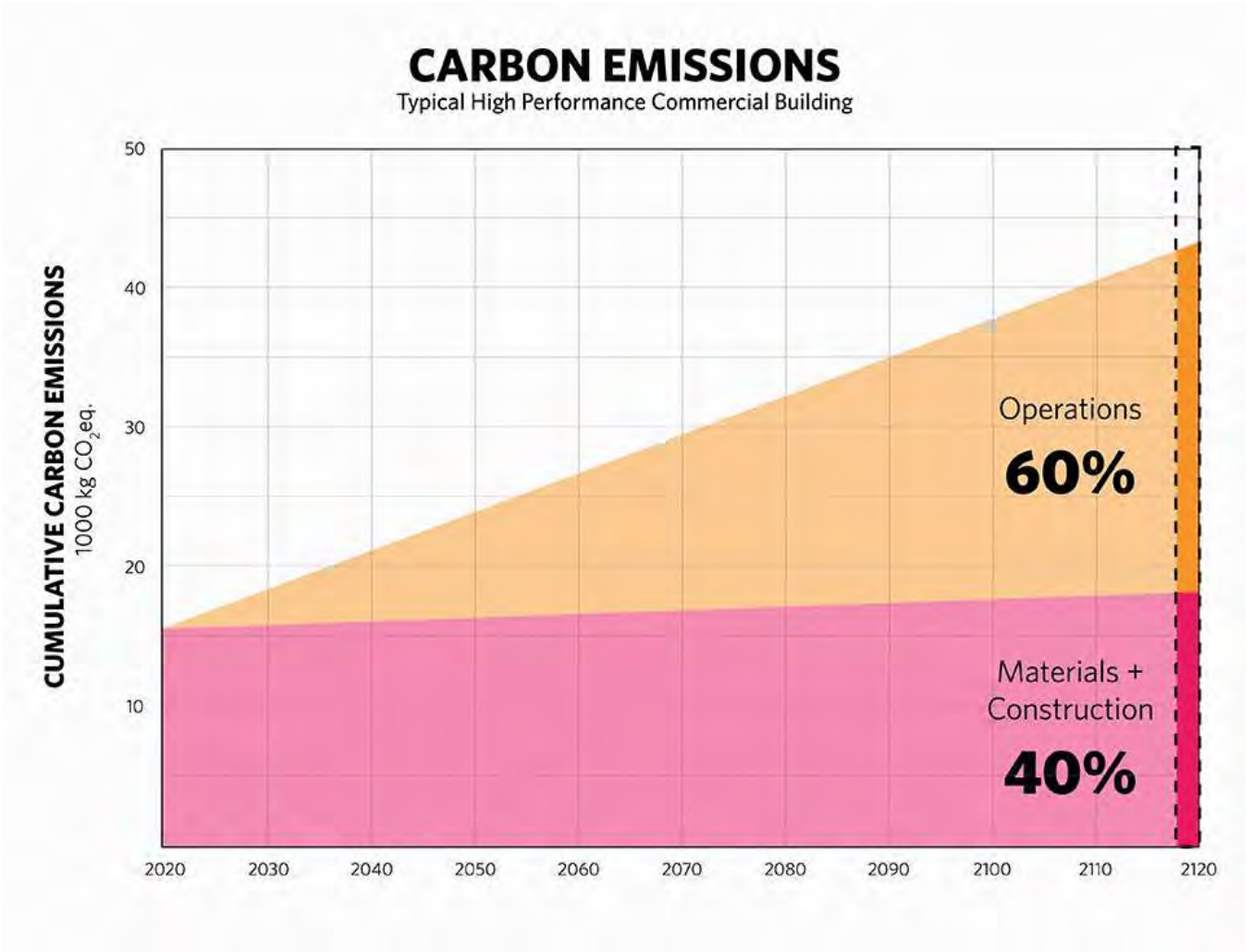
Meanwhile, embodied carbon starts getting attention…



Source image: Carbon Leadership Forum

Image by Skanska

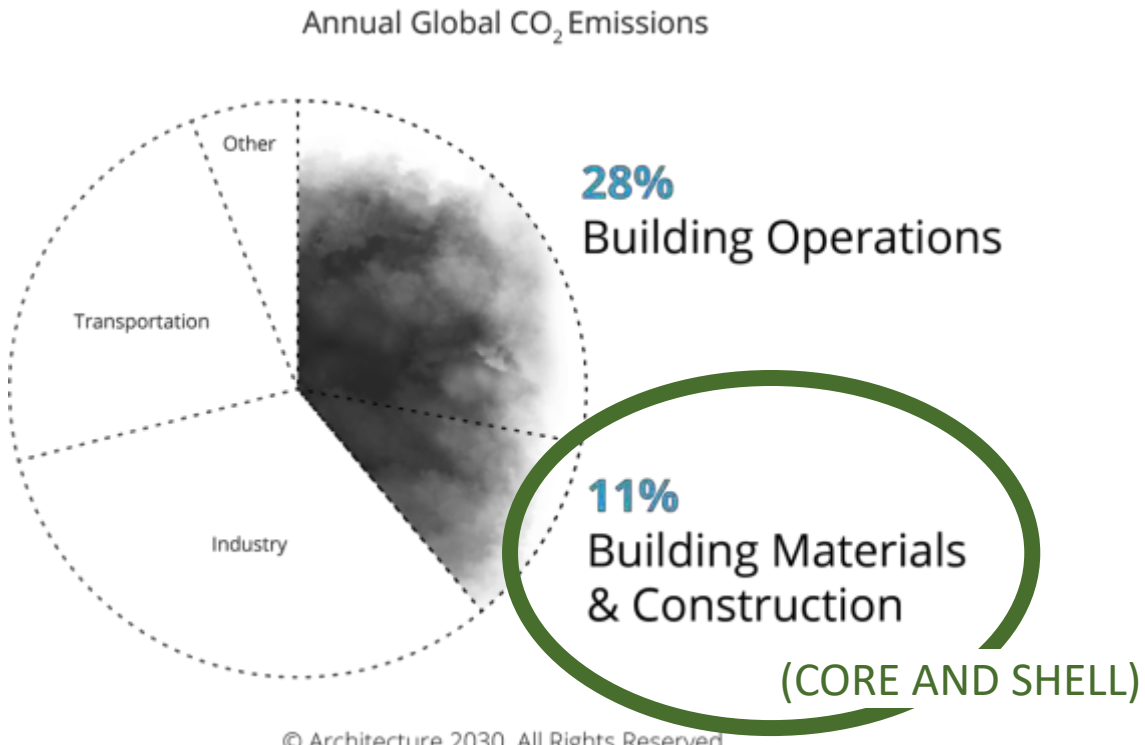
OPERATIONAL VS EMBODIED CARBON

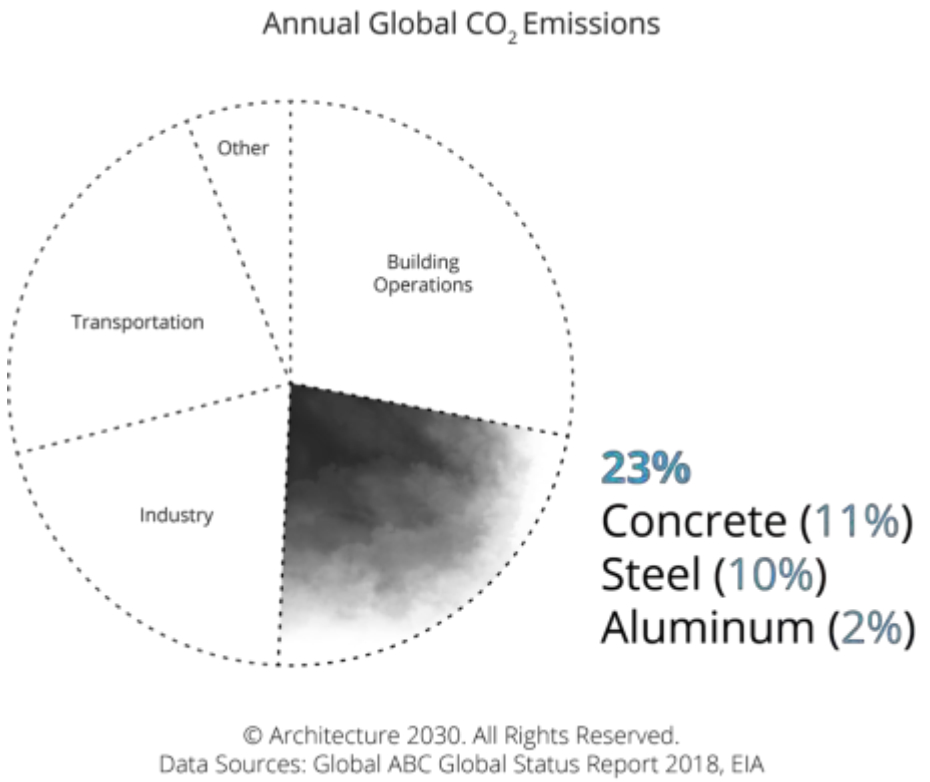


Initial embodied carbon of buildings with respect to operational energy over 50 years varies with building type:

