Carbon Accounting & How We Can Build More Sustainably

Sustainable Forestry and the Environmental Attributes of Wood Structures

Presented by

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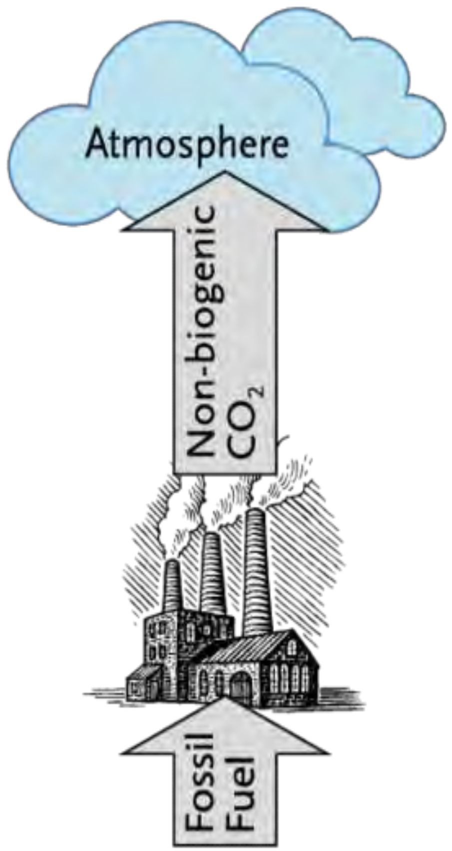
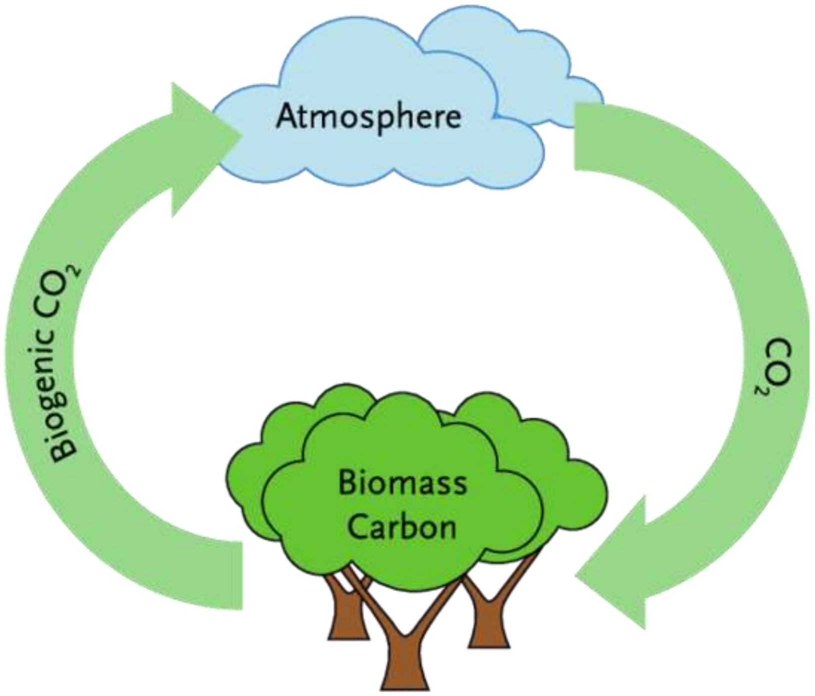
Life Cycle Assessment: Embodied Carbon and Biogenic Carbon





