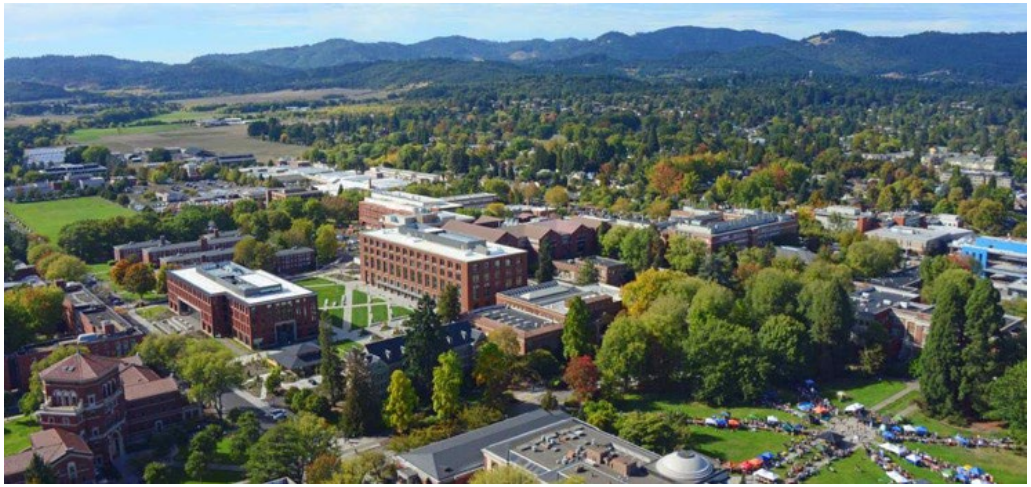
TALLWOOD

DESIGN INSTITUTE

A Unique Partnership Between the Colleges of Forestry and Engineering at Oregon State University and the College of Design at University of Oregon



Oregon State University

TALLWOOD DESIGN INSTITUTE

UNIVERSITY OF OREGON

People and Funding

- 10+ years history of mass timber research
- 25 faculty members currently engaged
  - Dept of Wood Science & Engineering, OSU
  - School of Civil & Construction Engineering, OSU
  - Dept of Architecture, UO
- TDI core team - Technical, Outreach and Education
- Around 100 papers on mass timber in last 3 years
- Approx. $10M in external funding for mass timber R&D (last 5 years)

Facilities

- Three structural testing labs
- Wood chemistry and identification labs
- Mechanical testing lab
- Composites lab
- Emmerson Lab fabrication capabilities (CLT fab, robotics, CNC)
- Green Building Materials Lab with multi-chamber environmental conditioning unit
- Energy studies in buildings lab

REACTS CONSORTIUM

Research on Engineering, Architecture & Construction of Timber Structures

Oregon State University

TALLWOOD DESIGN INSTITUTE

UNIVERSITY OF OREGON

Founding Members:

GOLD

SILVER

TIMBERLAB

kpff

BRONZE

KAISER+PATH

StructureCraft

MTC SOLUTIONS

DCI ENGINEERS

SRG

USDA

LEVER

MiTek

ASPECT STRUCTURAL ENGINEERS

odeh engineers

rothoblaas

DR JOHNSON WOOD INNOVATIONS

Holmes Structures

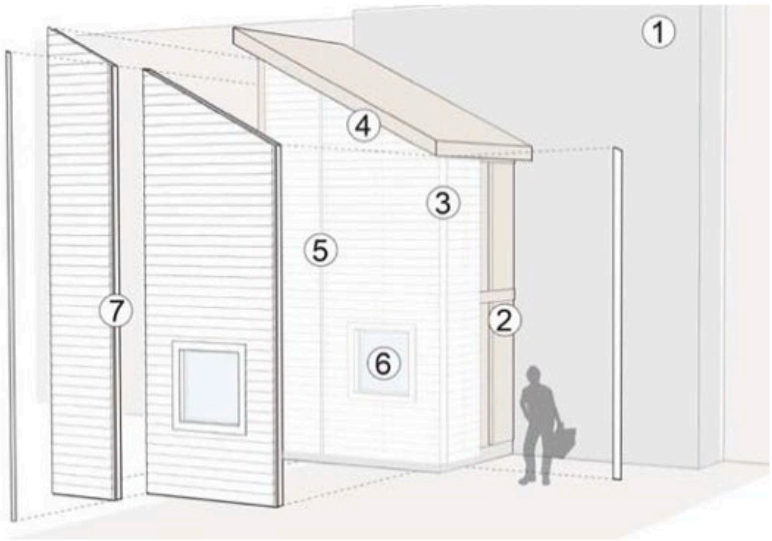
Thornton Tomasetti

KALESNIKOFF

WALSH CONSTRUCTION CO.

Rendering by Simone O'Halloran

MPP Panelized Housing: Pilot Project planned for Milwaukie, OR
University of Oregon Faculty Leads: Mark Fretz, Judith Sheine
EDA Build Back Better Regional Challenge



Prototype mock-up: 1) lab strong wall; 2) existing structure mock-up; 3) corner condition; 4) eave condition; 5) panel to panel condition; 6) window condition; 7) 2” MPP

Illustration of prefabricated panels craned onto existing housing exterior wall

MASS PLYWOOD PANELS IN SEISMIC AND ENERGY WALL RETROFITS

University of Oregon Faculty Leads: Mark Fretz, Judith Sheine

Oregon State University Lead: Andre Barbosa

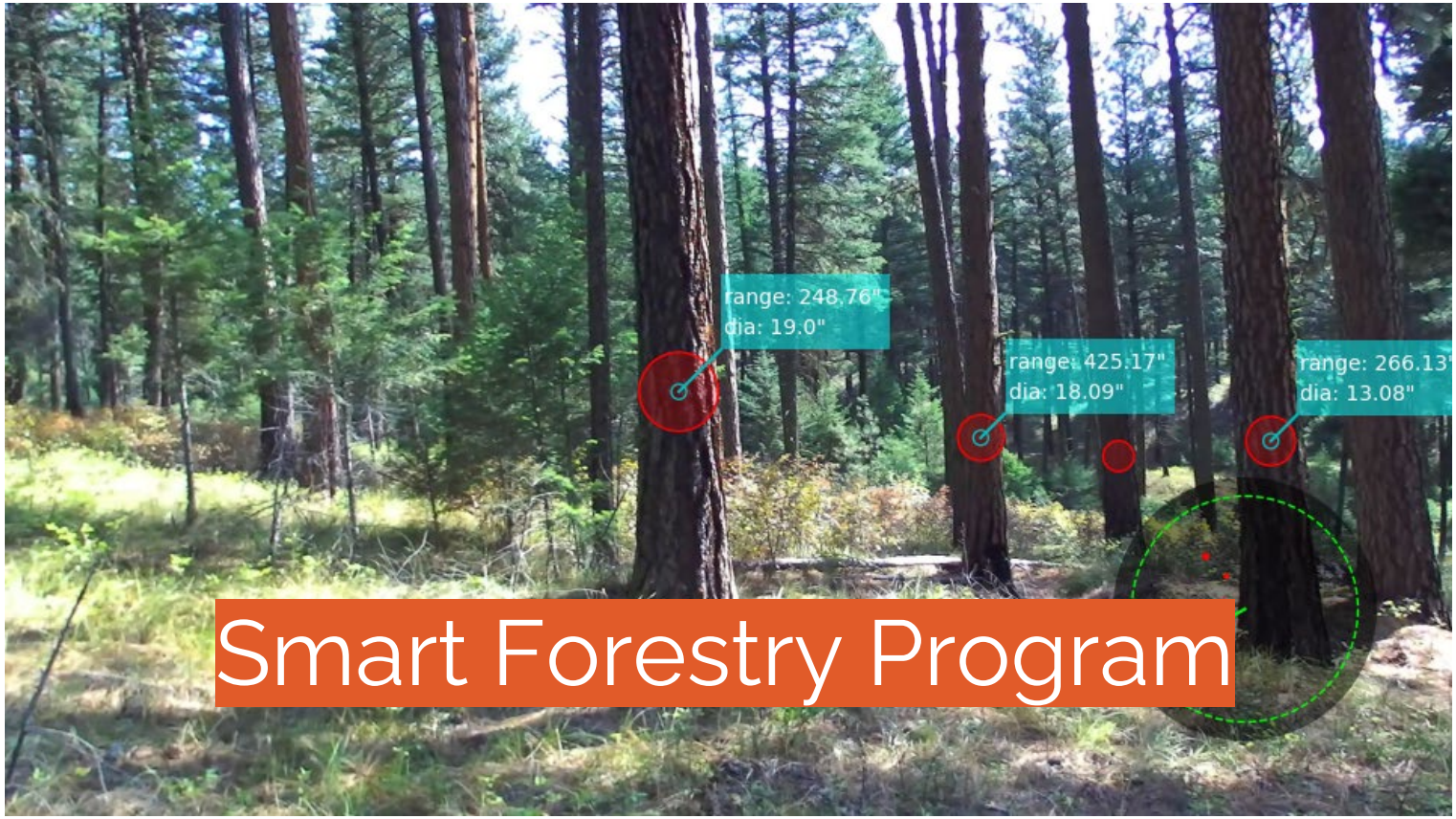
EDA-FUNDED UNIVERSITY RESEARCH AND TESTING FACILTY ADDITIONS

OREGON ACOUSTIC RESEARCH LAB

- State-of-art facility for acoustic testing of mass timber floor-ceiling assemblies
- Certified floor/ceiling testing needed for a large variety of mass timber panel assemblies to further the adoption of mass timber panels in the residential construction market
- Research expertise to help develop improved building materials and construction assemblies critical to developing affordable mass timber panel solutions for multi-family housing.

OREGON STATE UNIVERSITY MASS TIMBER FIRE TESTING CHAMBER

- Facility for fire testing of mass timber building assemblies
- Testing is needed for a large variety of mass timber assemblies to demonstrate their ability to meet U.S. building code requirements and assure the public of their safety
- Research expertise to help develop improved fire-resistant mass timber assemblies critical to affordable mass timber multi-family housing



Smart Forestry Program

T2 Innovation Campus & Workforce Training Cluster

Presented to Oregon Department of Forestry
Port of Portland
Tamara Kennedy, Director of Economic Development

March 8, 2023

Opportunity

Public Investments that

- Catalyze the emergent mass timber sector
- Expedite production of housing
- Create quality jobs in the manufacturing, construction, and forestry industries
- Increase wildfire resiliency of timber resources
- Share economic benefits between urban and regional regions of the state.

T2 Vision

Create a nationally recognized, regional hub of innovation and industry transformation for sustainable mass timber design, housing, development and construction.

- A 45- acre campus dedicated to housing innovation focused on mass timber
- Anchored by housing manufacturing
- R&D that supports expansion
- Inclusive workforce training
- Climate-smart industry growth
- Regional transportation hub via truck, rail & barge

Why

Oregon's housing undersupply threatens the very core of our common purpose as Oregonians. We cannot grow sustainably, move toward a more equitable economy, or address the full complexity of the homelessness crisis unless we substantially increase our supply of homes." (Oregon Housing Needs Analysis Legislative Recommendations Report Leading with Production)

Measured as a share of housing stock, Oregon ranks 4th in underproducing housing in the country behind California, Colorado, Utah, and ahead of Washington State

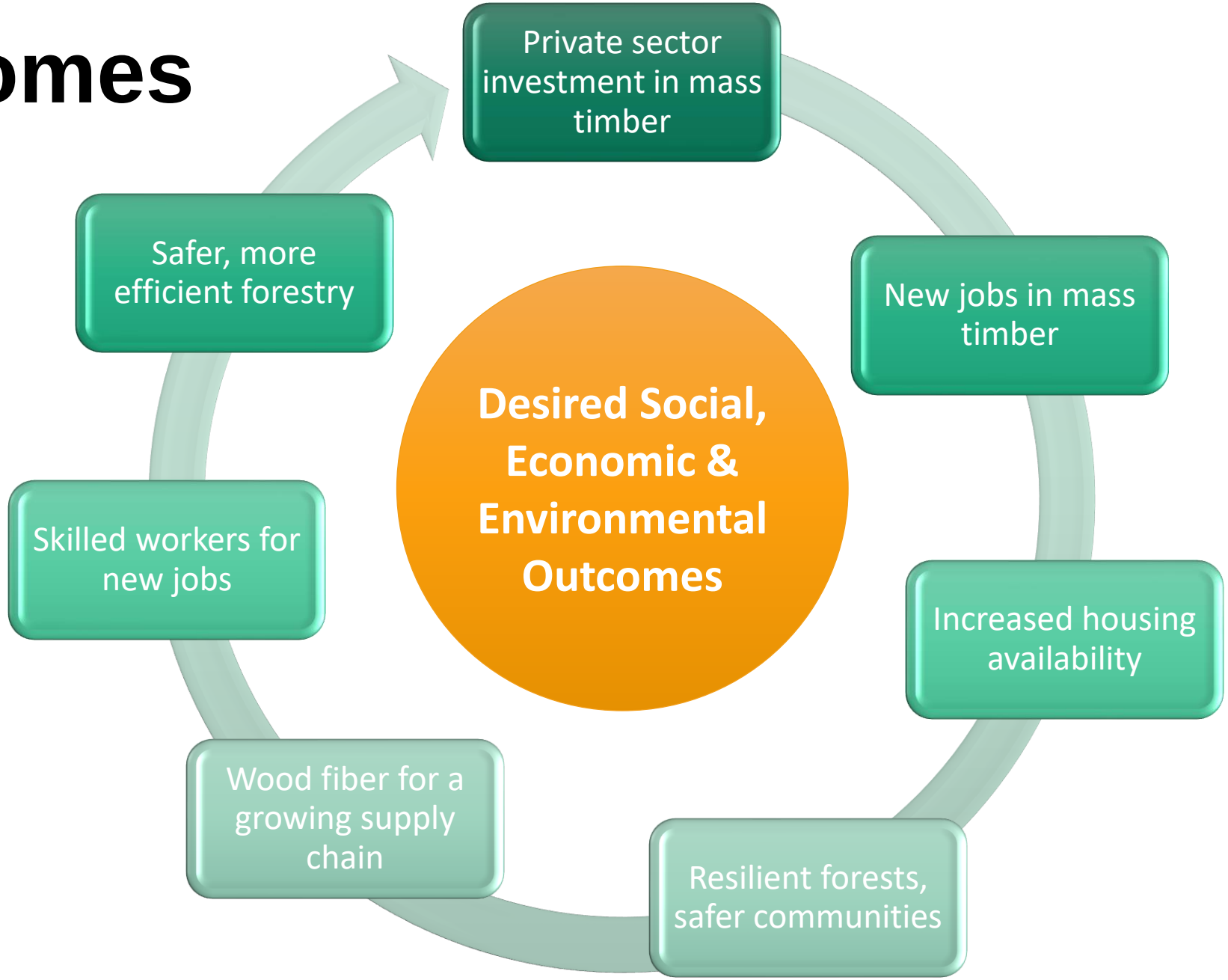
- Housing affordability and supply chain crisis
  - 550,000 housing units in the next 20 years – 30% Low Income
  - Workforce housing gap
  - Lack of housing is hindering the state's economic, social livability measures and
- Quality Jobs

- [Addressing Oregon's Housing Shortage, Workforce Needs | Oregon Office of Economic Analysis (oregoneconomicanalysis.com)]

Desired Outcomes

Prioritize these outcomes for:

- Underserved communities
- BIPOC community members
- Rural Oregonians

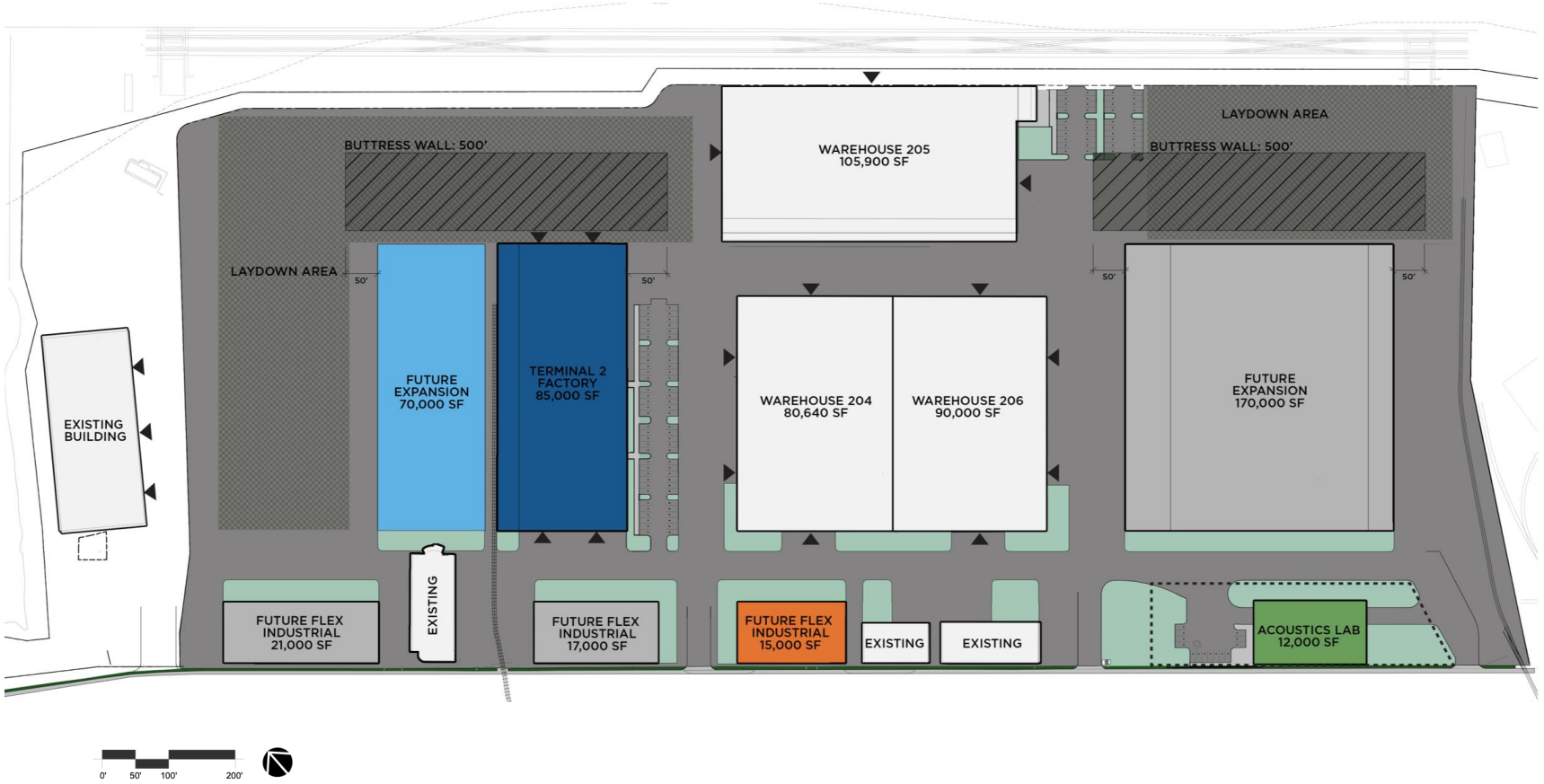


Innovation Campus

- The Innovation Campus will host a new mass timber housing factory, University of Oregon’s acoustics research laboratory, a modular housing factory and a variety of other companies involved in the offsite construction industry.

T2 -- The Real Estate

- Located in the heart of Portland's NW Industrial Area
- Access to rail and (possibly) barge transport
- Adjacent to Interstate 405
- Appropriate zoning and utility infrastructure
- Proximate to existing worker training sites
- Site preparation funded jointly by Port and EDA



Port of Portland | Terminal 2
12.15.2022

Architectural Site Plan - Option 1
© 2022 Mackenzie | 2180364.17

MACKENZIE.

Master Plan Elements

Existing warehouses hosting prototyping efforts

New buildings to include

- U of O Acoustics Testing Lab
- Mass timber housing factory
- Mass timber manufacturing

Needed land use and entitlements addressed

Project: Mass Timber Regional Training Cluster

Goals:

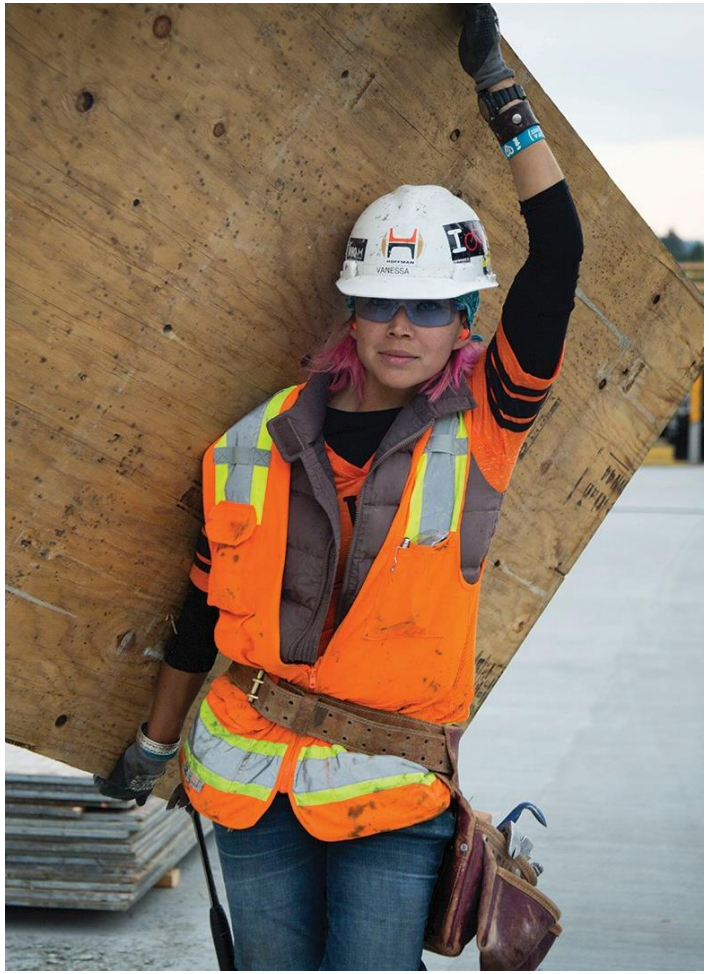
- Scale up housing production
- Create good urban and rural jobs
- Address race-based economic disparities
- Equitable job training in forestry, construction, and advanced manufacturing
- Support forest restoration and climate adaptation
- Provide additional timber resources to meet housing needs

OMTC Equity Oversight Committee Purpose

- Guide grantees in setting equity priorities
- Support grantees understanding where they need to engage and improve
- Assist OMTC in meeting its equity goals
- Provide oversight and accountability to grantees
- Connect underserved communities and individuals to opportunities in the growing mass timber sector

Equity Oversight Committee Overview

- 11-member panel
- Representative of urban and rural regions, BIPOC, and culturally-specific communities
- Industry, trades, labor, service providers, advocacy, and community-based organizations
- Committee staffed by OMTC, with facilitation provided during committee formation stage
- Participants will be compensated
- Initial participants selected by OMTC grantee organizations. Future committee members selected by



Questions?

Thank you

Code-UP

Oregon Mass Timber Coalition's Community Development Code Update Project

Graphics source: www.masstimbercoalition.org

DLCD

March 8, 2023

Kirstin Greene, AICP, Deputy Director

Code-UP initiative

Create markets for modular mass timber housing by removing zoning code and building code barriers

Phase I: Zoning Code and Building Code Audits Complete (2022)

- Participating fire-impacted cities:
  - Lincoln City
  - Gates
  - Detroit
  - Phoenix
  - Talent

Phase II: Code-UP Initiative

- 10 additional city zoning code and building code audits (2023-24)
- Local adoptions by August 2024
- 15-20 Additional zoning code and building code audits in 2025-2028
- Goals: 30 Local zoning codes updated; 7500 lots entitled

Code-UP initiative

Local Zoning Code and Building Code Audits

Key Findings

- Align definitions: Mass Timber Modular Dwellings are Prefabricated Structures
- Cottage Clusters
- Contemporary Park Designs
- Accessory Dwelling Units
- Plan Review Technical Guide

Image Source: www.masstimbercoalition.org

Photo courtesy of Forterra

DLCD

Department of Land Conservation & Development

March 8, 2023

Kirstin Greene, AICP, Deputy Director

Thank you!

Connecting Mass Timber & Housing Production

Oregon Board of Forestry

March 8, 2023

Margaret Van Vliet

TRILLIUM ADVISORS

VISION | INSIGHT | STRATEGY

The Big Idea

The combined forces of climate change, enduring rural economic despair, deepening race-based disparities, and chronic housing shortages demand new approaches.

Oregon has a once-in-a-generation opportunity to tackle these challenges by using Mass Timber in the production of housing,

The federal government has already recognized the potential through it's award of a $41.1M *Build Back Better* grant to the Oregon Mass Timber Coalition for a suite of projects designed to grow the mass timber economic cluster.

Building Back Better can only work ***if the housing sector seizes the opportunity to innovate and deploy the technology at scale.***

Office of the Governor
State of Oregon

EXECUTIVE ORDER NO. 23-04

ESTABLISHING A STATEWIDE HOUSING PRODUCTION GOAL AND HOUSING PRODUCTION ADVISORY COUNCIL

WHEREAS, Oregon is experiencing a severe housing shortage, which increases housing costs and reduces housing affordability, is the primary cause of the homelessness crisis in the state of Oregon, hinders the State's economic prosperity, and prevents too many Oregonians from maintaining housing stability, which is the foundation to every family's health, well-being, and economic stability;

WHEREAS, the greatest shortage of housing is housing that is affordable to households earning below the median income;

WHEREAS, the Oregon Housing Needs Analysis (OHNA) estimated that there is a current shortage of almost 140,000 homes across the state;

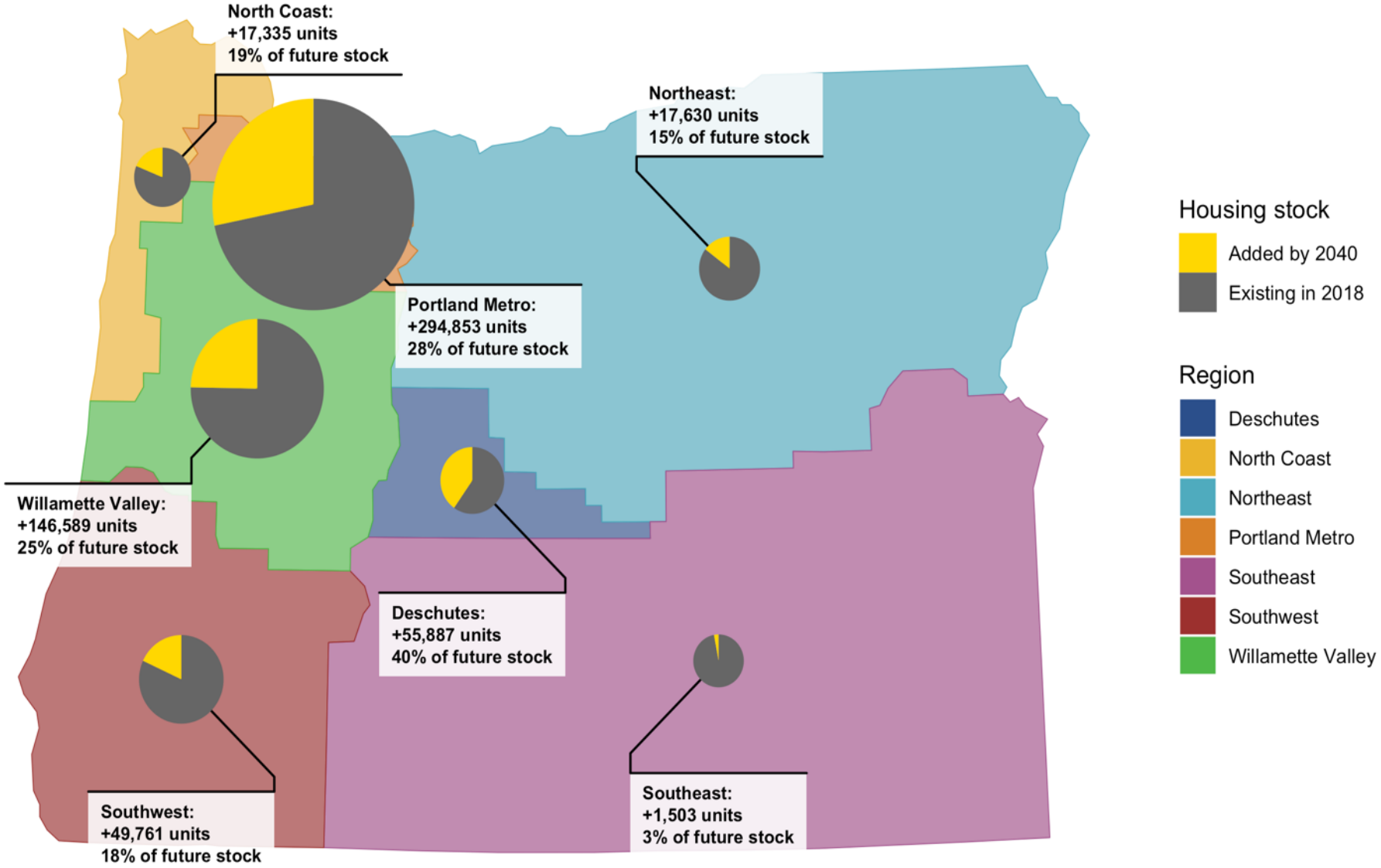
WHEREAS, the OHNA also estimated that, in addition to addressing the current shortage of housing, the state needs to produce 443,566 homes over the next twenty

Why Housing Matters

The lack of housing stability takes an enormous toll on insecure households as well as the broader community

- *Homelessness results from a shortage of housing*
- *When families, seniors, and people with disabilities spend too much on rent, they neglect other basic needs (medicine, food, transport)*
- *Children without stable housing suffer academically*
- *Employers struggle to recruit workers – especially in rural communities*
- *Long commutes contribute to emissions, tax our roads, and erode quality of life*
- *Long-standing segregation and persistent racism in financing, leasing, and home sales have produced deep disparities in outcomes for Black, Indigenous, and other people of color*

Current (2018) Housing Stock Plus 20 years of Housing Need



Source(s): ECONorthwest analysis; PSU, 2020-2070 Coordinated Population Forecasts; U.S. Census Bureau, 2018 ACS 1-year PUMS estimates; HUD, 2019 PIT count; ODE, SY 2018-2019 McKinney Vento data

Summary of housing need, regions and State, 2020 - 2040

	New units for each of the following...				
Region	Projected Need	Underproduction	Housing for the Homeless	Total Units	% of Units
Portland Metro	224,683	59,488	10,683	294,853	51%
North Coast	14,731	295	2,309	17,335	3%
Willamette Valley	101,704	35,913	8,972	146,589	25%
Southwest	34,896	10,287	4,579	49,761	9%
Deschutes	49,856	4,837	1,194	55,887	10%
Northeast	16,731	-	899	17,630	3%
Southeast	965	-	538	1,503	0%
Oregon	443,566	110,819	29,174	583,559	100%
% of Units	76%	19%	5%	100%	

Source(s): ECONorthwest analysis; PSU, 2020-2070 Coordinated Population Forecasts; U.S. Census Bureau, 2018 ACS 1-year PUMS estimates; HUD, 2019 PIT count; ODE, SY 2018-2019 McKinney Vento data

Average total units built per year for last 5 years?

