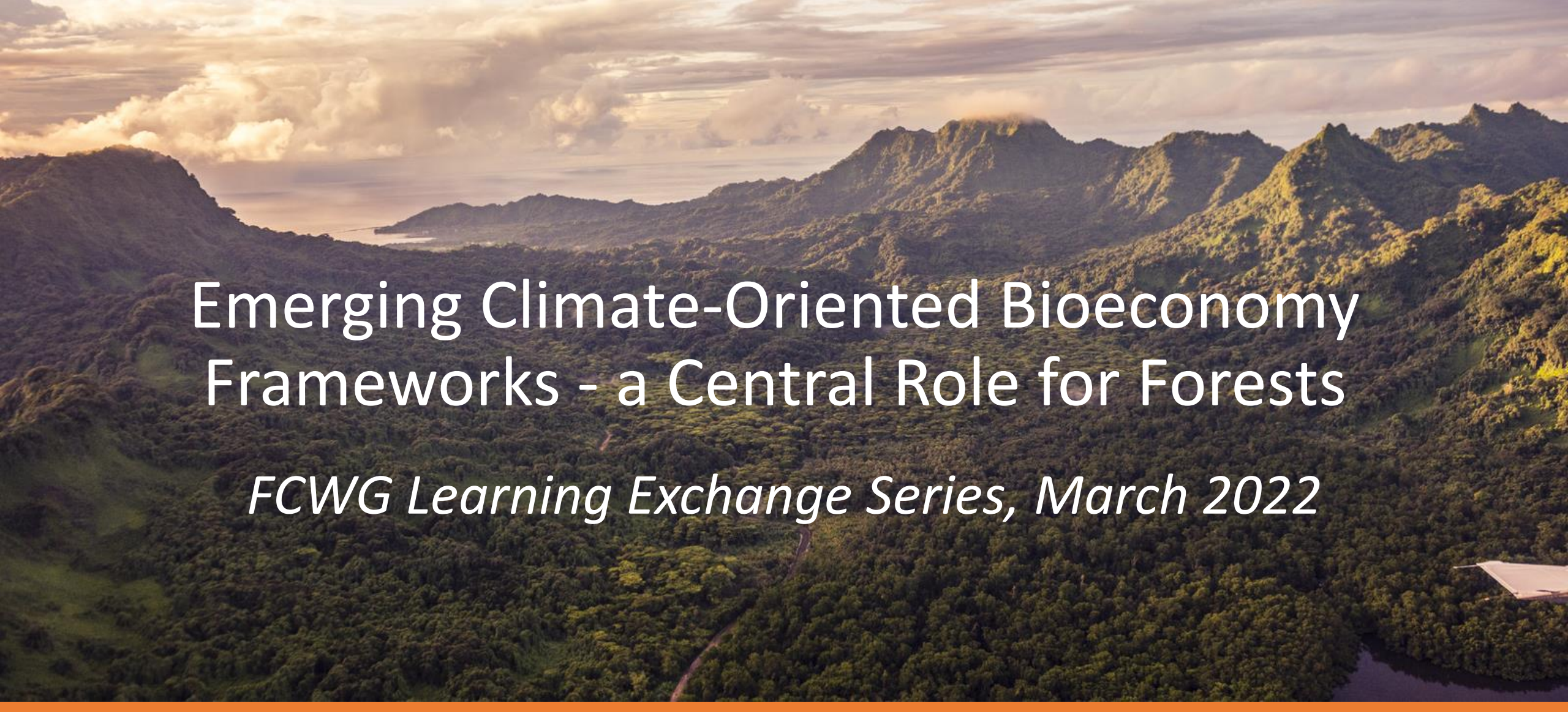

Emerging Climate-Oriented Bioeconomy Frameworks - a Central Role for Forests

FCWG Learning Exchange Series, March 2022

The Nature Conservancy: Rachel Pasternack, Ethan Belair, & Yangyang Wang

The Nature Conservancy

Disclaimer and Request

- Phases 1-3 are published in *Sustainability* 2022, 14(3).
- Phase 4 is an ongoing project, with preliminary results.
- We're still actively designing this research, somewhat like building a plane as you fly.
- Please don't share details from Phase 4 without checking first.

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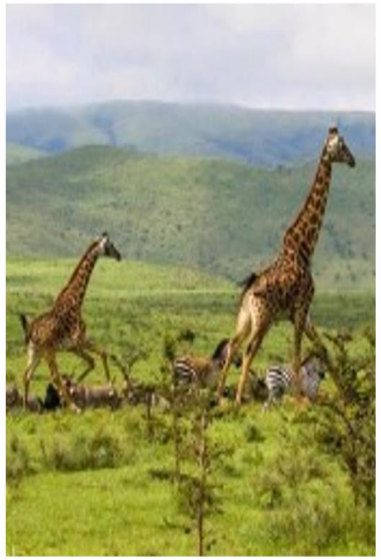
Who We Are

Global, science-based environmental NGO



GLOBAL REACH & SCALE

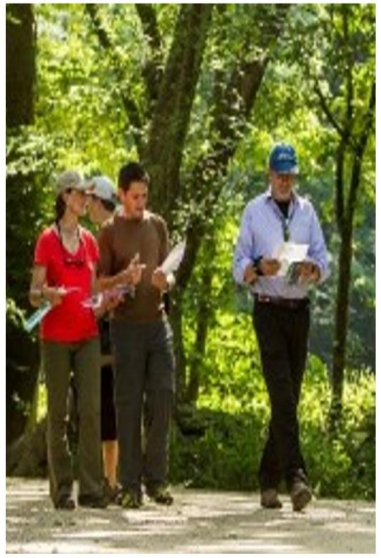
Largest conservation not-for-profit in the world

PLACE-BASED EXPERIENCE

At work across 50 States and >70 countries

SCIENCE-BASED KNOW-HOW

Home to more than 600 scientists



NETWORK OF RELATIONSHIPS

Powered by 1,350 trustees and 1 million members

20+ Collaborating Organizations

OUR PRIORITIES:

- Address the urgent **climate** crisis
- Protect the health of the world's **lands, oceans** and **freshwater**

© NASA/NOAA/ RETO STÖCKLI

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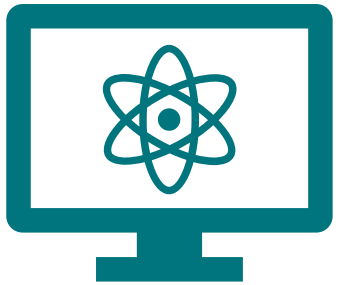
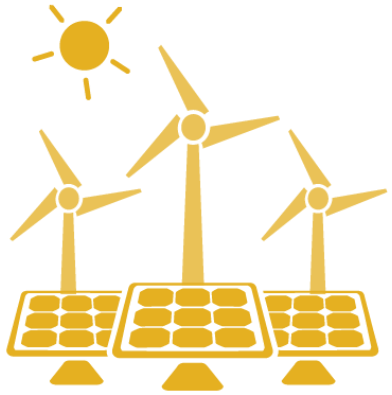
Our Climate Strategies