Fossil CO_2

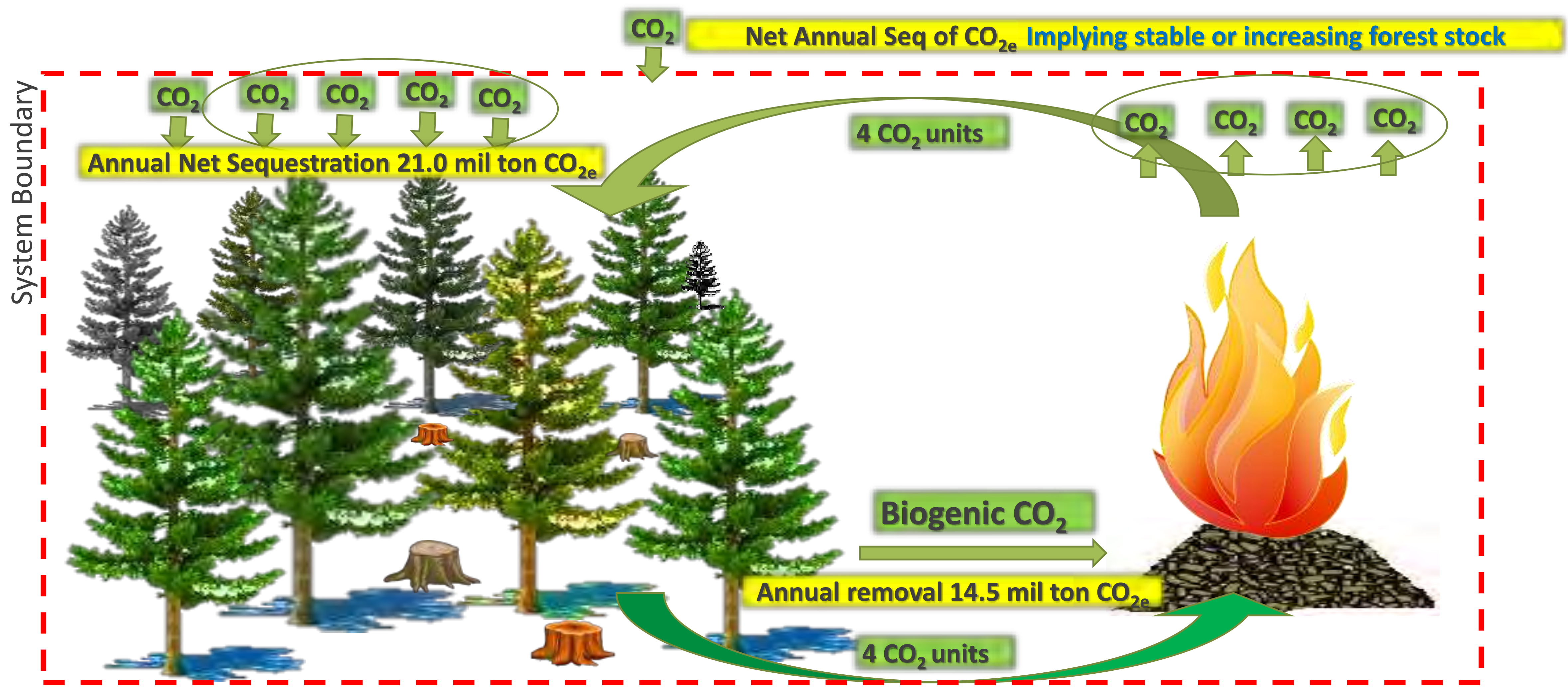
Biogenic CO_2

Biogenic Carbon Neutrality: Definition

1. **Carbon neutrality** as a property of wood or other biomass harvested from forests where **new growth *completely offsets*** losses of carbon caused by harvesting.
2. As carbon is released from harvested wood back into the atmosphere, usually as biogenic CO_2, growing trees are removing CO_2 from the atmosphere at a rate that completely offsets these emissions of biogenic CO_2, resulting in ***net biogenic CO_2 emissions of zero or less***.
3. A forest producing carbon neutral wood will have ***stable or increasing stocks of forest carbon***.
4. Forestland should continue to be forestland, either through plantation or natural regeneration (ensure no land use change).

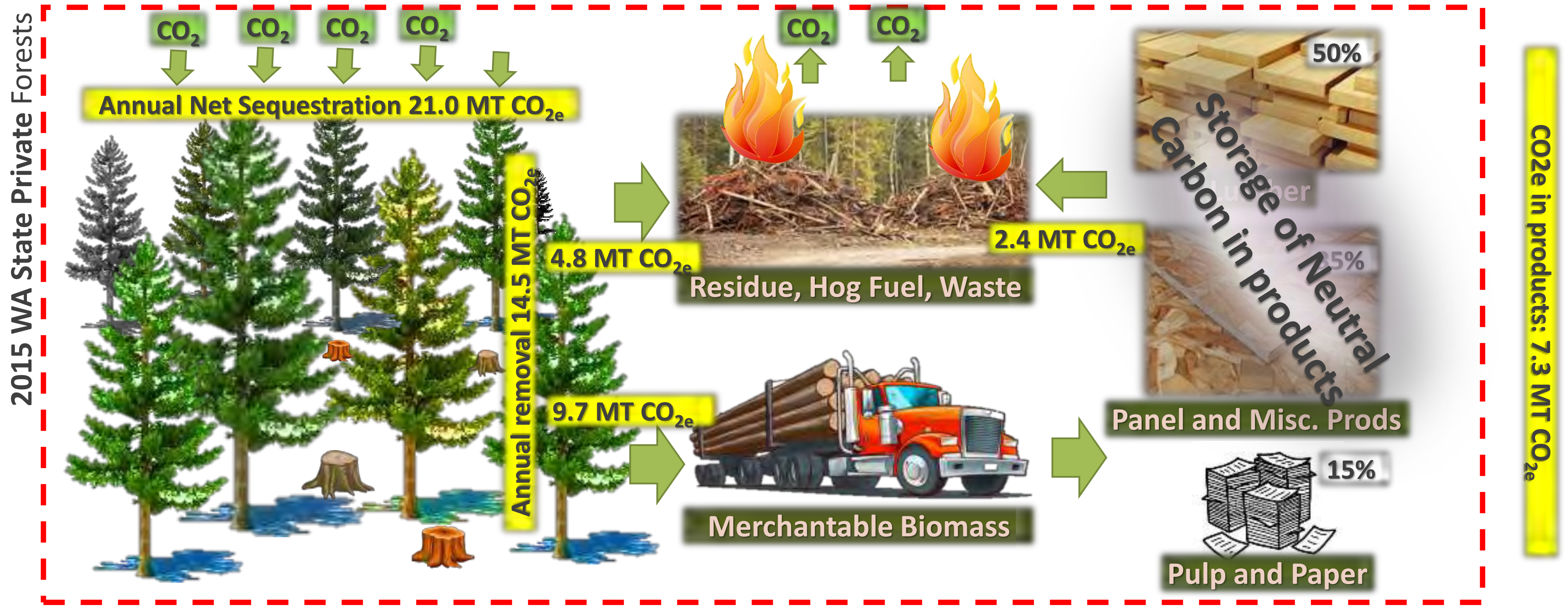
Definition by the Forest Solutions Group (FSG)