About 20,000

Governor Kotek's Call to Action:

36,000 per year

The Need for Innovation

- Housing construction methods and materials – and the associated supply chains – have hardly changed since WWII
- Oregon's land use system was adopted 50 years ago
- Affordable housing finance has not changed since 1986
- Localities charged with zoning and permitting lack capacity, slowing the development process
- The 2020 wildfires that destroyed 4200 Oregonians' homes underscored vulnerabilities in the housing "system"

➢ *Oregon is losing ground on housing*

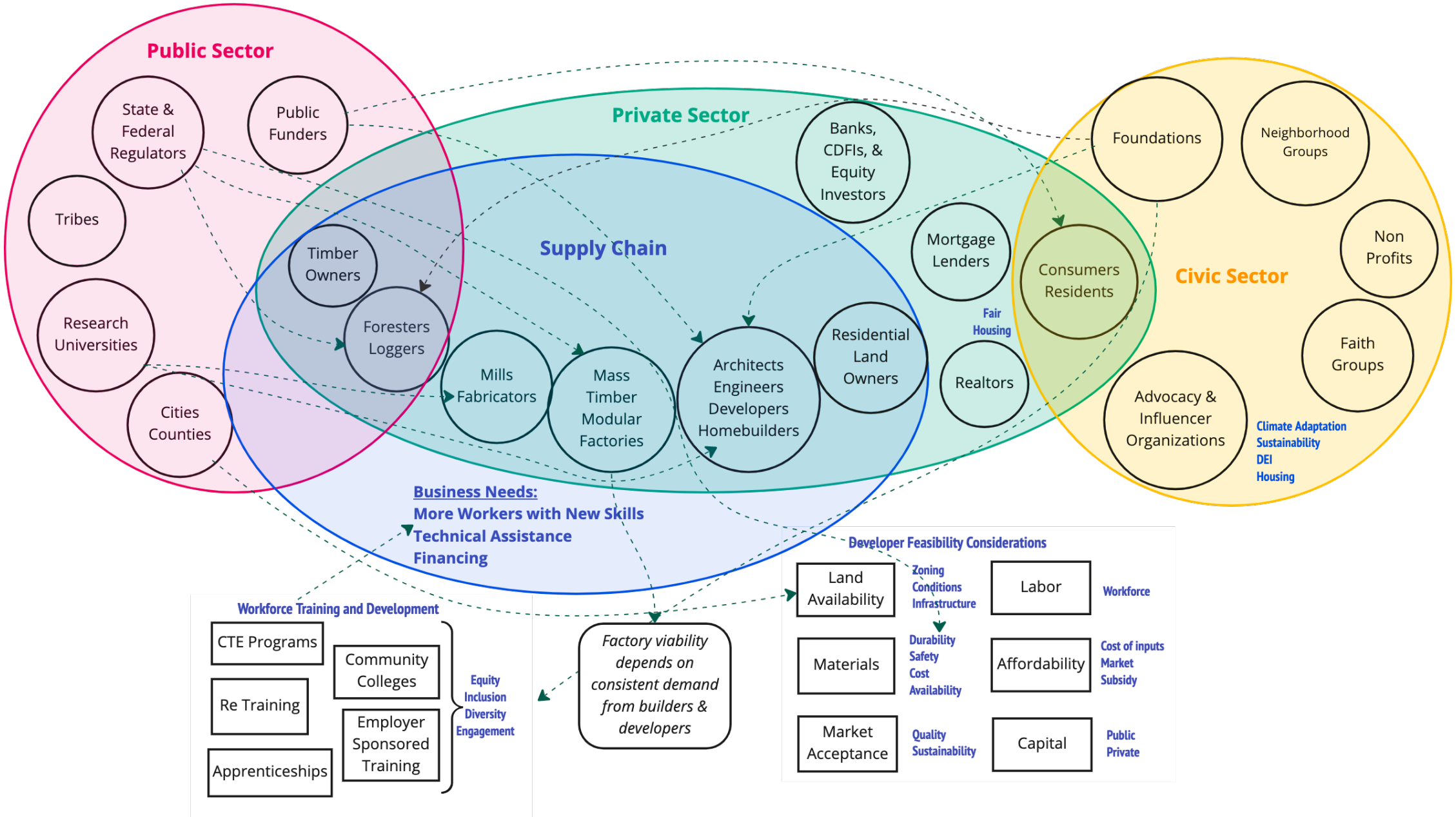
Industry Starting to Move…

…but that movement needs to reach scale and all parts of the supply chain need to quickly adapt

Advantages of modular housing widely recognized in Europe and elsewhere, but not here. Under the right conditions modular construction

- ✓Saves time
- ✓Improves working conditions
- ✓Wastes less in raw materials
- ✓Is more cost effective
- ✓Produces high-quality, energy efficient/net zero homes

Mass Timber Housing Ecosystem
The Case for a Center of Innovation Excellence



A Center for Innovation Excellence

- Connect R&D to developers, builders, and factory operators
- Engage and inform key public & private sector entities
- Assemble and deploy risk capital needed by entrepreneurs and existing businesses as they adapt
- Provide targeted technical assistance that helps accelerate market adoption
- Support and amplify workforce development efforts of others
- Serve as a central repository, connector, and “think tank”

Public Policy Drivers

- Climate adaptation
- Housing solutions
- Economic prosperity
- Equity & opportunity
- Resilience
- Preparedness
- Rural economic sustainability

Federal Forest Restoration Program

EDA Project – Advancing a Restoration Supply Chain

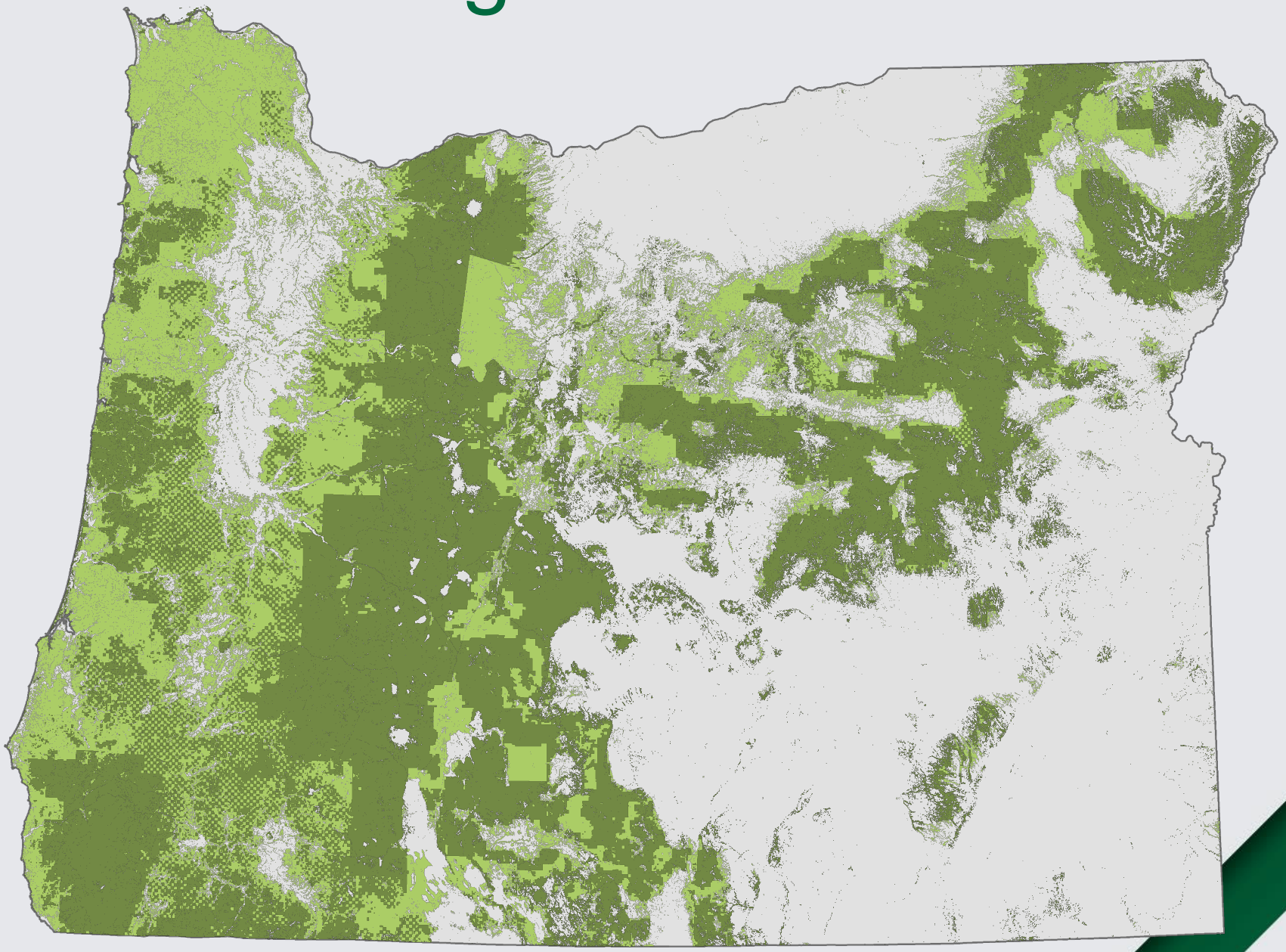
3/8/23

Kyle Sullivan-Astor

Federal Forest Restoration Program Lead

Oregon Dept. of Forestry

Oregon’s forests



Federal Forest Restoration Program: Why does it exist?

- Grounded in BOF work
  - *Achieving Oregon's Vision for Federal Forestlands* 2009 report
- ODF Mission
- 65% of land at highest risk to wildfire
- 20-year strategic plan
- Mechanism to link Board priorities to federal forestlands

Mission and Legislation

Core Mission – Accelerate the **pace**, **scale** and **quality** of forest restoration to increase the resilience of Oregon's federal forests.

Guiding State Legislation ORS 526.275– "…a policy of the state to pursue projects under the [GNA] **that**

- **increase timber harvest volume,**
- **contribute to job creation,**
- **reduce wildfire risks to all lands,**
- **improve wildlife habitat and watershed health and**
- **stimulate local economies**."

Federal GNA Investments

State Investments in FFR

Good Neighbor Authority *(Pace)*

Federal Partner Support *(Scale)*

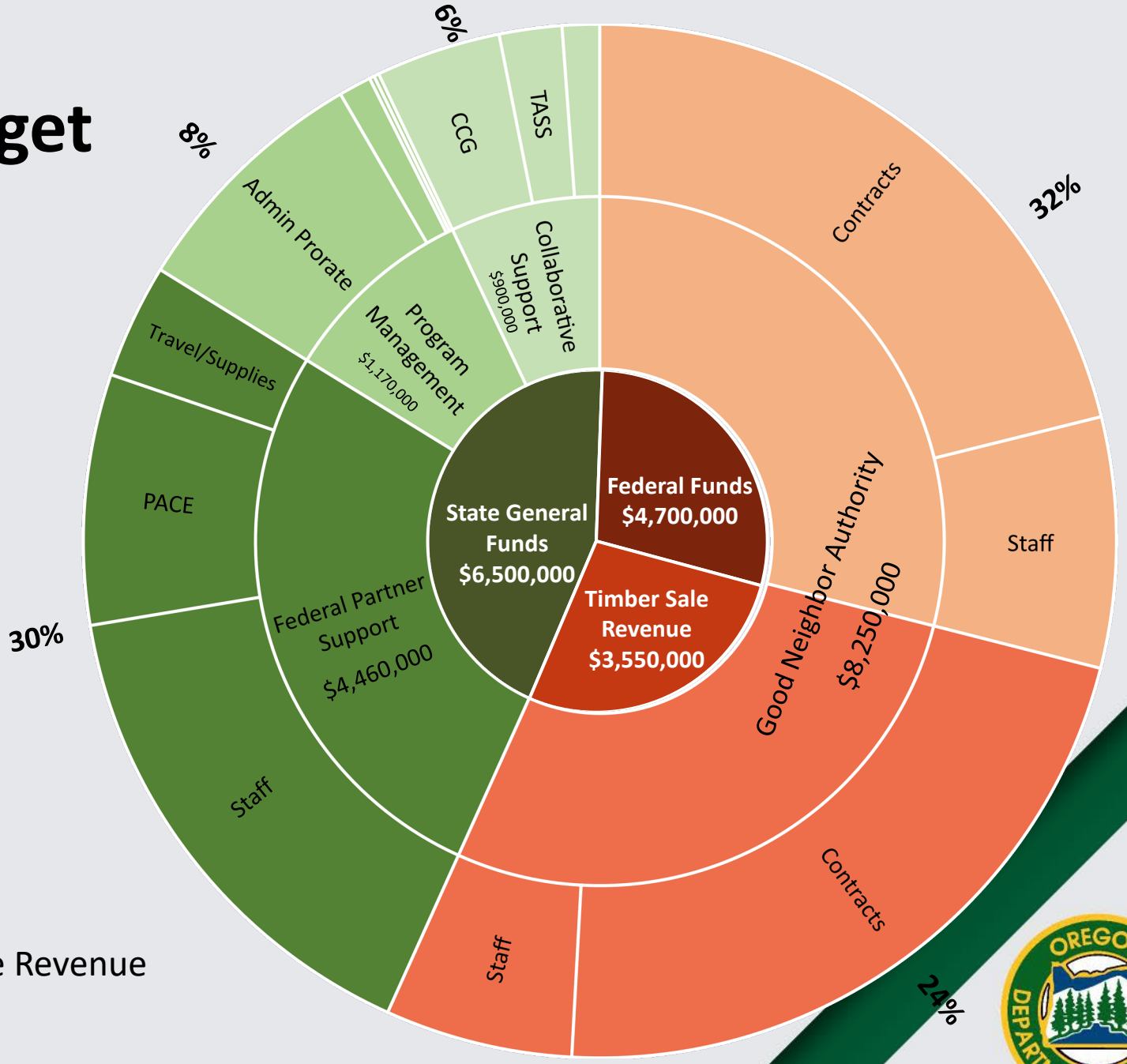
Collaborative Support *(Quality)*

2021-23 Biennium Budget

(July 1, 2021-June 30, 2023)

$14.8 M Total

- **$6.5M (44%) State**
- **$8.25M (56%) Federal**



*Federal Funds and GNA Timber Sale Revenue reflect expenditure authority

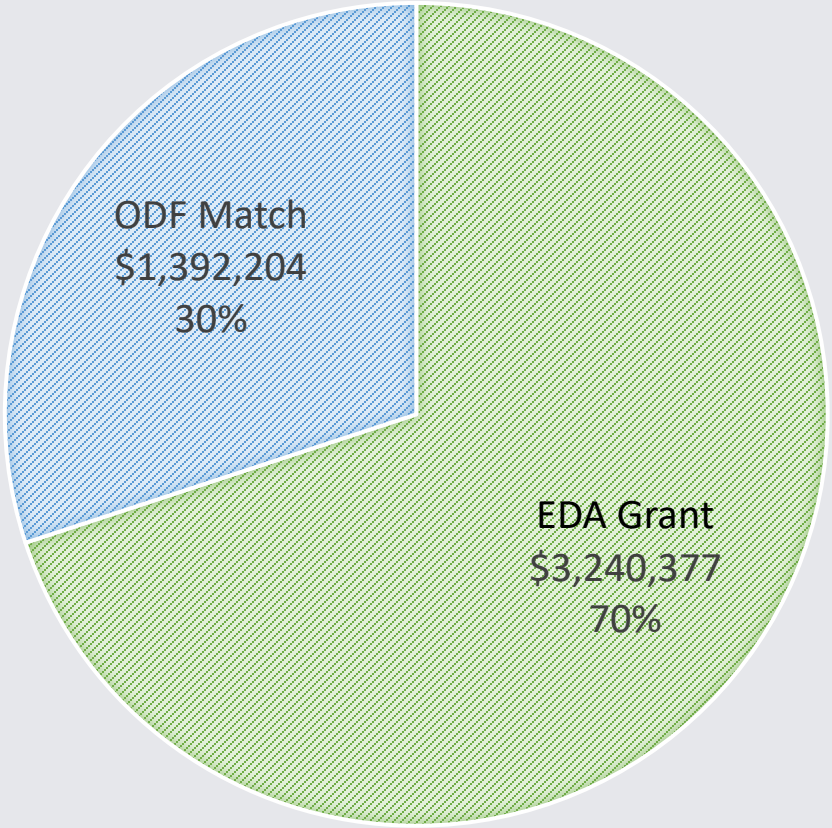
Accomplishments

- $4.3 million in grants supporting forest collaboratives
- 20,000 acres of non-commercial restoration
- 20,000 acres of commercial restoration, 107 million board feet sold
- 9 (NEPA) Categorical Exclusion projects covering over 35,000 acres
- 650 acres of post-implementation monitoring work
- Generated 38 jobs and $3 million in GDP per year
- Staff engaged with over 20 forest collaboratives in Oregon

Advancing a Forest Restoration Supply Chain - Project Summary

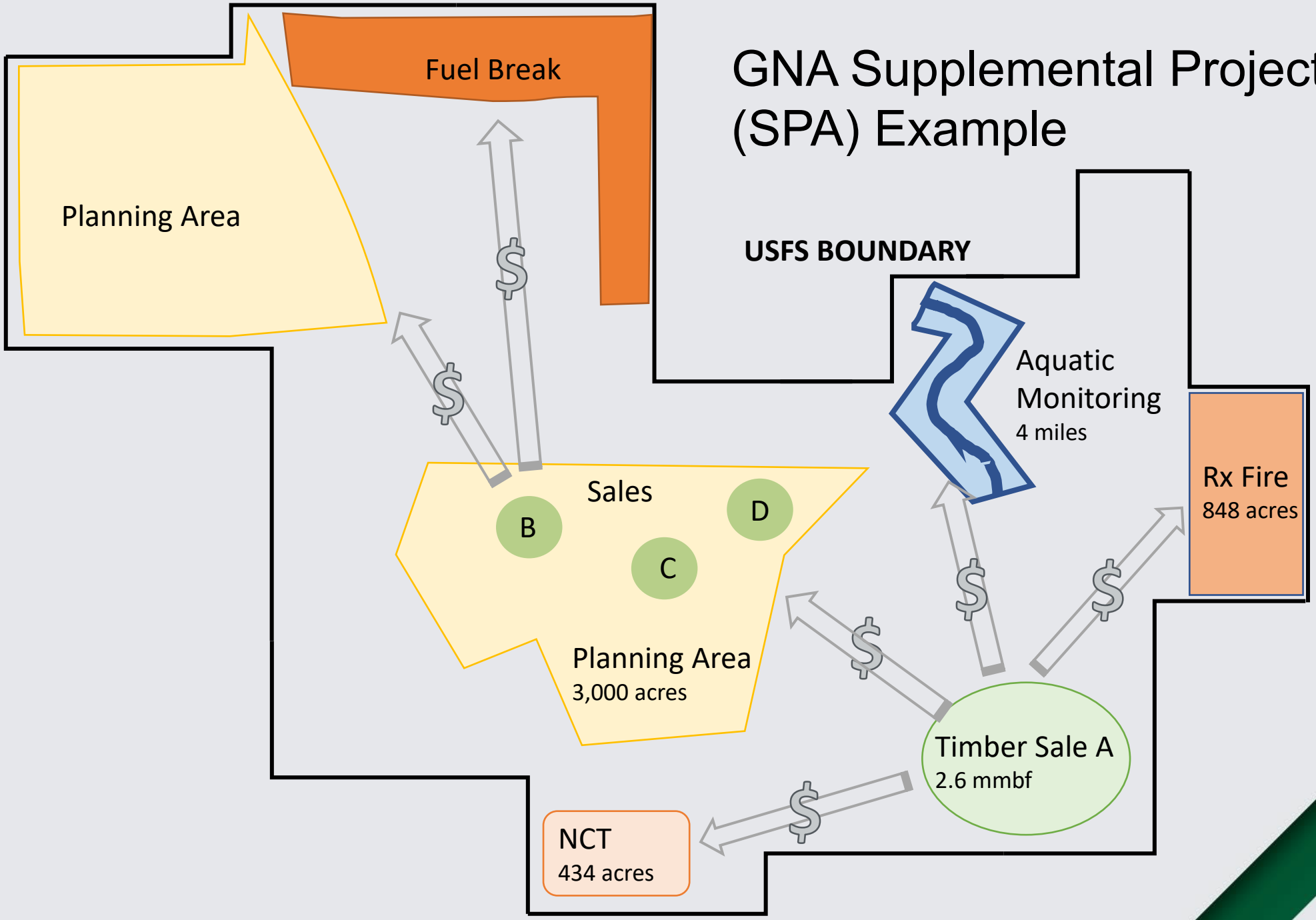
- Partner with the Willamette NF to **plan** and **implement** forest health and resilience treatments
- Planning –
  - Two 70 acre contract NEPA Categorical Exclusion (CE) projects
  - One larger planning area
- Implementation –
  - 470 acre 'NEPA-ready' commercial thinning project (Dry Beard)
  - 140 acre commercial thinning (ODF NEPA CE)

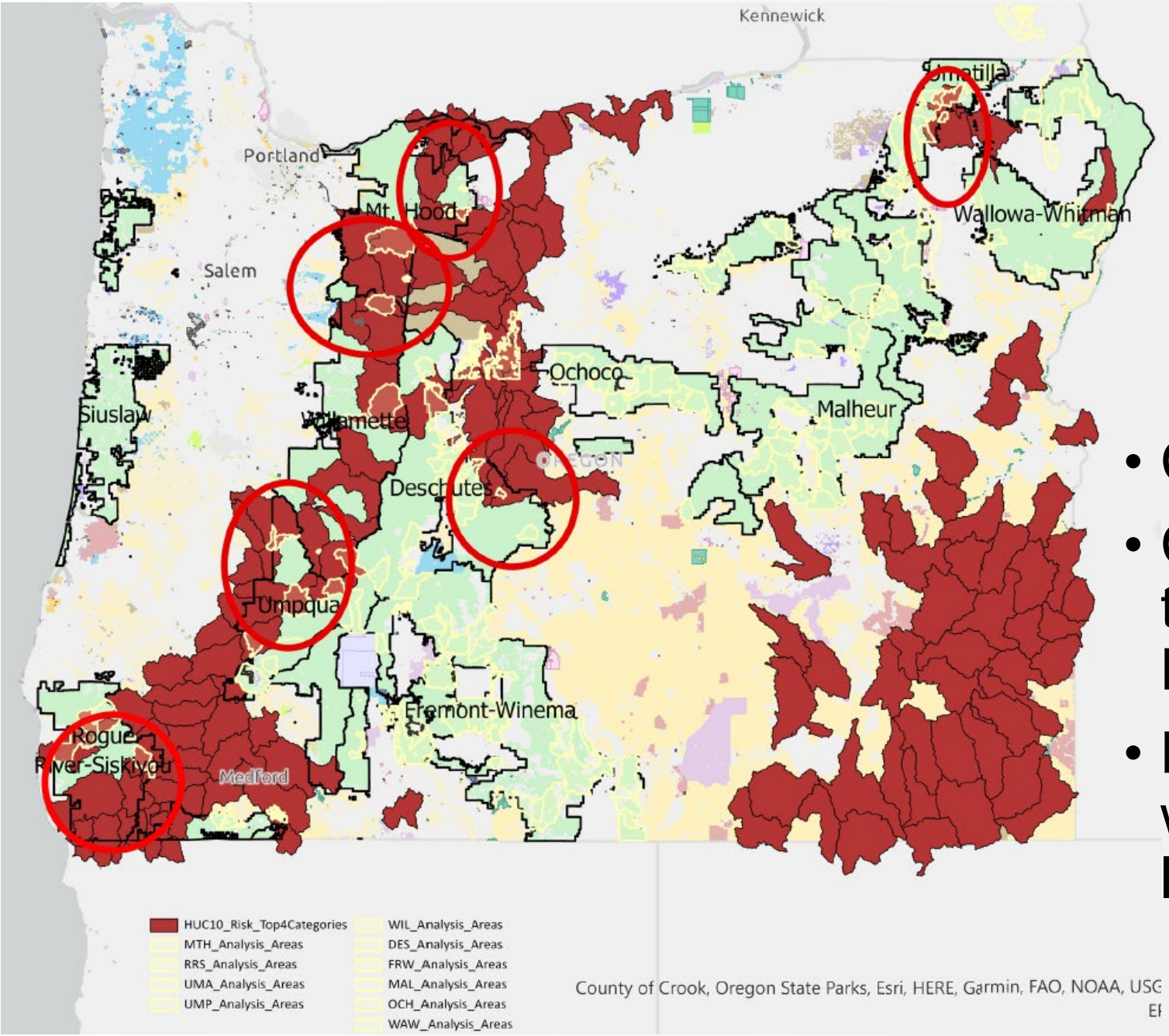
TOTAL PROJECT BUDGET



Total $4,632,581 or ~1.2M/year

GNA Supplemental Project Agreement (SPA) Example



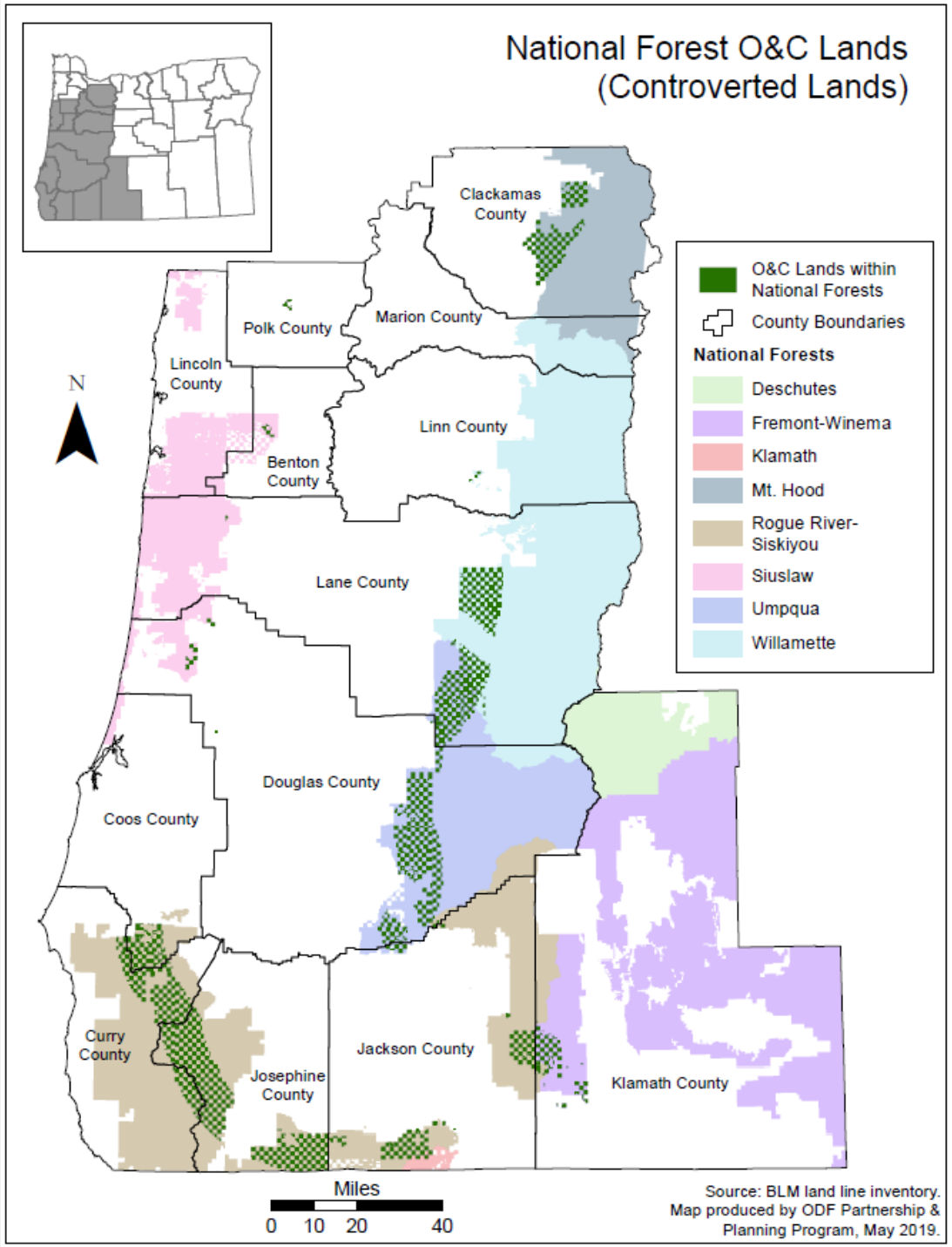


2023-25 opportunities and priorities

- Cross boundary projects
- Continue to pursue projects that are additive (ODF Contract NEPA)
- Plan and implement projects within high wildfire risk landscapes

Risks and Challenges

- Litigation
- Wildfire
- Payments to counties
  - Mitigated by being additive
- Achieving ‘pace and scale’ while maintaining social license
- Environmental reviews are costly and time consuming
- Many projects do not ‘pay for themselves’
  - Especially NE, Central, and SW




Questions?
OREGON
DEPARTMENT OF FORESTRY

Sustainable Northwest- Track and Trace Scope

Board of Forestry Meeting - March 8th, 2023

Paul Vanderford
Green Markets Program Director

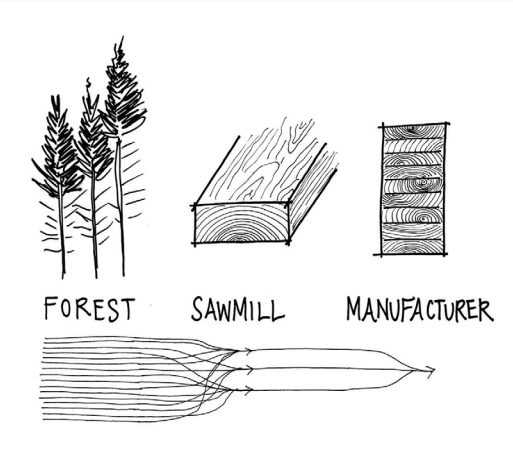
SUSTAINABLE NORTHWEST

Sustainable Northwest Mission

We bring entrepreneurial solutions to natural resources challenges to keep lands healthy and provide economic and community benefits.

SNW - Approach

1. Inspire projects with the opportunity for positive impact
2. Build relationships between the market and producers
3. Provide the tools needed for success



SNW - Pilots and Partners

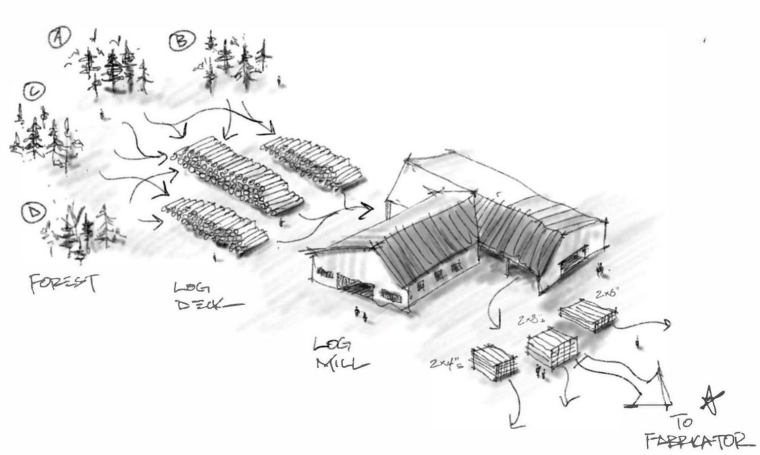
Six pathways for recognizing and rewarding the people and places that produce wood products.

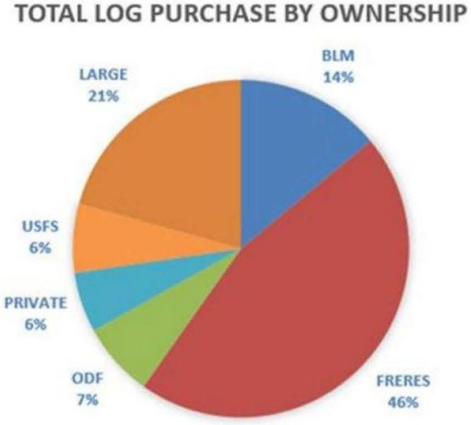
SNW - Creating Value by Focusing on Impacts

The greatest power of this approach is helping building projects and clients connect to people and the deep ecological, cultural, and community values behind wood products.

EDA - 1) Track and Trace Scope

Track & document fiber for Willamette National Forest, Freres, and affordable housing partners: Hacienda and PathHouse.





Hacienda Community Development Corporation

EDA - 2) Scientific Defensibility and Social License

Support project planning, monitoring, and measurement of the ecological, social, and economic impacts associated with forest treatments.