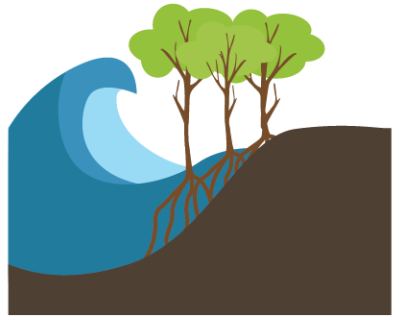


NATURAL CLIMATE SOLUTIONS SCIENCE



LOW-CARBON ECONOMY

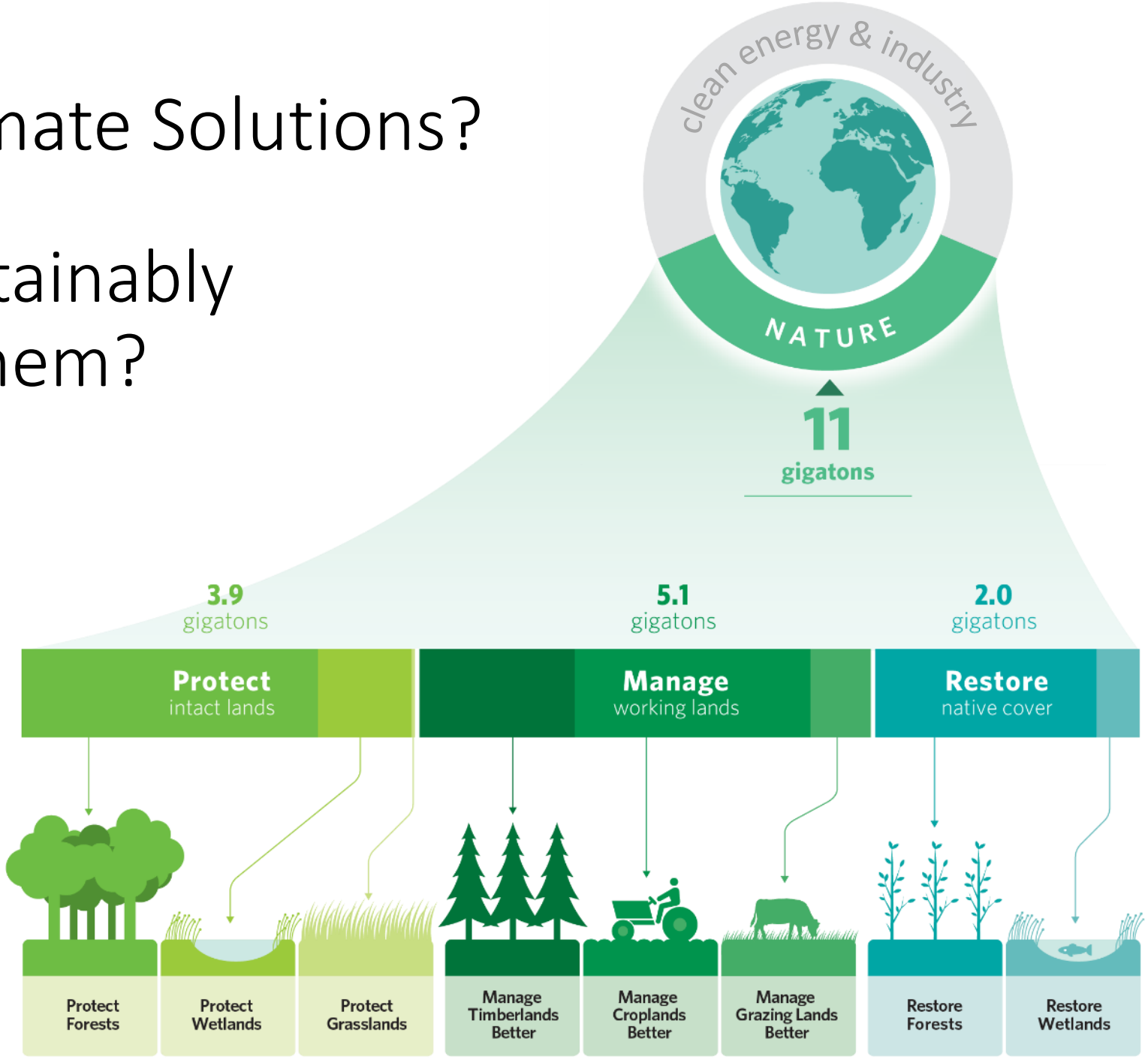
NATURAL CLIMATE SOLUTIONS-IMPLEMENTATION



RESILIENCE AND ADAPTATION

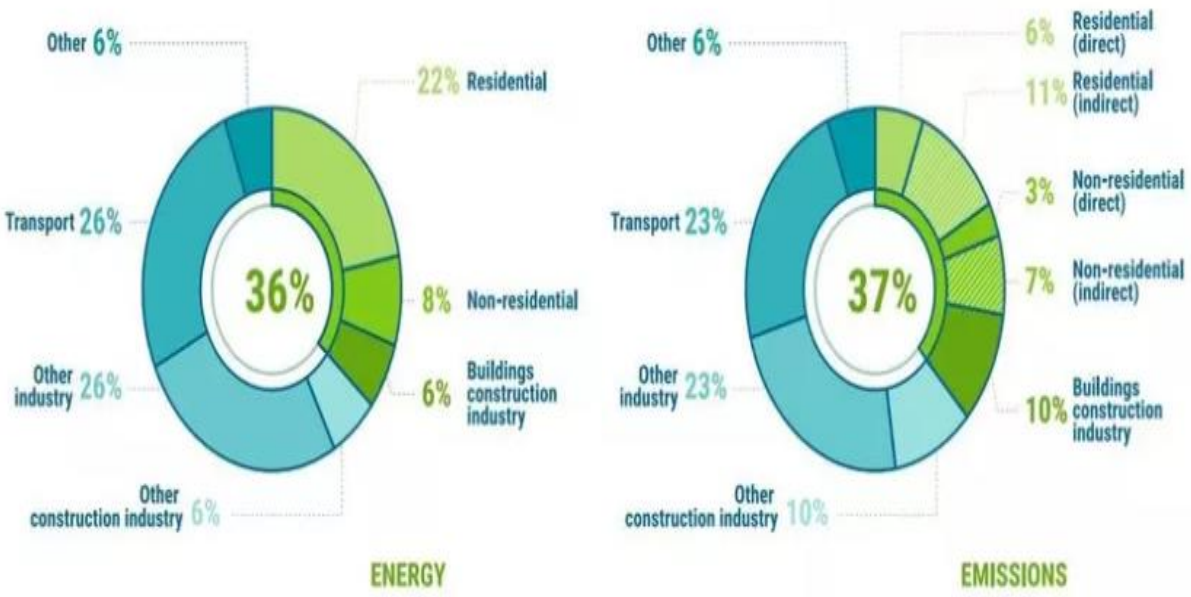
What Are Natural Climate Solutions?

How do we Sustainably Accelerate them?



What Is Mass Timber & Why is it Important?

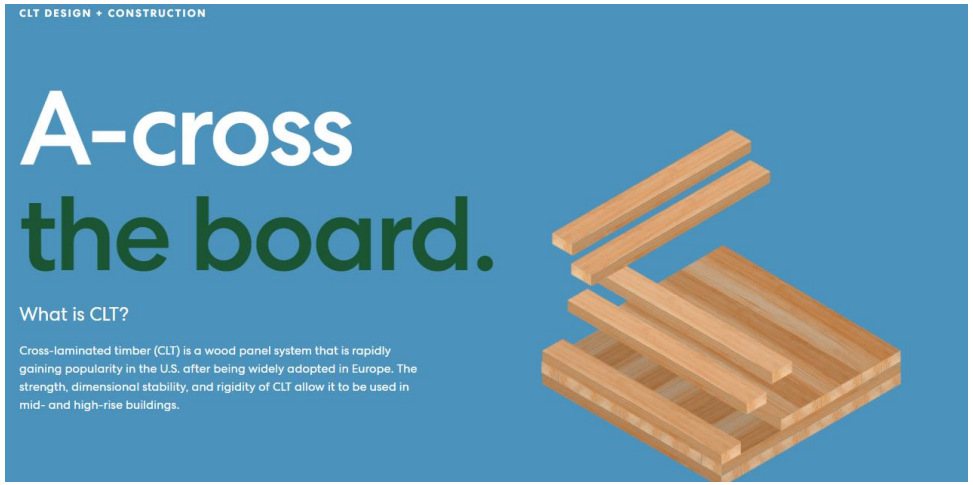
Figure 2. Buildings and construction's share of global final energy and energy-related CO_2 emissions, 2020

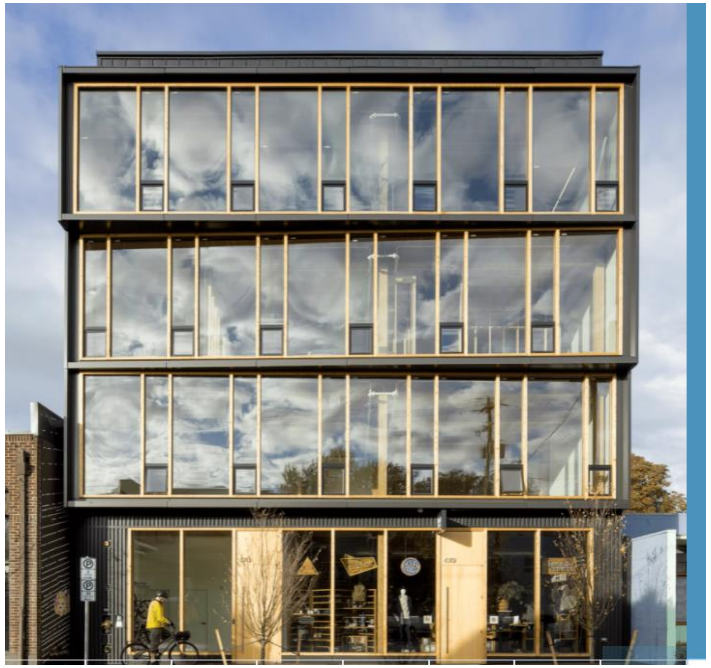


Note: "Buildings construction industry" is the portion (estimated) of overall industry devoted to manufacturing building construction materials such as steel, cement and glass. Indirect emissions are emissions from power generation for electricity and commercial heat.

Source: IEA 2021a. All rights reserved. Adapted from "Tracking Clean Energy Progress"

World Economic Forum, 2021.
https://www.weforum.org/agenda/2021/11/sustainable-mass-timber-green-building/





(Left) Albina Yard, a four-story office building in Portland, Oregon,
Photo and data credit to: Thinkwood, Thinkwood.com

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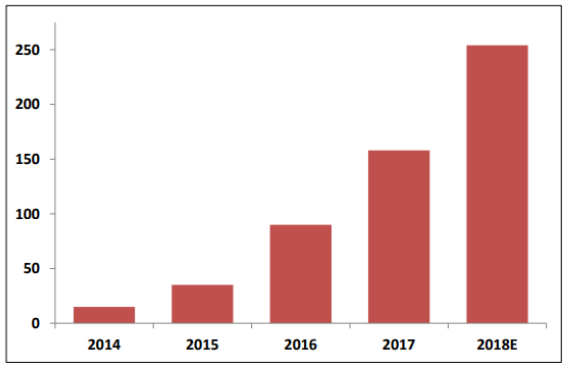
Demand for Mass Timber Is Rising….. But what does that mean for Forests?

Global Cross Laminated Timber (CLT) Market Will Reach USD 1606 Million By 2024: Zion Market Research

According to the report, the global cross laminated timber (CLT) market was valued at USD 603 million in 2017 and is expected to reach USD 1606 million in 2024, growing at a CAGR of 15% between 2018 and 2024.

December 18, 2018 08:16 ET | Source: Zion Market Research

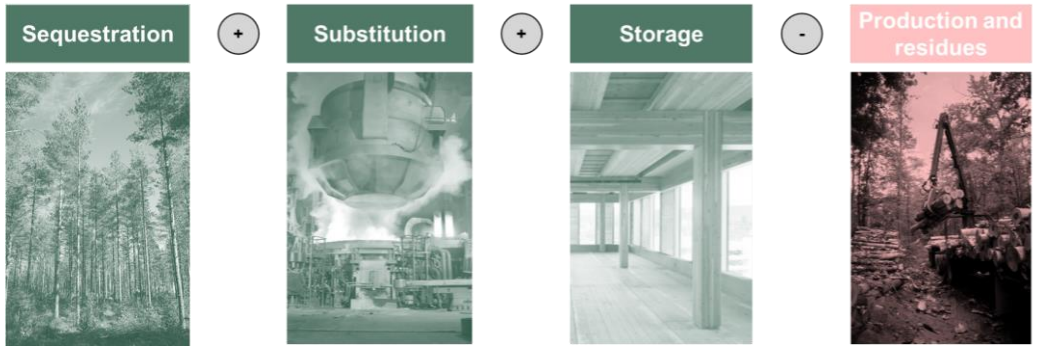
U.S. Mass Timber Projects by Year



As the chart illustrates, the number of projects initiated each year has grown rapidly, from fewer than 20 in 2014 to well over 200 (estimated) by the end of 2018.

WRITTEN BY The Economist INTELLIGENCE UNIT

Mass timber, which uses prefabricated solid wood panels for low- to mid-rise construction applications, is already becoming popular in Europe and shows increasing commercial potential worldwide. Substituting mass timber for concrete and steel can reduce greenhouse gas emissions in construction without compromising quality, though the net effect of mass timber on the climate also depends on its land use impacts. Ongoing research into these impacts, along with emerging efforts to integrate forest restoration projects into mass timber supply chains, could ultimately shed light on the potential value of mass timber for carbon removal.