System Boundary and the LCA concept of neutrality

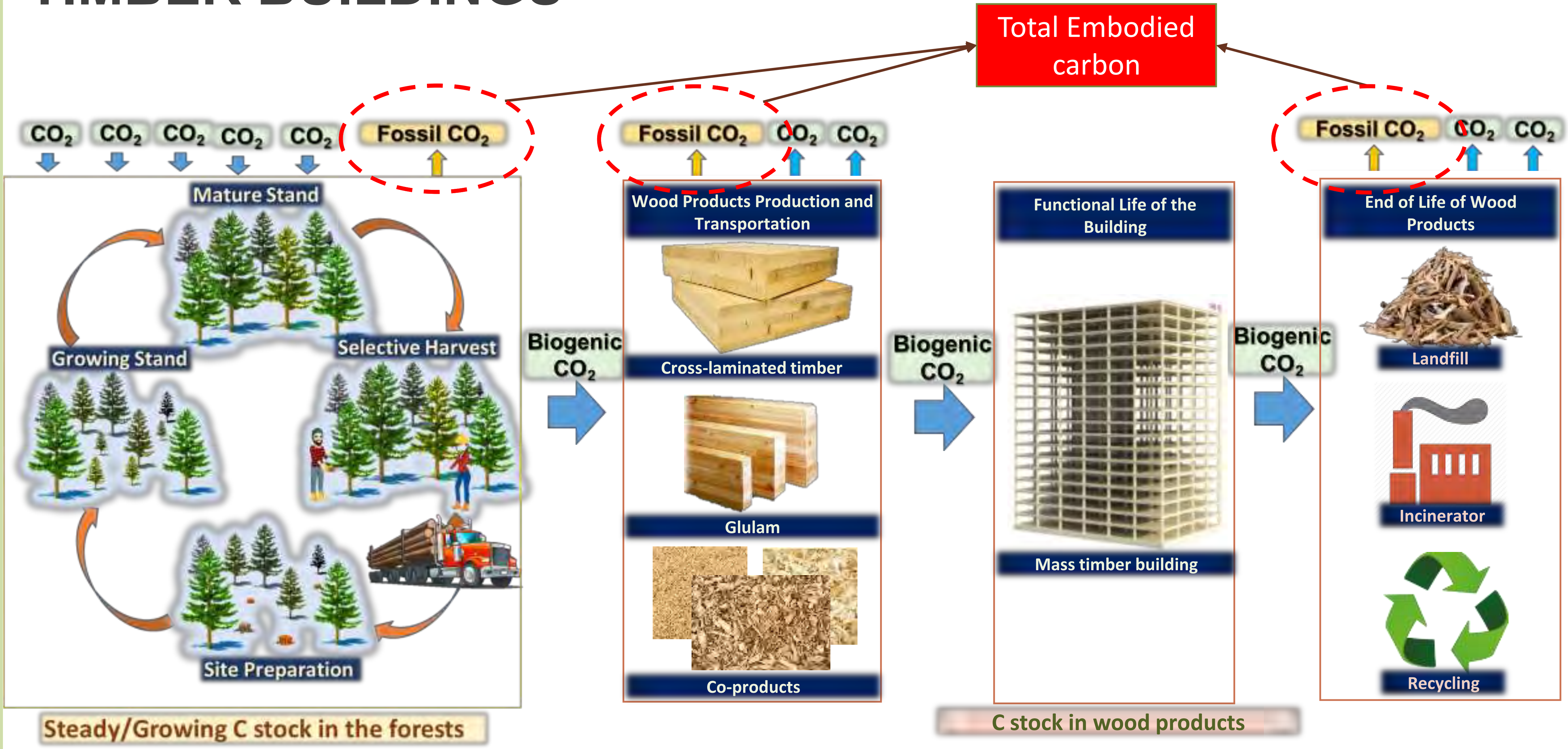


Biogenic Carbon Neutrality and Biogenic Carbon Storage

(e.g., of WA State)