EDA 3) Storytelling and Tours

The Story of Restoration Wood & Oregon State University

COLVILLE NATIONAL FOREST

SOURCE FOREST

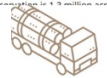
The Mill Creek A to Z Stewardship Project on the Colville National Forest is the first National Forest restoration project of its kind,

YAKAMA FOREST PRODUCTS

SOURCE FOREST

The Yakama Nation and its people have lived on and actively managed the landscapes of Central Washington since time

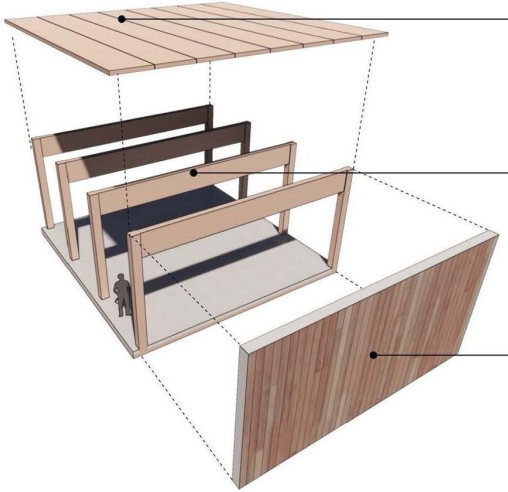
Where the wood went...



VAAGEN BROTHERS MILL

ZIP-O MILL

www.futureforestsnorthwest.org



FOREST RESTORATION WOOD

LOG PURCHASE TRANSPARENCY

VAAGEN TIMBERS CLT:
202,632 BF
RESTORATION TIMBER LOGS:
135,088 BF
FOREST HEALTH:
40 ACRES OF FOREST RESTORATION
JOBS CREATED IN:
STEVENS COUNTY

TRIBAL FOREST RESTORATION WOOD

VERTICALLY INTEGRATED MILL

ZIP-O LAMINATORS GLULAM BEAMS:
67,162 BF of lumber from Yakama Forest Products (50% of 134,324 TOTAL BF)
YAKAMA NATION LOGS:
47,972 BF
FOREST HEALTH:
14 ACRES OF FOREST RESTORATION
JOBS SUPPORTED IN:
YAKAMA AND LANE COUNTY

FAMILY FOREST WOOD

SMALL MILL DIRECT SOURCING

SUSTAINABLE NORTHWEST WOOD CEDAR SIDING:
10,900 BF
FAMILY FOREST LOGS:
11,000 BF
FOREST HEALTH:
10 ACRES (single tree selection)
JOBS SUPPORTED IN:
CLACKAMAS, WHATCOM, MARION, MULTNOMAH COUNTIES

Parallel Work on Private Forestland

$25M for Climate Smart Commodities

- Oregon and Washington
- 190 producers, including 5 Tribes
- 66,000 acres of restoration
- Impact measurement
- Mapping and market development
- Scaling practices and market recognition

Big Picture

There is strong nexus between federal, state, and private investment in:

Affordable housing,
Climate resilience of forests,
Rural community development.

To Achieve Scale

1) Strong scientific defensibility
2) Resources for and buy-in from partners
3) Communicate clear social, economic, and ecological values




Thank you

Paul Vanderford
Green Markets Program Director
Sustainable Northwest
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paulv@sustainablenorthwest.org

Smart Forestry

Paving the Way from Forest Restoration to Mass Timber

Woody Chung | Oregon State University

Contents

EDA Smart Forestry

Forest Restoration

CHALLENGES

Economic

Revenue vs. cost

Small diameter trees

Supply uncertainty

Infrastructure

Workforce

Steep terrain

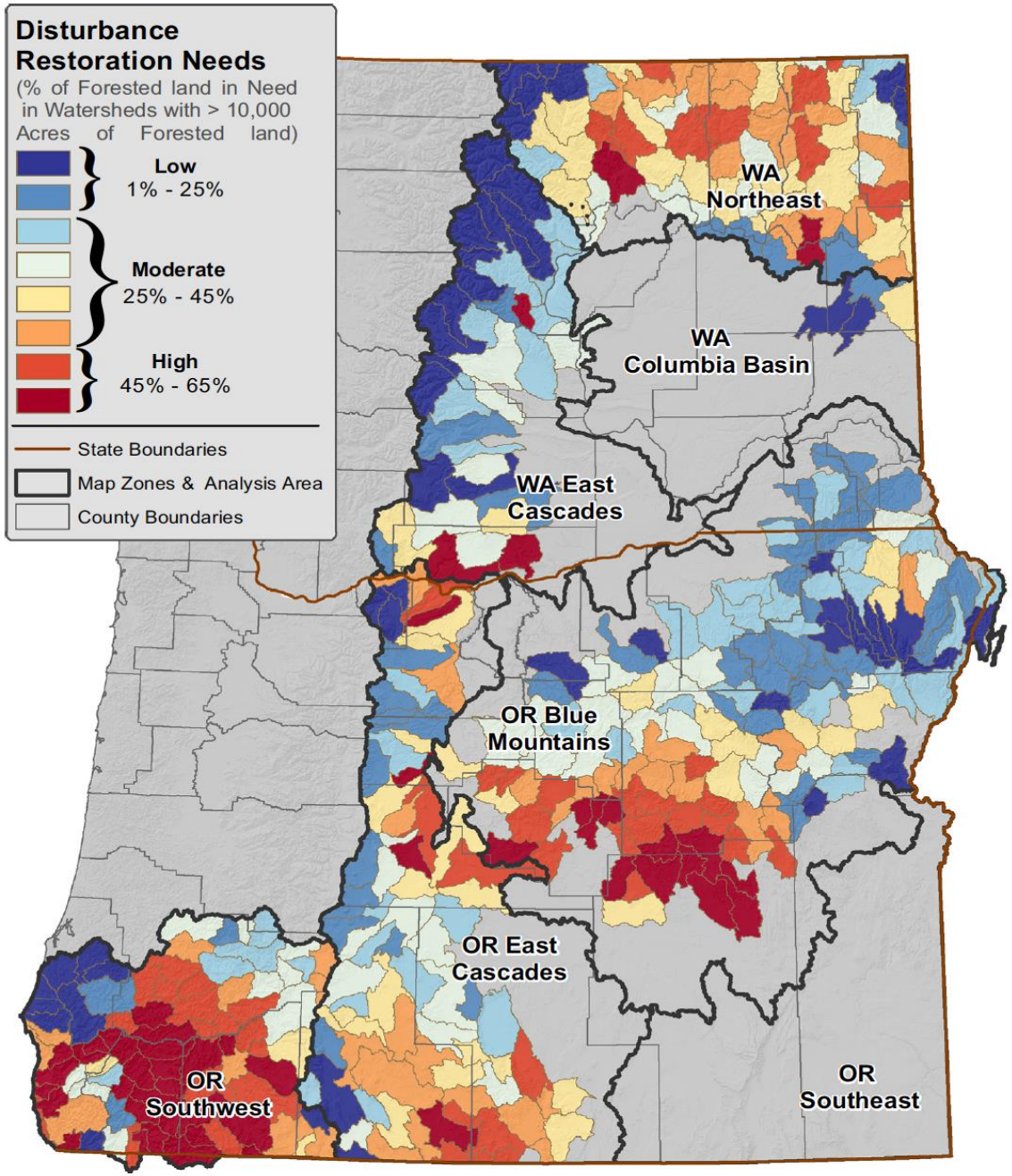
Dangerous work

Diminishing workforce

Rural areas

Restoration

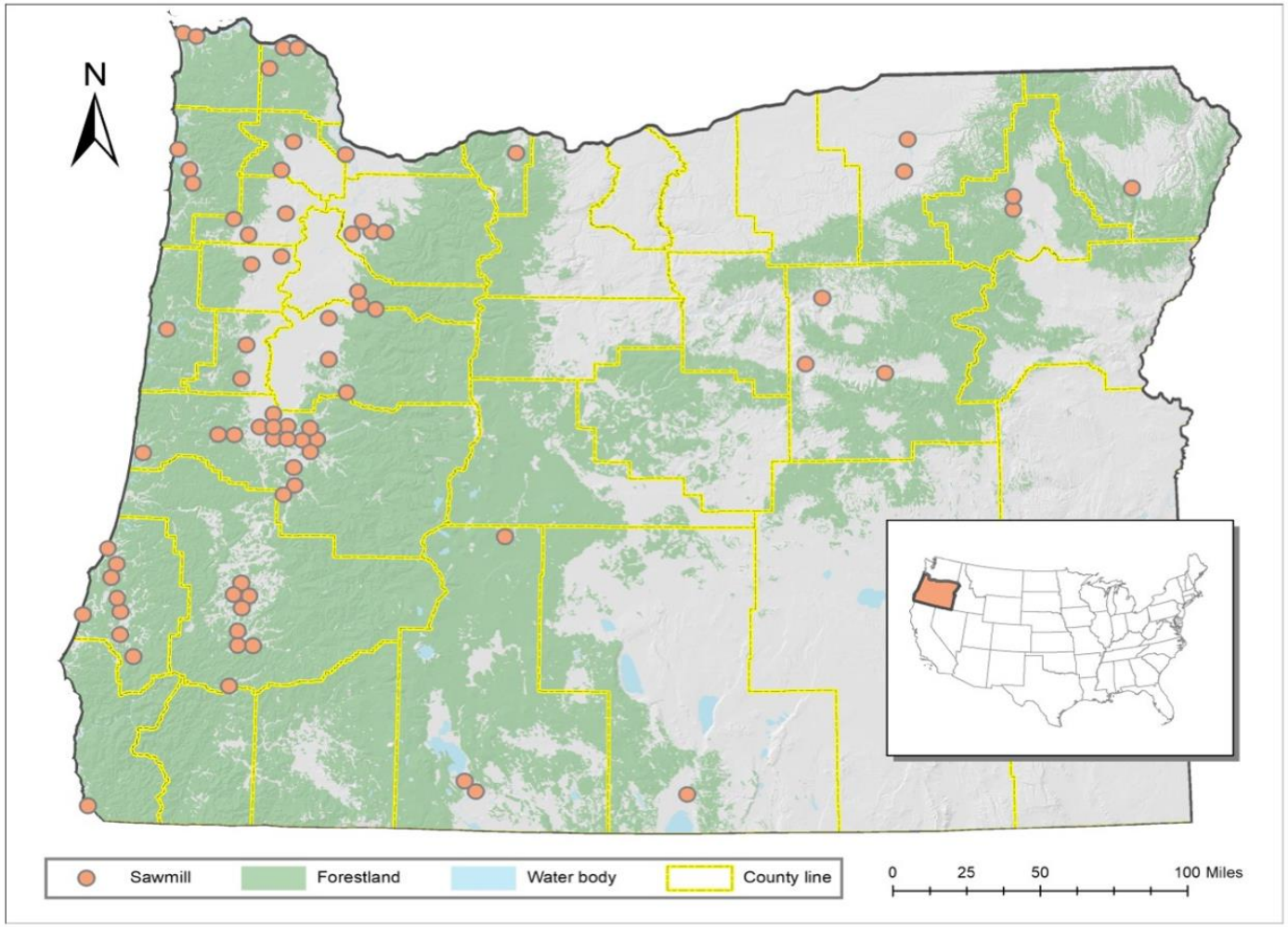
Eastern and Southwestern Oregon



Source: Haugo, R. D., C. Zanger, T. DeMeo, C. D. Ringo, A. J. Shlisky, K. Blankenship, M. Simpson, K. Mellen-McLean, J. Kertis, and M. Stern. 2015. A new approach to evaluate forest structure restoration needs across Oregon and Washington, USA. Forest Ecology and Management 355:37–50.

Active Sawmills

Oregon



Source: Donahue, T., T.A. Morgan and T. Dillon. 2021. Oregon Sawmill Energy Consumption and Associated Emissions, 2017. University of Montana Bureau of Business and Economic Researchurce

Treatment Costs

High costs (2017 $)

Average Costs ($ per acre)

- $2,110 (Mechanized thinning)
- $692 (Prescribed burning)
- $405 (Residue pile-burning)

Source: Campbell, R.M. and N.M. Anderson. 2019. Comprehensive comparative economic evaluation of woody biomass energy from silvicultural fuel treatments. Journal of Environmental Management 250 (2019) 109422.

Table A. Cost estimates for mechanized thinning, prescribed burning, residue pile-burning. Values converted to common units (2017 $ acre^{-1})

Source	Study Location	Forest Type	Mechanized Thinning Reported Value	Mechanized Thinning Cost ($ acre^{-1}, 2017 dollars)	Prescribed Burning Reported Value	Prescribed Burning ($ hectare^{-1}, 2017 dollars)	Residue Pile-Burning Reported Value	Residue Pile-Burning ($ hectare^{-1}, 2017 dollars)
Scott 1998	MT	Ponderosa Pine	N/A	N/A	$267 acre^{-1}	$992	$77 acre^{-1}	$286
Cleaves et al. 2000	USFS Region 2	Non-specific	N/A	N/A	$58 acre^{-1}	$238	$61 acre^{-1}	$250
Lynch and Mackes 2003	CO	Ponderosa Pine	$971 acre^{-1}	$3,195	N/A	N/A	N/A	N/A
Lynch and Mackes 2003	CO	Ponderosa Pine	$869 acre^{-1}	$2,861	N/A	N/A	N/A	N/A
Han et al. 2004 [b]	ID	Small Diameter Conifer	$432	$1,386	N/A	N/A	N/A	N/A
USFS 2004	Non-specific	Ponderosa Pine	N/A	N/A	$174 acre^{-1}	$558	N/A	N/A
Larson and Mirth. 2004	AZ	Ponderosa Pine	$672 acre^{-1}	$2,153	$200 acre^{-1}	$641	$50 acre^{-1}	$160
USFS 2005	Southwest US	Ponderosa Pine	$755 acre^{-1}	$2,341	N/A	N/A	N/A	N/A
USFS 2005	Intermountain US	Ponderosa Pine	$705 acre^{-1}	$2,186	N/A	N/A	N/A	N/A
USFS 2005	US Rockies	Ponderosa Pine	$655 acre^{-1}	$2,031	N/A	N/A	N/A	N/A
Arriagada et al. 2008	Western US	Non-specific	$620 acre^{-1}	$1,744	N/A	N/A	N/A	N/A
Evans 2008	National US	Non-specific	$625 acre^{-1}	$1,758	N/A	N/A	N/A	N/A
Hartsough et al. 2008 [a]	MT	Ponderosa Pine/ Douglas Fir	$2560 ha^{-1}	$1,671	$600 ha^{-1}	$753	N/A	N/A
Hartsough et al. 2008 [a]	OR	Ponderosa Pine/ Douglas Fir	$3620 ha^{-1}	$2,362	$320 ha^{-1}	$402	N/A	N/A
Hartsough et al. 2008 [a]	CA	Ponderosa Pine, White/Red Fir	$5150 ha^{-1}	$3,361	$460 ha^{-1}	$577	N/A	N/A
Hartsough et al. 2008 [a]	CA	Sierran Mixed Conifer	$2570 ha^{-1}	$1,677	$1,210 ha^{-1}	$1,519	N/A	N/A
Hartsough et al. 2008 [a]	CA	Sierran Mixed Conifer	N/A	N/A	$1,020 ha^{-1}	$1,280	N/A	N/A
Hartsough et al. 2008 [a]	AZ	Ponderosa Pine	$1730 ha^{-1}	$1,129	$310 ha^{-1}	$389	N/A	N/A
Selig et al. 2010	AZ	Ponderosa Pine	$697 acre^{-1}	$1,967	$200 acre^{-1}	$565	N/A	N/A
USFA 2012	Northwest	Mixed Conifer	N/A	N/A	N/A	N/A	$350 acre^{-1}	$923
Huang et al. 2013	AZ	Ponderosa Pine	$745 acre^{-1}	$1,937	$150 acre^{-1}	$389	N/A	N/A
Average Value				$2,110		$692		$405

Small Wood

Low product values

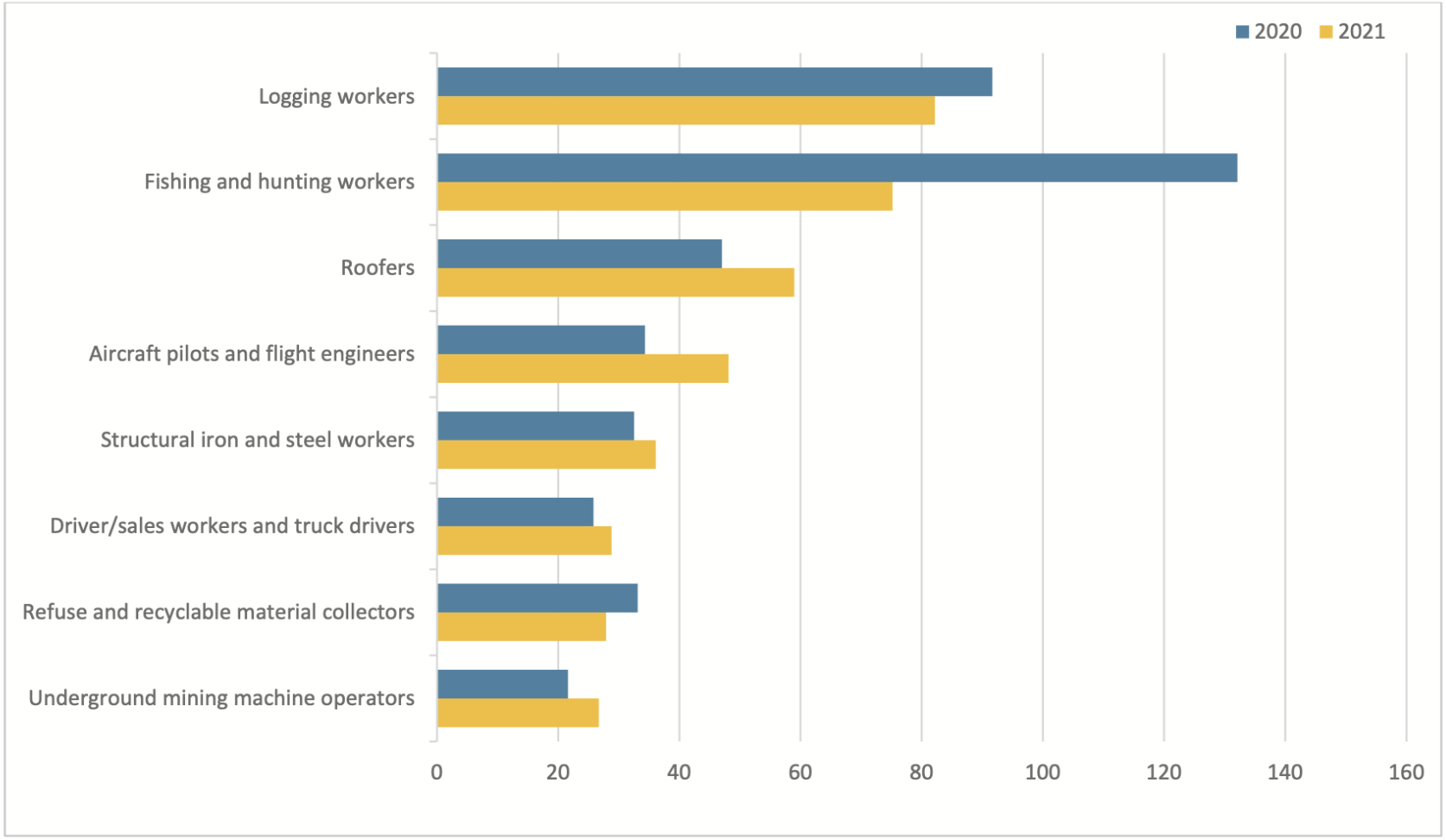
Source: U.S. Forest Service – Pacific Northwest Region

Workforce

Photo credit: Obie O'Brien

Workforce

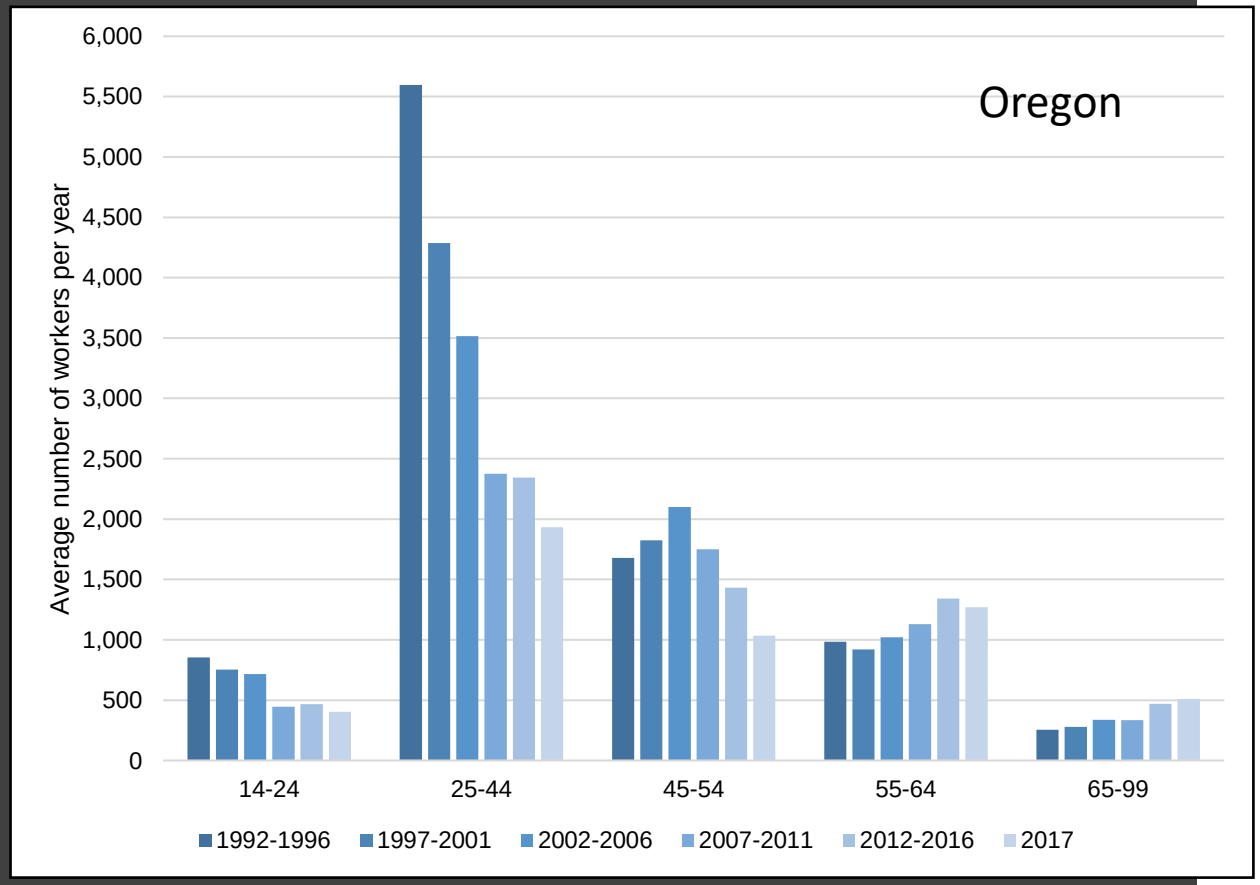
Highest Fatal Work Injury Rates

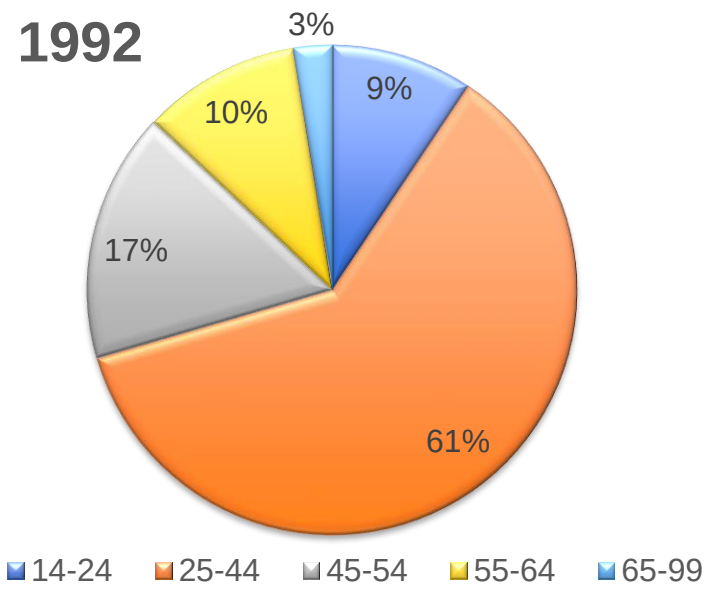


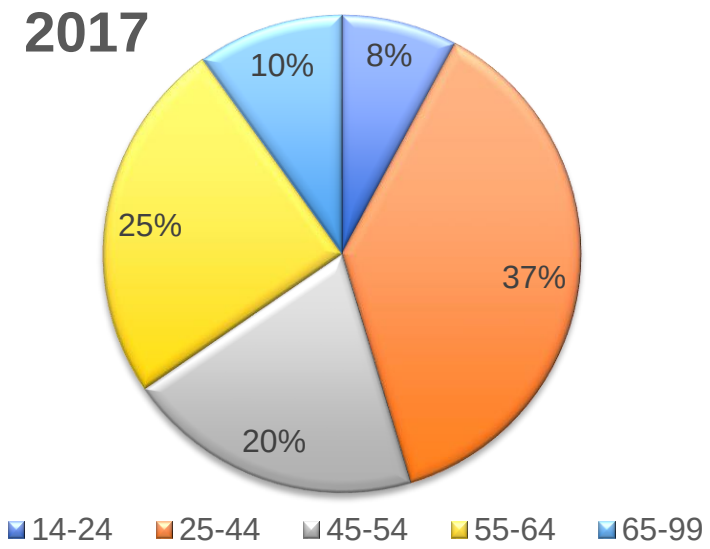
Source: U.S. Bureau of Labor Statistics

Workforce

Diminishing and Aging







Source: Francisca Belart, OSU Extension & U.S. Bureau of Labor Statistics

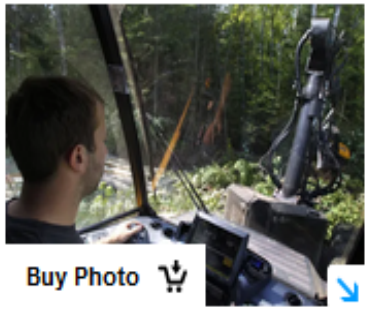
Workforce

Millennials & Gen Z?

- Dangerous
- Difficult
- Rural living
- Remote work locations
- Mediocre pay
- Public perception

Younger generations not interested in timber

By Rachel MinskePress-Gazette Media Published 7:53 p.m. CT July 6, 2014 | Updated 8:49 p.m. CT July 6, 2014



(Photo: Wm.Glasheen/Post-Crescent Media)

STORY HIGHLIGHTS

- Much like farming, the logging industry is often multi-generational and family-ran.
- No one under the age of 18 can legally operate power-driven equipment in sawmills.
- Low wages and long hours are keeping younger generations out of the forests.

CONNECT | TWEET | LINKEDIN | COMMENT | EMAIL | MORE

Scott Sawle was raised in the sawmill business.

He remembers working on his family's mill in southwestern Wisconsin when he was 10. That was in 1958, when child labor laws were more lax than they are today.

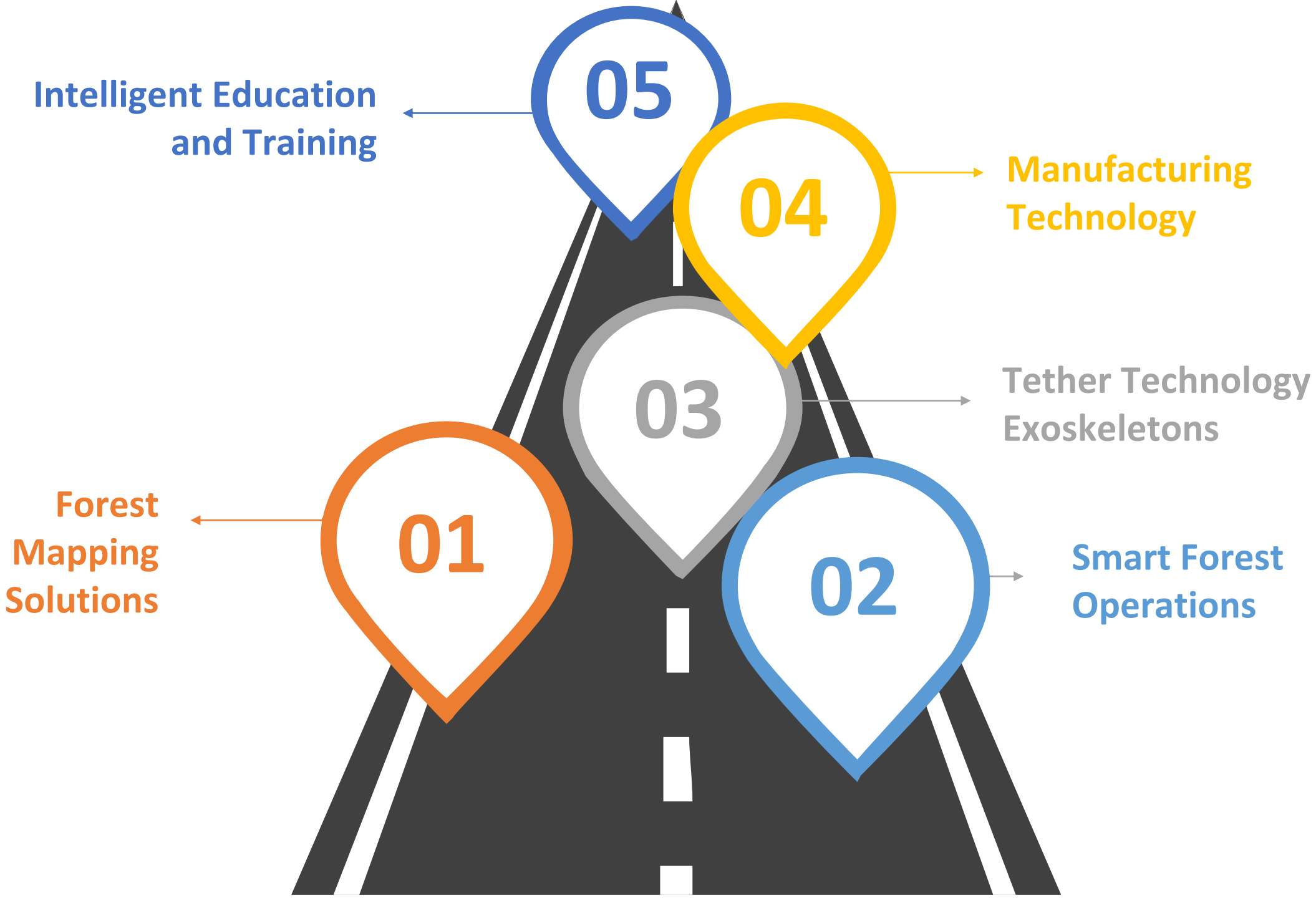
Now 66, Sawle is a second-generation sawmill owner, and he is convinced his Richland Center mill won't support a third.

"I've got two daughters who have no interest in getting involved," he said.

Accounting for 692 jobs statewide, logging is a viable industry in Wisconsin, but many are concerned about its future.

Many young people are not interested in pursuing a career in the field. Long hours, mediocre pay and a more informed general public are keeping younger generations out of the forests, Sawle said.

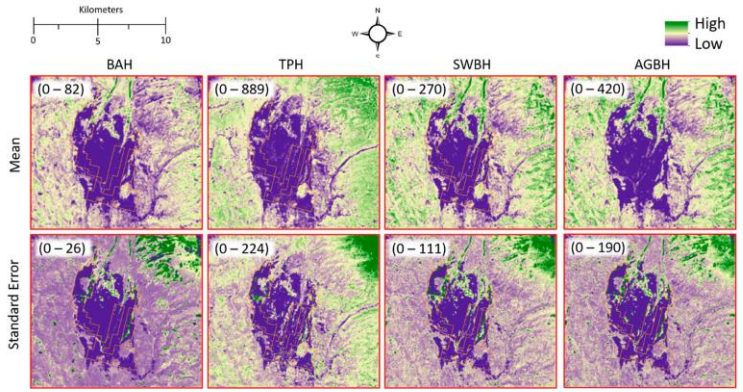
SOLUTIONS ?