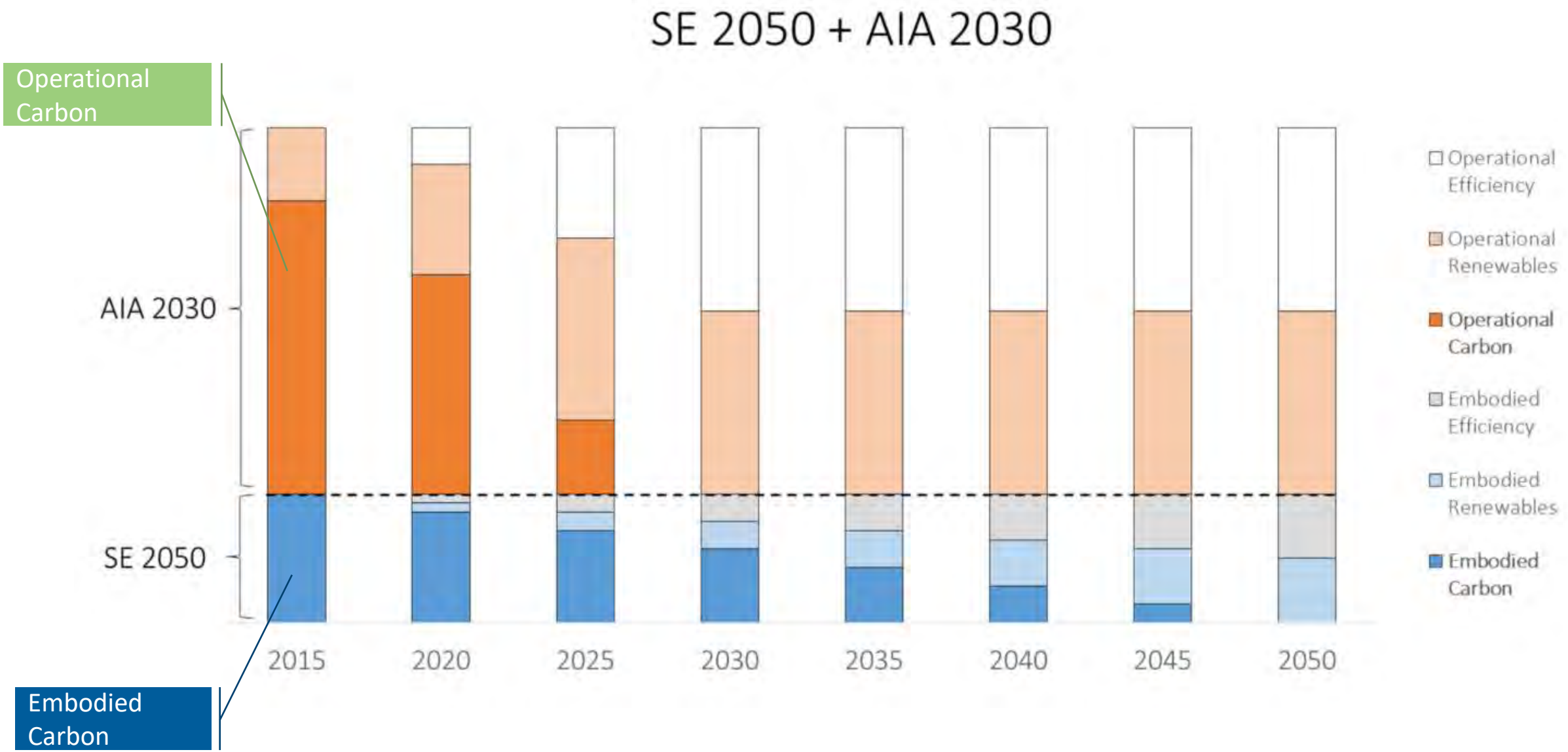
- Office 50%
- Residential 62%
- Warehouse 66%

CONSTRUCTION INDUSTRY = 39% +





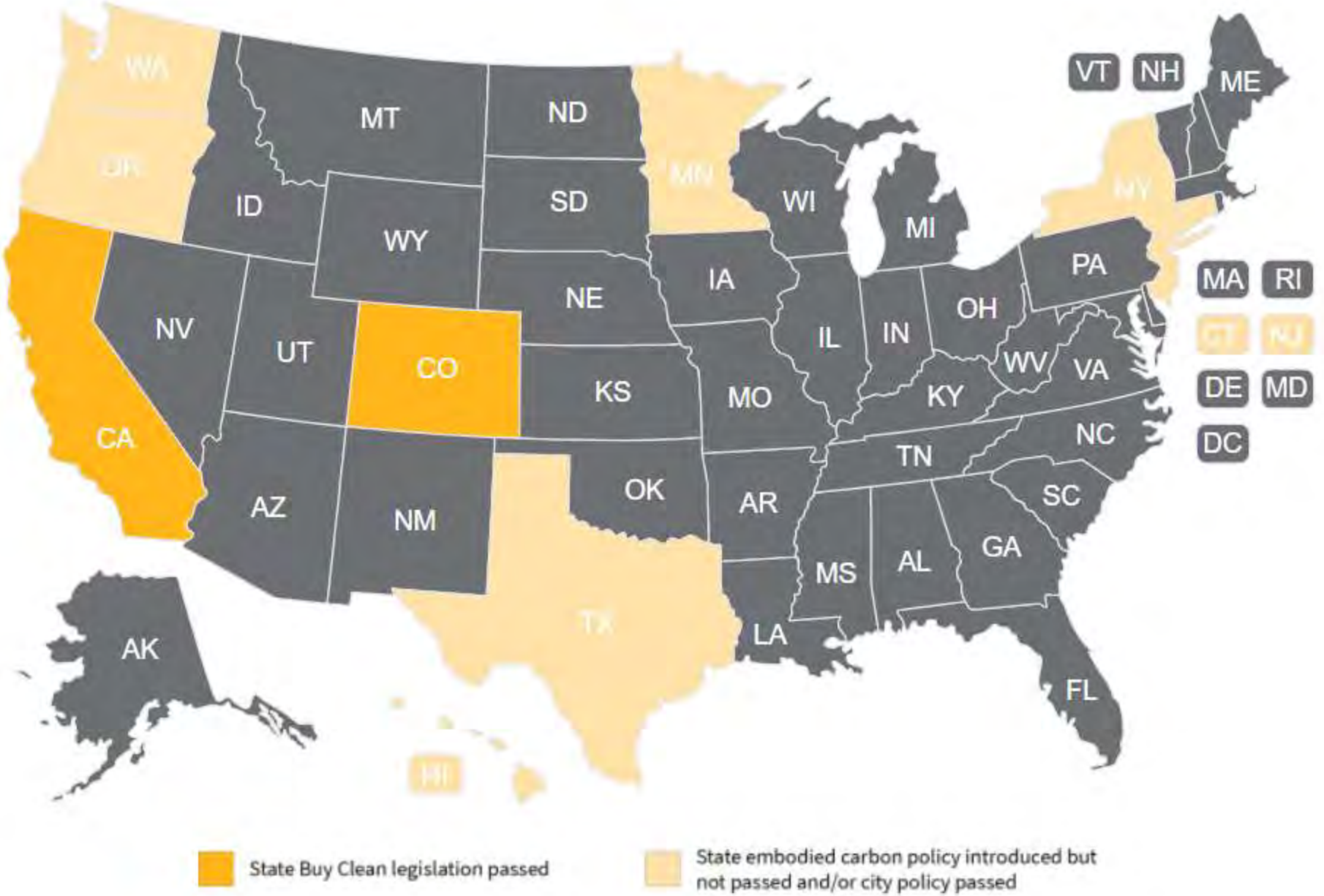
THE SE 2050 CHALLANGE



Source: SE 2050 Commitment Initiative Brief by the Carbon Leadership Forum and the SEI Sustainability Committee

Current embodied carbon policy in the U.S.

