LCAs & Wood: Environmental Impacts of Wood Throughout its Life Cycle

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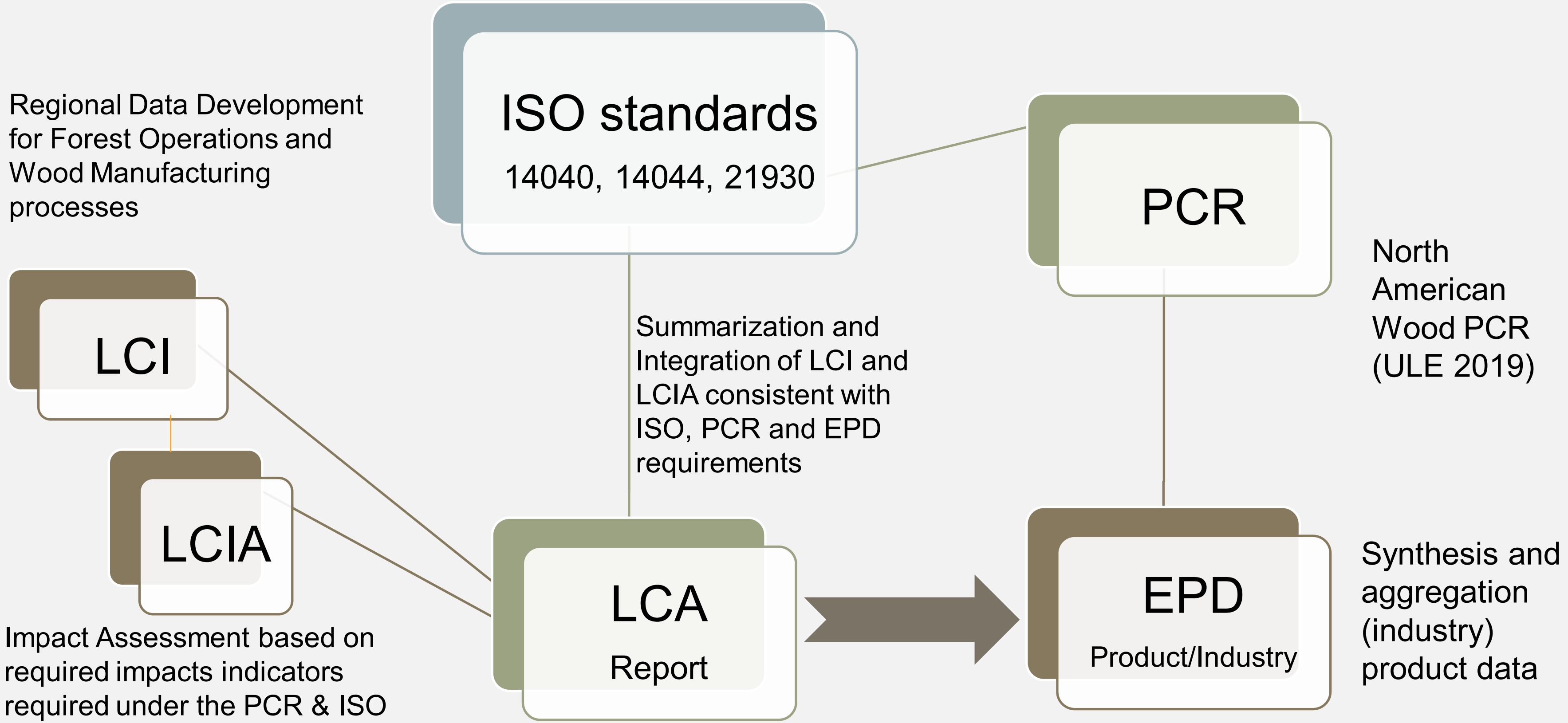
www.corrim.org

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

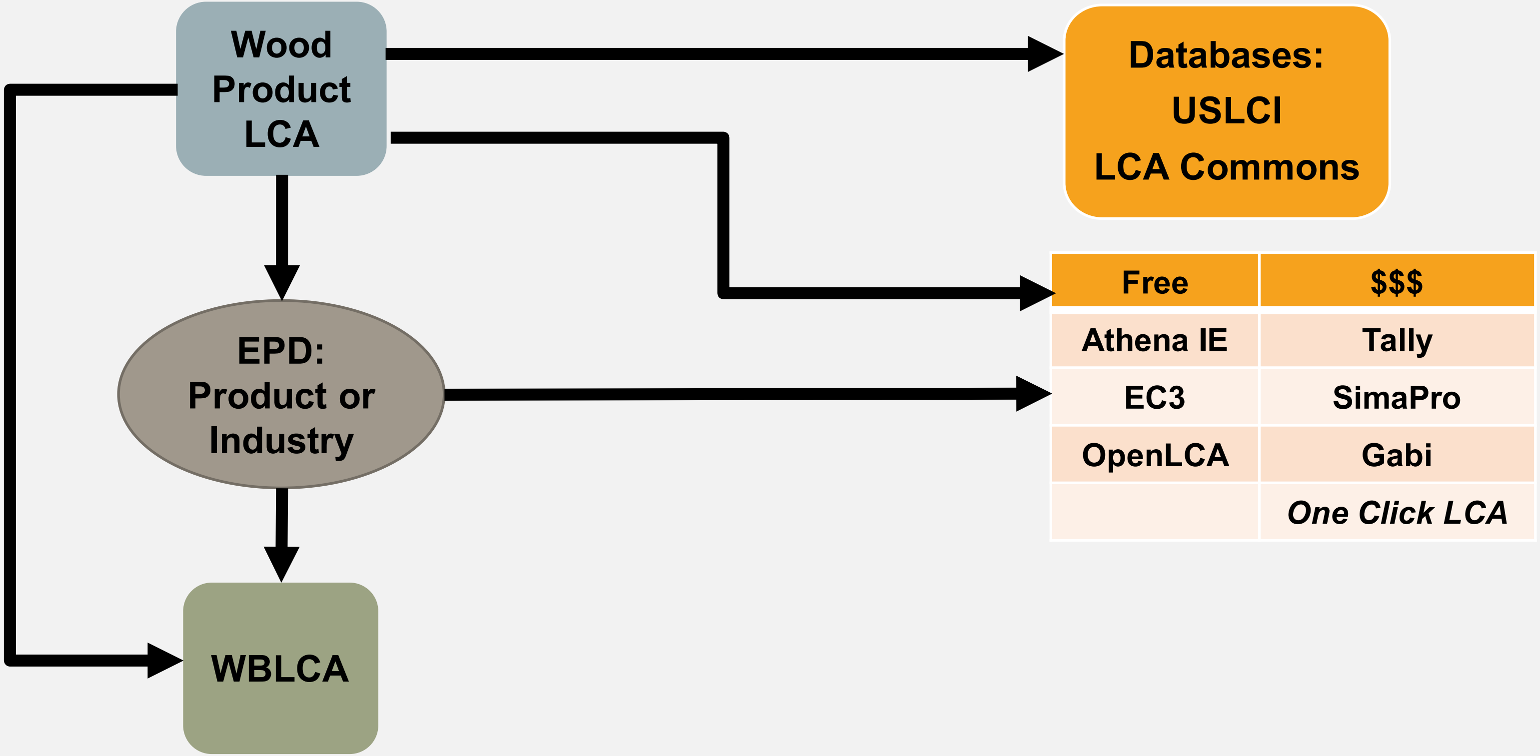
OUTLINE

- LCA Reporting Framework
- Wood Product LCAs
- Biogenic Carbon
- Whole Building LCAs
- The Future of Wood as a Building Material