Biological sequestration

Substitution and storage carbon benefits can be 3x the biological benefits of growing trees[4]

ıurces:
tps://www.globenewswire.com/news-release/2018/12/18/1668689/0/en/Global-oss-Laminated-Timber-CLT-Market-Will-Reach-USD-1606-Million-By-2024-Zion-Market-esearch.html
tps://www.oregon.gov/ODF/Documents/ForestBenefits/Beck-mass-timber-market-alysis-report.pdf
tps://carbonremoval.economist.com/mass-timber/

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Wood Innovations Overview & Progress to Date

Mass Timber, Massive Assumptions

- Common logic chain assumption, the **Environmentalist Edition**:

  More mass timber → more demand for wood → more timber harvesting → more deforestation/degradation

- This seems overly harsh, we should investigate these assumptions

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Mass Timber, Massive Assumptions

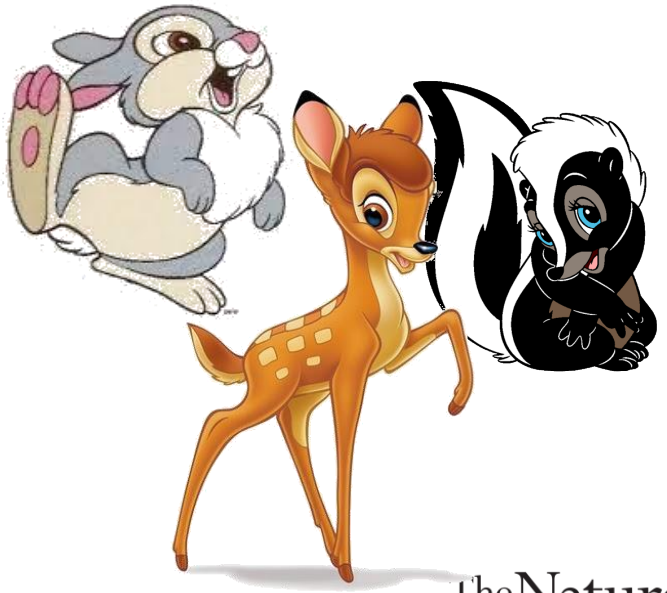
- Common logic chain assumption, the Rose-colored Glasses Edition:

  Mass timber is composite → could use small, low-value trees → balances silviculture and $ → healthier forests

- This seems overly optimistic, we should investigate these assumptions

+

=



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5-Phased Wood Innovations Project

- Theoretical benefits to substituting mass timber for oil-intensive, non-renewable materials

- What actual benefits will result, given myriad impacts on markets, carbon stocks, etc?

- Can we realize a meta benefit of integrating our thinking across different fields of study?
  - Logistics/Production & Natural Climate Solutions

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Phase 1: Comparative whole-building LCA

Phase 5: Integration & communication

Phase 2: Regional demand assessments (China, USA, Europe, Southern Cone of South America)

Phase 4: Regional forest modelling

Phase 3: Global trade modelling

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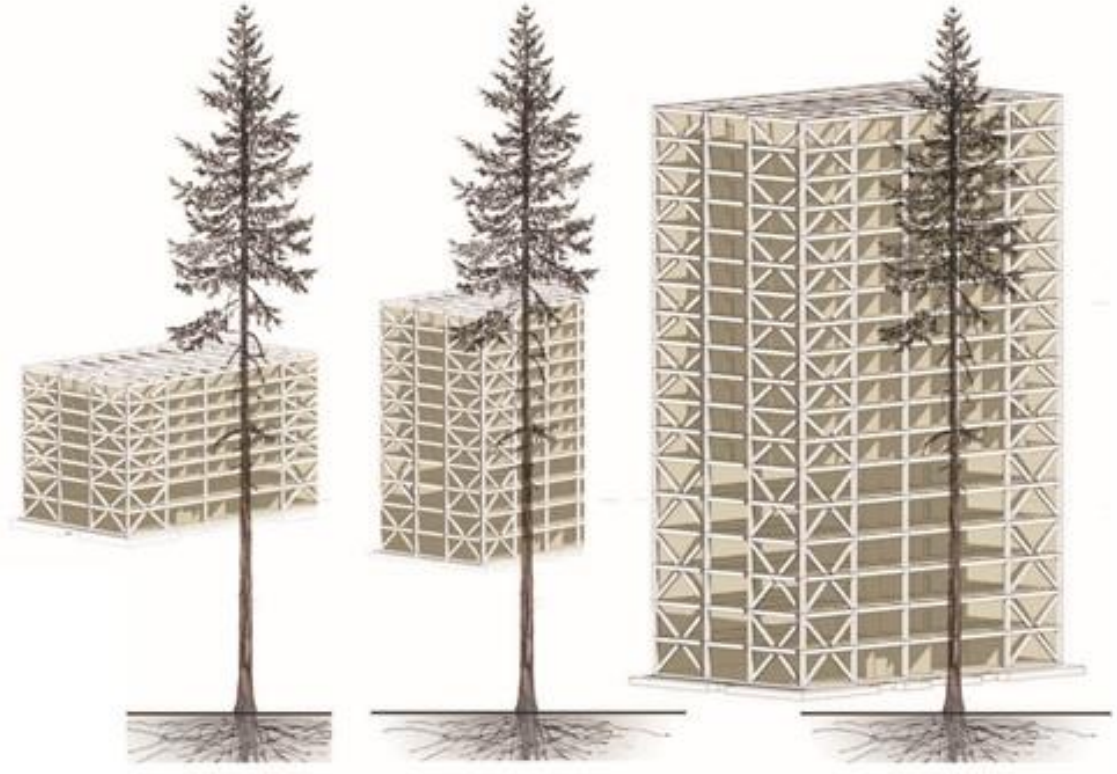
Phase 1: Whole Building LCA

- Wholistic comparison of emissions from extraction, processing, transport; longevity of carbon storage; energy sources; etc.
  - 3 pairs conventional, mass timber buildings
    - 8-, 12-, and 18-stories
  - Seattle, Boston, and Atlanta
  - 80-year lifespan, 100-year time horizon



- Results reaffirm potential for environmental benefits from mass timber, but benefits:
  - Not linear with building size
  - Vary be region
  - Increase with building lifespan

Forest Products Laboratory
WoodWorks
CORRIM
SCHOOL OF ENVIRONMENTAL AND FOREST SCIENCES
atelierjones, llc
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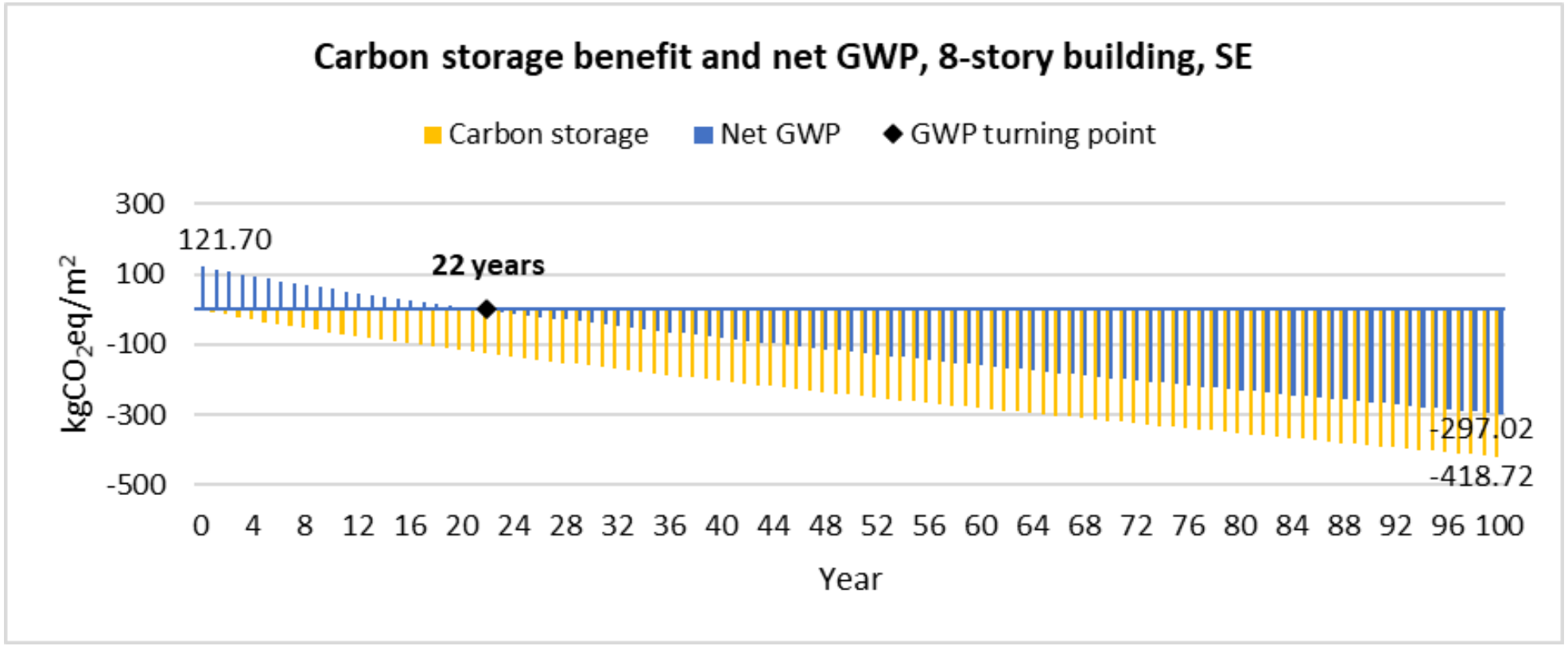
Phase 1: Whole Building LCA

Key lessons: minimize fossil GHG emissions, maximize biogenic carbon storage



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Phase 2: Regional Demand Assessment

- Estimate future demand for mass timber based on:
  - Housing starts data, modeled forward
  - Mass timber utilization based on performance, cost, and availability
  - Innovation diffusion models, based on exposure and adoption trends for new tech

- Predict demand for specific mass timber products based on specific building designs and needs

