RECENT FINDINGS ON BUILDING-SCALE CARBON LCAS

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Consortium for Research on Renewable Industrial Materials

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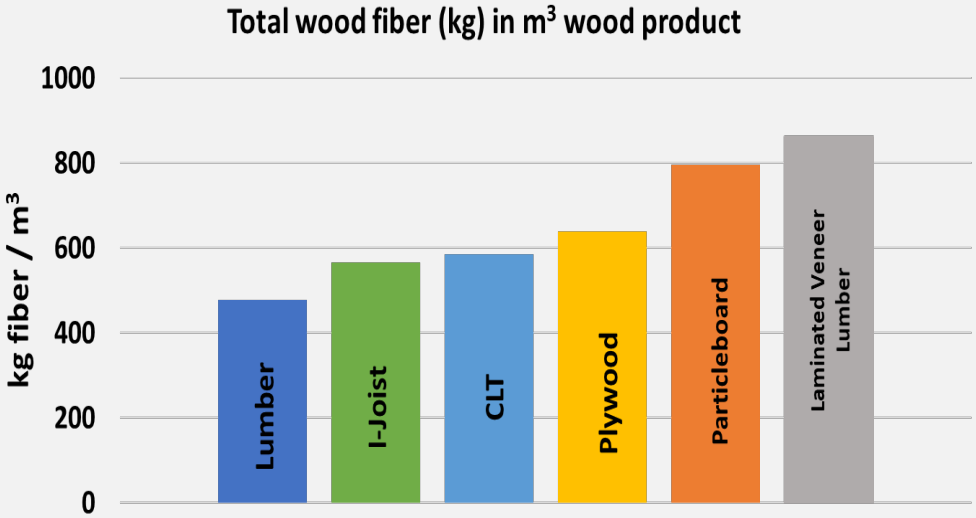
DECLARED VS. FUNCTIONAL UNITS

