Photo by Joe Anastasi

The Case for CLT Manufacturing In Maine

Compiled by
Maine Mass Timber Commercialization Center
University of Maine
https://composites.umaine.edu/key-services/wood-composites/maine-mass-timber-commercialization-center/

01/07/2019

About the Maine Mass Timber Commercialization Center

The Maine Mass Timber Commercialization Center (MMTCC) was founded in 2017 in direct response to a 2017 Department of Commerce federal interagency Economic Development Assessment Team (EDAT) report on the Maine forest-based economy, specifically Priority "E" of the EDAT report stating: "Invest in the research, development and commercialization of emerging wood technologies". In particular, the EDAT report singled out the unique opportunity that exists for development of Mass Timber (e.g. cross laminated timber) production in Maine:

"Cross Laminated Timber (CLT) research at the University of Maine is linked to several potential manufacturing facilities seeking east coast locations. Immediately form a collaboration of appropriate parties to promote the siting of a CLT facility in Maine and identify recommendations to incentivize wider use of CLT and possible demonstration projects."

Through the recommendations of the EDAT, MMTCC was established through a grant with the U.S. Economic Development Administration. Based at the University of Maine, the MMTTC works in collaboration with industrial partners, trade organizations, construction firms, architects, and other stakeholders in the region to support the revitalization and diversification of Maine's forest-based economy by means of encouraging innovative mass timber manufacturing in the State of Maine. Through science-based research and development at the University of Maine, the MMTCC is actively involved in exploring new applications and design practices for mass timber, with extensive regional outreach activities to increase awareness of mass timber technologies and practices throughout the Northeastern U.S. with architects, engineers, building contractors, investors, legislatures and fire/code officials to increase product demand and adoption.

Maine Mass Timber Advisory Committee Member Organizations:

- *American Wood Council*
- *Becker Structural Engineers*
- *CHA Architecture*
- *Consigli Construction*
- *Fontaine Inc.*
- *Gray Organschi Architecture*
- *Hancock Lumber Co.*
- *Innovative Natural Resource Solutions*
- *Katahdin Region Economic Development*
- *Leers Weinzapfel Associates*
- *LignaTerra Global, LLC*
- *Maibec Lumber Co.*
- *Maine Forest Products Council*
- *Maine Street Solutions*
- *MaineHousing*
- *Massachusetts Institute of Technology*
- *New England Forestry Foundation*
- *Northern Forest Center*
- *Northeastern Lumber Manufacturers Association*
- *Olifant, LLC*
- *Our Katahdin*
- *PDT Architects*
- *Pleasant River Lumber Co.*
- *Robbins Lumber Co.*
- *Scott Simons Architects*
- *SmartLam North America*
- *Stratton Lumber Inc.*
- *Thornton Tomasetti*
- *University of Maine*
- *University of New Hampshire Cooperative Extension*
- *University of Southern Maine*
- *Vermont Sustainable Jobs Fund*
- *Verrill Dana LLP*
- *WBRC Architects and Engineers*
- *Woodworks – Wood Products Council*
- *Yale School of Architecture*

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Table of Contents

Maine: The Choice for CLT Manufacturing in the Northeast

The Northeastern U.S. is known for its vast forestlands of commercial softwood timber. Sitting atop this region lies Maine – the most heavily forested state in the nation (as a percentage of land area) containing nearly 26 billion cubic feet of wood. With a unique combination of vast softwood resources and proximity to the large population centers of the Northeastern U.S., Maine's experienced workforce, sustainably managed private forests and economic development partners are working together to develop a "new forest economy". By supplementing our traditional products with advanced manufacturing, emerging technologies and new market applications, the goal is to continue Maine's 400-year history of supplying products to consumers both in our region and the world. This document demonstrates that Maine is well situated, and its many stakeholders are organized and fully supportive of mass timber products.

Demographics

Population	1.38 million
State capital	Augusta
Largest city	Portland
Land area	35,380 sq. miles / 91,633 sq. km
Length of coastline	3,478 miles / 5,597 km
Lakes and ponds	6,000
Forest	17.6 million acres / 6.9 million ha. (89% forest)
Location	Northeast region (includes Boston, New York, Philadelphia, and Washington D.C.) is home to 18% of the U.S. population and generates $3.75 trillion in annual economic output

Economy

GDP 2018	$56.7 billion
Median household income 2017	$56,277
Annual real GDP Growth	1.9%
State budget 2020-2021	$8 billion
Exports 2018	$2.8 billion
Imports via Maine 2018	$3.8 billion

Domestic and Regional CLT Demand

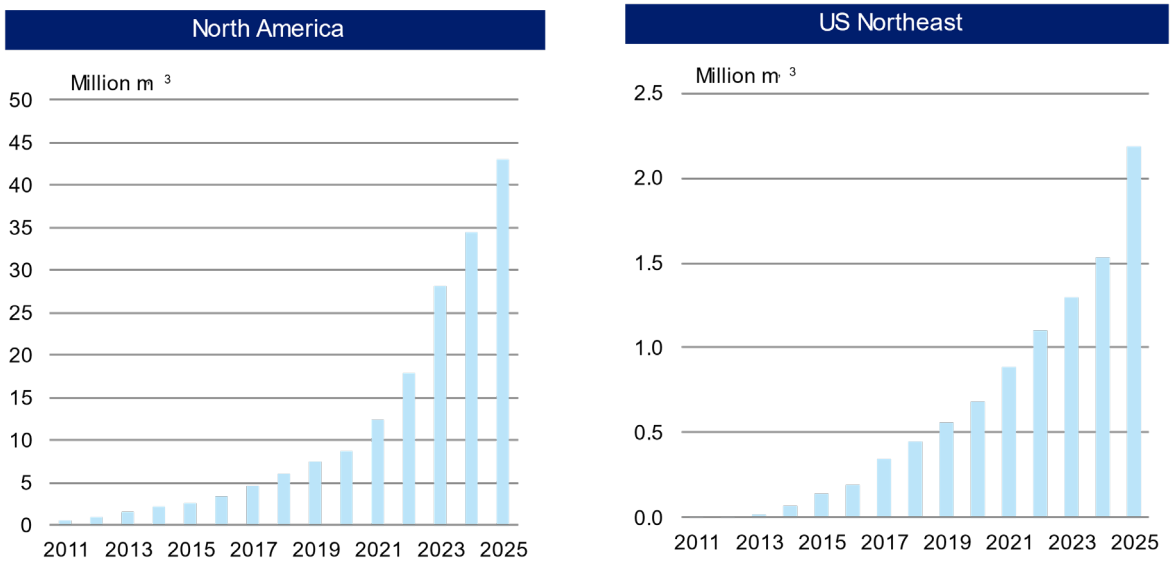
Around the world there are now numerous timber buildings constructed above six stories tall. In the United States, such buildings have been constrained by a strong reliance on prescriptive building code limits and less willingness to use performance-based fire protection engineering. Even with these challenges, mass timber construction has grown significantly; as of June 2019, 599 mass timber projects have been constructed or were in design in the United States, with 88 in the Northeastern U.S.[1] Most of these projects were within the size limits of the prevailing building codes of the time, with others successfully using an (more arduous) alternative means & methods process to go beyond the prescriptive code limits. In January 2019, the International Code Council (ICC) approved a set of proposals to allow certain types of tall wood buildings as part of the 2021 International Building Code (IBC). Based on these proposals, the 2021 IBC will include three new construction types—Type IV-A, IV-B and IV-C—allowing expanded use of mass timber. These new construction types are based on the previous Heavy Timber construction category (renamed Type IV-HT) but with additional fire-resistance ratings and levels of required noncombustible protection. The code will include provisions for up to 18 stories of Type IV-A construction for Business and Residential Occupancies. These code changes will be instrumental in increasing demand for mass timber products such as CLT.

With the adoption of the revised 2021 IBC standards, there are clearly defined national specifications and criteria for implementing mass timber into a variety of construction types to eliminate confusion and increase clarity to building code officials and architects in every state. These revisions will create market opportunities throughout the Northeastern United States as more code officials, architects, engineers and builders gain familiarity with the technology. To date, two states (Oregon and Washington) have been early adopters of these 2021 tall wood code provisions. There are significant efforts currently taking place by several organizations to educate building code officials, Fire Marshalls, architects and contractors on these code updates and the building system opportunities afforded by CLT construction methodologies across the nation and in the Northeastern region. An advisory committee of the Maine Mass Timber Commercialization Center is currently in discussions with officials in Maine on the subject as well.

Figure 1 outlines the predicted growth of cross-laminated timber in North America and the Northeastern U.S. As these predictive models were established prior to the adopted revisions of the IBC, it is reasonable to expect a potentially greater rate of growth due to the clarity of code adoption provided to code agencies and architects.

[1] Source: WoodWorks

Figure 1: Predicted North America and Northeast CLT Demand (Source: Poyry, 2017)



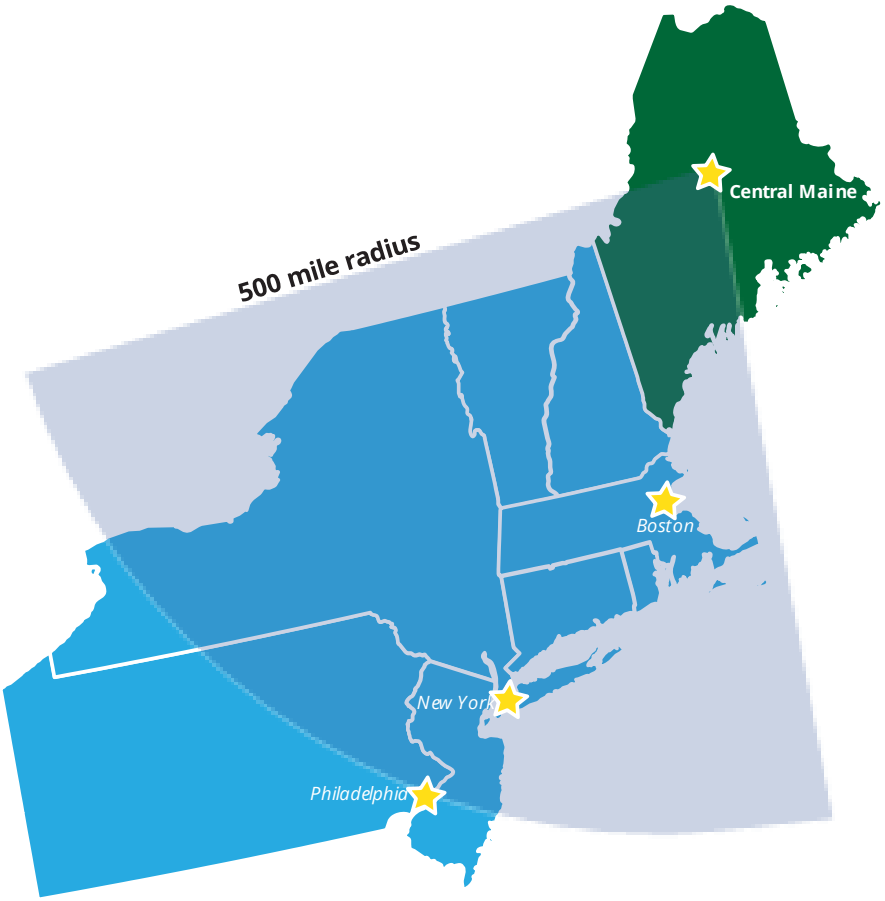
Proximity to Markets

The Northeastern United States contains over 56 million people, with nearly 20 million located in the Greater New York Metropolitan Area. Most of the large population centers within the Northeastern United States fall within 500 miles of the geographic center of Maine (Table 1 and Figure 2). This allows mass timber harvested and manufactured in Maine to be eligible for LEED regional materials status with the U.S. Green Building Council.

Table 1: Major Metropolitan Regions, Northeastern U.S.[2]

Metropolitan Region	2018 Population Estimate	Distance to Central Maine
Boston, MA	4,875,390	234
New York-Newark-Jersey City, NY-NJ	19,979,477	437
Philadelphia, PA-NJ	6,096,372	500

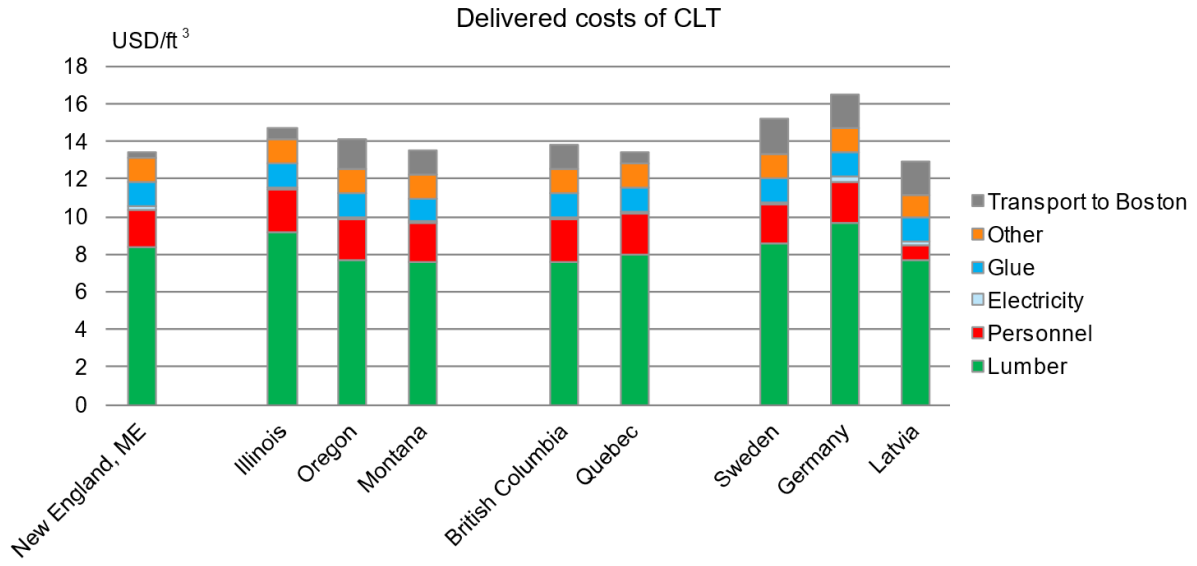
Figure 2: Relation of Central Maine to Major Northeastern Markets



[2] Source: US Census Bureau

Figure 3 outlines the estimated delivered cost of CLT panels by cubic foot based on various global mill locations to the Boston metropolitan area. Delivered pricing from international mills will vary widely based on the prevailing exchange rates between the nations. At the time of this analysis, the exchange rate and their lower lumber and labor costs relative to other European nations slightly favored Latvia. However, this introduces a level of uncertainty in long-term design and building projects. The hypothetical modeled cost of manufacturing CLT panels in Maine and delivering within the Northeastern U.S. is comparable or favorable with manufacture outside the region.

Figure 3: Delivery Cost of CLT to Boston by Mill Location (Source: Poyry, 2017)



Supply of Softwood Sawlogs

For CLT manufacture, availability and access to spruce-pine-fir-south (SPF-S) lumber is critical. There are 10 species that make up the SPF-S grouping in the U.S. with the eastern half containing red *(Picea rubens),* black *(Picea mariana),* and white spruce *(Picea glauca),* Norway *(Picea abies)* spruce, balsam fir *(Abies balsamea)*, jack *(Pinus banksiana)* pine, and red *(Pinus resinosa)* pine. Based on the USDA 2018 FIA data, there are nearly 3 billion cubic feet of spruce-fir and 140 million cubic feet of red pine sawtimber on Maine's timberland. Within the Northeast, Maine has the highest volume and concentration of accessible spruce-fir and red pine sawlogs.

Figure 4 shows the county-level density of available SPF-S sawlogs on timberlands throughout the Northeastern U.S., indicating the highest concentrations throughout Maine.

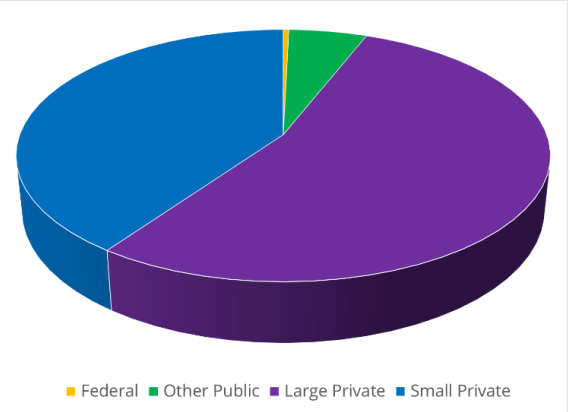
Figure 4: SPF-S Sawlog Availability in Northeastern U.S., by County (Source: USDA)

Maine Forest & Timberland Information

Maine has the largest percentage of timberland acres of any state (85%). At 16.7 million acres, Maine has the largest amount of timberland acres of any state in the Northeast, providing accessible timber resources to supply a CLT facility.

Contrary to land ownership in the Western United States, very little of Maine's timberlands are owned by the government. The timberland acreage of Maine is primarily privately owned (94%) with large private corporations consisting of 60% of the private land holdings (Figure 5). Unlike other regions where large harvesting operations on State or Federal lands often leads to legal action, Maine's private forests allow for simplified commerce. The long-standing culture of Maine supports active forest operations and the concept of working forests.

Figure 5: Timberland Ownership in Maine, by Category



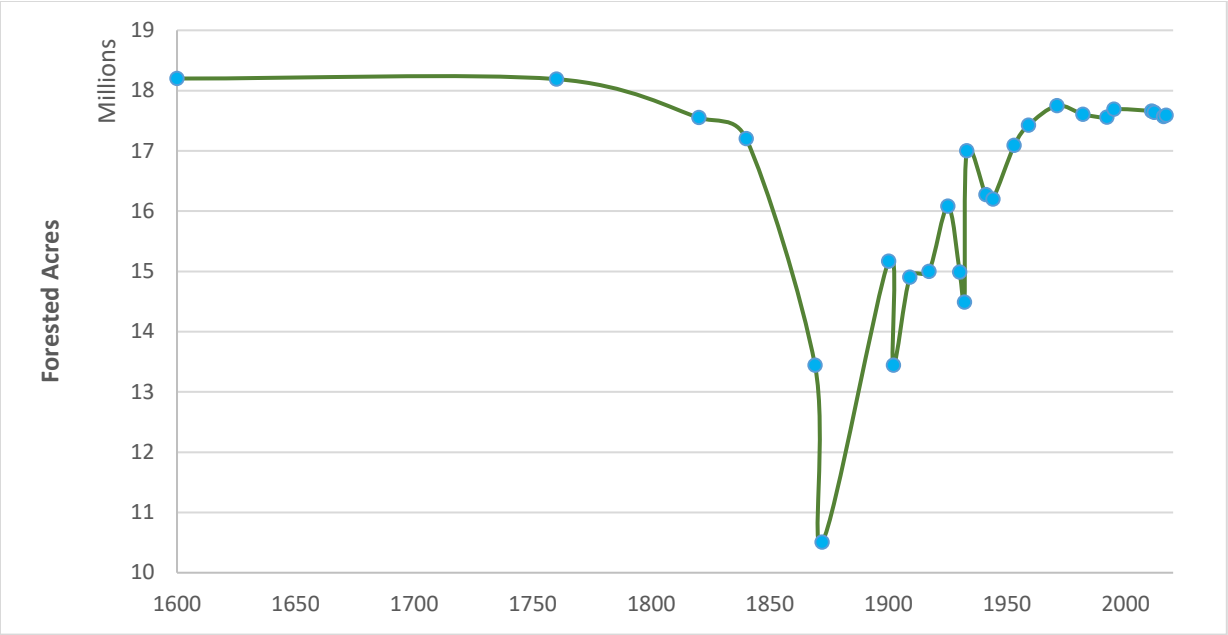
Sustainability of Maine's Forests

The state of Maine has historically been proactive regarding the stewardship of our forests. For the last 150 years, there has been a strong public awareness of the unique value of maintaining our forest resources in a sustainable manner. 98% of Maine's forest growth is naturally regenerated, maintaining forest diversity and increasing resilience to pests and disease. In addition, 97% of Maine's logging activities are centered around partial harvesting and shelterwood harvesting, not large-scale clearcutting, with separation zones and setbacks to reduce impacts to soil, ecology, watersheds and wildlife. These activities help to maintain our forest biodiversity (over 65 different tree species), support over 20,000 species of wildlife, and maintain a high level of water quality.

Figure 6 outlines the acreage of forests within Maine over the last 400 years. Upon European settlement of Maine in the 1600's, the state was 92% forested (Barton, 2012). By 1872, Maine's forested acreage reached a low of 10.5 million acres (Whitman, 1873). Beginning in the mid-1850s, the United States Conservation Movement increased public awareness of our natural resources, inspiring Maine's citizens, landowners and legislatures to return the state back towards its historical forested nature. While there were dips in the forested acres in Maine coinciding with the resource demands associated with World War II and the Great Depression, the state was able to return to a forested level near 90%. Given the

economic value of the Maine forest resource to the state, the fact that the forest land base has remained relatively consistent for over 60 years contributes to a stable economic resource base.

Figure 6: Forested Acreage History of Maine (Source: Barton, 2012)



Certified Forests in Maine

As of 2018, nearly one half of all Maine's timberlands are certified under one or more certification agencies (Table 2). The value of forest certification is that the quality and sustainability of the forest management and harvesting practices are accessed and monitored by a third-party agency. Forest certification, and associated labelling, is a way of informing consumers about the sustainability of the forests from which wood and other forest products were produced. Most forest management certification standards address a wide range of economic, social, environmental and technical aspects of forest management, including the well-being of workers and of families living in and around the forest area subject to certification. As environmental factors become more important in consumer purchasing decisions (sustainability; carbon sequestration), CLT and other building products produced from certified wood will factor into product selection.

For more information on the various forest certification programs, refer to the following web links

Forest Stewardship Council (FSC) - https://us.fsc.org/

Sustainable Forestry Initiative (SFI) - https://www.sfiprogram.org/

American Tree Farm System (ATFS) - https://www.treefarmsystem.org/

Table 2: Certified Forests in Maine, 2018 (Source: Sirois, 2018)

Certified Land Manager	SFI Certification	FSC Certification	Dual Certification	SFI Only	FSC Only	ATFS	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres
BBC Land LLC	969,434			969,434			
Conservation Resource Partners, LLC	221,797			221,797			
Fallen Timber LLC	135,097			135,097			
Hilton Timberlands, LLC	45,368			45,368			
J.D. Irving Limited	1,247,880	1,255,000	1,247,880		7,120		
Katahdin Forest Management LLC	300,000			300,000			
Landvest, Inc.	317,000	27,614	27,614	289,386			
Maine Bureau Parks and Lands	632,365	632,365	632,365				
Pingree Associates	830,807	836,471	830,807		5,664		
Prentiss & Carlisle	777,341	743,376	743,376	33,965			
Rayonier USFR	124,495			124,495			
The Conservation Fund	36,975	5,947	5,947	31,028			
Wagner Forest Management, Ltd	1,020,393	731,684	731,684	288,709			
Weyerhaeuser Company	839,100			839,100			
Downeast Lakes Land Trust		55,576			55,576		
Trust to Conserve Northeast Forestlands		3,682			3,682		
New England Forestry Consultants Inc		7,636			7,636		
Mid-Maine Forestry		8,126			8,126		
Baskahegan Company		118,193			118,193		
The Nature Conservancy		228,251			228,251		
Subtotal	7,498,052	4,653,922					
Total			**4,219,673**	**3,278,379**	**434,249**	**375,000**	**8,307,301**

Maine Megaregion and County Level Forest Data

Figure 7 outlines the four megaregions of Maine with the inclusive counties.

Figure 7: Forest Inventory and Analysis (FIA) Megaregions of Maine (McCaskill et. al, 2016)

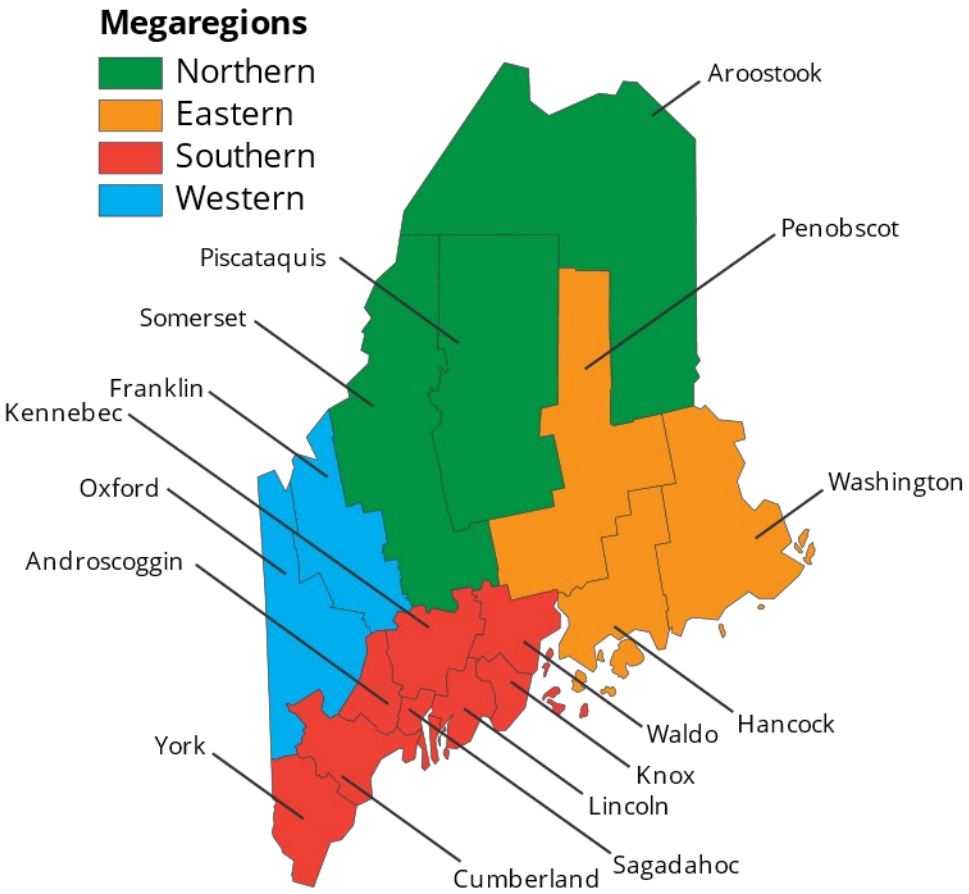


Table 3 outlines the distribution of land area and timberland acreage in Maine and by Megaregion, with the percentage of each Megaregion's timberland are determined based on the state total. The important points to note are:

- The Northern Megaregion (Aroostook, Somerset, and Piscataquis counties) accounts for nearly half (48%) of all of Maine's timberland acreage
- The majority of Maine's timberland acreage are contained within the Northern, Eastern and Western Megaregions, with timberland concentrations over 85%
- The Southern Megaregion counties (with major population centers) coincide with the lowest levels of timberland acreage

Table 3: Forest and Timberland Distribution in Maine, by Megaregion (USDA 2018)

Region	Land Area (acres)	Timberland (acres)	% Timberland	% Maine Timberland
Maine	19,718,493	16,763,654	85.0%	
Megaregion				
Northern	9,300,854	8,173,961	87.9%	48.8%
Eastern	4,822,952	4,169,430	86.4%	24.9%
Southern	3,189,124	2,266,960	71.1%	13.5%
Western	2,405,560	2,153,303	89.5%	12.8%

Figure 8 shows the timberland density of spruce-fir and white/red pine in Maine on a tons/acre basis, emphasizing the availability of Spruce-fir in the Northern, Western and Eastern megaregions, with high concentrations of white/red pine in the Southern and Eastern Megaregions. Note that while red pine is part of the SPF-S lumber grouping, white pine is not.

Figure 8: Density of Spruce-fir and White/Red Pine on Maine Timberlands (Source: Sewall, 2018)

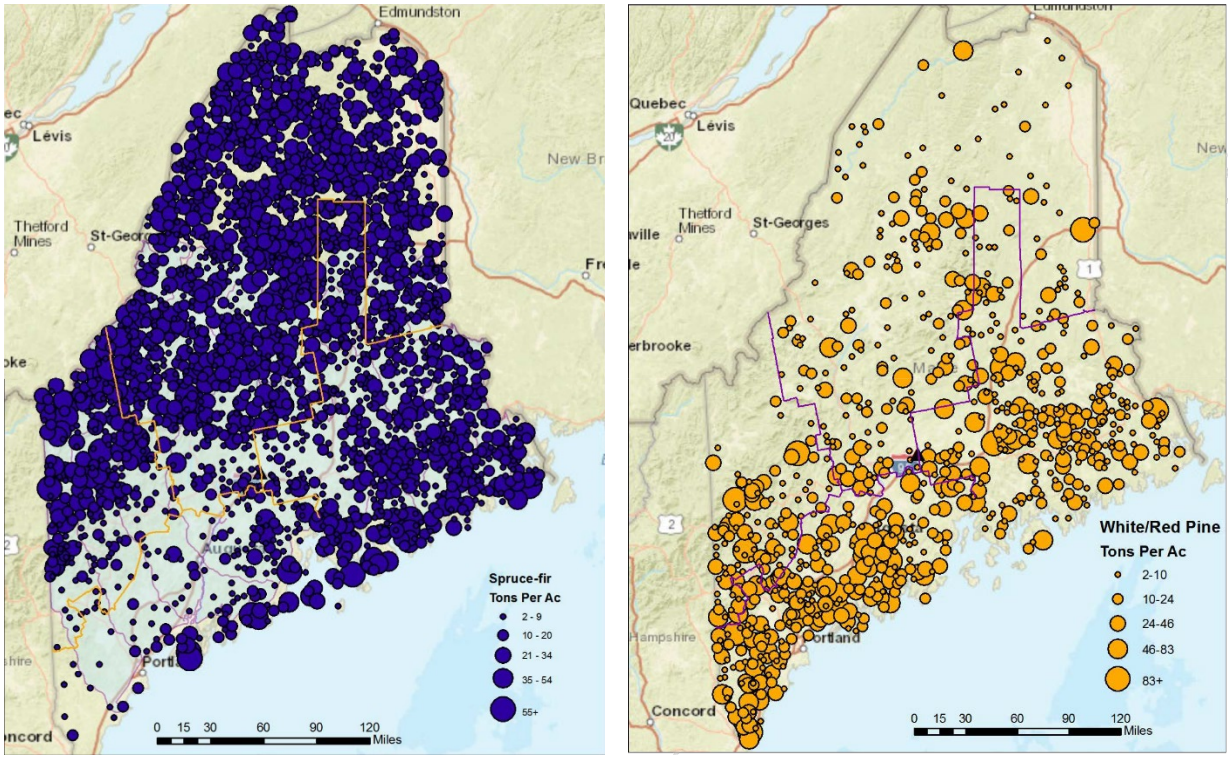


Table 4 outlines the net sawtimber availability of spruce-fir and red pine in Maine and by Megaregion. All four of Maine's megaregions provide significant levels of spruce-fire sawlogs, while the Eastern, Northern and Southern Megaregions provide the highest levels of red pine sawlogs.