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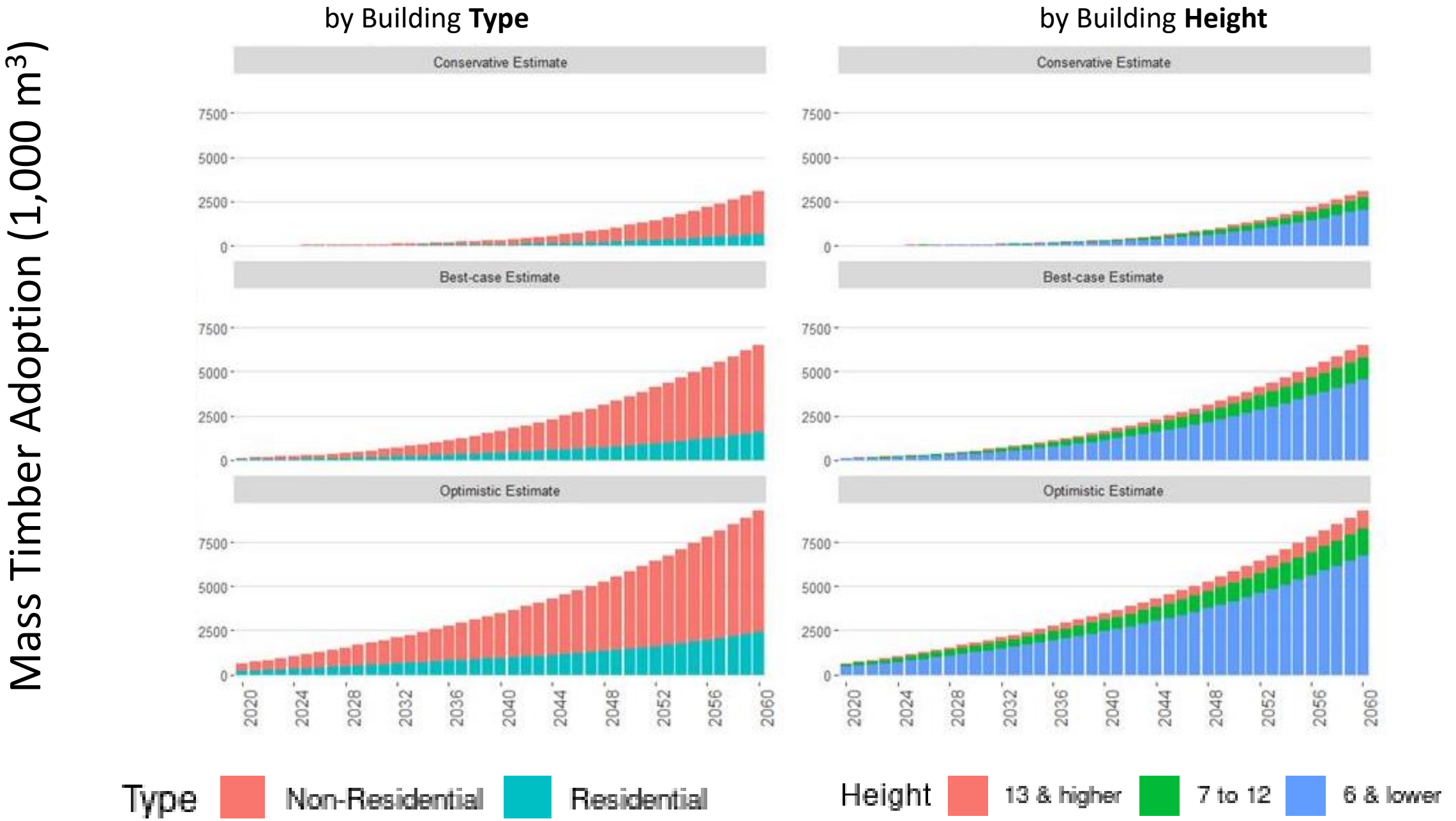
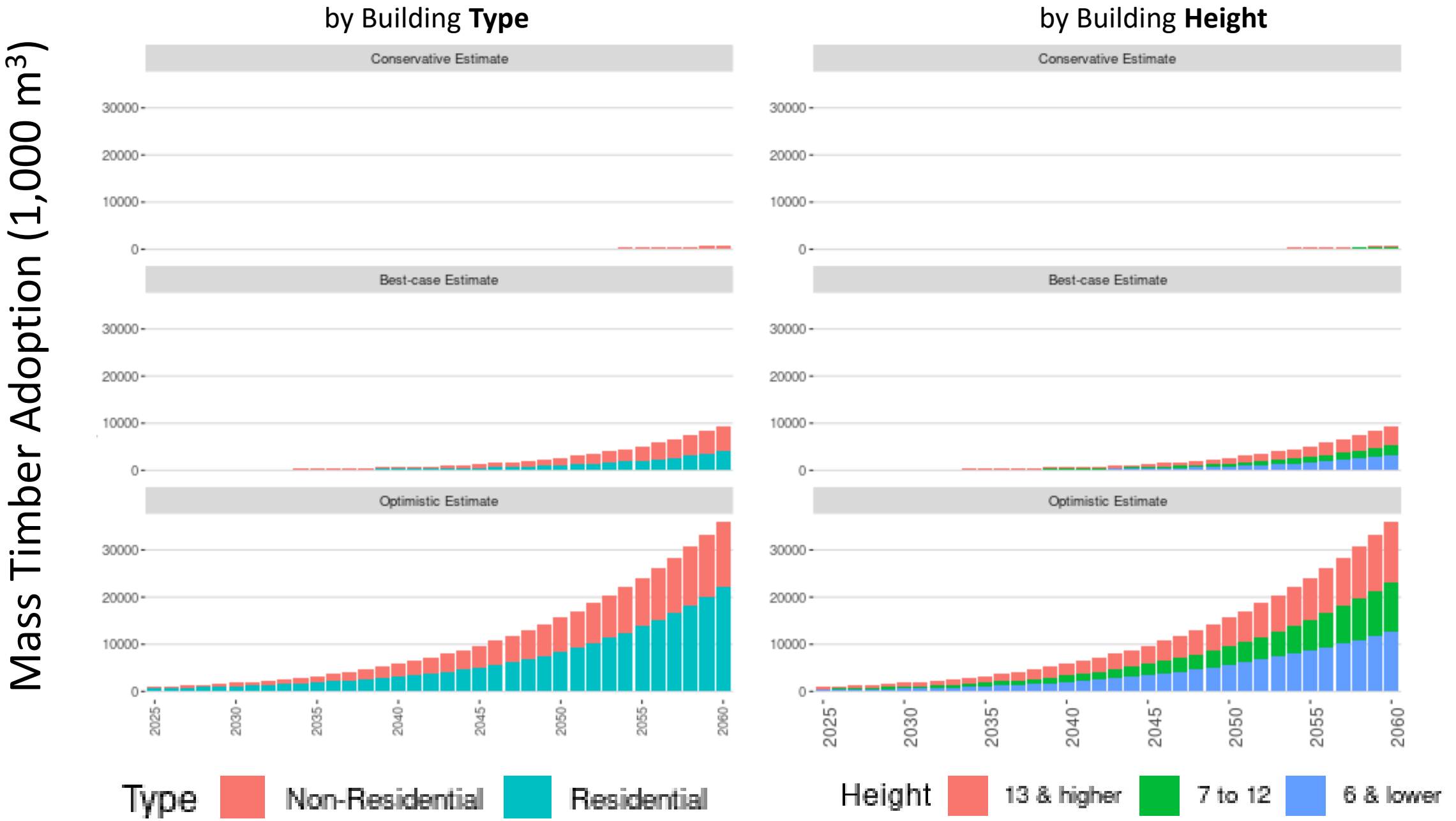
USA


Mass Timber Adoption (1,000 m³)
by Building **Type**
by Building **Height**
Conservative Estimate
Best-case Estimate
Optimistic Estimate
7500
5000
2500
0
2020
2024
2028
2032
2036
2040
2044
2048
2052
2056
2060
Type
Non-Residential
Residential
Height
13 & higher
7 to 12
6 & lower

China


by Building **Type**
by Building **Height**
Mass Timber Adoption (1,000 m³)
Conservative Estimate
Best-case Estimate
Optimistic Estimate
30000
20000
10000
0
2025
2030
2035
2040
2045
2050
2055
2060
Type
Non-Residential
Residential
Height
13 & higher
7 to 12
6 & lower

Phase 2: Regional Demand Assessment

Key Lessons:

- Adoption varies by locale
  - Social, cultural, economic drivers
- Within region, adoption varies across building types
- Expected demand for mass timber in moderate to high adoption regions in the <u>low millions of cubic meters</u>