Source: Carbon Leadership Forum



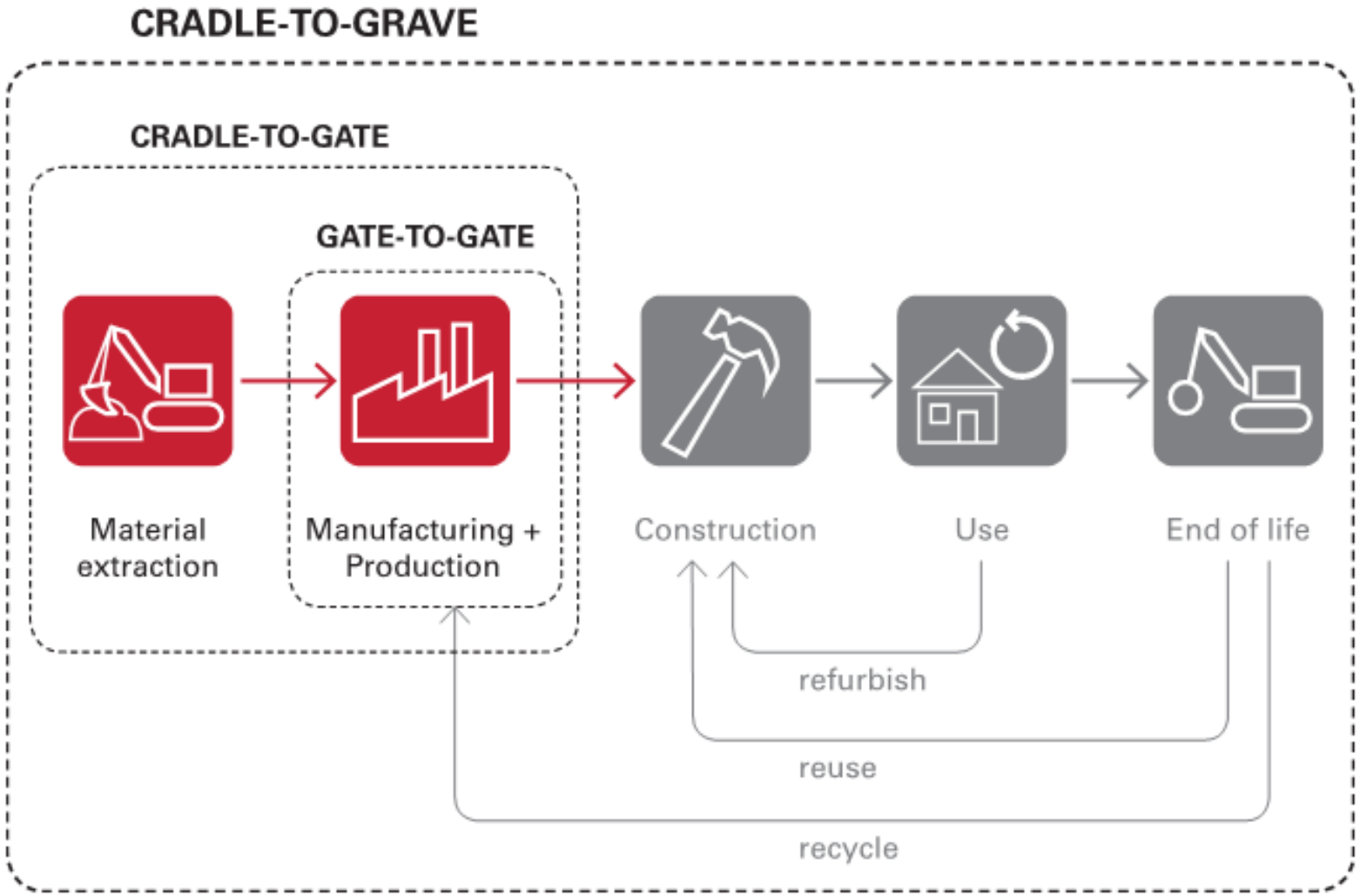
LIFE CYCLE ASSESSMENT (LCA)

TRACKS ENVIRONMENTAL IMPACTS FROM ALL THE STAGES OF A PRODUCT OR PROCESS,

INCLUDING:

- EXTRACTION
- MANUFACTURING
- CONSTRUCTION
- SERVICE
- END OF LIFE
  - RECYCLE
  - REUSE
  - DISPOSAL

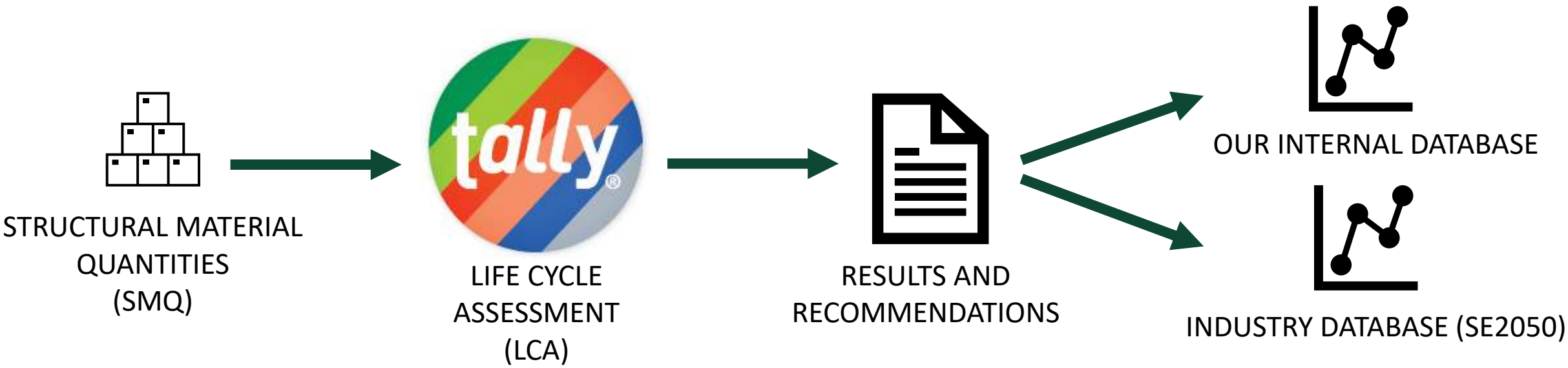
AND EXPRESSES IT AS “GLOBAL WARMING POTENTIAL” OR **GWP**



MEASURING EMBODIED CARBON

- GWP = GLOBAL WARMING POTENTIAL ($kgCO_2eq$)

- UNDERSTAND AND IDENTIFY HOT SPOTS
- UNDERSTAND THE IMPACT OF OUR MODIFICATIONS AND INNOVATIONS
- VALIDATE DECISIONS AND INVESTMENTS



https://info.**thinkwood**.com/platte-fifteen-life-cycle-assessment

Platte Fifteen Life Cycle Assessment

Authors

KL&A Engineers and Builders

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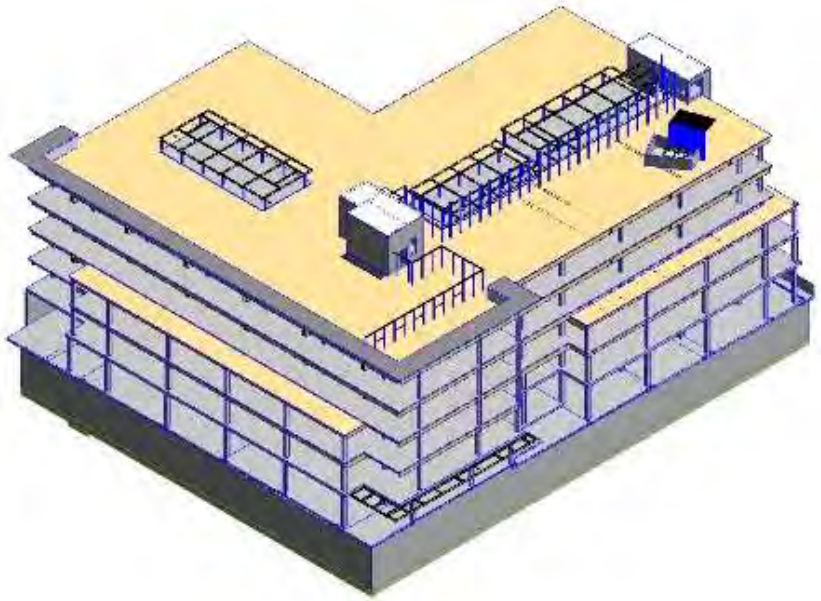
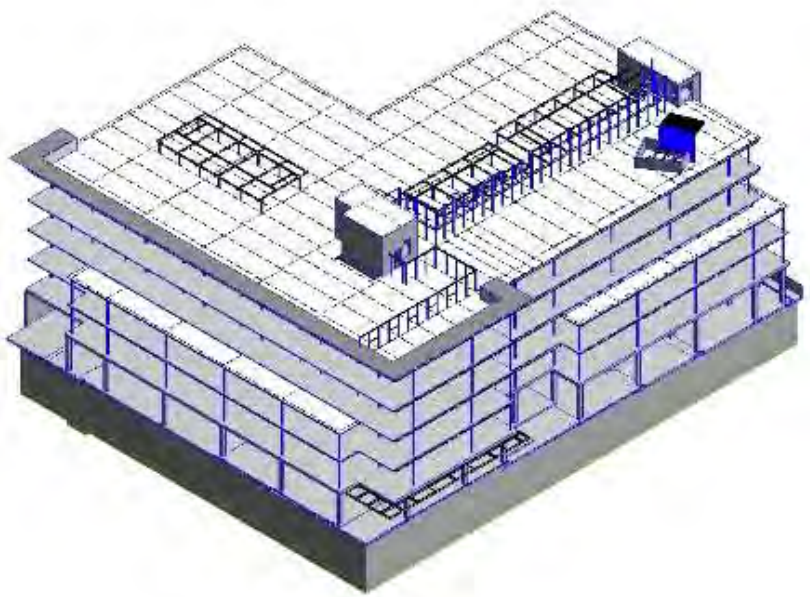
WOODWORKS

JULY 2021

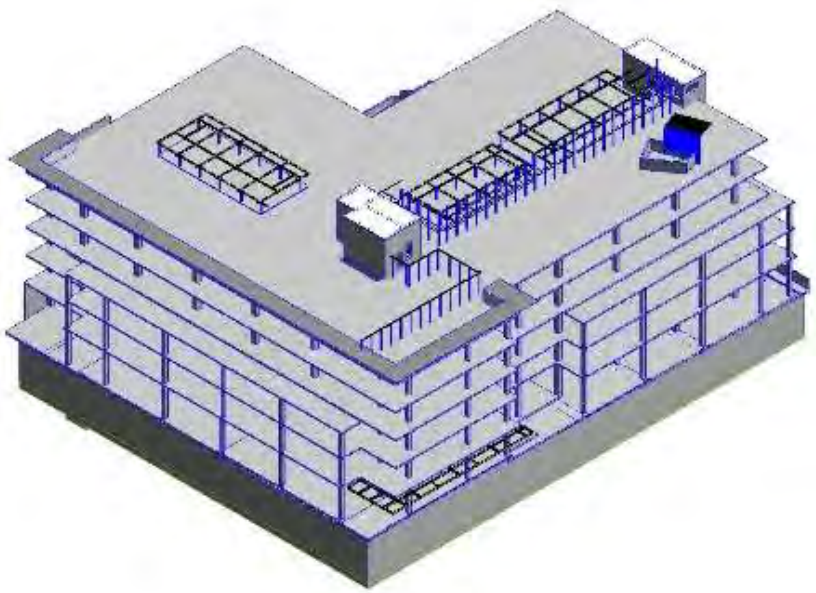
PLATTE FIFTEEN LCA



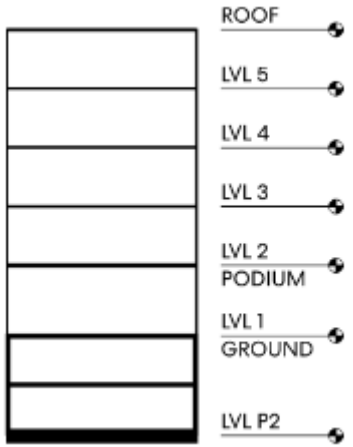
MASS TIMBER
(AS CONSTRUCTED)



