Ushering in the Timber Age: Economic & Sustainable Opportunities for the 21st Century

Prepared for Northeast Wood Design Symposium

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NEW ENGLAND FORESTRY FOUNDATION

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Course Description

Building owners and designers have a unique opportunity to help address the significant environmental and development demands placed on the built environment by the twin needs to expand housing and address climate change. At a moment when the built environment is facing dramatic shifts, the need for innovation and sustainable design approaches is more essential than ever. This session will outline current research on how forests can link to cities through demand, design, technology, supply, and sustainability. Topics will include: a summary of the latest climate science, energy efficiency, the importance of local sustainability criteria and sourcing, and technological opportunities associated with mass timber methods of construction.

Learning Objectives

1. Participants will understand the urgency of addressing climate change, and the challenges inherent in providing buildings for housing and economic needs in the face of climate change.

2. Participants will understand the three carbon reduction possibilities inherent in mass timber construction: offsets, sequestration, and urban form.

3. Participants will understand how reductions in greenhouse gas emissions associated with mass timber construction depend on sourcing and sustainability issues in the forest that provides the timber.

4. Participants will be aware of the how to maximize the benefits of mass timber's use in urban buildings, performing triple functions of structure, finish and carbon sequestration.

NEFF’s Mission

Through the application of our core expertise in conserving forestland and advancing Exemplary Forestry, New England Forestry Foundation (NEFF) helps the people of New England to sustain their way of life, protect forest wildlife habitat and ecosystem services, and mitigate and adapt to climate change.

Objective 1. Urgency of addressing climate change

IPCC report, October 2018

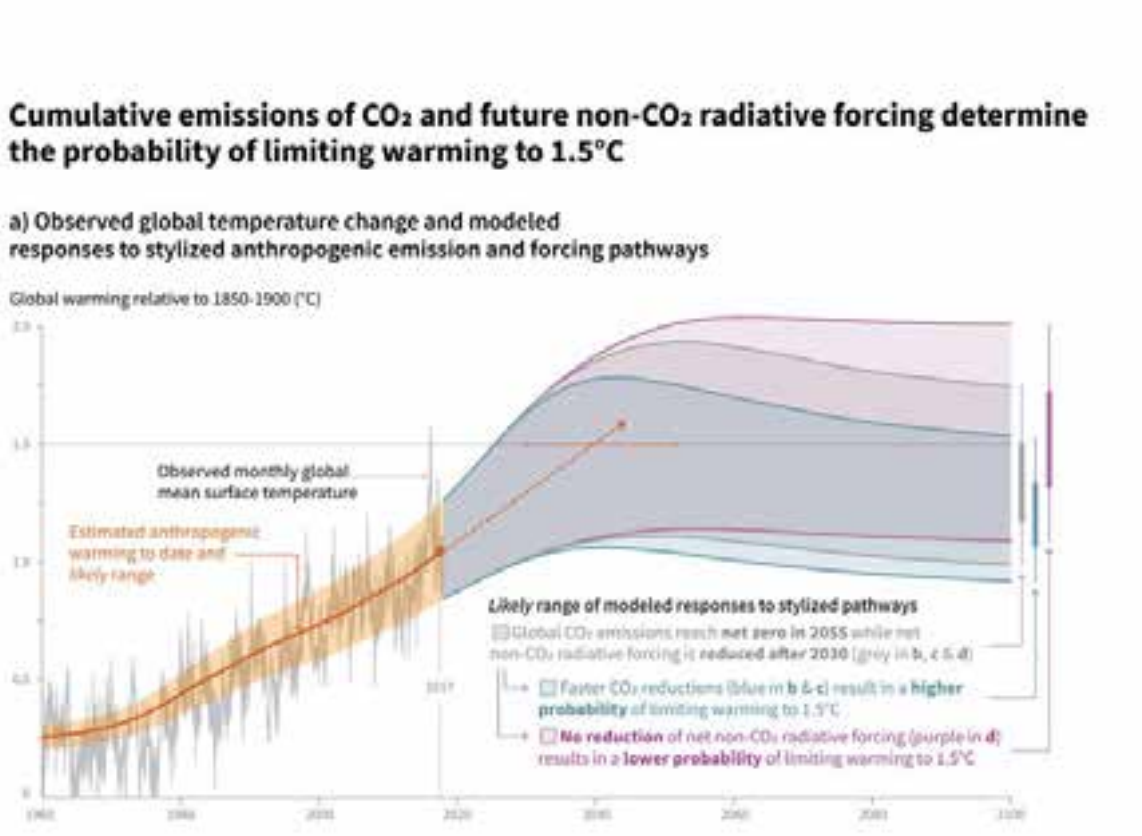
It's the diagnosis you don't want from your doctor:

"Every possible test has been done and the news is not good"

--Katherine Hayhoe, Texas Tech University

Report accessible at
https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf

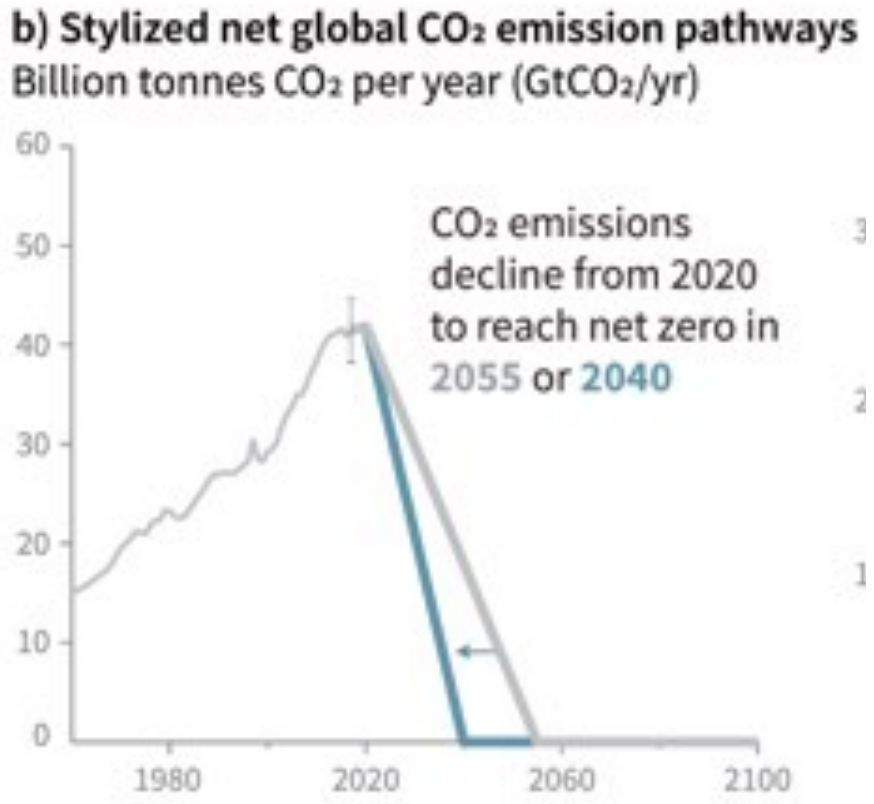
Science of the report



- Report indicates 1.5°C of warming could occur between **2030 and 2052**
- High probability of limiting emissions to 1.5°C requires **net zero carbon emissions by 2040**
- High probability of avoiding exceeding 2°C requires **net zero emissions by 2055**

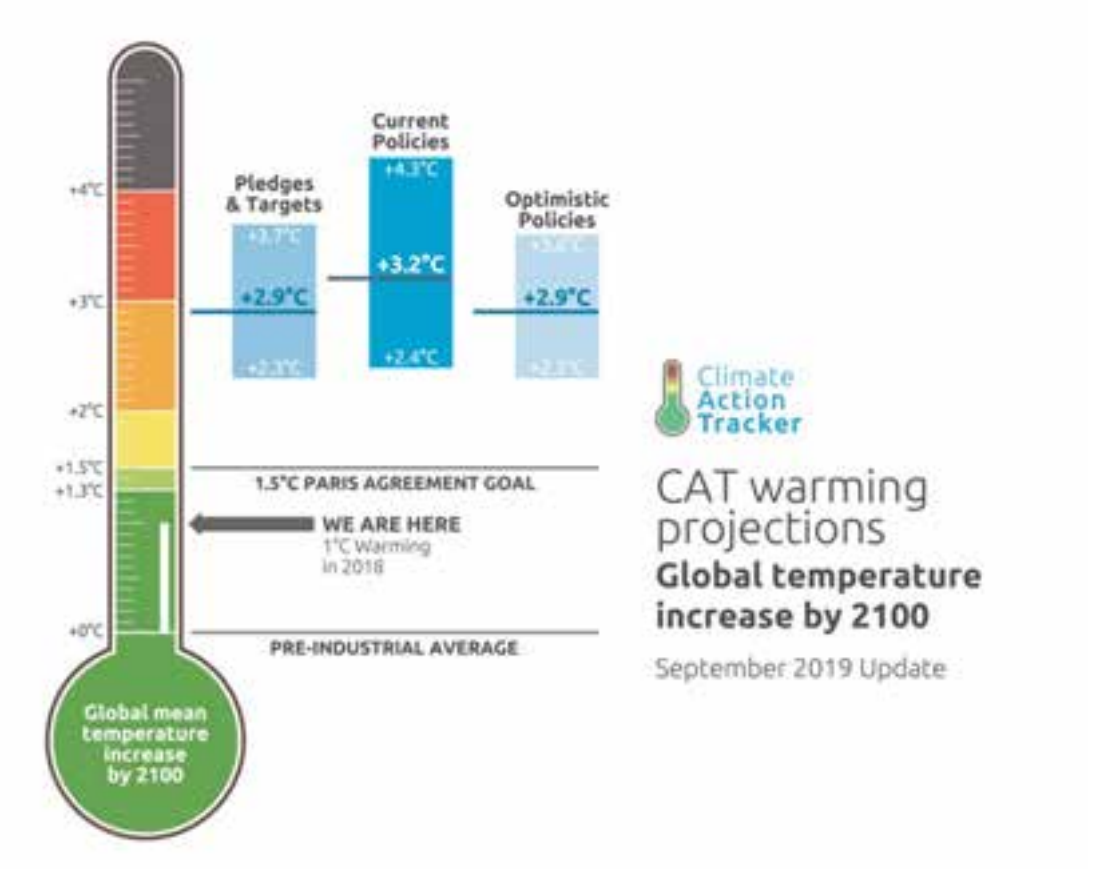
“Unprecedented”