LCA based Embodied Carbon Calculation of MASS TIMBER BUILDINGS

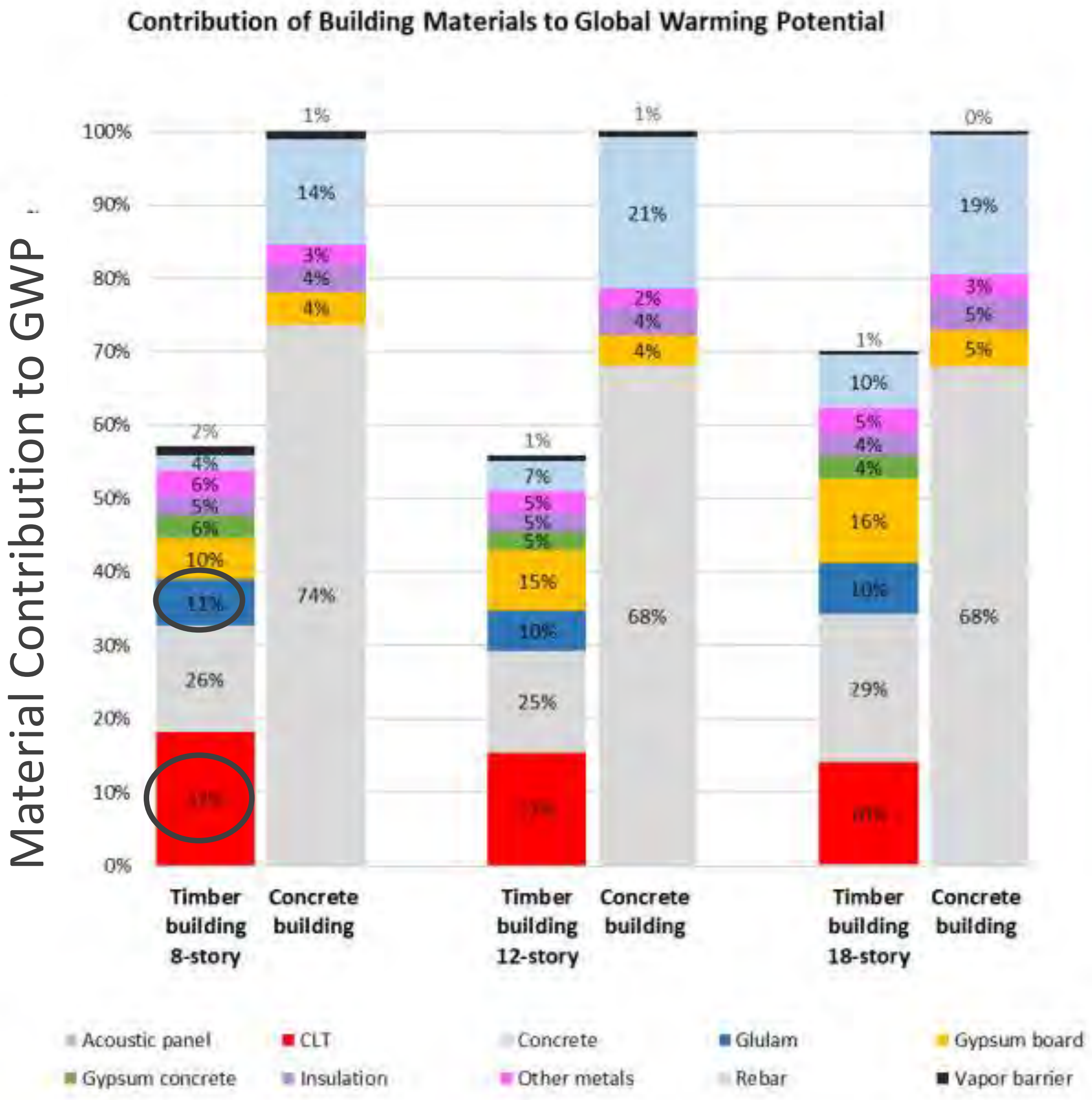


Functional equivalent buildings:
Mass Timber vs. Traditional Concrete Structural Designs