05
Intelligent Education and Training
04
Manufacturing Technology
03
Tether Technology Exoskeletons
01
Forest Mapping Solutions
02
Smart Forest Operations

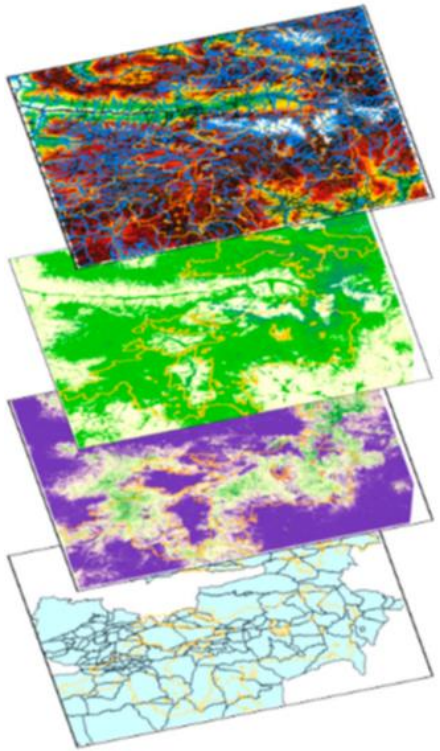
01

Mapping Solutions

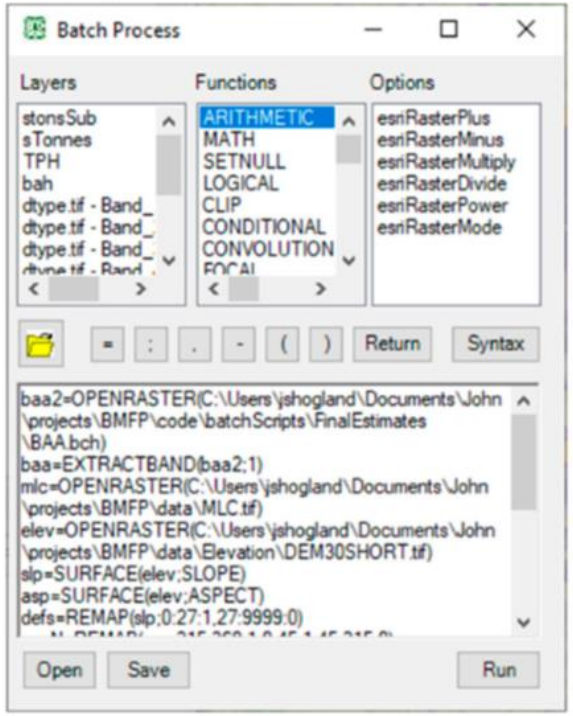
Next-Generation Mapping Technology



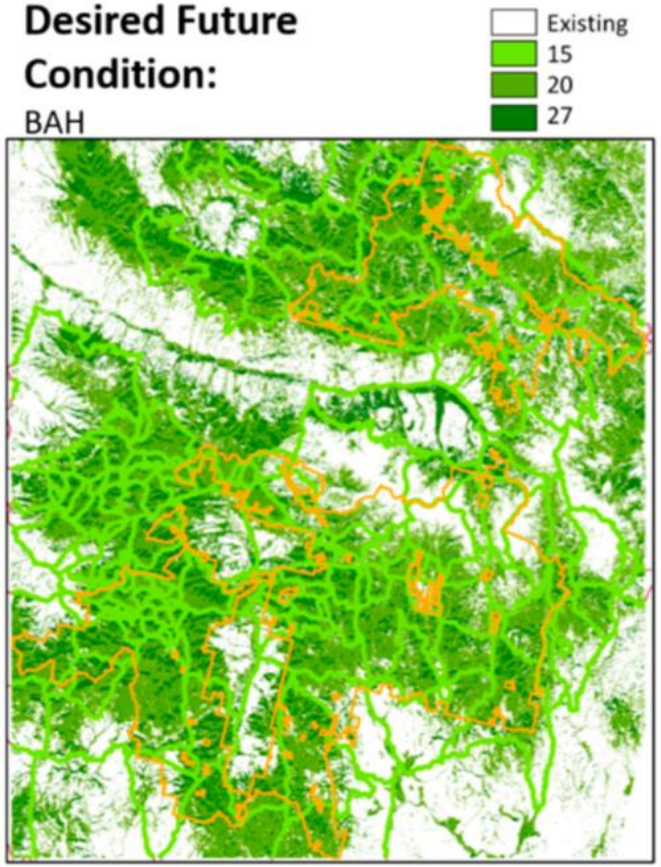
Inputs:
DEM, PODs, Streams, DomType



Batch Processing & Function Modeling:
Remap and Arithmetic Analyses

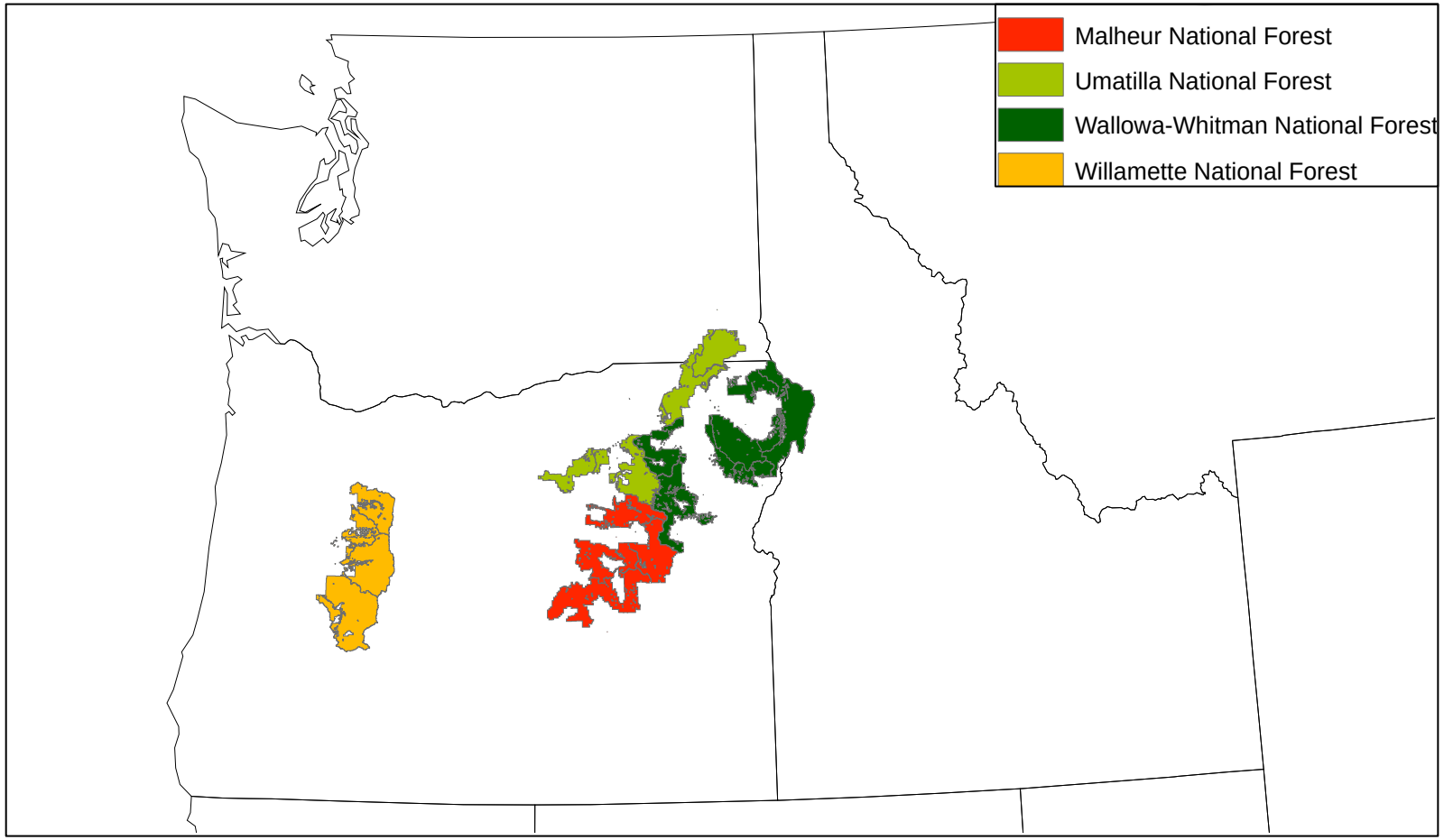


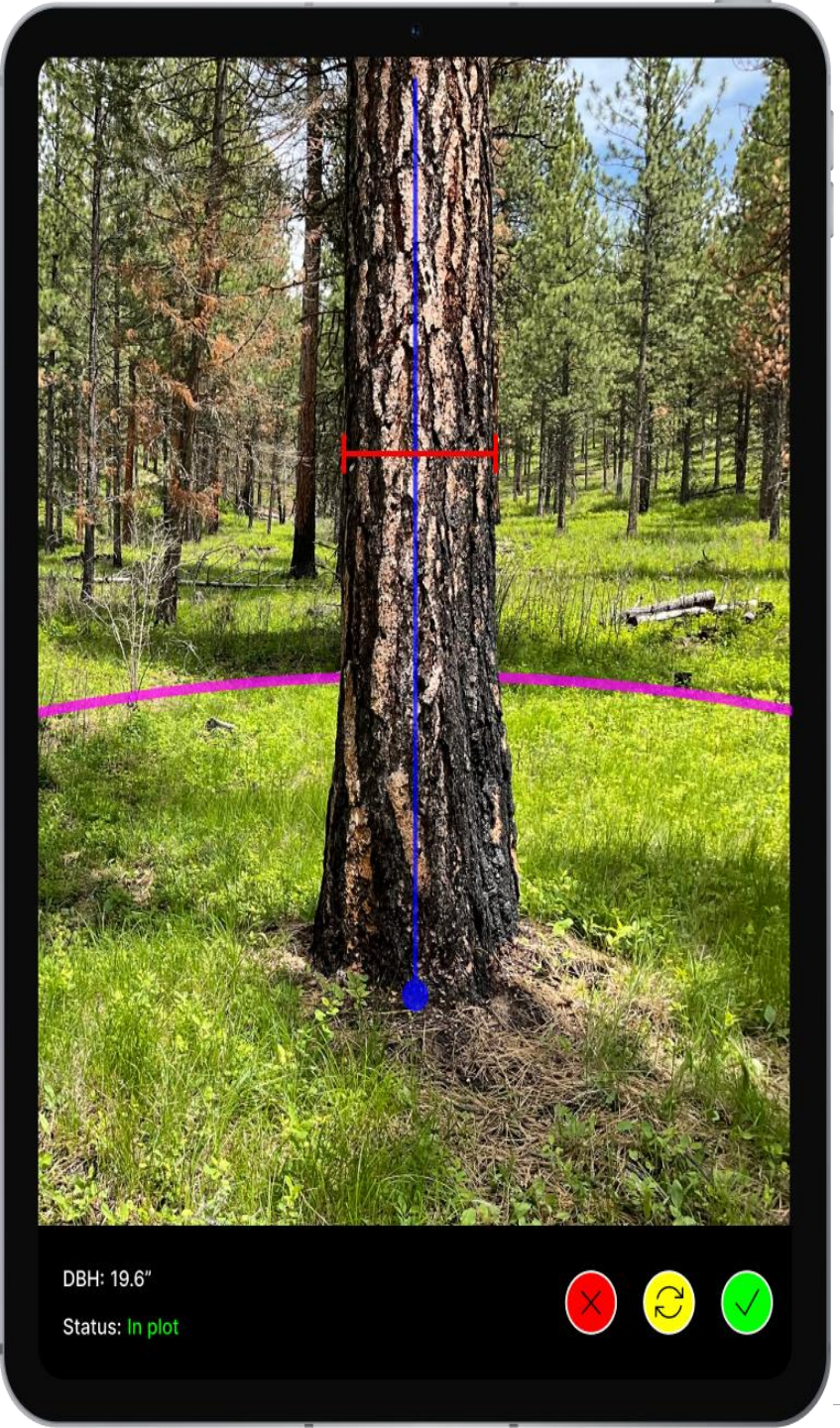
Desired Future Condition:
BAH

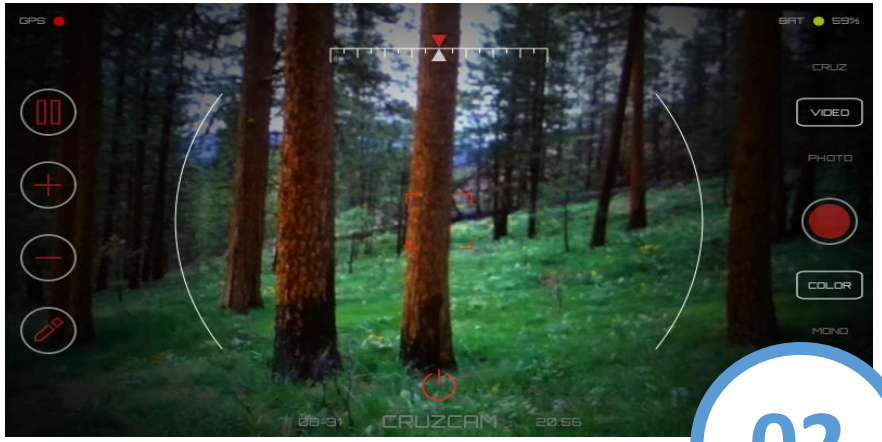


Mapping Solutions

Next Generation Technology



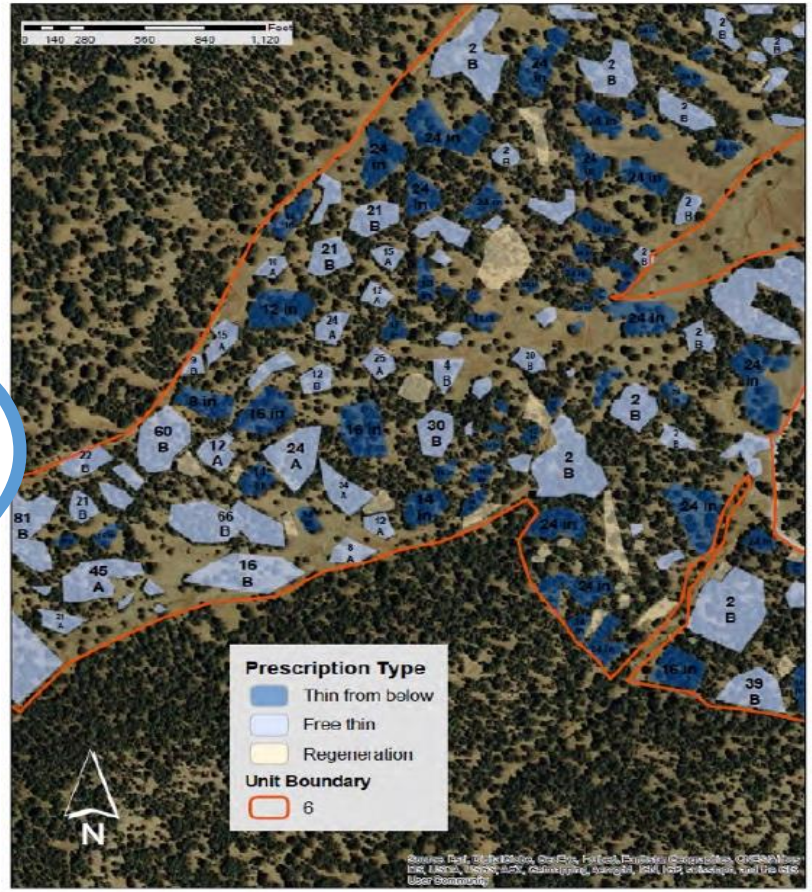


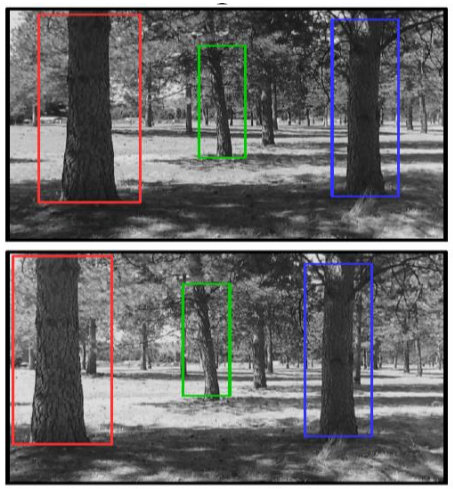


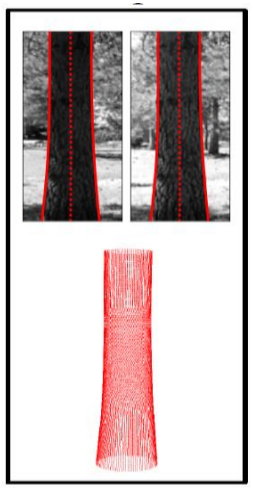
02

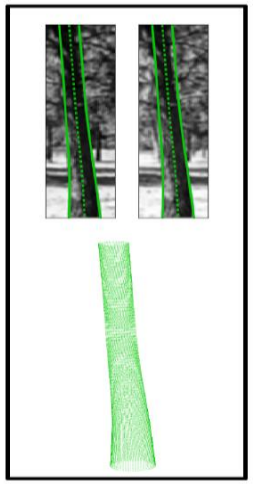
Smart

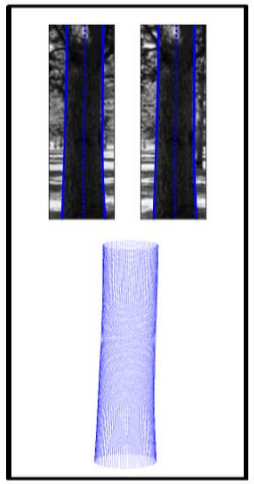
Forest Operations

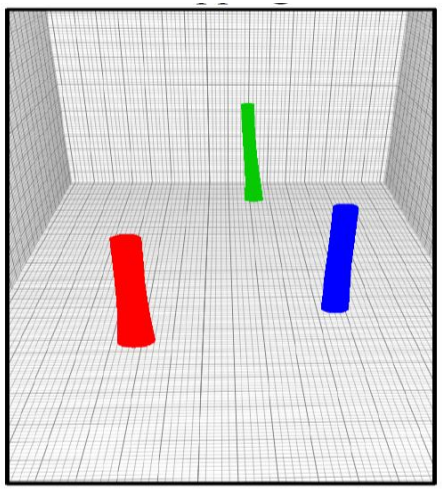


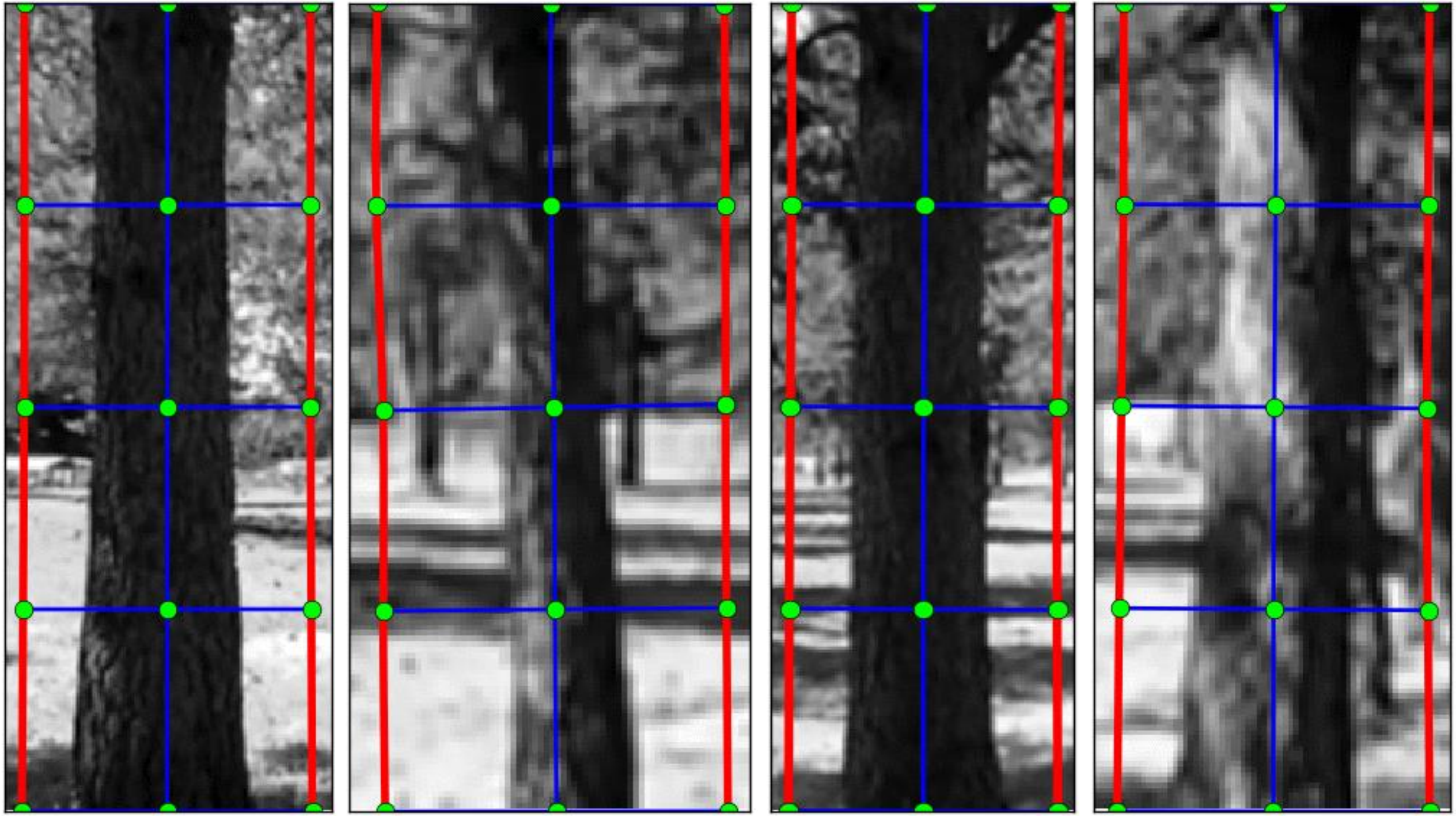






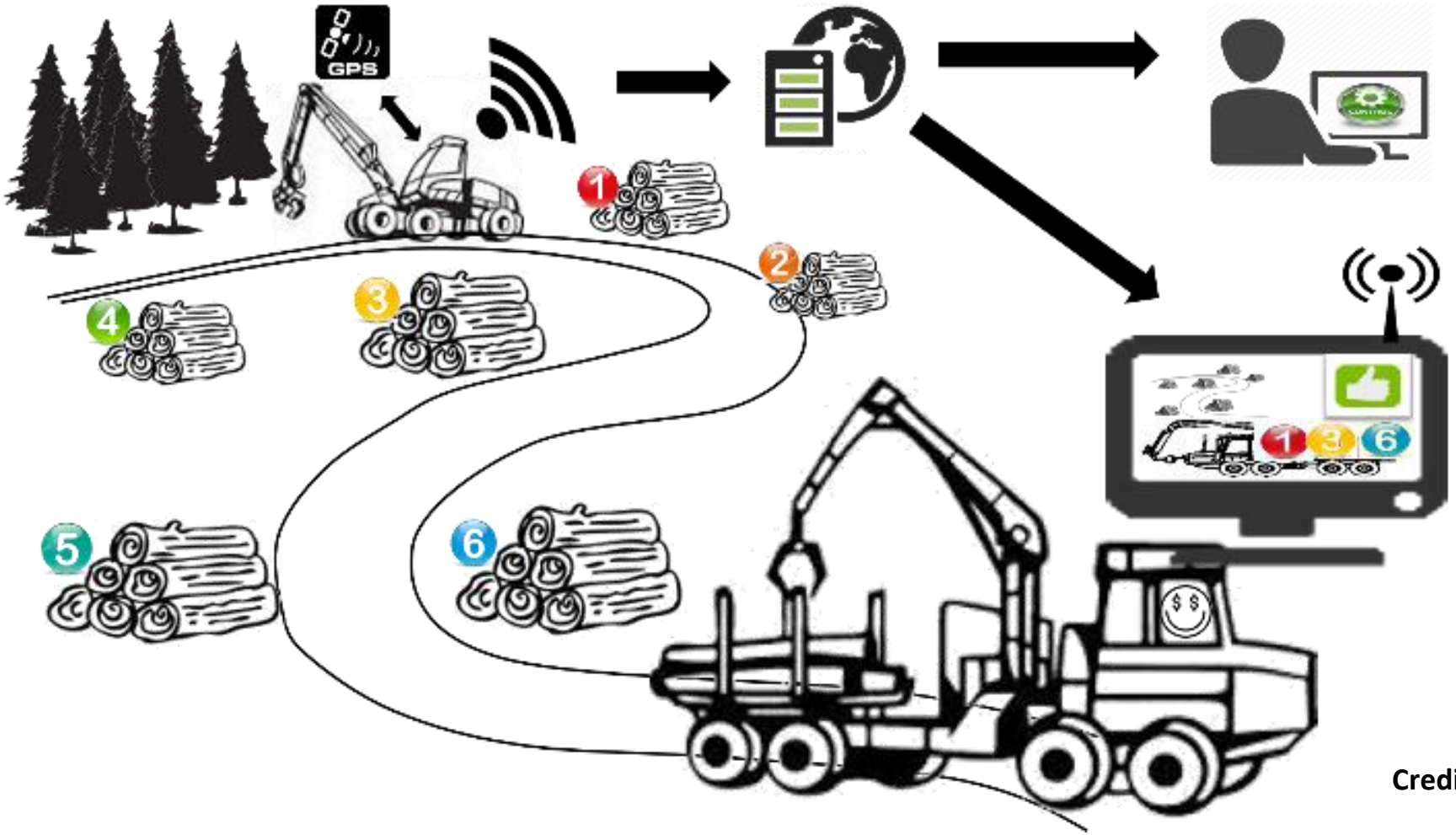






Wood Supply Logistics Optimization

Real-time Cut-to-order



Credit: Jeff Halbrook, USFS

03

Tether Technology

Credit: Miller Timber Services

03

Exoskeletons

Workers' Health and Safety

Exoskeletons are wearable, external structures that assist the strength and performance of the wearer by providing assistive joint moments (i.e. torque) and/or structural supports.

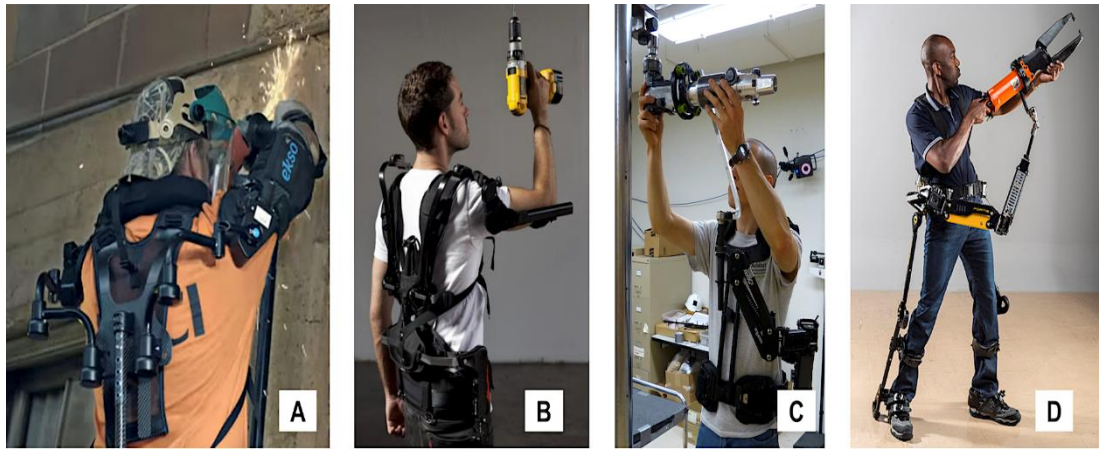
Exoskeletons in Occupational Settings

Mining

Construction

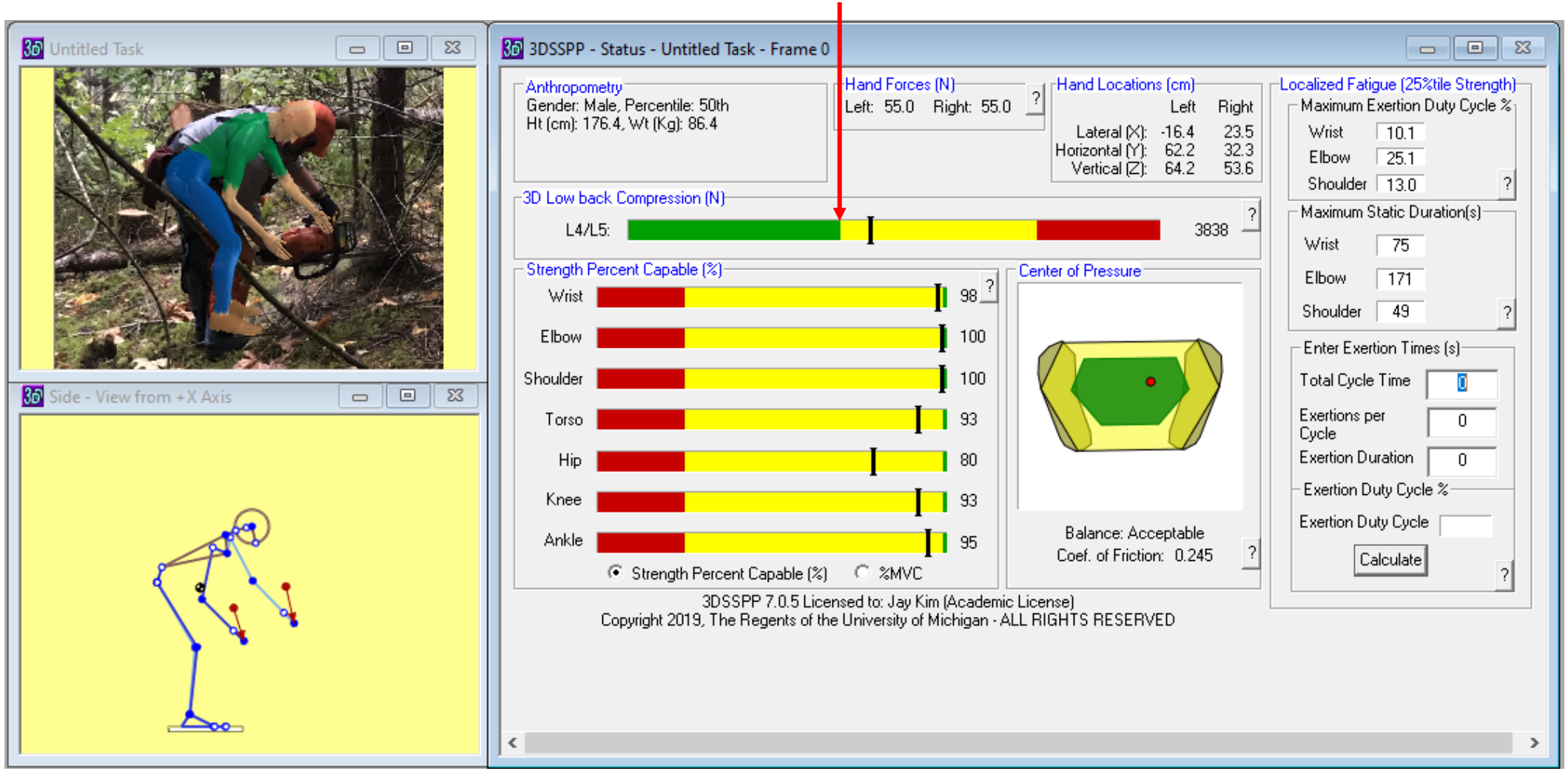
Healthcare

Agriculture



Posture During Timber Falling

Low back compressive force exceeded the NIOSH action limit (3,400 N)



04

Manufacturing Technology

Restoration Wood to Mass Timber

Log Size

Tree Species

Edge Bonding Technology

05

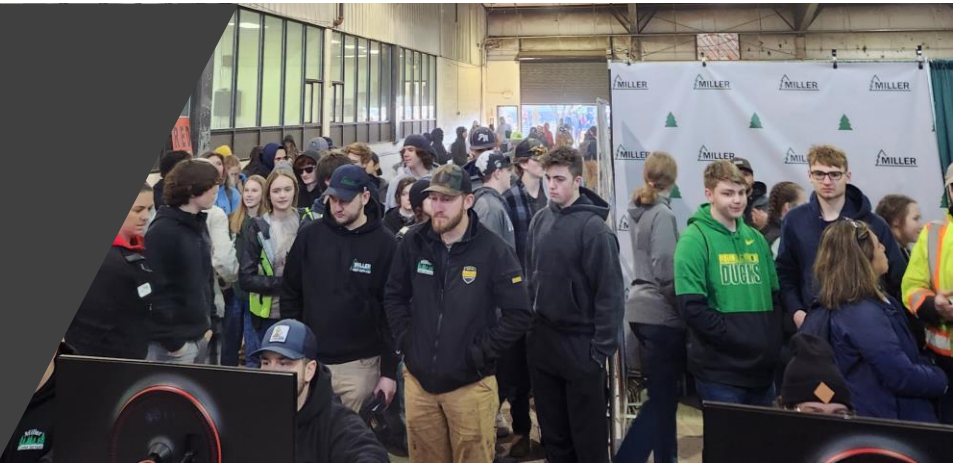
Workforce

Intelligent Education and Training

Education Curriculum
Training Program
Workshops

SMILE
K4-12

CTE
Highschool



FMAP
College

Oregon State University Precollege Programs

SMILE Clubs

Science & Math Investigative Learning Experiences (SMILE)

Elementary Schools

Cross laminated timber

Middle Schools

Managing Oregon forests together

Climate change

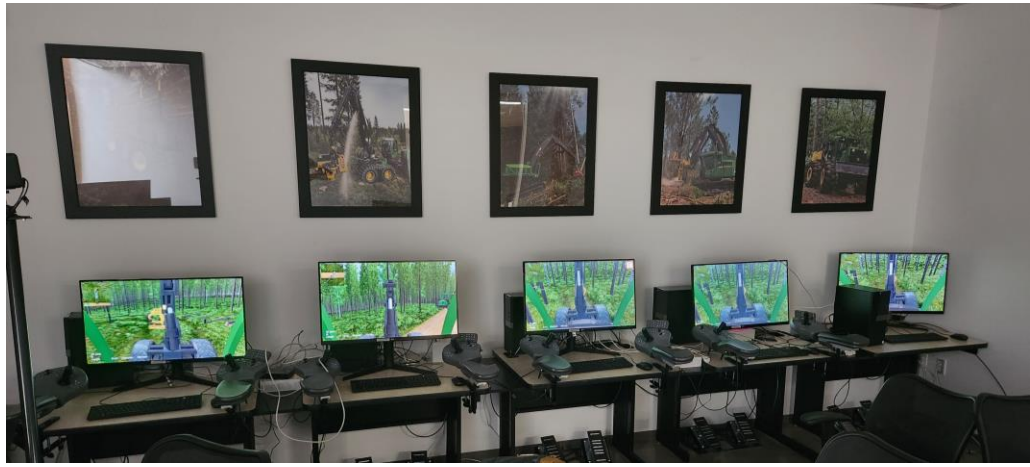
Forest restoration

Career and Technology Education

High School Natural Resource CTE program

Simulator

OSU Mechanized Harvesting Lab.