- Achieving the emissions targets requires unprecedented reductions in carbon emissions
- No industrial economy has ever sustained this scale of reductions for such an extended period of time
- Reductions in wealthy nations will likely have to be faster to achieve these goals, in order to accommodate just poverty alleviation and economic development goals in nations still experiencing widespread poverty



Impacts of 1.5 vs 2°C

- IPCC report and other economic analyses indicate strong economic losses with change from today's temperatures to 1.5°C, and more losses with to 2°C
- Current policies are not sufficient by far to meet even a 2°C goal
- Temperature rise of 3.66°C would increase economic damage nearly 10 fold vs 1.5°C



Source: https://climateactiontracker.org/publications/time-to-boost-national-climate-action/

Economic development needs are not just a developing country issue

"The Metro Mayors Coalition will need to add 185,000 housing units from 2015 – 2030 in order to meet demand and reduce – or at least stabilize -- housing costs."

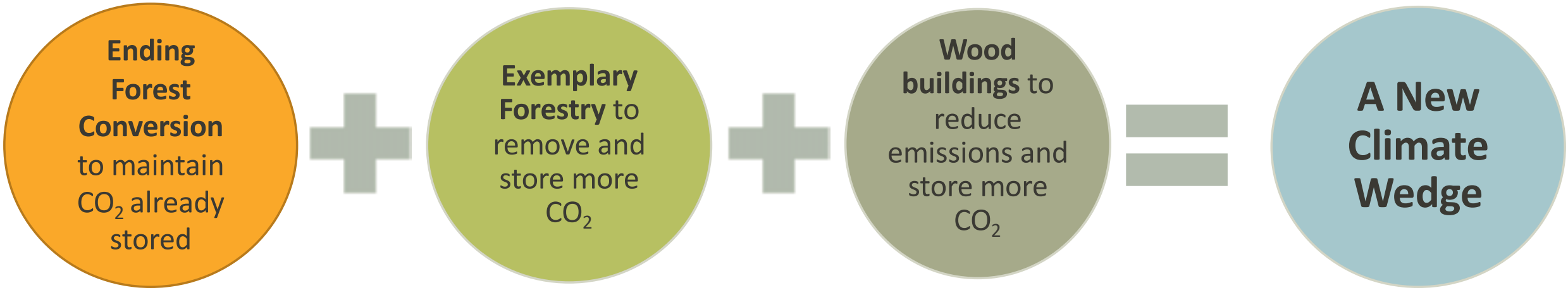
Recommendations in the IPCC report

- Cut concrete emissions– but only by using carbon capture and storage.
- Plant up to 2.5 billion more acres of forests by 2050– but little focus on retention or management of existing forests
- Rapid transformation of urban infrastructure including deep reductions in energy use in buildings– but only focused on operational energy
- Carbon pricing of up to $5500 per ton of CO2 needed by 2030– equivalent to 5x to 10x the going per acre rate for Maine forest land.

We can do better than this!

Objective 2: The Climate Potential of Mass Timber Construction

What's not in the report: A three part climate solution



The New York Times

Build More Wooden Buildings

Frank Lowenstein, Brian Donahue and David Foster

ACROSS North America, trees stand ready to help us solve the climate crisis. Trees remove carbon dioxide from the atmosphere and store it in their wood. One way to respond to a challenge from the United Nations secretary general, António Guterres, to seek "bold action and much greater ambition" on climate change is to protect forests from development, improve forest management and use sustainably harvested wood to build tall buildings. This will allow us to pump carbon from the atmosphere and store it in forests and in cities. It will also support rural economies, improve wildlife habitat and create more affordable housing.