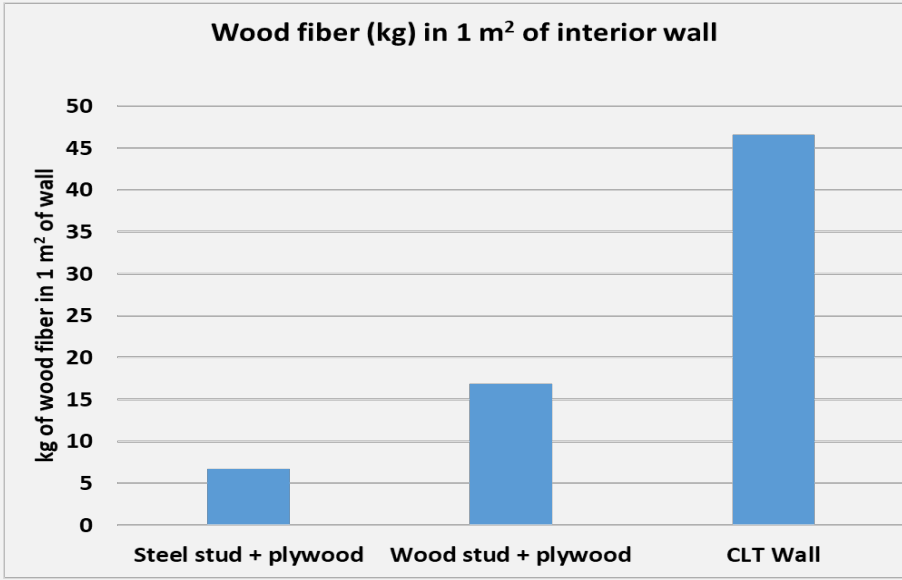
ENVIRONMENTAL PRODUCT DECLARATIONS

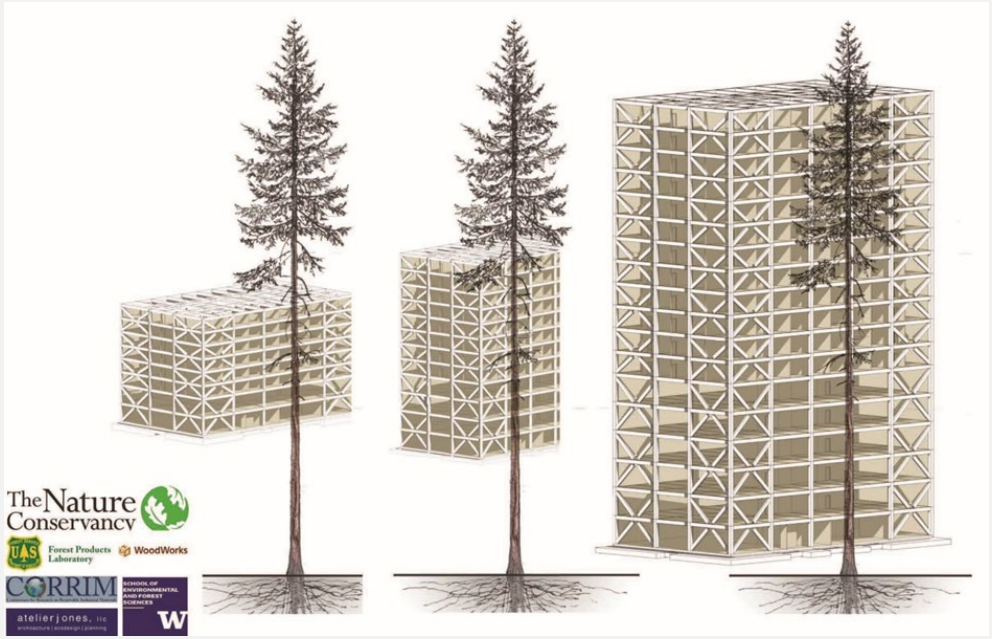
m^3

INTERIOR WALL

m^2







WHOLE BUILDING LCA TNC STUDY PHASE I

- Comparative life cycle assessments of functionally equivalent mass timber and conventional buildings in Europe, China, Chile, and the US.
- We were to report the **embodied carbon** and **carbon storage** of mass timber utilization at the individual building level.

Open Access Article

Comparative LCAs of Conventional and Mass Timber Buildings in Regions with Potential for Mass Timber Penetration

by Maureen Puettmann [1,*], Francesca Pierobon [2], Indroneil Ganguly [2], Hongmei Gu [3], Cindy Chen [4], Shaobo Liang [3], Susan Jones [5], Ian Maples [5] and Mark Wishnie [6]

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United States

Open Access Article

Mass Timber Building Life Cycle Assessment Methodology for the U.S. Regional Case Studies

by Hongmei Gu [1,*], Shaobo Liang [1], Francesca Pierobon [2], Maureen Puettmann [3], Indroneil Ganguly [2], Cindy Chen [4], Rachel Pasternack [5], Mark Wishnie [6], Susan Jones [7] and Ian Maples [7]

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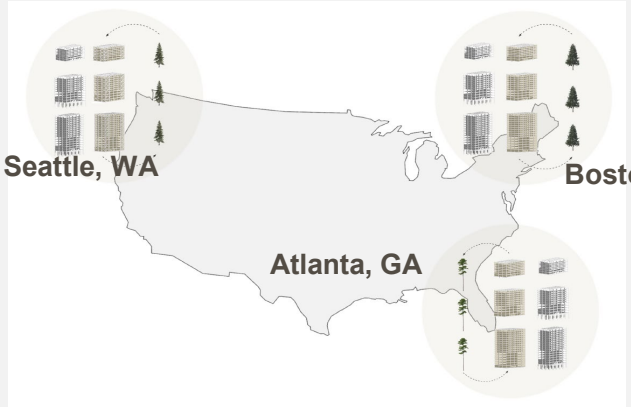
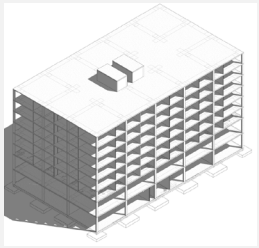
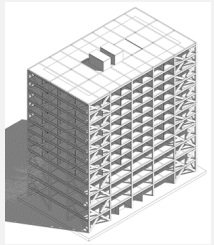
METHODOLOGY