Education Program Development

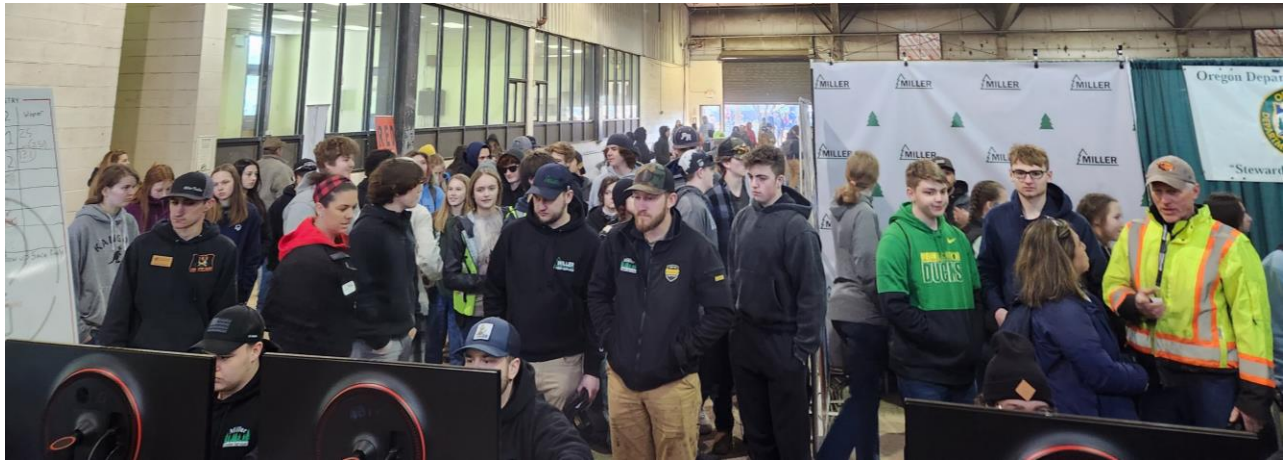
Curriculum that includes forestry

Hands on education

Highschool Competition

Oregon Logging Conference

Annual competition event

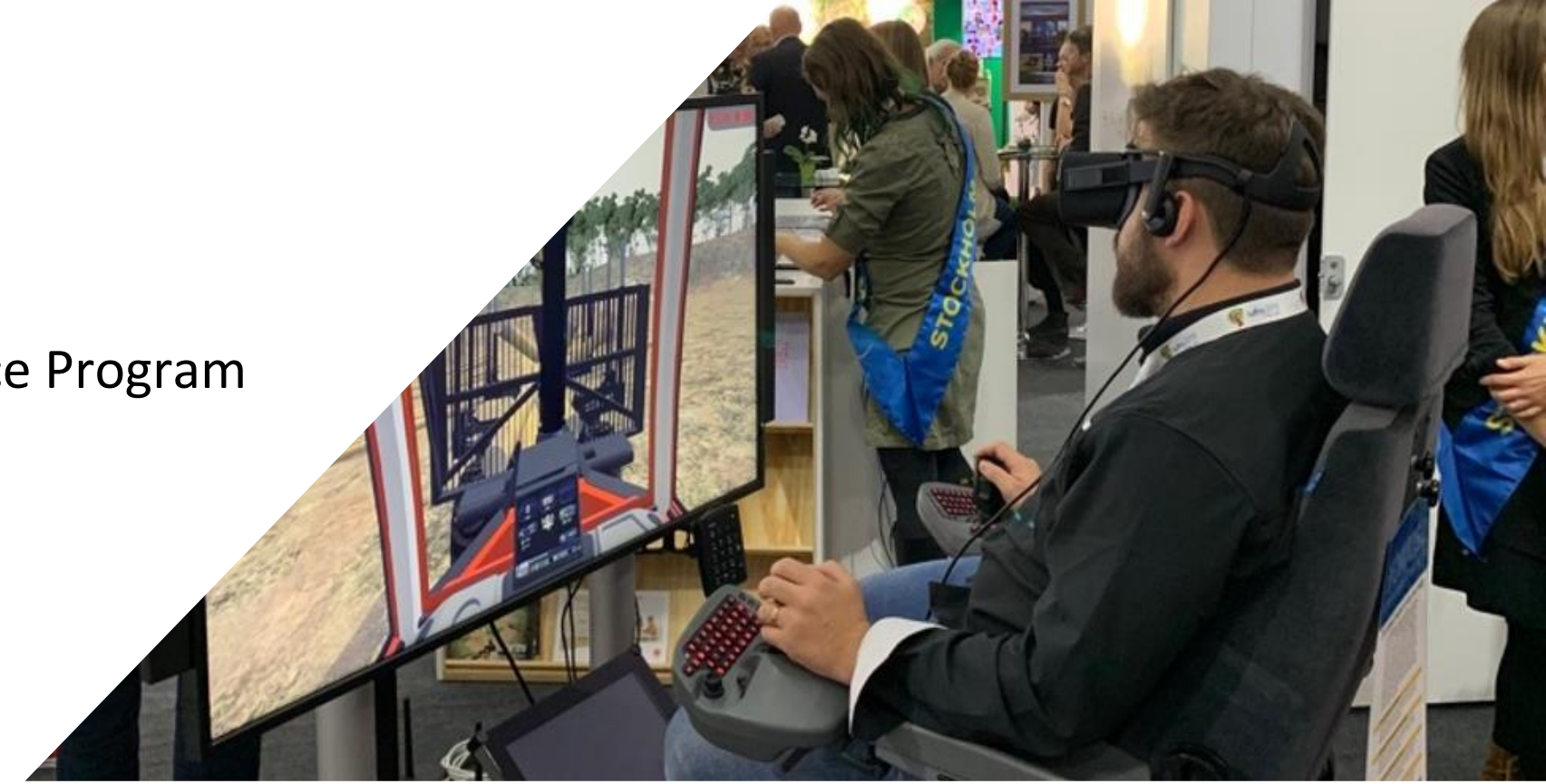


FMAP

Forest Machine Apprentice Program

Miller Timber Services

Finster Forestry



Goals

1. Develop a forest machine training program at OSU
2. Provide workforce development opportunities
3. Provide industry supporters
4. Foster collaboration between OSU and logging industry

WHO ?

Sustainable

Safe

Machine-human harmonized

Agile

Resilient

Technology-driven Forestry

SSMART

FORESTRY GROUP

SSMART Forestry Group

Participants

Research Organizations

Oregon State University

Forest Service U.S. Department of Agriculture

University of Montana

Industry Partners

SILVXLABS

Miller Timber Services

PONSSE

Associated Oregon Loggers, Inc.

Community Partners

Wallowa Resources

Oregon FNRL – Future Natural Resource Leaders

Blue Mountains Forest Partners

SSMART
FORESTRY GROUP

Vision

Resilient Forests
Resilient Communities

Mission

Restore forest health
Modernize forest practices
Improve occupational safety
Transform forestry jobs
Support rural communities

THANK YOU

WOODY CHUNG

woodam.chung@oregonstate.edu

EDA O4. Manufacturing Technology

restoration wood to mass timber

Tree species
Log sizes
Lumber quality
Edge bonding technology

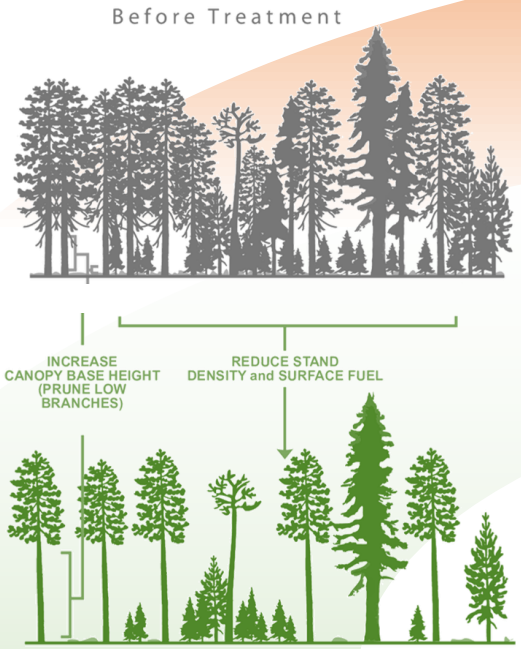
Lech Muszyński

Department of Wood Science and Engineering

Oregon State University

Presentation for Forestry Board of Directors Meeting March 8, 2023

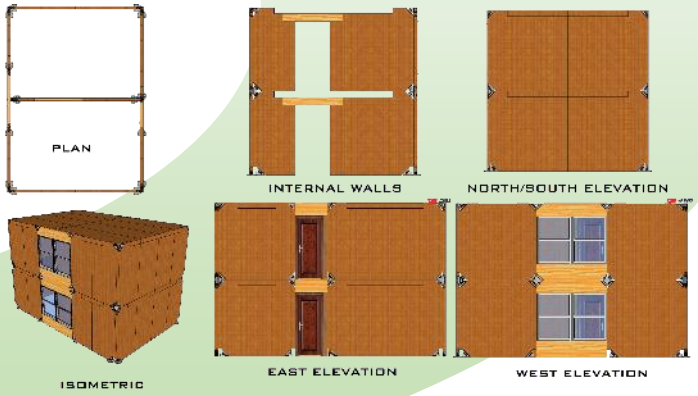
https://www.cbc.ca/news/science/copernicus-hottest-year-1.5865911



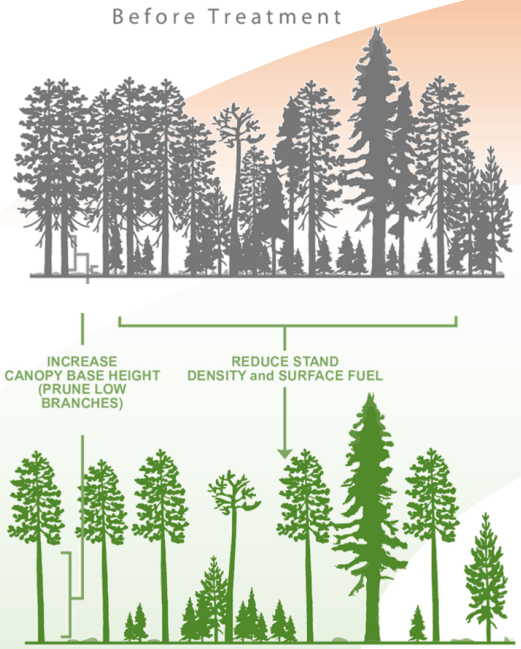
Preventive landscape treatments

Small log processing

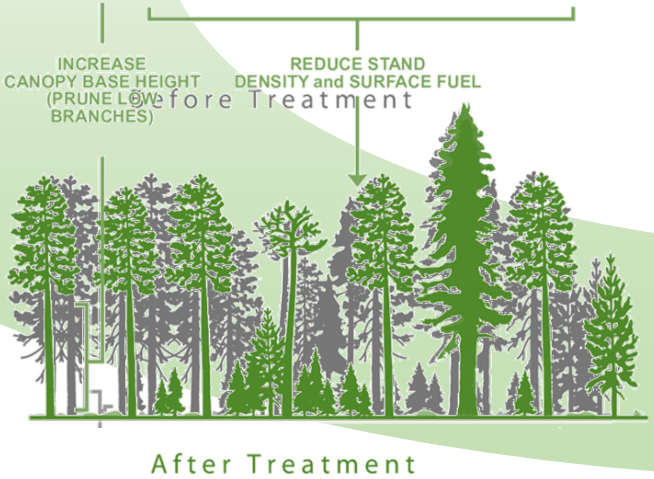
MTP fabrication



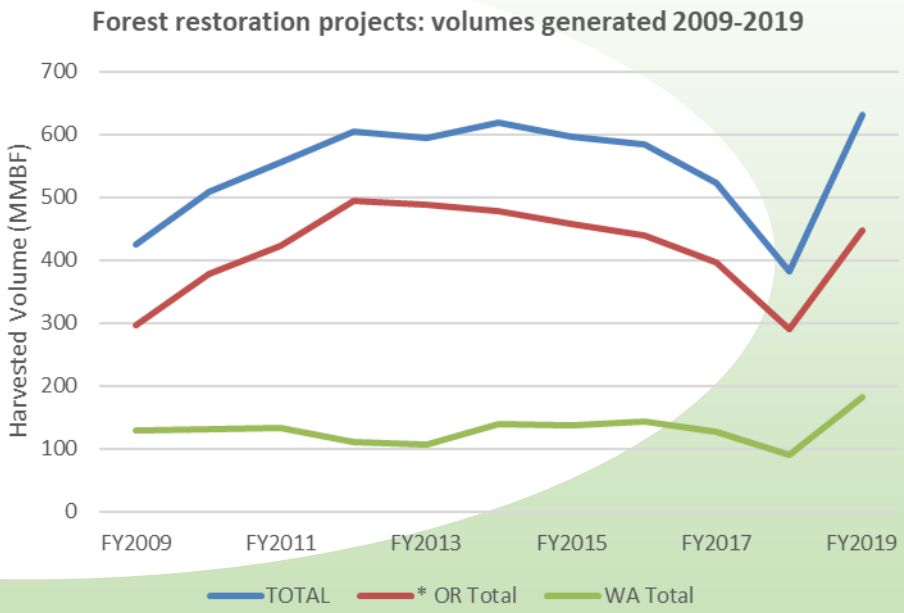
Modular design

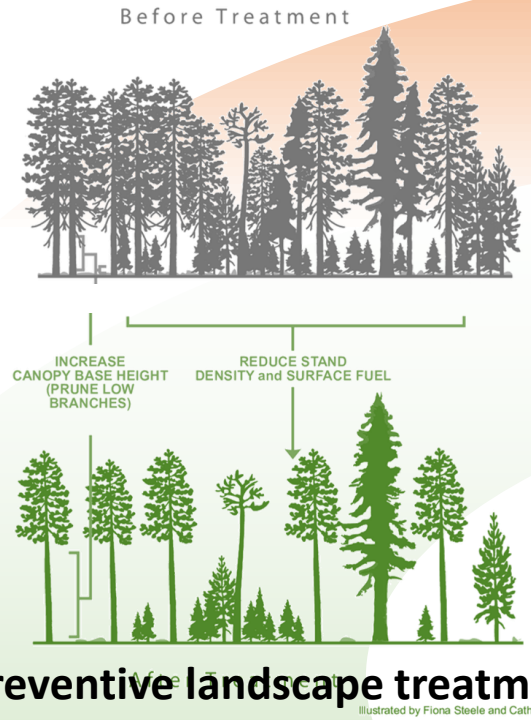


Preventive landscape treatments



Removed fiber…





Preventive landscape treatments

$$631\ MMBF/year$$
$$\cong 1.49\ M\,m^3/year$$

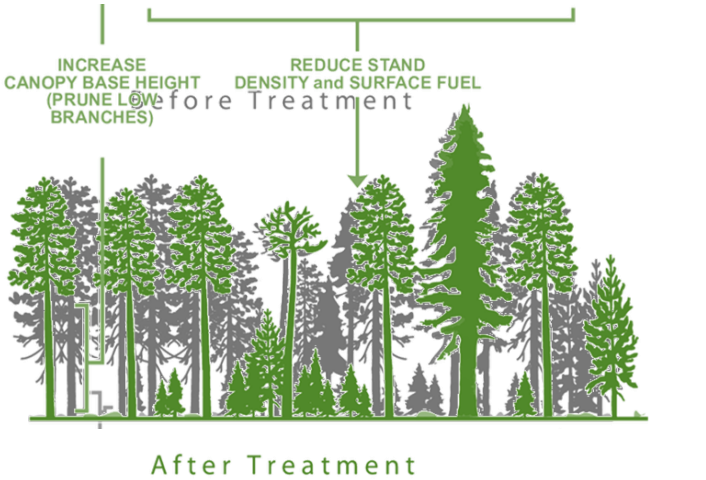
Small log processing

Scan & assess standing trees marked for thinning

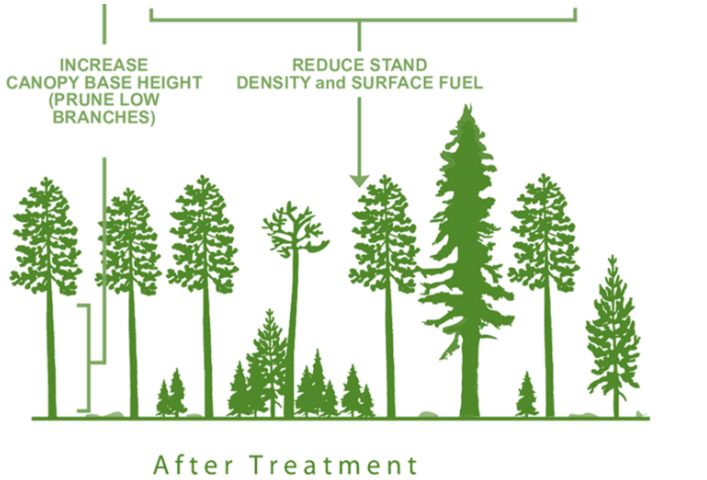
Potential for structural uses

Other uses

Trees not marked for thinnings

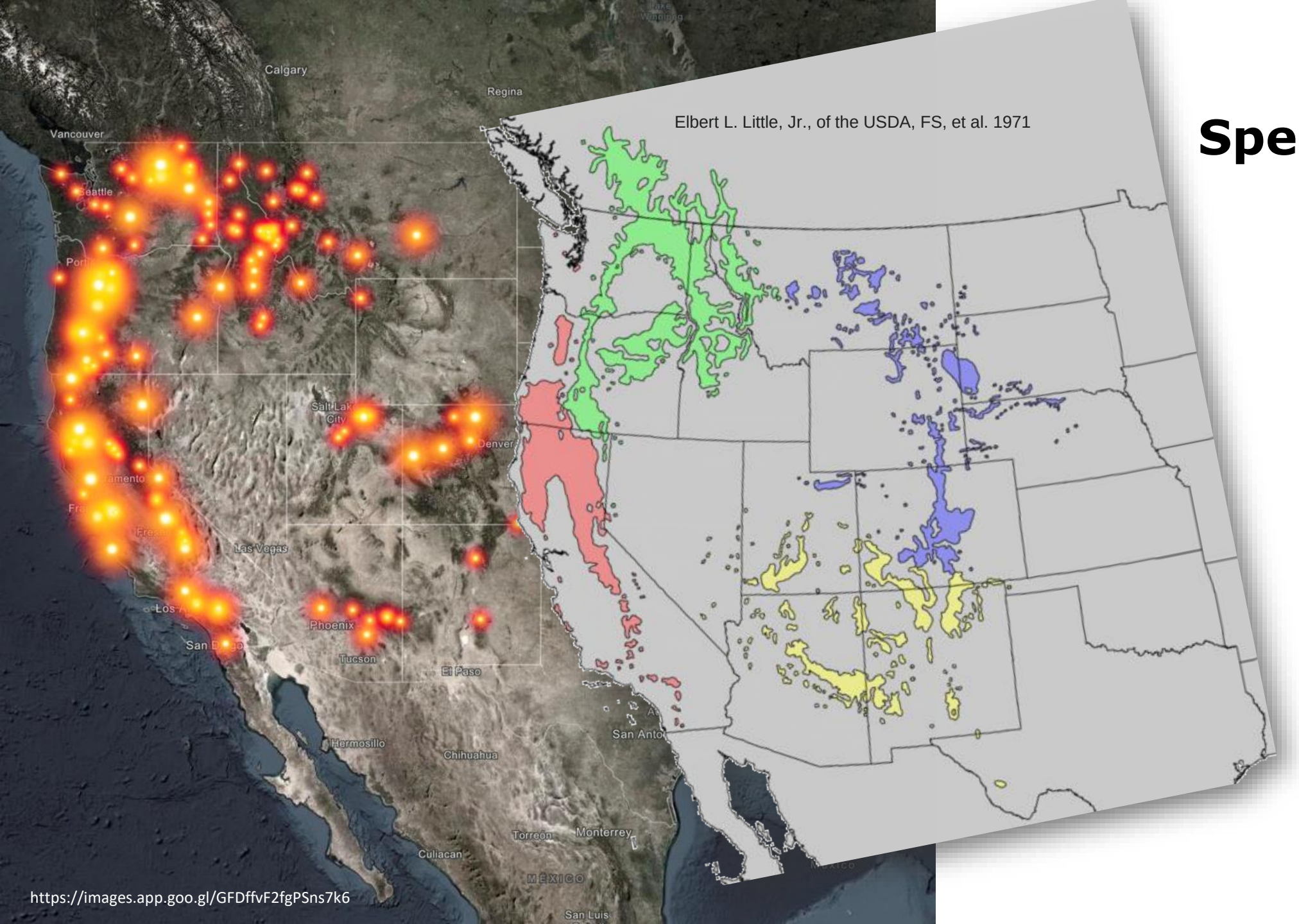


Illustrated by Fiona Steele and Cathy Koot



Illustrated by Fiona Steele and Cathy Koot

Species…



https://images.app.goo.gl/GFDffvF2fgPSns7k6

Species…

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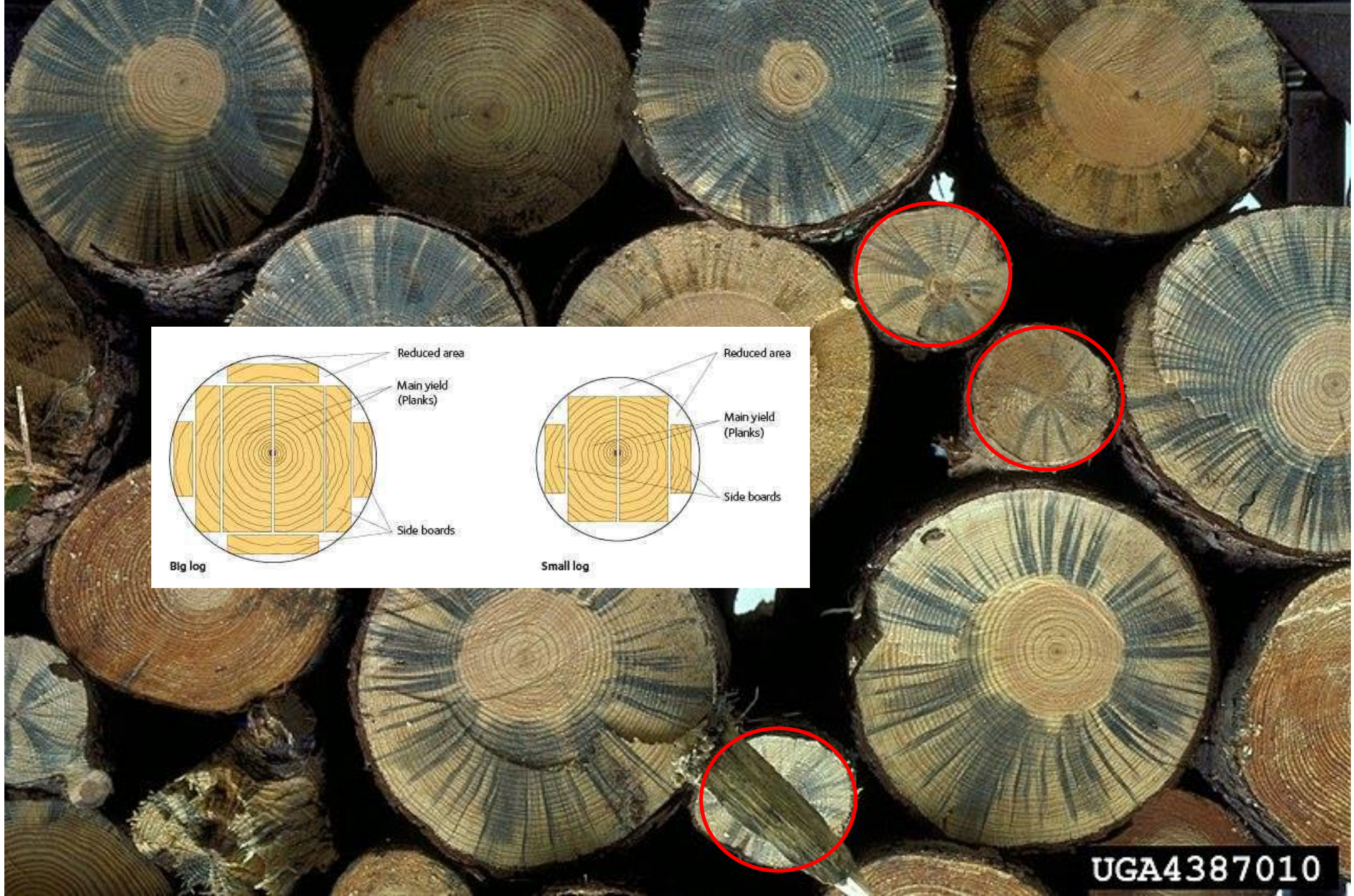


https://commons.wikimedia.org/wiki/File:Bursaphelenchus_xylophilus_on_Pinus_sp._with_blue_stain_fungi.jpg

Smart Forestry: Paving the Way from Forest Restoration to Mass Timber. Component of Build Back Better with Mass Timber BBBRC.