STEEL



PT CONCRETE



LIFE CYCLE ASSESSMENT SCOPE

CRADLE TO GATE →

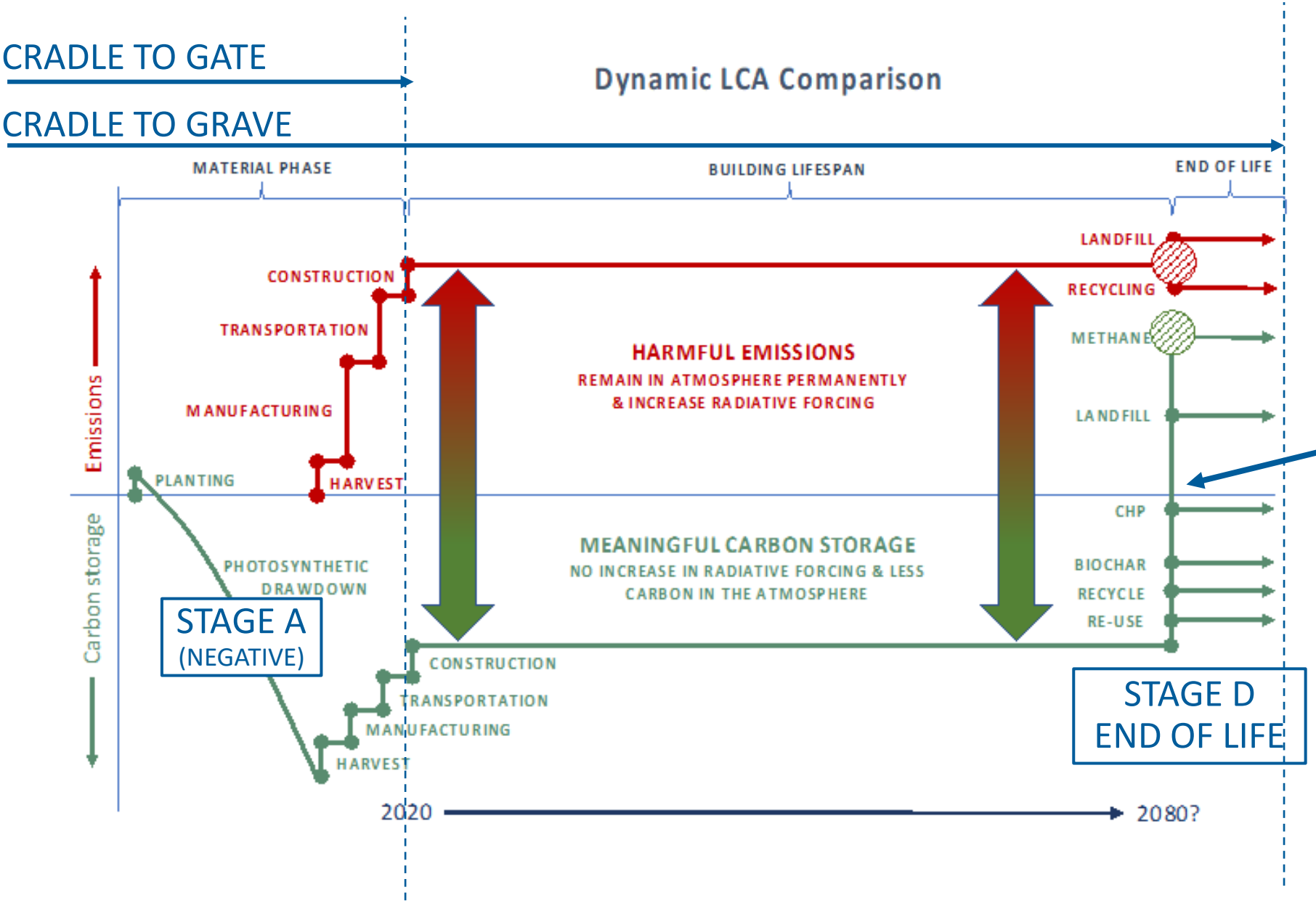
CRADLE TO GRAVE →

Life Cycle Stages & Study Scope

Product			Constr-uction		Use							End-of-Life				Module D		
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D1	D2	D3
Raw material supply	Transport	Manufacturing	Transport	*Construction\Installation*	Use	Maintenance	Repair	Replacement	Refurbishment	*Operational Energy Use*	Operational Water Use	Deconstruction	Transport	Waste Processing	Disposal	Reuse	Recycling	Energy Recovery
✓	✓	✓	✓			✓	✓	✓	✓				✓	✓	✓	✓	✓	✓

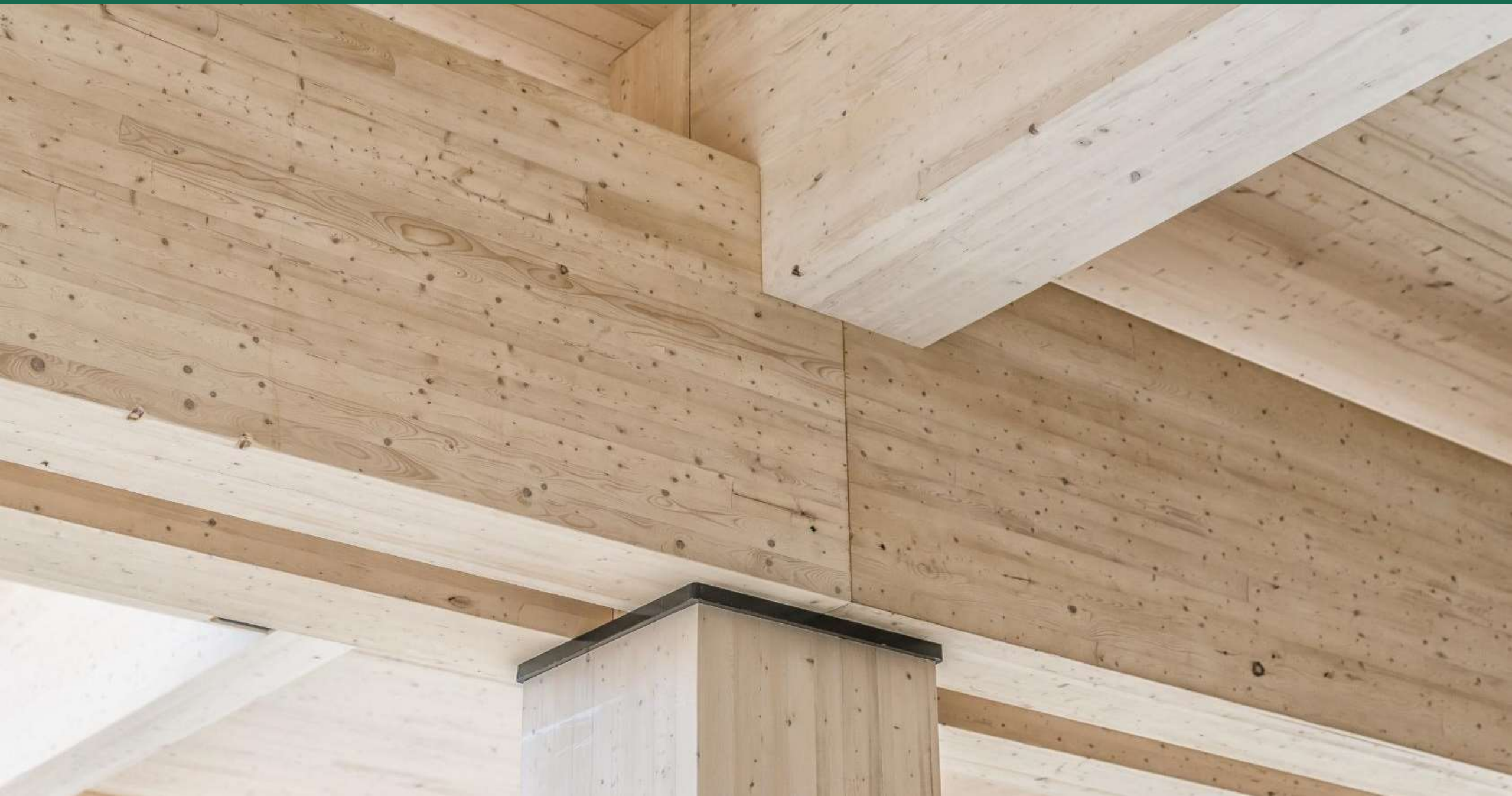
Figure 3. Life Cycle Stages[3] as defined by EN 15978. Processes included in Tally modeling scope are shown in bold. Italics indicate optional processes.