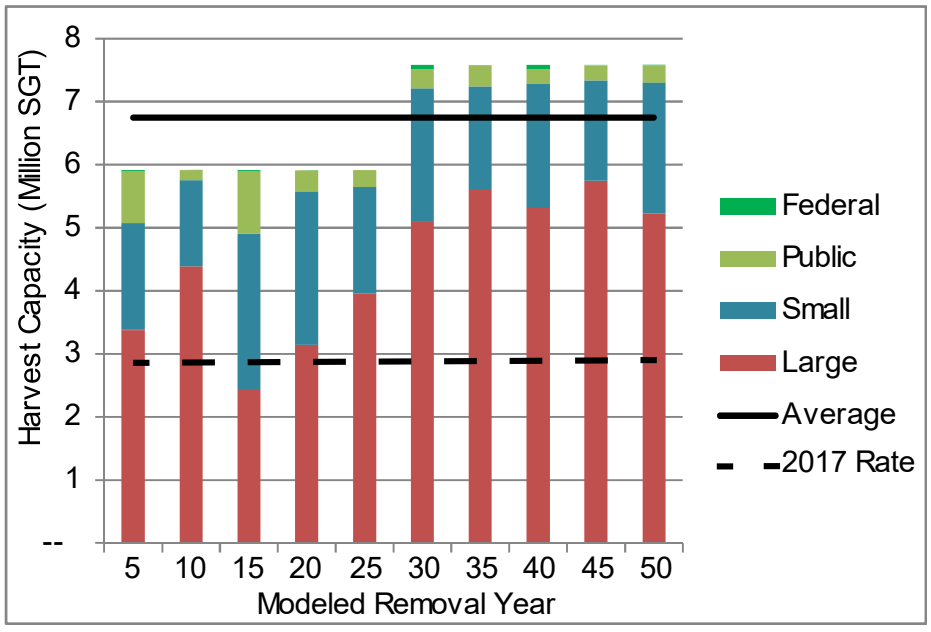
Table 4: Net Spruce-fir and Red Pine sawlog volume of sawtimber trees, in cubic feet, on timberland (Source: USDA FIA 2018)

	Spruce-fir		Red Pine	
Region	Sawlogs (ft^3)	Sawlog Density (ft^3/acre)	Sawlogs (ft^3)	Sawlog Density (ft^3/acre)
Maine	2,876,978,806	172	138,367,984	8.3
Megaregion				
Northern	1,532,787,635	188	67,864,816	8.3
Eastern	755,310,439	181	43,379,762	10.4
Southern	187,229,253	83	17,642,034	7.8
Western	401,651,479	187	9,481,372	4.4

Predicted 50-Year Spruce-fir Wood Supply in Maine

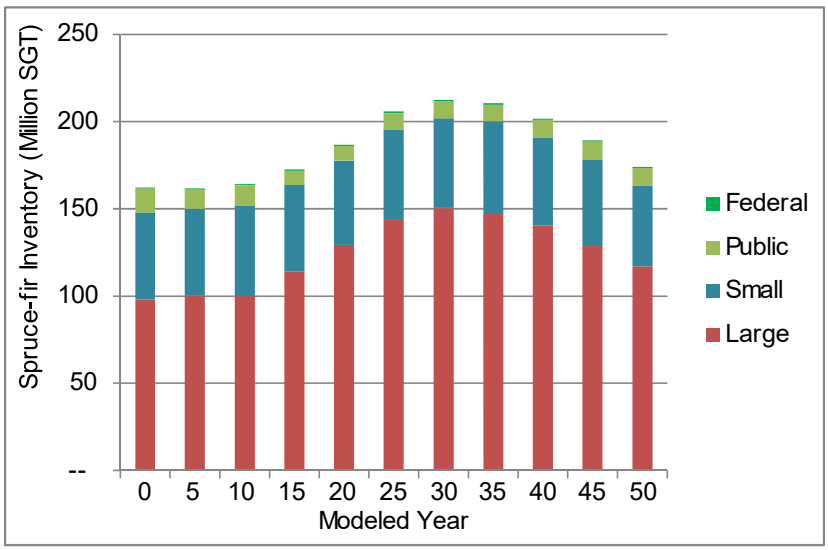
In 2018, Maine's Forest Opportunity Roadmap (FOR/Maine) commissioned the James W. Sewall Company to conduct a wood volume projection study on Maine's forests. In this analysis, a variety of species of wood were evaluated for their potential sustainable harvest levels to determine the state's capacity to increase production. In the modeling criteria, harvest levels were permitted to increase over the state's 2017 level, and inventories at the end of the 50-year analysis had to remain greater than or equal to starting inventories. Figure 9 outlines the potential short green ton harvest rates (by landowner type) for spruce-fir in Maine over the 50-year period. These increased potential harvest rates have become possible in Maine through the closure of several paper mills in the state which were significant historical consumers of SPF-S species. This creates an opportunity for new technologies and industries to utilize a resource which was otherwise committed to the manufacture of newsprint and bonded paper.

Figure 9: 50-Year Spruce-fir Harvest Rate by Landowner Type (Source: Sewall, 2018)



Similarly, the 50-year spruce-fir inventory levels were modeled to maintain a sustainable growth rate within the state (Figure 10).

Figure 10: 50-Year Spruce-fir Inventory Levels by Landowner Type (Source: Sewall, 2018)



Next, the type of wood harvested was separated into sawtimber and pulpwood. The current mix of spruce-fir inventory in Maine ranges from 70-98% sawtimber depending on the mill specifications for roundwood. Utilizing the "worst-case" of 70% sawtimber, the average potential harvest in Maine by category over the next 50 years is outlined in Table 5.

Table 5: 50-Year Potential Harvest Levels of Spruce-fir in Maine

Studwood Specifications	7" dbh - 16'6" min to a 5.0 top		5" dbh - 8'6" min to a 4.0 top	
Period	**Year 1-25**	**Year 26-50**	**Year 1-25**	**Year 26-50**
Pulp Only (sGT/year)	1,733,122	2,244,564	115,541	149,638
Sawable (sGT/year)	4,043,952	5,237,317	5,661,533	7,332,244
Total	**5,777,074**	**7,481,881**	**5,777,074**	**7,481,881**

In short, Maine can increase spruce-fir harvesting by over 2.8 million short green tons over the next 25 years and by 4.5 million short green tons over the 25 years following with no loss in current inventory levels (Table 6), pointing to sustainable inventory capacity for the addition of new mass timber manufacturing in Maine.

Table 6: Potential Spruce-fir Harvest Increase Volumes Compared with 2017 Actual Harvest Rates

Harvest Type	Volume (sGT)	Potential Increase (sGT)
2017 Harvest[1]	2,910,810	
Year 1-25 Harvest[2]	5,777,074	2,866,264
Year 26-50 Harvest[2]	7,481,881	4,571,071

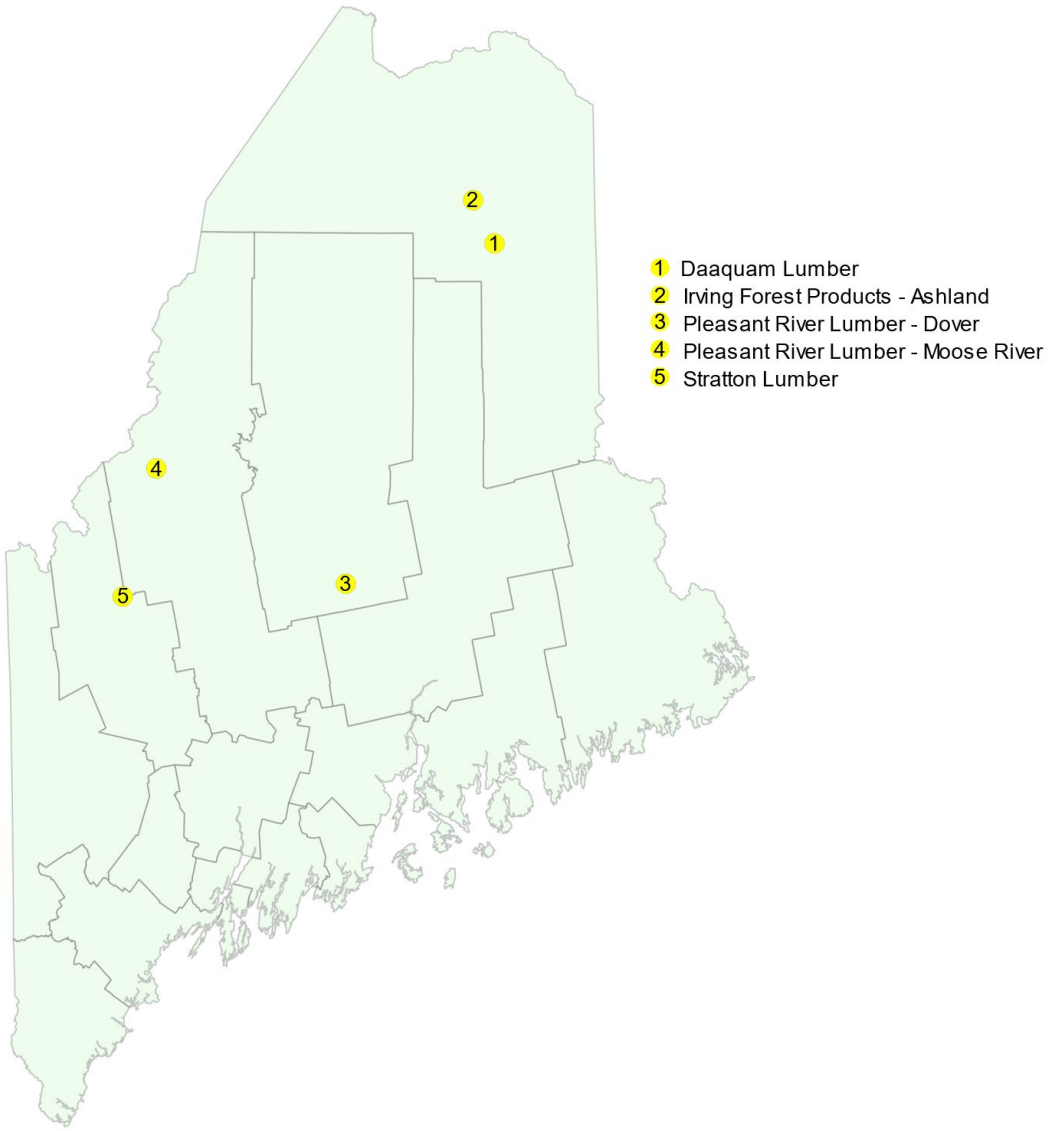
Source: [1]Maine Forest Service Wood Processor Report, 2018
[2]Sewall, 2018

SPF-S Sawmills in Maine

Figure 11 shows the current spruce, pine, and fir south (SPF-S) mills in Maine who are members of the Northeastern Lumber Manufacturer's Association (NeLMA). These are the current mills in Maine which could support a CLT facility and represent roughly 500 MMBF of lumber annually. With over 2.8 million green tons of sustainably harvestable spruce-fir sawlog capacity in the state available over current sawmill demand, the state can support five or more sawmills (depending on design capacity). Currently, SPF-S is a qualified species group for CLT (V4 grade, as listed in ANSI/APA PRG-320, Standard for Performance-Rated Cross-Laminated Timber). In addition, the University of Maine is currently qualifying two new CLT grades utilizing SPS-S lumber.

Information on each mill site is outlined in the sections below.

Figure 11: NeLMA SPF-S Sawmills in Maine (Source: NeLMA)



Current Maine SPF-S Mills

Daaquam Lumber Maine, Inc.

Mill Info	1200 Masardis Road, Route 11 Masardis, ME 04732 P: (207) 435-6401 F: (207) 435-6117
Contact 1	Janick Bouffard, Sales Representative P: (418) 571-5465
Contact 2	Phil Nadeau, Shipping Manager P: (207) 435-6401 X102
Production	ANNUAL PRODUCTION: 100 MMBF GRADE STAMP: 155 SERVICES: Manufacturer SPECIES: SPFs, Balsam Fir, Assorted Spruce PRODUCTS: FSC Certification, MSR Lumber, Structural Grades, Heat Treatment, Kiln Drying

Irving Forest Products - Ashland

Mill Info	1218 Portage Road Nashville Plantation, ME 04732 P: (207) 435-3132 www.jdirving.com
Contact 1	Christian Gilbert, Sales Manager, Spruce P: (506) 632-6331 gilbert.christian@jdirving.com
Contact 2	Scott Schryer, Spruce Sales P: (506) 632-5133
Production	ANNUAL PRODUCTION: 100 MMBF GRADE STAMP: 011 SERVICES: Manufacturer SPECIES: Eastern Spruce - Balsam Fir, SPFs PRODUCTS: Structural Grades, FSC Certification, Kiln Drying, Heat Treatment, SFI Certification

Pleasant River Lumber Company – Dover-Foxcroft

Mill Info 432 Milo Road
Dover-Foxcroft, ME 04426
P: (207) 564-0242
F: (207) 206-7257
www.pleasantriverlumber.com

Contact 1 Jason Brochu, Co-President
P: (207) 564-8520
jason@pleasantriverlumber.com

Contact 2 Bill Ossenfort, V.P. Sales
P: (207) 564-0242

Production ANNUAL PRODUCTION: 90 MMBF
GRADE STAMP: 098
SERVICES: Manufacturer
SPECIES: SPFs
PRODUCTS: Structural Grades, FSC Certification, Dimension Lumber, Kiln Drying, Heat Treatment, Boards, Rough Sawn Lumber, Furring Strips

Pleasant River Lumber Company - Moose River

Mill Info 25 Talpey Road
Jackman, ME 04945
P: (207) 564-0242
F: (207) 206-7257
www.pleasantriverlumber.com

Contact 1 Jason Brochu, Co-President
P: (207) 564-8520
jason@pleasantriverlumber.com

Contact 2 Bill Ossenfort, V.P. Sales
P: (207) 564-0242

Production ANNUAL PRODUCTION: 85 MMBF
GRADE STAMP: 054
SERVICES: Manufacturer
SPECIES: SPFs
PRODUCTS: Structural Grades, Dimension Lumber, Kiln Drying, Heat Treatment, Timbers, Boards, Rough Sawn Lumber, Furring Strips

Stratton Lumber, Inc.

Mill Info	66 Fontaine Road Stratton, ME 04982 P: (207) 246-4500 F: (207) 246-3253 www.fontaine-lumber.com
Contact 1	Nicolas Fontaine, President P: (207) 246-4500 nfontaine@fontaine-lumber.com
Contact 2	Michael LoPresti, Vice President of Sales P: (845) 562-0362
Production	ANNUAL PRODUCTION: 60 MMBF GRADE STAMP: 104 SERVICES: Manufacturer SPECIES: SPFs PRODUCTS: Structural Grades, FSC Certification, Kiln Drying, Heat Treatment

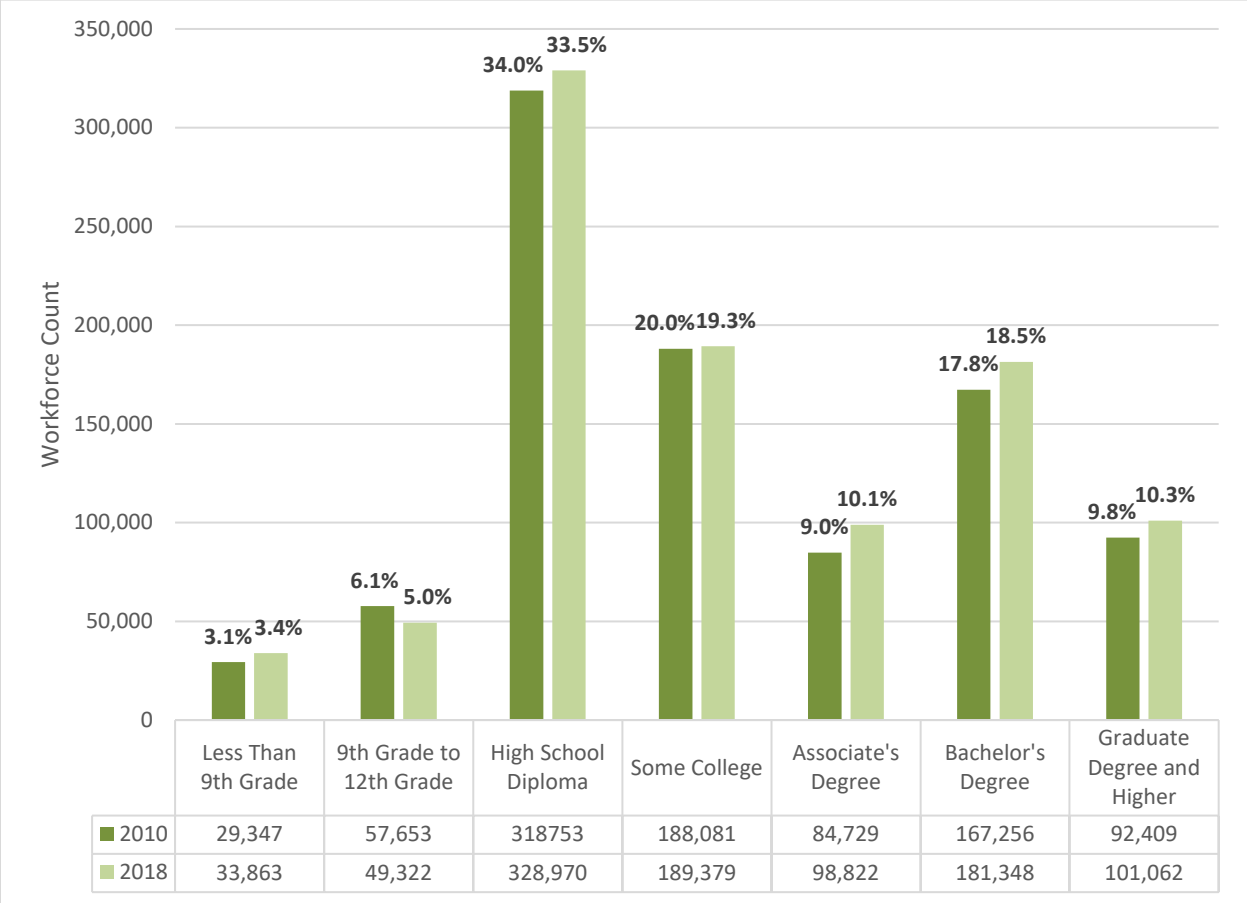
Workforce

Maine has always been regarded as an entrepreneurial state. A diverse business base is the foundation of the state's success. Maine workers are constantly praised for their high work ethic and have an international reputation for high quality work done on time and under budget. Quality of work...Quality of place...Quality of life.

Mainers are known for their "Yankee ingenuity" and commitment to delivering quality performance every workday. Labor disputes are rare. Employers consider their workers their best asset. Mainers continue working well into their 'retirement' years and labor force participation rates are among the highest in the nation. In comparison with other states in the Northeast, Maine has more people employed in wood processing careers per 1,000 workers (6.6 per 1,000 employed).

Figure 12 outlines the education level of Maine's workforce. A significantly higher share of Maine's workforce has completed high school (91.5%) compared to the nation (86%), 58% of Maine's workforce has received some level of post-primary educational experience.

Figure 12: Maine Workforce Education Level, 2010 + 2018 (Source: EMSI; MCBER)



	Less Than 9th Grade	9th Grade to 12th Grade	High School Diploma	Some College	Associate's Degree	Bachelor's Degree	Graduate Degree and Higher
2010	29,347	57,653	318753	188,081	84,729	167,256	92,409
2018	33,863	49,322	328,970	189,379	98,822	181,348	101,062

Note: Percentages correspond to respective year totals.

Wood Product Manufacturing Workforce

Table 7 shows employment, growth, and average earnings in related industries across Wood Product Manufacturing.

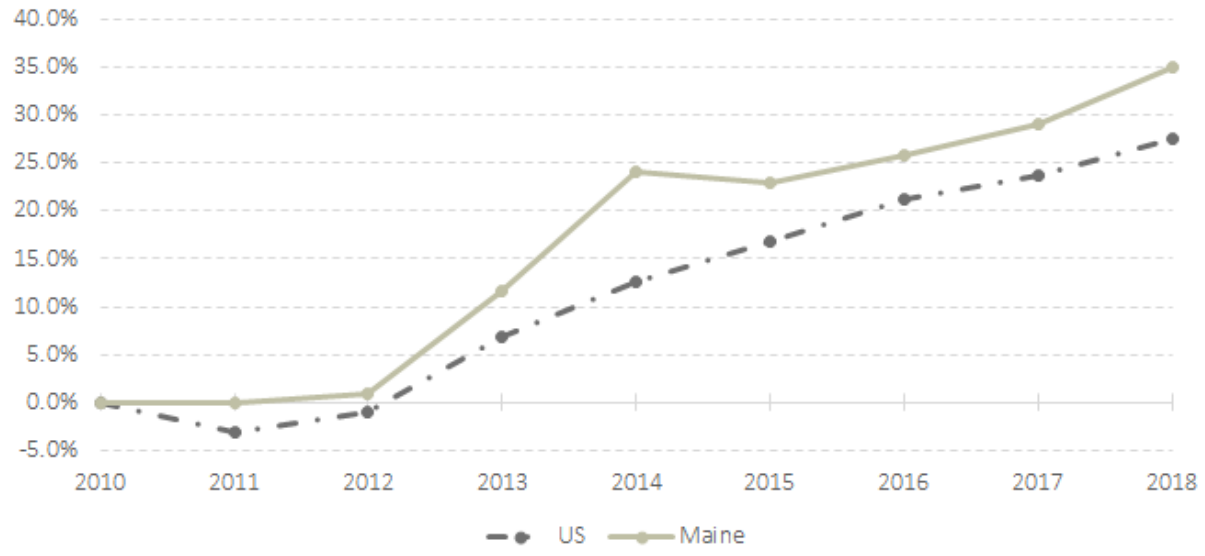
Table 7: Maine Employment Trends in Wood Processing (Source Maine CBER)

Description	2010 Jobs	2018 Jobs	2010-2018 % Change	Avg. Earnings Per Job
Sawmills and Wood Preservation	1,746	2,028	16%	$58,965
Veneer, Plywood and Engineered Wood Product Manufacturing	495	668	35%	$67,279
Other Wood Product Manufacturing	1,863	1,868	0%	$45,201
Wood Product Manufacturing Total	4,104	4,565	11%	$54,549

The harvesting, manufacturing, and production of forest and related products has been the heartbeat of Maine communities for decades and this knowledge and experience is embedded in the workforce. Relative to the overall size of the state's workforce, Maine has 3 times the specialization in forest products than the national average and 3.4 times in wood product manufacturing industry.

Specific to *Engineered Wood Product Manufacturing* the talent pool is not only specialized but growing in Maine - employment in the industry increased by 35% between 2010-2018, outpacing the national growth rate of 27.5% over the period (Figure 13).

Figure 13: Maine Employment Trends in Engineered Wood Product Manufacturing (Source: EMSI; Maine Center for Business and Economic Research (MCBER))



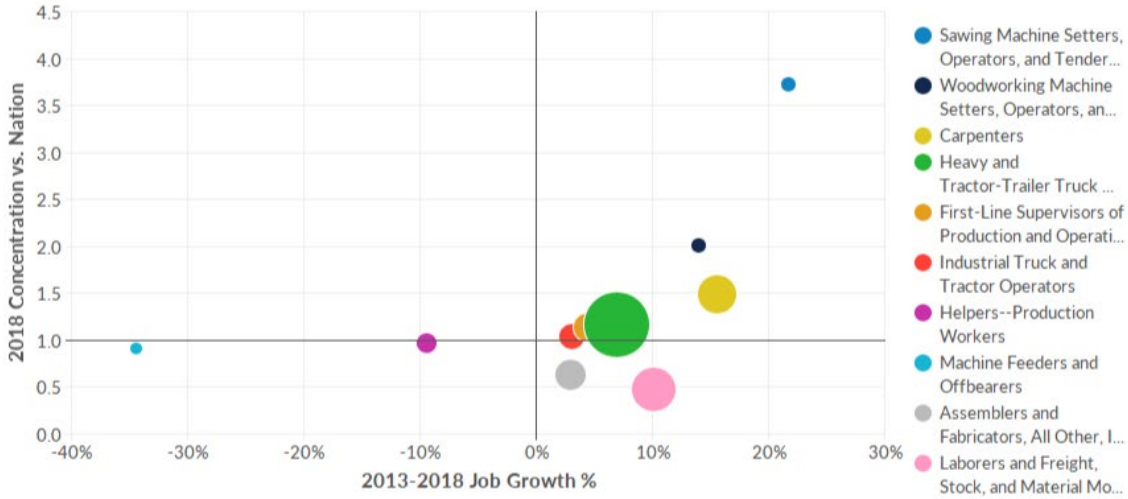
The talent pool is not limited to *Engineered Wood Product Manufacturing*, but occupations commonly found in this industry are more prevalent on the whole as a share of Maine's workforce suggesting

above average workforce availability. Meanwhile, employment in these occupations across the economy grew at 6.4 percent between 2013 and 2018 suggesting the talent pool is growing statewide (Figure 14).

Figure 14: Key Maine Workforce Availability Data in Wood Product Manufacturing

Workforce Availability

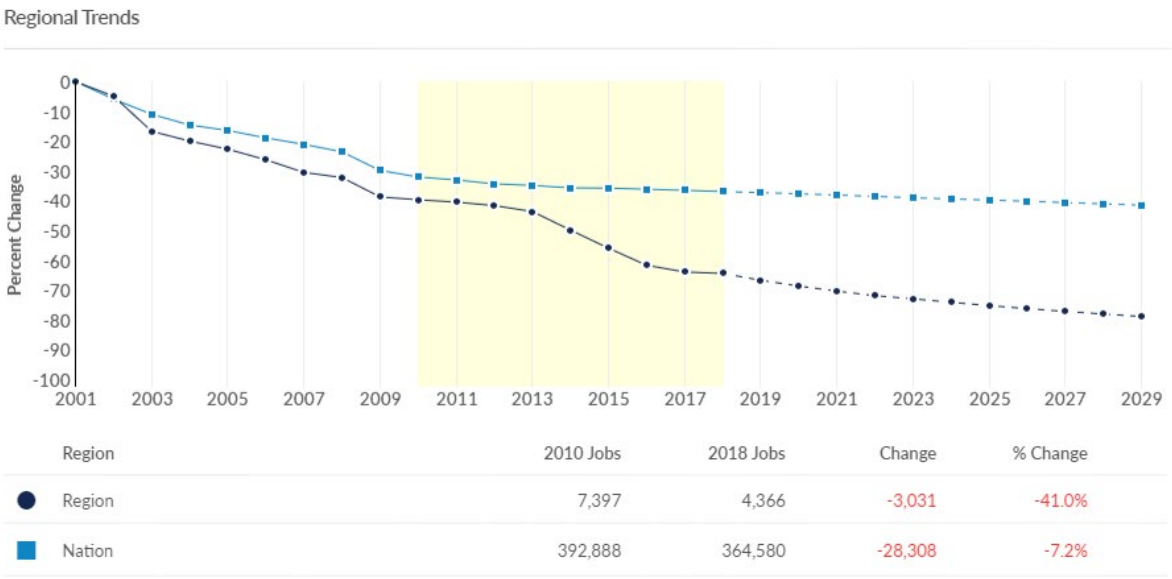
Key occupations for the selectedVeneer, Plywood, and Engineered Wood Product Manufacturing have an overall concentration of 1.46, indicating above average workforce availability. These occupations experienced overall job growth of 6.4% from 2013-2018, indicating that the regional talent pool is increasing.



SOC	Key Occupation	Concentration	2013 Jobs	2018 Jobs	2023 Jobs	Median Hourly Earnings	Average Hourly Earnings
51-7041	Sawing Machine Setters, Operators, and Tenders, Wood	3.73	677	825	782	$15.24/hr	$16.06/hr
51-7042	Woodworking Machine Setters, Operators, and Tenders, Except Sawing	2.02	597	681	648	$12.73/hr	$13.97/hr
47-2031	Carpenters	1.50	3,967	4,586	4,626	$19.22/hr	$19.57/hr
53-3032	Heavy and Tractor-Trailer Truck Drivers	1.16	8,263	8,837	8,687	$18.30/hr	$19.55/hr
51-1011	First-Line Supervisors of Production and Operating Workers	1.13	2,807	2,931	2,879	$29.16/hr	$29.31/hr
53-7051	Industrial Truck and Tractor Operators	1.04	2,545	2,624	2,598	$17.40/hr	$17.56/hr
51-9198	Helpers--Production Workers	0.97	1,866	1,691	1,678	$14.52/hr	$15.37/hr
53-7063	Machine Feeders and Offbearers	0.91	494	324	307	$12.59/hr	$13.00/hr
51-2098	Assemblers and Fabricators, All Other, Including Team Assemblers	0.64	3,367	3,467	3,291	$16.28/hr	$17.22/hr
53-7062	Laborers and Freight, Stock, and Material Movers, Hand	0.48	5,120	5,639	5,838	$12.03/hr	$13.03/hr
	Total	1.46	29,703	31,603	31,334		$18.37/hr

As Maine's forest products sector transitions from declining market segments to a new forest products economy, there are also workers who historically were involved in forest product oriented manufacturing who have training and experience in wood processing that can be repurposed to manufacture CLT in Maine with minimal training (Figure 15). In particular, plant closures in the paper manufacturing industry have resulted in a pool of about 3,000 workers over the last 8 years, many of which possess skill sets adaptable to CLT manufacturing at lower costs.

Figure 15: Employment trends in Paper Manufacturing in Maine, 2010-2018 (Source: Emsi; MCBER)

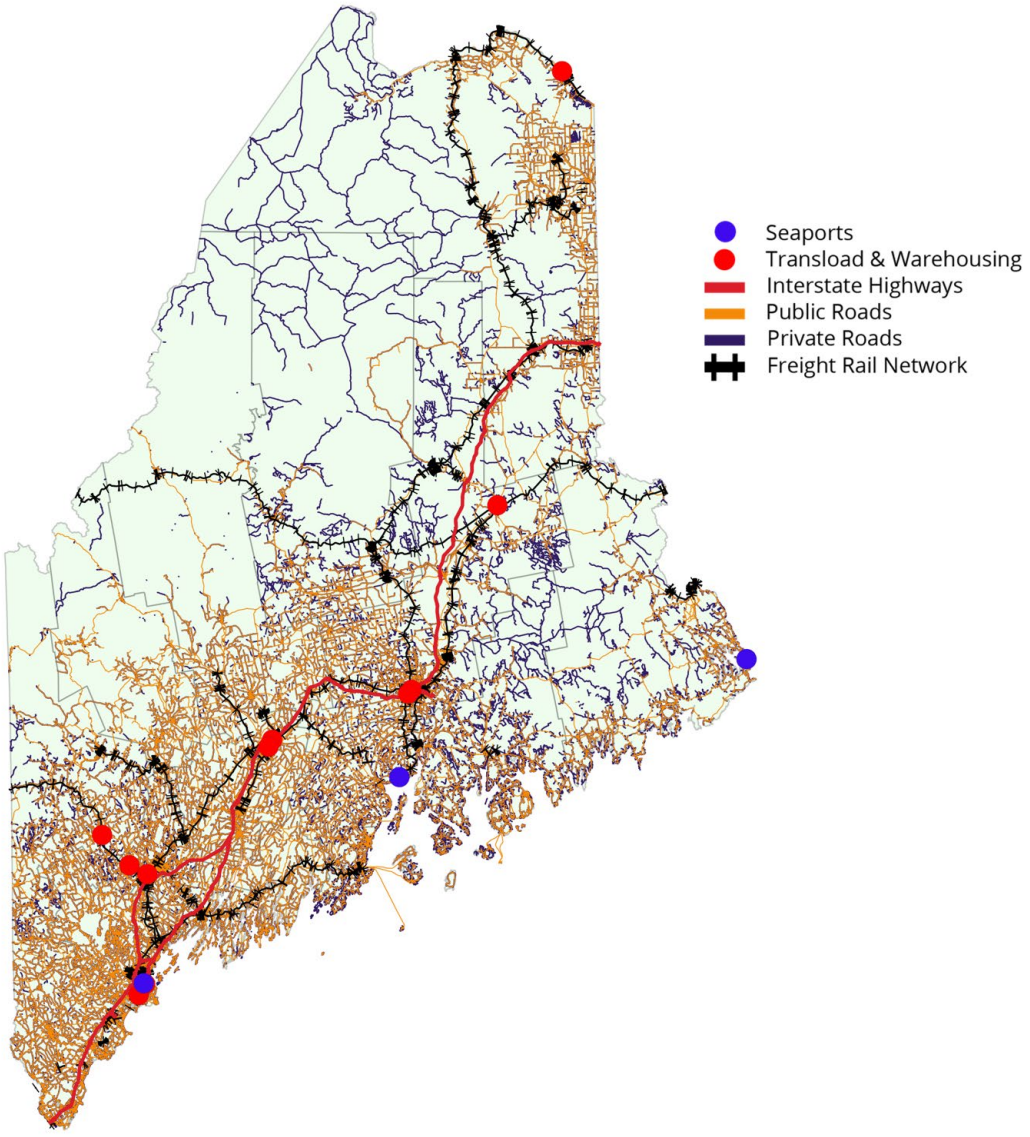


Region	2010 Jobs	2018 Jobs	Change	% Change
Region	7,397	4,366	-3,031	-41.0%
Nation	392,888	364,580	-28,308	-7.2%

Infrastructure

With an extensive private logging road network to transport sawlogs to mills, through a complete modern intermodal transportation system to move finished goods to customers, Maine can move CLT products to market (Figure 16). In 2015, nearly 97 million tons of goods worth $96 billion traveled on Maine's roads, rails and ports (Source: Cambridge Systematics, Inc., 2017).

Figure 16: Infrastructure Network of Maine (Source: MEGIS)



With over 30 million potential consumers within 500 miles, Maine's location provides access to wood resources, regional markets and international opportunities through its infrastructure (Table 8).