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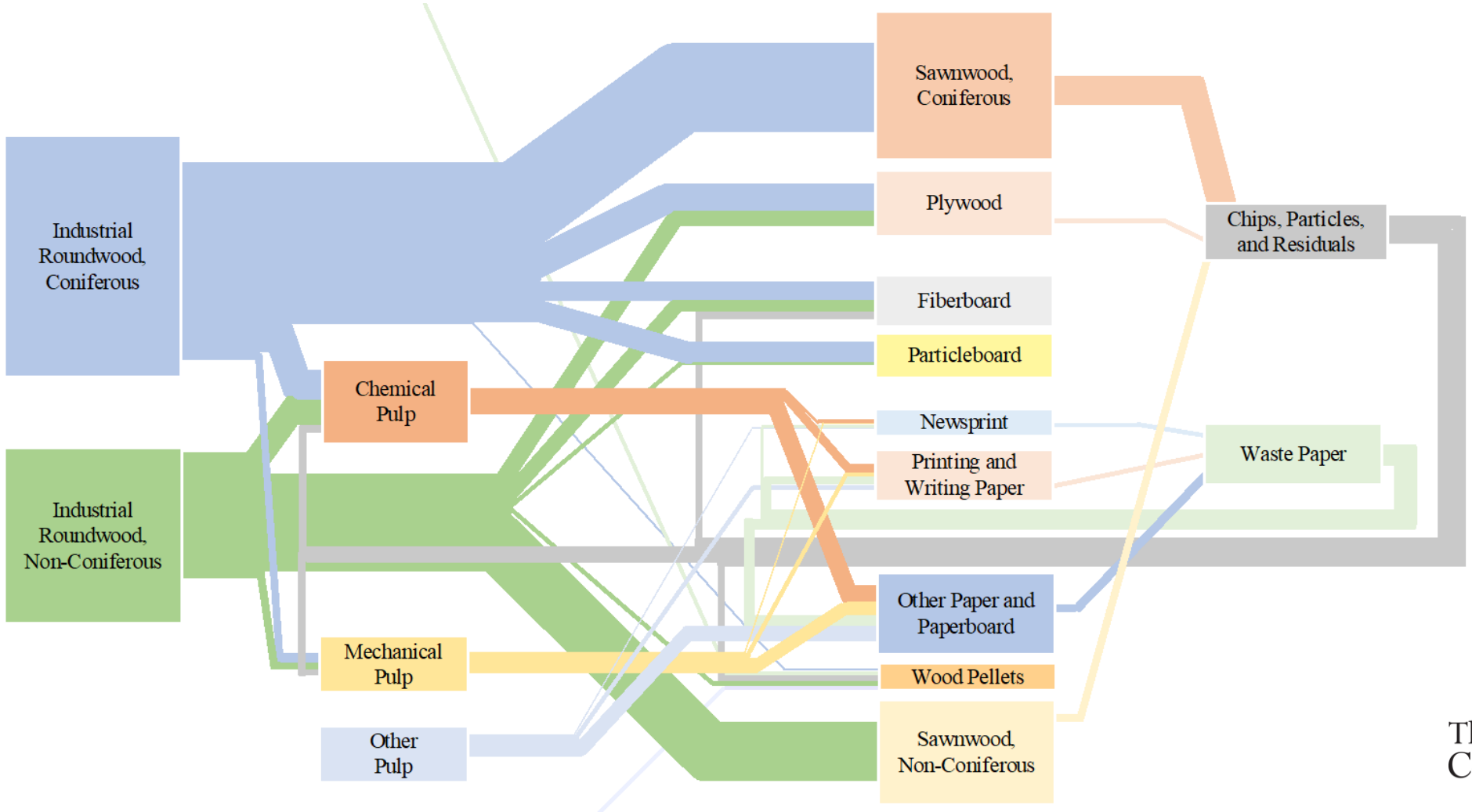
Phase 3: Global Trade Impacts

- FOROM: estimates changes in wood products harvested and traded



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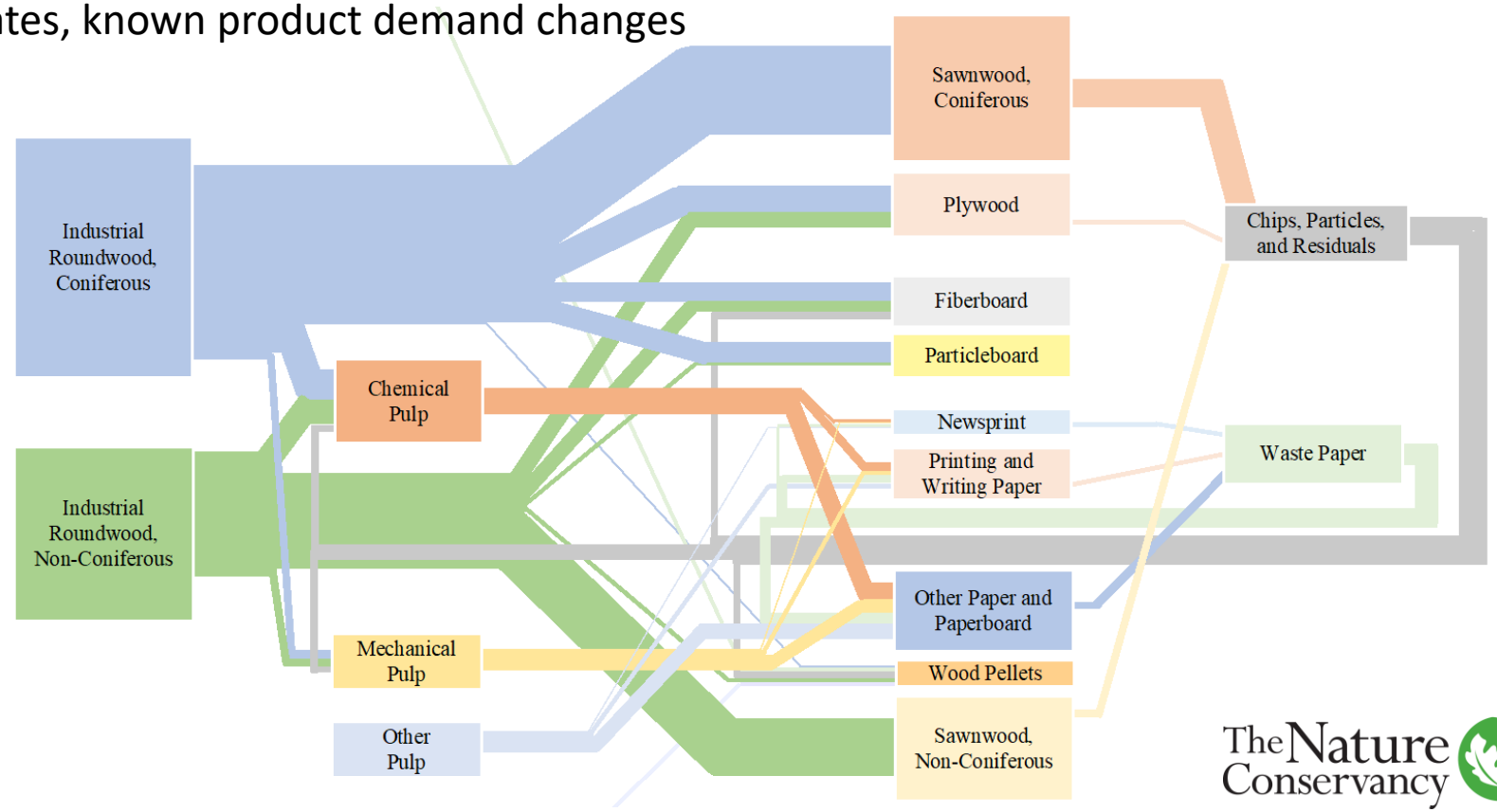
Phase 3: Global Trade Impacts

- FOROM: estimates changes in wood products harvested and traded

- Uses social, economic, and environmental predictors
  - Regional population, GDP estimates, known product demand changes

- Mass timber demand → Wood volume consumed



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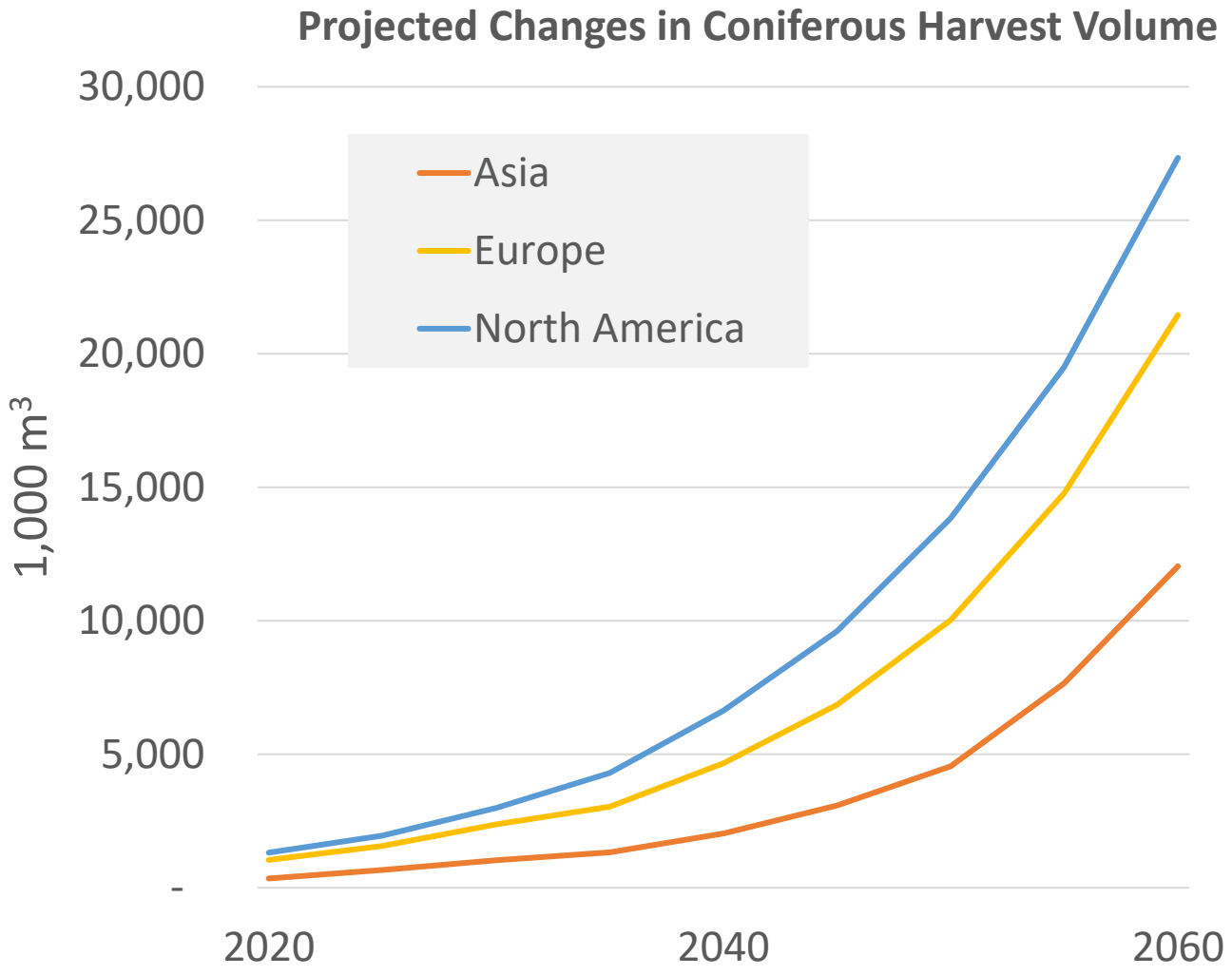
Phase 3: Global Trade Impacts

Key Lessons:

- Increased MT demand will likely increase harvest of coniferous species in MT producing regions