This opportunity arises from cross-laminated timber, or CLT. First introduced in the 1990s, it enables architects and engineers to design tall, fire-safe and beautiful wood buildings. Recent examples in the United States include the seven-story T3 building in Minneapolis, the eight-story Carbon12 building in Portland, Ore., and a six-story dormitory at Rhode Island School of Design in Providence. In Canada, Norway, Sweden, England and Australia, even taller wooden buildings are already in use. The Mjøsa tower in Brumunddal, Norway, is only 25 feet shorter than the Statue of Liberty.

Private industry is gearing up to provide engineered wood for more tall wood buildings here in the United States. This year a highly automated, large CLT plant opened in Washington state. Last week, the first ever CLT plant in New England was announced in Maine.

The energy embodied in the materials for new buildings around the world — mostly steel and concrete — accounts for 11 percent of global carbon emissions. Typically, coal is used to heat these materials to temperatures over 1,500 degrees Fahrenheit in the manufacturing process.

Wood, in contrast, is forged from sunlight. A study by scientists from Yale University and the University of Washington showed that expanding wood construction while limiting global harvesting to no more than the annual growth could produce a combination of emissions reduction and carbon sequestration equivalent to eliminating construction emissions altogether. This could take a big bite out of the carbon problem, roughly equivalent to the present contribution from all types of renewable energy.

One study conducted by researchers in British Columbia found that building a five-story office building with wood had less than a third of the global warming impact when compared with a steel and concrete building of the same size. Beyond taking less energy to produce, wood buildings store carbon that otherwise would have returned to the atmosphere as those trees died and began to decay. The wooden structure of the new 18-story Brock Commons dormitory at the University of British Columbia, for example, stores 1,753 metric tons of carbon dioxide. That carbon will be locked up for decades, if not a century or more, until the building is torn down, and if the wood is reused, perhaps even longer.

Additional benefits come from the fact that these new wood technologies make it affordable to construct mid-rise housing of six to 12 stories. Conventional wood framing is limited to five stories by building codes, or six stories if a concrete first floor is included. The high cost of materials and construction — for example, renting a tower crane and hiring someone to operate it — usually push developers working to construct steel and concrete housing to design and build structures of more than 12 stories to provide a suitable return on investment.

Transportation hubs in the inner suburbs of cities in the United States are often surrounded by multifamily housing of only five or six stories. With CLT, those buildings could be taller, creating more housing close to trains, subways and buses, and a more compact urban development pattern. That would save forests on the urban fringe from being cut to make way for more housing, and cut emissions and congestion on highways. Taller mid-rise wood buildings would also help lower the cost of housing by increasing supply.

To stabilize climate and support the wood building revolution, we need to stop the conversion of forests to other uses — whether to pastures in the Amazon or to shopping malls, houses and solar arrays near Amherst, Mass. When forests are cleared, the carbon stored in the forest is typically released to the atmosphere, and the ability of the forest to capture future carbon is lost. To avoid this, Harvard Forest and Highstead Foundation developed a 50-year vision that aims to conserve 30 percent of New England's remaining forest.

A 2014 study by scientists from Harvard Forest and the Smithsonian Institution examined the carbon consequences of applying exemplary management to forests across Massachusetts. The results showed we could double production of wood while maintaining wildlife habitat, clean air and water, forest carbon and places for human recreation. In the heavily harvested industrial forest lands of northern New England there is even more potential for a greater carbon sequestration. The New England Forestry Foundation estimates that with exemplary management these forests could absorb hundreds of millions of tons of carbon, removing as much carbon from the atmosphere as would be released by all seven million cars in New England for 20 years.

Forest ecosystems and wood buildings can be our most important climate allies. We should minimize the conversion of forests, enable more wood construction and incentivize private landowners to improve their stewardship. Policies to achieve these goals should include greater state and local funding to amplify the impact of private land conservation funding. Incentives that encourage the construction of wood buildings that are drawn from forests with outstanding management are key to our climate future and the future of the forest.

These policies will produce more carbon standing in living, beautiful, productive forests, which also provide the raw materials for equally beautiful, affordable cities that store even more carbon.

By tying together the city and the forest, this effort could unite rural and urban citizens toward shared goals — a livable climate, a viable economy and a vibrant landscape. □

Trees are some of our best allies in solving the climate crisis.