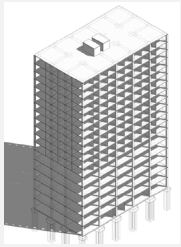
Stories	Building Height	Total Floor Area
	meters	m^2
8	26	9,476
12	48	14,214
18	71	21,321



Spread footing
8 story



Mat footing
12 story

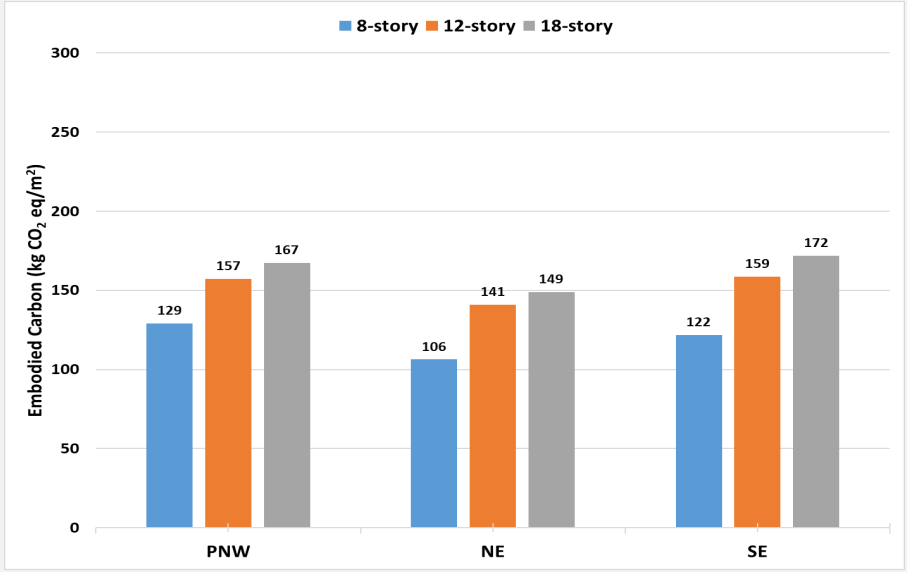


Piles and spread footing
18 Story

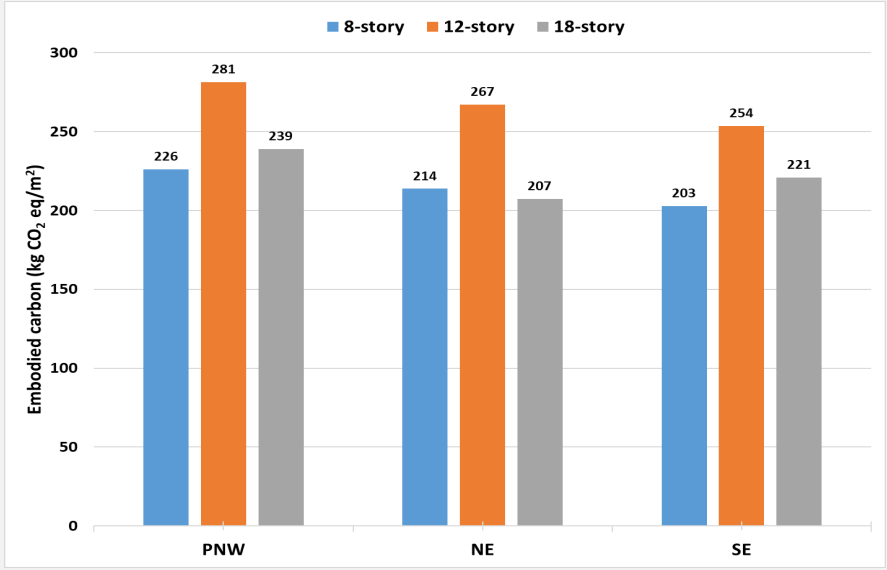
System Boundary				
PRODUCTION STAGE			CONSTRUCTION STAGE	
A1	A2	A3	A4	A5
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation