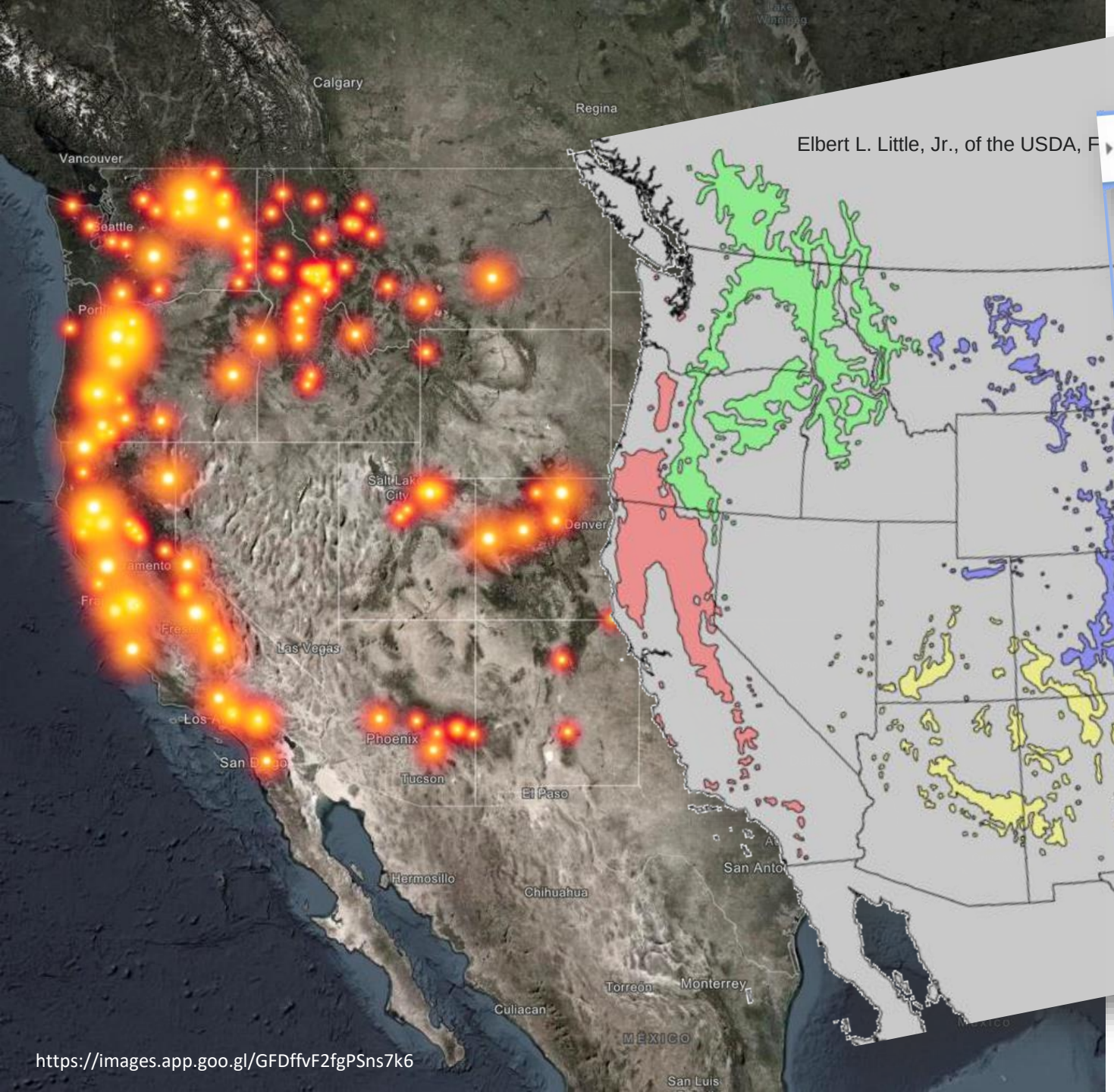
PI: W. Chung, **co-Pis:** N. Anderson, F. Belart, Y. Chen, R. De Amicis, J. Hogland, J. Johnson, J. Kim, K. Lyons, L. Muszyński, N. Streletskaya (2022)

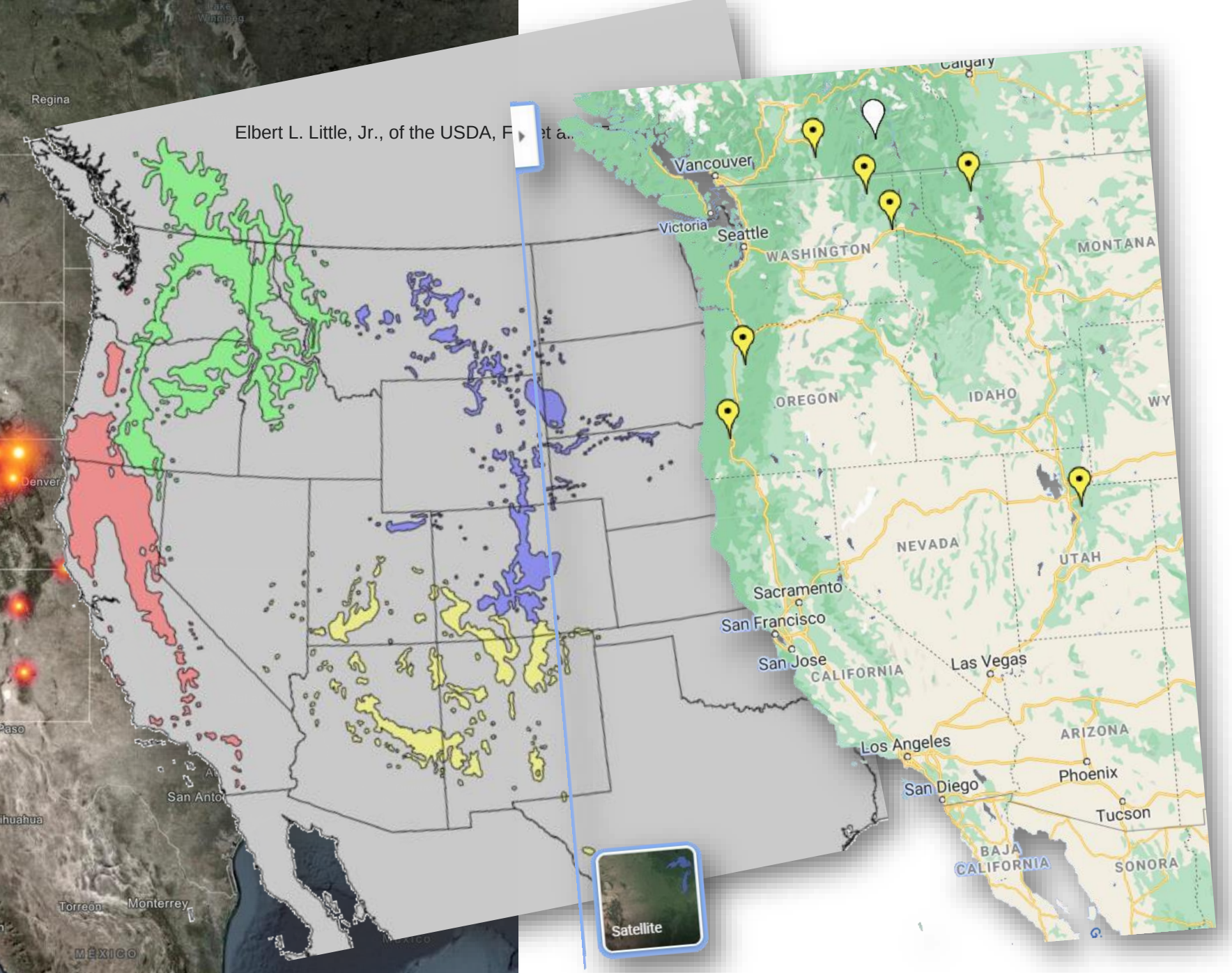
Motivation and goals

Smart Forestry uses technology and science-based solutions to source wood from forest restoration activities to supply mass timber and housing industries.

We propose technological advancement of traditional forestry to:

- ❑ improve the safety and efficiency of forest restoration work,
- ❑ **secure low-value wood for the mass timber industry,**
- ❑ support workforce development, and
- ❑ revitalize forest-dependent rural communities.





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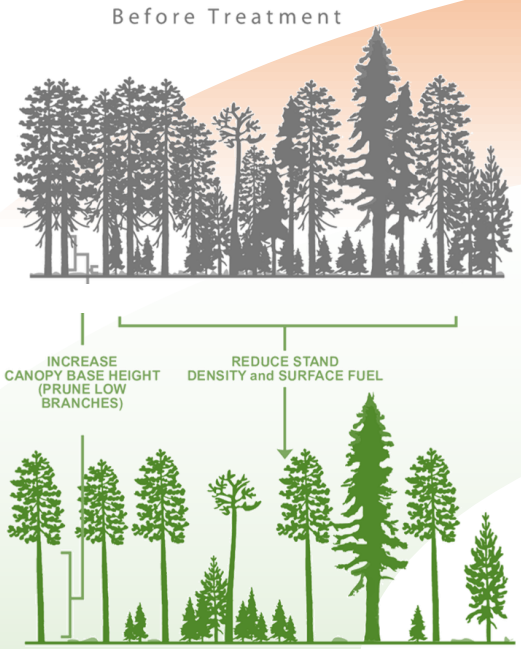
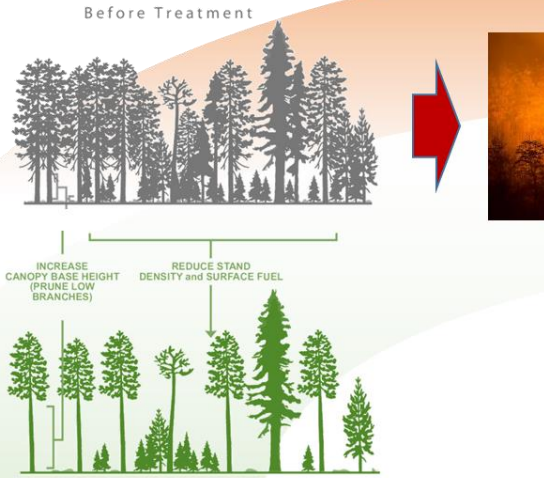


Preventive landscape treatments

Small log processing

MTP fabrication

Beyond proof of concept!



Preventive landscape treatments

Small log processing

MTP fabrication

Assess standing trees marked for thinning

No. 1

No. 2

No. 3

Potential for structural uses

Other uses

Trees not marked for thinnings

Primary processing including:

- Re-merchandising logs
- Visual grading lumber

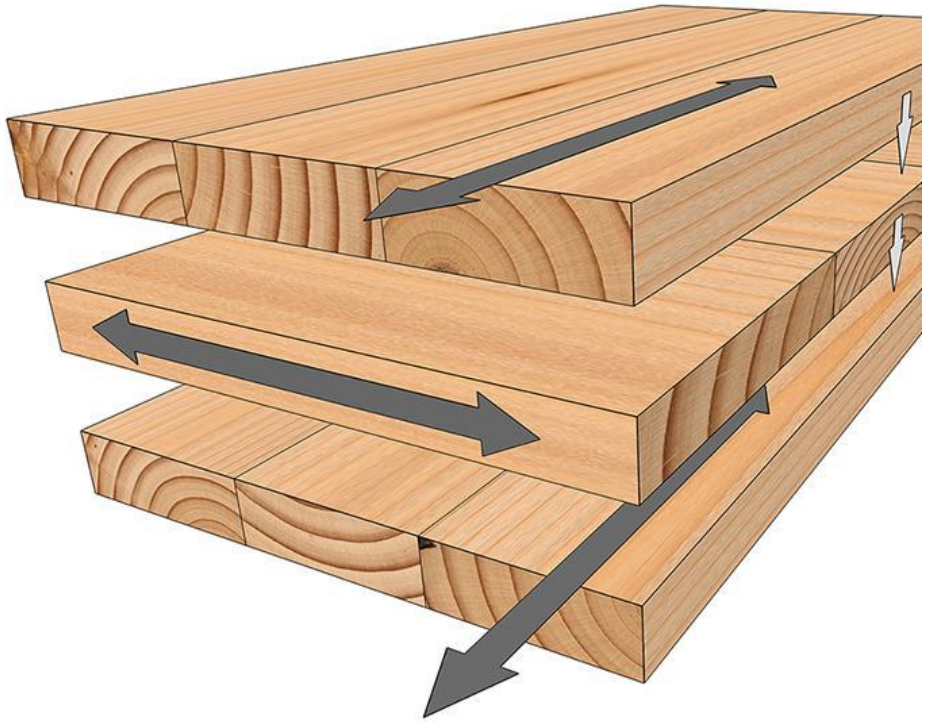


Image Courtesy: chemical-materials.elsevier.com

Cross-laminated Timber (CLT)

- Plate-shaped engineered wood product consisting of layers of lumber glued perpendicularly.
- Custom CLT : CLT not defined as “standard” by the product standard that defines the cross-laminated timber properties (PRG-320)
- Custom CLT can be defined after passing some criteria prescribed by the standard.

Focus on utilization of restoration lumber in CLT

- L. Muszyński, A. Sinha, A. Barbosa, R. Gupta (2013): **Hybrid CLT panels for sustainable building solutions.** *USDA NIFA FPR, ($289,942/36 months)*

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- L. Muszyński, E. Fischer (2020): **Fire Performance of connections made up of Custom CLT Layups Utilizing Pine from Logs Harvested in Western Forest Restoration Programs.** *USDA FS 2020 Wood Innovation Program. ($377,030/24 months)*

**The totals include the USDA WIG support and 33% of in-kind support*

Assess standing trees marked for thinning

Potential for structural uses

No. 1

No. 2

No. 3

Other uses

Trees not marked for thinnings

Primary processing including:

- Re-merchandising logs
- Visual grading lumber

Re-scanning at CLT plant:

- Potential reassignment of grades
- Visual grades
- Database of grade defining features
- Surface scan images

No. 1

No. 2

No. 3

No grade/ other uses

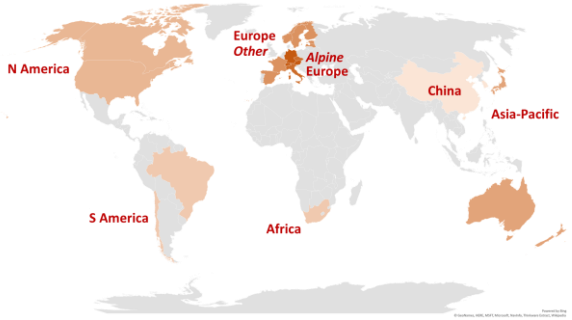
Global MTP

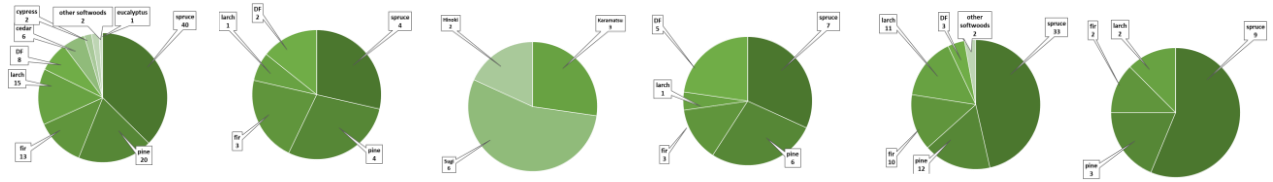
- L. Muszyński, P. Larasatie (2020): Global Mass Timber Panel (MTP) Industry in Post-Pandemic New Normal. USDA ARS/CoF TallWood Design Institute program. ($30,000/12 month). funded at $20,000

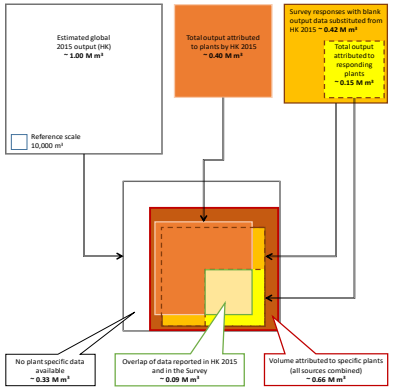
GRAs: Pipiet Larasatie (PhD), J.E. Martinez Guerrero (PhD), Raquel Albee (MS), *Taylor Barnett (MS), Evan Bright (MS)*

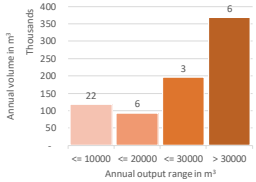
What we do…

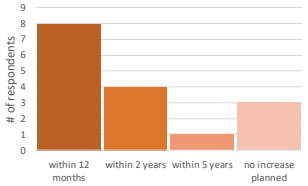
Surveys, interviews, site tours, literature reviews, monitoring trade gossip columns

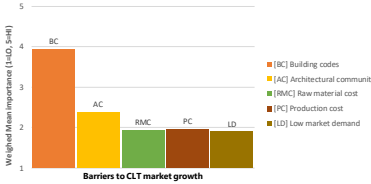


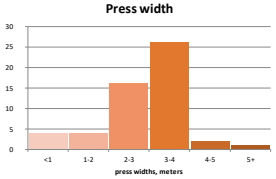


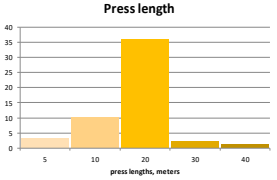


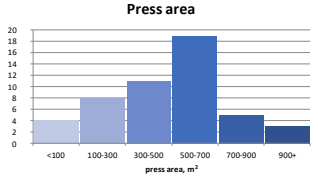


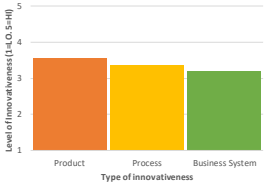


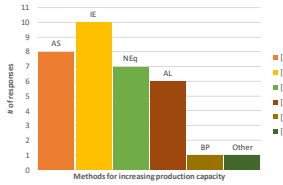


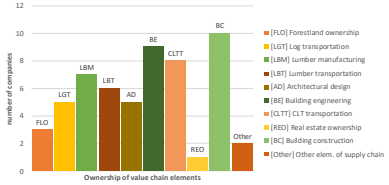


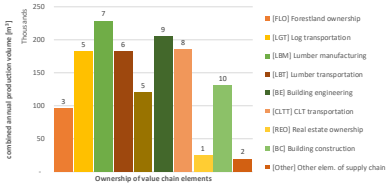


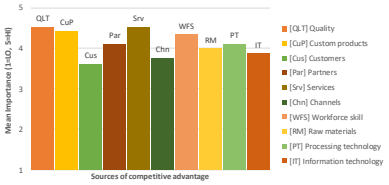


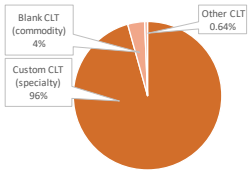


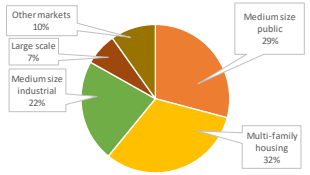


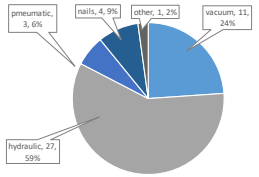


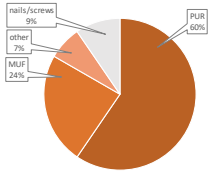


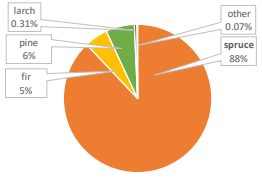


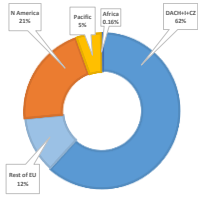


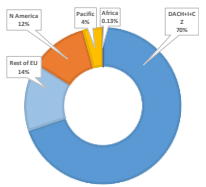


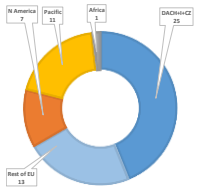












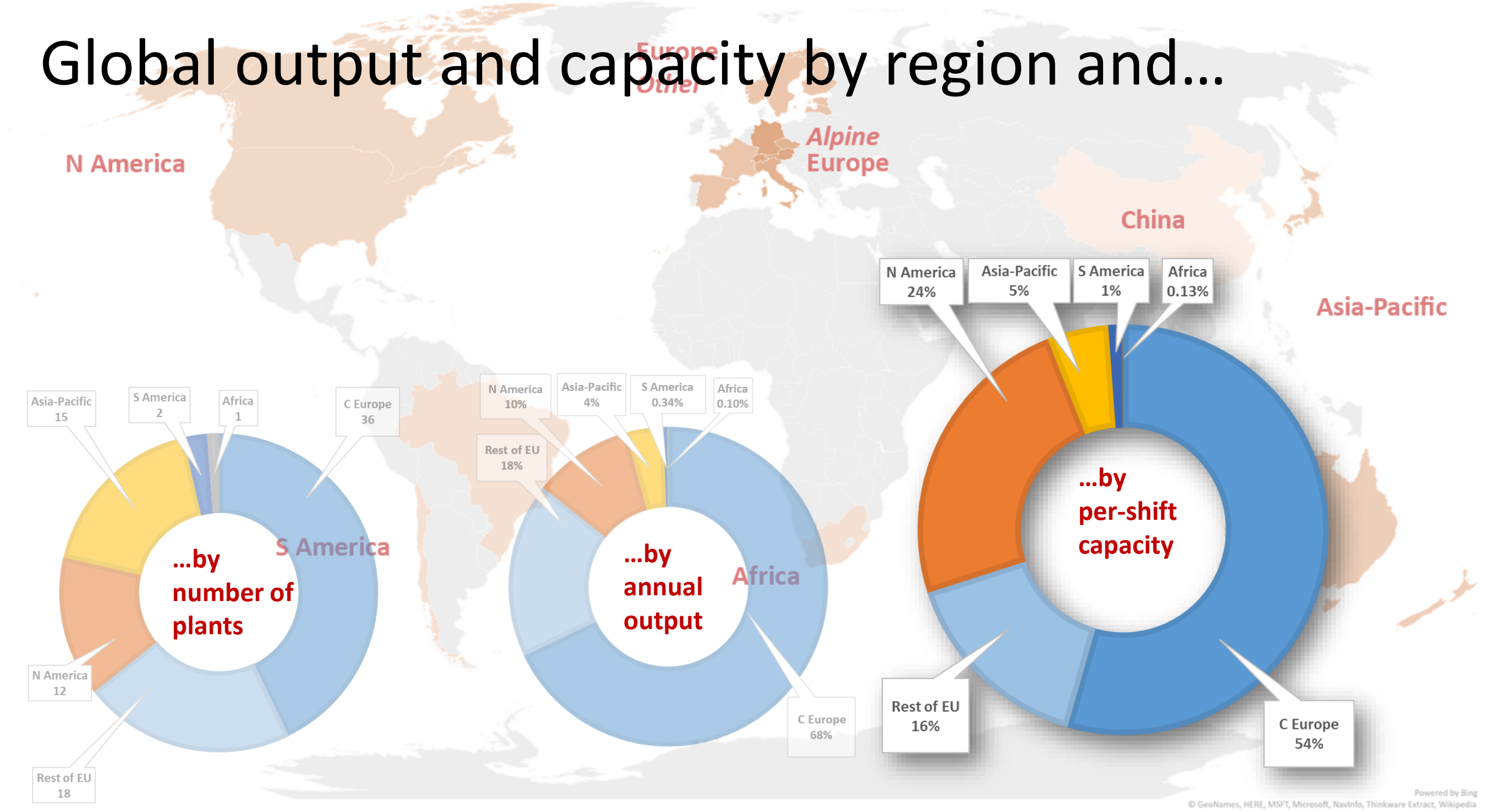
As of now MTP is boutique industry…

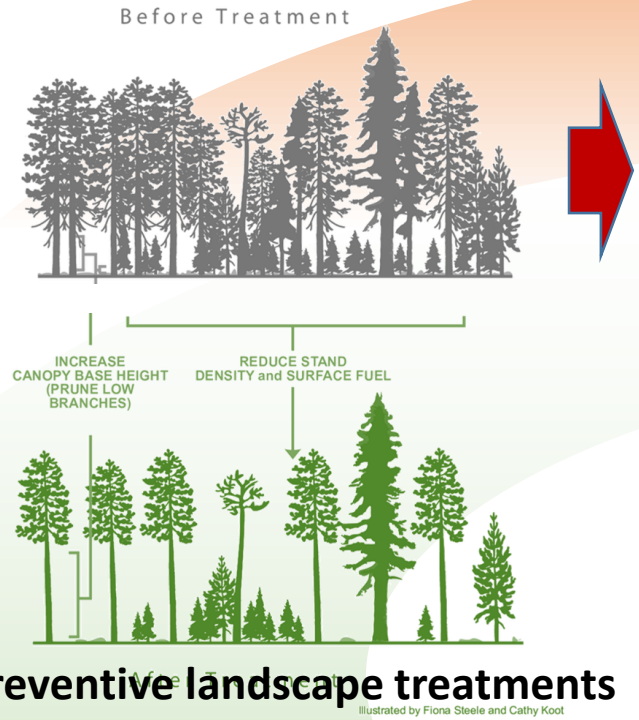
Global CLT output $\sim 2.5\ M\ m^3$

Global plywood output $\sim 118\ M\ m^3$ **(2020)**

https://www.fao.org/forestry/statistics/80938/en/

Global output and capacity by region and…

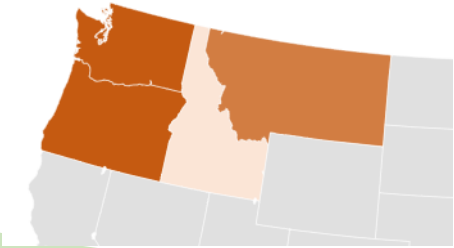




Preventive landscape treatments

Scaling the problem vs. opportunity

OR & WA: $1.49\ M\,m^3/year$



Current CLT capacity in the Region:
$0.27\ M\,m^3/year$

Global MTP fabrication: $2.5 M\,m^3/year$

Focus on utilization of restoration lumber in CLT

- L. Muszyński, A. Sinha, A. Barbosa, R. Gupta (2013): **Hybrid CLT panels for sustainable building solutions.** *USDA NIFA FPR, ($289,942/36 months)*
- L. Muszyński, A. Barbosa, A. Sinha, R. Gupta, J. Redfield (2014): **Commercialization of Cross Laminated Timber Panels Production in Oregon.** *Oregon Built Environment & Sustainable Technologies Center (BEST) Commercialization Grants to OSU & Riddle Laminators, ($150,000/24 months)*
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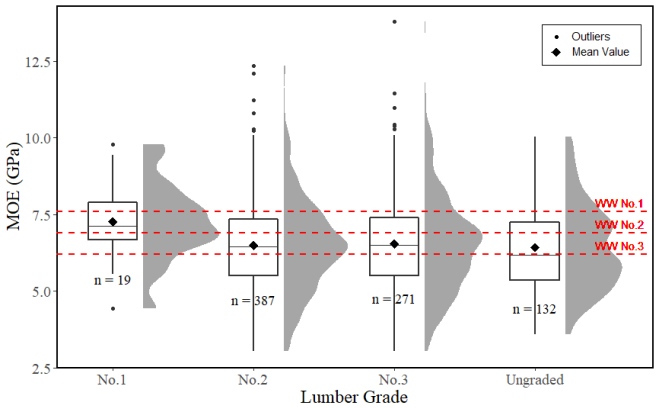
- L. Muszyński, E. Fischer (2020): **Fire Performance of connections made up of Custom CLT Layups Utilizing Pine from Logs Harvested in Western Forest Restoration Programs.** *USDA FS 2020 Wood Innovation Program. ($377,030/24 months)*

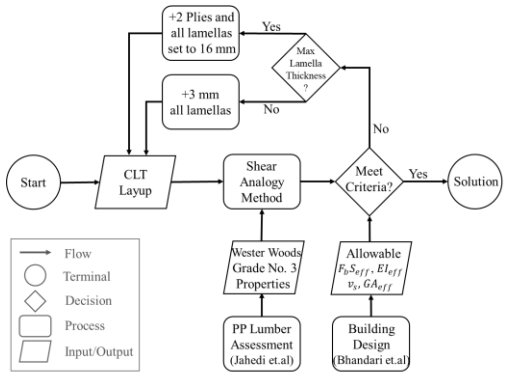
Defining project-specific custom CLT grade utilizing low-value Ponderosa pine lumber from logs harvested in SW Oregon and Northern California forest restoration programs.

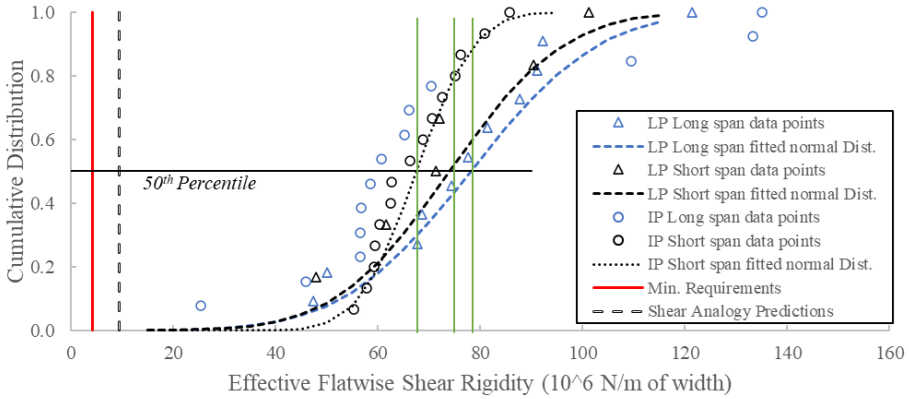
GRA: ***<u>Sina Jahedi (PhD)</u>, PIs:*** *L. Muszyński, M. Riggio, J. Morrell & R. Gupta (2016)*

Main takeaways:

- PP is not DF, but viable CLT with predictable properties can be produced
- Low elastic and strength properties may be designed around, custom layups may be designed for stiffness and capacity to meet design demands
- Lumber from selectively harvested small logs does not meet NDS values for WW. Specific design values must be generated.



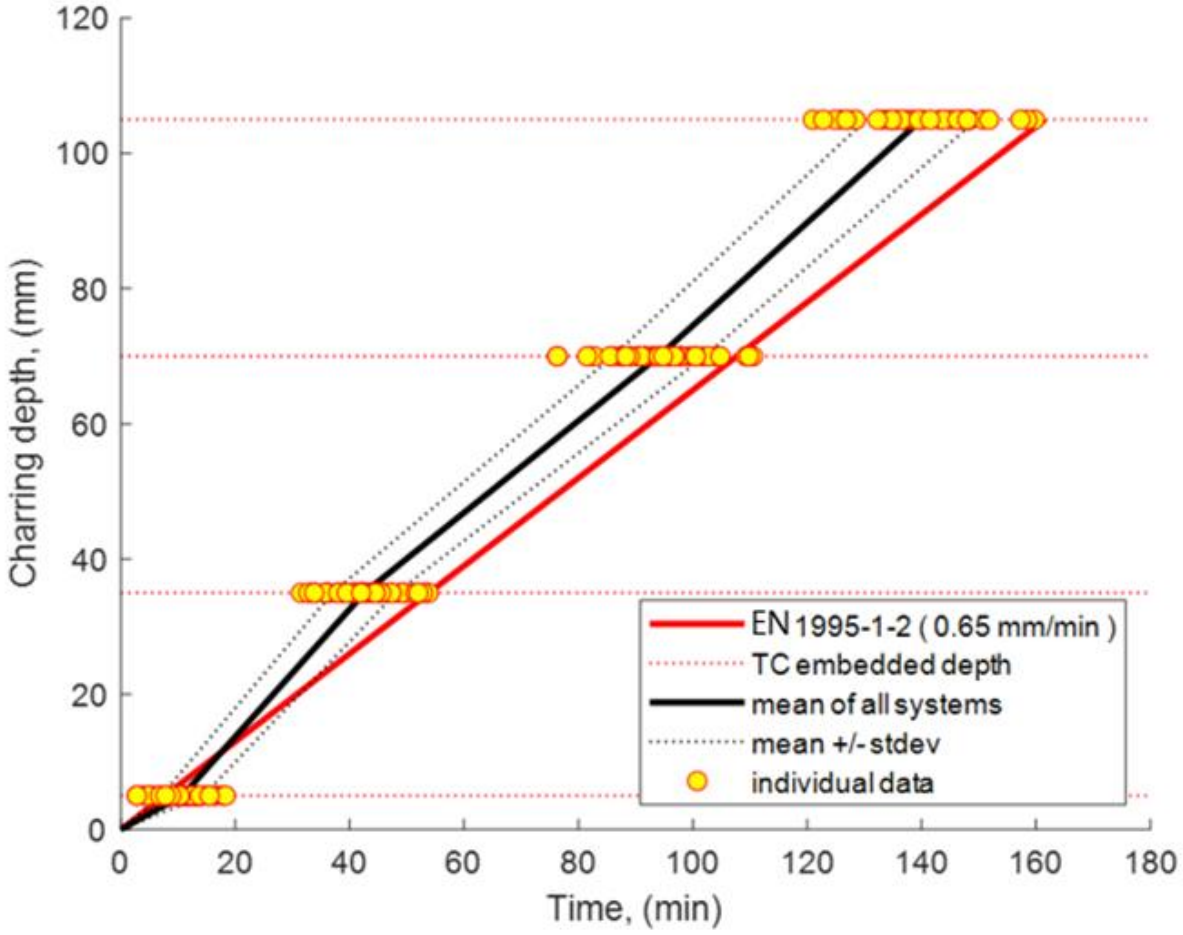


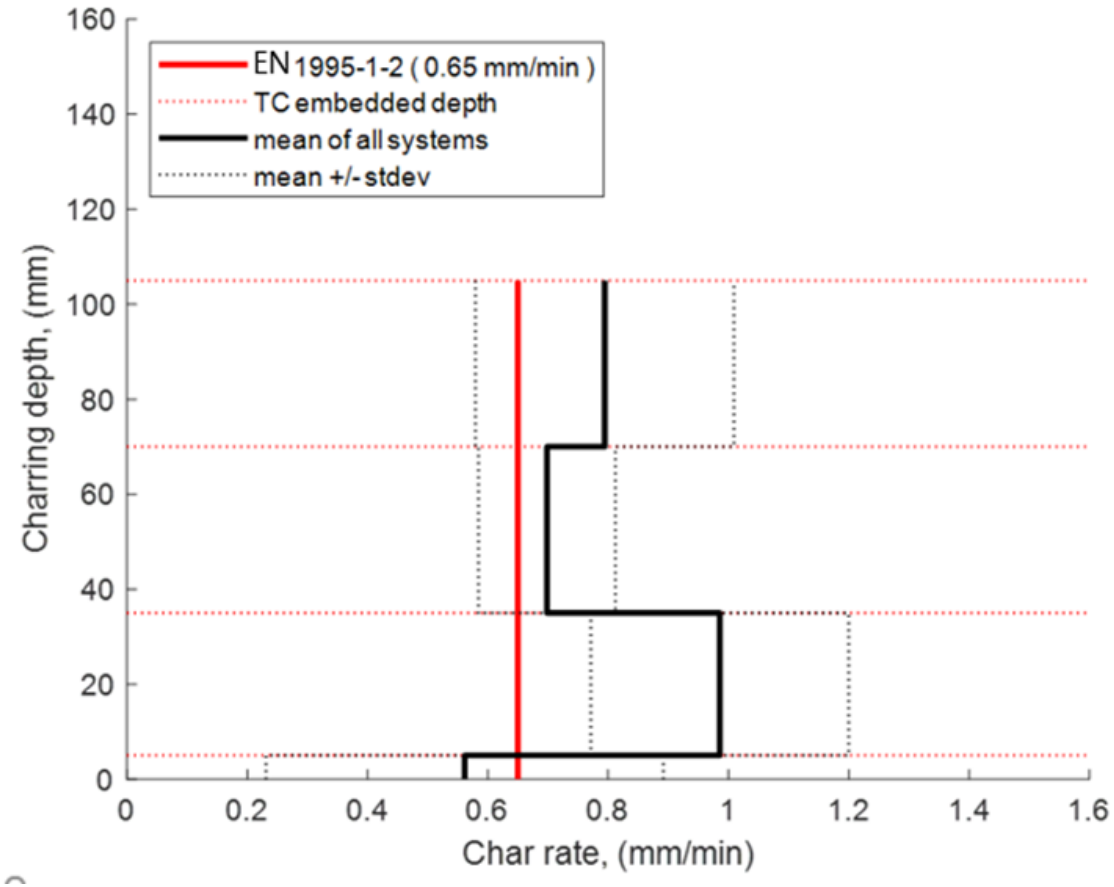


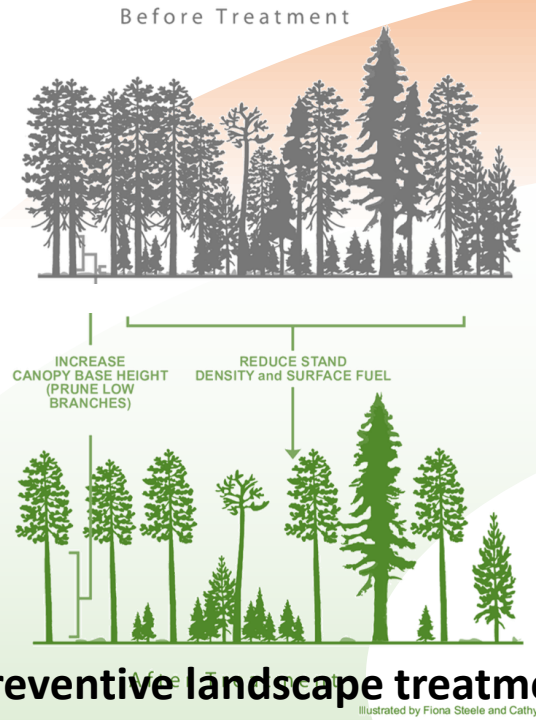
Fire Performance of Custom CLT Layups Utilizing Pine from Logs Harvested in Western Forest Restoration Programs.