Table 8: Distance to Markets from Central Maine (Source: U.S. Census Bureau)

Metropolitan Region	2018 Population Estimate	Distance to Central Maine
Boston, MA	4,875,390	234
New York-Newark-Jersey City, NY-NJ	19,979,477	437
Philadelphia, PA-NJ	6,096,372	500

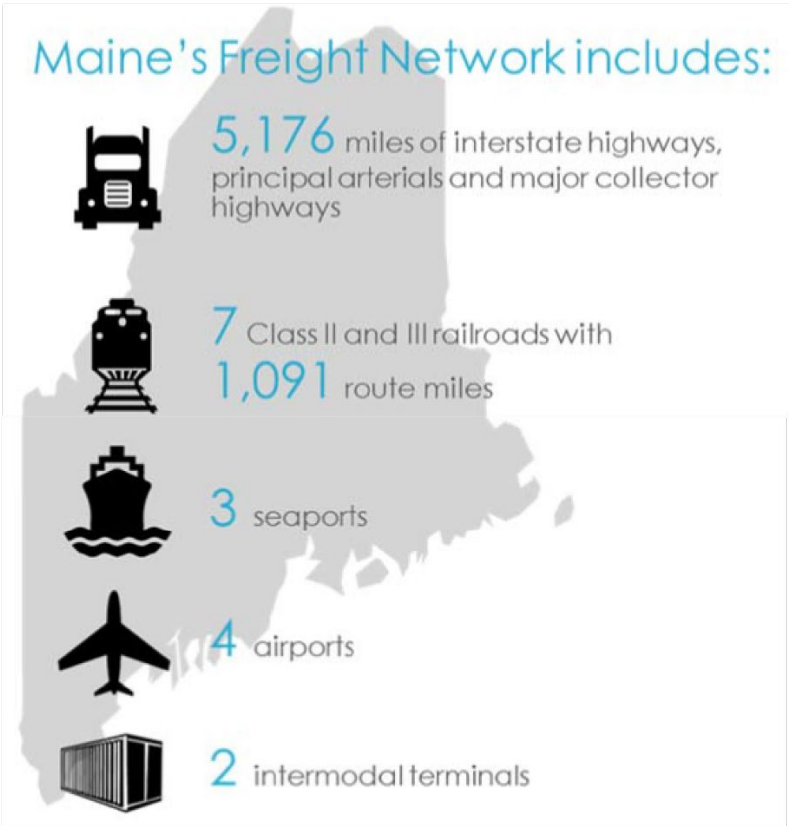
Off-Highway Logging Roads

Over 20,000 miles of privately maintained and operated logging roads cover a significant portion of the North Maine woods. This road network was established beginning in the late 1960's to efficiently move sawlogs from the forests to mills in lieu of river log drives.

Intermodal Truck, Rail & Seaport Facilities

Maine has an extensive network of intermodal transport options open to manufacturers to move finished goods throughout and out of state (Figure 17).

Figure 17: Maine's Freight Network (Source: Cambridge Systematics, 2017)



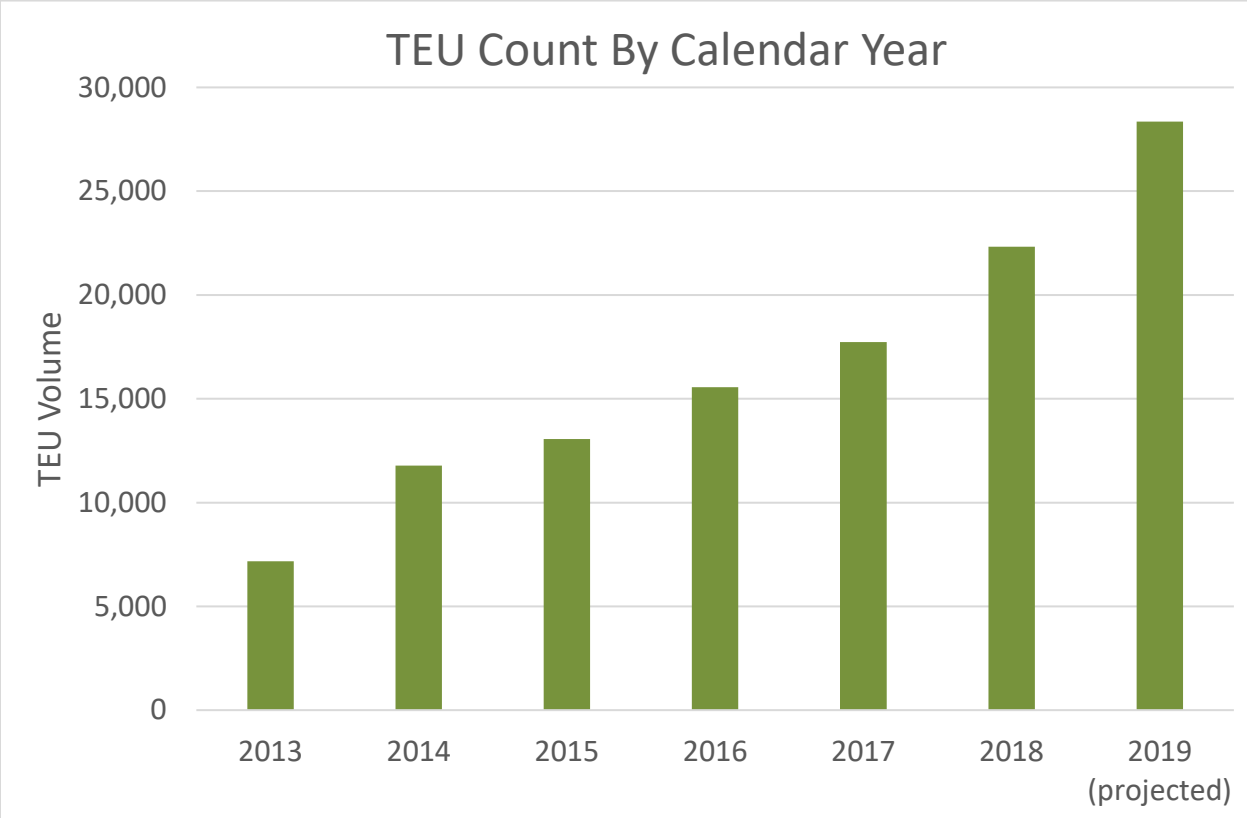
Maine State Highway System

Through a 23,513-mile network of interstate, state and route roads, Maine's highway network provides ease of movement of goods and materials throughout the state. The central corridor of this network is Interstate I-95, traversing from Houlton through Kittery in Maine, then through Boston, New York City, Philadelphia and Washington D.C., terminating south of Miami, FL. As the longest North-South interstate and the sixth longest interstate overall in the U.S., I-95 provides access through the entire eastern seaboard of the U.S. from one road. The 5,176 miles of principal arteries and highways in Maine account for 86% of all freight tonnage moved through and out of the state.

Seaports

With the 2013 arrival of Iceland's largest shipping company, Eimskip, in Portland and the acquisition of a $14 million federal grant to help fund improvements at the state's three deep-water ports, Maine is becoming an international shipping hub. Since 2013, Maine's international marine terminal volumes have experienced significant growth (Figure 18), with a four-fold increase in TEU volumes in six years.

Figure 18: Annual International Marine Terminal Volumes in Maine (Source: Maine Port Authority)



Eastport

The Maine Port Authority (MPA) operates the Estes Head Cargo Terminal (EHCT) in Eastport, the deepest natural seaport in the continental United States. The Terminal can accommodate a ship of 900 feet length overall (LOA) in Berth A and one up to 550 feet in Berth B. Berth B is also an excellent berth for barges. EHCT's 55-acre site has several open storage areas, three 20,000 square foot, drive-thru

warehouses, and one 43,000 square foot warehouse. The operations are easily supervised from the Federal Marine Terminals' office located just above the Estes Head pier. Approach depths to this pier are also well in excess of 100 feet and a 64-foot MWL depth. With an additional 140 acres of open land available for future expansion and operations updates, the Port of Eastport can accommodate a variety of growth possibilities.

Accompanying the pier at Estes Head is 133K square feet of dry warehouse storage and a state-of-the-art bulk materials handling system. The system, completed in 2013 as part of a $10M USD port expansion, is anchored by a 7-acre open storage pad with additional acreage available for future expansion. Adding to this is the automated conveying system that runs direct from storage to ship loading. The system is capable of 1,000 tons per hour loading rate dependent on density. The facility also has modern receiving and truck weighing capabilities.

With the recent infrastructure and investments, Estes Head is well positioned for increased freight volume.

Portland

The Port of Portland has a collection of privately-operated terminals capable of accepting all forms of cargo including project, containerized, bulk & break bulk and petroleum. The Maine Port Authority operates the International Marine Terminal, primarily handing container traffic, moving $460M worth of goods through the terminal in 2018[3]. The MPA continues to develop transportation infrastructure and multi-modal capacity, opening Maine to new markets, business and investment. With recently updated rail siding and transloading capacity, the International Marine Terminal features a 785-foot pier with a depth of 35 feet MLW.

The Sprague Terminal operates an 800-foot LOA cargo dock. With rail service by Pan Am Railways, the terminal provides the transfer of goods and equipment easily from truck or rail to ship with a designated depth of 36 feet mean low water (MLW) and 50,000 deadweight tonnage (DWT).

The Port of Portland is currently participating in the New England Marine Highway Project (NEMHP). Sponsored by the Maine Port Authority, the NEMHP is a short-sea shipping initiative to design, build and operate a containerized Articulated Tug Barge (ATB) along the M-95 Marine Highway, servicing ports from Portland to New York/New Jersey. The NEMHP offers a regional short haul alternative to potential CLT manufacturers in Maine to transport CLT panel systems to the New York metropolitan area.

Searsport

Sprague Energy is the terminal operator in the Port of Searsport. Searsport is located at the heart of Penobscot Bay. The Port of Searsport is one of five official cargo ports in the State of Maine, and it is the second largest deep-water port. With the port's recently reconstructed rail yard, freight can readily be distributed throughout the United States and Canadian heartlands. With a tidal range of ten feet, the

[3] Source: Maine Port Authority

approach channel and turning basin in the Port of Searsport offer a depth of 35 feet mean low water (MLW).

The Mack Point Marine Intermodal Cargo Terminal is the main cargo-handling facility in the Port of Searsport. Mack Point has a dry cargo pier with a 1.3-acre working surface, a 90 thousand square foot warehouse, five supplemental paved storage pads and an additional 70 acres of land available for development. The dry cargo pier has two berths, each of them almost 800 feet long with alongside depths of 40 and 32 feet MLW. Mack Point terminal has more than 6,500 feet of on-site rail siding operated by the Central Maine and Quebec Railway with direct connections to the Canadian Pacific Railway.

Rail System

With over 1,000 rail miles in the state connecting hundreds of communities local to forest resources, Maine's six freight railroads can move your goods to markets or into the intermodal system.

Freight rail has been an important component of Maine's freight network for over 150 years. Unlike the Interstate highway system, which connects Maine south to the northeast and Atlantic U.S. states and east to New Brunswick, Maine's rail lines were designed in part to link the State north and west to Montreal and the Great Lakes (Maine Dept of Transportation, 2014). While trucks are now the dominant mode of freight shipping in the State, railroads still provide significant freight capacity for domestic and international trade and provide alternatives for shippers. Freight rail is a cost-effective option for moving high-volume, low-value commodities, so rail continues to play a particularly important role for Maine's forest products industry. In 2015, an estimated 66,100 carloads of rail freight originated or terminated in Maine, and approximately 42 percent of the carloads originating in Maine carried pulp, paper, lumber, and wood products (Cambridge Systematics, 2017).

Rail Operators

Table 9 outlines the rail operators in Maine and their track mileage in the State.

Table 9: Rail Operators in Maine (Source: Cambridge Systematics, 2017).

Rail Operator	2015 Mileage Operated
Class II	
Central Maine and Quebec Railway (CMQR): **Connects to the Canada Pacific (CP); links northern Maine, Saint John, New Brunswick, and Montreal; and provides access to the port facilities of St. John in New Brunswick and Searsport, Maine. The rail's route from Searsport to Montreal can accommodate double-stack intermodal services and has the capacity to carry 286K lb. rail cars.**	295
Pan Am Railway (PARI): **Formerly known as the "Guilford Rail System." Main line connects Mattawamkeag in Maine to Mechanicville in New York, via the lines of other New England-based rail lines. Maintains repair shops in Waterville, Maine.**	372
Subtotal	*667*
Class III	
Maine Northern Railway (MNR): **Operates on a portion of the former "Montreal, Maine, and Atlantic Railroad" (MMA) lines, which are now state-owned Aroostook Lines. Major freight commodities are forest products, including finished lumbers, wood products, wood chips, and paper. Uses a yard at Oakfield as its operational hub for the Aroostook lines.**	233
Eastern Maine Railway (EMRY): **Created as a holding company to own trackage in Maine. Operations provided by the New Brunswick Southern Railroad (NBSR).**	105
Saint Lawrence and Atlantic Railroad (SLR): **Headquartered in Auburn, Maine and Richmond, Quebec. Contiguous mainline track between Maine and Quebec. Serves warehouse distribution and intermodal transloading facilities in Maine.**	84
Subtotal	*422*
Terminal and Switching	
Turner's Island, LLC (TI): **Connects with Pan Am Railways in South Portland, Maine to provide shipping nationwide. Privately owned and operated. Open area with 14 acres for bulk storage, 9,000 sq. feet of dry warehouse space.**	2
Total	1,091

Terminals and Intermodal Connectors

The rail freight network depends not only on the railroads, but also on yards, terminals, and other facilities that allow for storage, repair, rail switching, interchange (moving rail cars between railroads), intermodal transfers (moving containers between rail and other modes), and transloading (transferring bulk commodities between rail and other modes). As of 2010, there were 15 general purpose freight rail yards in Maine with different rail operators: nine operated by Pan Am Railway, three by Central Maine and Quebec, three by Saint Lawrence and Atlantic. The only active intermodal facility transferring containers between truck and rail is the Pan Am Intermodal Facility in Waterville owned by Pan Am

Railways. This facility has two transfer tracks and currently is primarily used for intermodal service for Poland Springs Water. The intermodal ramp at the Portland IMT has also been used in the past years for truck to rail transfers. Two other facilities at Presque Isle and Auburn are capable of intermodal activity but have not operated recently.

There are also several facilities in the State offering transloading of bulk materials (but not transfer of containers), including the Port of Auburn, Savage-Safe Handling in Auburn, GAC Chemical in Searsport, Truck/Rail Log/Chip Transfer along the CMQR and MNR, Turner's Island marine-rail terminal in South Portland, and the Rockland Cement Pier.

Bulk Transload and Warehouse Facilities

Privately owned and operated transload and warehouse facilities throughout the state allow the transfer and temporary storage of freight between rail and truck.

Auburn

Lynch Logistics operates a 115,000 square foot facility in Auburn with 4 railcar doors, 3 truck doors and specializes in dry storage, floor level load/unload and covered rail exchange. Located 2.8 miles from the Interstate, the facility is serviced by St. Lawrence & Atlantic Railroad.

NEPW Logistics operates a 75,000 square foot facility in Auburn with 6 railcar doors, 8 truck doors, are located 3 miles from I-95 and is serviced by St. Lawrence & Atlantic Railroad and Pan Am Railways.

Bangor

Lynch Logistics operates a 142,000 square foot facility in Bangor with 6 railcar doors, 9 truck doors and specialize in paper handling. The facility is less than a mile from the Maine Turnpike (I-95). Located on Pan Am Railways, Lynch Logistics sister company Central Maine Transport can handle trucking from Bangor to points nationwide.

Galt Block's facilities are comprised of 5 buildings totaling 376,000 square feet on a campus in Bangor. The facilities are in close proximity to three I-95 interchanges and is serviced by Pan Am Railways.

Fairfield

NEPW Logistics operates a 42,000 square foot facility in Fairfield with 3 railcar doors, 8 truck doors, are located 1 mile from I-95 and is serviced by Pan Am Railways.

Hermon

Since 1972, Pottle's Transportation has continued to expand, transforming into a major motor carrier operation in the Northeast. Pottle's 75,000 square foot warehouse in Hermon specializes in paper handling, has 3 railcar doors and 7 truck doors with service on Pan Am Railways.

Mattawamkeag

Perma Treat, a division of Pan Am Railways, provides lumber and other reload services at its Mattawamkeag, ME cogen facility. The facility can handle boxcars, gondolas and center beam flatcars.

Mechanic Falls

NEPW Logistics operates a 80,000 square foot facility in Mechanic Falls with 8 railcar doors, 8 truck doors, are located 7 miles from I-95 and is serviced by St. Lawrence & Atlantic Railroad.

Portland

NEPW Logistics operates a 175,000 square foot facility in Mechanic Falls with 14 railcar doors, 9 truck doors, are located 3 miles from I-95 and is serviced by Pan Am Railways.

Scarborough

NEPW Logistics operates a 147,000 square foot facility in Scarborough with 8 railcar doors, 12 truck doors, are located 4 miles from I-95 and is serviced by Pan Am Railways.

South Paris

NEPW Logistics operates a 233,000 square foot facility in South Paris with 11 railcar doors, 6 truck doors, are located 21 miles from I-95 and is serviced by St. Lawrence & Atlantic Railroad and Pan Am Railways.

South Portland

Turners Island (TI) is a privately owned and operated 14-acre marine-rail cargo terminal located in South Portland, Maine. TI can handle almost any cargo that can be shipped by either rail or sea. Commodities presently handled include biodiesel, poles, scrap steel and dimensional stone.

Van Buren

A part of the JD Irving family of companies, New Brunswick & Maine Railways operates a lumber reload facility at Van Buren, ME. Sister company, Sunbury Transport, provides flatbed service to and from the reloads for Canadian origins.

Waterville

US Intermodal operates a container loading operation at the Pan Am Railways Waterville intermodal terminal with two 3,000-foot intermodal tracks and 100 feet of paved area between tracks for loading and unloading freight with two reach stackers/packers. With additional yard tracks available in the Waterville yard, this site has infrastructure in place for additional volume and expansion.

State Incentives

As part of the State of Maine's efforts to encourage new, expanding, or relocating businesses of all kinds of sizes, Maine offers a wide variety of assistance including financial, practical, and technical. Assistance includes Pine Tree Development Zones, Municipal Tax Increment Financing, the Business Equipment Tax Exemption Program, the Research Expense Tax Credit, New Market Tax Credits, and State of Maine Training Incentives. These are summarized below to present assistance options that could be leveraged by a CLT manufacturer newly locating or expanding in Maine.

Pine Tree Development Zones

The Pine Tree Development Zones (PTDZ) program offers eligible businesses the chance to greatly reduce or virtually eliminate state taxes for up to ten years when they create new, quality jobs in certain business sectors, or move existing jobs in those sectors to Maine. This program is available currently through the end of 2021 barring extension by the state legislature. More than 240 Maine businesses have participated in the PTDZ program with reimbursements from thousands to hundreds of thousands of dollars for taxes paid on new employees.

Eligible sectors are:

- Biotechnology
- Aquaculture and Marine Technology
- Composite Materials Technology ***(CLT qualifies here)***
- Environmental Technology
- Advanced Technologies for Forestry and Agriculture ***(CLT qualifies here)***
- Manufacturing and Precision Manufacturing ***(CLT qualifies here)***
- Information Technology
- Financial Services

A **new, quality job** is defined as one that:

- Meets the income requirements for the current year. Income includes "income derived from employment" (IDE) or employee earnings, and employer payments toward employee benefits including retirement, health insurance, education, and dependent care. That total for any new, quality job must exceed the per capita personal income for that county
- Includes access to group health insurance with an employer contribution encouraged but not required
- Includes access to group retirement benefits subject to ERISA with an employer contribution encouraged but not required

The PTDZ incentives that a new CLT facility would qualify for are as follows:

- Corporate Income Tax Credit (100%, Years 1-5; 50%, Years 6-10):
  The tax credit benefit derives from net new PTDZ payroll and property as a percentage of all Maine payroll and property. Since all payroll and property is new, the full credit is available.

- Employment Income Tax Financing (80% in a Pine Tree Zone, Years 1-10):
  This program refunds 80% of the state withholding taxes paid by the business for up to ten years for all net new employees hired (minimum 5 new full-time employees, 1 in a PTZ). The company must offer those employees a group health care plan and an Employee Retirement Security Act (ERISA)-qualified retirement plan. In addition, average annual income for each new employee must be higher than the average for the county in which the business is located.

- Sales and Use Tax (100% Personal and Real Property Exemption, Years 1-10):
  This tax exemption benefit derives from the qualified business paying no tax on all new tangible property purchases that are to be physically incorporated in, and become a permanent part of, real property of a qualified business and used in its qualified business activity, and all new tangible personal property purchases for its qualified business activity.

- Access to reduced electricity rates as requested by Central Maine Power and/or Emera Maine and approved by the Public Utilities Commission.

For more information on the Pine Tree Development Zone Program, go to the State of Maine Revenue Service at https://www.maine.gov/revenue/taxrelief/ptdz.htm

Municipal Tax Increment Financing

Tax Increment Financing (TIF) is a flexible finance tool used by municipalities, towns, plantations, and the Unorganized Territory to leverage new property taxes generated by a specific project or projects within a defined geographic district. A percentage of the new taxes may be used to finance public or private projects for a defined period of time up to 30 years.

The program is locally-driven: the municipality, town, or city defines the district and chooses how much of the new taxes will go to what public and private projects over what period of time, with the whole package requiring local political approval.

A business may approach a municipality with a proposal for investment for which a TIF district would provide financing. Or, a town might take advantage of an already-planned and financed project and create a TIF district around it, capturing a portion of new property tax revenue for specific uses.

For more information on Municipal Tax Increment Financing, go to the Maine Department of Economic and Community Development at https://www.maine.gov/decd/business-development/tax-incentives-credit/municipal-tax-increment-financing

Business Equipment Tax Exemption Program

The Business Equipment Tax Exemption (BETE) Program helps new and established businesses to invest for growth. This program eliminates the personal property tax on eligible business equipment that is first subject to assessment on or after April 1, 2007.

For more information on the Business Equipment Tax Exemption Program, go to the State of Maine Revenue Service at https://www.maine.gov/revenue/propertytax/propertytaxbenefits/bete.htm

Research Expense Tax Credit

The credit is based on a percentage of the federal Credit for Increasing Research Activities. Limitations: the credit is limited to 5% of the excess qualified research expenses over the previous three-year average plus 7.5% of the basic research payments under IRC § 41(e)(1)(A). The credit is further limited to 100% of the first $25,000 in tax liability plus 75% of the tax liability in excess of $25,000. The credit cannot be carried back but can be carried forward for up to 15 years.

For more information on the Research Expense Tax Credit, Refer your tax professional to http://legislature.maine.gov/statutes/36/title36sec5219-K.html

New Market Tax Credits (NMTC)

The New Markets Tax Credit (NMTC) is a federal program designed to increase the flow of capital to businesses and low-income communities. Over the last 15 years, the NMTC has proven to be an effective, targeted and cost-efficient financing tool valued by businesses, communities and investors across the country

The program attracts capital to low income communities by providing private investors with a federal tax credit for investments made in businesses or economic development projects located in some of the most distressed communities in the nation – qualifying census tracts have poverty rates of at least 20 percent or where median family income does not exceed 80 percent of the area median. A NMTC investor receives a tax credit equal to 39 percent of the total qualified investment and the credit is realized over a seven-year period.

In addition to the Federal Program, Maine has created a parallel program, the Maine New Markets Capital Investment Program. The two programs can be used together in the federal designated qualifying census tracks.

The State Program is administered by the Finance Authority of Maine, in cooperation with Maine Revenue Services and the Maine Department of Economic and Community Development.

For more information on Maine's New Market Tax Credits Program, go to the Finance Authority of Maine at https://www.famemaine.com/business/programs/equity-capital/maine-new-markets-investment-program/

Maine Seed Capital Tax Credit Program

This program is designed to encourage equity and near equity investments in young business ventures, directly and through private venture capital funds. State income tax credits to investors for up to 50% of the cash equity they provide to eligible Maine businesses may be authorized. Investments may be used for fixed assets, research or working capital.

Eligibility

- Businesses located in Maine.
- Investor must own less than 50% of the business.

- Principal owners and their immediate relatives are not eligible.
- Annual gross sales of less than $5,000,000.
- Business must either:
    - be a manufacturer;
    - provide goods or services with 60% of sales derived from outside the state or to out-of-state residents;
    - develop or apply advanced technologies;
    - be a value-added natural resource enterprise; or
    - be certified as a visual media production company.
- Operating the business must be the professional, full-time activity of at least one of the principal owners.

For more information on the Maine Seed Capital Tax Credit Program, go to the Finance Authority of Maine at https://www.famemaine.com/business/programs/equity-capital/maine-seed-capital-tax-credit-program/

Jobs and Investment Tax Credit

This program helps businesses with an income tax credit on equipment and facilities that generate new jobs. The program provides a credit against Maine income taxes for investment in most types of personal property that generates at least 100 new jobs within two years, as long as the investment is at least $5 million for the taxable year. The credit amount is tied to the federal investment tax credit and is limited to $500,000 per year with carry-forwards available for seven years.

For more information on the Jobs and Investment Tax Credit, Refer your tax professional to http://legislature.maine.gov/statutes/36/title36sec5215.html

Opportunity Zones

Based on the bipartisan Investing in Opportunity Act, Opportunity Zones is a national community investment tool established by Congress in the Tax Cuts and Jobs Act of 2017 to encourage long-term investments in low-income urban and rural communities nationwide. Opportunity Zones provide a tax incentive for investors to re-invest their unrealized capital gains into dedicated Opportunity Funds. In the state of Maine, there are a total of 32 Opportunity Zones located throughout the state, many of which are in prime areas of softwood resource availability.

For more information on Maine's Opportunity Zones, go to the Maine Department of Economic & Community Development at https://www.maine.gov/decd/business-development/opportunity-zones

Maine Innovation Partners

The University of Maine System

Established in 1968, the University of Maine System (UMS) is a network of public Universities in the state of Maine consisting of eight universities, each with a distinct mission and regional focus. Within the system, there are approximately 35,000 students enrolled.

The University of Maine

Founded in 1865, the University of Maine is located in Orono, eight miles from Bangor. This institution is Maine's land grant university and the flagship of the University of Maine System. Approximately 12,000 students attend the institution. The University of Maine in Orono will be a tremendous resource for a company producing a product that requires engineers and other professionals with a focus on the forest products industry.

Office of Innovation and Economic Development

The University of Maine Office of Innovation and Economic Development helps support new and existing businesses. This is done by linking businesses and industry experts; facilitating commercialization activities, such as new innovations developed at UMaine; and helping to transfer university research and development into marketable products and services. The office also is a responsive liaison, facilitating the relationship between the University of Maine at large and elected officials.

For more information, go to https://umaine.edu/econdev

Advanced Structures and Composites Center

The University of Maine's Advanced Structures and Composites Center is a world-leading, interdisciplinary center for research, education, and economic development encompassing material sciences, manufacturing, and engineering of composites and structures. The Center is housed in a 100,000 ft^2 ISO 17025 and PRG-320 accredited testing laboratory with more than 150 full and part time personnel. The center has over 20 years of research experience in mass timber manufacturing and evaluation, with over $1M USD of research on CLT in the last three years and is expected to continue to expand as expertise is built.

Housed within the ASCC, the Maine Mass Timber Commercialization Center (MMTCC) was founded in 2017 focused on collaborating with industrial partners, trade organizations, construction firms, architects, and other stakeholders in the region to promote mass timber and tall wood construction in Maine and New England. The MMTCC serves to educate stakeholders and the public on mass timber technologies and benefits while promoting Maine's timber supply and geography as an ideal location for mass timber manufacturing facilities to support the growing mass timber industry needs of the Northeastern United States.

For more information, go to https://composites.umaine.edu

Forest Bioproducts Research Institute

The University of Maine's Forest Bioproducts Research Institute and its Technology Research Center (TRC) validates, demonstrates, and helps commercialize developing fuel, chemical and advanced material technologies from forest bioproducts at an industrially relevant scale. It provides wood suppliers and wood users the opportunity to collaborate with each other and with University of Maine faculty researchers. TRC is a one-stop shop for processing and analysis of technologies. The 40,000-square-foot facility, located in Old Town, Maine, features state-of-the-art process control and process information systems.

For more information, go to https://forestbioproducts.umaine.edu

Advanced Manufacturing Center

The Advanced Manufacturing Center (AMC) is part of the University of Maine's College of Engineering which provides a link from the traditional University of Maine activities of education and research with the University's active industrial support and economic development programs. The AMC is an engineering support and service center that is committed to maintaining a first-class facility equipped with the latest manufacturing technologies. It designs and builds prototypes and development projects ranging from large scale fabrications to machined parts with micro-millimeter tolerances. The AMC has the ability to expand its range of expertise by working with engineering faculty, other UMaine research centers, and our partners in private industry.

For more information, go to https://umaine.edu/amc

University of Maine Contact:

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The University of Southern Maine

Established in 1878, the University of Southern Maine (USM) is situated in Maine's economic and cultural center. As public university with 8,000 undergraduate and graduate students taking courses online and at campuses in Portland, Gorham and Lewiston-Auburn, USM is known for its academic excellence, student focus and engagement with the community. USM provides students with hands-on experience that complements classroom learning and leads to employment opportunities in one of the nation's most desirable places to live.

Maine Center for Business and Economic Research

Since 1977, the Maine Center for Business and Economic Research (CBER) has been critical resource in supporting Maine's economy by providing the public and private sectors with university-based expert

research and services. CBER is designated by the US Economic Development Administration (EDA) as a University Center for the state of Maine and is supported in part by the Maine Economic Improvement Fund (MEIF). In addition to providing sponsored services to organizations across the state, the Center's core programs are focused on supporting innovation and diversification in Maine's forest resource economies and communities and supporting efforts that build Maine's knowledge workforce.

CBER provides services and expertise in the following areas:

- Economic Modeling & Forecasting
- Labor Market & Workforce Research
- Industry and Occupational Analyses
- Demographic Forecasting
- Spatial Analysis & GIS
- Local & Regional Economic Development
- Market Research
- Survey Design & Implementation
- Program Evaluation

CBER maintains a host of analytical suites, including models of Maine's economy developed by Regional Economic Models Incorporated (REMI), that allow modeling and forecasting a range of economic, demographic, and policy scenarios. CBER is a forecast manager for Maine for the New England Economic Partnership (NEEP) and prepares timely briefs on key economic issues affecting the state's economies.

For more information on the Maine Center for Business and Economic Research, go to https://www.mainecber.com

Maine Center for Business and Economic Research Contact:

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Maine & Company

Maine & Company is a private, non-profit organization that helps companies grow and expand in Maine. Maine & Company believes in the power of growth in the private sector. The Board of Directors, consisting of leaders of Maine's private economy, have invested their own resources to promote employment and company growth in Maine.

Their mission is to see companies succeed in Maine and will help companies find the resources they need to be successful in Maine. They offer the following assistance and services to organizations seeking to locate in Maine no cost to their clients.

- *Real Estate Site Searches.* After consulting with the client and determining relevant real estate needs, Maine & Company's staff searches a statewide database for appropriate properties and connects with regional and local real estate leaders.
- *Data Collection and Analysis.* Maine & Company provides detailed and up-to-date information on incentives, labor, employment, energy, real estate, taxes, telecommunications, and wages.
- *Incentives Identification and valuation.* Maine & Company's staff assists companies in identifying and packaging all the relevant programs available for business expansion, relocation activities, and analyzes the short- and long-term value of these incentives.
- *Site Visit Coordination.* On behalf of our clients, Maine & Company coordinates in-state site visits with local public and private sector representatives for the purpose of evaluating business location opportunities and addressing technical questions about doing business in Maine.
- *Workforce Analysis.* Maine & Company will work with clients to provide a workforce analysis that is based on both quantitative data from respected and trusted databases and anecdotal information from actual employers in the regions under consideration to get a true feel for the hiring culture.

For more information on Maine & Company, go to http://www.maineco.org

Maine & Company Contact:

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pjdelgreco@maineco.org

Maine Department of Economic & Community Development (DECD)

The Maine Department of Economic & Community Development (DECD), is comprised of more than two dozen experts whose broad mission is to help communities and businesses prosper through a variety of programs providing everything from targeted tax relief to community block grants to tourism marketing. Whether a business wants to make a film here, bring a Maine-made product to market, expand an aquaculture project, or explore financing when moving a business to our state, the experienced DECD staff can help.

DECD and its partners show companies how to benefit from millions of dollars in tax credits, reimbursements, R & D credits, capital loans, even direct investment. Every year, DECD helps Maine communities attract jobs and grow infrastructure with unique financing programs.

DECD's Office of Business Development specializes in assisting businesses of all sizes to grow, including startups, innovators, entrepreneurs, and large industries that have reached scale. The Office of Business Development also works to attract new investment to the State. The Office of Business Development has worked with hundreds of companies all over Maine helping with issues from high speed internet access to finding facilities to house 100 employees to helping communities and companies benefit from the creation of special Pine Tree Development Zones and Tax Increment Financing districts to ease the tax burdens on new and growing businesses.

For more information on the Maine Department of Economic & Community Development, go to http://www.maine.gov/decd

DECD Contact:

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Charlotte.Mace@maine.gov

Finance Authority of Maine (FAME)

The Finance Authority of Maine (FAME), a quasi-governmental agency, has several financing options available to companies designed to provide commercial grade credits with access to attractive interest rate structures.