BIOGENIC CARBON

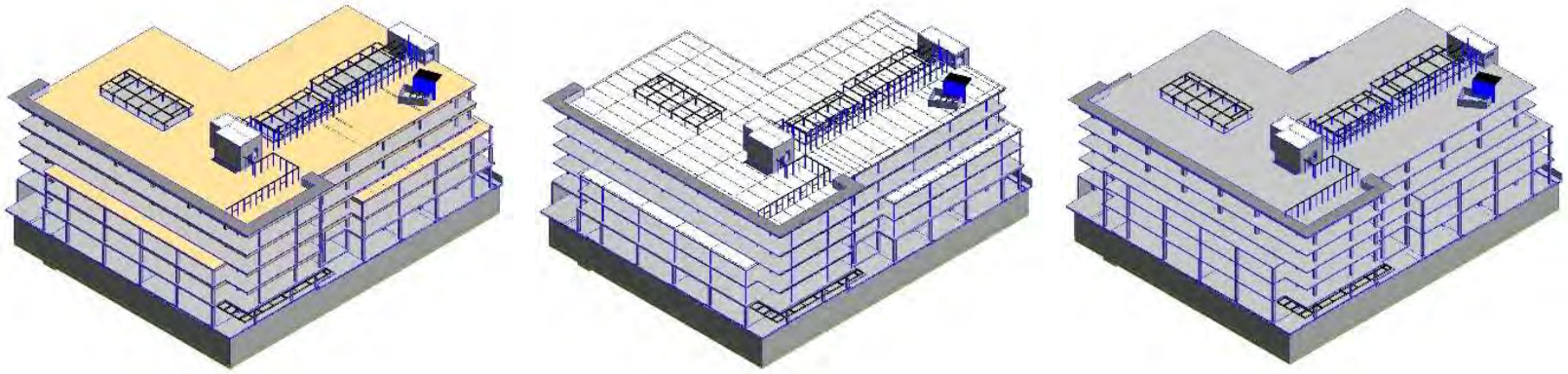


NET POSTIVE GWP IMPACT

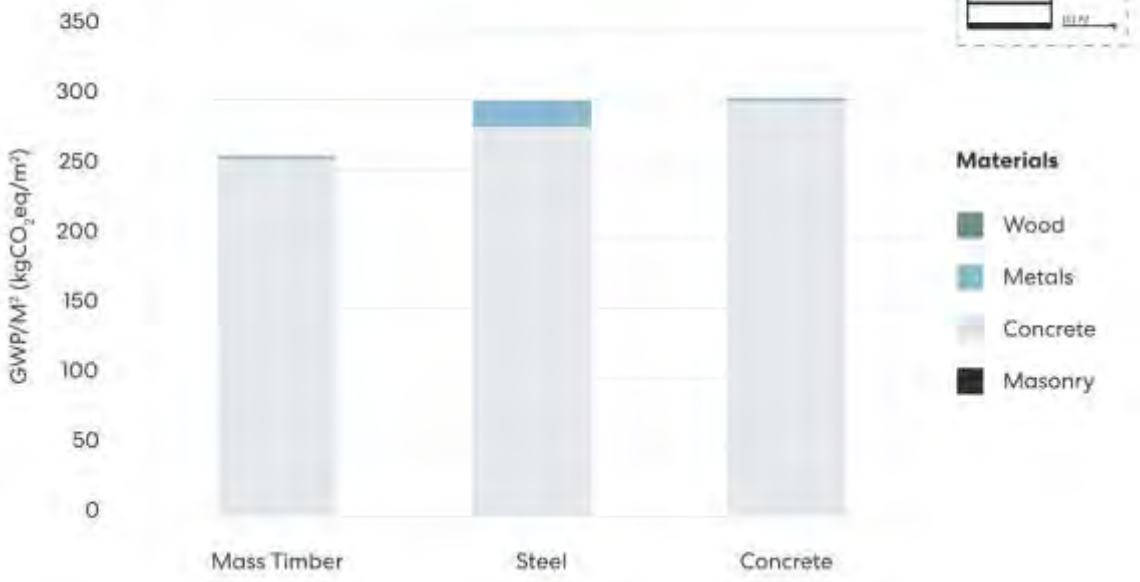
BIOGENIC CARBON AT END OF LIFE



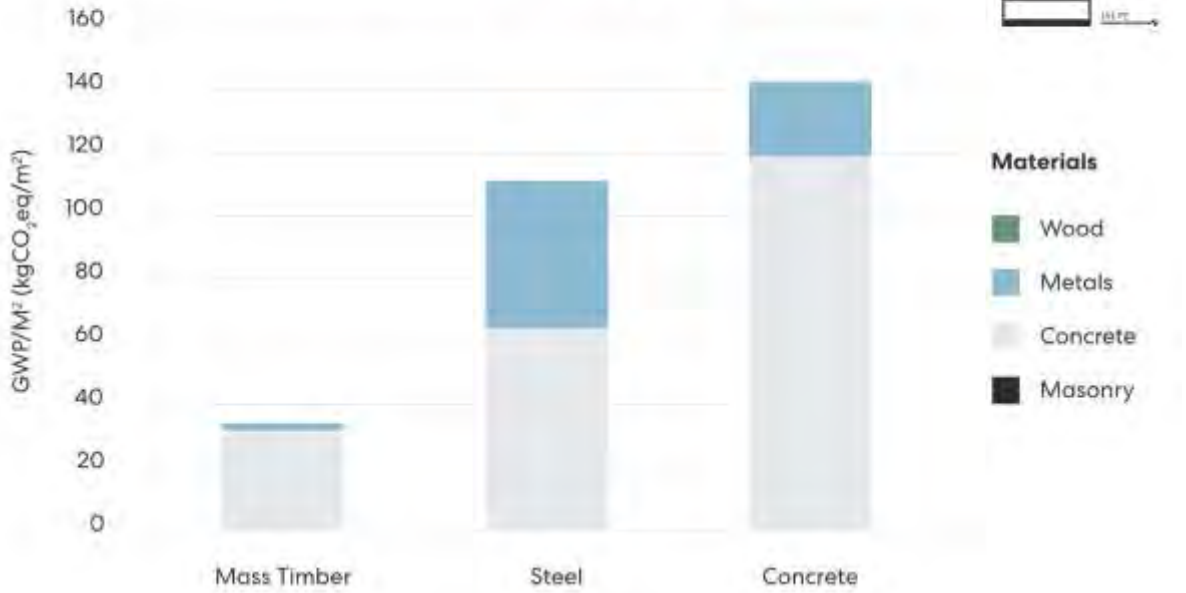
PLATTE FIFTEEN LCA STUDY



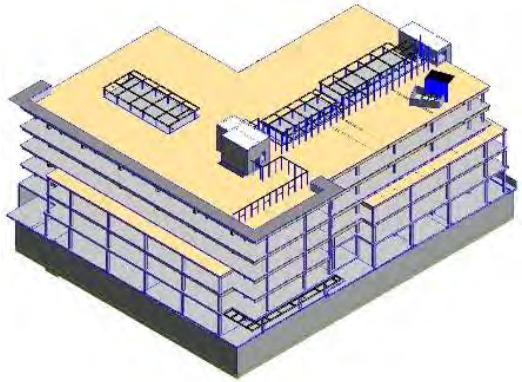
Total GWP/M² Per Building System

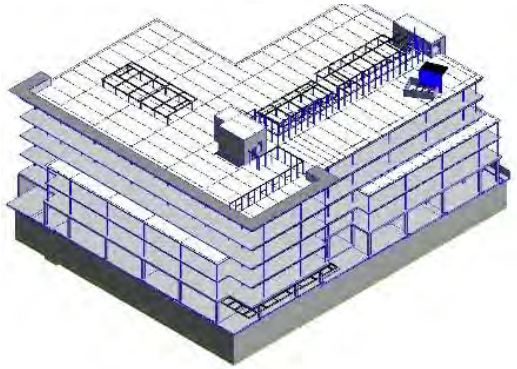


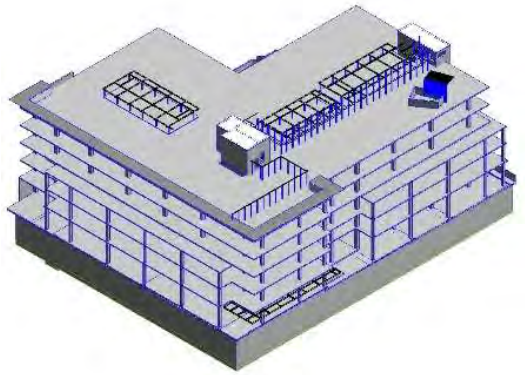
Total GWP/M² Above Podium Slab Per Building System