FRANK LOWENSTEIN is the chief conservation officer of the New England Forestry Foundation. BRIAN DONAHUE is an associate professor of American Environmental Studies at Brandeis University. DAVID FOSTER is the director of the Harvard Forest and the president of the Highstead Foundation.

Articulating that approach in print:

https://www.nytimes.com/2019/10/03/opinion/wood-buildings-architecture-cities.html

Part 1. Stop conversion of forests to other uses

Whether for agriculture in the Amazon or for homes near Amherst deforestation releases carbon already stored and eliminates future potential to store more

Video still from NY Times.
https://www.nytimes.com/video/world/americas/100000006721982/amazon-rainforest-fires-burning.html

Part 2. Manage forests better

Potential to address climate change through improved forest management on existing forest lands

- Higher stocking and productivity
- Addressing non-carbon effects of forest on albedo, water vapor and other critical climate variables

Photo by John Brissette, Northeastern Research Station

Potential benefits are enormous

- Achieving exemplary forestry outcomes in New England would store 1.9 Gt of CO^2 in new living wood.
- If achieved over 20 years this equals would be equivalent to removing all vehicles in New England from the roads for the same time period or longer.
- Production of sawlogs could increase.

Part 3. Build wood buildings

Lower emissions

Sequestration in the building

Different pattern of development

Courtesy of John Horner/RISD

From carbon source to carbon sink.

About 5000 tons C02 emissions avoided.
Typical mass timber mid-rise building

Rendering, façade detail.
SHoP Architects, NY, NY
From Timber City exhibit

Additional long term storage of carbon in the structure itself

Photo courtesy of UBC

Brock commons at the University of British Columbia:

- 1753 metric tons CO_2 stored in the wood of the building

Change the pattern of development

- Switch from 5 over 1 wood frame around transit hubs to 6-12 story mass timber housing.
- Less forest clearing on urban fringe
- Less congestion and transit emissions

Objective 3: Carbon benefits depend on sustainability of harvesting

- Oliver et al 2014: 14 to 31 percent of global carbon emissions
- BUT– presumed harvesting limited to growth on annual basis
- Currently in Maine harvesting on some investor-owned lands greatly exceeds growth creating a carbon debt

Sustainable sourcing is key for the future of mass timber

- Third party certification is a minimum step
- LCAs need to include in-forest impacts in a meaningful manner
- Sourcing requirements can help drive desirable outcomes in the forest
- NEFF's Exemplary Forestry standards represent one articulation of a higher sustainability standard

Potential Results for Mass Timber

- Forest products at the center of climate-driven development
- More jobs in depressed rural communities
- More housing, with more affordable pricing
- Improve mobility and reduce future sprawl
- Maintain wildlife habitat, clean air, clean water
- Help solve the climate crisis

Objective 4: What's needed to make CLT work here in New England?