Some commonly used options:

- The Secondary Market Tax Exempt Bond Program– This program provides tax-exempt interest rate bond financing for manufacturing borrowers.

- The Secondary Market Taxable Bond Program– This program provides long-term bond financing on loans of for real estate and machinery and equipment acquisitions.

- The Major Business Expansion Bond Program– This program provides long-term, credit-enhanced financing up to $25,000,000 at taxable bond rates for businesses creating or retaining 50 jobs and long-term, tax-exempt bond rates on bonds of up to $10,000,000 that are used to finance manufacturing expansions.

In addition, FAME offers direct lending programs for forestry-based manufacturing companies including:

FAME DIRECT LOAN

This program helps new or existing businesses with flexible gap financing. Businesses must be Maine-based, exhibit reasonable ability to repay the loan, and demonstrate that other sources of capital have been exhausted. Fixed rate loans of up to $1,000,000 may be available if substantial public benefit is demonstrated and sufficient funds are available. Most often, however, FAME Direct Loans are less than $500,000. Loan terms are a maximum of five years. Amortization may be based on the useful life of the assets being financed or additional collateral pledged, with a balloon payment at the end.

Interest Rate
Wall Street Journal Prime plus 2%, at time of loan commitment.

Guarantees
Any individual or entity that owns 20% or more of the borrower or owns 5% or more of the borrower and receives substantial income from the borrower, must guarantee the loan. All loans must be guaranteed by owners of at least 51% of the borrower in aggregate, except for nonprofit borrowers and borrowers owned by 20 or more shareholders. Exceptions to this policy must be approved by the FAME board.

Forestry, Fishing and Farming Initiative (3Fs)
This initiative's goal is to provide access to capital in order to leverage Maine's natural resources. This program will provide subordinate (gap) financing to assist new entrants and/or existing companies undertaking a project to materially expand their operations in forestry, fishing and farming industries.

Eligibility
New entrants to Maine-based natural resources businesses working in Maine's forestry, fishing and farming sectors, or existing companies in those industries undertaking a project to materially expand their operations. This initiative is available for a limited time.

Interest Rate

- FAME Direct Loans: Prime, fixed
- Commercial Loan Insurance: Lending institution's current lending rate Loan Term
- FAME Direct Loans: Maximum term of 5 years (up to 10-year amortization)
- Commercial Loan Insurance: Set by the lender Security Business assets and other collateral as required. Guarantees Unlimited personal guarantees of the business principals secured by personal real estate (where available) generally required.

For more information on the Finance Authority of Maine, go to http://www.famemaine.com

FAME Contact:

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cemmons@famemaine.com

Maine Technology Institute (MTI)

The Maine Technology Institute (MTI) is an industry-led, publicly-funded, nonprofit corporation that offers early-stage capital and commercialization assistance in the form of competitive grants, loans and equity investment for the research, development and application of technologies that create new products, processes and services, generating high-quality jobs across Maine.

Maine Technology Institute was established by the Maine State Legislature in 1999. MTI, working with partners across the state, "shall encourage, promote, stimulate and support research and development activity leading to the commercialization of new products and services in the State's technology-intensive industrial sectors (one of which is Forest Products and Agriculture where a CLT manufacturer would qualify for funding) to enhance the competitive position of those sectors and increase the likelihood that one or more of the sectors will support clusters of industrial activity and to create new jobs for Maine people." MTI is critical to the State's economic development strategy and a significant driver in the long-term expansion of research and development assets resulting in the creation of new ventures.

For more information on the Maine Technology Institute, go to https://www.mainetechnology.org

MTI Contact: info@mainetechnology.org or Ready to Start?

Coastal Enterprises, Inc

Founded in 1977, Coastal Enterprises (CEI) integrates financing, business and industry expertise and policy solutions to grow good jobs, environmentally sustainable enterprises and more broadly shared prosperity in Maine and other rural regions. CEI assists Maine businesses through a variety of services, including:

- Lending to and investing in businesses and community organizations
- Providing comprehensive business development advice
- Working with entrepreneurs to find operations and workforce solutions
- Offers expert advice in natural resource-based industries
- Advocates for pragmatic policies that build an economy that works for everyone

For more information on Coastal Enterprises, go to https://www.ceimaine.org

CEI Contact:

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FOR/Maine

Established in 2016, Forest Opportunity Roadmap/Maine (FOR/Maine) is a unique cross-sector collaboration between industry, communities, government, education, and non-profits, which have come together to realize the next generation of Maine's great forest economy. The coalition was created with support from the U.S. Economic Development Administration, U.S. Department of Agriculture, and the Maine Timberlands Charitable Trust, to assess Maine's current industry, assets and readiness, and determine a strategy to capitalize on new opportunities. FOR/Maine combines collaborative actions, innovation, market and resource management expertise, and reliable data to guide smart investment and market expansion in the forest economy.

For more information on FOR/Maine, go to https://formaine.org/

FOR/Maine Contact:

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Maine Forest Service

Under the Department of Agriculture, Conservation and Forestry, the Maine Forest Service (MFS) works to ensure that the trees and forest lands of Maine will continue to provide benefits for present and future generations of Maine people. The MFS accomplishes this through three primary divisions:

- Forest Health and Monitoring
- Forest Policy and Management
- Forest Protection

Through these three divisions, the Maine Forest Service develops, advocates for, and promotes activities that encourage the sound long term management of Maine's forest resources. The Maine Forest Service has 10 District Foresters who provide technical assistance and educational services to landowners, loggers, schools and educational institutions, municipalities and other stakeholders. Field Foresters conduct educational workshops, field demonstrations, media presentations and can provide limited one-on-one contact with individual landowners. MFS provides publications on various aspects of Maine forests, including annual wood processing, silviculture and harvesting reports.

For more information on the Maine Forest Service, go to https://www.maine.gov/dacf/mfs/

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Maine International Trade Center

Maine International Trade Center (MITC) is Maine's leading source for international business assistance. MITC offers customized consulting and research, affordable trade show participation, and an extensive network of connections across Maine and around the world to help businesses expand global markets for their products and services. A public-private partnership, MITC activities are supported by annual membership dues of nearly 300 businesses and organizations, corporate sponsors, and the Maine Department of Economic & Community Development (DECD).

MITC members are in each of the 16 counties throughout Maine, range from sole proprietors to major employers, and represent a wide variety of industry sectors. MITC members include manufacturers and service providers, economic development and government agencies, educational and research institutions and trade organizations. MITC supports activities with both exporters and importers.

Current MITC programs include:

- Invest in Maine - A collaborative program between MITC and the Maine Department of Economic and Community Development established to promote job creation and growth through overseas business attraction.
- Maine North Atlantic Development Office (MENADO) – formed in 2013 as an initiative by MITC to increase trade, investing and collaborative activity between Maine and the markets of the North Atlantic and to develop Maine's engagement in Arctic affairs.

For more information on the Maine International Trade Center, go to https://www.mitc.com/

MITC Contact:

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Regional Forest-Focused Partners

These agencies work within Maine and the region dedicated to a sustainable forest economy

Northern Border Regional Commission

Established in 2008, The Northern Border Regional Commission (NBRC) is a Federal-State partnership for economic and community development in northern Maine, New Hampshire, Vermont, and New York. Each year, the NBRC provides Federal funds for critical economic and community development projects throughout the northeast. These investments lead to new jobs being created and leverages substantial private sector investments. The mission of the Northern Border Regional Commission is to catalyze regional, collaborative, and transformative community economic development approaches that alleviate economic distress and position the region for economic growth.

Working with states in the region, Northern Border Regional Commission invests in four areas:

- Economic & Infrastructure Development Investments
- Regional Forest Economy Partnership
- Local Development Districts
- State Capacity Grant Program

For more information on the Northern Border Regional Commission, go to http://www.nbrc.gov

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U.S. Forest Service – Northern Research Station

The Northern Research Station's science is complex, but the need for the research is simple. Land managers, city planners, and policy-makers need sound science on all aspects of the natural world and its complex connections with people to achieve decisions resulting in a healthy and sustainable future for present and future generations of Americans. In a region extending from Maine to Minnesota and from Missouri to Maryland, Northern Research Station science aims to understand all of the elements of forests and related landscapes. Part of the Forest Service Research and Development program, the Northern Research Station is one of seven Forest Service research units conducting research with in all 50 States as well as in U.S. territories and commonwealths.

Northern Research Station scientists reach these audiences in a variety of ways, including:

- Publishing in peer-reviewed journals and Station General Technical Reports; approximately 12,000 publications authored or co-authored by Northern Research Station scientists.
- The Station develops web-based tools that deliver sound, peer-reviewed science in a format that is convenient for land managers and others.

The Station manages 22 of the 80 experimental forests that are part of the Forest Service Experimental Forest Network; most of these long-term research sites lie within National Forests. The ability to conduct scientific research in-house, to apply research findings on National Forest System lands, and to transfer these findings to others for use on all of the nation's forest land sets the Forest Service apart as a natural resource agency.

For more information on the U.S. Forest Service's Northern Research Station, go to https://www.nrs.fs.fed.us

U.S. Forest Service Northern Research Station Contact:

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New England Forestry Foundation

Founded in 1944, the 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. Through the application of our core expertise in conserving forestland and advancing Exemplary Forestry, NEFF works to manage and conserve the natural forest resources in New England for future generations to work and recreate in. NEFF accomplishes this through the following pathways:

- Conserving forestland for future generations through purchases, gifts, and bequests of land and easements.
- Actively managing NEFF-owned lands as demonstration and education forests, applying advanced practices in sustainable forestry and modeling tools and techniques that private landowners may wish to adopt.
- Advocate for policies and incentives that encourage and sustain private forestland ownership, ensuring that landowners have economically viable alternatives to selling their land for development.
- Keep more than 140 NEFF lands open to the public as Community Forests, with no charge for admission, ensuring New Englanders have access to all the recreational opportunities that forests provide.
- Serve as a resource for forestland owners in our region, helping them to achieve their own land management and legacy objectives.
- Educate landowners and the general public about the importance of forestry through outreach and programming.
- Steward conservation easements that have been entrusted to us, ensuring that landowners' conservation intents are sustained in accordance with their expressed wishes.
- Are future-focused and committed to innovation and integrity. NEFF helps prepare the region for a future where forestry is increasingly important, not only to keep forests healthy in the face of climate change, but also as a part of a global environmental solution to climate change. NEFF engages in numerous strategic initiatives to expand the region's land protection capacity, further forest education, and ensure that NEFF fulfills its mission.
- Endorse and partner with organizations and supporters to work towards the Harvard Forest Wildlands and Woodlands vision to conserve 30 million acres of New England forest.

For more information on the New England Forestry Foundation, go to https://newenglandforestry.org

NEFF Contact:

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Northern Forest Center

Founded in 1997, The Northern Forest Center has rallied people around a vision for the region's future that is built on three essential ingredients: thriving communities, healthy forests and innovative and resilient local economies. The Center's mission is to build economic and community vitality while fostering sound forest stewardship across the Northern Forest of Maine, New Hampshire, Vermont and New York. The Center advances its mission through network-based programs to create jobs, leverage investment and conserve forests for community benefit. Program strategies focus on locally grounded projects to secure tangible benefits for the region's people, communities and ecosystems through a series of focused efforts:

- **Community Vitality** - Partner with community leaders to implement projects that attract and retain residents who value quality of life and connections to the forest.
- **Automated Wood Heating** - Catalyze market demand for high-efficiency, automated wood heating systems to support the forest economy, reduce heating costs, keep dollars circulating locally, reduce net carbon dioxide emissions and generate millions of dollars of regional positive economic impact.
- **Wood Products Innovation** - Assist wood products manufacturers to implement innovations and advance worker training and career opportunities. These programs help businesses become more competitive, enabling them to sustain and create living-wage jobs.
- **Community Forests** - Advance creation of locally-owned and managed community forests that conserve forestland and generate economic and community benefits such as recreational tourism, timber income and outdoor classrooms.
- **Tourism** - Strengthen the tourism segment of the economy to enhance visitor experiences and improve job opportunities in rural communities. Programs deliver direct business assistance and advance quality-based branding and destination development.
- **Tax Credit Financing** - Facilitate New Markets Tax Credit (NMTC) financings that provide capital for and subsidize multimillion-dollar projects that promote the forest-based economy while also providing community and environmental benefits.
- **Regional Strategy** - Advocate for the needs of the Northern Forest's communities at the state and federal level. The Center brings a unique regional perspective, grounded by specific local projects, to each state capital and the region's congressional delegation and federal agency staff in Washington, D.C. to help shape public policy and secure federal funding for the Northern Forest.

For more information on the Northern Forest Center, go to https://northernforest.org

Northern Forest Center Contact:

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Workforce Training & Education

Maine is a leader in developing programs and training initiatives that meet business demands for a highly skilled, technical workforce. Employers praise the state's customized approach, which includes broad-range training, reimbursement, and apprenticeship programs. From covering the cost of training for new employees to partially reimbursing training costs for upgrading skills to providing on-the-job and classroom instruction, Maine strives to help companies have the best employees possible.

Public Colleges and Universities

University of Maine

The University of Maine, founded in Orono in 1865, is the state's Land Grant university and the leading research university in the state. It is among the most comprehensive higher education institutions in the Northeast and attracts students from across the U.S. and 65 countries. It currently enrolls approximately 12,000 total undergraduate and graduate students. UMaine students directly participate in groundbreaking research working with world-class scholars. The University of Maine offers undergraduate and graduate degrees in several areas of interest to the forest economy, including engineering, engineering technology, forestry and forest products.

For more information about the University of Maine, go to https://umaine.edu

University of Maine at Augusta

The University of Maine at Augusta (UMA) is the third largest public university of Maine with its main campus in the state's capital and a sister campus in Bangor. UMA also operates a system of nine University Centers and 27 Community Sites to deliver education and distance learning opportunities to communities throughout the state. Of interest to a potential CLT manufacturer, UMA offers the only professional architecture degree in Maine and the only public 5-year professional degree in northern New England.

For more information on the University of Maine at Augusta, go to https://www.uma.edu

University of Maine at Farmington

The University of Maine Farmington (UMF) is the premier teacher education and public liberal arts college for the state of Maine, preparing students for engaged citizenship, enriching professional careers, and an enduring love of learning. Since 1864, UMF has focused on educating teachers with the distinctive contemporary mission as a public liberal arts college.

For more information on the University of Maine at Farmington, go to https://www.umf.maine.edu

University of Maine at Fort Kent

Nestled in the St. John Valley, an international crossroads of Maine, Quebec and New Brunswick, the University of Maine at Fort Kent (UMFK) is a unique learning institution that is a perfect place for people seeking a rural scholastic atmosphere of modern academic standards combined with an eclectic mix of rugged outdoor vistas, world class sports opportunities, and access to cosmopolitan epicenters across

two countries. Since 1878, UMFK has provided education experiences to students in the northern border region.

For more information on the University of Maine at Fort Kent, go to https://www.umfk.edu

University of Maine at Machias

Founded in 1909, the University of Maine at Machias (UMM) has served as Maine's coastal university, providing Environmental Liberal Arts education and creating enriching opportunities for students in collaboration, leadership and community engagement to enhance the social, cultural, economic, and natural environments of the State of Maine.

For more information on the University of Maine at Machias, go to https://machias.edu

University of Maine at Presque Isle

Founded in 1903, the University of Maine at Presque Isle (UMPI) has provided traditional and non-traditional students with life-changing opportunities in a caring, small-university environment. UMPI combines liberal arts and selected professional programs and serves as a cultural and educational resource for the entire region.

For more information on the University of Maine at Presque Isle, go to https://www.umpi.edu

University of Southern Maine

The University of Southern Maine is a second largest public university of Maine with its main campus in Portland, and two sister campuses located in Gorham and Lewiston. USM offers degrees of interest to potential CLT manufacturers in Mechanical and Electrical Engineering.

For more information on the University of Southern Maine, go to https://usm.maine.edu

University of Maine School of Law

Founded in 1962, the University of Maine School of Law (Maine Law) is the only American Bar Association-accredited law school in Maine. Focused only on matters of Law, Maine Law's primary mission is to educate students to serve the public and private sectors with distinction, to contribute to the advancement of the law through scholarly and professional research and writing, and to engage in public services aimed at improving the legal system.

For more information on the University of Maine School of Law, go to https://mainelaw.maine.edu/

Maine Maritime Academy

Maine Maritime Academy is a public, co-educational college located in the coastal town of Castine, Maine. Our student population numbers approximately 950 students in courses of study in engineering, management, science, and transportation. MMA students become world-class engineers, supply chain managers, logistics professionals, and scientists here in Maine and beyond.

For more information about Maine Maritime Academy, go to https://mainemaritime.edu

Maine Community College System

Consisting of seven colleges with nine campuses throughout the state (Table 10), the Maine Community College System trains over 16,000 students in a variety of disciplines focused on business needs. Training areas specifically of interest to a potential CLT manufacturer include Building Construction Technology, Architectural and Civil Engineering, Electromechanical Technology, Facilities Maintenance and Management, Precision Manufacturing Technology, Electrical & Automation Technology, Woodworking, and Trade & Technical Occupations.

Table 10: List of Maine Community Colleges

College	Location	URL
Central Maine Community College	Auburn	http://www.cmcc.edu/
Eastern Maine Community College	Bangor	http://www.emcc.edu/
Kennebec Valley Community College	Fairfield; Hinckley	http://www.kvcc.me.edu/
Northern Maine Community College	Presque Isle	http://www.nmcc.edu/
Southern Maine Community College	South Portland; Brunswick	http://www.smccme.edu/
Washington County Community College	Calais	http://www.wccc.me.edu/
York County Community College	Wells	http://www.yccc.edu/

For more information about the Maine Community College System, go to https://www.mccs.me.edu

Maine Career and Technical Education Schools

With a network of 27 locations co-located within high schools throughout Maine, the goal of the Career and Technical Education Schools is to ensure that students acquire the high-quality technical skills that will prepare them for post-secondary education and entry into an ever-changing workplace. Offering direct training experiences to Maine's high school students, the CTE programs expose students to a variety of career path options and provide hands-on experience to supplement their education.

For more information on Maine Career and Technical Education Schools, go to http://mainecte.org

Maine Quality Centers

The Maine Quality Centers program provides customized recruitment and guaranteed fast-track training designed to employer specifications. The Maine Quality Centers have helped over 261 Maine businesses expand and strengthen their workforce and trained over 17,000 people for new positions. The program is offered at no cost and is delivered by the state's community college system. Funds are available to new or expanding firms or consortia creating a minimum of eight new full-time jobs with benefits in the state of Maine. The award is based on skill requirements, wage benefit levels, and company and labor market analysis.

For more information on the Maine Quality Centers, go to Maine's Community Colleges at https://www.mccs.me.edu/workforce-training/train-my-workforce/maine-quality-centers/

Maine Apprenticeship program

The Maine Apprenticeship program is available to businesses that want to train their existing and/or new employees in registered apprenticeship positions. It is a customized, systematic training program

designed to meet the needs of Maine employers through on-the-job training (OJT) and related classroom instruction. The program pays for a portion of the registration fees for two courses per semester during the apprenticeship period.

For more information on the Maine Apprenticeship Program, go to the State of Maine Department of Labor at https://www.maine.gov/labor/jobs_training/apprenticeship/

Workforce Information Services

Center for Workforce Research and Information

The Center for Workforce Research and Information develops and disseminates state and area labor market information to employers, job seekers, and other users; provides measurements of labor market outcomes to assist local and state officials, employers, educators, trainers, and the public in making decisions that promote economic opportunity and efficient use of state labor resources; and supports the Department with management and actuarial analyses for program planning and delivery.

For more information on the Center for Workforce Research and Information, go to https://www.maine.gov/labor/cwri

Economic and Business Development Groups

Within Maine there are several economic and business development groups focused on business success in their regions. These groups provide access to a variety of programs, including business lending, workforce development, business services and procurement assistance. Working with the local and regional development groups also provides businesses clear pathways to understanding state and local resources available to businesses and employers.

Maine Economic Development Districts

- Androscoggin Valley Council of Governments http://www.avcog.org
    - Coverage Area: Androscoggin and Franklin counties as well as all of Oxford County EXCEPT for the municipalities of Denmark, Fryeburg, Hiram, Lovell, Porter, Stoneham, Stow, and Sweden
- Eastern Maine Development Corporation www.emdc.org
    - Coverage Area: Hancock, Penobscot, and Piscataquis counties as well as the Waldo County municipalities of Belfast, Frankfort, Knox, Liberty, Monroe, Morrill, Montville, Prospect, Searsport, Stockton Springs, and Winterport
- Greater Portland Council of Governments https://www.gpcog.org
    - Coverage Area: 26 municipalities in the Greater Portland and Lakes Region, including Bridgton, Cape Elizabeth, Casco, Chebeague Island, Cumberland, Dunham, Falmouth, Freeport, Frye Island, Gorham, Gray, Harrison, Long Island, Naples, New Gloucester, North Yarmouth, Portland, Pownal, Raymond, Scarborough, Sebago, South Portland, Standish, Westbrook, Windham, and Yarmouth
- Kennebec Valley Council of Governments www.kvcog.org
    - Coverage Area: Kennebec and Somerset counties as well as well as the Waldo County municipalities of Burnham, Freedom, Palermo, Thorndike, Troy, and Unity
- Midcoast Council of Governments www.mceddme.org
    - Coverage Area: Knox County as well as the Waldo County municipalities of Belmont, Lincolnville, Northport, and Searsmont
- Northern Maine Development Commission http://www.nmdc.org
    - Coverage Area: Aroostook and Washington counties
- Southern Maine Regional Planning Commission www.smpdc.org
    - Coverage Area: The Oxford County municipalities of Brownfield, Denmark, Fryeburg, Hiram, Lovell, Porter, Stoneham, Stow, and Sweden

Other Regional Development Partners

- Aroostook Partnership http://www.aroostookpartnership.org
    - Coverage Area: Aroostook County
- Our Katahdin http://www.ourkatahdin.com
    - Coverage Area: Katahdin region, including the communities of East Millinocket, Medway, Millinocket, Patten and surrounding areas.
- Sunrise County Economic Council http://sunrisecounty.org

- Coverage Area: Washington County

Maine Small Business Development Centers (SBDCs)

Since 1977, Maine's Small Business Development Centers have leveraged federal, state and higher education resources to assist entrepreneurs and spur economic growth. The SBDC concept is a simple but effective one: assist entrepreneurs and small businesses through no-cost confidential business advising and training.

The Maine SBDC program helps build and strengthen small businesses through business advising, training and educational resources. Certified business advisors provide guidance on topics such as business feasibility, business plan development, capital acquisition, financial management, marketing and sales, e-commerce, customer service, personnel management, small business strategic planning and more.

The Maine SBDC is a program of the U.S. Small Business Administration, the Maine Department of Economic and Community Development and the University of Southern Maine. Accredited by America's Small Business Development Centers, the Maine SBDC operates a network of 22 service centers in partnerships with development groups throughout the state to provide a variety of services to Maine's small businesses and startups, including:

- Business planning
- Financing and taxes
- Marketing and sales
- Operations and management

For more information on the Maine Small Business Development Centers, go to http://www.mainesbdc.org

Workforce Development Boards

Within Maine there are several boards dedicated to addressing workforce challenges by developing strategies and programs to connect employees and employers with resources which align employee skillsets with employer needs to increase employment and employee retention.

State Workforce Board

The State Workforce Board was created by the Maine Legislature to ensure that the State's workforce development system helps Maine people and businesses compete successfully in the global economy. It is part of a larger network called the Workforce Development System (WDS) which includes other State agencies such as Department of Education, Adult Education, Department of Health and Human Services, as well as the College and University System and employers. The board works with industry and state partners to develop strategies to:

- Address current and emerging skill gaps in Maine's workforce
- Provide a means to engage directly with industry across traditional boundaries, and
- Better align state programs and resources serving employers and workers

For more information on the State Workforce Board, go to https://www.maine.gov/swb

Central Western Maine Workforce Development Board

Serving Androscoggin, Franklin, Oxford, Kennebec and Somerset counties, the Central Western Maine Workforce Development Board is the primary coordinator for providing comprehensive, professional and timely workforce development services for job seekers and employers in the region. CWMWDB guides investments in workforce preparation, skill development, education and training to result in a diverse and satisfied workforce meeting the needs of employers. By designing initiatives which consider and address the demands and areas of focus for local employers, businesses, educators and trainers, CWMWDB strives to resolve skill and education gaps within the available local workforce to strengthen local businesses and create a more resilient workforce. CWMWDB believes regular interaction between the education system, employers and the workforce development system is absolutely necessary for success.

For more information on the Central Western Maine Workforce Development Board, go to http://cwmwdb.org

Coastal Counties Workforce, Inc.

Serving Maine's six coastal counties (York, Cumberland, Sagadahoc, Lincoln, Waldo and Knox), CCWI develops and directs regional workforce development policies and regional strategies. Through their role as regional convener and ongoing partnerships with other local, state and federal agencies, education, and economic development organizations, CCWI strives to provide access to jobs, skill development and business services vital to the social and economic well-being of our region's communities.

For more information on the Tri County Workforce Investment Board, go to http://www.coastalcounties.org

Tri County Workforce Investment Board

Serving Penobscot, Hancock, and Piscataquis counties, the Tri-County Workforce Investment Board is a local organization dedicated to bringing together employers and employees to promote a healthy economy in the region. The board directs the use of employment resources for the benefit of employees and current and future employers by:

- nurturing partnerships,
- working in conjunction with local economic development initiatives,
- and being mindful of the needs of the local economy.

The Tri County Workforce Investment strives to develop a skilled and diverse workforce, create opportunities for employers and employees, maintain a high quality of life sustainable over changing economic conditions.

For more information on the Tri County Workforce Investment Board, go to http://www.tricountylwib.org

Additional Online Resources

These resources are outlined to provide additional information for exploring Maine as a viable CLT manufacturing location.

Maine Forest Service

Annual reports on silviculture, stumpage and wood processing
https://www.maine.gov/dacf/mfs/publications/annual_reports.html

Maine Department of Transportation

Maine Freight Map https://www.maine.gov/mdot/maps/docs/FreightMap2016.pdf

Maine Rail System Map https://www.maine.gov/mdot/maps/docs/RailSystem_2016.pdf

Maine Highway Corridor Priorities Map
https://www.maine.gov/mdot/docs/maps/Highway_Corridor_Priorities%20_October2017.pdf

USFS Regional Forest Resource Reports

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Appendices

Appendix I: Poyry CLT Feasibility in New England Report

PÖYRY

NEW ENGLAND FORESTRY FOUNDATION

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

July, 2017

X325305

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PREFACE

Helsinki/London July 2017

Assessing the wood supply and investment potential for a New England engineered wood products mill

New England Forestry Foundation (NEFF) assigned Pöyry Management Consulting to evaluate the engineered wood product investment opportunity in the New England region of the US. The focus was to identify engineered wood products that can penetrate the high and mid rise construction market.

In this report Pöyry and NEFF have identified that Cross Laminated Timber (CLT) would have the highest investment potential from both market and wood supply perspective. The preliminary analysis also indicates that local CLT production could be competitive in the US Northeast market.

Pöyry hopes that the result of this assignment will encourage new investments in cross laminated timber in New England.

Pöyry Management Consulting

Cormac O'Carroll

Antti Koskinen

EXECUTIVE SUMMARY

CLT is the most promising engineered wood option for New England – it has the potential to take significant market share in segments where no wood is used

- ***The capacity of traditional engineered wood products (LVL, LSL, PSL, glulam) is sufficient to meet demand in the medium term but we have identified a significant opportunity for new CLT capacity to meet the growing demand for non-residential and multifamily housing – CLT is uniquely suitable for mid-rise construction***

- ***There are currently no CLT mills in the U.S. Northeast – regional CLT capacity would have a competitive advantage supplying the Boston and New York metro markets***

- ***Construction and industry players consider mass timber (CLT and glulam) to be the most promising option for penetrating new construction segments - wood consumption in mass timber buildings is typically double that used in conventional build***

- ***The share of wood currently used in building segments suitable for mass timber is low – taking only 1% market share of multifamily and non-residential construction in the Northeast U.S. would equate to 50,000m^3 of CLT demand = 1-2 mills output.***

- ***Supportive building codes are the critical enabler for growing CLT markets in New England***

EXECUTIVE SUMMARY (CONT'D)

Preliminary calculations indicate an IRR up to 40%

- ***New England has sufficient forest resources to support a CLT investment.***
- ***New England sawmilling capacity is heavy to spruce/fir (50%) which is suitable for CLT - other softwood species could also be used which is a potential opportunity for Eastern hemlock***
- ***A CLT investment would have a marginal impact on wood consumption in New England***
- ***Preliminary analysis indicates that CLT production in New England is cost competitive***
- ***Greenfield investment cost for a CLT plant is circa USD 20 million - utilizing existing sites and buildings would reduce this significantly.***
- ***CLT is not a commodity product so pricing is opaque – but the majority of the market is in the USD 620-800/m^3 range which equates to an IRR up to 40%***
- ***Best option is to integrate CLT production with an existing glulam factory***

CONTENTS

ENGINEERED WOOD PRODUCTS OVERVIEW

Laminated veneer lumber (LVL)
A structural composite lumber (SCL) made from multiple layers of wood veneers glued together under heat and pressure into a panel and then resawn into lumber. All the veneers are oriented with the grains along the lengthwise direction of the panel. Main applications are beams and headers, with I-joist flanges on the increase.

Laminated strand lumber (LSL)
One last product under the SCL umbrella, LSL is very similar to OSL. The difference between LSL and OSL is in the geometry of the wood flakes. In LSL, the strands are shorter and wider. Applications include millwork components, studs, beams, and timber framing. LSL can also be used for I-beam flanges.

Oriented strand lumber (OSL)
A type of SCL, OSL is made from short, thin strands of flaked wood that are placed parallel to each other and formed into a mat that is glued and pressed together. OSL can be considered the lumber version of OSB and applications include millwork components, studs, beams and timber framing.

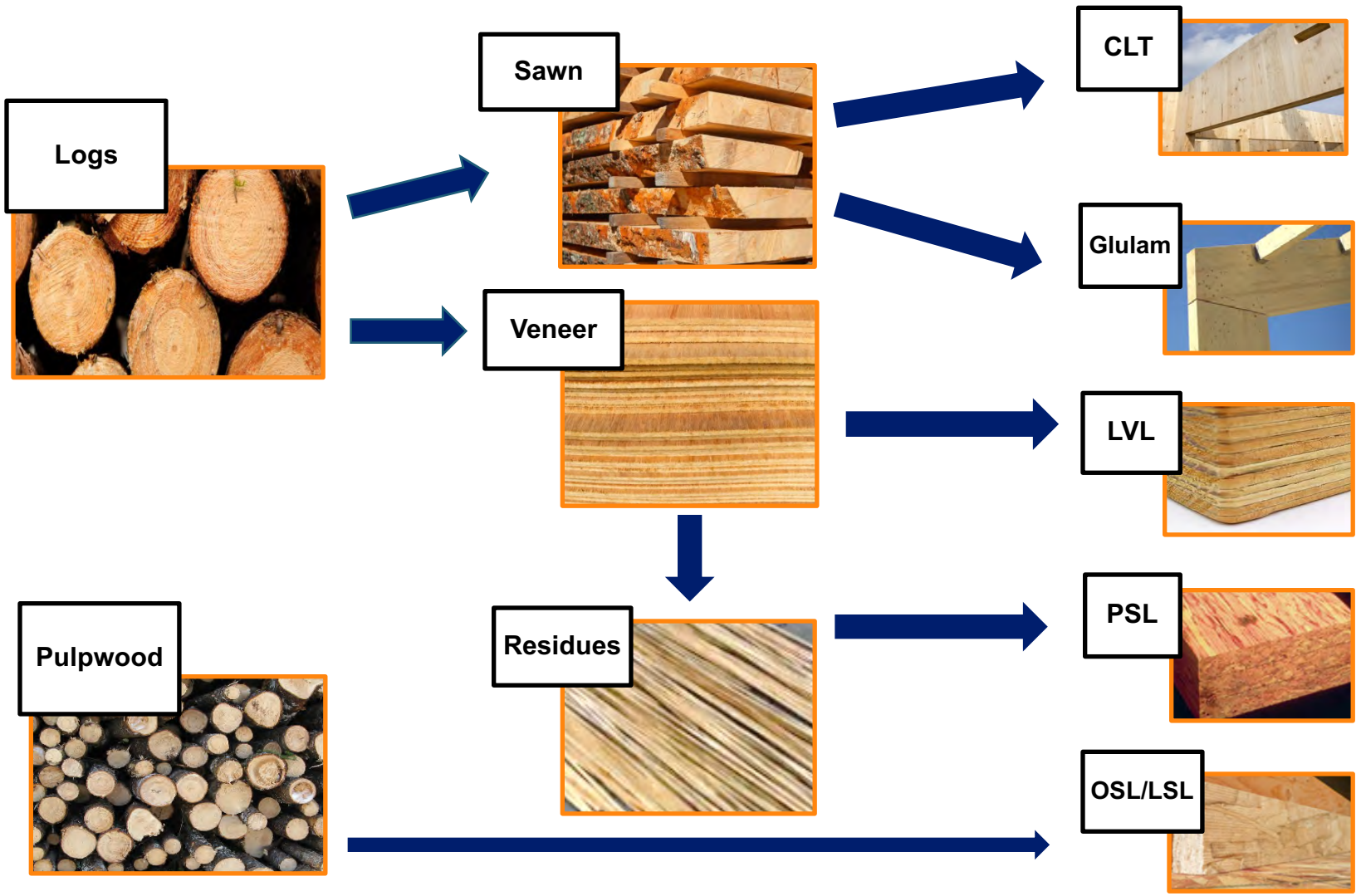
Parallel strand lumber (PSL)
Also an SCL, production is similar to OSL but PSL is made from long thin strands of wood cut from veneer that are placed parallel to each other and formed into a mat that is glued and pressed together. Made to make larger dimension lumber, applicable for beams, headers and load-bearing columns.