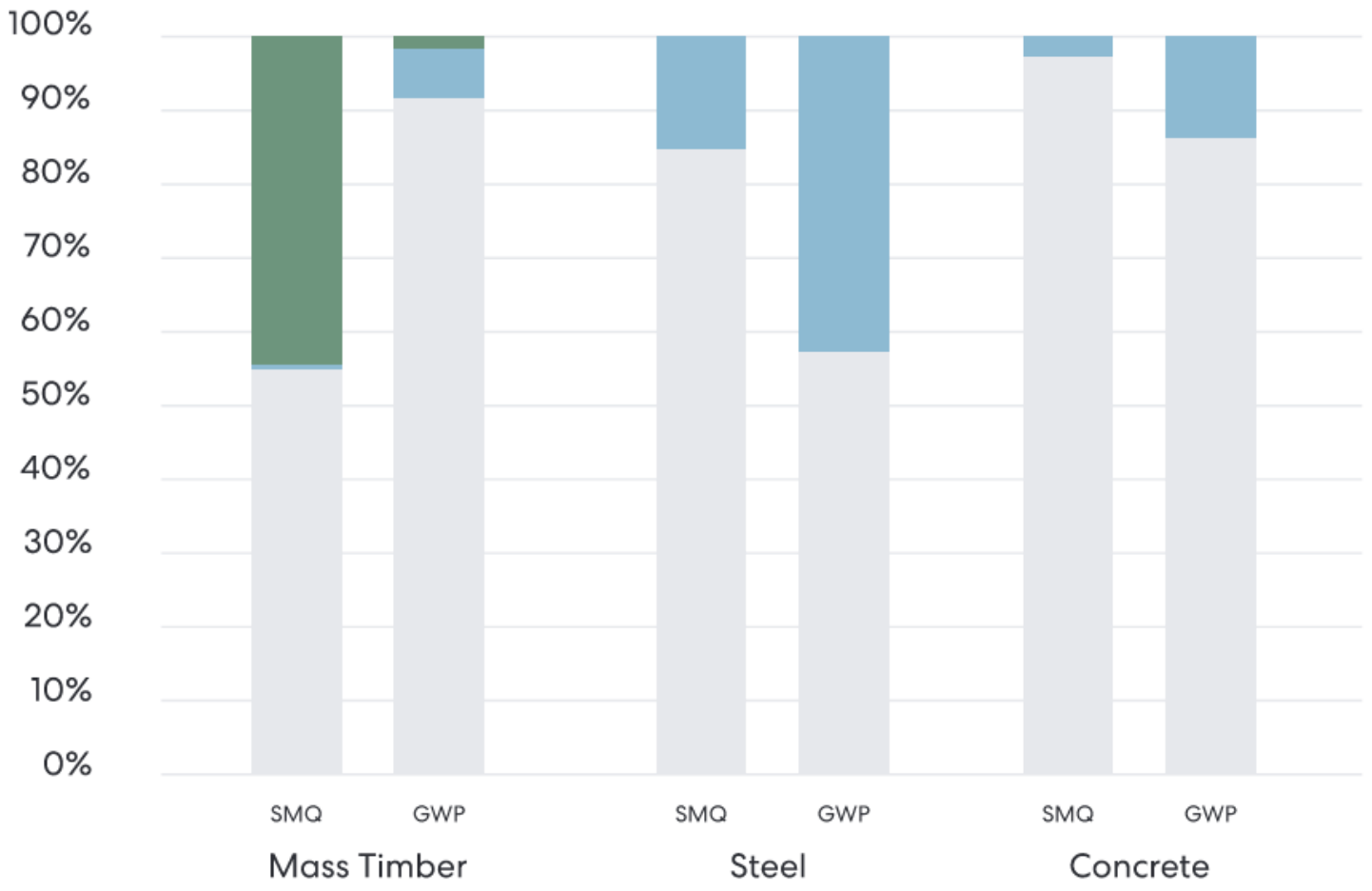
PLATTE FIFTEEN LCA STUDY

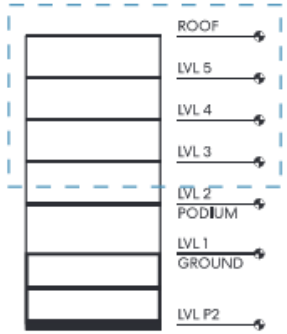






Percent Mass to Percent GWP Per Material Above Podium Slab

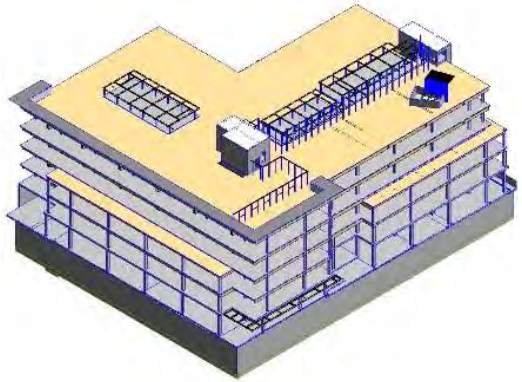


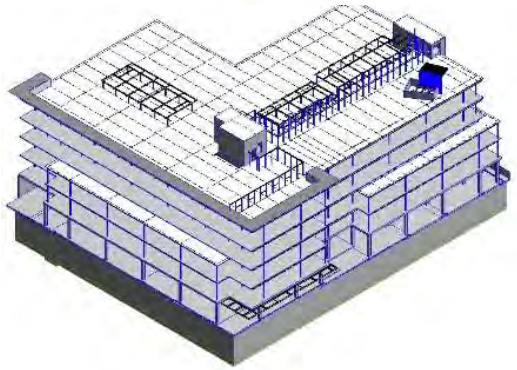


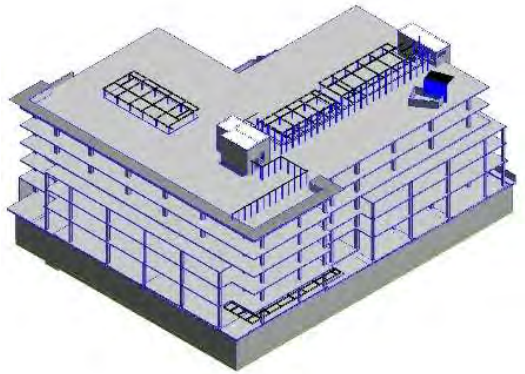
Materials

- Wood
- Metals
- Concrete

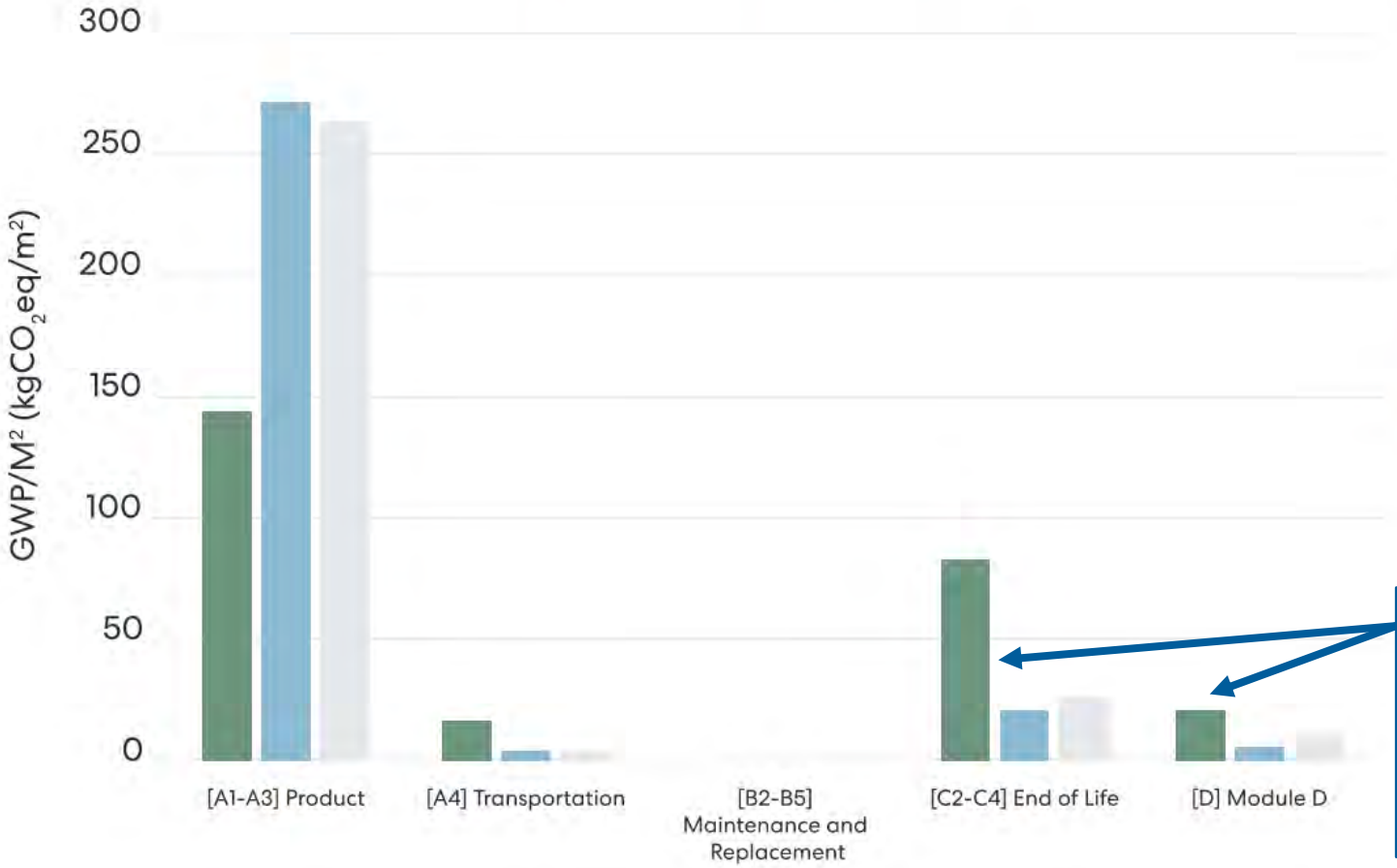
PLATTE FIFTEEN LCA STUDY

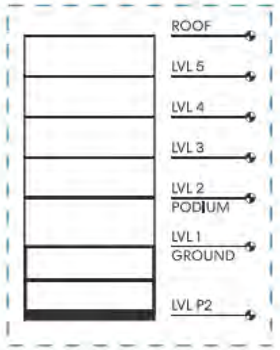






Total GWP/M² Per Life Cycle Stage





Building Systems

- Mass Timber
- Steel
- Concrete

Tally Mix Assumptions for Wood:

- 65.5% landfill
- 17.5% incineration
- 17.5% recycle

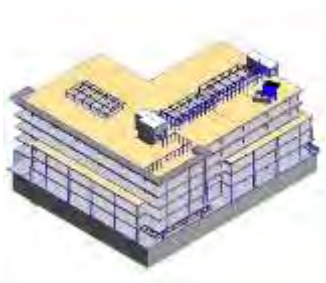
LONG LIFE, LOOSE FIT, EASY CARE


WHAT ABOUT COST?