Build Supply

Build Demand

CLT Supply Potential

U.S. Forest Service
Wood Innovations Grant

Pöyry Global

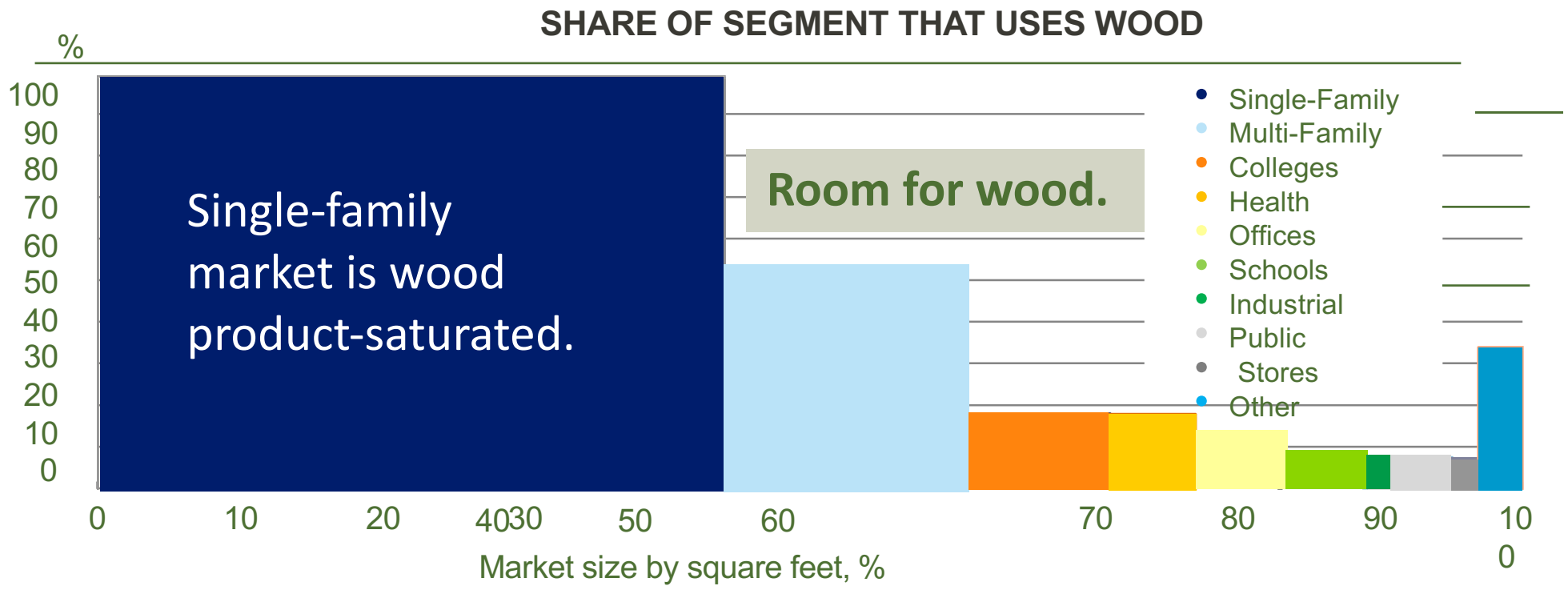
Innovative Natural Resource Solutions

ASSESSING THE WOOD SUPPLY AND INVESTMENT POTENTIAL FOR NEW ENGLAND ENGINEERED WOOD PRODUCTS MARKETS AND MILL

July, 2017

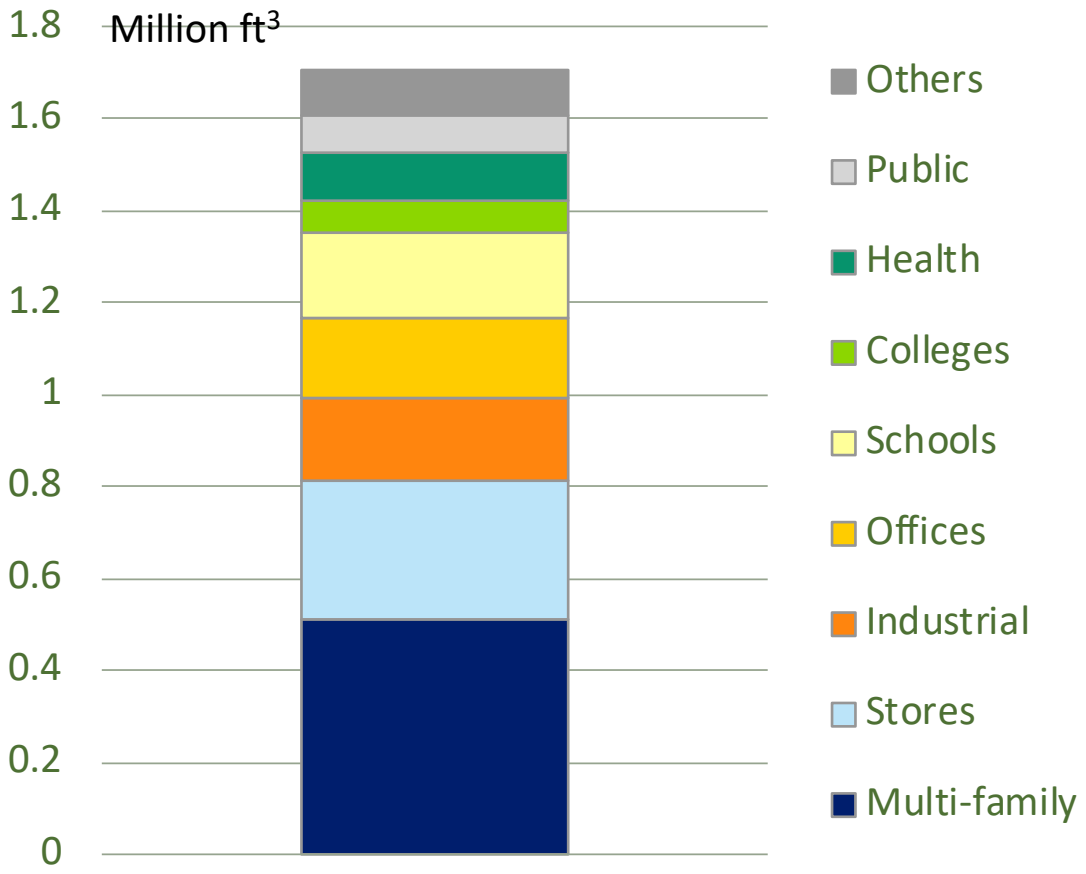
CONSTRUCTION MARKET – U.S. NORTHEAST

Commercial and taller residential buildings provide the largest new opportunities for wood.