Mass timber – potential in taller buildings and non-residential buildings

Cross-laminated timber (CLT)
An engineered lumber product that comprise of 3-9 layers of sawnwood that has been glued together perpendicular to each other. The resulting panel is large, thick and strong, and highly suitable for structural purposes like wall, roof and flooring elements.

Glued laminated lumber (Glulam)
Made of small dimensional lumber that has been finger-jointed with a structural adhesive to make a high load-bearing, larger dimension lumber. Glulam has properties that make it suitable for spanning large distances and is therefore often used in beams, headers, rafters and other structural applications.

ENGINEERED LUMBER PRODUCTS



MULTI-STORY CONSTRUCTION AND USES FOR EWPs

Traditional light framing method
Typically prefabricated large wall elements made from **lumber** or **EWP**s in taller buildings.

- Used concept in North American low rise multi-story, built onsite instead of prefabrication
- EWP consumption 0.1-0.2 ft^3/ft^2, SW lumber 0.4-0.6 ft^3/ft^2

Massive panels (CLT)
All bearing structures made from CLT, basically replacing concrete elements. Elements can be prefabricated prior to installation.

- Commonly used in Europe
- Introduced in North America
- CLT consumption 0.6-1.5 ft^3/ft^2

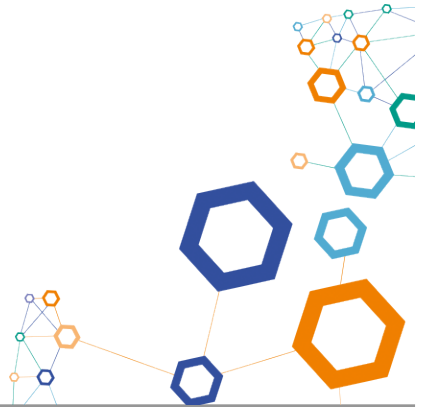
Post & Beam
Frame of the building is made from **glulam** or **LVL**. Exterior walls can be made from CLT or lumber based elements. Floors typically from LVL or CLT. Potential for **PSL** use. Hybrid structures also used combining glulam columns and CLT.

- Commonly used in Europe
- EWP consumption 0.7-0.7 ft^3/ft^2

Modular elements
High degree of prefabrication where elements are made offsite. Elements can be made of various wood products such as **lumber** or **EWP**s. Wood consumption depends on wood products used.

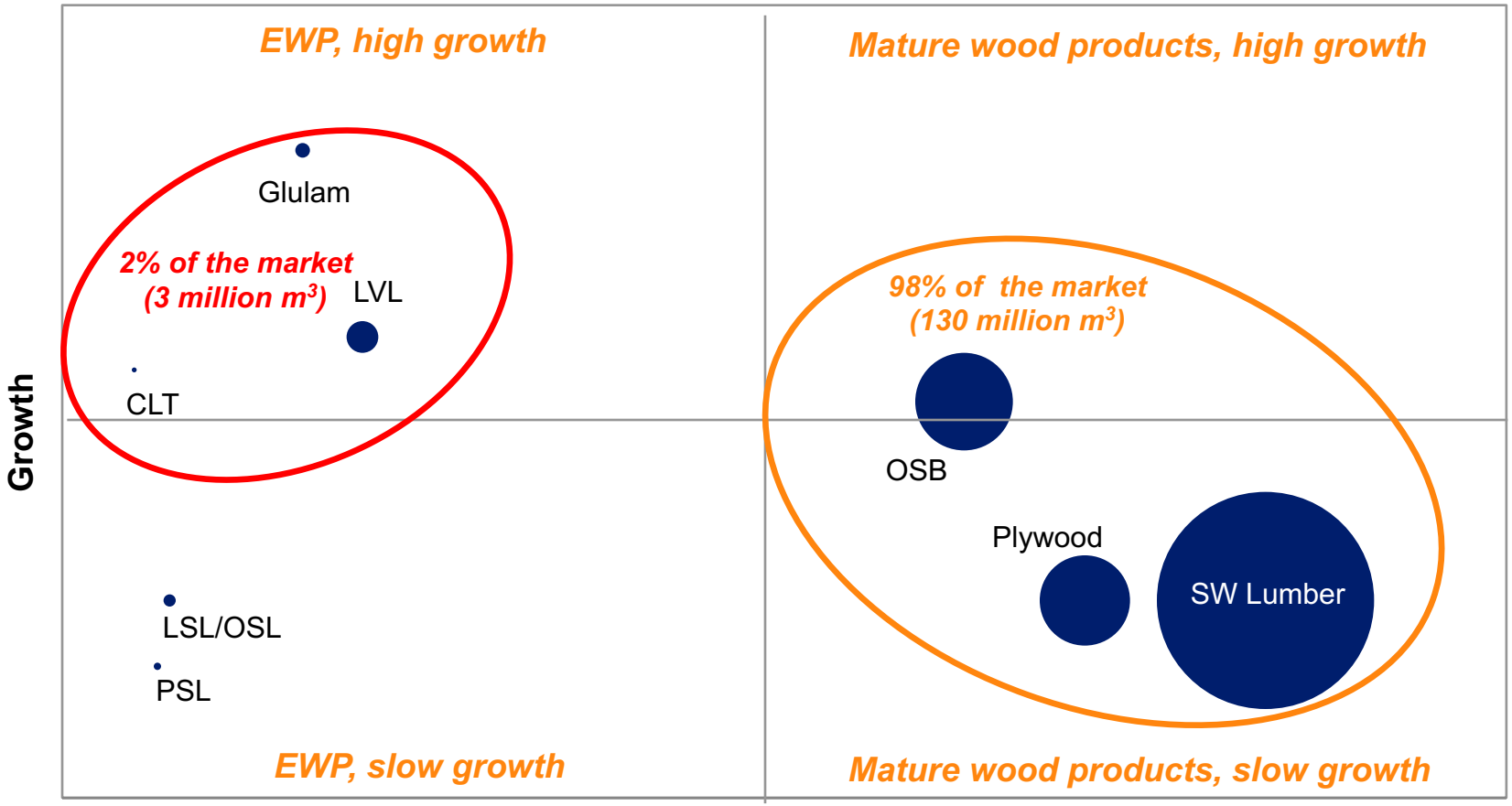
- Popular in Sweden

MARKET ANALYSIS



NORTH AMERICAN ENGINEERED WOOD PRODUCTS MARKET

Engineered wood products are still small in market size, but have a faster growth pace than traditional wood products

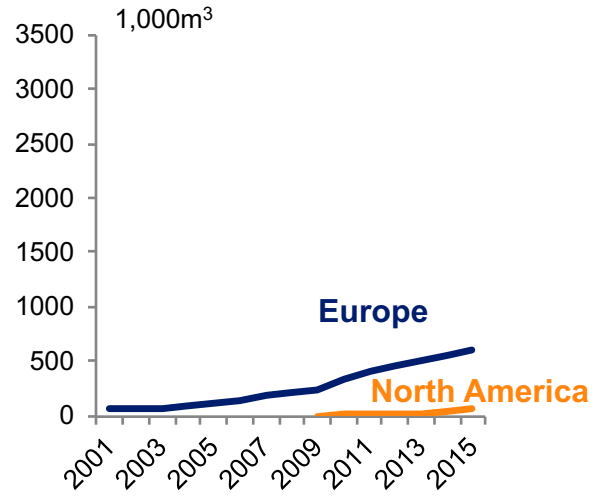


* Size of circle represents demand

GLOBAL ENGINEERED LUMBER MARKETS

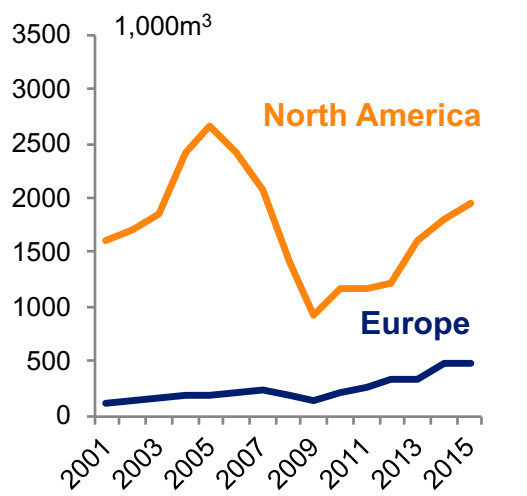
The CLT market is in an early stage of development both in Europe and N-America. Glulam and LVL are more mature products.

CLT



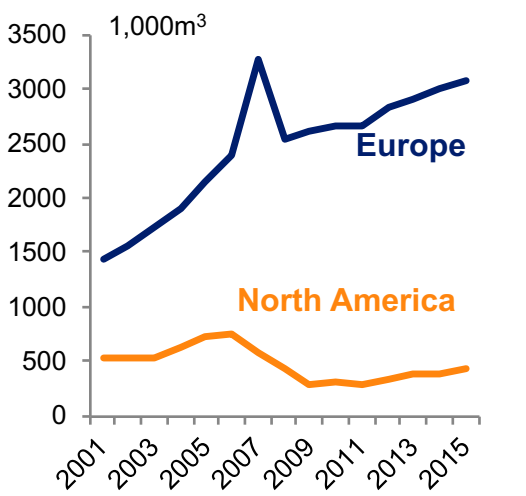
- New product
- Growing capacity
- 30-35 producers in Europe and increasing

LVL



- Well established in North America
- New producers and capacity in Europe

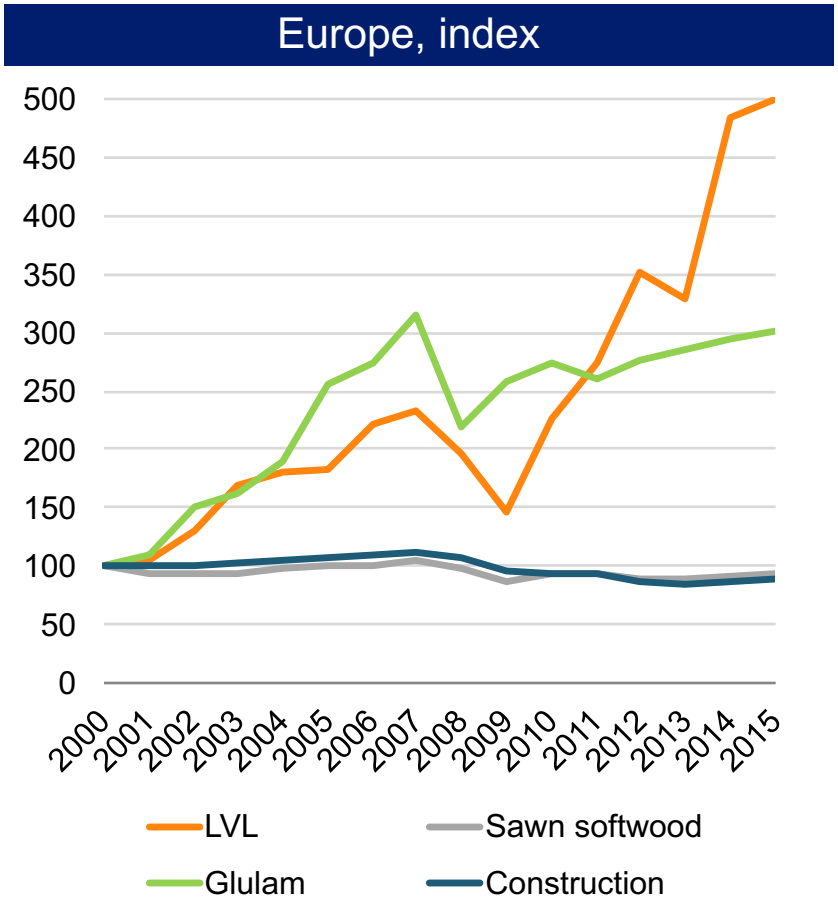
GLULAM

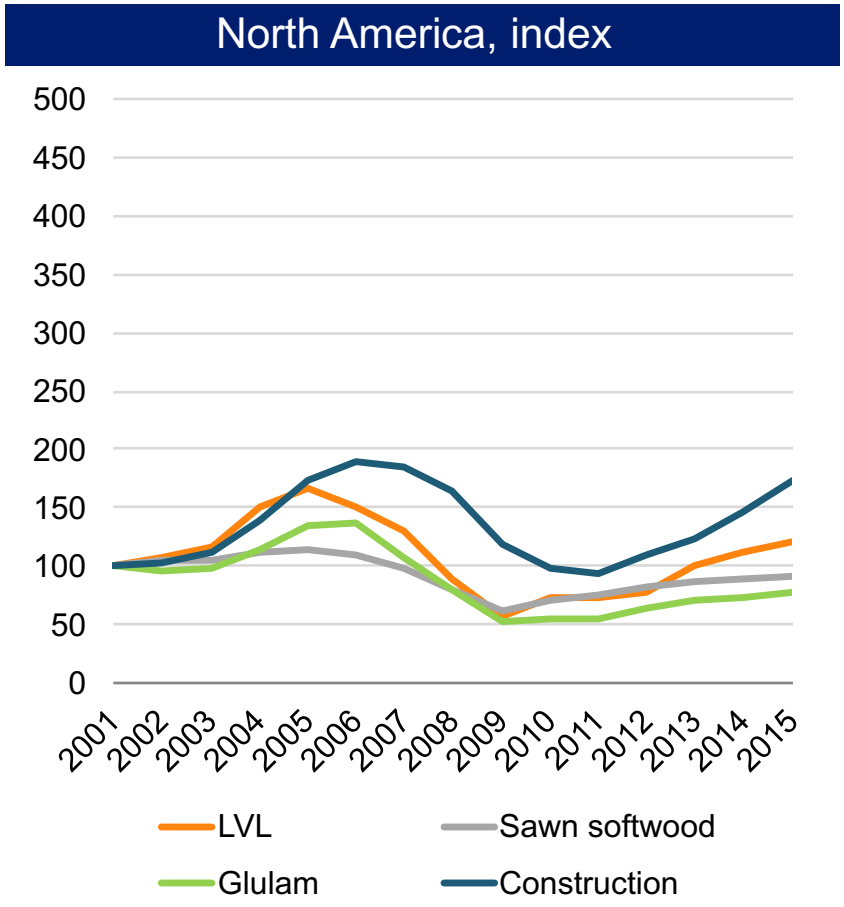


- Maturing market in Europe
- Relatively small in North America

MARKET TRENDS OF ENGINEERED LUMBER

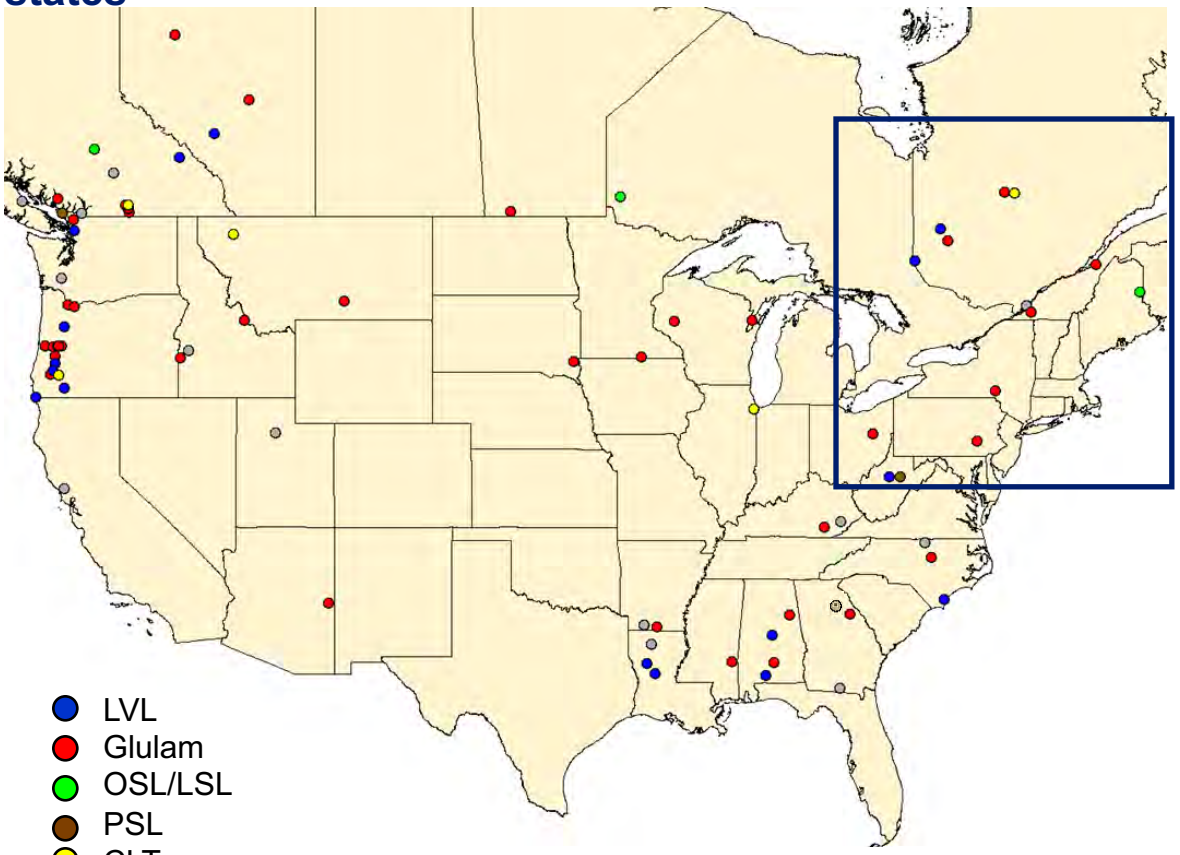
The market for engineered lumber products in Europe still grows faster than construction, whereas in North America they have become mature products exposed to market cycles.





ALL ENGINEERED WOOD PRODUCTS – MAP OF PRODUCERS

While the largest number of facilities are concentrated in the Pacific Northwest and US Southeast regions, the Northeast has two mills and 11 other mills in surrounding states



Greater New England Producers

LVL
- Forex, Amos (PQ)
- Global LVL, Ville Marie (PQ)
- Weyerhaeuser, Buckhannon (WV)

Glulam
- Art Massive, St. Jean-Port-Joli (PQ)
- *Arch. Toubois, Laval (PQ)*
- GoodLam, Delson (PQ)
- Nordic, Chibougamau (PQ)
- RigidPly, Rigidply (PA)
- Stark Truss, Beach City (OH)
- TecoLam, Val-d'Or (PQ)
- Unalam, Unadilla (NY)

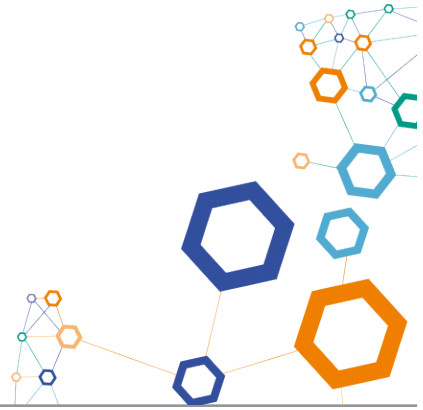
OSL/LSL
- LP, Houlton (ME)

PSL
- Weyerhaeuser, Buckhannon (WV)

CLT
- Nordic, Chibougamau (PQ)

Idled capacity

MARKET ANALYSIS
LAMINATED VENEER LUMBER (LVL)



LAMINATED VENEER LUMBER (LVL)

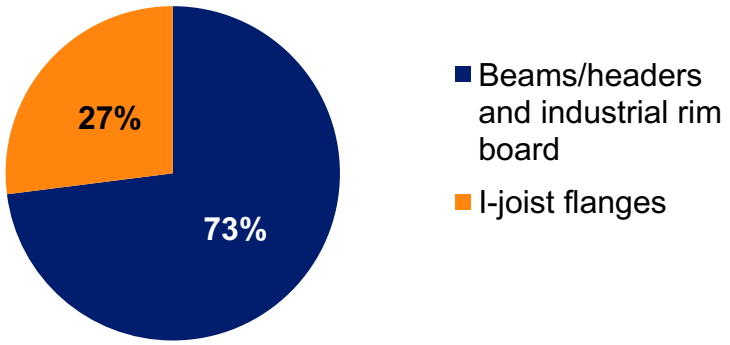
LVL has an established position in North America and is expected to keep growing

- Laminated veneer lumber is an engineered structural lumber made from layers of thin veneers glued together into panels under heat and pressure. The grain of the veneers are oriented parallel to the length of the panel, which is then sawn into lumber.
- LVL is used as a structural material in construction and substitutes materials like steel and particularly lumber, as it is typically straighter, stronger and more uniform.
- Specific applications include beams and headers, hip and valley rafters, I-joists, large structures and pre-fabricated construction elements.
- Common lengths are 48-66 feet, but can be up to 80 feet. Typical width range is 24-48 inches and thickness range is ¾ - 2 ½ inches.
- Typical species used are Douglas fir, larch, southern yellow pine, spruce and poplar.

LVL layered structure

LVL

Main end use segments in North America

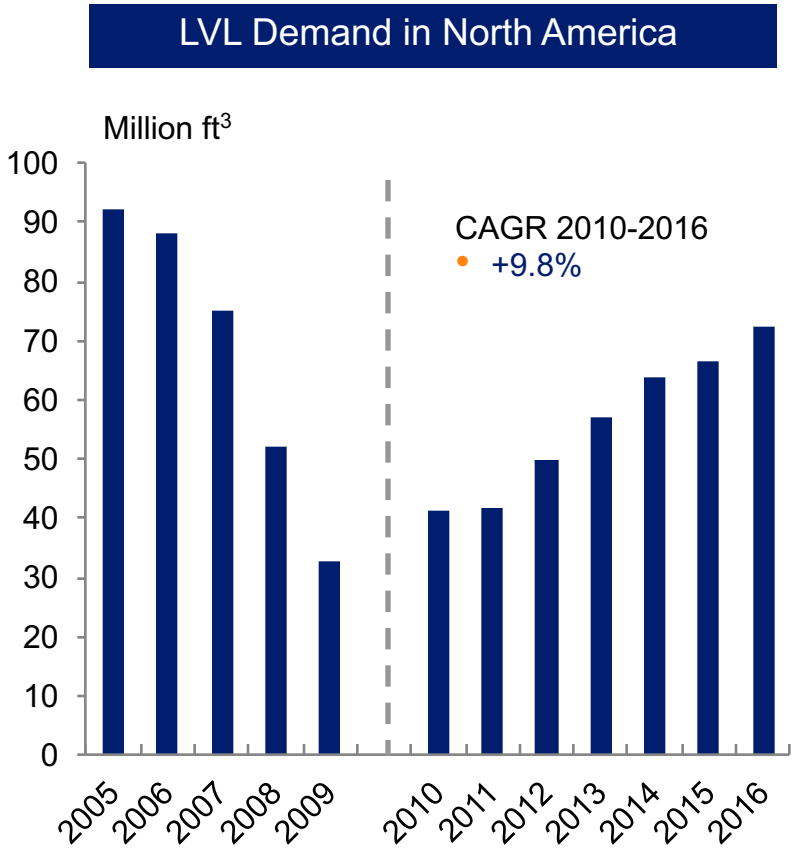


Source: APA – The Engineered Wood Association

LVL – NORTH AMERICAN MARKET

The North American LVL market is growing steadily, but has not yet reached the pre-recession level

- LVL is a maturing product in North America representing the largest product group (~70%) within engineered wood products
- Since 2010, total demand has increased by 76% and has been growing at a CAGR of 9.8%
- Structural end uses – beams and headers – represent approximately 70% of the total end use
- No international trade
- Since 2005 the number of producers has remained unchanged (10), but the number of operating facilities has decreased from 21 to 16
  - Boise acquired GP's Engineered Lumber Business in 2016
- Current capacity is estimated at 92 million ft^3

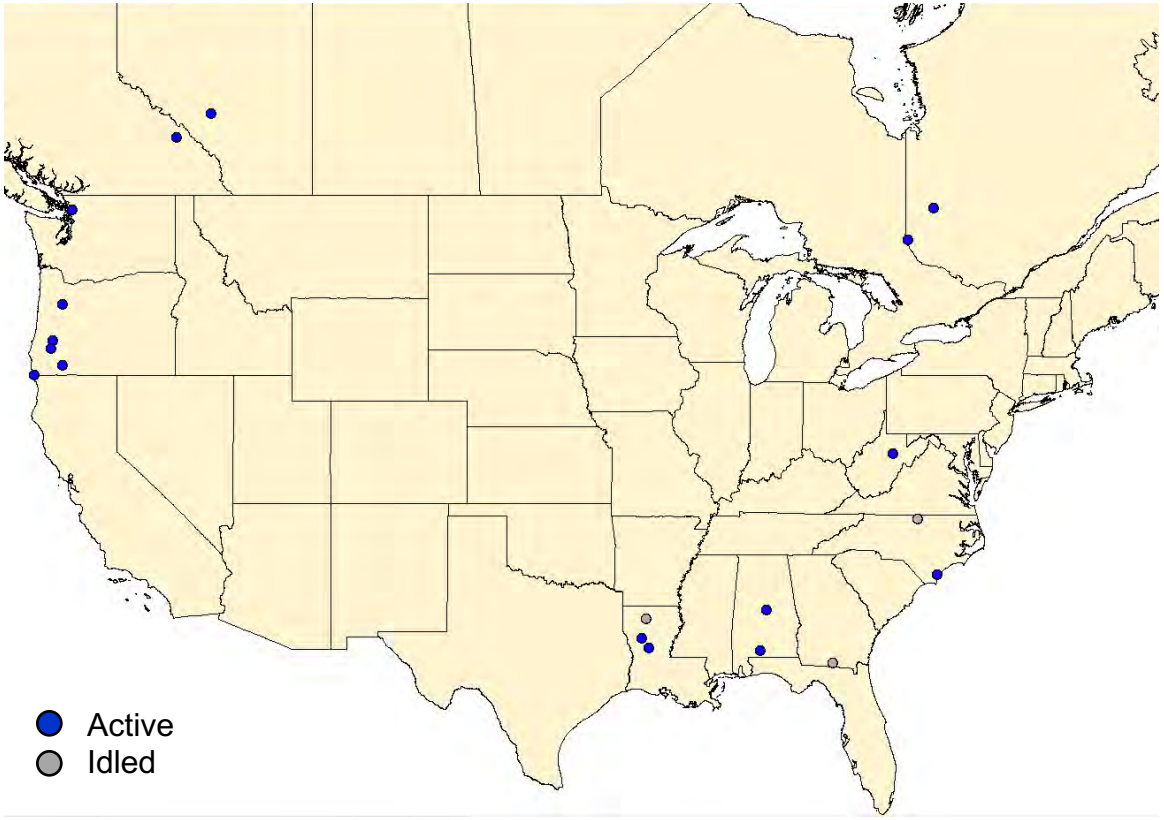


** conversion factor 1ft^3 = 0.0283 m^3*

72 million ft^3 = 2 million m^3

LVL – MAP OF PRODUCERS

Global LVL and Forex in Quebec and Weyerhaeuser in West Virginia are the LVL producers in the greater Northeast region



LVL Producers

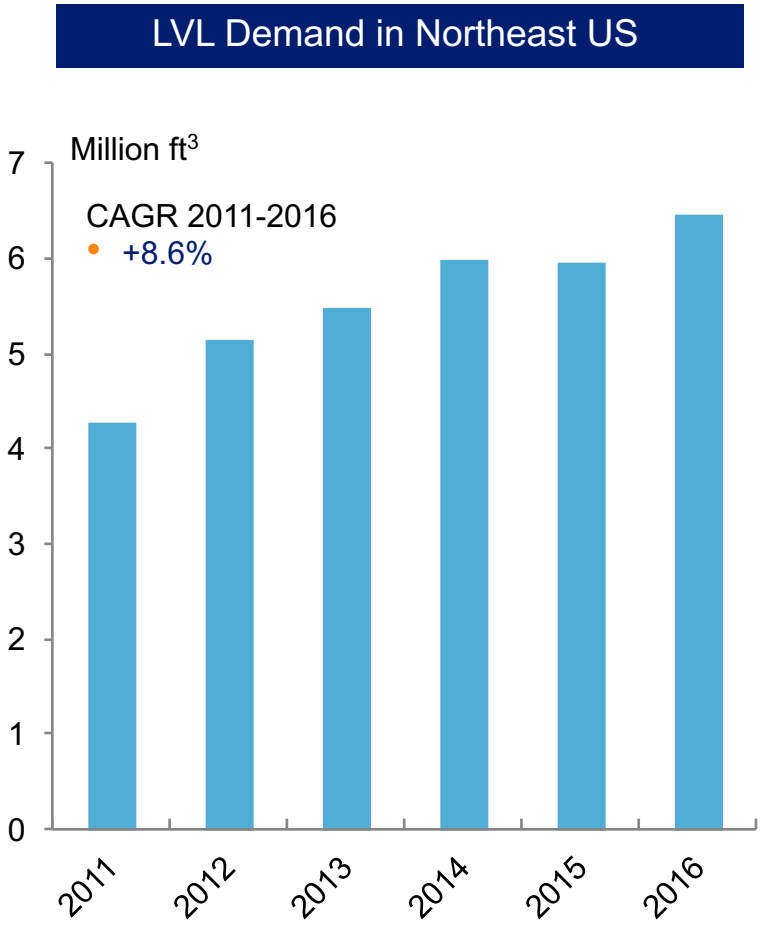
- Boise, Lena (LA)
- Boise, White City (OR)
- Boise, Roxboro (NC)
- Boise, Thorsby (AL)
- Forex, Amos (PQ)
- Global LVL, Ville-Marie (PQ)
- LP, Golden (BC)
- LP, Wilmington (NC)
- Murphy, Sutherlin (OR)
- Pacific Wood Lam., Brookings (OR)
- Pacific Woodtech, Burlington (WA)
- Redbuilt, Stayton (OR)
- Roseburg, Riddle (OR)
- W. Fraser, Rocky Mtn. House (AB)
- WY, Buckhannon (WV)
- WY, Evergreen (AL)
- WY, Natchitoches (LA)
- WY, Simsboro (LA)
- WY, Valdosta (GA)

North East Producers *Idled capacity*

LVL – NORTHEAST MARKET

LVL production is heavily dependent on the strength of residential construction

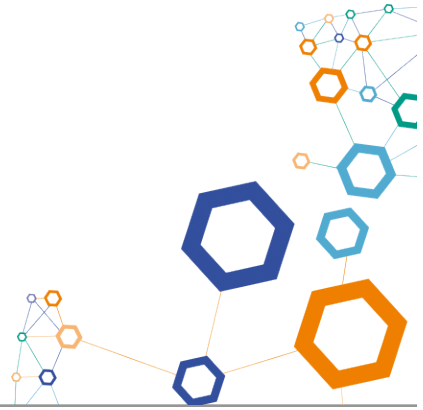
- About 80% of LVL production is used in residential construction and only 20% in non-residential
- 2016 estimated LVL demand in construction was 6.5million ft^3, which is 9% of US total demand
- For the past 5 years, annual LVL demand growth in the Northeast has been a little lower than the national average. Construction growth in the Northeast has been slower compared to the total US, especially in the single-family housing sector, where most of LVL is consumed
- 80% of LVL is used in floor applications, 13% in wall and the remaining 7% in roof applications; shares are relatively similar to total US average use



** conversion factor 1ft^3 = 0.0283 m^3*

7 million ft^3 = ~200,000 m^3

MARKET ANALYSIS
GLUED LAMINATED TIMBER (GLULAM)



GLULAM – NORTH AMERICA

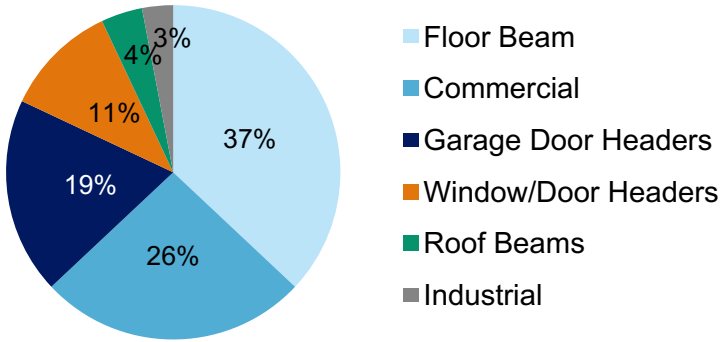
Glulam is a structural product, competing with LVL, and is the second largest segment of EWP

- Glulam is made from small dimension lumber that is finger-jointed with a structural adhesive to create a larger dimension lumber.
- Glulam can be produced in various cross sections, lengths and shapes, and is ideal for large spans and high load bearing constructions.
- The key applications include beams, headers, rafters, lintels, floor beams, columns or decking where it substitutes lumber.
- Glulam competes with LVL as well as other non-wood products.
- Glulam is available in both custom and stock sizes; typical thickness for stock size ranges from 4 ½ - 7 inches and width from 3 ½ - 9 ¼ inches. Laminating stock may be end jointed into lengths of up to 130 feet.