WELL ESTABLISHED INTERNATIONAL FRAMEWORK & HIERARCHY

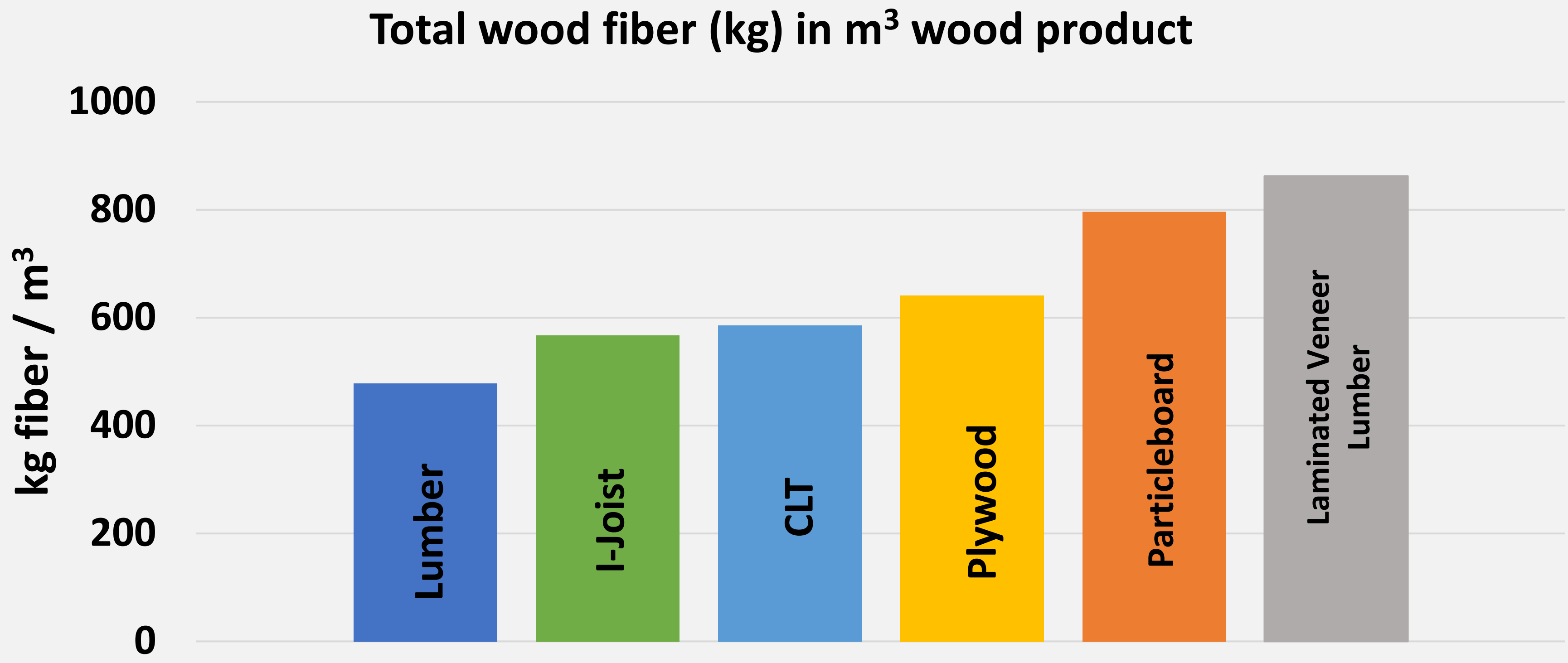


LCAs FROM WOOD PRODUCT TO WHOLE BUILDING

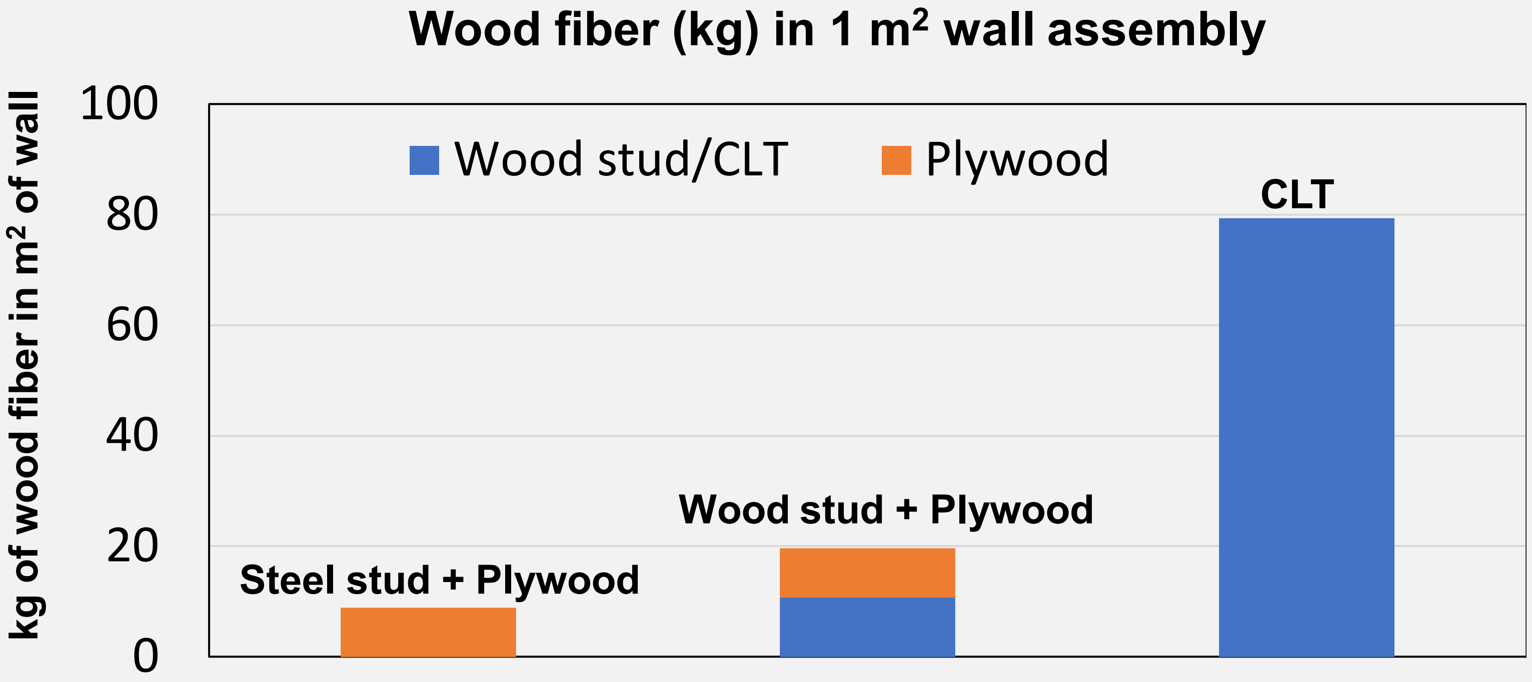


Free	$$$
Athena IE	Tally
EC3	SimaPro
OpenLCA	Gabi
	One Click LCA

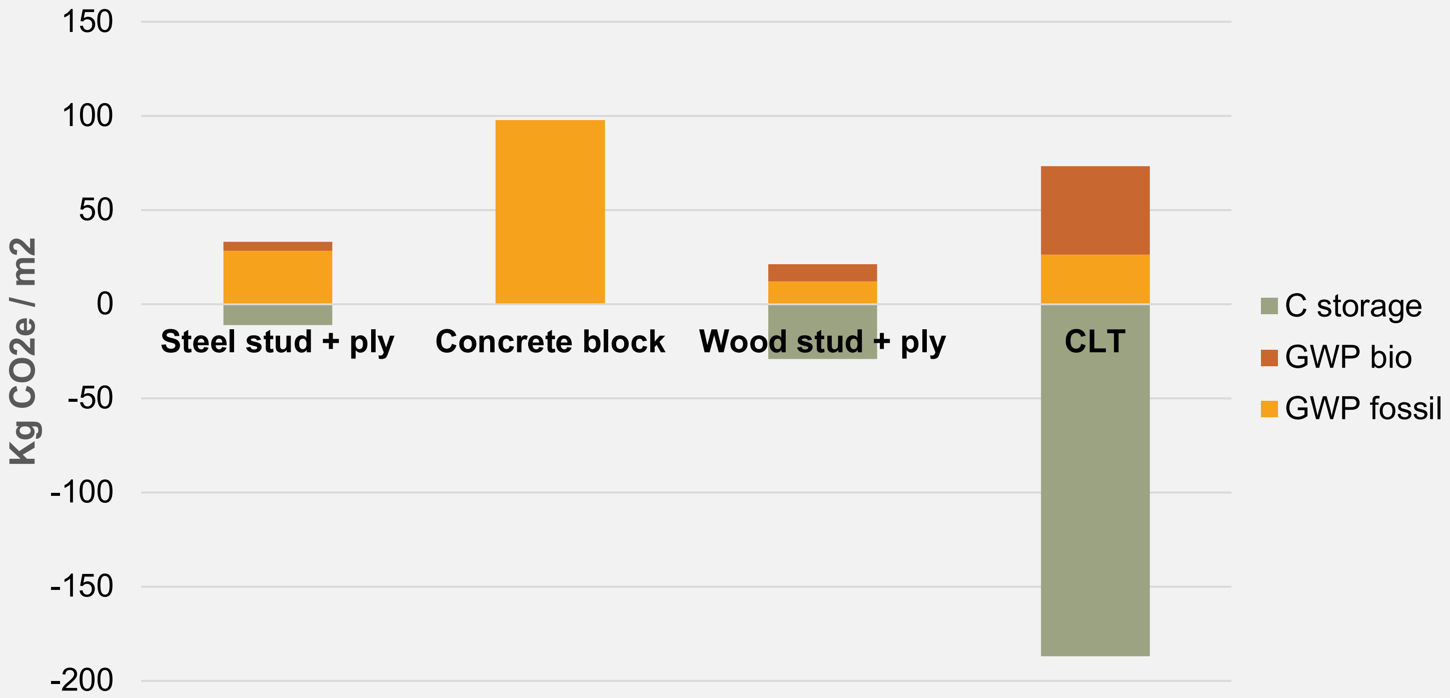
WOOD USE / VOLUME OF WOOD

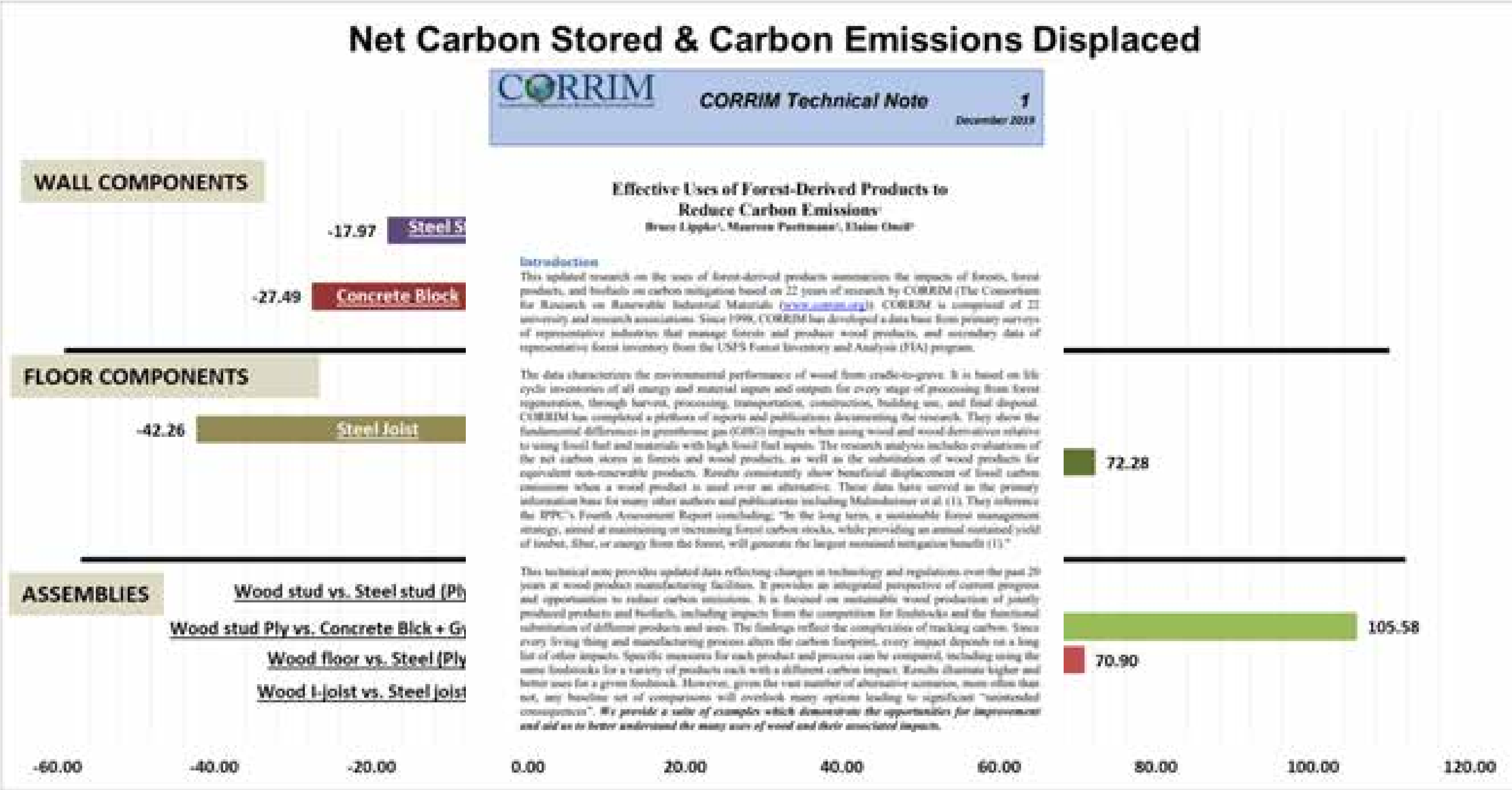


WOOD USE PER AREA



NET EMBODIED CARBON PER AREA





CORRIM **CORRIM Technical Note** **1**

December 2019

Effective Uses of Forest-Derived Products to Reduce Carbon Emissions

Bruce Lippke[1], Maureen Puettmann[1], Elaine Oneil[2]

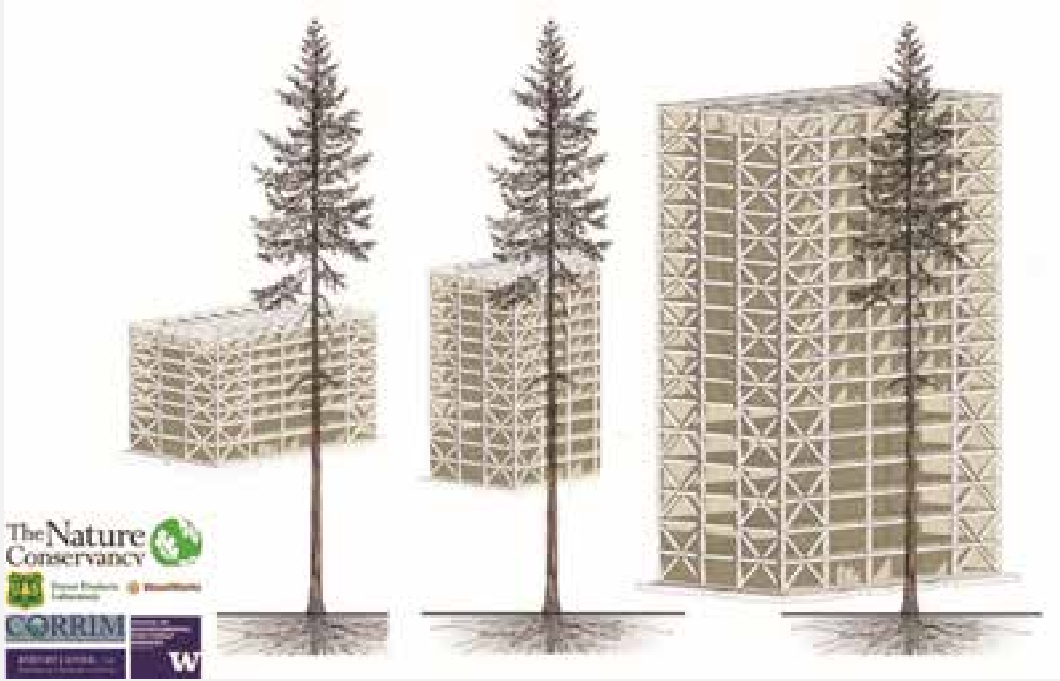
Introduction

This updated research on the uses of forest-derived products summarizes the impacts of forests, forest products, and biofuels on carbon mitigation based on 22 years of research by CORRIM (The Consortium for Research on Renewable Industrial Materials (www.corrim.org)). CORRIM is comprised of 22 university and research associations. Since 1998, CORRIM has developed a data base from primary surveys of representative industries that manage forests and produce wood products, and secondary data of representative forest inventory from the USFS Forest Inventory and Analysis (FIA) program.

The data characterizes the environmental performance of wood from cradle-to-grave. It is based on life cycle inventories of all energy and material inputs and outputs for every stage of processing from forest regeneration, through harvest, processing, transportation, construction, building use, and final disposal. CORRIM has completed a plethora of reports and publications documenting the research. They show the fundamental differences in greenhouse gas (GHG) impacts when using wood and wood derivatives relative to using fossil fuel and materials with high fossil fuel inputs. The research analysis includes evaluations of the net carbon stores in forests and wood products, as