1% market share for CLT in Northeast

Large projects from both private and public sector would accelerate the demand relatively quickly.



1 U of M, Amherst project or ~200 dorm rooms

2-3 schools (Franklin Elementary, VW)

2-3 big projects

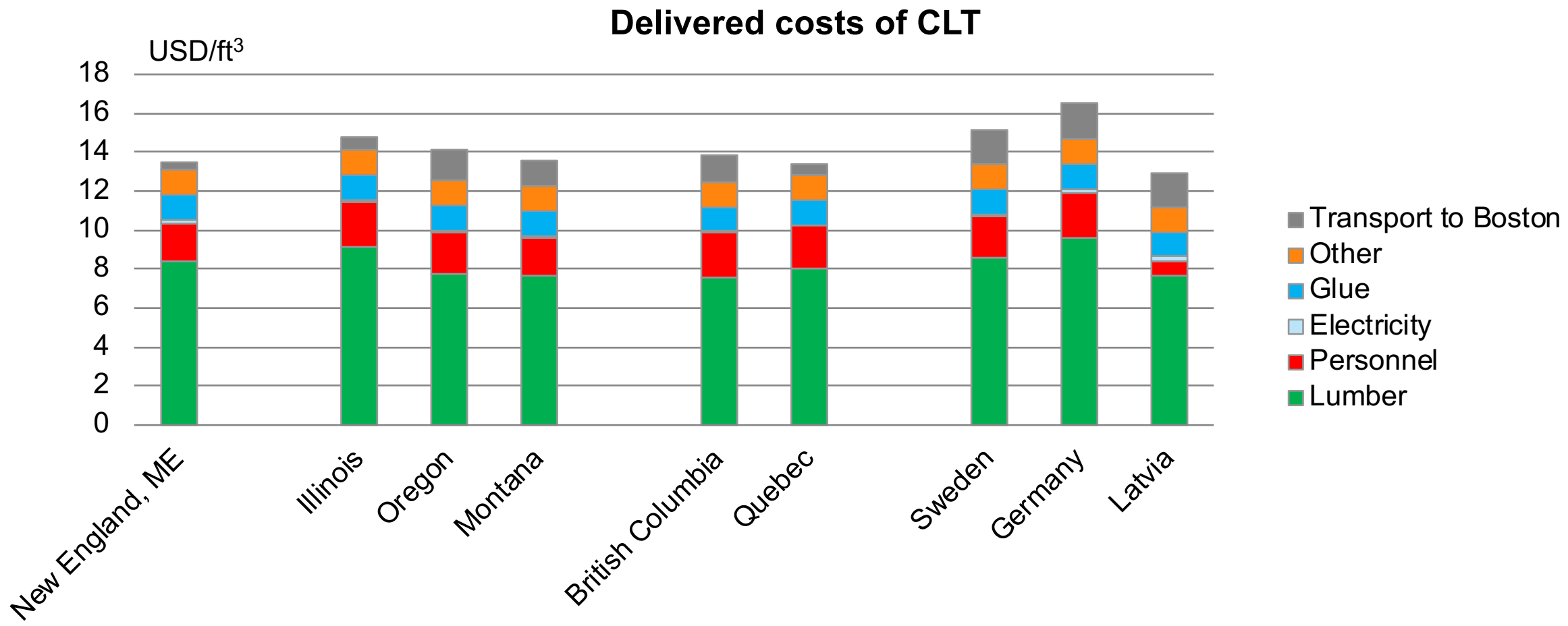
2 CLT mills?

3 bigger shopping malls

400-500 apartments

CLT – INTERNATIONAL COST COMPARISON

When taking into account transport costs, the costs of New England are on par with or better than competitors for delivery to a construction project in Boston.



PÖYRY

PROFITABILITY

Sales prices have to be clearly above the cost of import at current $/€ exchange rate to justify a greenfield investment. Integrating CLT production with an existing glulam factory is an attractive opportunity even with current import parity price.