Glulam building frames

Glulam beams

Main end use segments in North America

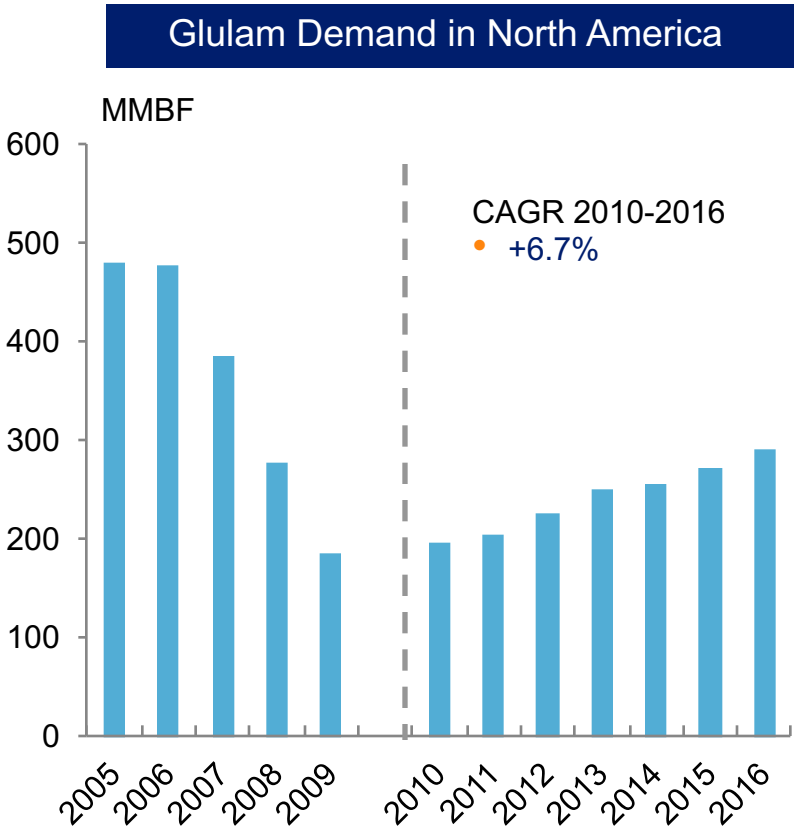


Source: USDA

GLULAM – NORTH AMERICAN MARKET

The North American glulam market is growing. Many facilities are not operating at full capacity

- In North America, the glulam market is rather limited as other wood products like LVL are traditionally preferred
- Since 2010 total demand has increased by 48% and has been growing at a CAGR of 6.7%
- International trade is rather marginal- approximately 2% of the total volume
- Despite a large drop in demand since 2005, the number of production facilities has not changed much- decreasing from 42 to 38
  - Remaining producers not operating at full capacity

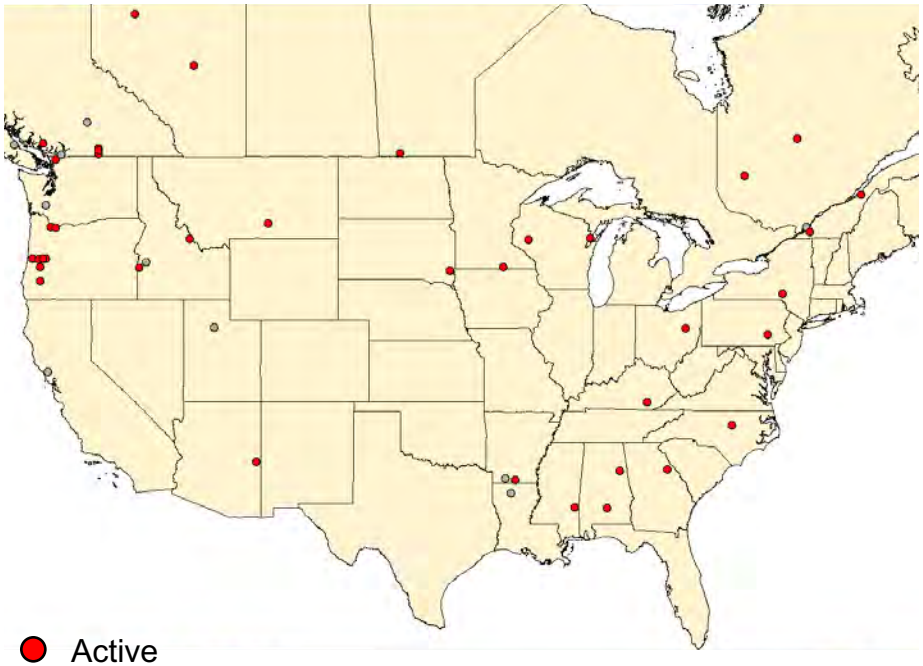


** conversion factor m^3 = 632 bd ft*

290 million bd ft = 460,000 m^3

GLULAM – MAP OF PRODUCERS

There are 6 producers of glulam in the greater Northeast region



Glulam Producers

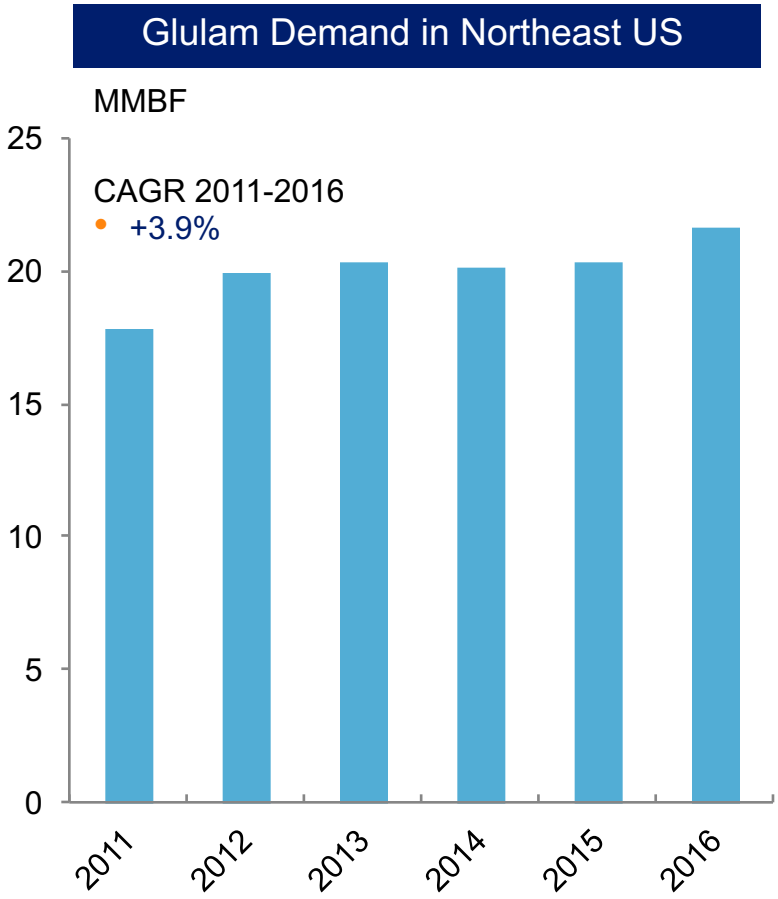
- Alamco, Albert Lea (MN)
- American Lam., Drain (OR)
- American Lam., Swisshome (OR)
- Anthony, El Dorado (AR)
- Anthony, Washington (GA)
- Arizona Struct., Eagar (AZ)
- ArkLam, Magnolia (AL)
- Arch. Toubois, Laval (PQ)
- Art Massive, St. Jean-Port-Joli (PQ)
- Boise, Emmet (ID)
- Boise, Homedale (ID)
- Boozer, Anniston (AL)
- Boucher, Nampa (AB)
- Calvert, Vancouver (WA)
- Calvert, Washougal (WA)
- Canfor, Chilliwack (BC)
- Cascade Struct., Chehalis (WA)
- Compwood, Kamploops (BC)
- Cumberland, Cumberland (BC)
- D.R. Johnson, Riddle (OR)
- Enwood, Morrisville (NC)
- FraserWood, Squamish (BC)
- G-L, Magna (UT)
- Goodlam, Delson (PQ)
- Gruen-Wald, Sioux Falls (SD)
- Lam. Timbers, London (KY)
- Mississippi, Shubuta (MS)
- Nordic, Chibougamau (PQ)
- QB Corporation, Salmon (ID)
- RedBuilt, Windsor (CA)
- Rigidply Rafters, Rigidply (PA)
- Rosboro, Springfield (OR)
- Rosboro, Vaughn (OR)
- Sentinel, Peshtigo (WI)
- Stark Truss, Beach City (OH)
- Stimson Lumber, Chehalis (WA)
- Structural Wood Systems, Greenville (AL)
- Structurlam, Okanagan Falls(BC)
- Structurlam, Oliver (BC)
- Structurlam, Penticton (BC)
- Tecolam, Val-d'Or (PQ)
- Terminal Forest, Everson (WA)
- Timber Tech, Colfax (WI)
- Timberweld, Billings (MT)
- TSW Lam., Okanagan Falls (BC)
- Unalam, Unadilla (NY)
- W. Archrib, Boissevain (MB)
- W. Archrib, Edmonton (AB)
- W. Structures, Eugene (OR)
- WY, Simsboro (LA)
- Zip-O Laminators, Eugene (OR)

**North East Producers* *Idled capacity*

GLULAM – NORTHEAST MARKET

Nonresidential construction is the main driver for glulam demand in Northeast

- In the Northeast over 80% of glulam production is used in nonresidential construction, where the total US average glulam consumption is fairly split between residential and nonresidential construction
- Schools, health and public institutions consumed 60% of non-residential volume
- About half of the volume is used in floor applications and the rest is evenly split between wall and roof applications
- In 2016 estimated glulam demand in construction was 35 million board feet and the annual growth rate has been lower than the national average because:
  i. construction growth in the Northeast has been slower compared to the total US
  ii. nonresidential construction has had the slowest growth rate, where most glulam volume is consumed



** conversion factor m^3 = 632 bd ft*

MARKET ANALYSIS
LAMINATED STRAND LUMBER (LSL)
ORIENTED STRAND LUMBER (OSL)

LAMINATED AND ORIENTED STRAND LUMBER (LSL/OSL) – NORTH AMERICA

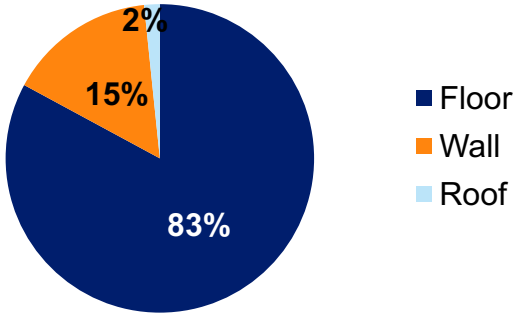
LSL and OSL belong to the structural composite lumber category together with LVL and PSL

- LSL and OSL are produced by orienting flake wood strands in the same direction to form a large billet that is then pressed and the strands bonded with an adhesive. The strand geometry results in length-to-thickness ratios of approximately 75 for OSL and 150 for LSL
- Application areas for LSL and OSL overlap and are varied, from millwork components to studs, beams, headers, rim boards and timber framing. In North America the key application is construction.
- Similar to OSB but like with LVL, the resulting large panels are resawn into the desired shape and size; typical thicknesses are 1½ -3 ½ inches and typical widths are 3 ½ -24 inches
- A desirable feature of these products is that they can be made from species that otherwise are not suitable for making solid wood products, like poplar and aspen, but also from pine.

Laminated strand lumber (LSL)

Oriented strand lumber (OSL)

Main end use applications in North America

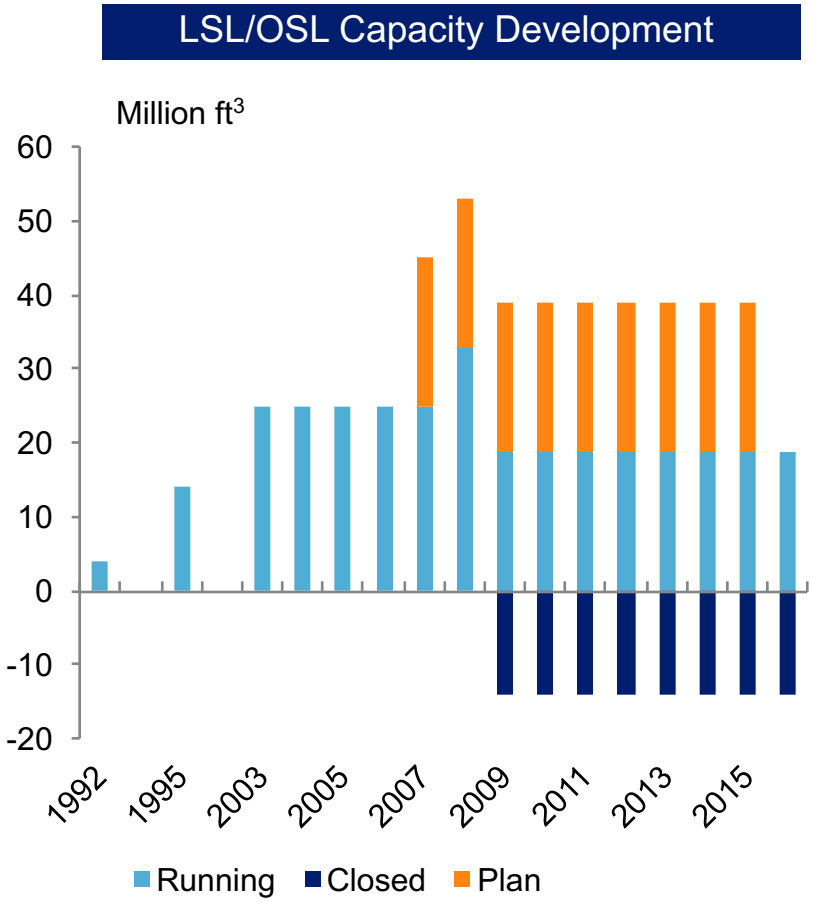


Source: APA – The Engineered Wood Association

LSL/OSL – NORTH AMERICAN MARKET

The LSL/OSL market has remained unchanged over recent years. The capacity of two producers – 18.7 million ft³ – fulfills demand

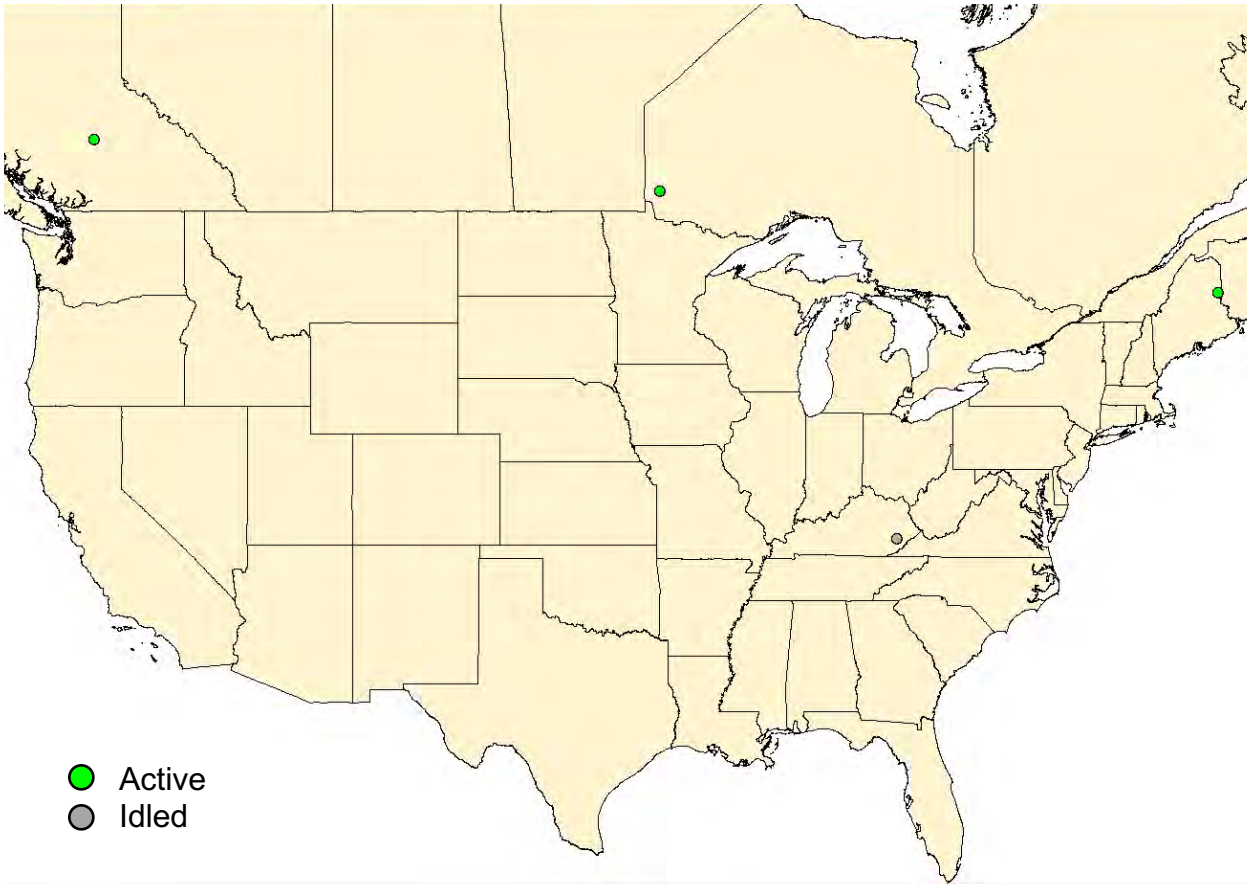
- Weyerhaeuser and Louisiana-Pacific are the only producers of LSL/OSL in North America
- Weyerhaeuser has one active LSL mill in Kenora, Ontario, with a capacity of 11 million ft³
- Louisiana-Pacific has one mill in Houlton, Maine, with a capacity of 7.7 million ft³
- At the moment there is no OSL production. For several years Ainsworth was planning to start a large (20 million ft³) OSL mill in Grande Prairie, Canada, where they are currently making OSB, but the project was never completed.
- The LSL market has stagnated; the only change in capacity was in 2009 due to the closure of Weyerhaeuser's LSL mills in Deerwood, Minnesota and Hazard, Kentucky.
- Actual demand for LSL is estimated to be much lower than capacity (8 million ft³)



** conversion factor m³ = 35 ft³*

OSL/LSL – MAP OF PRODUCERS

There are only three active LSL/OSL producing mills in North America



OSL/LSL Producers

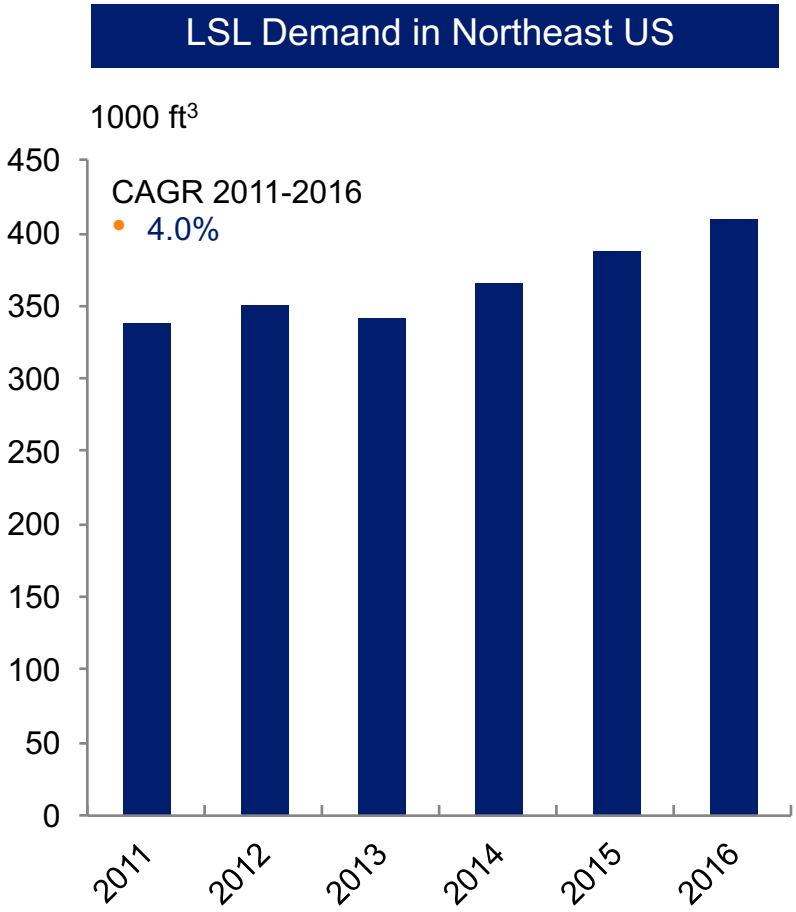
- Norbord, 100 Mile House (BC)
- LP, Houlton (ME)
- WY, Hazard (KY)
- WY, Kenora (ON)

**North East Producers* *Idled capacity*

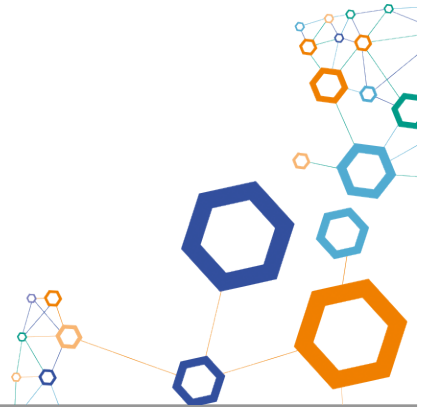
LSL/OSL – NORTHEAST MARKET

Single-family and nonresidential construction are the main end-use segments

- In the Northeast LSL consumption is fairly split between single-family and nonresidential construction. ~75% of total average US LSL volume is used in single-family construction
- More than 90% of LVL volume is used in floor applications both in the Northeast and in the US s a whole
- Based on known capacity, estimated LSL demand in 2016 could potentially by about 410,000 ft^3, which is about 5% of the US total market size
- Demand growth for LSL is lower than the US construction industry average. Construction growth in the Northeast has been slower compared to the total US, especially in the single-family and nonresidential housing sectors, where most LSL is consumed



MARKET ANALYSIS
PARALLEL STRAND LUMBER (PSL)

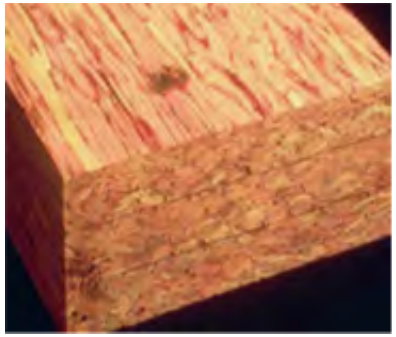


PARALLEL STRAND LUMBER (PSL) – NORTH AMERICA

PSL is an engineered wood product made from veneer strands, belonging to the same structural composite lumber category as LVL, OSL and LSL

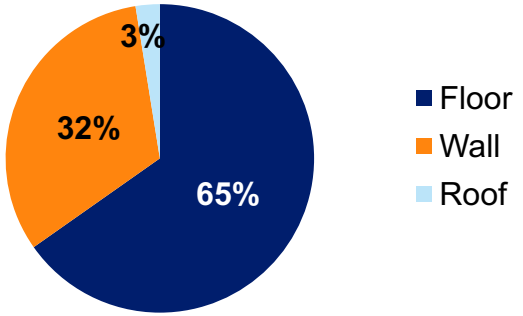
- Parallel strand lumber is made from long, thin strands cut from veneer that are placed in parallel in a billet and, with an adhesive, pressed and glued together to make larger dimension beams. The strands typically have a length/thickness ratio of 300, with strand length from 2-8 feet.
- As another structural composite lumber, the high bending strength of PSL makes it suitable for structural applications such as beams and headers, but also load-bearing columns. PSL can substitute for LVL and glulam in these applications.
- In Canada PSL is made from Douglas fir, while it is made from southern pine in the US. PSL can also be made from other species like poplar and hemlock.

Parallel strand lumber (PSL)



PSL beams

Main end use applications in North America

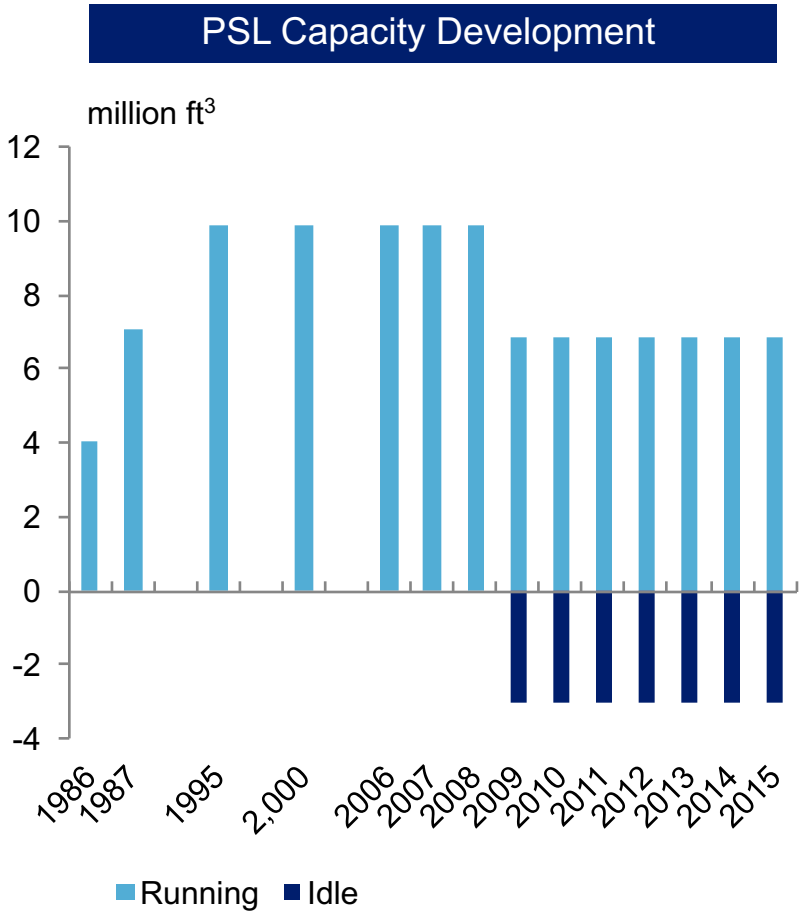


Source: APA – The Engineered Wood Association

PSL – NORTH AMERICAN MARKET

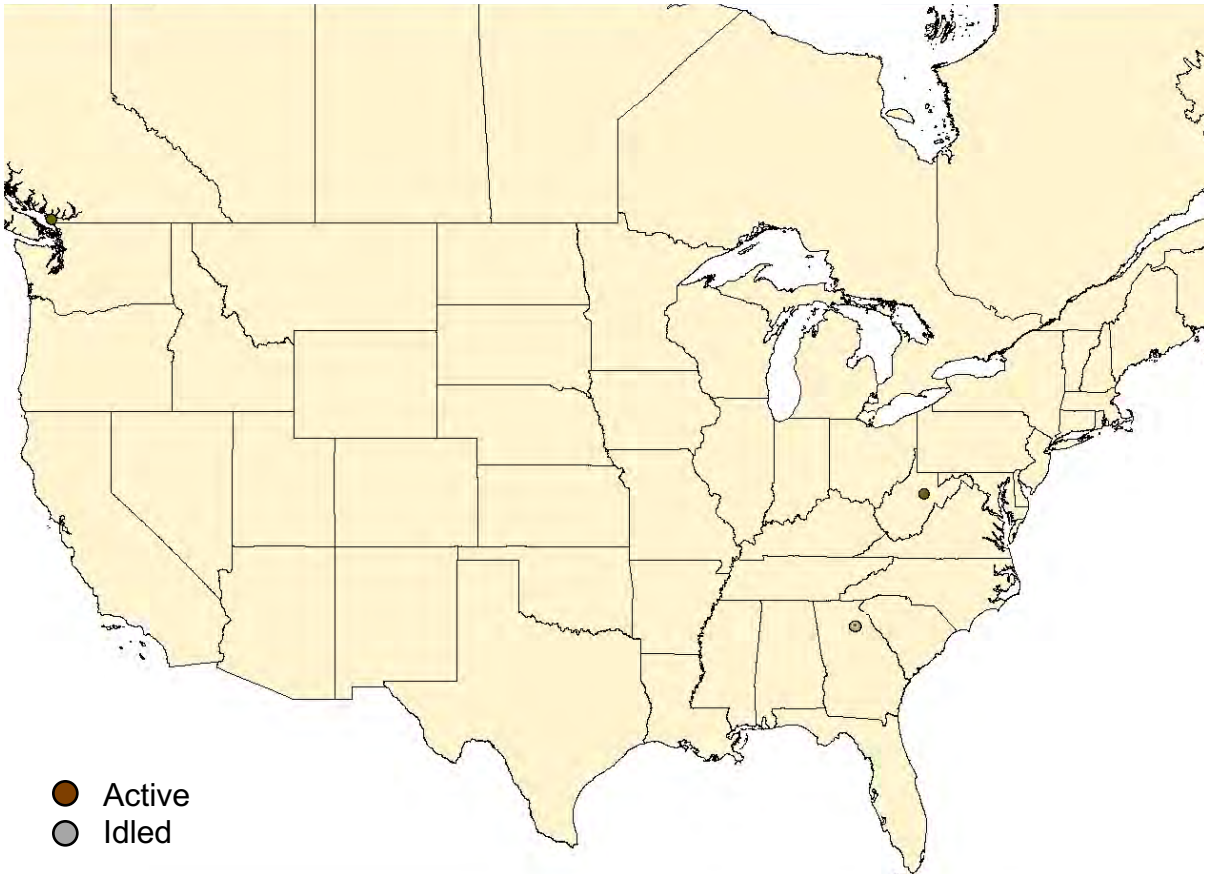
The PSL market has remained unchanged over the past years. Weyerhaeuser is the only producer in North America

- With two facilities, Weyerhaeuser is the only PSL producer in North America
  - Vancouver, Canada- capacity 4 million ft^3
  - Buckhannon, US- capacity 2.8 ft^3
- Weyerhaeuser uses a patented process to produce PSL under the brand name Parallam™
- Due to a decline in the construction market, Weyerhaeuser closed the Colbert mill in 2009, removing 3 million ft^3 of PSL capacity from the market
- Actual demand for PSL is estimated to be much lower than capacity (3-3.5 million ft^3)