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

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

PNW Material Contribution to GWP



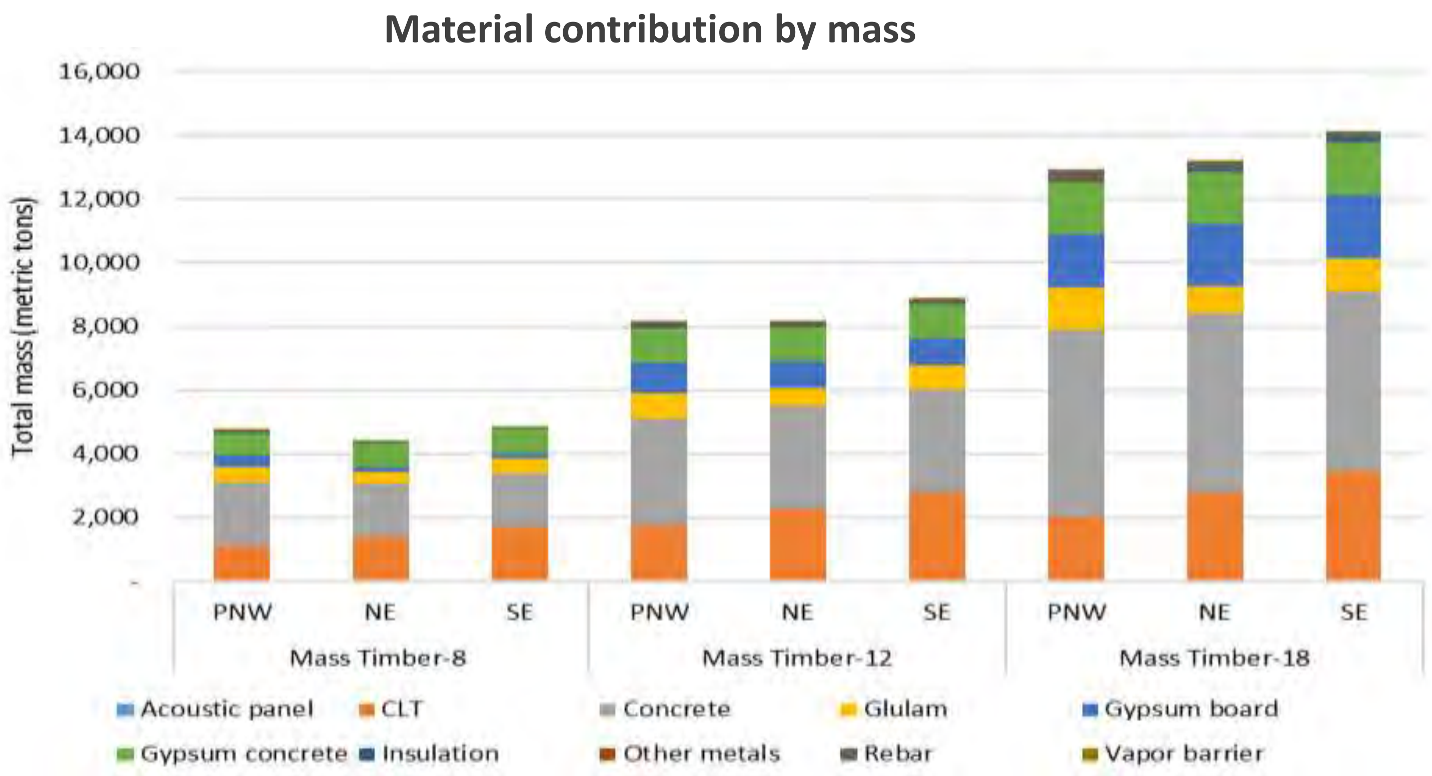
MT reduction in GWP

43% - 8 story

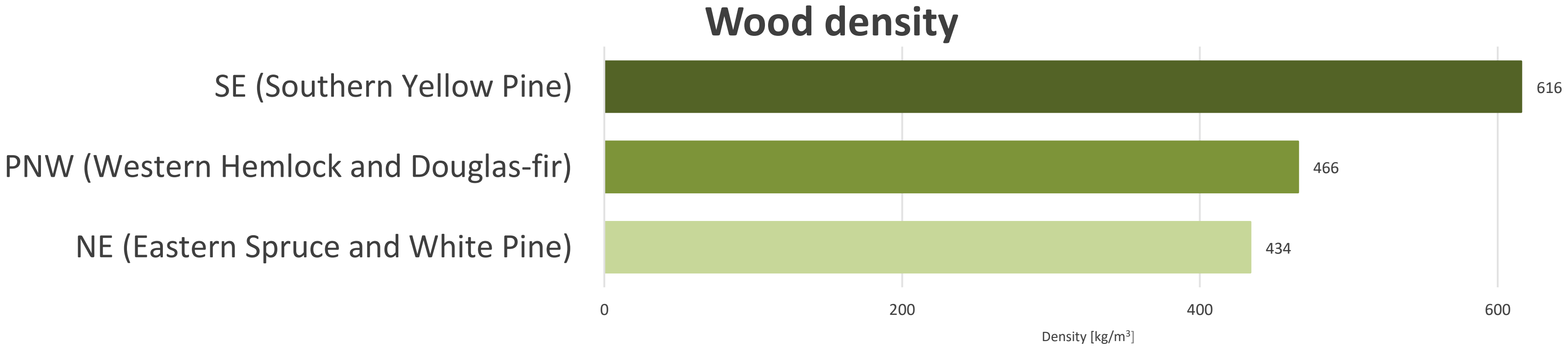
44% - 12 story

30% - 18 story

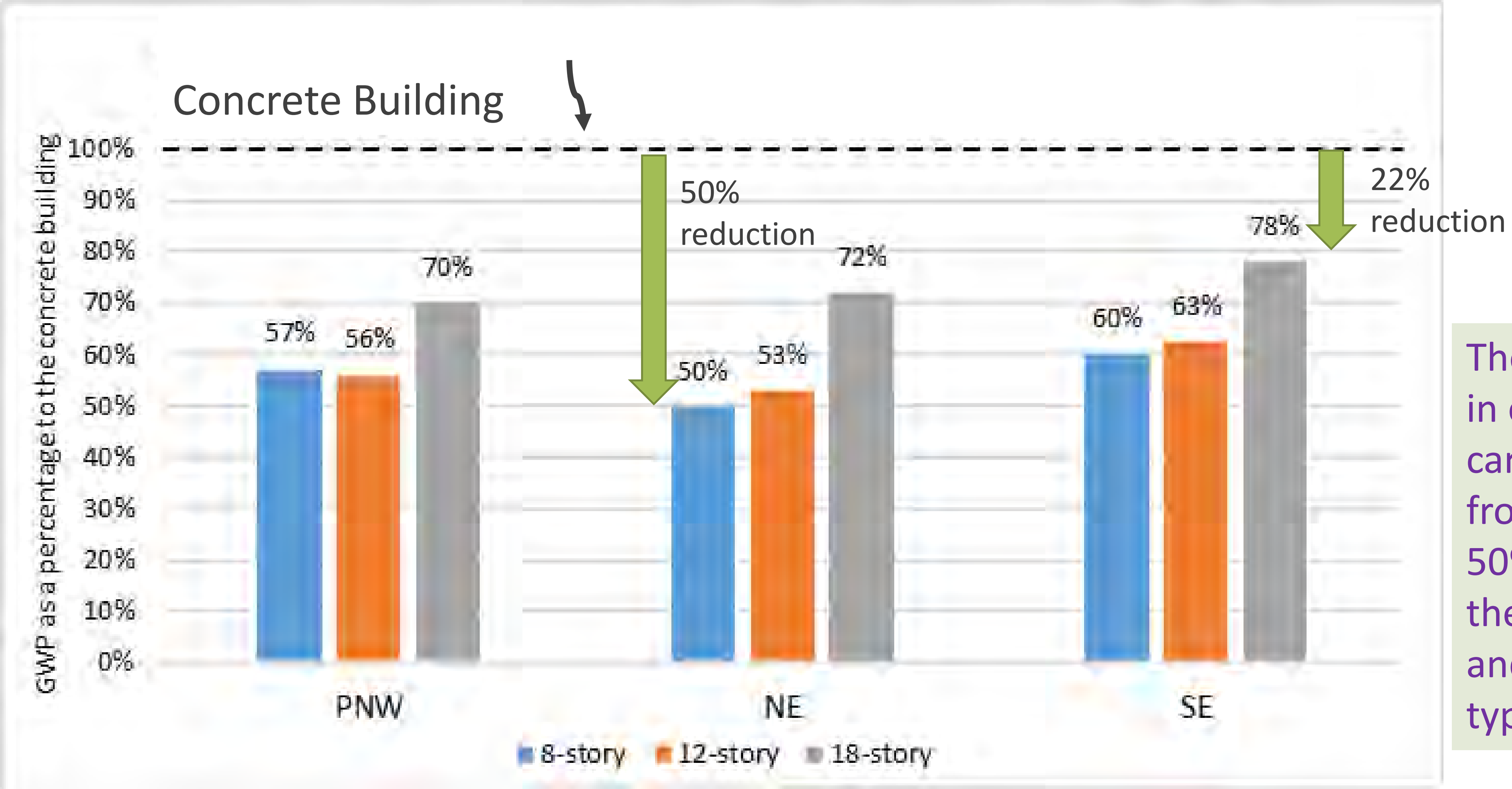
COMPARISON BETWEEN THE THREE CASE STUDIES



- **PNW uses more concrete and less mass timber** compared to SE and NE to meet the requirements of the **seismic design**.
- The three case studies use **wood species mix** with **density** values in the order: **SE > PNW > NE**.