well as the substitution of wood products for equivalent non-renewable products. Results consistently show beneficial displacement of fossil carbon emissions when a wood product is used over an alternative. These data have served as the primary information base for many other authors and publications including Malmsheimer et al. (1). They reference the IPPC's Fourth Assessment Report concluding: "In the long term, a sustainable forest management strategy, aimed at maintaining or increasing forest carbon stocks, while providing an annual sustained yield of timber, fiber, or energy from the forest, will generate the largest sustained mitigation benefit (1)."

This technical note provides updated data reflecting changes in technology and regulations over the past 20 years at wood product manufacturing facilities. It provides an integrated perspective of current progress and opportunities to reduce carbon emissions. It is focused on sustainable wood production of jointly produced products and biofuels, including impacts from the competition for feedstocks and the functional substitution of different products and uses. The findings reflect the complexities of tracking carbon. Since every living thing and manufacturing process alters the carbon footprint, every impact depends on a long list of other impacts. Specific measures for each product and process can be compared, including using the same feedstocks for a variety of products each with a different carbon impact. Results illustrate higher and better uses for a given feedstock. However, given the vast number of alternative scenarios, more often than not, any baseline set of comparisons will overlook many options leading to significant "unintended consequences". ***We provide a suite of examples which demonstrate the opportunities for improvement and aid us to better understand the many uses of wood and their associated impacts.***