- Context is key.
  - Global - ~2%

  - Asia – 4% increase
  - Europe – 2%
  - N America – 1%



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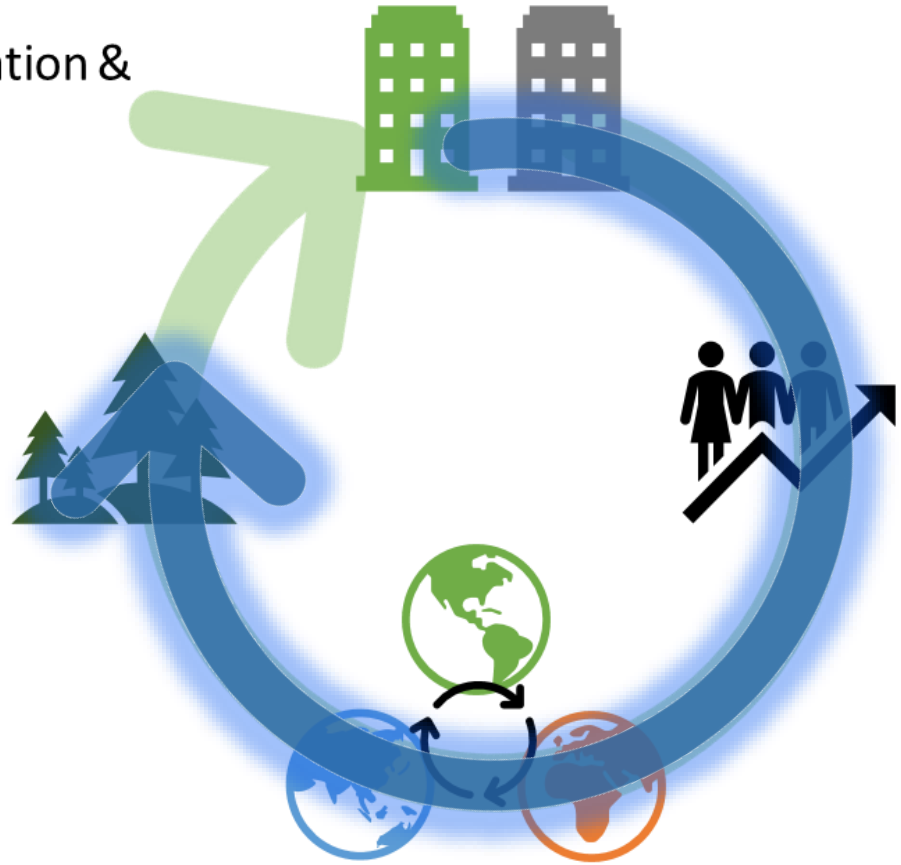
Phase 1: Comparative whole-building LCA

Phase 5: Integration & communication



Phase 2: Regional demand assessments (China, USA, Europe, Southern Cone of South America)

Phase 4: Regional forest modelling of impacts in US

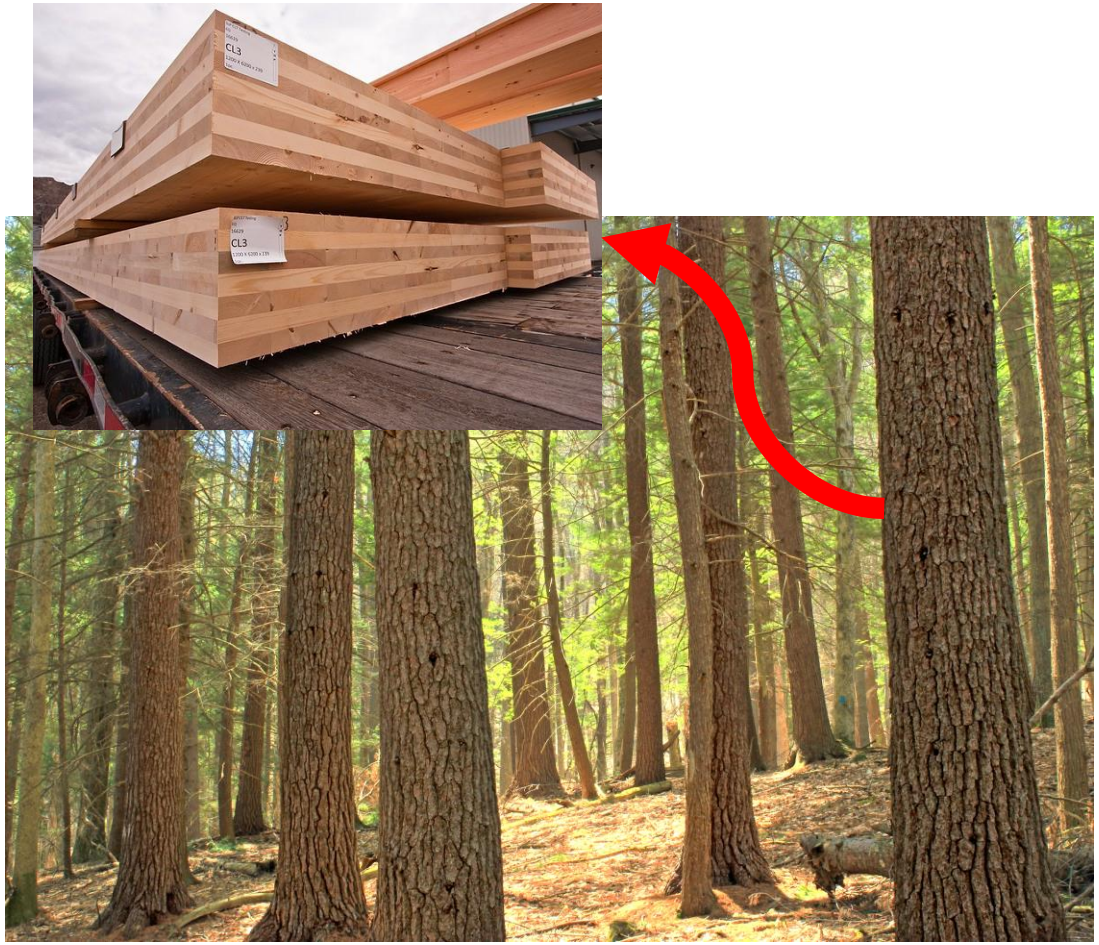
Phase 3: Global trade modelling

Phase 4: Regional Forest Modeling

- Connecting regional demand changes to stand-level carbon impacts

- Incorporating
  - Production parameters
  - Logistical constraints
  - Biological variables

- Exact model form, frame in development currently
  - Several scenarios
  - Simple → Complex



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MODEL FRAMEWORK

DATA

TIMBER HARVEST INVENTORY

SUSTAINABLE FOREST MANAGEMENT & SOCIAL-ENVIRONMENTAL SAFEGUARDS

FOREST INVENTORY DATA

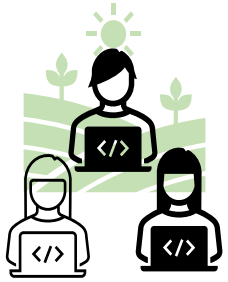
DISTURBANCES PREDICTION

CLIMATE SCENARIOS

MODELS

- Harvest Patterns
- Mass Timber Management Framework
- Tree Growth Model/Forest Ecosystem Carbon Model
- Forest Vegetation Simulator Disturbance Database
- Climate-Forest Vegetation Simulator (Climate-FVS)

OUTPUTS



FOREST IMPACT ASSESSMENT

Carbon

HARVESTED CARBON AND SUSTITUTION EFFECTS + CARBON DYNAMICS IN FOREST ECOSYSTEMS

biodiversity of an ecological system

FOREST COMPOSITION AND STRUCTURE

IMPACT WITH UNCERTAINTIES

IMPACTS ASSOCIATED WITH DISTURBANCES AND CLIMATE CHANGE

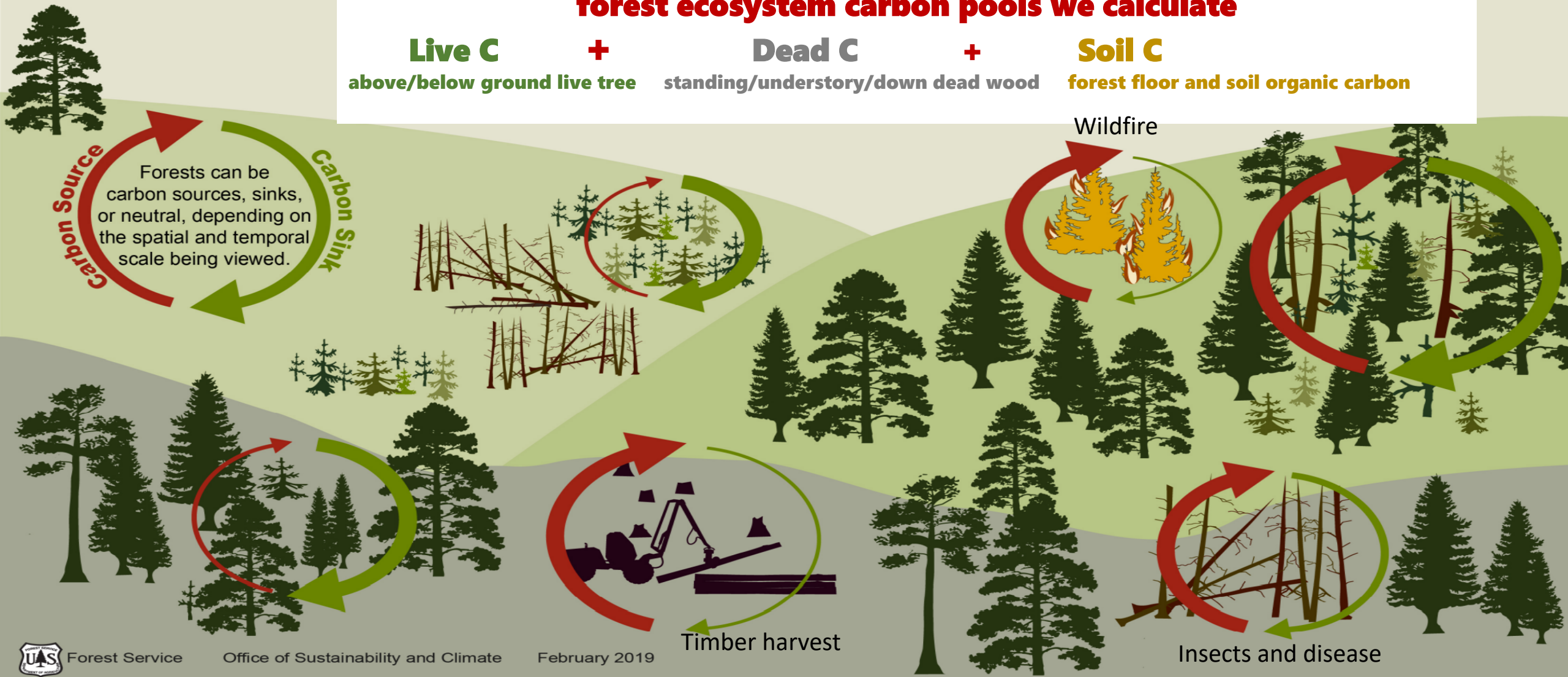
Phase 4: Regional Forest Modeling

Carbon in Time and Space

forest ecosystem carbon pools we calculate

Live C + **Dead C** + **Soil C**

above/below ground live tree | **standing/understory/down dead wood** | **forest floor and soil organic carbon**