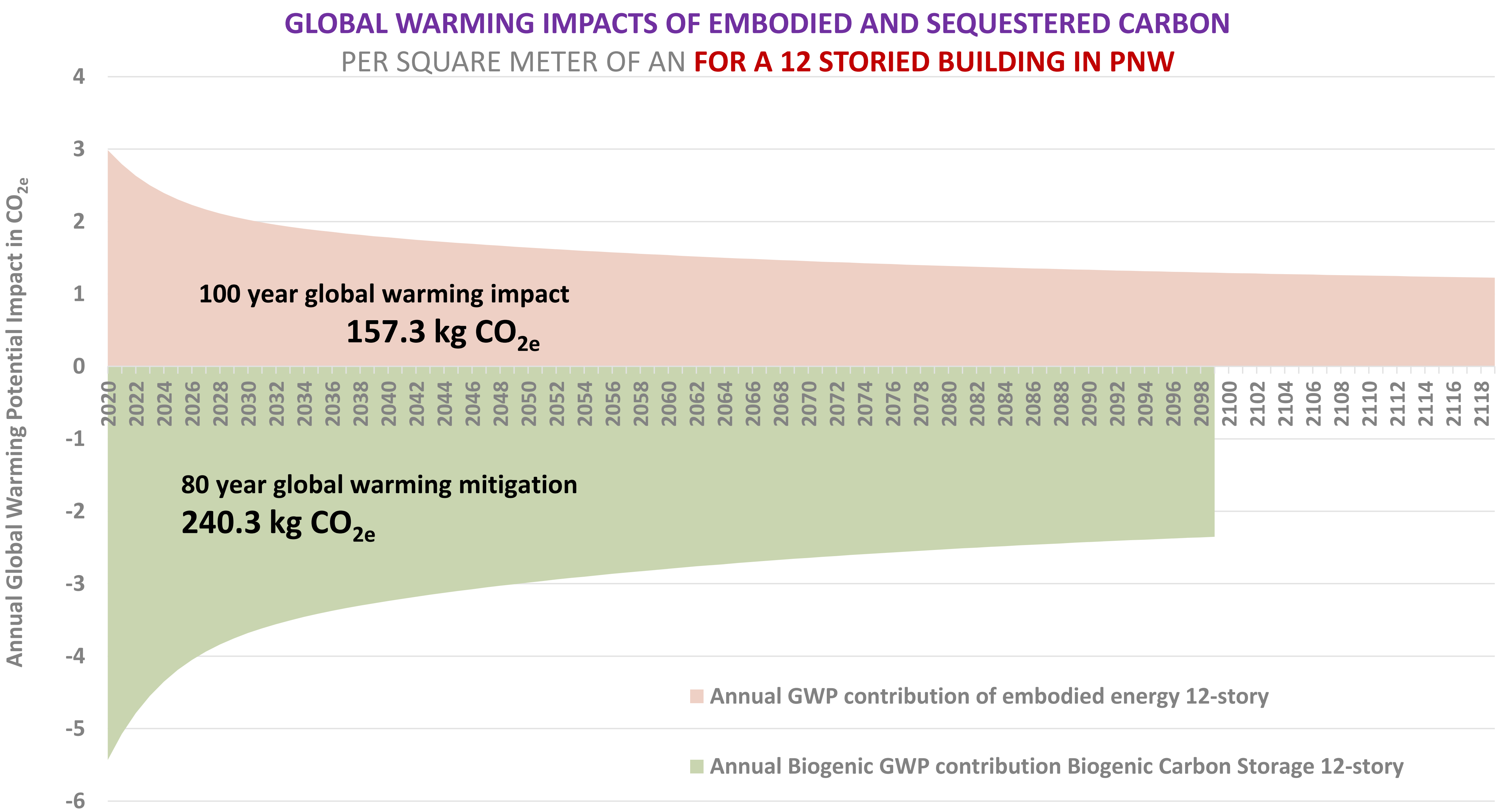
Results – embodied carbon



The reduction in embodied carbon ranged from 22% to 50% across all the regions and building types