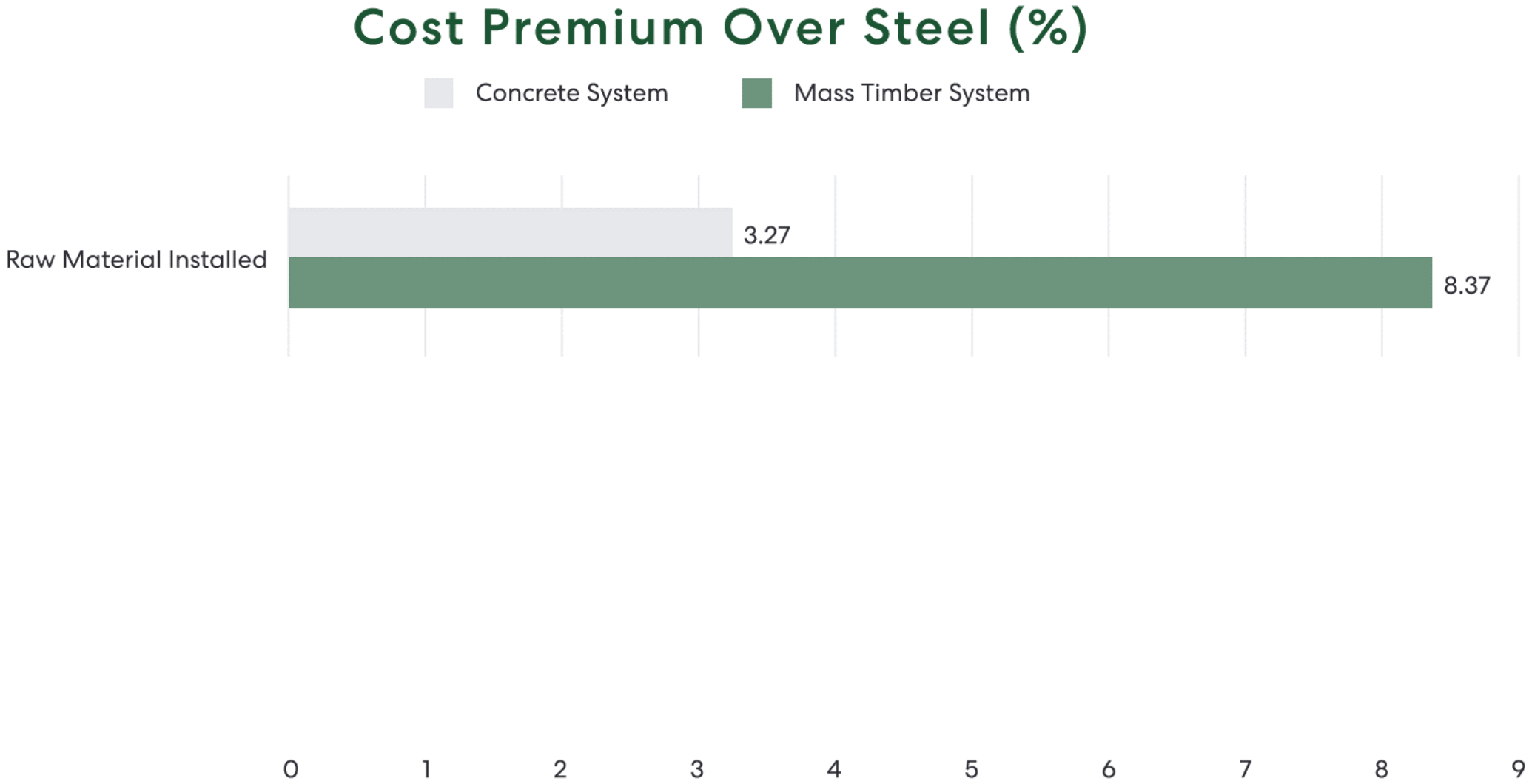
MATERIAL COST (STRUCTURE AND VERTICAL ENCLOSURE)