WHOLE BUILDING LCA
TNC STUDY PHASE I

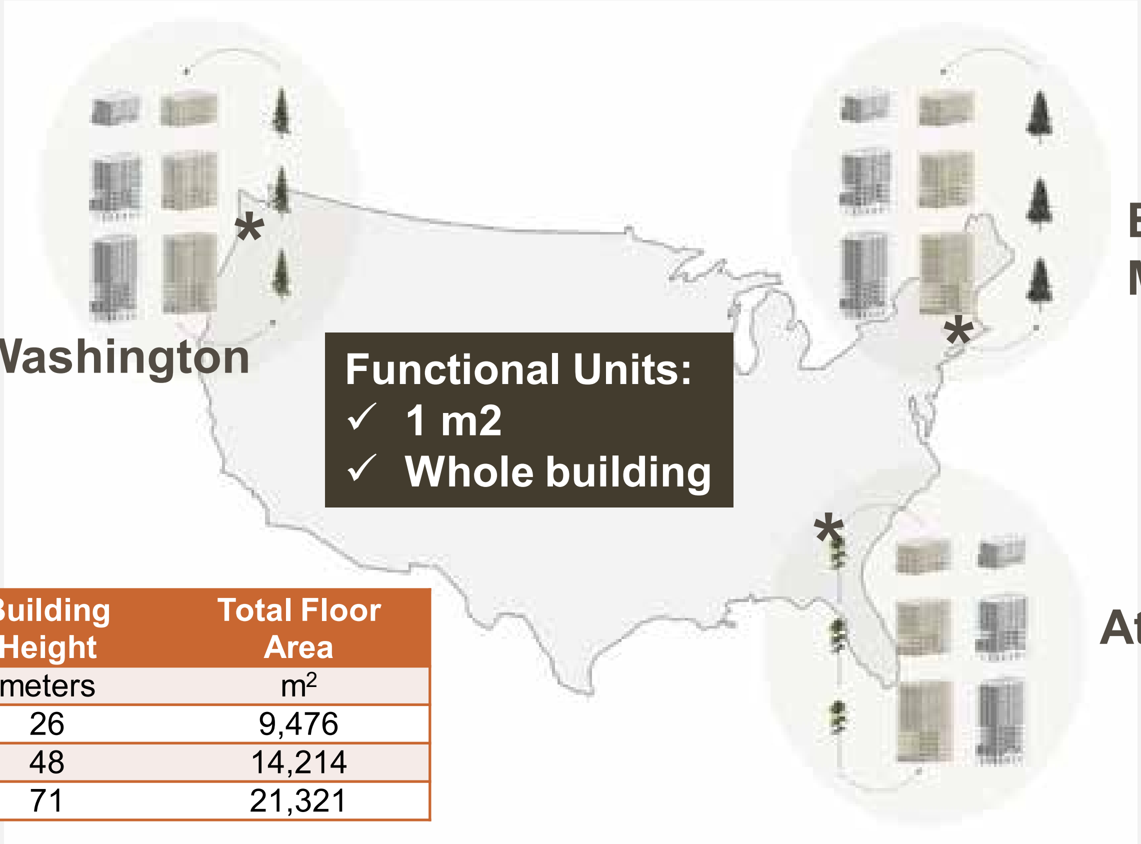


THE US LCA TEAM – PHASE I

atelierjones, LLC - *Susan Jones, Ian Maples, & Olga Amigud*
University of Washington - *Cindy Chen, Francesca Pierobon, & Indroneil Ganguly*
USDA Forest Product Laboratory - *Hongmei Gu & Shaobo Liang*
CORRIM – *Maureen Puettmann*
TNC - *Mark Wishnie (BTG), Rachel Pasternack, Guy Lomax (Exeter University), & Barry Ulrich*

Other contributors
WoodWorks - *Scott Brenneman, Richard McLain, & Ethan Martin*
Coldstream Consulting – *James Salazar*
USDA Forest Products Laboratory – *Marco Lo Ricco*