GRA: ***<u>Seung hyun Hong</u> (MSc), PIs:*** *L. Muszyński, R. Gupta*

Main takeaway: Ponderosa pine chars faster…







Preventive landscape treatments

Need adjusted design specifications and guidelines

Small log processing

MTP fabrication

https://fsmedia.imgix.net/4b/47/f8/fe/82f5/45e3/b3d2/988fd4fd2fc2/some-models-of-wood-skyscrapers-that-could-one-day-come-to-fruition.jpeg

Focus on utilization of restoration lumber in CLT

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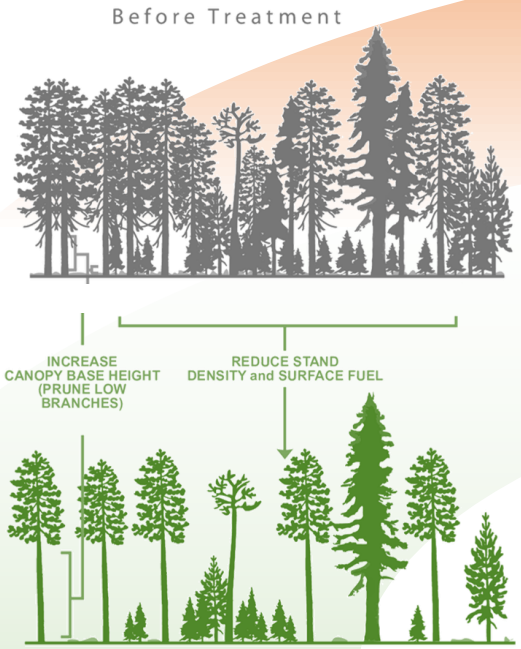
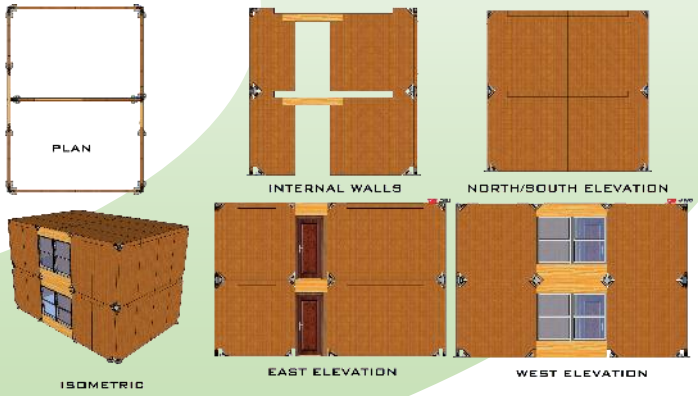


Preventive landscape treatments

Small log processing

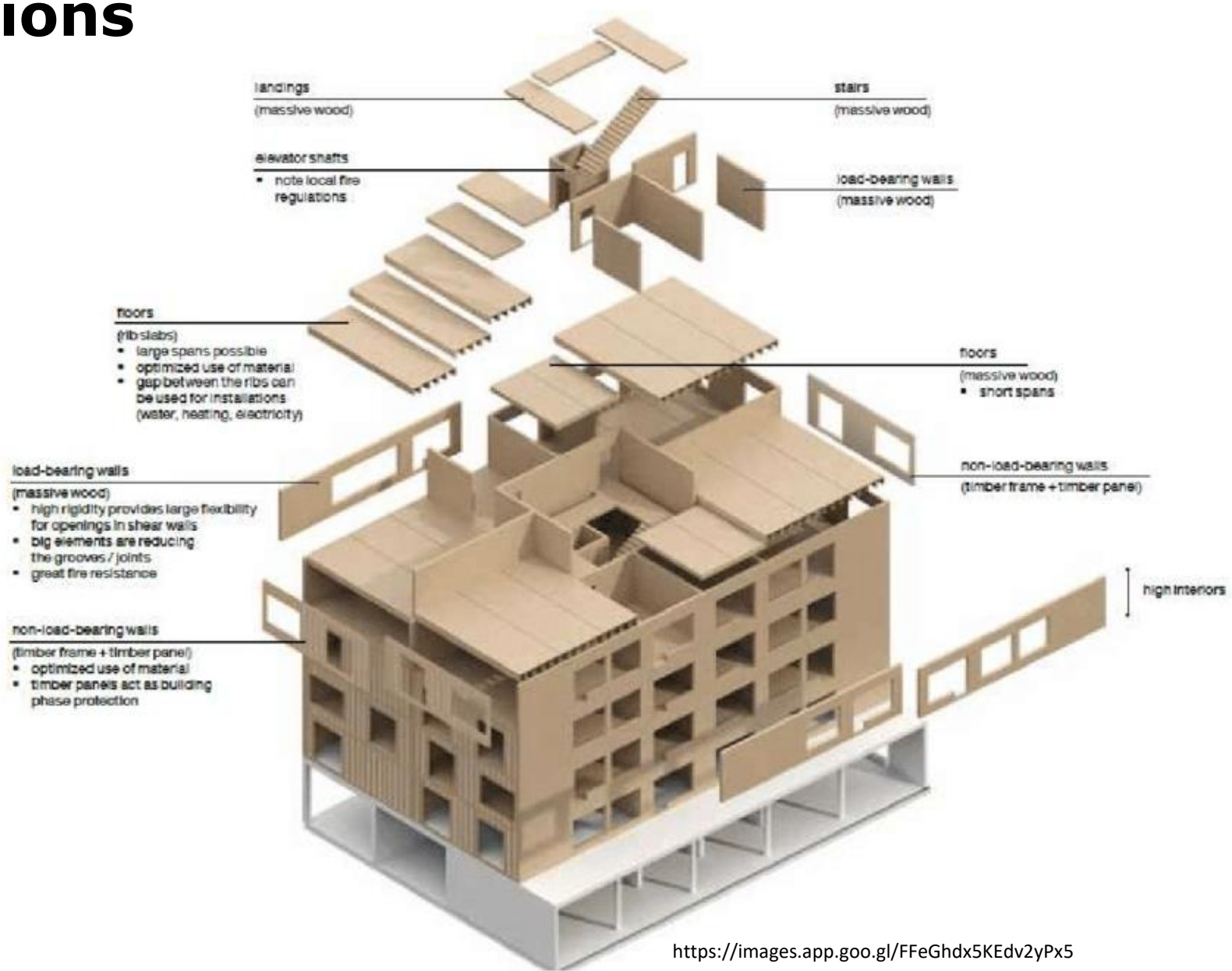
MTP fabrication



Modular design

Targetted applications

- Need a market for large volumes of low value PP lumber
- White unicorn CLT buildings won't do
- **Mass produced modular CLT systems may...**



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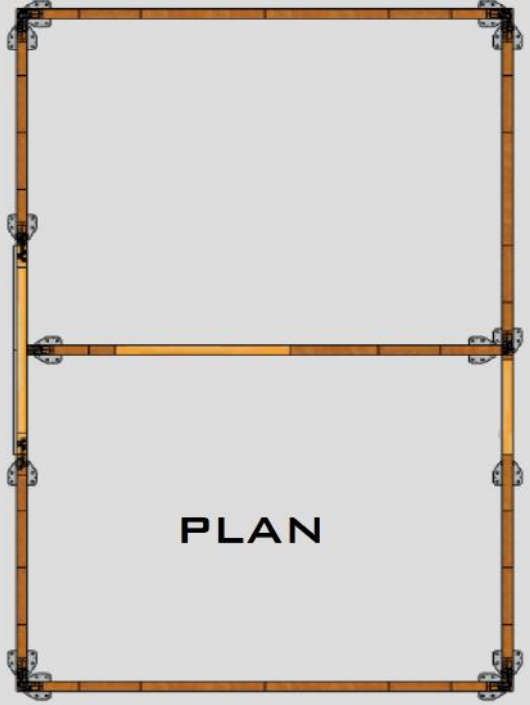
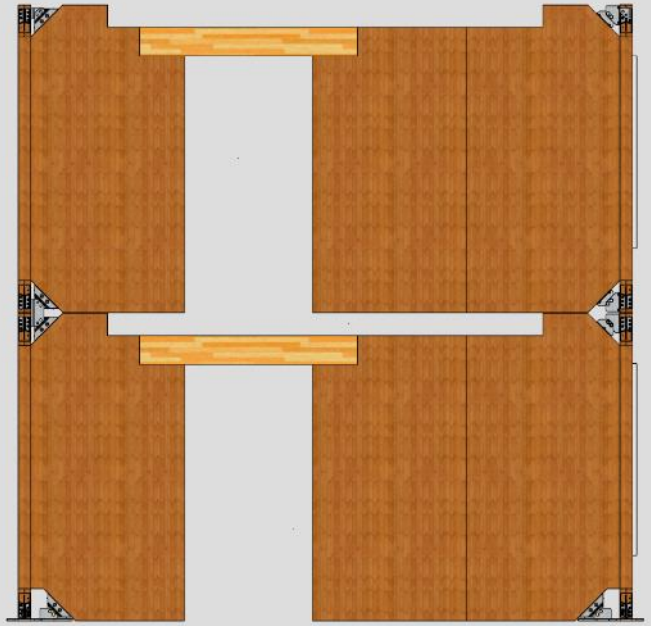
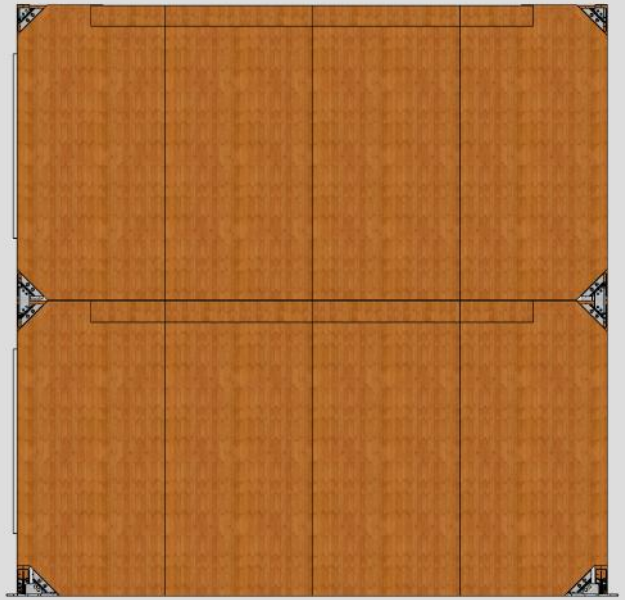


PLAN



INTERNAL WALLS



NORTH/SOUTH ELEVATION

ISOMETRIC

EAST ELEVATION

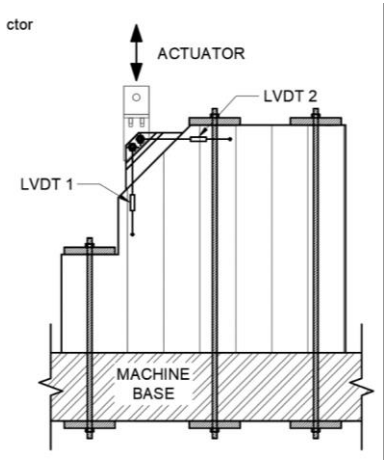
WEST ELEVATION

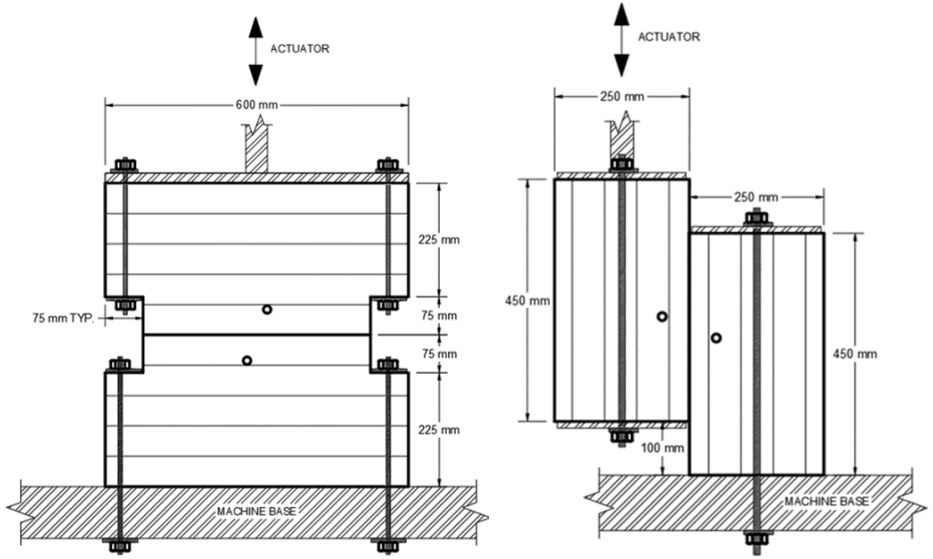
Demonstrating Use and Performance of a CLT Modular Building Utilizing Low-value Pine Lumber from Logs Harvested in Pacific NW Forest Restoration Programs.

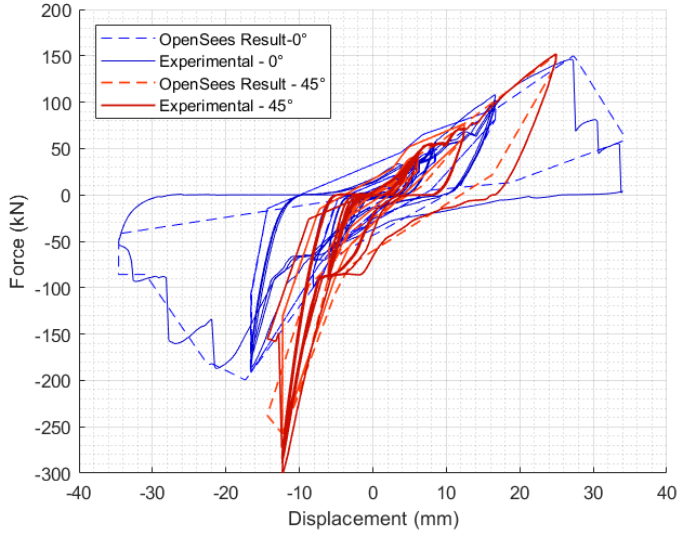
GRA: ***<u>Sujit Bhandari (PhD)</u>, PIs:*** *M. Riggio, E. Fischer, L. Muszyński (2018)*

Main takeaways:

- ❑ PP CLT can hold a variety of connectors suitable for seismic loading
- ❑ Performance predictable, can be modeled to support design
- ❑ Rapid-deployment modules viable, need more work







Focus on utilization of restoration lumber in CLT

- L. Muszyński, C. Knowles, J. Tokarczyk, C. Davis (2015): **Utilization of low-value lumber from small-diameter logs harvested in Pacific Northwest forest restoration programs in hybrid cross laminated timber (CLT) core layers.** *USDA FS 2015 Wood Innovation Program ($425,420/36 months)**

- L. Muszyński, M. Riggio, J. Morrell & R. Gupta (2016): **Defining project-specific custom CLT grade utilizing low-value Ponderosa pine lumber from logs harvested in SW Oregon and Northern California forest restoration programs.** *USDA FS 2017 Wood Innovation Program ($372,475/36 months)**

- M. Riggio & L. Muszyński (2018): **Demonstrating Use and Performance of a CLT Modular Building Utilizing Low-value Pine Lumber from Logs Harvested in Pacific NW Forest Restoration Programs.** *USDA FS 2018 Wood Innovation Program ($375,000/36 months)**

- R. Gupta, L. Muszyński, D. Barber (2018): **Fire Performance of Custom CLT Layups Utilizing Pine from Logs Harvested in Western Forest Restoration Programs.** *USDA FS 2018 Wood Innovation Program ($375,850/24 months)**

- L. Muszyński, E. Fischer (2020): **Fire Performance of connections made up of Custom CLT Layups Utilizing Pine from Logs Harvested in Western Forest Restoration Programs.** *USDA FS 2020 Wood Innovation Program. ($377,030/24 months)*

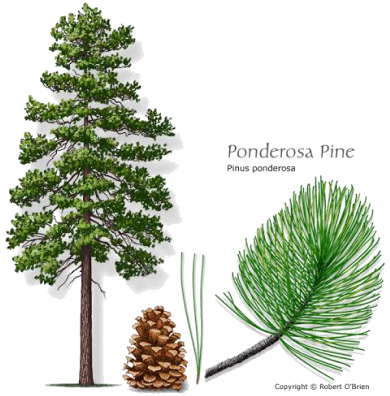
- W. Chung, N. Anderson, F. Belart, Y. Chen, R. De Amicis, J. Hogland, J. Johnson, J. Kim, K. Lyons, L. Muszyński, N. Streletskaya (2022): **Smart Forestry: Paving the Way from Forest Restoration to Mass Timber**. Component of Build Back Better with Mass Timber BBBRC. *DOC EDA Program, Award # 07-79-07914 ($5,500,000/48 months)*

**The totals include the USDA WIG support and 33% of in-kind support*

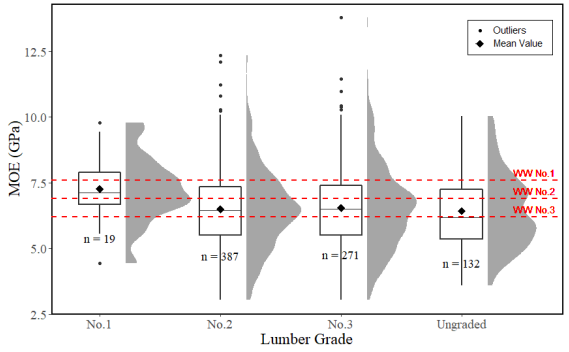
EDA
U.S. ECONOMIC DEVELOPMENT ADMINISTRATION

~~Barriers~~ Hurdles to be negotiated

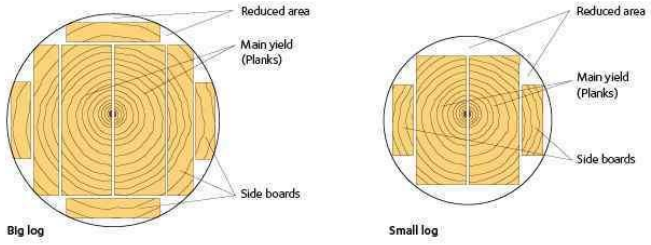
Compared to commercial harvests lumber from restoration thinnings is likely to include:



- Larger proportion of species marginally used in construction



- Larger proportion of juvenile wood (missing published NDS design values



- Larger proportion of thin and narrow sizes

Task 4. Mass timber product design specifications for restoration tree species

1. Determine standard design characteristics for lumber from small diameter logs in restoration tree species groups (e.g., pines, fir, hemlock, and spruce)
2. Investigate edge-bonding technology for CLT laminations from narrow lumber (e.g., 1x2, 1x3, 2x3) to address PRG320 thickness to width limitations.
3. Determine design characteristics of CLT panels with and without edge-bonded laminations
4. Define a custom PRG320 CLT grade for a class of standardized modular housing systems.

Edge bonding press

Project Tasks, Milestones, Deliverables, and Timelines

Task	PI	Milestone	Deliverable	Year	Measure
1. Mapping solutions	JH JJ WC NA	✓ Advancing the existing forest inventory and wood procurement mapping tools for improved resolution and spatial analysis ✓ Launching mapping tools with applications and training materials	✓ Raster-Tools[1] Machine learning libraries ✓ Publicly available mapping tools, data, workshops, user guide documents	2023-2025	TRL 6-9[2]
2. Smart forestry solutions	WC NA JK YC	✓ Testing cable-assist technology for mechanized forest restoration on steep slope for worker's safety ✓ Improving the existing machine vision system with acoustic sensor for real-time tree property measurements ✓ Evaluating wearable exoskeletons for forest workers ✓ Optimizing wood supply logistics with segregation and handling of mass timber eligible trees ✓ Field-testing and commercializing ✓ Analyzing socio-economic impacts of smart forestry solutions to rural communities	✓ Operational feasibility of steep slope cable-assist operations ✓ Prototype stereo camera system to measure tree species, knots, and stiffness ✓ Effective and safe exoskeletons ✓ Logistic optimization tools and applications ✓ Patent application ✓ Data libraries; research synthesis papers	2023-2026	TRL 6-9
3.Design specs.	LM WC	✓ Determining design values of restoration tree species for National Design Specification (NDS) ✓ Evaluating mass timber manufacturing technology from narrow-size lumber laminations	✓ NDS for lumber from restoration tree species groups ✓ Prototype of edge bonding technology	2023-2024	NDS TRL 6
4. Forest workforce	RD KL FB WC	✓ Developing XR[3] training and simulation tools and contents for forest education and workforce training ✓ Conducting professional development workshops for instructors of SMILE[4] and CTE[5] programs ✓ Development and implementation of education and training curriculums (K-12, college, workforce), and career development activities	✓ XR training tools; digital contents; real-world applications; guide documents ✓ Instructor training workshops; training materials ✓ In-class curriculums; education materials; new CDA activities and contents	2023-2026	TRL 6-9

Assess standing trees marked for thinning

Potential for structural uses

No. 1

No. 2

No. 3

Other uses

Trees not marked for thinnings

Primary processing including:

- Re-merchandising logs
- Visual grading lumber

Re-scanning at CLT plant:

- Potential reassignment of grades
- Visual grades
- Database of grade defining features
- Surface scan images

No. 1

STOP

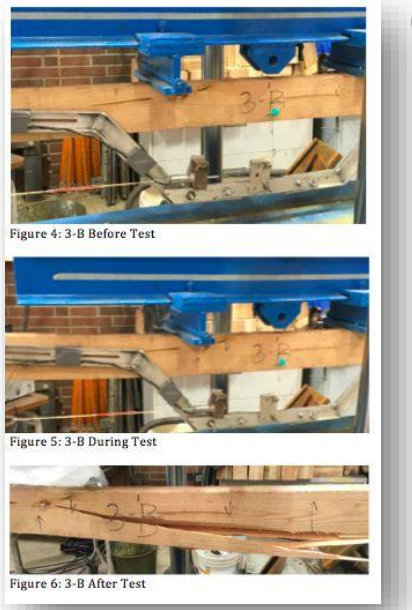
No. 2

No. 3

No grade/ other uses

STOP

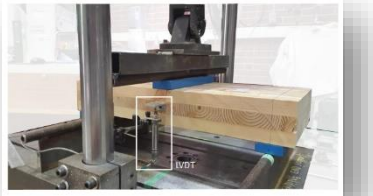
Determination of design values (per NDS)



Fabrication of CLT specimens (w/ narrows)

Edge bonding press

Determination of design values for CLT

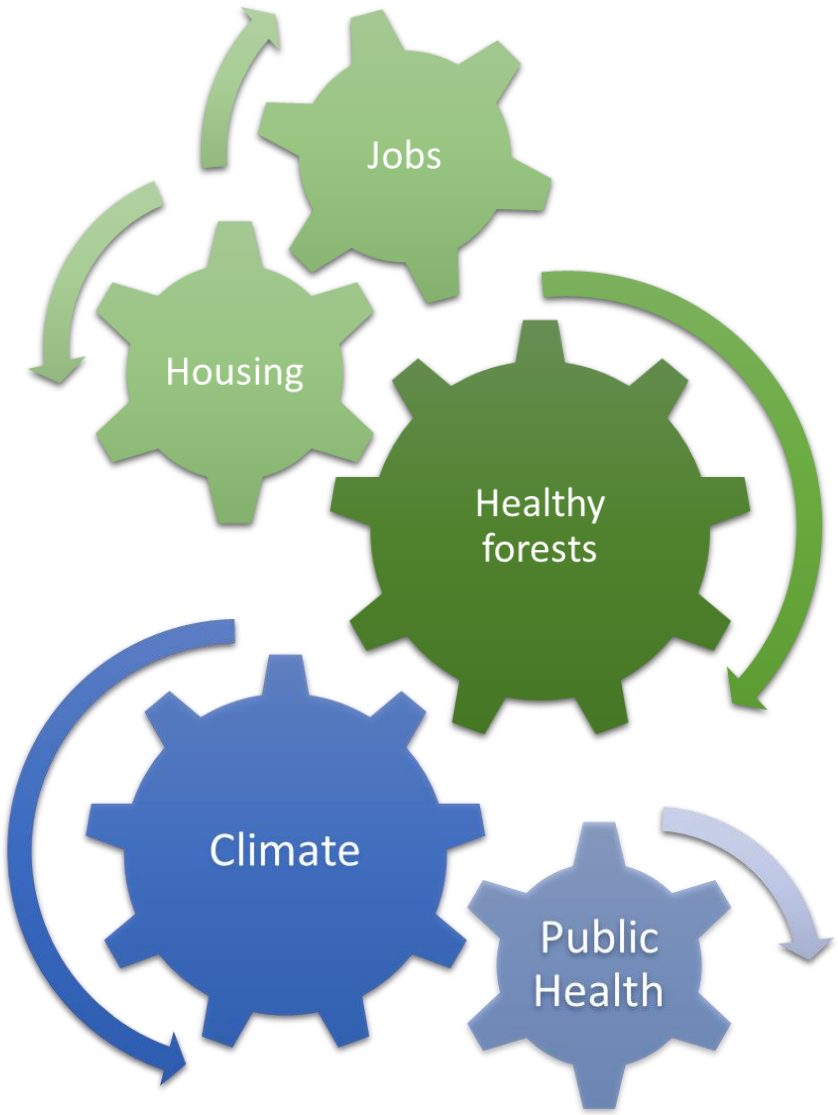


Impacts and Synergies

Custom CLT grades optimized for modular designs to be executed in large numbers create opportunities to utilize volumes of lumber that otherwise might not be accepted for standard CLT grades

Hypothesis: 100 modular units a year will lead to

- **utilization** of approximately 33 MMBF of restoration pine lumber
- **treatment** of about 460 additional acres of threatened forestland
- retaining or creation of about 303 **jobs*** in lumber industry
- creation of extra 57 **jobs** directly for the CLT manufacturing**
- total **job** creation in the sector about 360 jobs/yr.



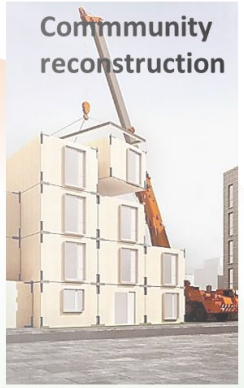
* est. 9.2 jobs/MMBF (Beck Group)
** Beck Group estimate

Summary

- Adjusted design values prerequisite for structural uses
- Edge-bonding technology to increase utilization rates
- MTP a contributing solution, not the sole solution (scale!)

Parallel work

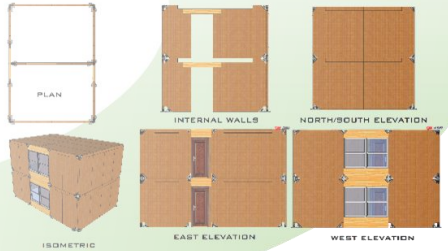
- Modular design to incentivize investment in CLT production capacity in the region
- Promoting solution addressed as one of a suit of synergistic issues



Preventive landscape treatments

Small log processing

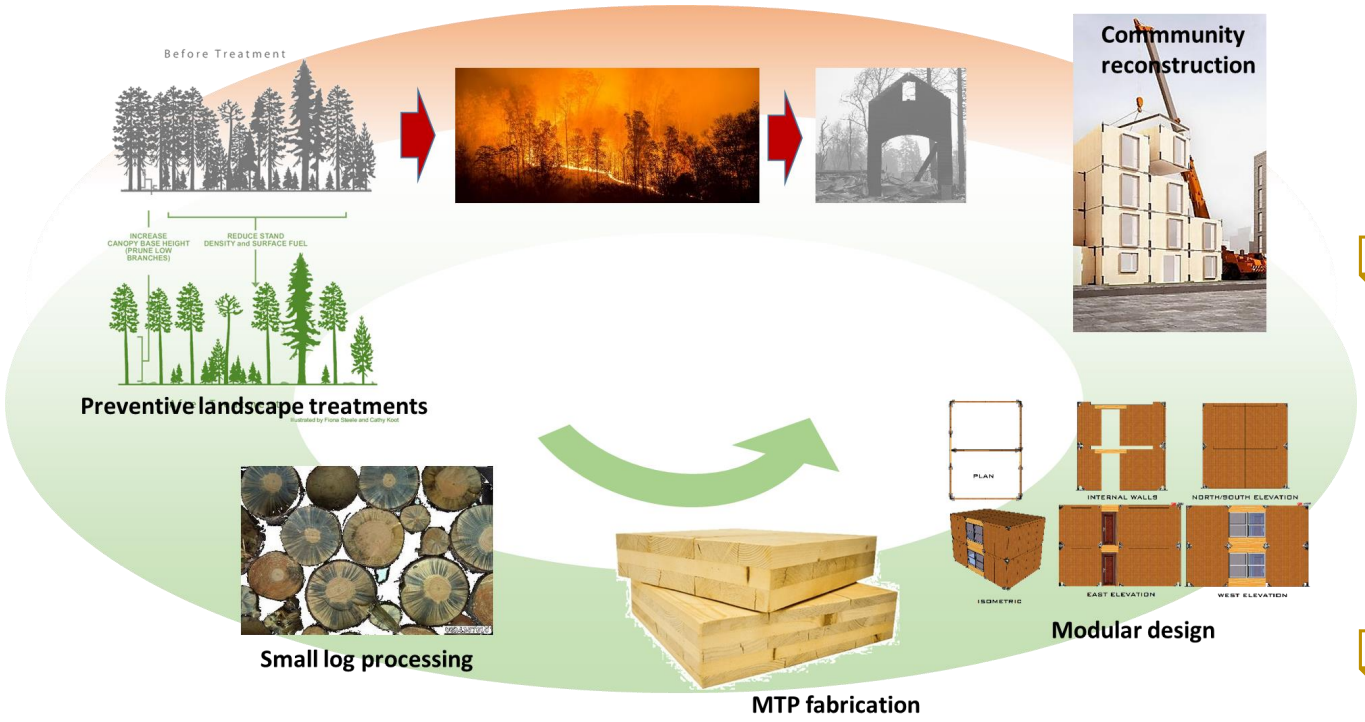
MTP fabrication



Modular design


Let’s talk…

Before Treatment



Modular Construction

- Repeating 3D modules “constructed with standardized units or dimensions for flexibility and variety in use” built off-site, delivered and assembled on-site.
- Saves on-site construction time
- Useful for buildings with repeated pattern, such as hotels, multi-family housing, dormitories, schools, etc.
- Beneficial for temporary relocatable and emergency housing

Custom CLT grades optimized for modular designs to be executed in large numbers create opportunities to utilize volumes of low value lumber.