Forest Service Office of Sustainability and Climate February 2019

Assessing Business-as-Usual Harvest Patterns

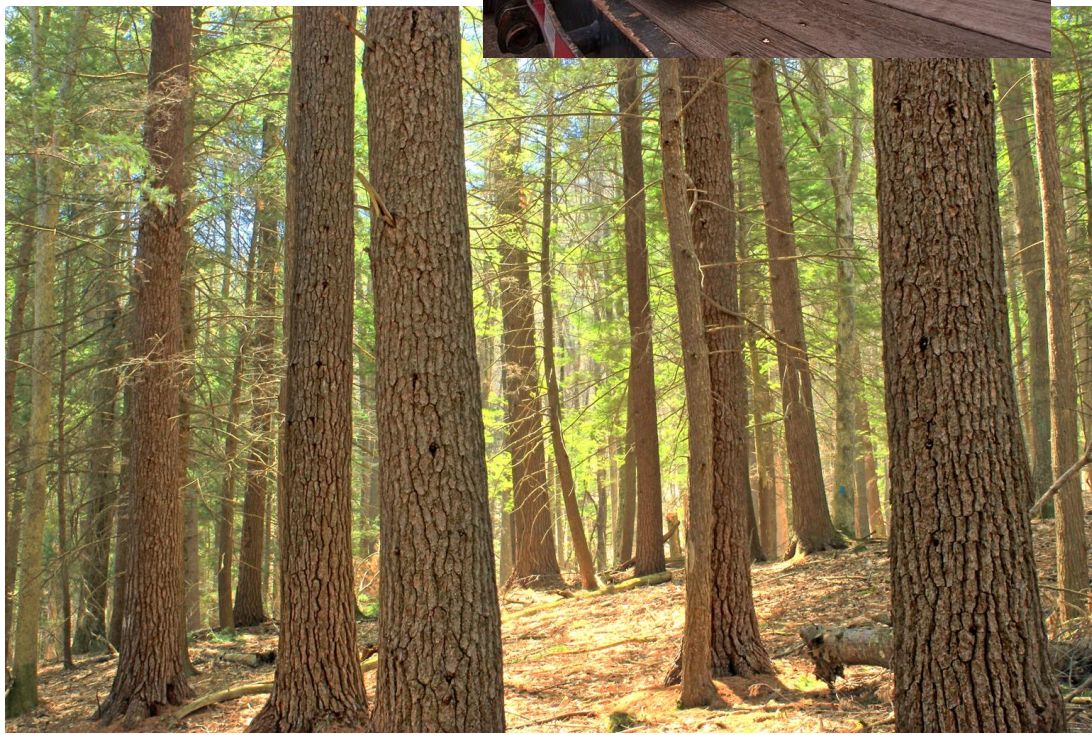
Step 1: Determine variables used to define BAU harvest frames

Dependent variables:

- harvest intensity
- harvest occurrence

Independent variables:

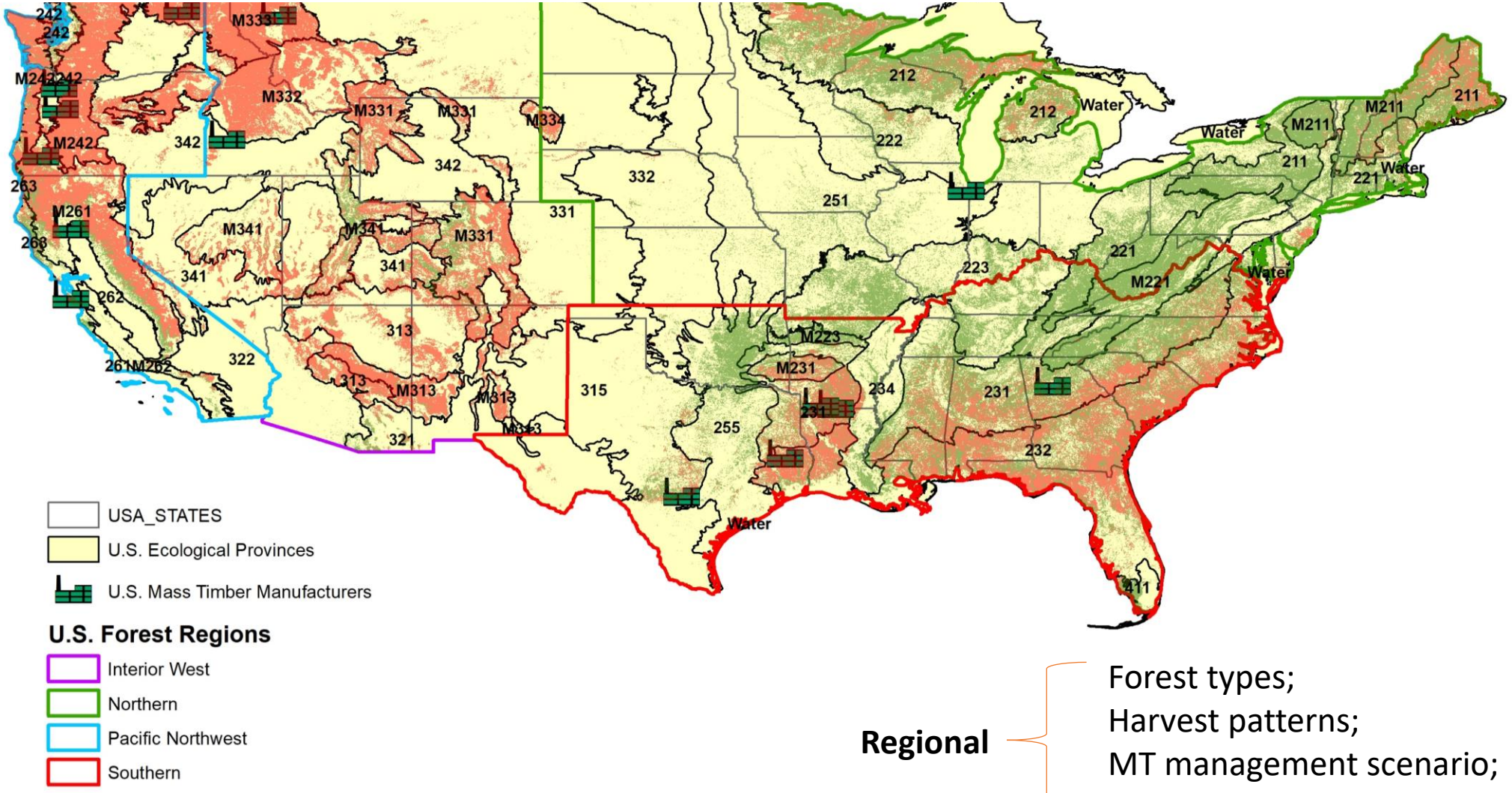
- Elevation
- Site productivity
- Ownership
- Political boundary
- Ecoregion