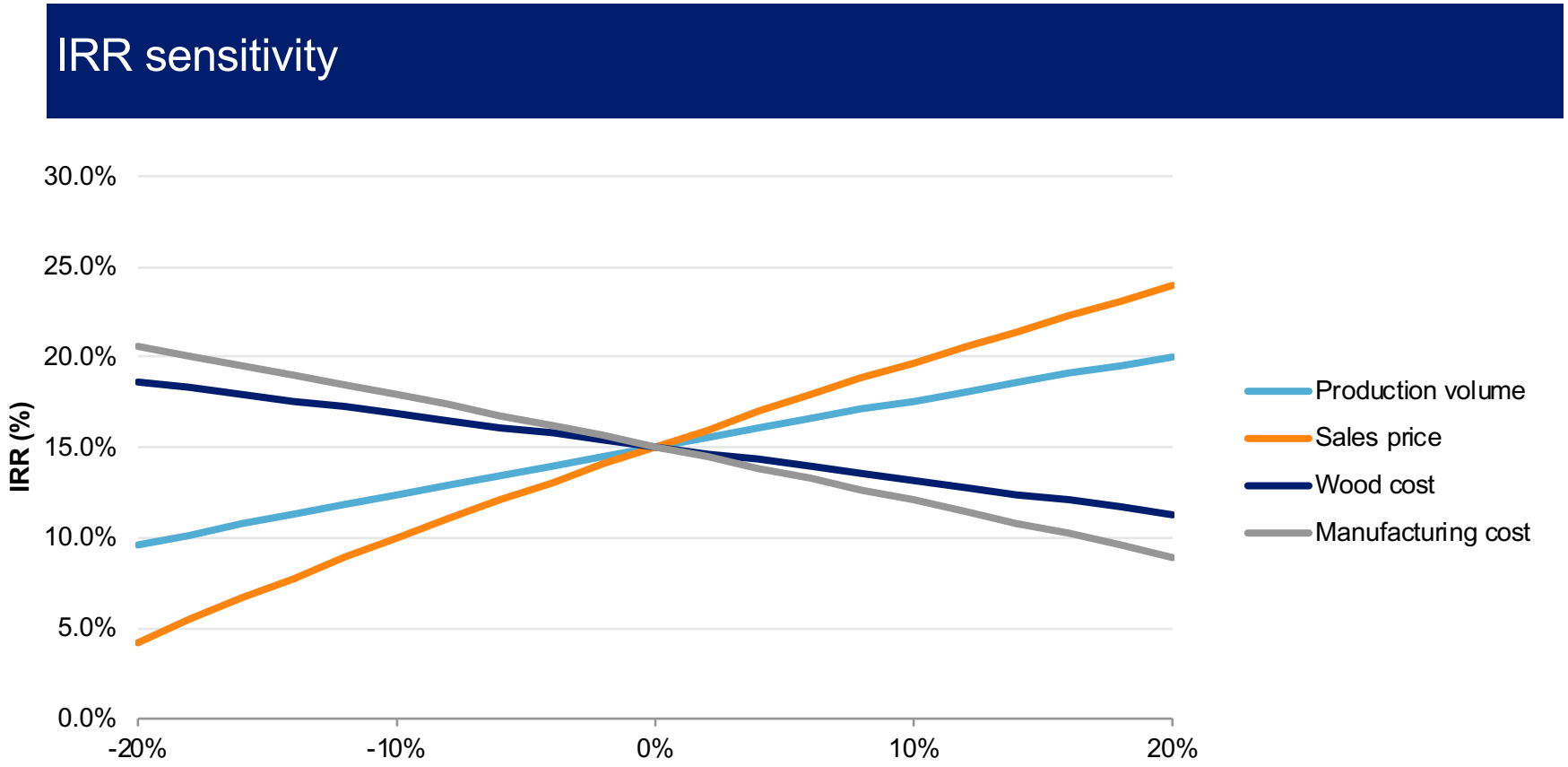
	IRR %
Local pricing	15.1%
Import parity price	2.9%
Brownfield integration * Local pricing	40.3%
Brownfield integration * Import parity price	14.9%

*Existing building and infrastructure, existing lamella production, investment 7 MUSD investment in manual technology (+50% production & maintenance personnel) and modifications of buildings

SENSITIVITY ANALYSIS – LOCAL PRICING SCENARIO

The project will have a positive net present value given a local pricing scenario for reasonable fluctuations in sales price, and production volume and costs

- The internal rate of return will be positive under all reasonable circumstances, and vary between 5-25% given the change in input factor prices and costs



PÖYRY

Driving demand– showing it's possible

Photo by Alex Schreyer

U. Mass –Amherst Design Building – opened in January, 2017

Potential incentives

- Wood first/wood alternative policies
  - Public sector
  - Private sector
- Public policies that would scale state aid for housing and/or schools based on climate impact
- Investor-based strategies
  - Investment tax credits
  - Carbon credits
  - Recruiting climate-interested investors
- Reducing interest costs based on climate benefits
- Private sector strategies to drive sustainability and conservation through sourcing requirements

Forests to Cities: Grow, Build, Live

Forged from photosynthesis

Photo: Wildlands and Woodlands, Harvard Forest

QUESTIONS?

This concludes The American Institute of Architects Continuing Education Systems Course

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