GLOBAL WARMING IMPACTS OF EMBODIED AND SEQUESTERED CARBON

PER SQUARE METER OF AN **FOR A 12 STORIED BUILDING IN PNW**



GLOBAL WARMING IMPACTS OF EMBODIED AND SEQUESTERED CARBON
PER SQUARE METER OF AN FOR A 12 STORIED BUILDING IN PNW
Annual Global Warming Potential Impact in CO2e
4
3
2
1
0
-1
-2
-3
-4
-5
-6
100 year global warming impact
157.3 kg CO2e
80 year global warming mitigation
240.3 kg CO2e
2020
2022
2024
2026
2028
2030
2032
2034
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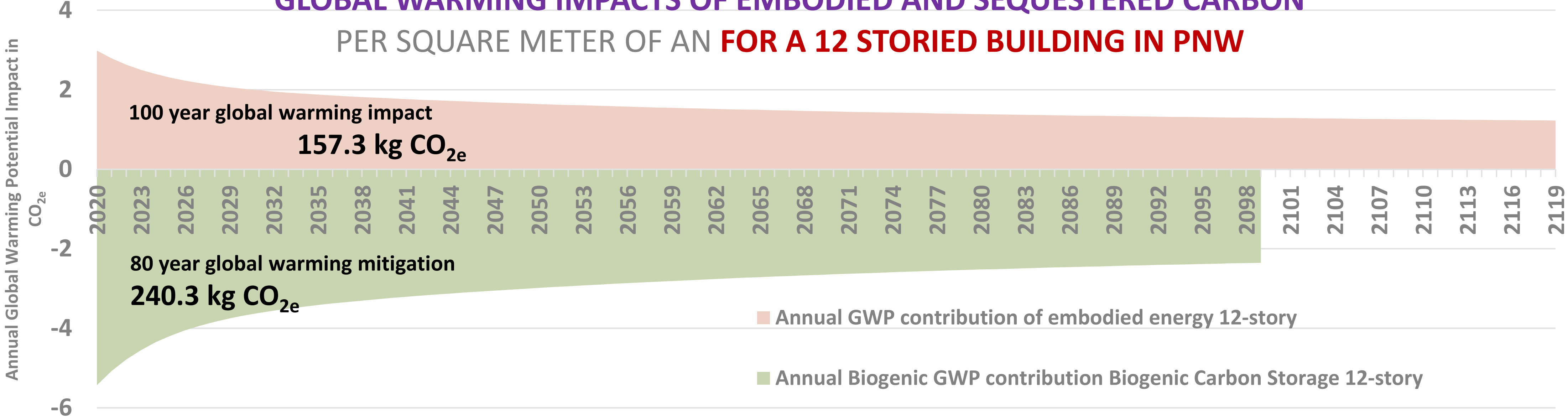
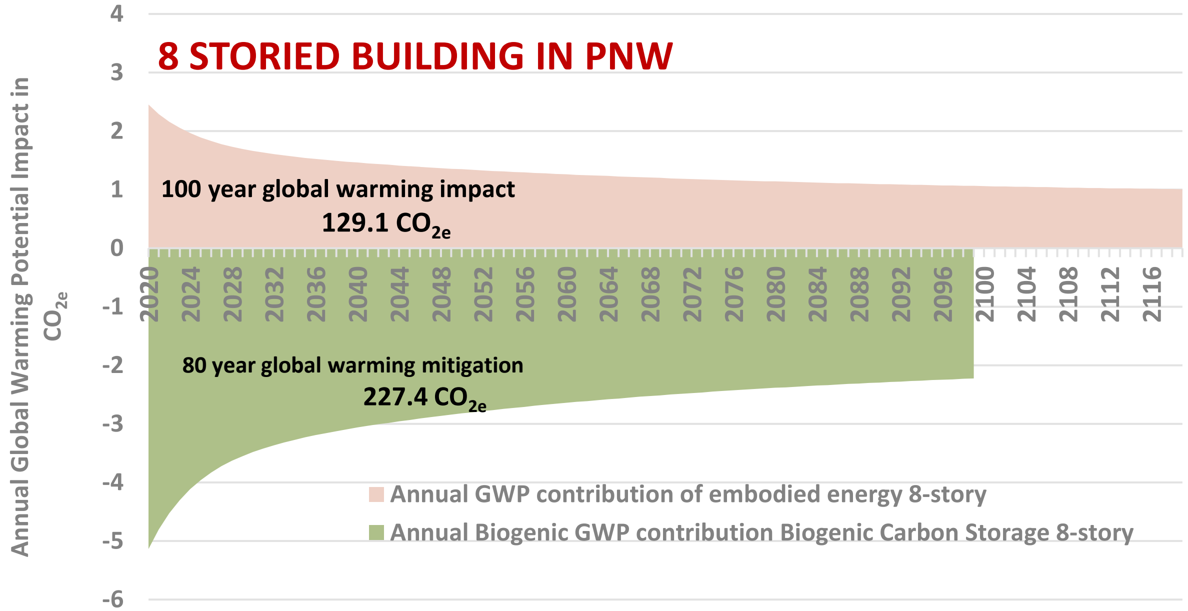
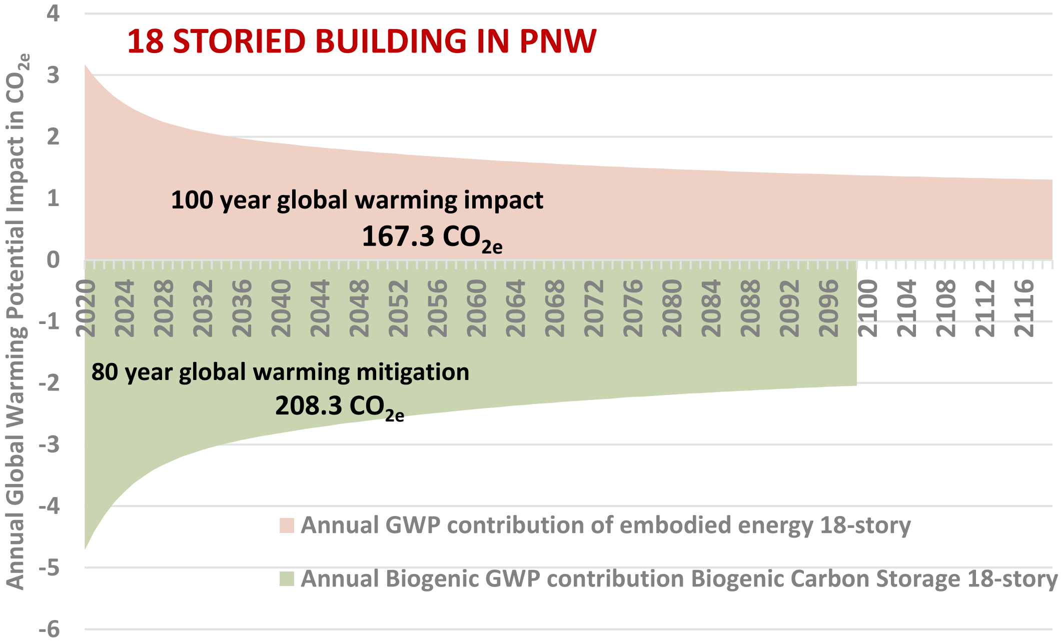
2108
2110
2112
2114
2116
2118
Annual GWP contribution of embodied energy 12-story
Annual Biogenic GWP contribution Biogenic Carbon Storage 12-story