Step 2: Assess "average" BAU harvesting in a set of analytical frames

- Frames must necessarily be mutually exclusive
- Accurate, compact, applicable,

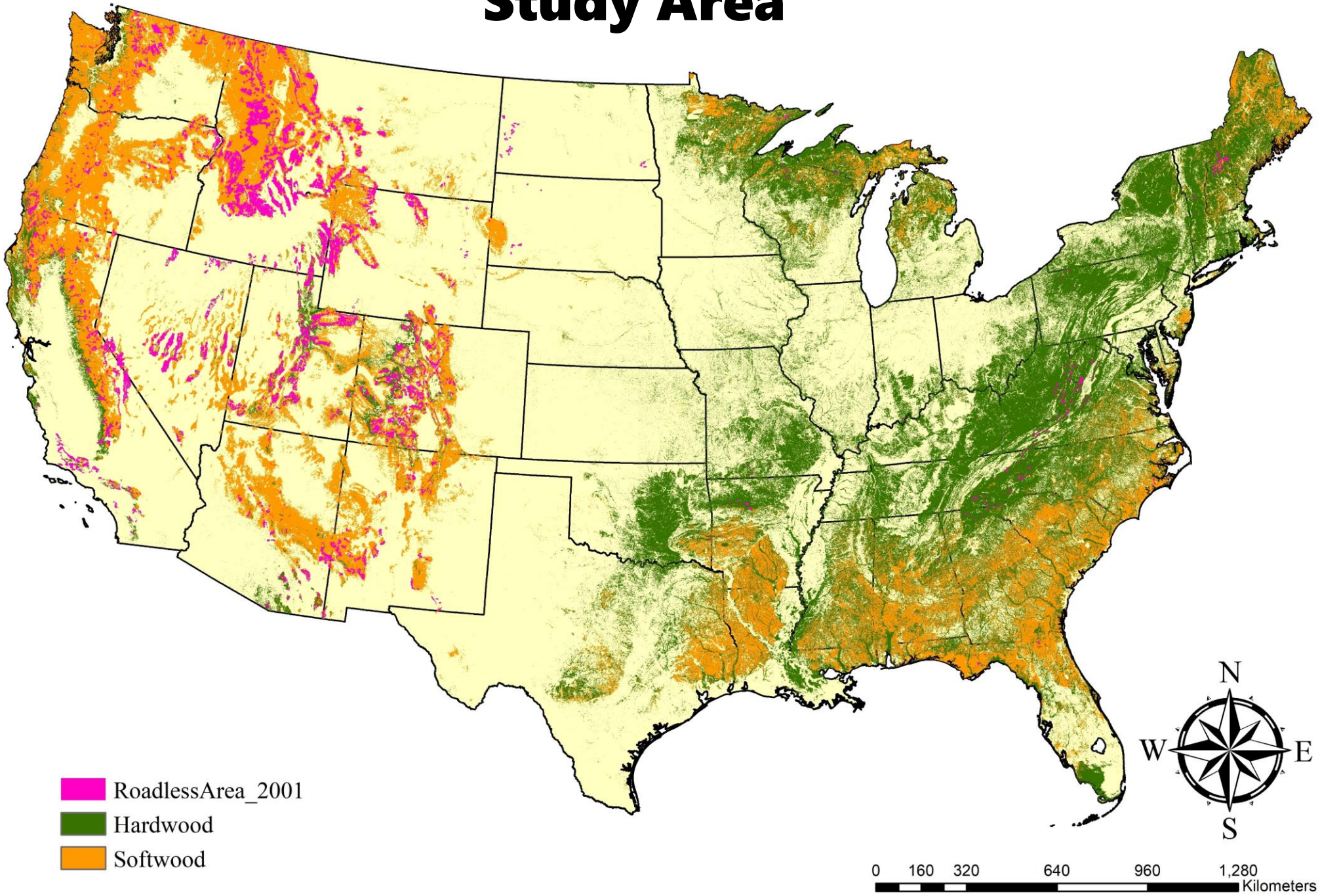
Regional mass timber impact assessment

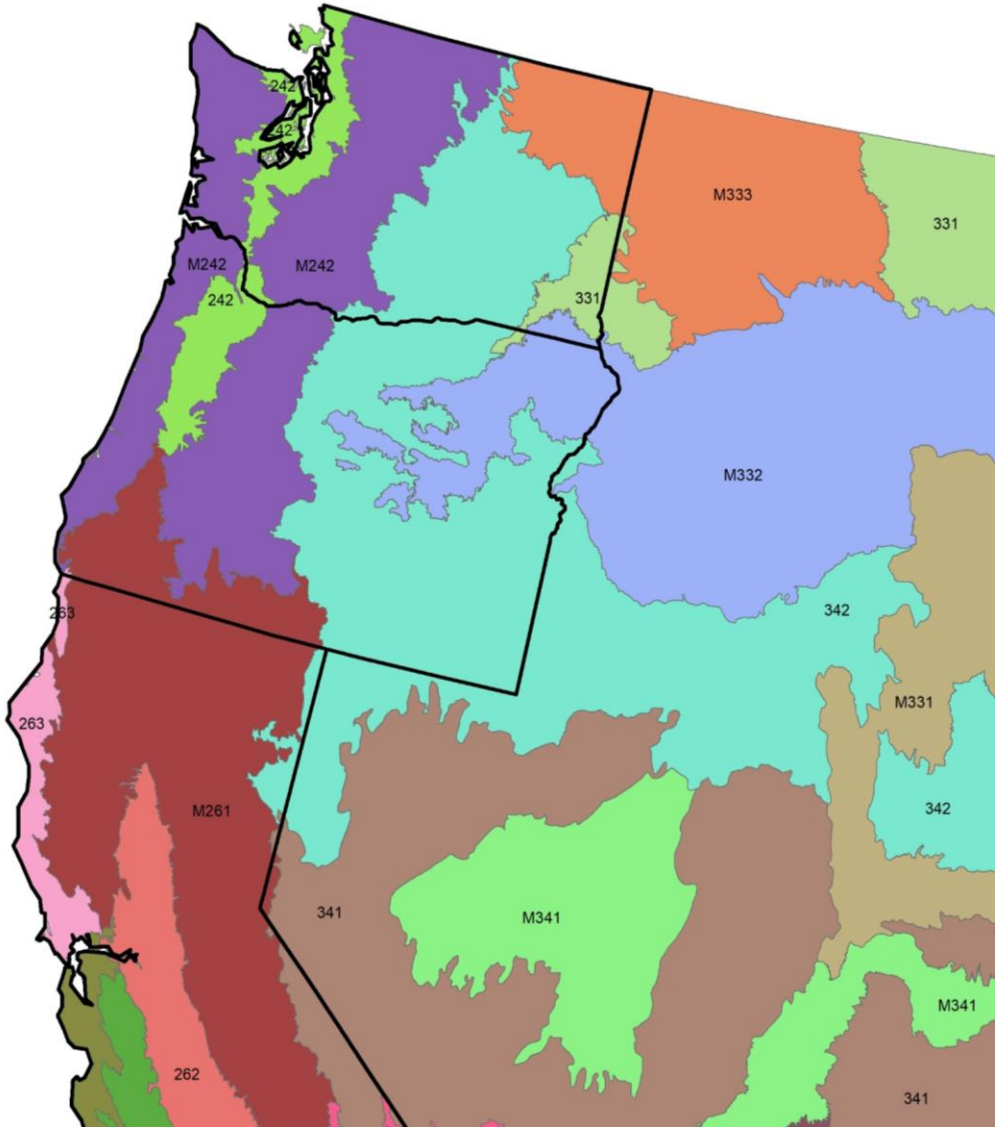


Regional

- Forest types;
- Harvest patterns;
- MT management scenario;
- Disturbances

Study Area


RoadlessArea_2001
Hardwood
Softwood
N
W
E
S
0
160
320
640
960
1,280
Kilometers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341

Work conducted for the past next 6 months

- Mass timber study
- Forest condition assessment in PNW area
- Harvest pattern model development

Workplan for next 6 months

Create	Create a set of mass timber harvest scenario based on Phrase 2
Run	Run FVS to see the impact on forest carbon associated with/without extra timber harvest for mass timber use
Incorporate	Incorporate computed climate change scenarios and natural disturbance scenarios

Phase 4: Regional Forest Modeling

- Expected outcomes
  - Concentrated mgmt. will have… concentrated impacts
  - If harvest increases are dispersed, carbon stock declines should be minimal
  - What if… mass timber production parameters could be relaxed?

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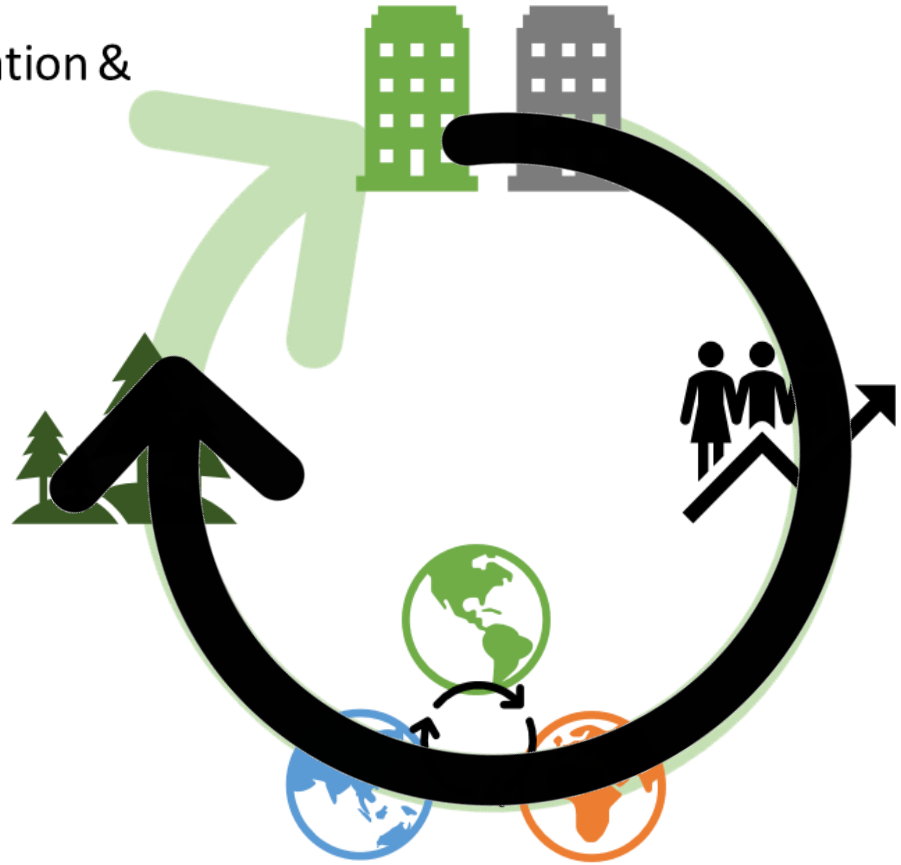
Phase 1: Comparative whole-building LCA

Phase 5: Integration & communication



Phase 2: Regional demand assessments (China, USA, Europe, Southern Cone of South America)

Phase 4: Regional forest modelling

Phase 3: Global trade modelling

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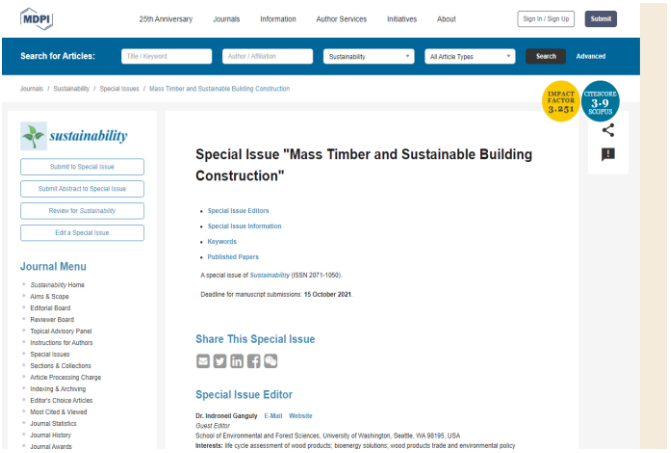
Phase 5: Project Integration & Collaboration



Further Research & Global Guiding Principles

PILLARS	Issue Areas	Existing Standards							
		ITTO	REDD	CSF	FCPF	WB	AFi	FAO	IFAD
Ecosystem Health and Function	Biodiversity	x	x			x		x	
	Habitat	x			x			x	
	Ecological resilience/ climate change adaptation	x		x			x		x
	No conversion of natural forests		x				x		
	Resource efficiency & pollution prevention					x			
Social and Economic Impacts	Local employment/ income/ poverty reduction	x	x	x	x		x		x
	Labor and working conditions	x				x		x	
	Community Involvement/ indigenous participation/ gender equality		x		x	x		x	x
	Cultural value/ practices				x	x		x	
GHG Emissions (3S)	Net reduction in GHGs; additionality		x	x					
	Minimizing reversals		x						
	Minimizing leakage/ displacement		x						

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Thank you!