EMBODIED CARBON MASS TIMBER AND CONCRETE BUILDING

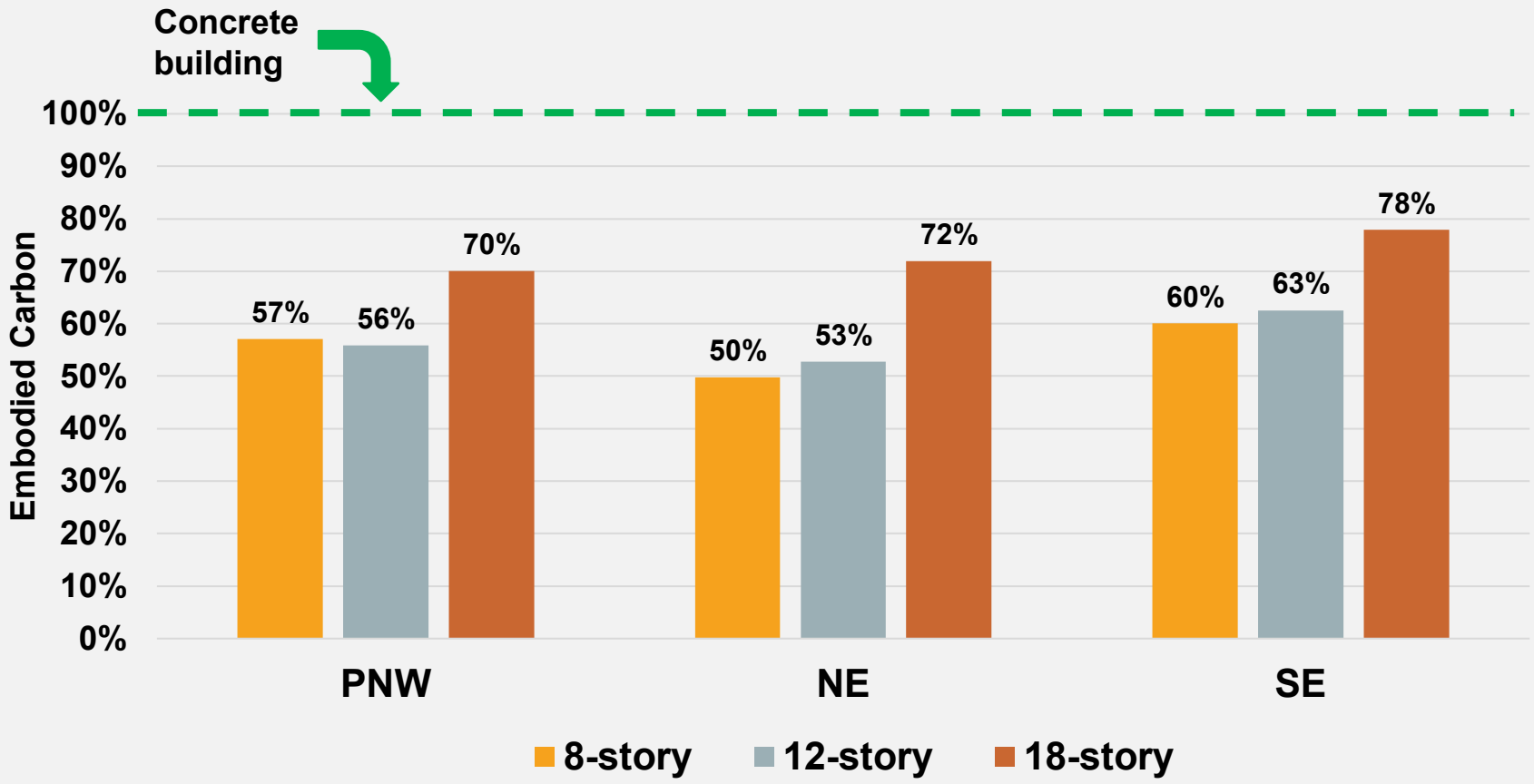
MASS TIMBER BUILDINGS



CONCRETE BUILDINGS



RESULTS – EMBODIED CARBON

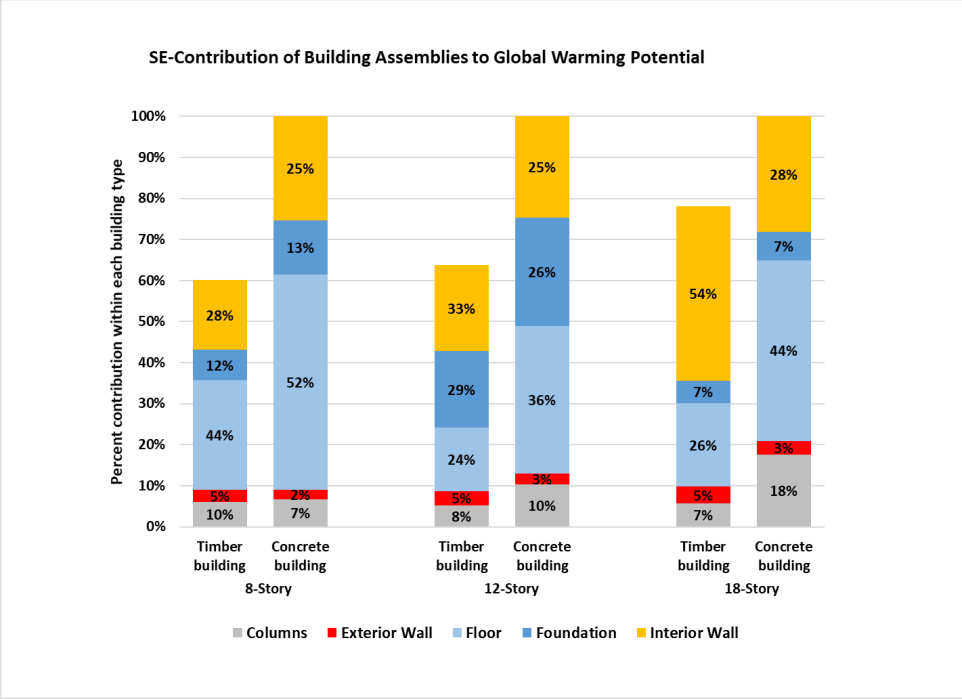


EMBODIED CARBON BY LIFE CYCLE STAGE
NE BUILDINGS

NE Embodied Carbon kg CO_2e / m^2

		A1-A3		**A4**		A5		Total	
8-story	Mass Timber building	90.7	85.2%	**12.0**	**11.2%**	3.7	3.5%	106.3	100.0%
	Concrete building	203.7	95.3%	**2.7**	**1.3%**	7.4	3.5%	213.8	100.0%
12-story	Mass Timber building	121.4	86.1%	**14.2**	**10.1%**	5.3	3.8%	141.0	100.0%
	Concrete building	254.0	95.1%	**3.1**	**1.2%**	9.9	3.7%	267.0	100.0%
18-story	Mass Timber building	130.0	87.2%	**13.0**	**8.7%**	6.1	4.1%	149.1	100.0%
	Concrete building	196.3	94.6%	**2.6**	**1.2%**	8.6	4.1%	207.4	100.0%

CONTRIBUTION OF BUILDING ASSEMBLY TO TOTAL EMBODIED CARBON



Southeast – Interior Wall			
	Mass kg/m2	**Composition by mass**	**Contribution to Embodied Carbon**
Concrete	158.7	50.7%	30.2%
CLT	53.0	16.9%	17.3%
Gypsum Wall board	**89.3**	**28.5%**	**30.1%**
Insulation	1.9	0.6%	3.1%
Other metals	0.9	0.3%	3.0%
Rebar	9.5	3.0%	16.3%