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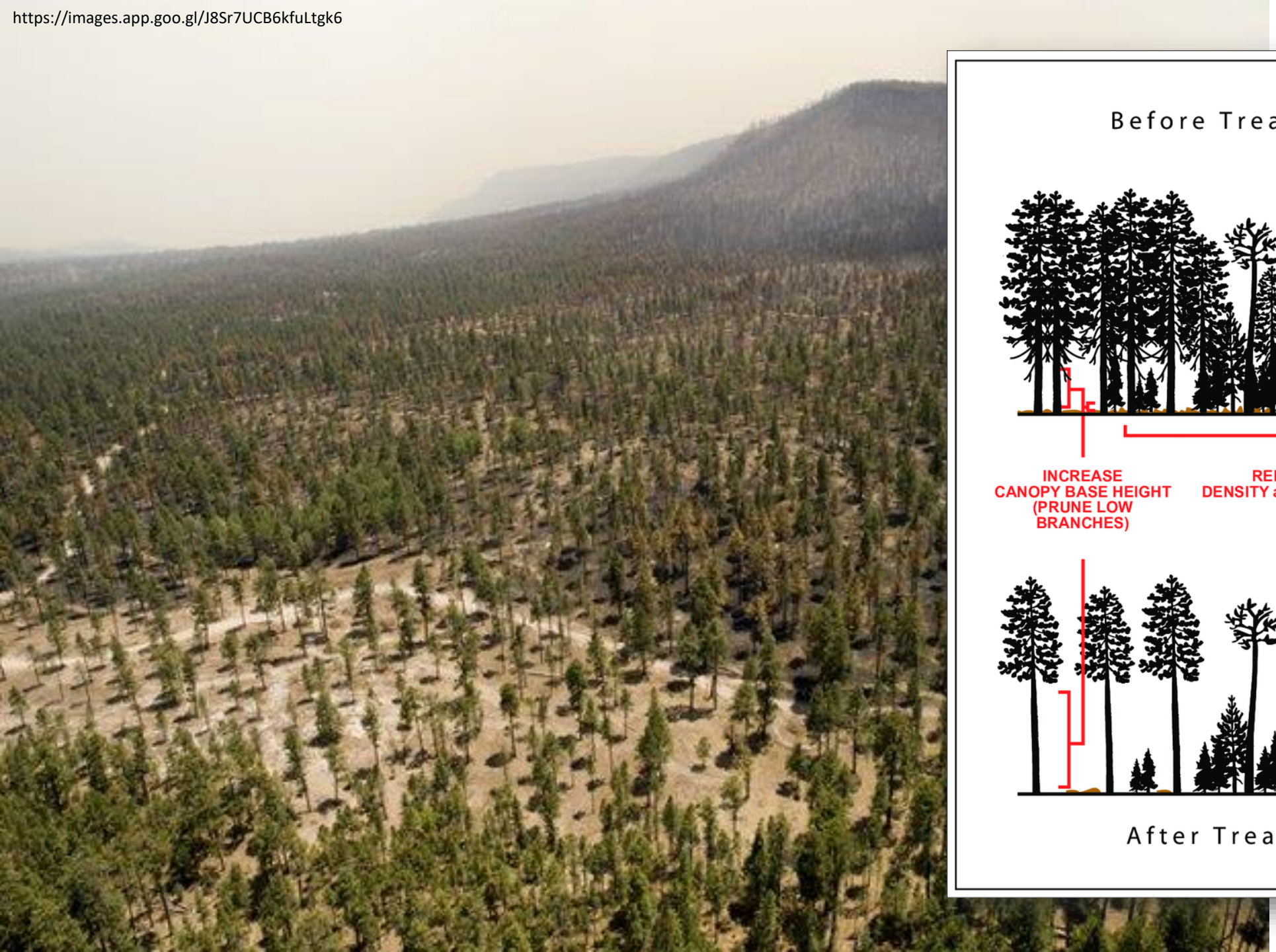

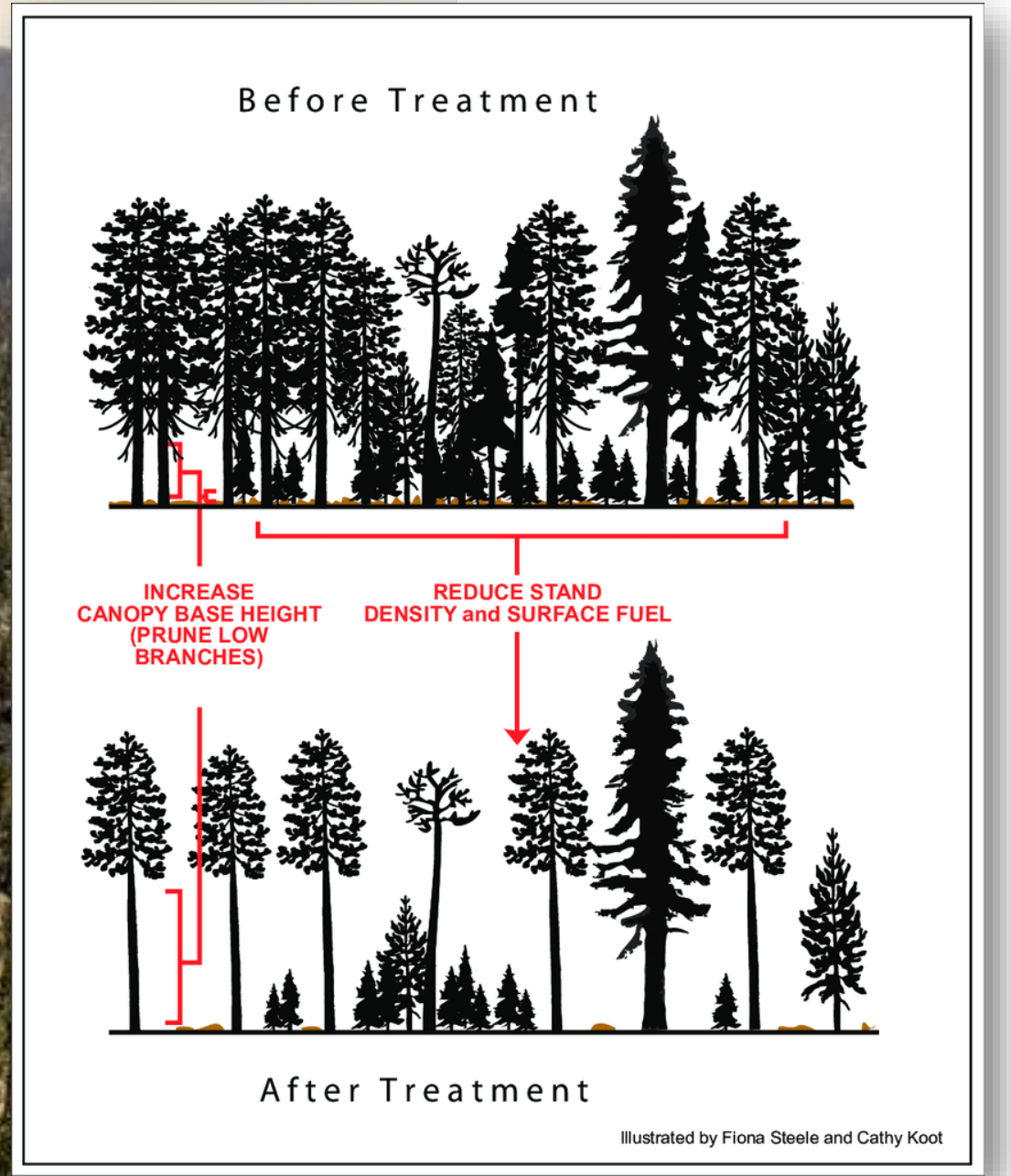

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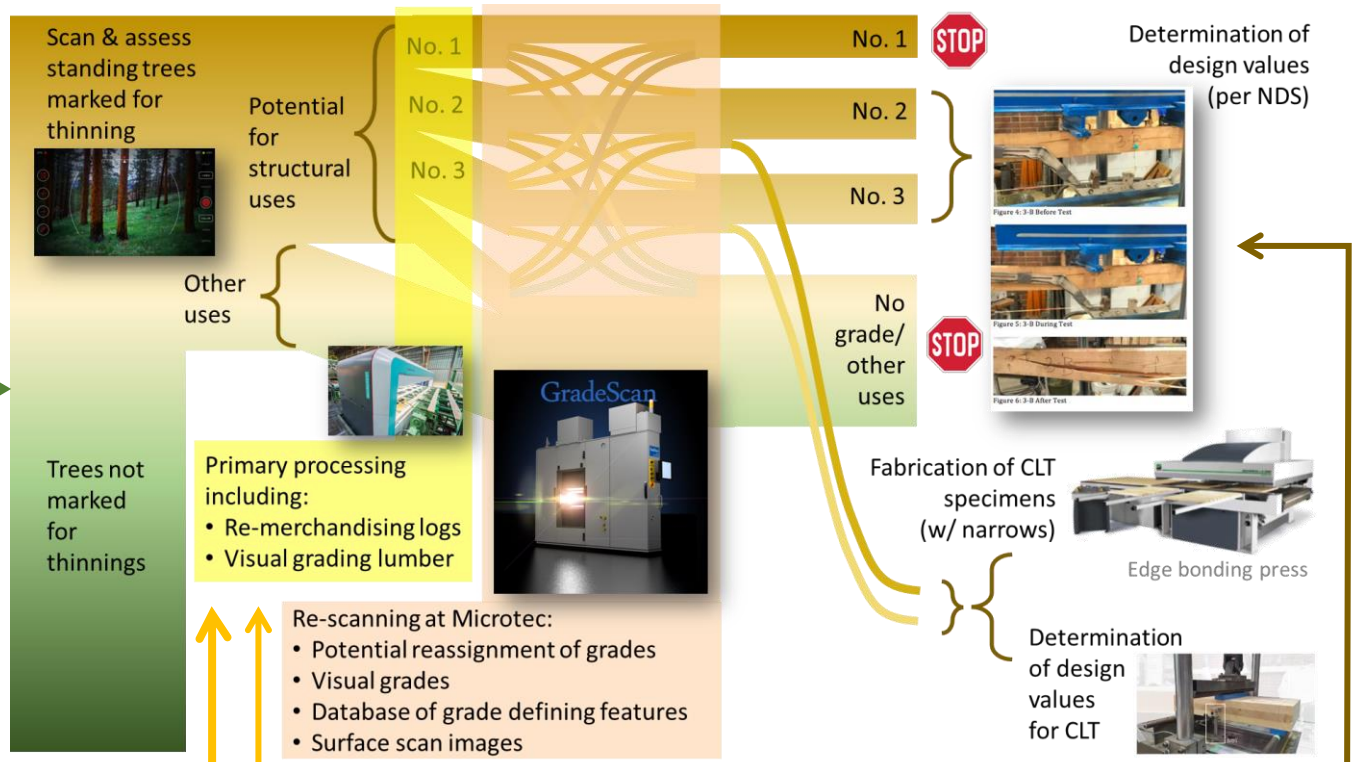
Creating unique data set

That may be used for calibration of the assessments



Initial assessment of quality and value of logs at the harvester (predictors?)

Re-evaluation of merchandable logs at the sawmill log yard

Visual grades of lumber assigned at sawmill (no component metrics available)

Visual grades assigned at CLT plant (incl. component metrics)

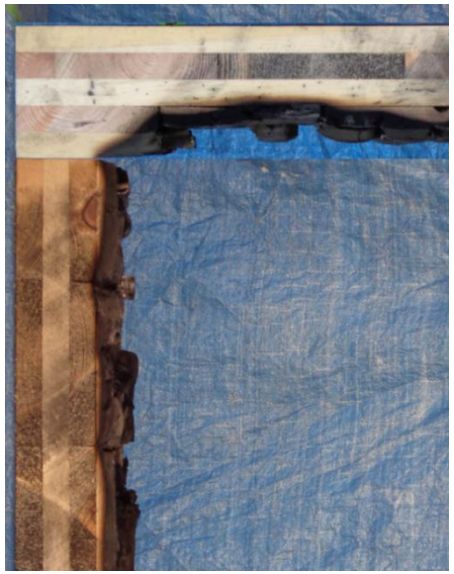
Design values for lumber

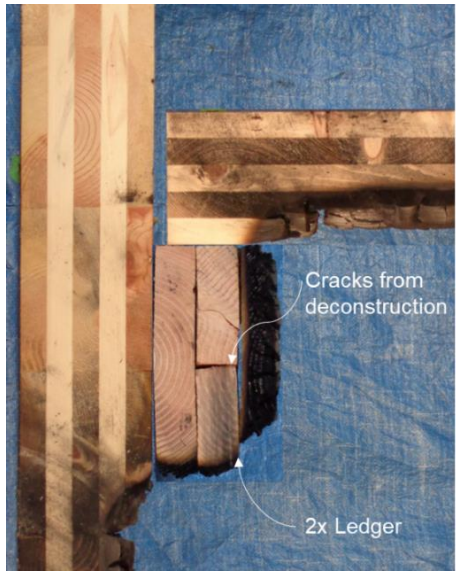
Design values for custom CLT built from that lumber

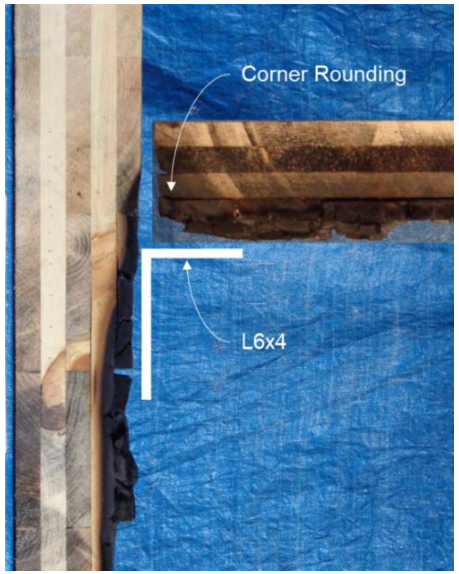
Fire Performance of connections made up of Custom CLT Layups Utilizing Pine from Logs Harvested in Western Forest Restoration Programs.

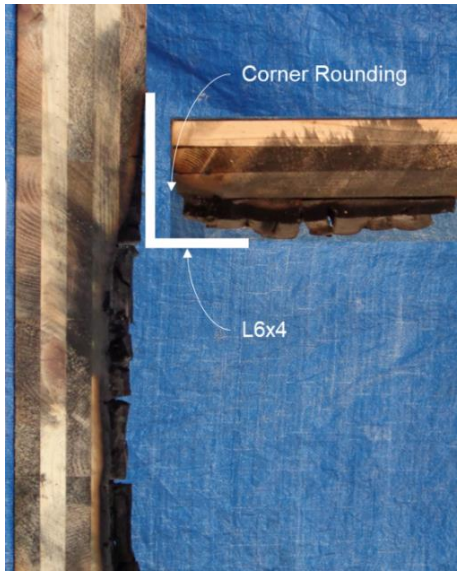
GRA: <u>Aaron Redus (MSc)</u>, PIs: *L. Muszyński, E. Fischer, D. Barber*

Main takeaway: Performance of floor-to-wall connections <u>controlled by charring</u>









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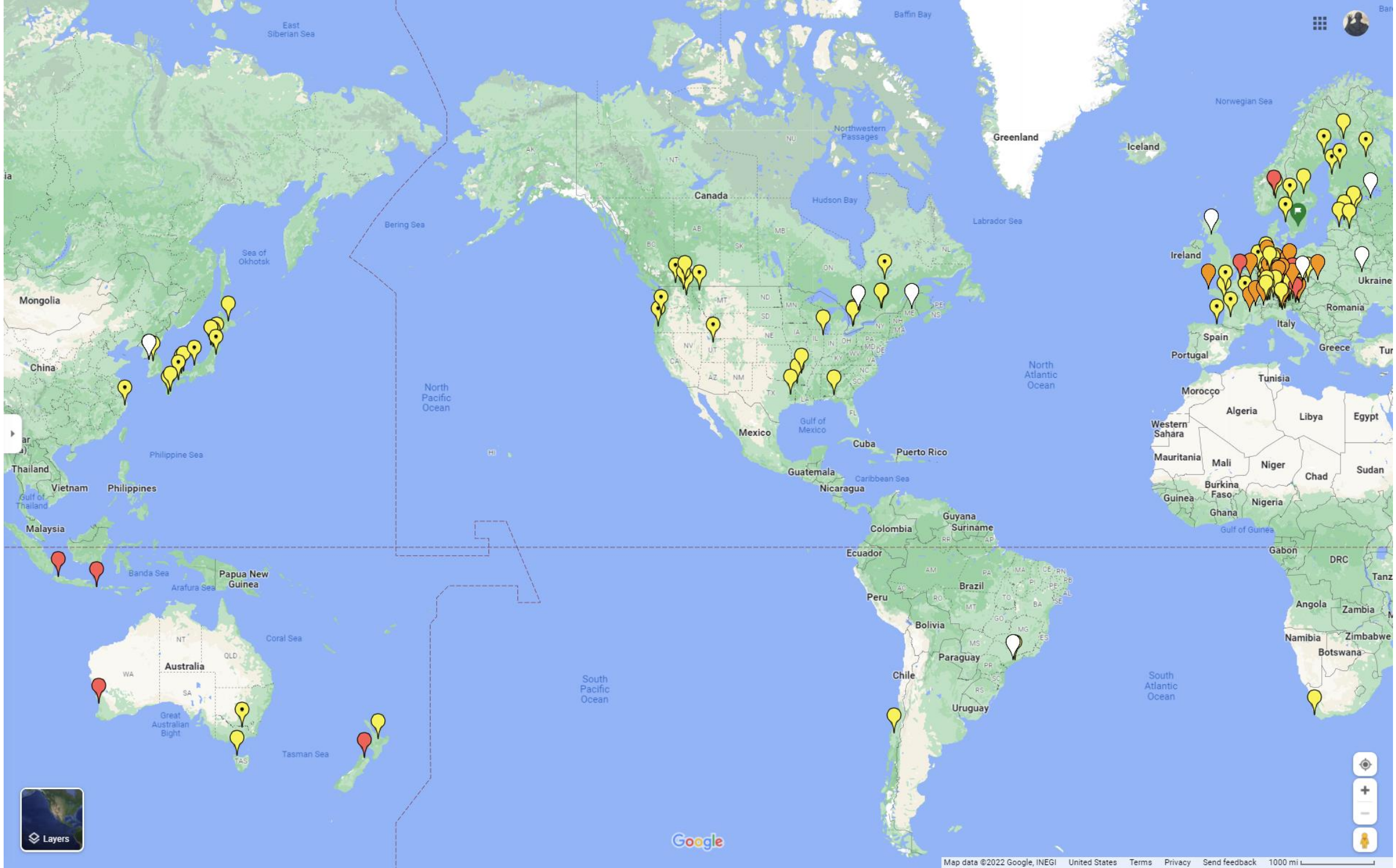
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Norwegian Sea
Greenland
Iceland
Northwestern Passages
Canada
Hudson Bay
Labrador Sea
Bering Sea
Sea of Okhotsk
Mongolia
China
North Pacific Ocean
North Atlantic Ocean
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Romania
Italy
Spain
Portugal
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Tunisia
Morocco
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Libya
Egypt
Western Sahara
Mauritania
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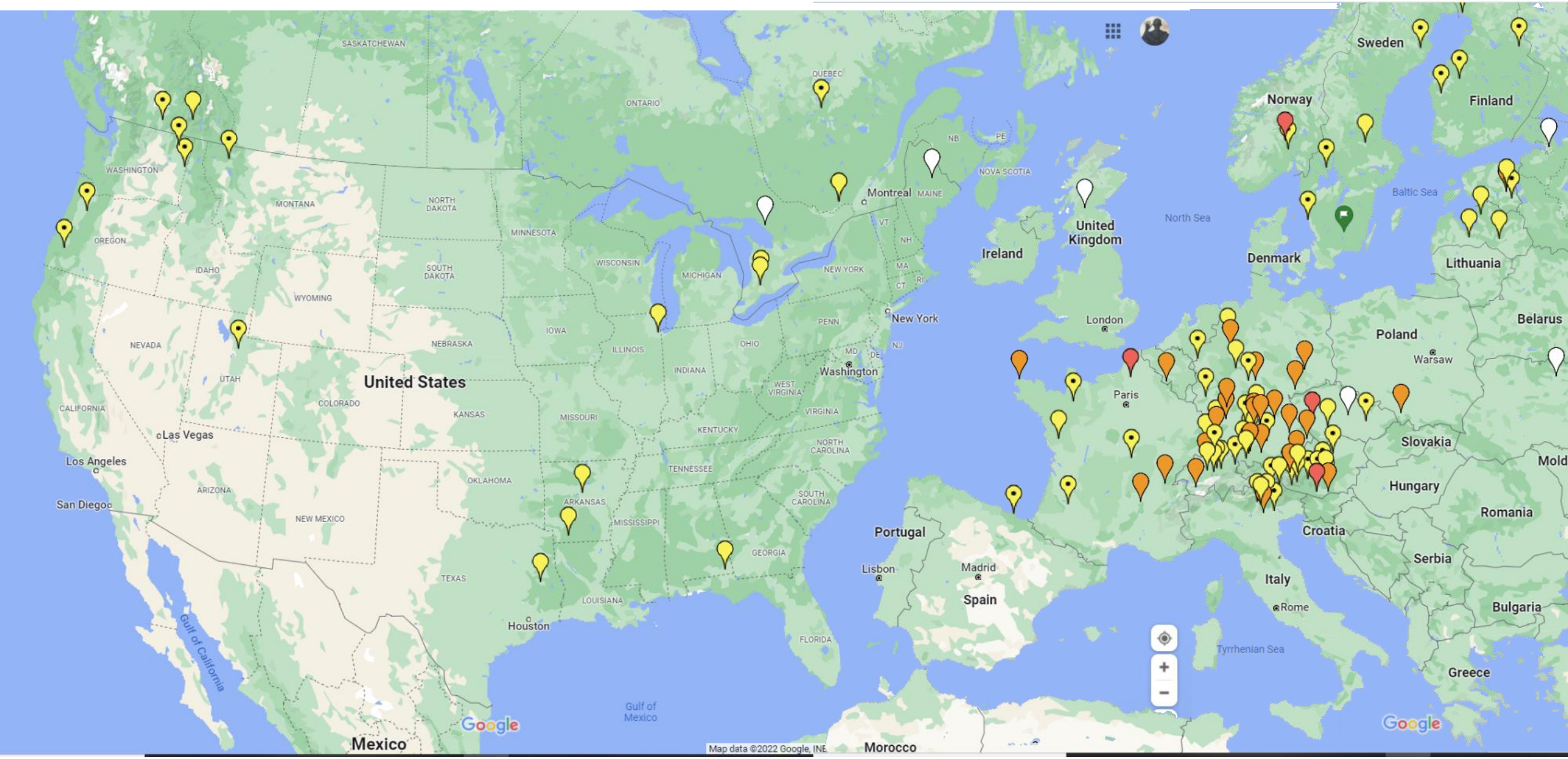
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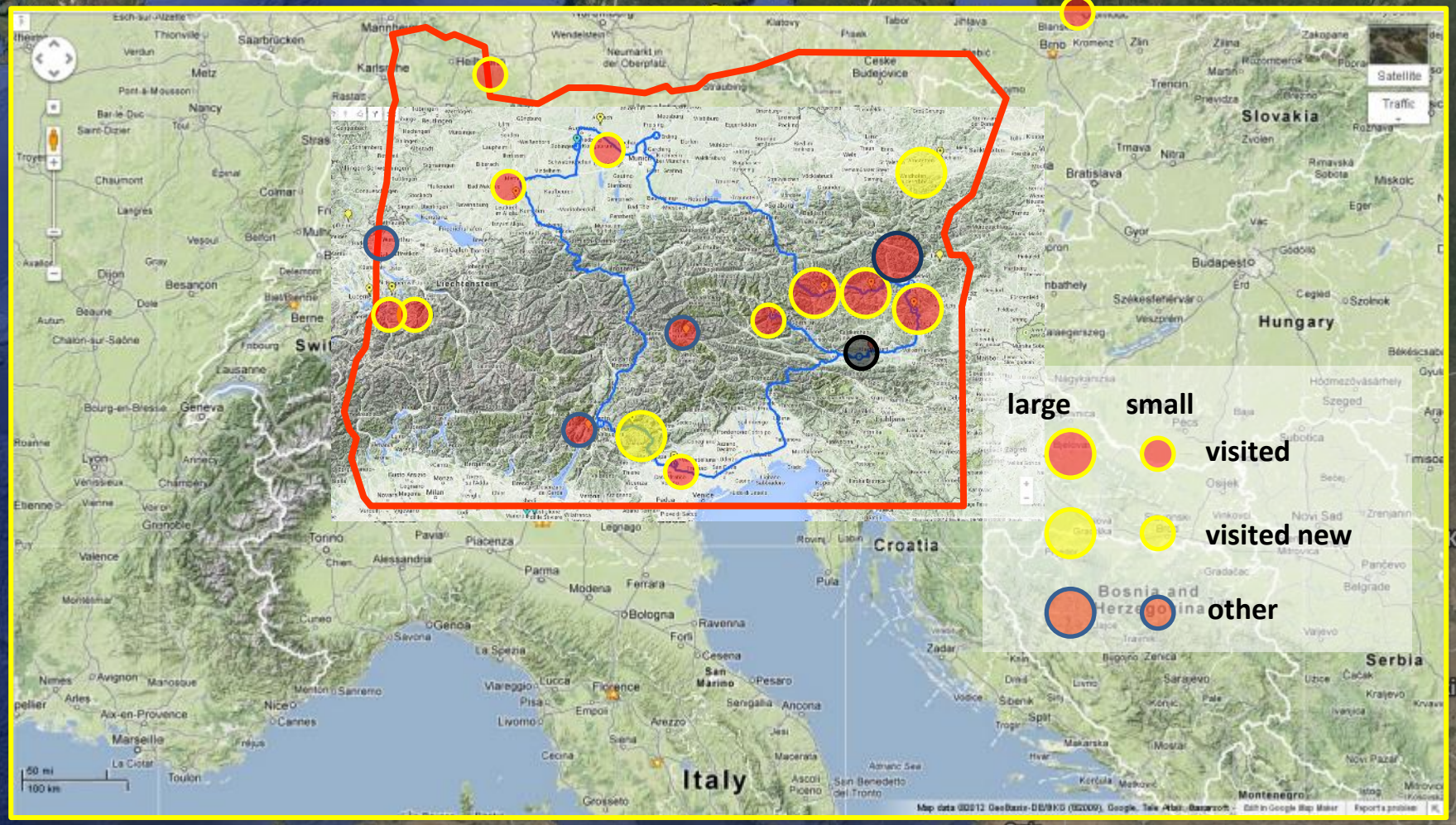
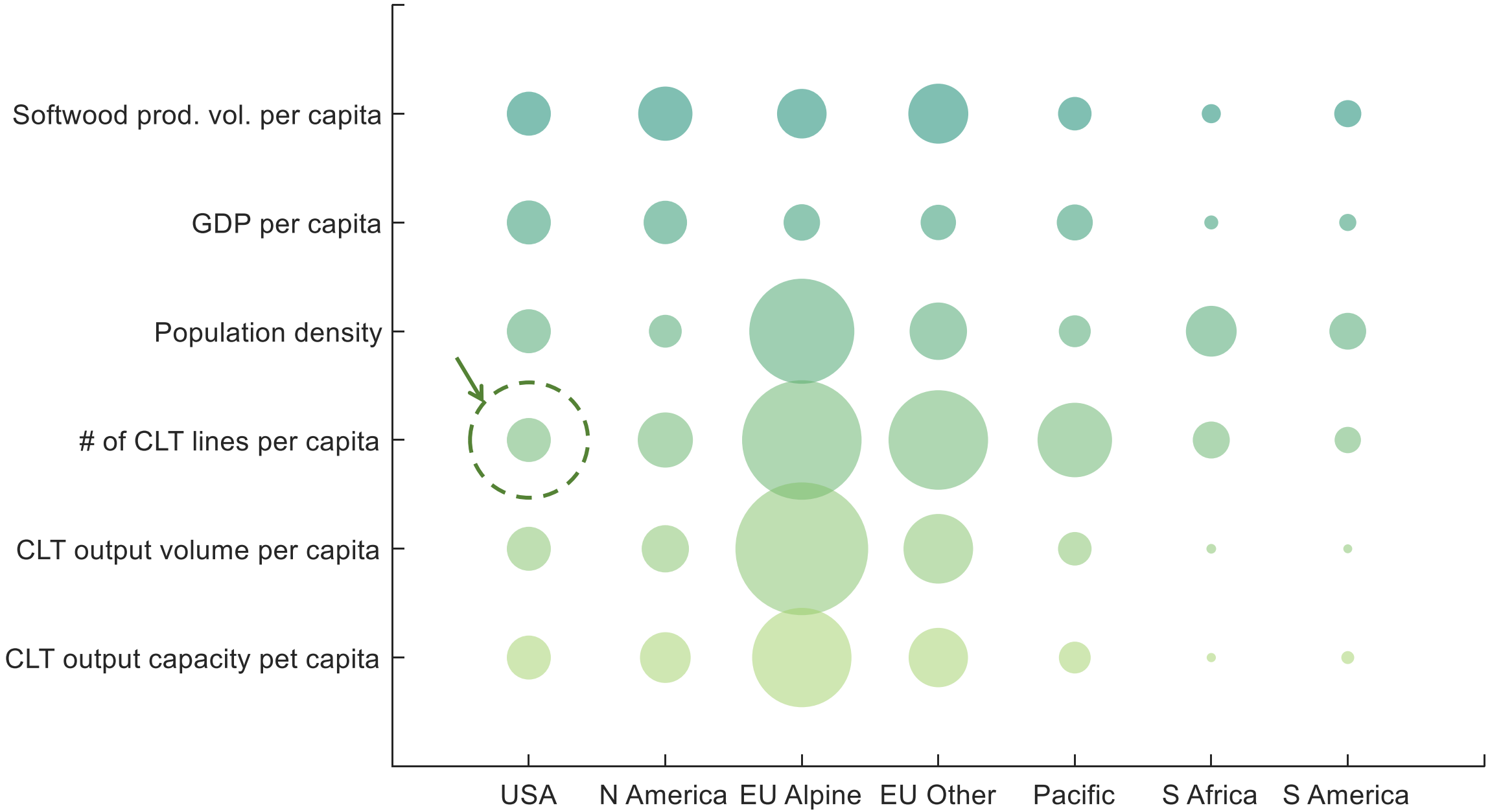
An opportunity




Softwood prod. vol. per capita
GDP per capita
Population density
# of CLT lines per capita
CLT output volume per capita
CLT output capacity pet capita
USA
N America
EU Alpine
EU Other
Pacific
S Africa
S America