PSL – MAP OF PRODUCERS

Weyerhaeuser is the only producer in North America



PSL Producers

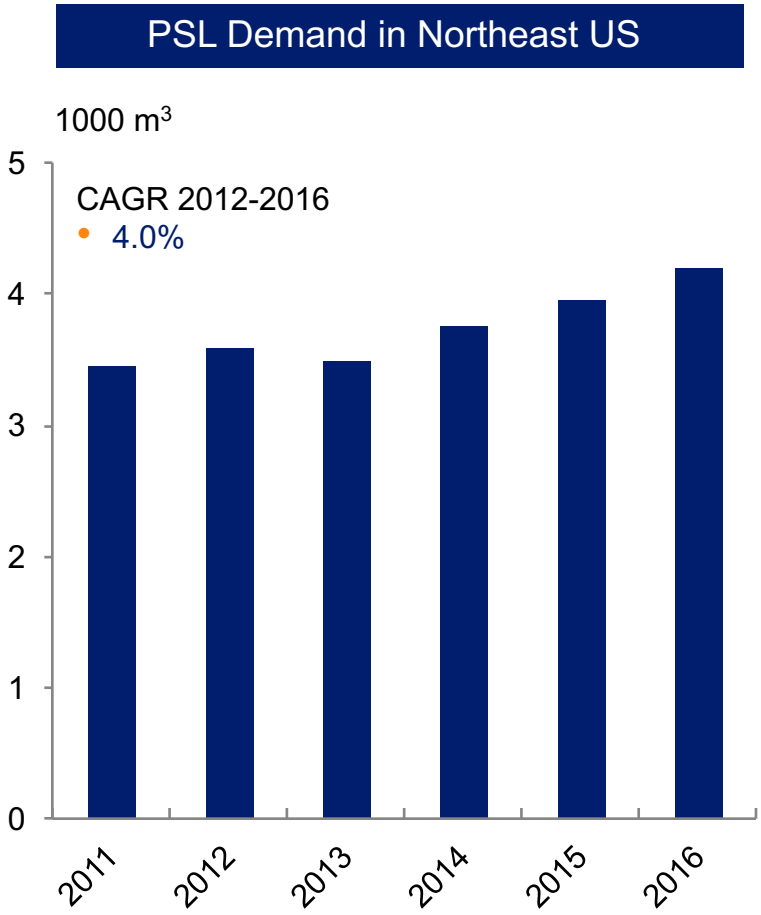
- WY, Annacis Island (BC)
- WY, Buckhannon (WV)
- WY, Colbert (GA)

**North East Producers* *Idled capacity*

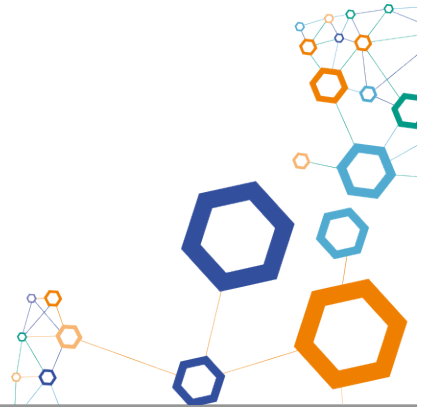
PSL – NORTHEAST MARKET

Residential construction is the main end-use segment for PSL

- About 80% of PSL is consumed by residential construction both in Northeast and in US total market
- Floor and walls are the main end-used application splitting PSL volume rather equally
- Based on known capacity, estimated PSL demand for construction in 2016 could potentially by about 4,200 m^3, which is 5% of the US total market size
- Demand growth for PSL is lower than construction industry average in US; construction growth in Northeast has been slower compared to US total, especially on the single-family housing sector, where most of PSL is consumed



MARKET ANALYSIS:
CROSS-LAMINATED TIMBER (CLT)



CROSS-LAMINATED TIMBER (CLT)

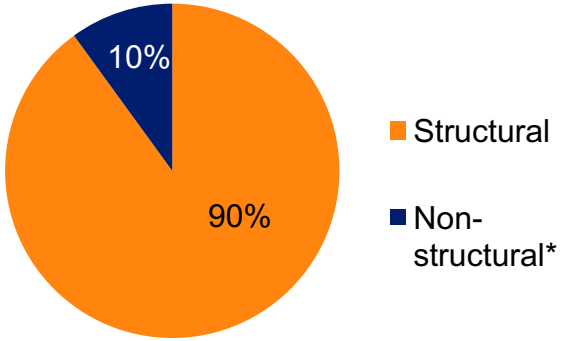
CLT can replace other traditional construction materials in high rise residential buildings

- CLT is a solid wood panel produced using several layers, usually 3-9 layers, of lumber boards, stacked perpendicular to each other and glued together.
- Because of its characteristics, the panels come in a range of sizes but typical dimensions are widths of 2-10 feet, thicknesses up to 20 inches and lengths up to 60 feet. (A length of 98 feet is possible but rare).
- The resulting panel is lightweight; only 20% of the weight of conventional structural materials, and substitutes concrete elements in structural applications.
- Typical construction applications include wall panels, roof slabs and flooring elements in multi-story buildings, as well as bridge decking.
- CLT is still in a growth phase and in the long term prices are expected to settle close to that of glulam

CLT layered structure

CLT wall elements

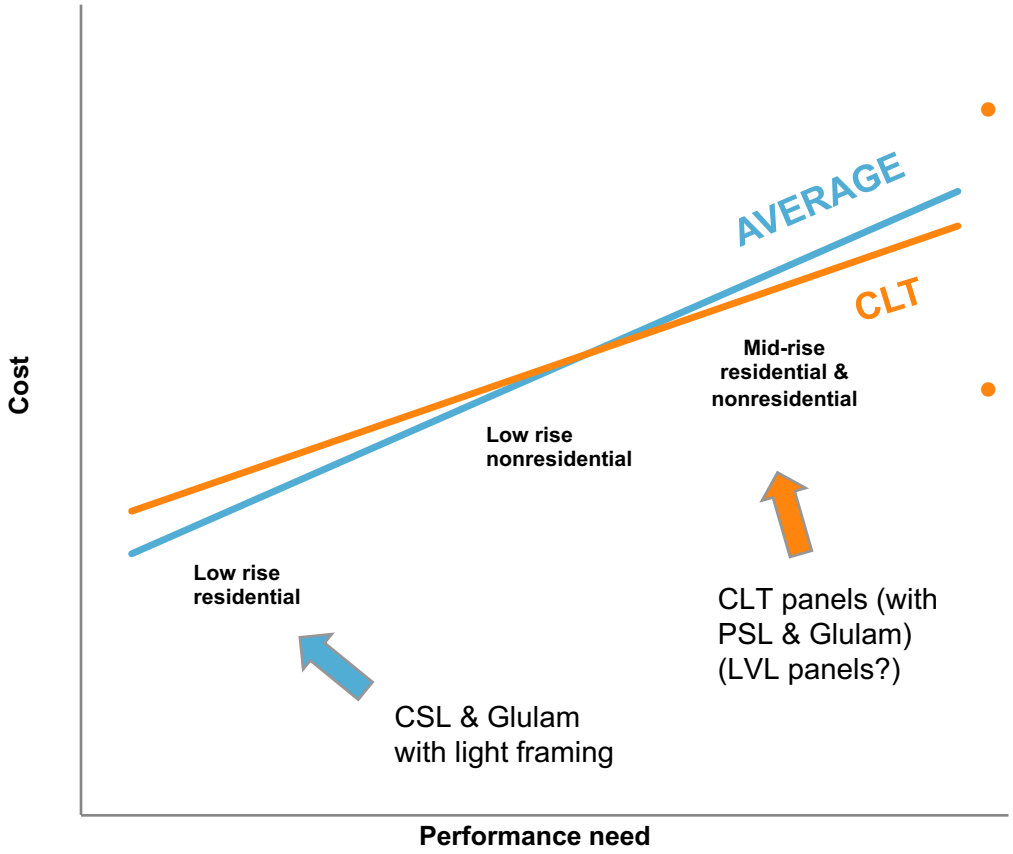
CLT End Uses in North America



** Non-structural CLT is largely composed of mats used in heavy construction.*

INDICATIVE COST & PERFORMANCE OF EWPS

CLT and mass timber is seen as most competitive in mid-rise construction applications where the share of wood is still low



Source: FP innovations, Interviews; adapted by Pöyry

- EWPs have not typically been the predominant building material in wooden buildings
- Typically glulam and composite structural lumber (LSL, LVL & PSL) have been used in light framing to complement lumber in applications where longer spans and smaller dimensions are required
- CLT could be competitive in segments where wood has not been traditionally used (mid-rise) due to building codes or even in low-rise buildings where CLT has benefits over other materials:
  - Design flexibility
  - Construction time
  - Environmental performance

CLT – NORTH AMERICAN MARKET

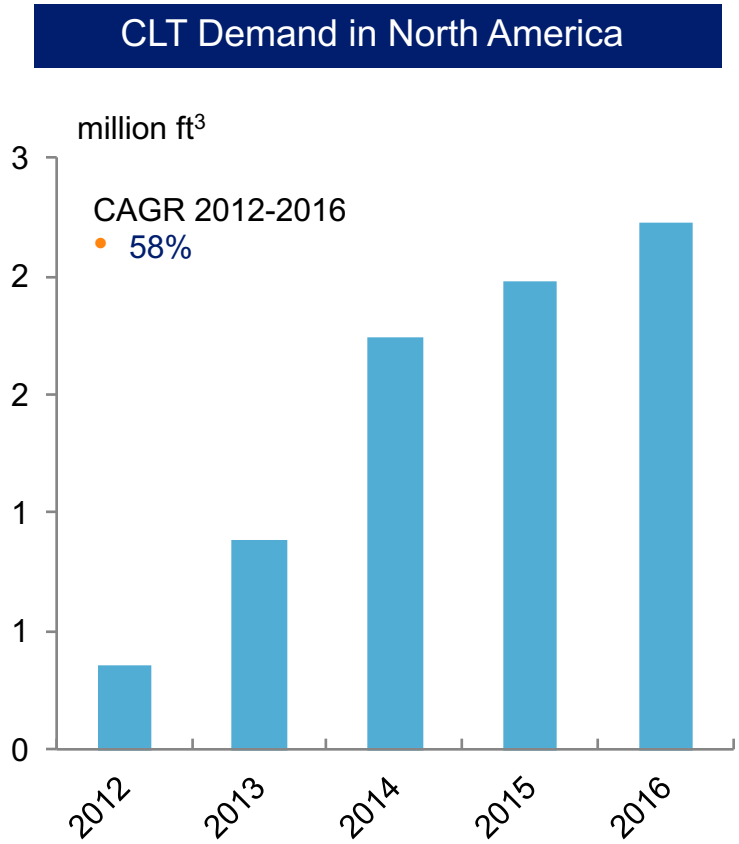
CLT is a new product in the market, which has been rapidly growing

- Less than 10 % of global CLT production is located in North America, where the first CLT mill started operating in 2010
- CLT production is concentrated in the Pacific Northwest. There are 5 CLT producers:
  - D.R. Johnson (Riddle Laminators)*, Riddle (OR)
  - Nordic Structures*, Chibougamau (PQ)
  - Structurlam*, Penticton (BC)
  - Smartlam, Columbia Falls (MT)
  - Sterling Lumber* ^ (IL)
- At the moment CLT has mainly been used in individual nonresidential construction projects as its legislative acceptance as a structural building material is still under process
- CLT has also been imported from Europe

** Produce other EWPs at the mill*
^ Produces only non-structural CLT

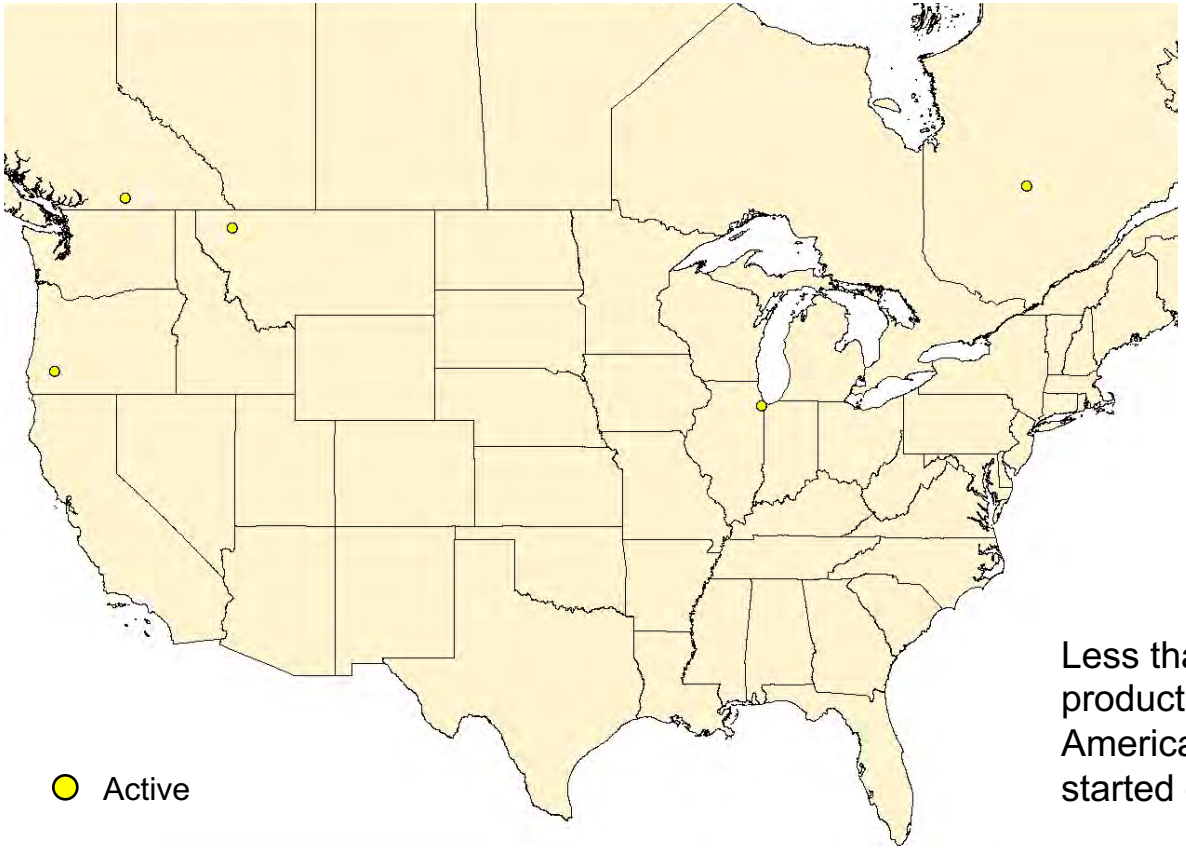
** conversion factor 1ft³ = 0.0283 m³*

2.2 million ft³ = ~63,000 m³



CLT PRODUCERS IN NORTH AMERICA

There are only 5 operating CLT mills in North America. None are in the U.S. Northeast. One is in the greater Northeast, in Canada.



CLT Producers

- D.R. Johnson, Riddle (OR)
- Nordic, Chibougamau (PQ)
- SmartLam, Columbia Falls (MT)
- StructurLam, Penticton (BC)
- Sterling, Phoenix (IL)

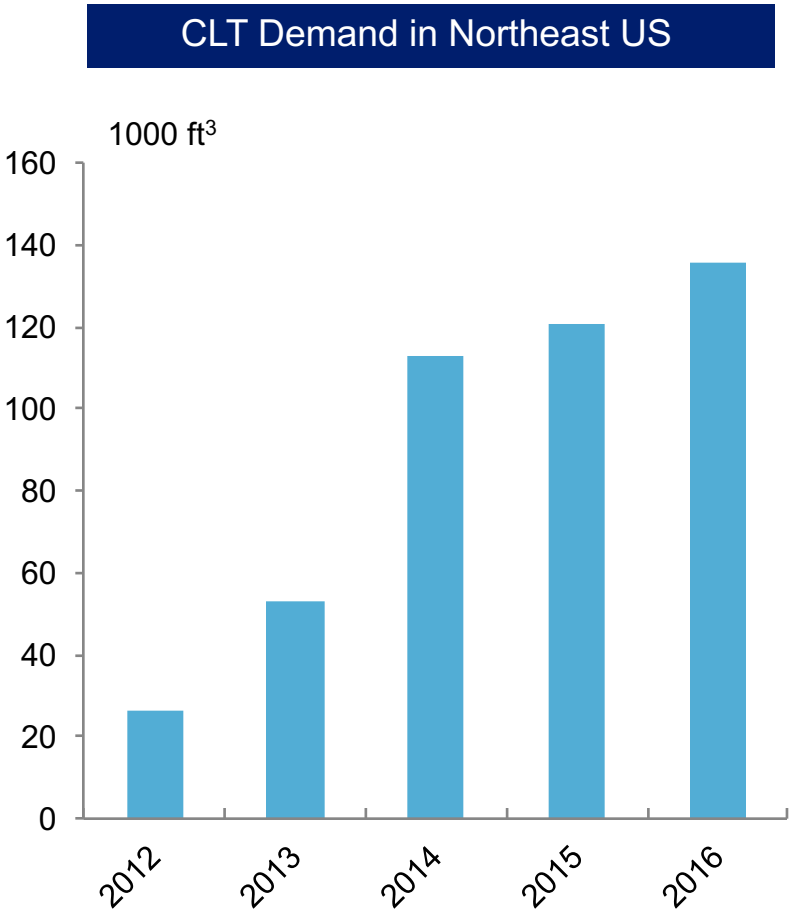
Less than 10 % of global CLT production capacity is located in North America, where the first CLT mill started operating in 2010

**North East Producers* *Idled capacity*

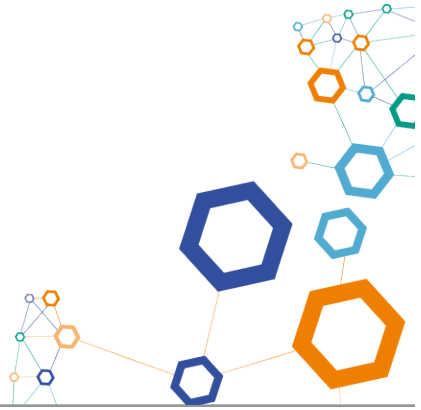
CLT – NORTHEAST MARKET CURRENT LIMITATIONS

Demand for CLT is still based on individual projects rather than true market demand

- Projects such as the Design Building at the University of Massachusetts Amherst, which was constructed by using both CLT and glulam, consuming around 70,000 ft^3 of wood
- The Northeast does not have Estimated CLT demand in 2016 for construction was ~140,000 ft^3, which is about 6% of the total U.S. CLT demand.
- CLT and mass timber is still a marginal product and not yet widely recognized by Northeast developers and construction companies.
- Lack of local supply typically restricts the market development



CONSTRUCTION MARKET & DEMAND SCENARIOS



MEETING CONSTRUCTION CODE REQUIREMENTS FOR CLT

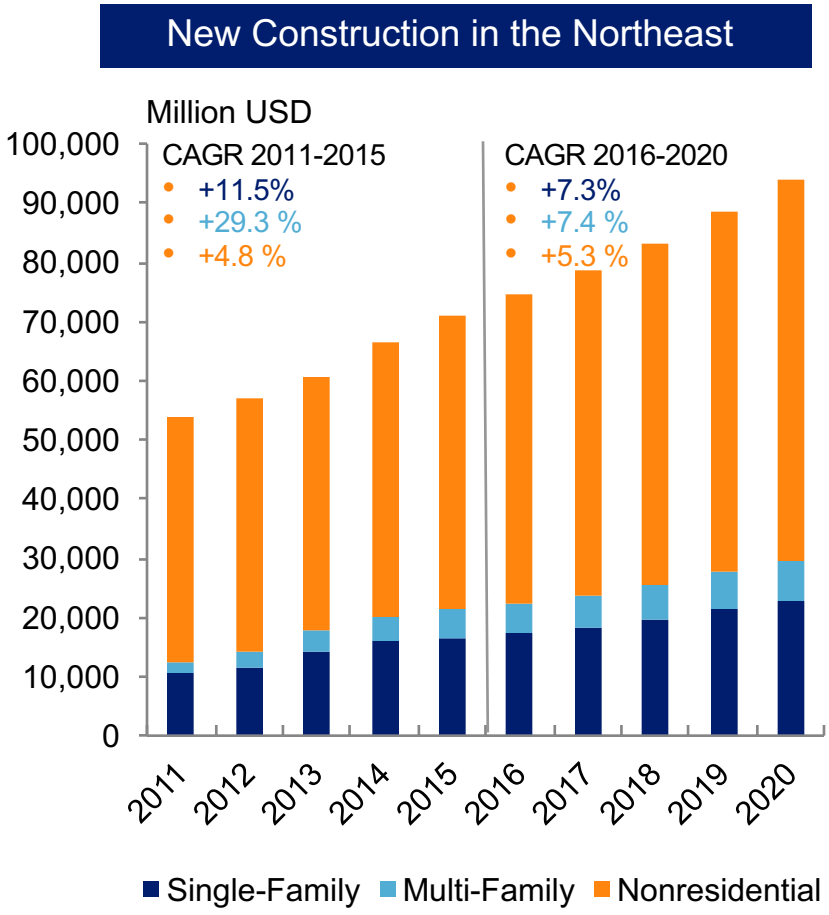
Recently approved changes in the 2015 International Building Code will streamline acceptance of CLT buildings

- Currently, US building codes do not explicitly recognize mass timber systems. Maximum height for wood-frame structures is limited to six stories (85 ft). This, however, does not prohibit EWP use under alternative method provisions, e.g., IBC Section 510 gives special provisions for certain occupancies, construction types and building configurations. Under current versions of the IBC some mass timber projects have moved forward, e.g.:
  - 475 West 18th St- a 10-story residential condominium building planned for New York City
  - Framework Project- a 12-story mixed-use building planned for Portland, OR
- The **International Building Code** (IBC) regulates health and safety concerns for buildings based upon performance related requirements. A large portion of the IBC deals with fire prevention in regard to construction and design. After CLT successfully passed floor/ceiling penetration firestop test, it was included in the 2015 IBC.
- The 2015 IBC and 2015 **International Residential Code** recognize CLT products when they are manufactured according to the American National Standards Association standard **ANSI/APA PRG 320-2012**; details manufacturing and performance requirements for qualification and quality assurance for CLT.
- CLT can be used in all types of combustible constructions (Type I-IV), i.e., wherever combustible framing or heavy timber materials are allowed.

NEW CONSTRUCTION MARKET OUTLOOK – U.S. NORTHEAST

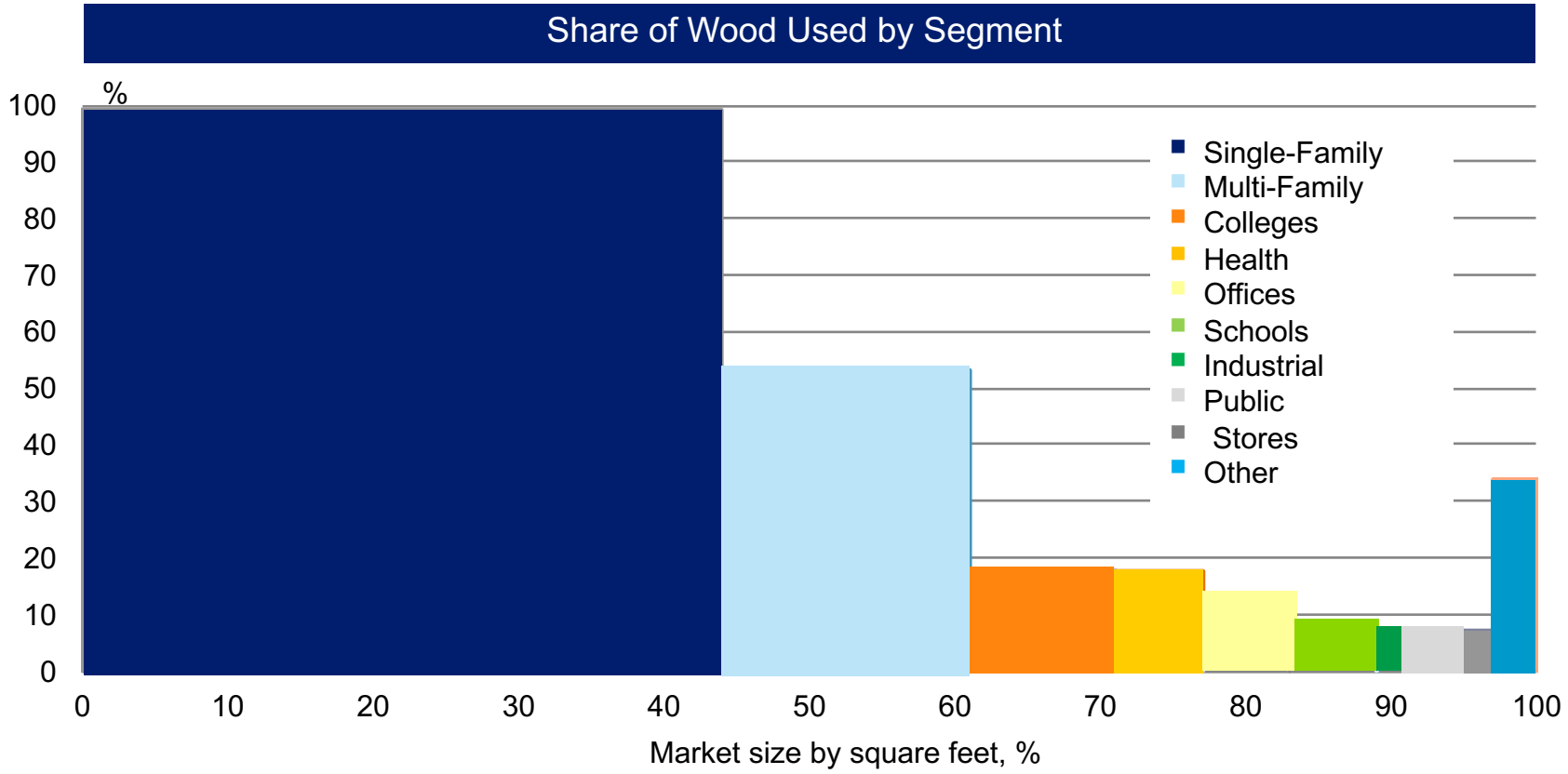
The construction industry has largely rebounded from the recession and growth is expected to continue. Non-residential construction is larger in terms of value, but smaller in terms of volume.

- While recovery from the recession started with slower growth from 2011-2012, all sectors picked up speed to achieve double digit growth from 2014-2015.
- Future growth is not likely to continue at the same rate, as labor has started to become an industry bottleneck.
- While single-family construction is still a larger market, multi-family construction has grown at a faster rate than any other construction sub-sector (CAGR 2011-2015 = 29%)
- Residential construction growth rates are expected to slow down, whereas non-residential construction growth is expected to remain stable.



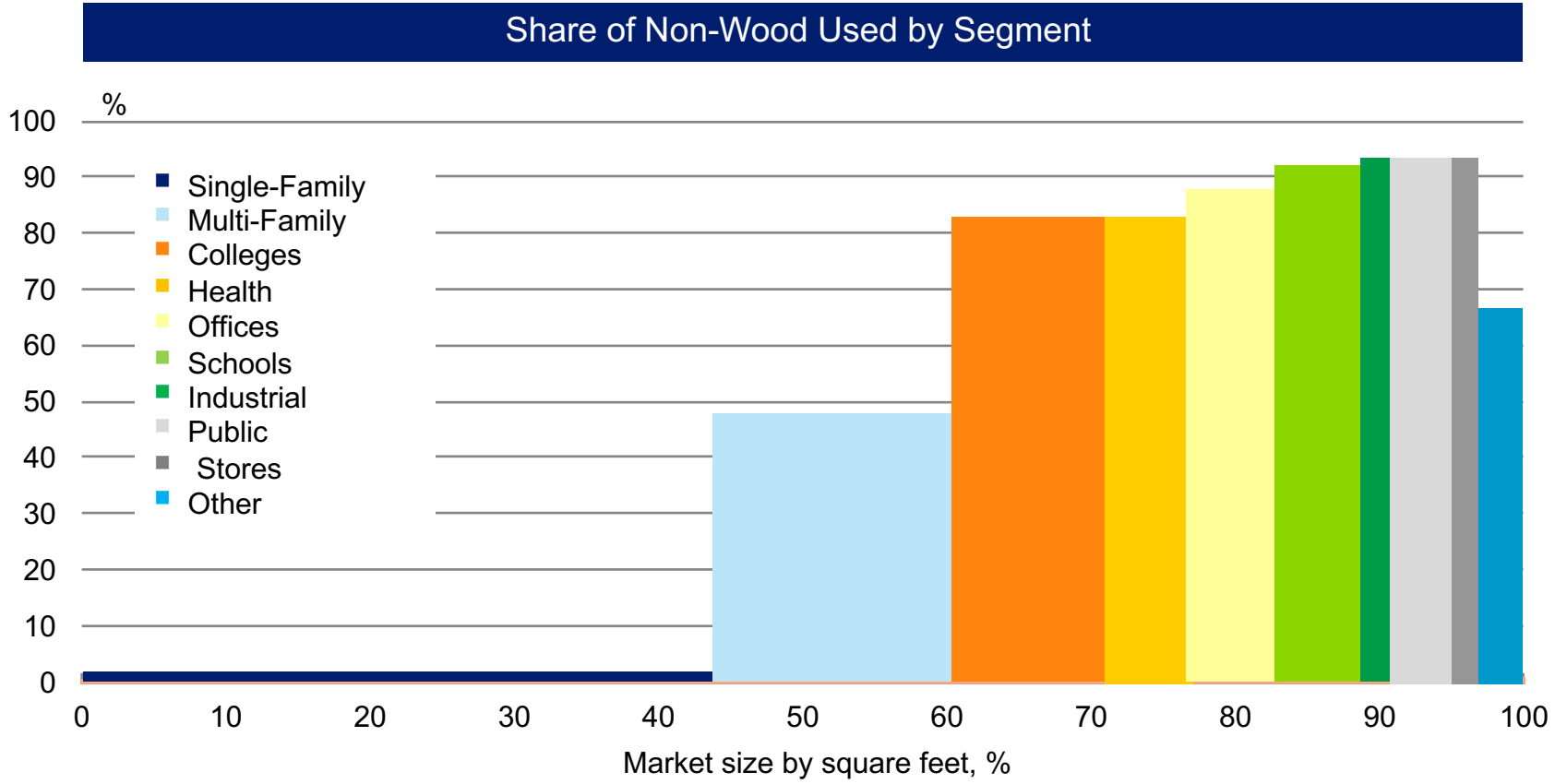
CONSTRUCTION MARKET – NORTHEAST

Non-residential and multi-family buildings provide the largest opportunity for wood to increase its presence. Wood share in nonresidential is below 20%. In multi-family buildings in the U.S. Northeast, wood's share is about 30% lower compared to the national average.



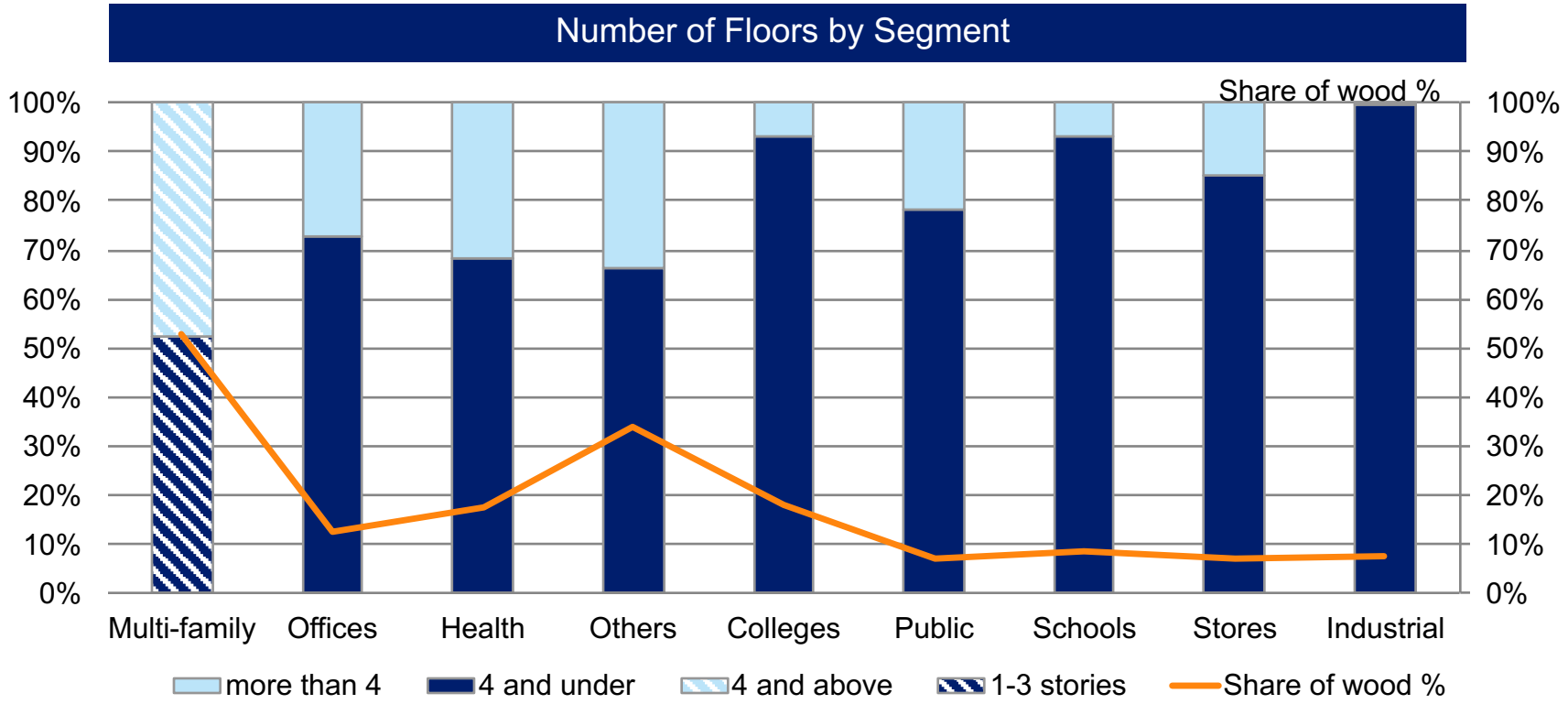
CONSTRUCTION MARKET – NORTHEAST

Non-wood (concrete & steel) construction materials currently dominate the non-residential segment, where wood occupies on average less than 20%. Room for wood to increase its market share.