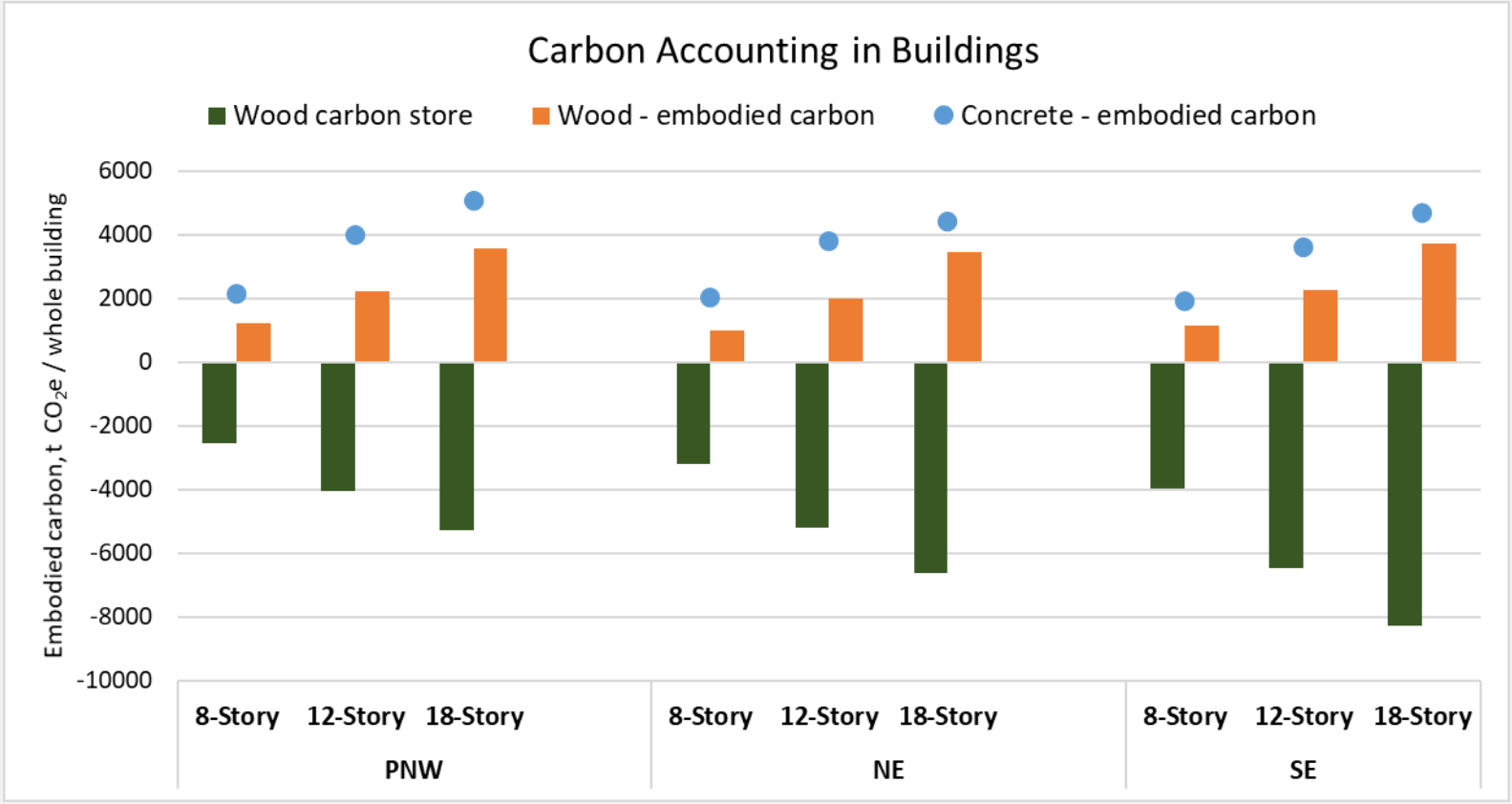
Table 4. Material contribution of the interior wall assembly for mass timber 18-story buildings from the Pacific Northwest, Northeast, and Southeast United States.