GLOBAL WARMING IMPACTS OF EMBODIED AND SEQUESTERED CARBON

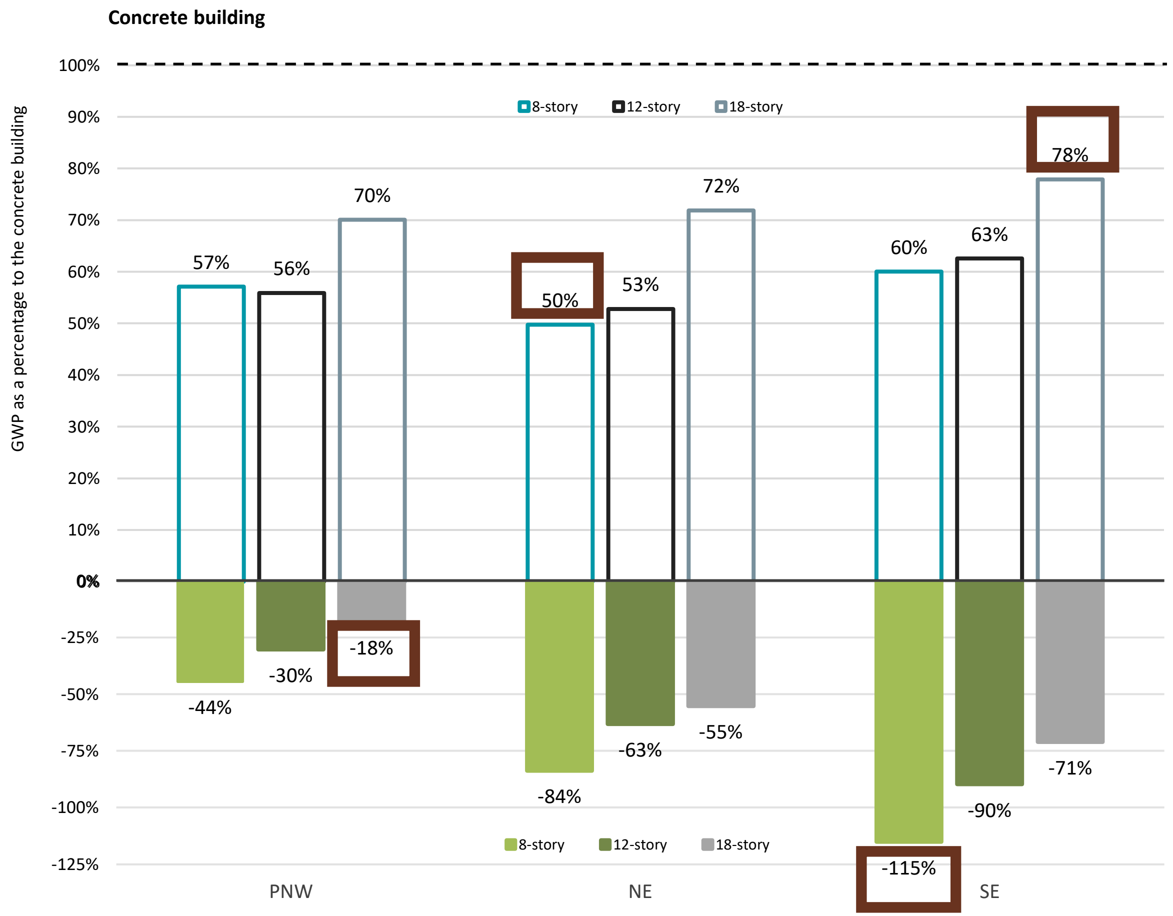
PER SQUARE METER OF AN **FOR A 12 STORIED BUILDING IN PNW**







NET GLOBAL WARMING POTENTIAL OF MASS TIMBER BUILDINGS COMPARED TO CONCRETE BUILDINGS



Building lifetime:

80 years

CONCLUSIONS

- **Including biogenic carbon storage benefits** in the GWP evaluation, and assuming a building life span of 80 years, mass timber buildings show **a net negative GWP** in all case studies and in all building designs.
- When considering only embodied carbon, CLT buildings may result in 22% - 50% reduction in global warming potential.
- However, when we factor in the benefits of long-term carbon storage, CLT buildings may account for 118% to 215% reduction in global warming potential as compared to traditional structures.

Thank you!

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END-OF-LIFE CONSIDERATIONS

- End of life (EoL) scenarios were not a part of Phase I of the current study, but they **can influence the overall environmental impact** of concrete and timber buildings.
- The **reuse of CLT and glulam** at the end of one building life into another building life or economically reprocess into new products for new applications will significantly influence the GW impacts.
- In the case of CLT, if panels can be directly reused, the **need for raw materials will be reduced** and will have a lower embodied carbon and energy at the start of its new “life”.
- This potential reuse of CLT not only reduces the impact of producing new materials, but also **extends the period of carbon stored in the wood**.
- The final treatment option of building materials is **strongly dependent on regional policies**.