METHODS - BUILDING LOCATIONS



Seattle, Washington

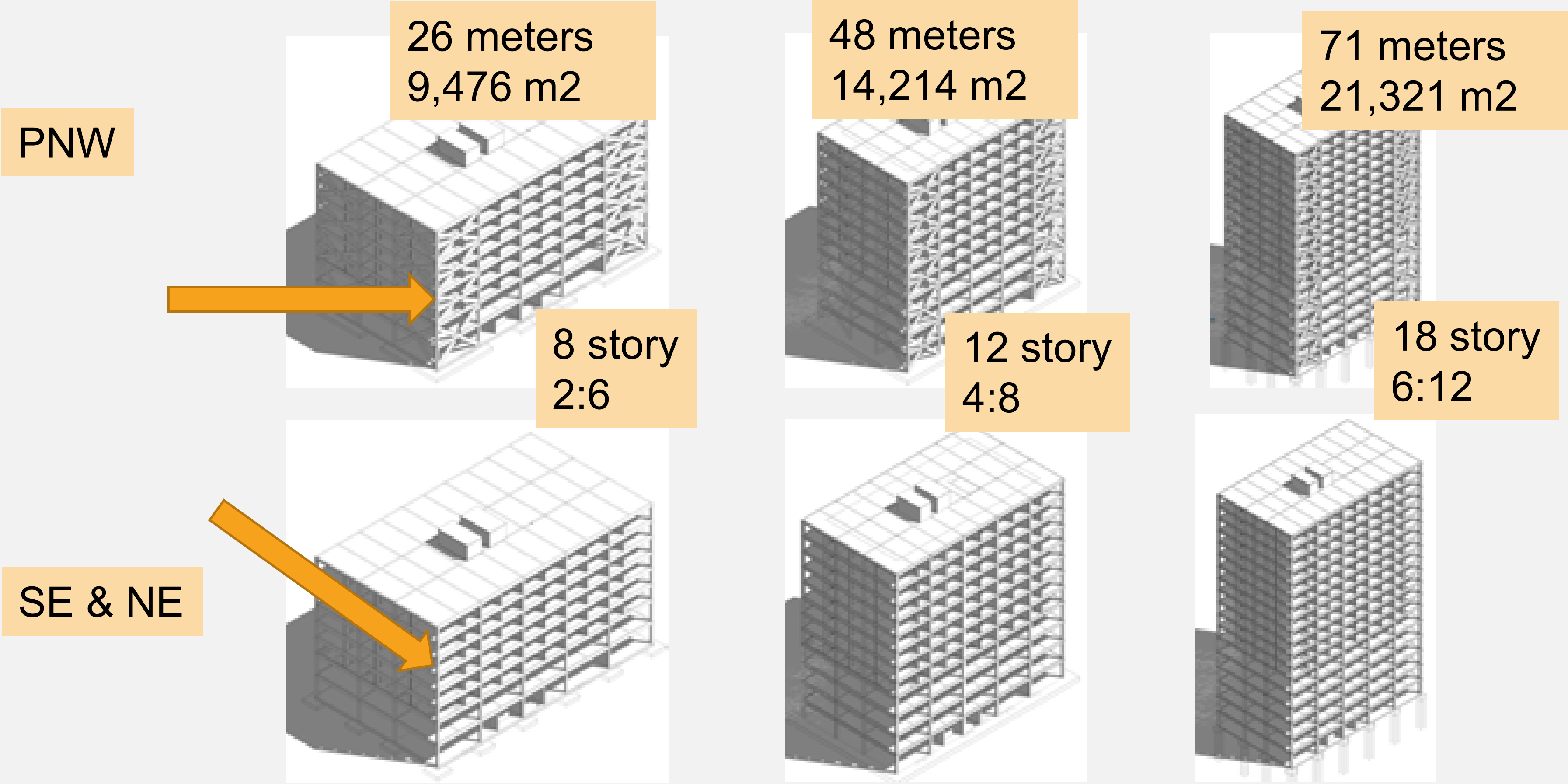
Boston, Massachusetts

Atlanta, Georgia

Functional Units:
- ✓ 1 m2
- ✓ Whole building

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

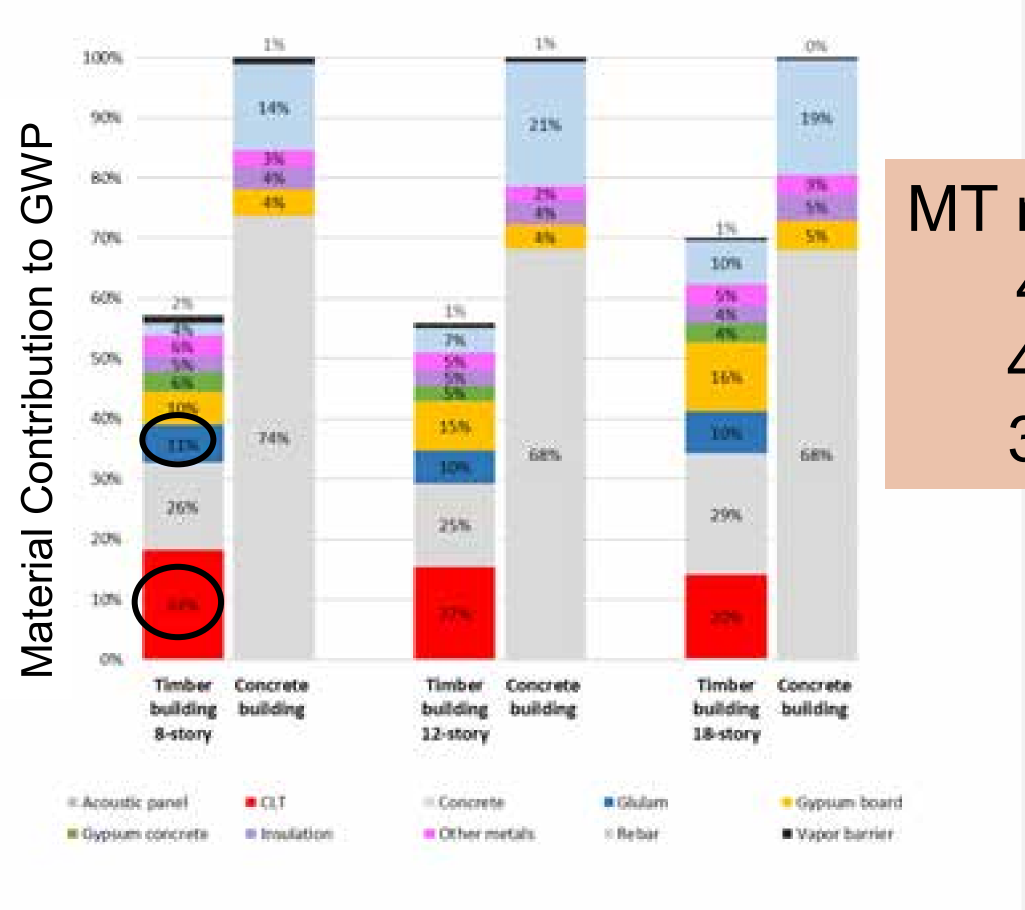
BUILDING DIFFERENCES



METHODS – LCA SCOPE

- LCA is a cradle to gate (A1-A5) analysis of the materials effects of structure, envelope, and interior walls or timber and concrete building designs.
  - A1-resource extraction,
  - A2-transportation of materials to product manufacturing,
  - A3-Product manufacturing,
  - A4 -transportation of materials to construction site, and
  - A5-construction energy use
  - C1-C4 – DID NOT INCLUDE EOL IN PHASE I
- Functional equivalent buildings: Mass Timber vs. Traditional Concrete Structural Designs
- SimaPro software tool using CORRIM, Datasmart, and Ecoinvent databases

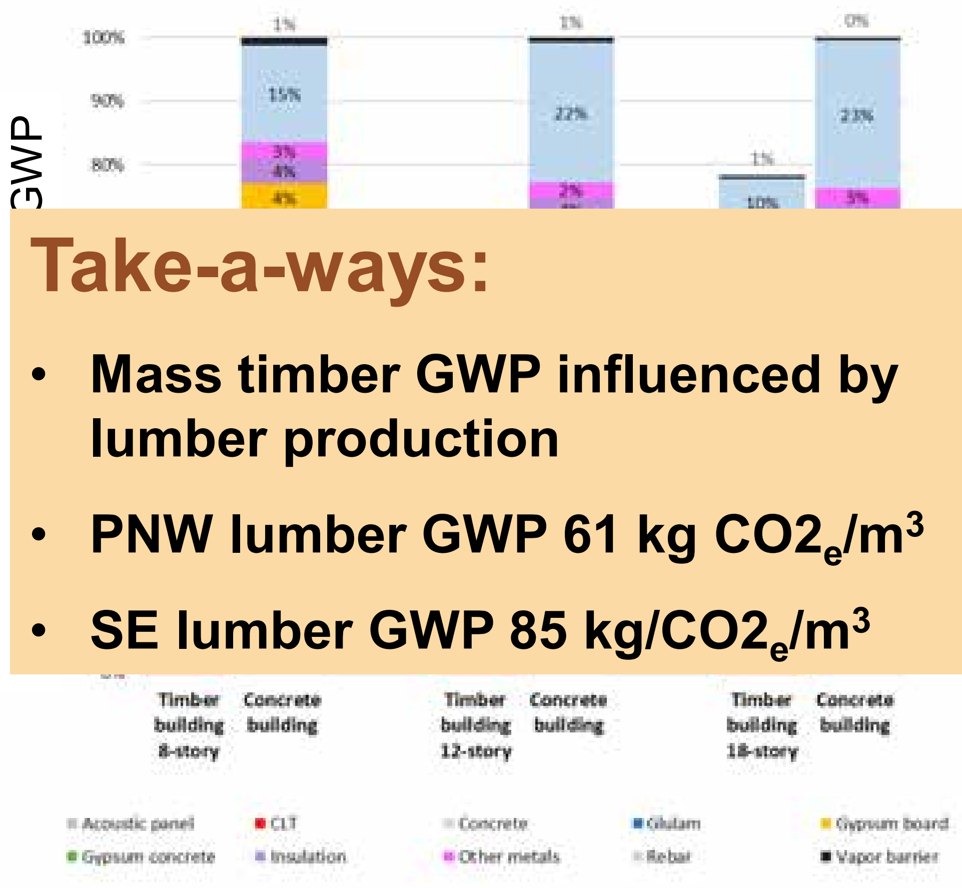
PNW MATERIAL CONTRIBUTION TO GWP



33%

MT reduction in GWP
43% - 8 story
44% - 12 story
30% - 18 story

SE MATERIAL CONTRIBUTION TO GWP



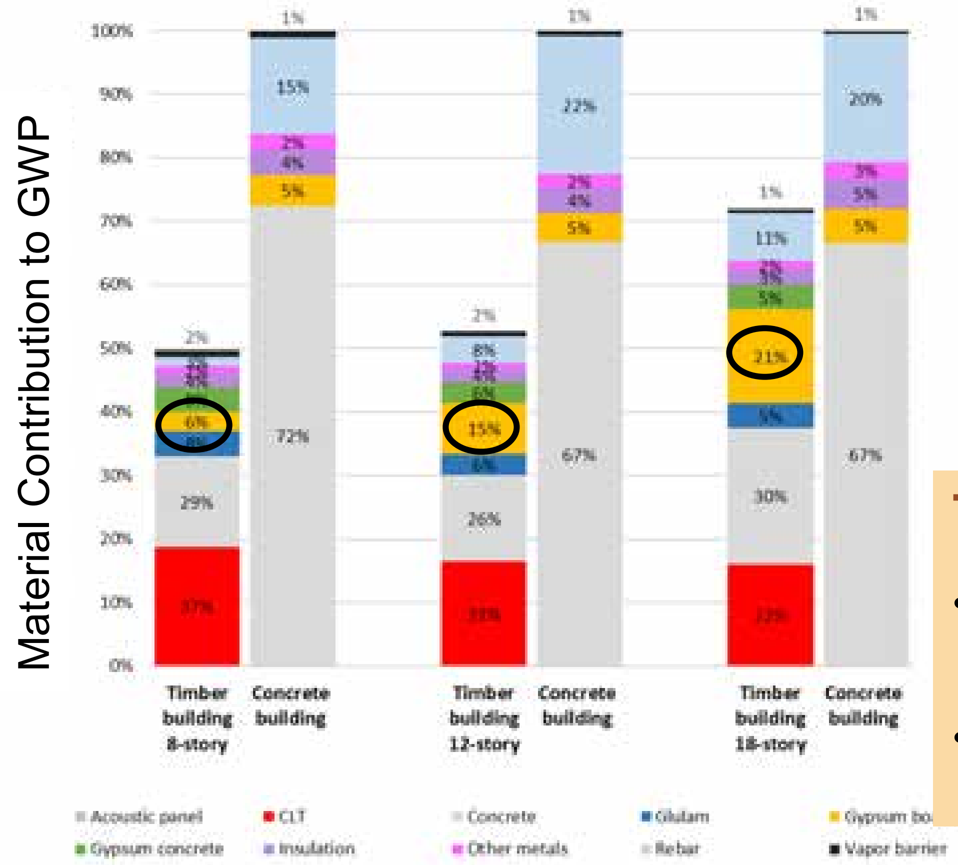
59%

Take-a-ways:

- **Mass timber GWP influenced by lumber production**
- **PNW lumber GWP 61 kg $CO2_e/m^3$**
- **SE lumber GWP 85 kg/$CO2_e/m^3$**