Material Used the Interior Walls	Mass of Materials kg/m^2 of Floor Area	Composition by Mass	Contribution to Embodied Carbon
	Pacific Northwest		
Concrete	165.4	65.0%	32.8%
CLT	0.0	0.0%	0.0%
Gypsum wall board	75.3	29.6%	31.5%
Insulation	1.5	0.6%	5.7%
Other metals	2.9	1.1%	10.6%
Rebar	9.5	3.7%	19.4%
	Northeast		
Concrete	145.3	52.3%	32.9%
CLT	39.4	14.2%	11.6%
Gypsum wall board	81.6	29.4%	32.7%
Insulation	1.8	0.6%	3.3%
Other metals	0.8	0.3%	3.1%
Rebar	8.7	3.1%	17.0%
	Southeast		
Concrete	158.7	50.7%	30.2%
CLT	53.0	16.9%	17.3%
Gypsum wall board	89.3	28.5%	30.1%
Insulation	1.9	0.6%	3.1%
Other metals	0.9	0.3%	3.0%
Rebar	9.5	3.0%	16.3%

WOOD PRODUCTS MANUFACTURING

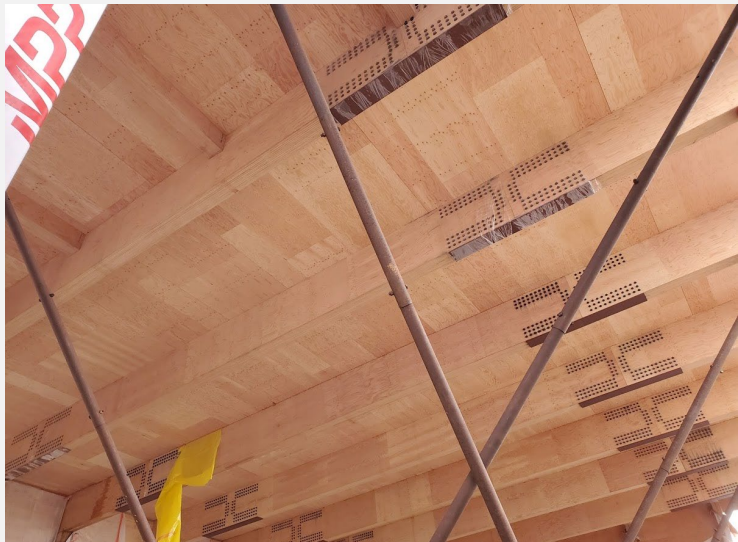
Region	Main wood species	Species density	Lumber GWP	Electricity Production
		kg/m^3	kg CO_2 eq./m^3	kg CO_2 eq./kWh
PNW	Douglas-fir & western hemlock	467	60.97	0.50
NE	E. Spruce & white pine	434	46.78	0.30
SE	Southern pine	510	85.03	0.80

CRADLE TO GATE (A1-A5) CARBON ACCOUNTING



SUMMARY

- There are many opportunities for reducing embodied carbon of buildings
  - Material choices
  - Building designs
  - Improvements and updates to building codes to reflect actual risk
  - Consistency in reporting comparative results through education and outreach



- Local wood sources and products to reduce transportation impacts
- Long service life, reuse, and recycling potential
- Design for deconstruction
- Replacing fossil-based materials and fuels with renewable materials and fuels

WOOD BUILDINGS AS A CARBON MITIGATION STRATEGY

- Lower the Embodied Carbon
- Substitution Benefits
- Long service Life
- Re-use

THANK YOU

- For full suite of LCA product reports please visit www.corrim.org/lcas-on-wood-products-library/

- Papers related to this talk today Special Issue Mass Timber and Sustainable Building Construction

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