Steel: Lowest
= Baseline

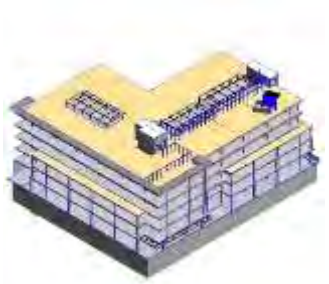
Concrete: Middle



Mass Timber:
Highest



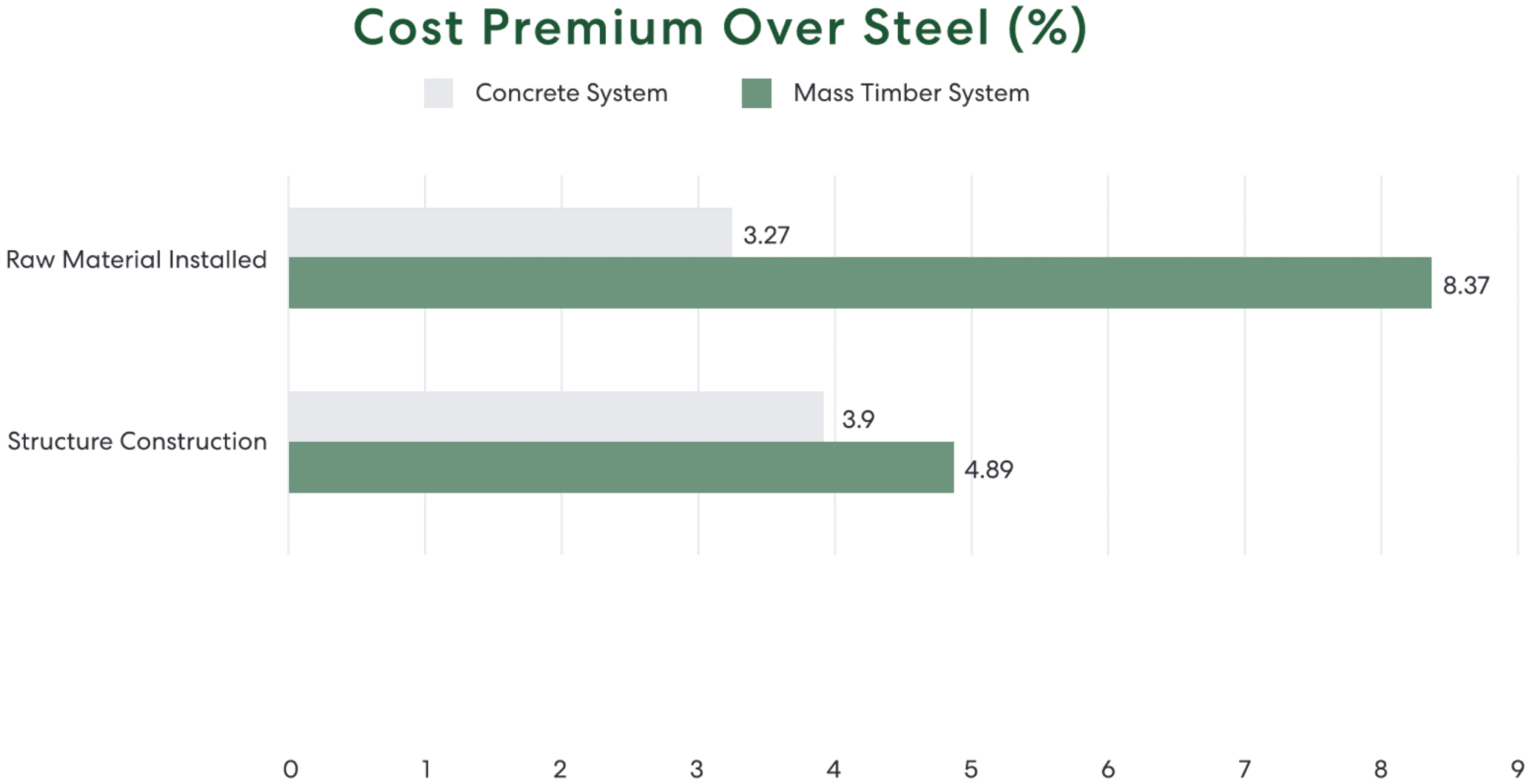
SUPERSTRUCTURE



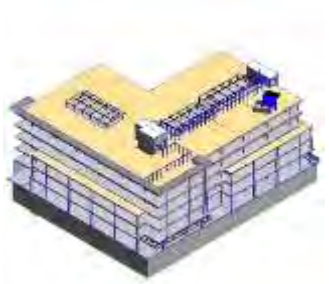
Mass Timber:
Baseline time

Steel:
+ 2 months

Concrete:
+ 3.5 months



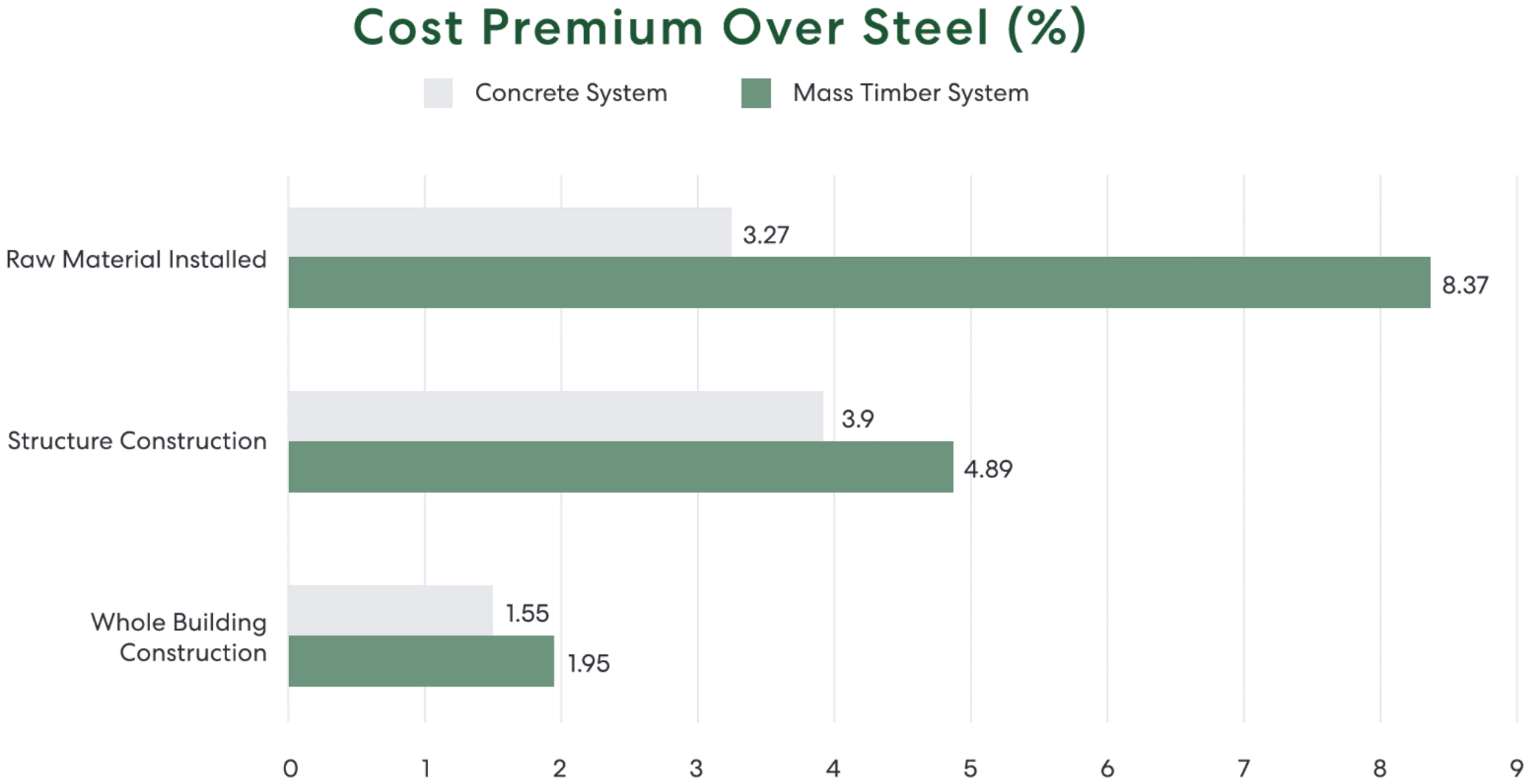
TOTAL BUILDING COST



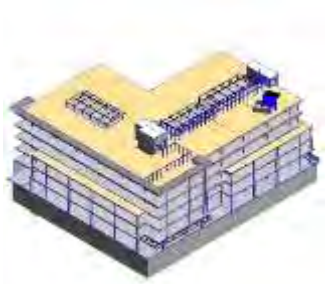
Mass Timber:
Baseline time

Steel:
+ 2 mos

Concrete:
+ 3.5 mos



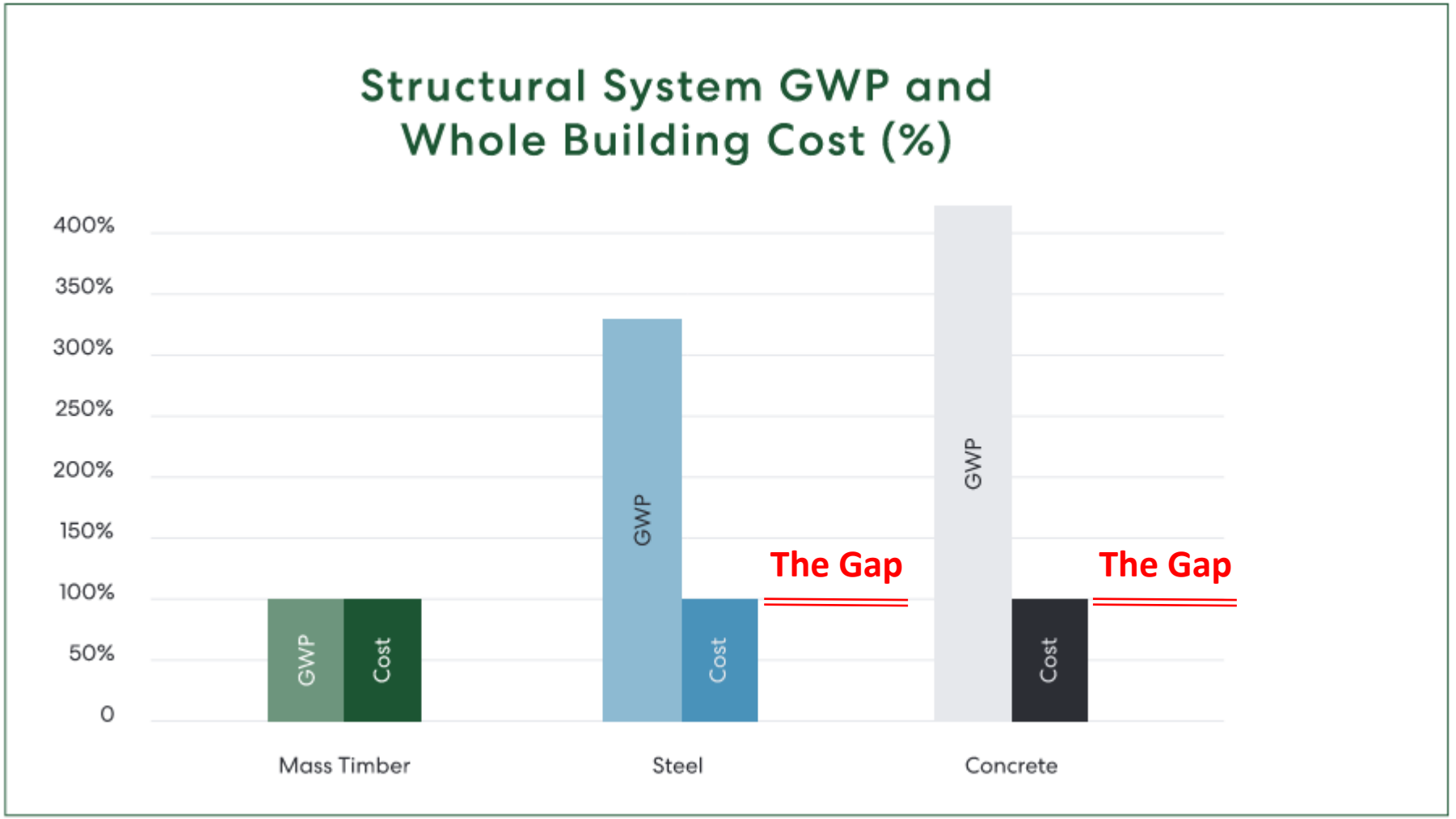
EMBODIED CARBON COST vs. DOLLAR COST



Mass Timber: Baseline

Steel

Concrete



"**The Gap**" in this study is less than 2% of building cost

WHY MASS TIMBER

UNDER CONSTRUCTION, MASS TIMBER…

- IS FAST
- REQUIRES LIMITED LABOR
- IS QUIET
- HAS LITTLE WASTE
- REDUCES CONSTRUCTION TRAFFIC

WHY MASS TIMBER

IN THE FINISHED BUILDING, MASS TIMBER…

- LOOKS GREAT!
- CREATES A HEALTHY ENVIRONMENT (BIOPHILIA)
- GENERATES HIGH LEASE RATES AND HIGH LEASING VELOCITY

WHY MASS TIMBER

MASS TIMBER IS SUSTAINABLE

- RENEWABLE
- REUSABLE, EASE OF DECONSTRUCTION
- SUPPORTS FOREST HEALTH
- SUPPORTS RURAL ECONOMIES
- SEQUESTERS CARBON / LOW EMBODIED CARBON (50% CARBON BY DRY WEIGHT)

Photo by Aleksandar Radovanovic on Unsplash

Photo Credit: JC Buck

QUESTIONS?

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