duction in GWP
)% - 8 story
% - 12 story
% - 18 story

NE MATERIAL CONTRIBUTION TO GWP



MT reduction in GWP

50% - 8 story

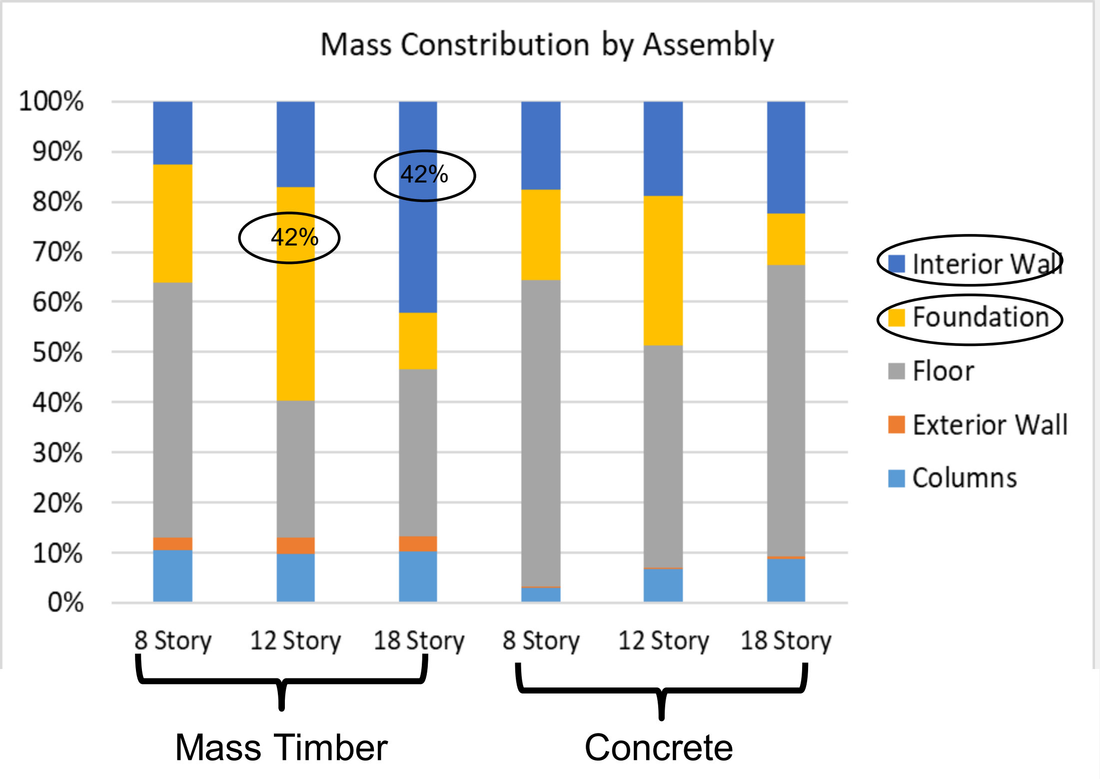
47% - 12 story

28% - 18 story

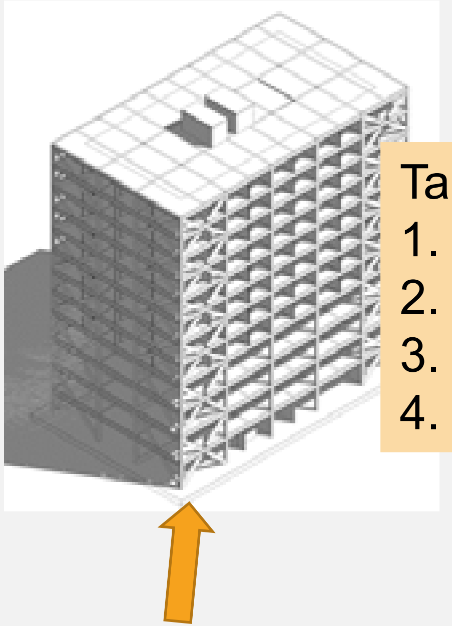
Take-a-ways:

- **Gypsum board contributes 4-21% of the GWP in the <u>Whole Building</u>**
- **While only representing 3-15% of the mass in MT buildings**

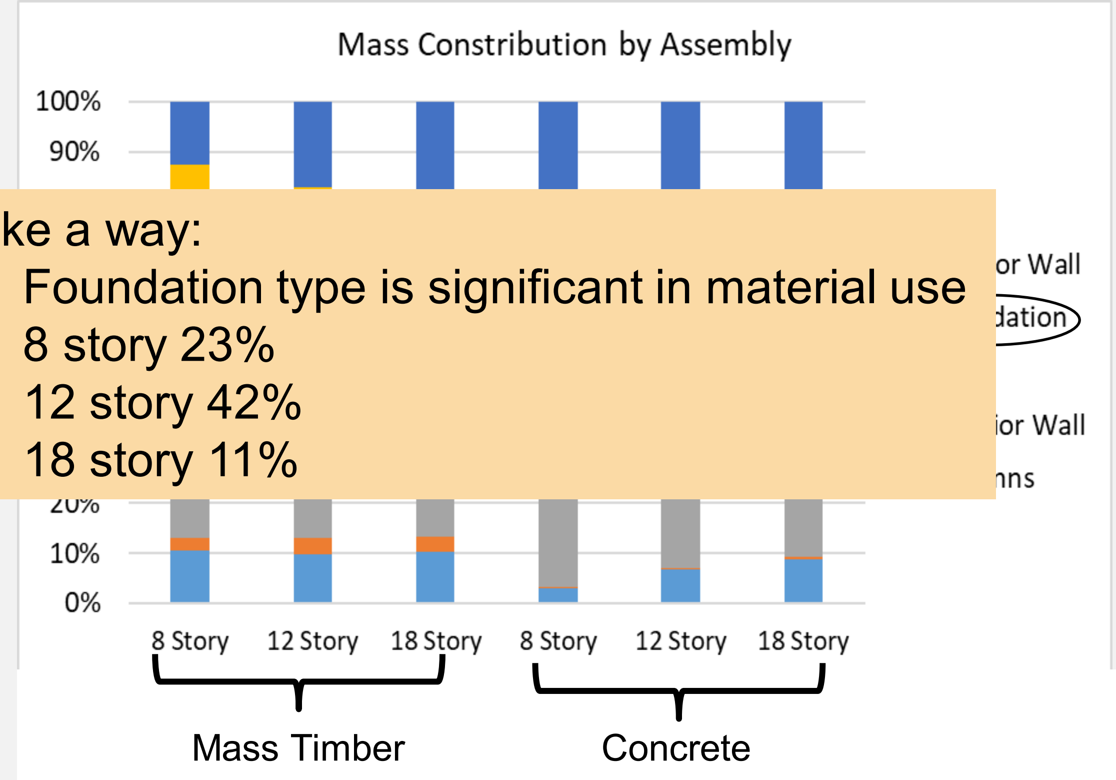
PNW – ASSEMBLY CONTRIBUTION: BY MASS AND TO GWP



PNW – ASSEMBLY CONTRIBUTION: BY MASS AND TO GWP



Mat footing

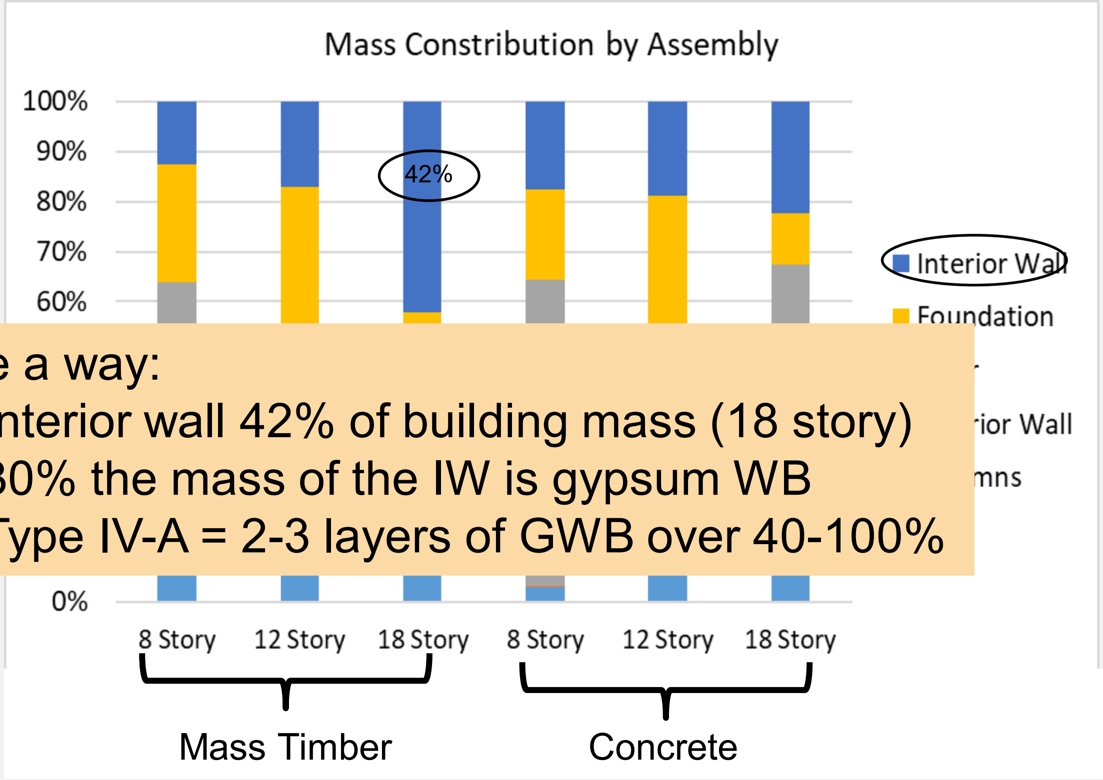


Take a way:

1. Foundation type is significant in material use
2. 8 story 23%
3. 12 story 42%
4. 18 story 11%

PNW – ASSEMBLY CONTRIBUTION: BY MASS AND TO GWP

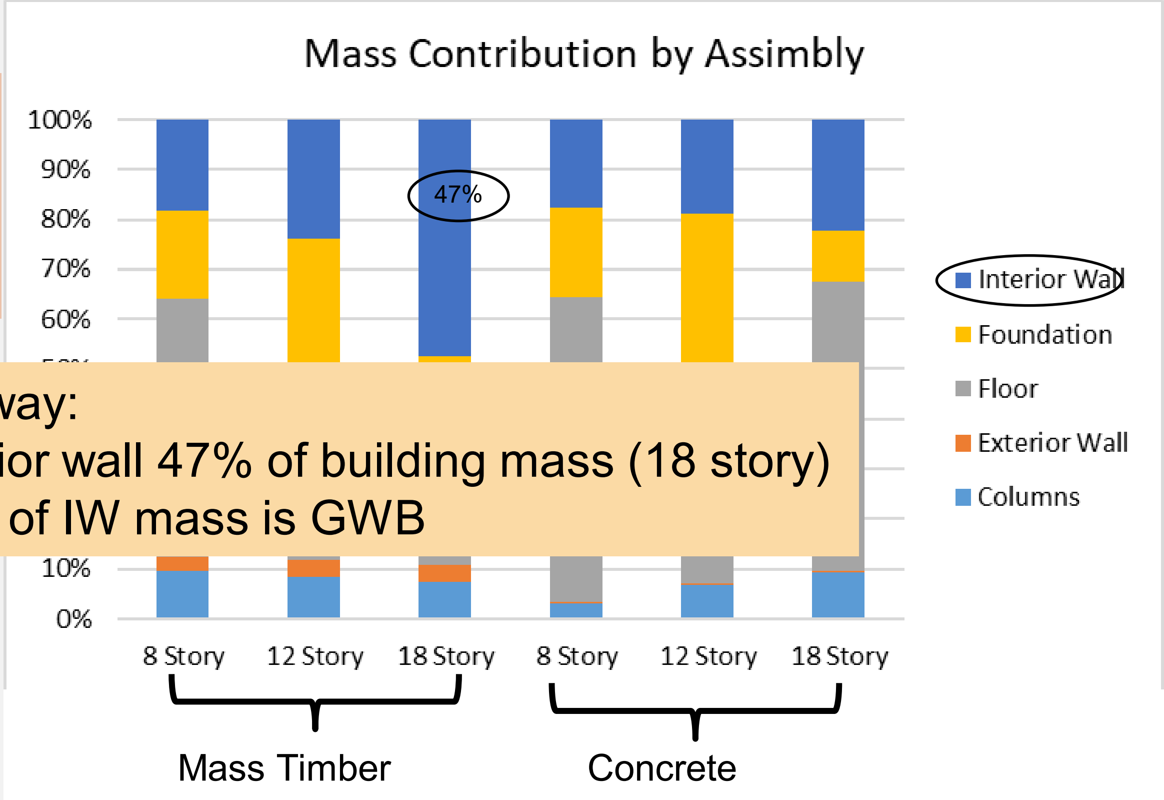
Interior Wall by Mass
Concrete 65%
GWB 30%
Other 5%



Take a way:
1. Interior wall 42% of building mass (18 story)
2. 30% the mass of the IW is gypsum WB
3. Type IV-A = 2-3 layers of GWB over 40-100%

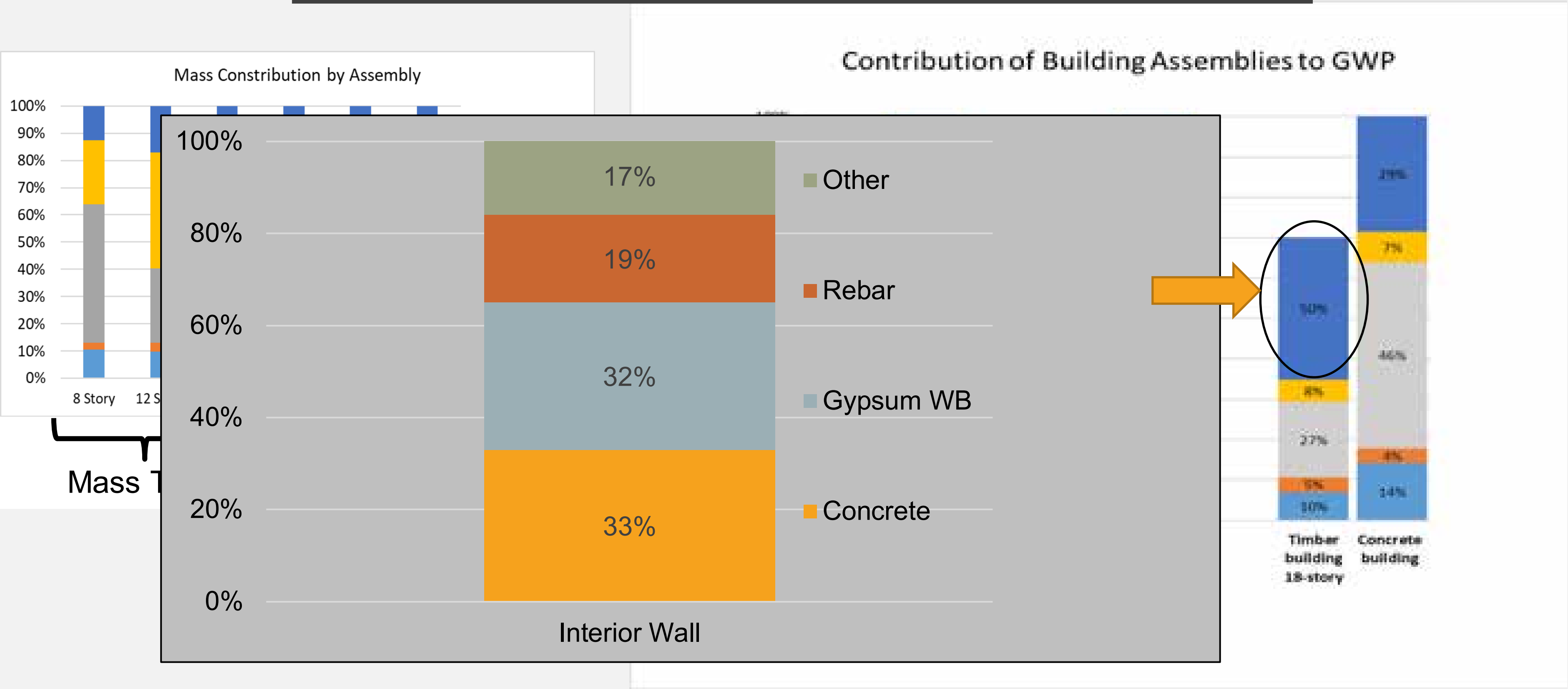
SE – ASSEMBLY CONTRIBUTION: BY MASS AND TO GWP

Interior Wall by Mass
Concrete 51%
Mass timber 17%
GWB 29%
Other 4%

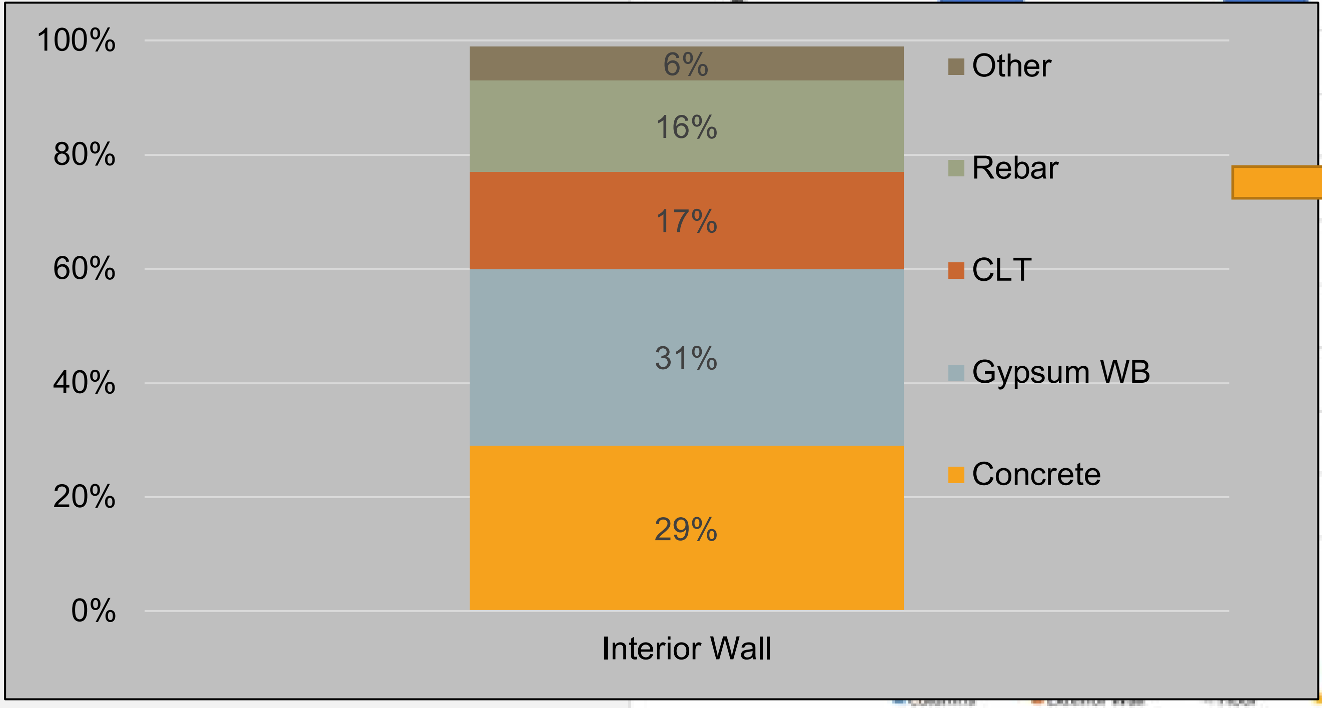


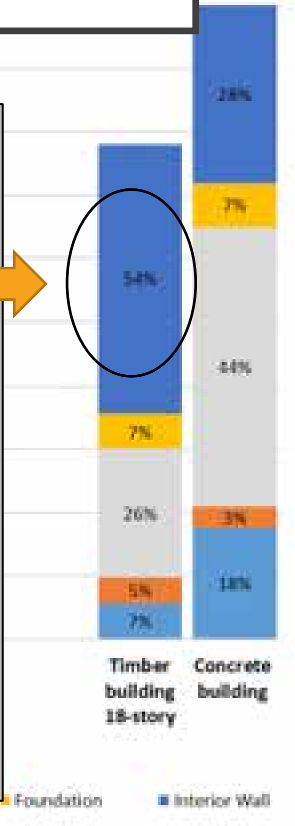
Take a way:
1. Interior wall 47% of building mass (18 story)
2. 29% of IW mass is GWB

PNW – ASSEMBLY CONTRIBUTION: BY MASS AND TO GWP

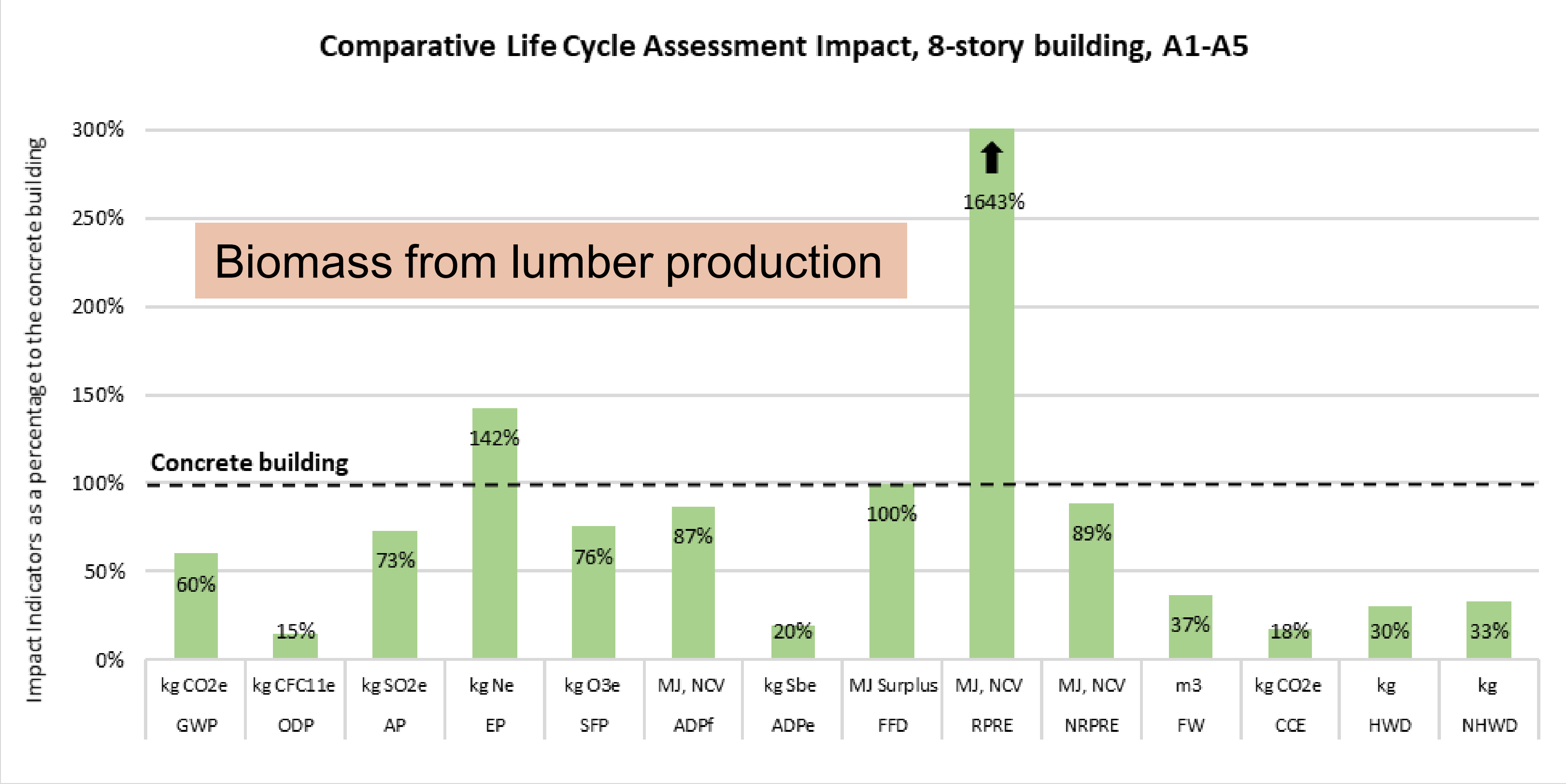


SE – ASSEMBLY CONTRIBUTION: BY MASS AND TO GWP

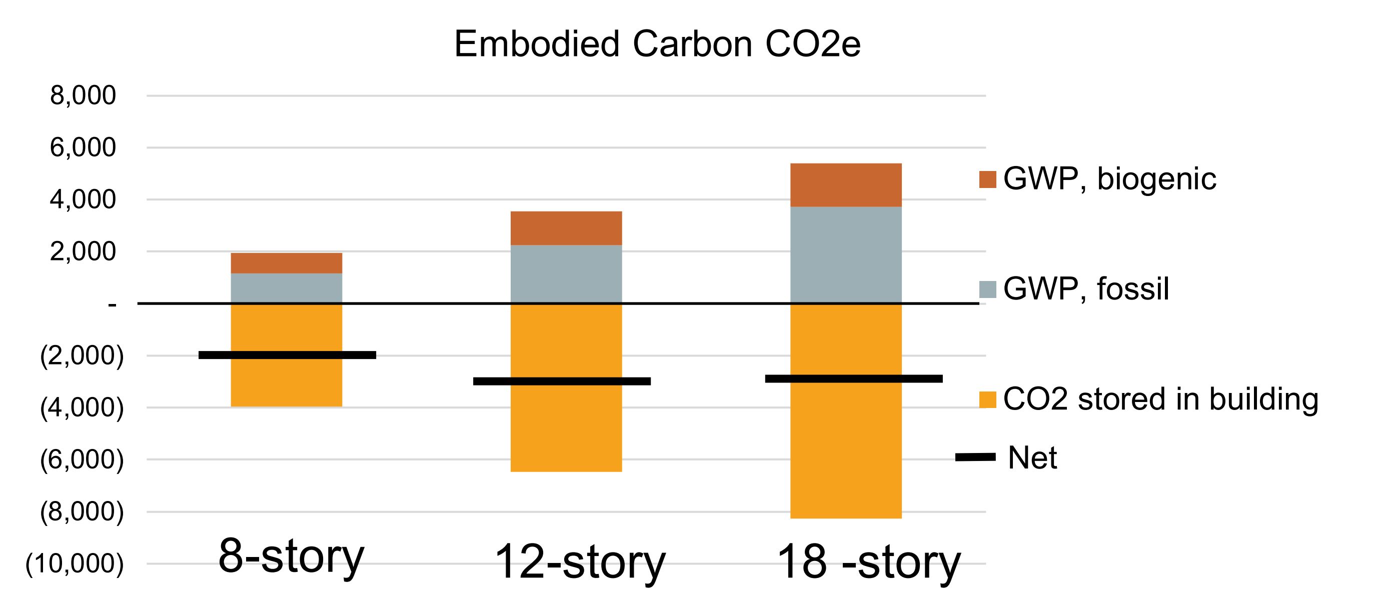




SE LCIA 8 STORY BUILDINGS



SE WHOLE BUILDING EMBODIED CARBON



THE FUTURE OF WOOD AS A BUILDING MATERIAL

- The opportunities for improvement in the use of wood as a building material are endless
  - Material choices
  - Building designs
  - Building codes
  - Communication and education

- Wood-use opportunities for reducing global carbon emissions can be achieved by
  - Growing more trees & sustainable forest management
  - Local wood sources and products to reduce transportation impacts
  - Long service life**, reuse, and recycling potential**
  - **Design for deconstruction**
  - Replacing fossil-based materials with materials made from using renewable fuels

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