HOUSING MARKET – U.S. NORTHEAST

Half of multi-family buildings are 4 stories and above. In the nonresidential segment the highest number of 4+ story buildings are offices, health facilities and hotels (part of others). Over the past decade the average number of stories has increased nationwide. In the U.S. Northeast, however, the average number of stories has not changed



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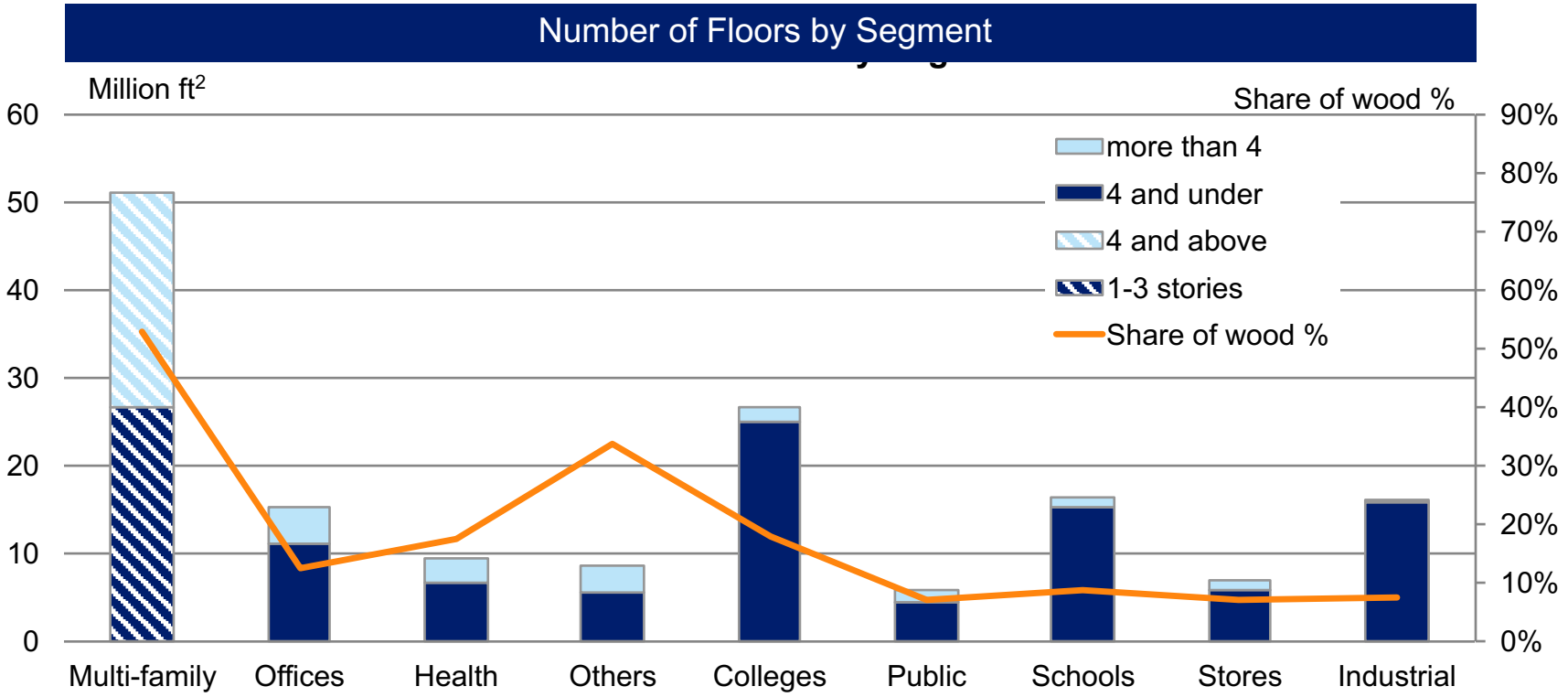
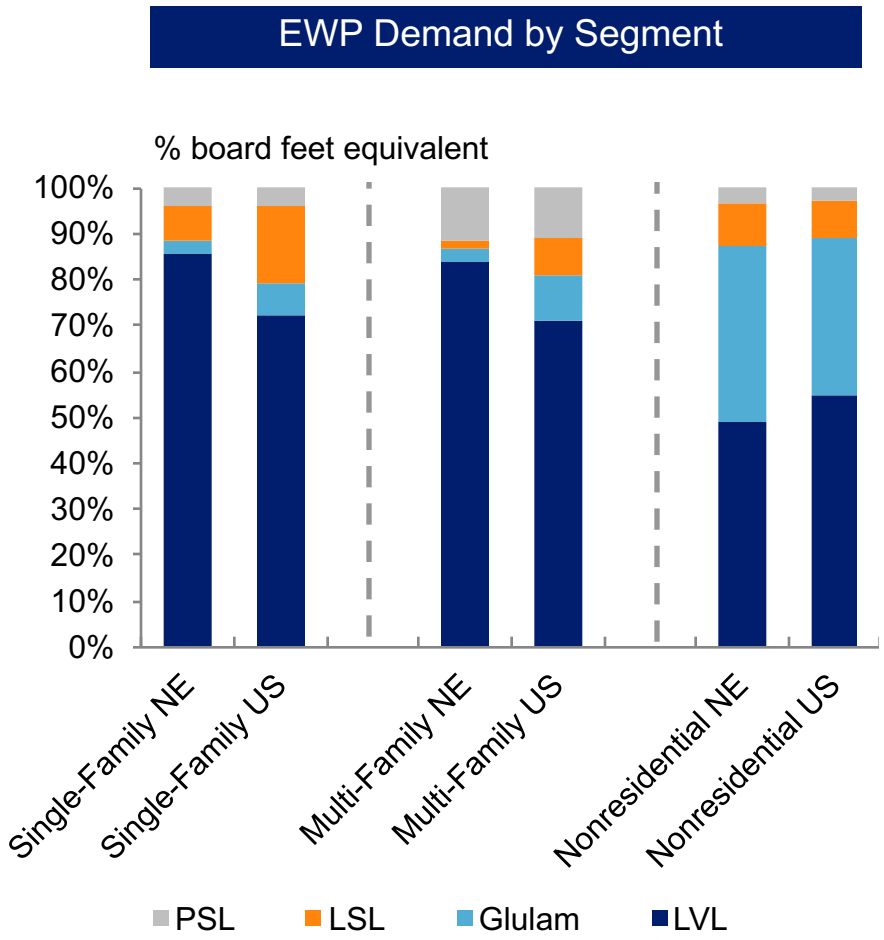


HOUSING MARKET – NORTHEAST

The Northeast has traditionally used more LVL and Glulam

- Over the past five years with slower demand growth for lumber (~5%) and wood panels (~3%), EWP have been able to capture construction industry growth and increase market share
- LVL is the largest product group, representing 75% of the total EWP market
- CLT has the highest annual growth rate at about 50%. It is still a relatively new wood product and was not yet being used for residential construction in 2012. With only one producer in the Northeast its total volume is estimated at ~140,000 ft^3
- Glulam is used primarily in nonresidential buildings. Schools and public construction consume the most volume
- A small volume of LSL is used mainly in single-family and nonresidential buildings
- Demand for EWP in the Northeast represents about 10% of the total US market



POLICIES IN WOOD CONSTRUCTION

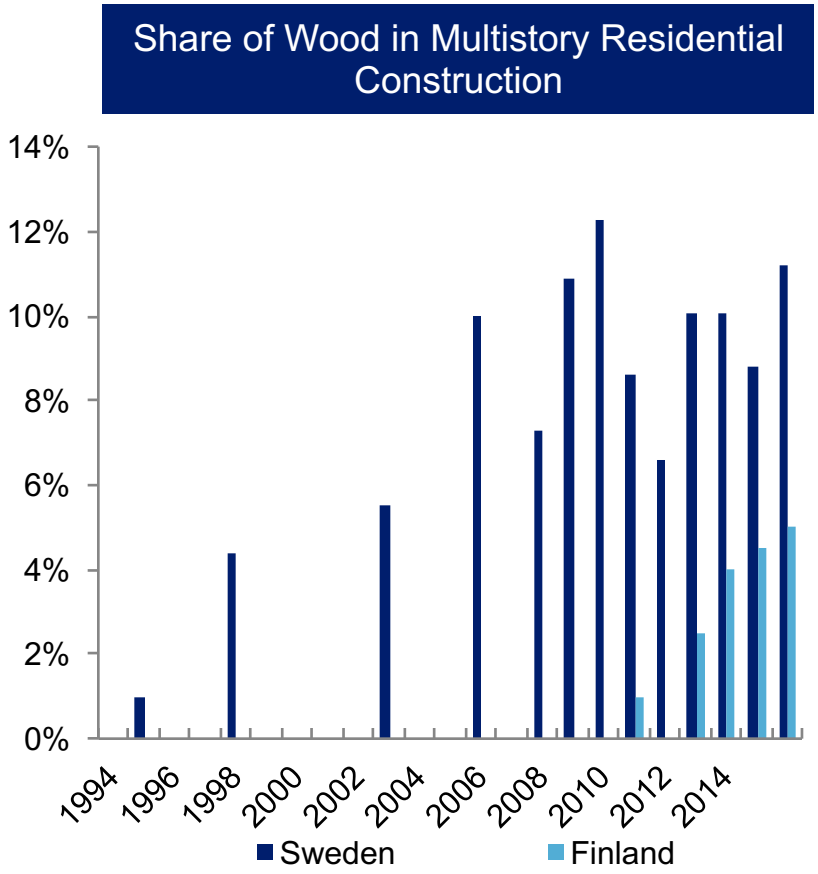
Wood has been recognized as future's building material and new policies have been established around the world to enhance the use of wood in construction.

Country	Policies and actions
Finland & Sweden	• Change in building codes • National strategy to support wood construction • Public promotion and funding for education research and development • Local wood construction initiatives, supported by land use planning
France	• The new national industrial policy with funds for research and training includes wood construction as one of the key development sectors due to sustainability and availability of local resources.
Japan	• Act for Promotion of Wood in Public Buildings • Wood Use Points Program to promote the use of local wood products in building and stimulating the use of lesser used wood species with subsidies
Australia	• Wood Encouragement Policies in several councils/regions, which generally requires wood to be considered as the construction material in public buildings.
Canada	• Wood First Act (B.C) "to facilitate a culture of wood by requiring the use of wood as the primary building material in all new provincially funded buildings, in a manner consistent with the building regulations…" • Wood First Acts are in force in more than 50 communities in B.C.

PENETRATION OF WOOD IN MULTISTORY CONSTRUCTION – SWEDEN AND FINLAND CASE STUDY

Multistory construction picked up quickly in Finland after following the example set in Sweden.

- The most important driver for increasing wooden multi-story construction has been the change in building codes
  - In Sweden the allowed number of stories was increased to 8 in 1994 and later to 16 stories
  - In Finland the change to 8 stories was applied in 2011
  - There are no common codes in Europe and very tall buildings can be built based on case specific design
- The change of building codes also encouraged EWP manufacturers to develop their concepts and to cooperate with construction companies
- Governments have also been supporting mass timber construction through various programs and cities have been developing their own mass timber construction programs and areas
- Different methods have bee used in multistory construction including light framing, modular elements and CLT



POLICY AND PROMOTION WORK IN EUROPE – FINLAND CASE STUDY

Finland has worked hard at promoting wood in taller construction with encouraging results

- **Wood construction has been identified as government's priority development areas:**
  - Building codes have changed and taller buildings can be built with wood
  - Funds have been allocated to R&D and education in timber engineering
  - Supporting cities and municipalities
  - Cooperation with the industry and on international level

  - ➢ *Local commitment to wood in construction*
  - ➢ *New residential areas have been allocated for wood construction*
  - ➢ *Public procurement of wood buildings (schools, kindergartens, etc.)*

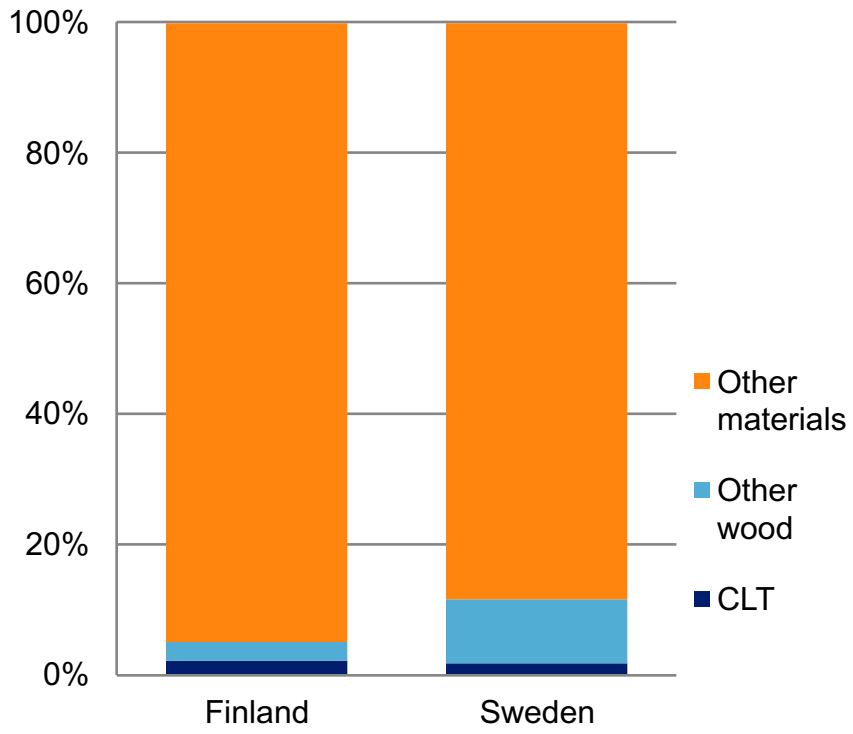
- **Industry associations and companies have promoted new uses for wood in construction**
  - Extensive lobbying and education for politicians, civil servants and construction professionals
  - Standards have been developed for design, but improvement potential still exists
  - Cooperation with construction companies with joint projects

  - ➢ 3 CLT plants & 1 LVL plant (panels and beams) since 2016
  - ➢ Growth from 0.5% to 5% share in residential multistory construction
  - ➢ Investment in prefabrication plants

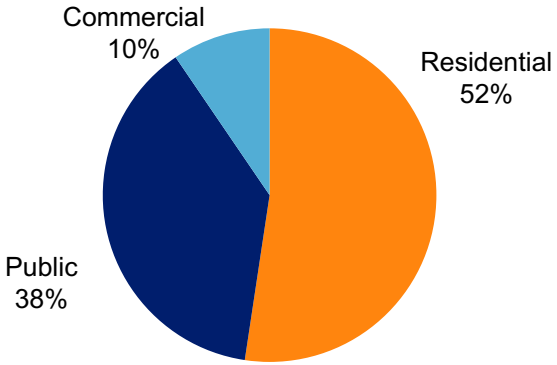
USE OF CLT IN EUROPE

CLT is not only used in multistory construction, but also in low-rise residential, public and commercial buildings

Materials in Residential Multistory Construction



CLT End Uses in Europe



- CLT has versatile end use possibilities in construction and it has also gained market share in public buildings

BUILDING WITH CLT IN EUROPE

CLT consumption is typically double compared to conventional light framing construction and project sizes can be significant

Building type	CLT consumption examples
Single family homes	Not commonly used in industrial scale, but depending on design and size from 1,000ft^3 up to 5,000ft^3 (30-150m^3)
Multifamily homes	From 500m^3 up to 1,200ft^3 per apartment (15-35m^3) Single projects consume from 10,000ft^3 up 88,000ft^3 (300-2,500m^3)
Dormitories	250-350 m^3 per room (7-10 m^3) Project up to 228,000 ft^3 have been executed in Europe
Public buildings	Kindergartens, schools and libraries have been built with CLT Typical project size varies between 7,000 m^3 and 53,000ft^3. Often low-rise buildings. (200 m^3-1500 m^3)
Commercial	Building types include offices, hotels, shops and manufacturing buildings consuming from 3,000ft^3 up to 105,000ft^3. Often low rise buildings but also mid-rise. (100 m^3 - 3,000 m^3)

INDUSTRY FEEDBACK – NORTH AMERICA

Mass timber is seen as the most attractive option in increasing the share of wood in construction

Types of Engineered Wood Products

- Most interviewees look to the Mass Timber building system (Glulam + CLT) as having the brightest future
  - Developments in **Europe** have been closely followed and **advantages** have been identified
  - **Encouraging experiences** from projects in **North America and Europe**
- OSL, LVL, and PSL will remain products limited to low-rise construction
- Light framing remains the most economical option for low-rise buildings, using a small % of EWPs

Advantages of Mass Timber

- Time on-site was cited as being the most significant driver, followed closely by reduction in labor costs
- Many architects were interested in EWPs for aesthetic reasons as a way to differentiate the building
- Saleability was also mentioned as an important driver for apartments/office buildings
- Cost savings in the foundation
- Cleaner, less congested construction sites with less truck deliveries and less heavy equipment
- Little / no experience necessary- examples of crews trained on site
- Environmental aspects – wood vs. concrete and steel

INDUSTRY FEEDBACK – NORTH AMERICA

There was general agreement from developers, architects and industry organizations concerning the potential of EWPs in Northeast

Drivers and Opportunities

- All interviewees agreed that mid-rise (from 6 to 14 stories) has the greatest potential
- Steel and concrete become more economical around 10-14 stories
- Urbanization being driven by millennials
  - Overall positive outlook in both major Northeast cities (New York, Boston) and second-tier cities (New Haven, Portland, Providence)
  - Larger cities reported to have more challenges from unions
- Potential in any type of building where components repeated- e.g., hotels, dorms, schools, offices
- Steady increase of multi-family's share of residential housing

Challenges and Solutions

- Current code approves usage up to 6 stories, but a variance is required for taller buildings
- Mass timber building is more prevalent in the Pacific Northwest due to a favorable political climate, while the atmosphere in the Northeast seems more adversarial, due to union opposition and lack of awareness
- Strong marketing and education campaigns are necessary to counter misconceptions and overall inform players across the building and construction industry
  - Misconceptions over engineered wood's performance in terms of strength and fire
- Wood is a small portion of curriculum for engineering and architectural students
- Presence at trade shows and in industry publications needed to foster interest
- Target developers to drum up demand

QUOTES FROM THE INDUSTRY

"We work primarily with commercial buildings, so we try to limit our use of wood as much as possible. We don't use it structurally. The only reason we use it is for aesthetics, i.e. ceilings or floors. I don't see engineered wood growing."

Manager in NYC office, Gensler Architects

"OSL and LVL are used on a select basis in low-rise suburban homes, when you need to make long spans. Glulam and CLT require more expertise, and these will be the primary building materials for larger projects. Nail-lam doesn't need a factory and is very economical, but you don't get quite the same strength/aesthetics as CLT."

Amir Shahrokhi, SHoP Architects

"There are some boutique architecture firms arguing for it, but then you run into a whole new set of issues: Engineered Wood Products are hard to source. Where do I even get it? From out west!"

Philip DeNormandie, DeNormandie Companies

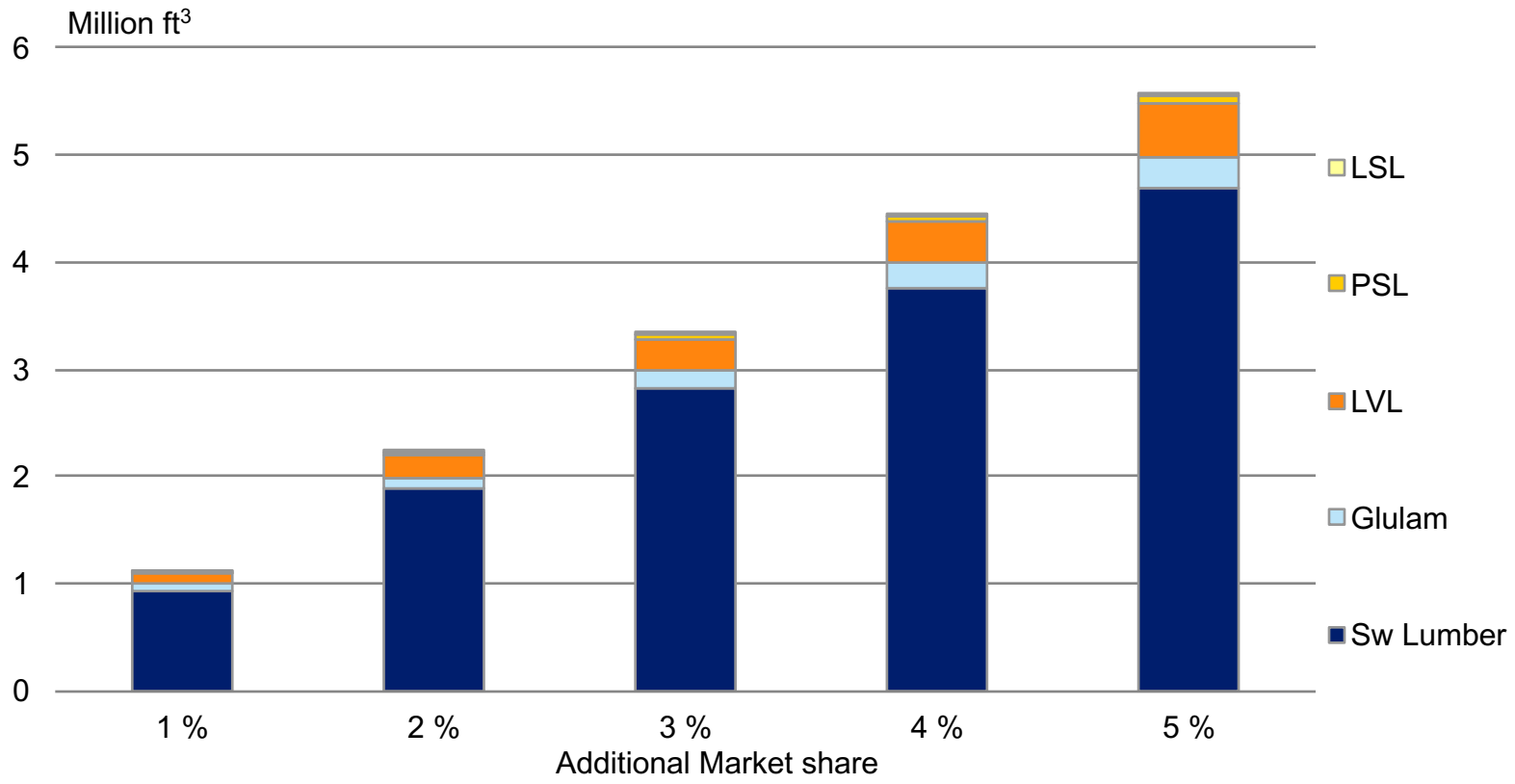
"The biggest potential is in the 8-9 story range. Steel and concrete become more economical around 10-12 stories high. Right now code limits all wood construction, whether wood-frame or CLT, to 5 stories. Right now there's just nothing in that space, and the place for those buildings is going to be places like New Haven where they are trying to densify the population, but it's not a huge city like NYC or Boston, where you have to build high."

Alan Organschi, Gray Organschi Architecture

INCREASING SHARE OF WOOD WITH EXISTING METHOD

Increasing the share of wood in multifamily and nonresidential construction in the Northeast would have a marginal impact on EWP demand

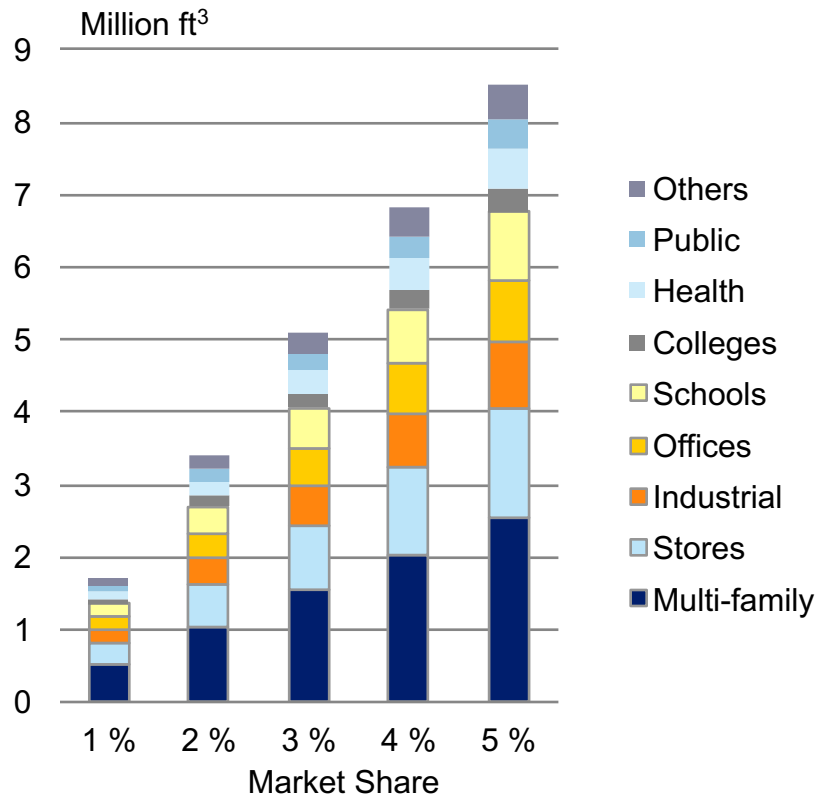
Conventional Light Framing Potential*



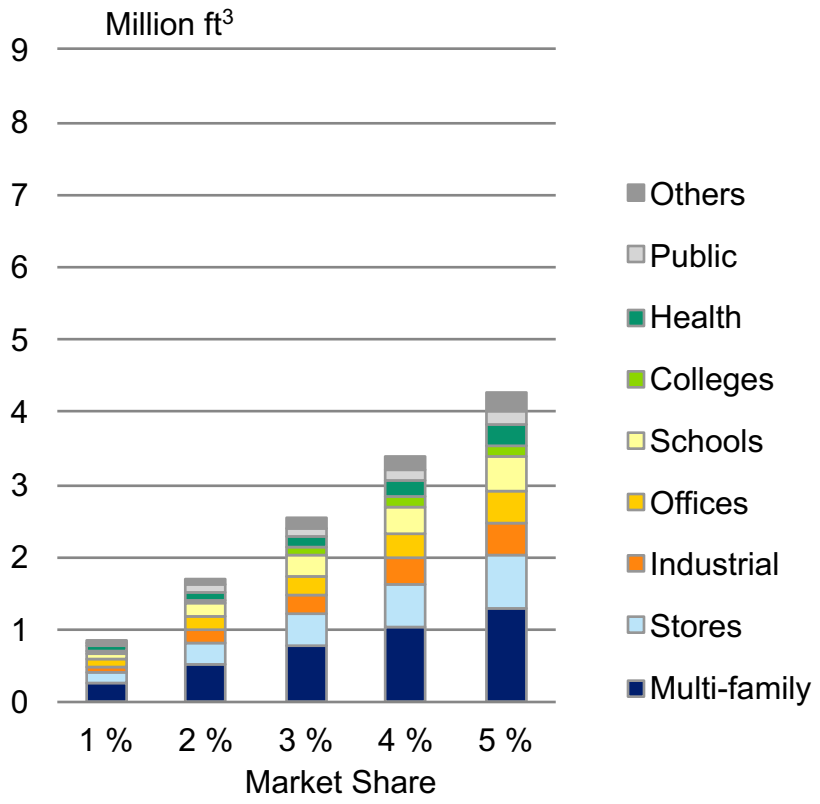
INCREASING SHARE OF WOOD WITH NEW METHODS

Introducing new methods could increase the demand for CLT or glulam significantly and support local investments

CLT Potential*



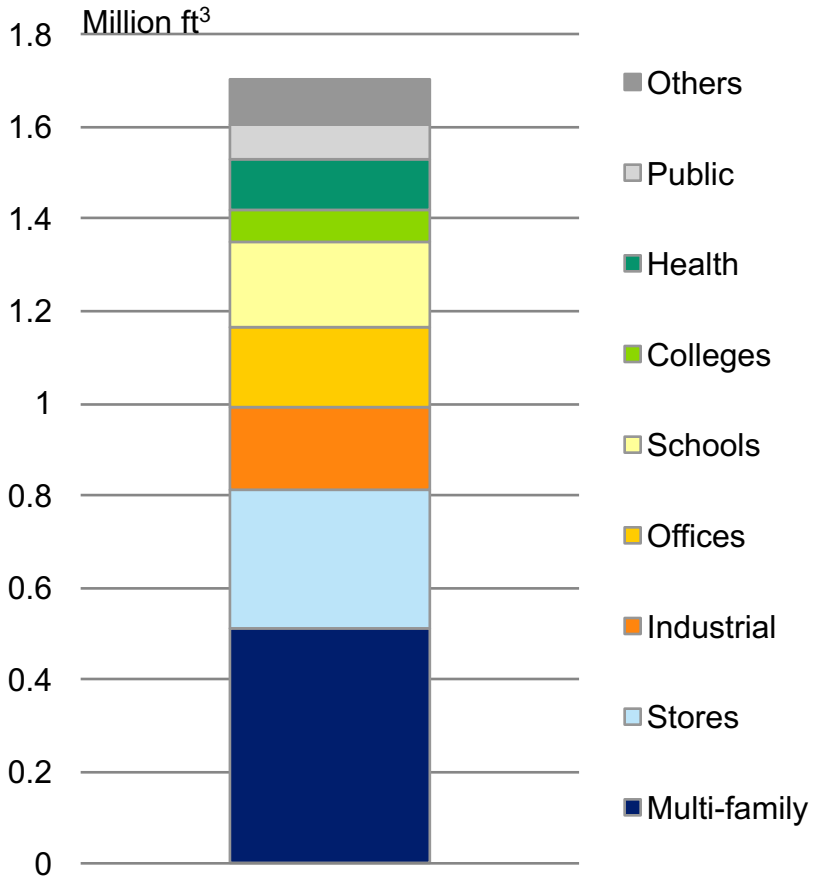
Post and Beam Potential*



*1ft^3 of CLT /ft^2, 0,5 ft^3 Glulam or LVL /ft^2

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?

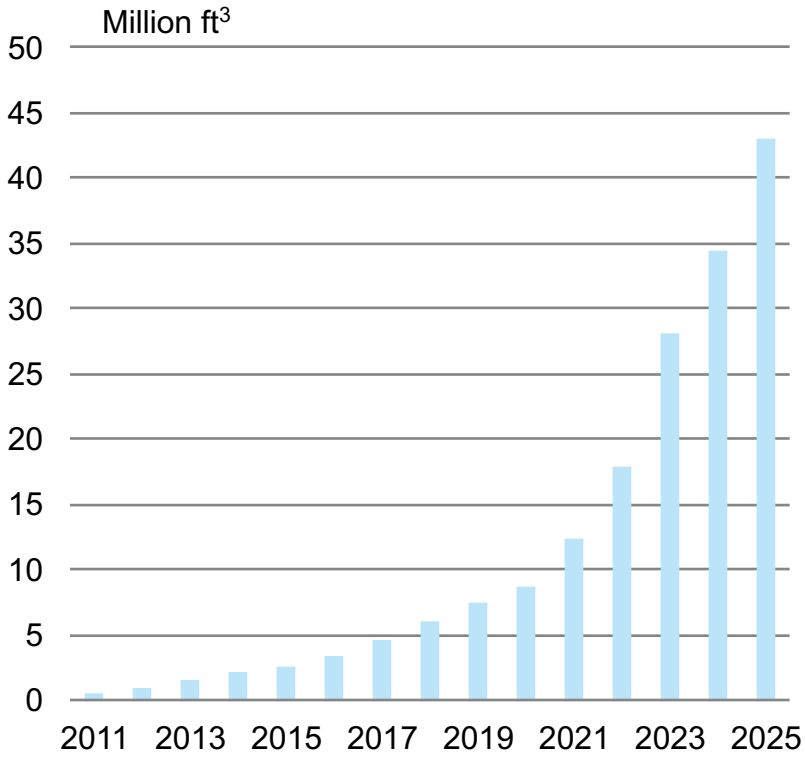
3 bigger shopping malls

400-500 apartments

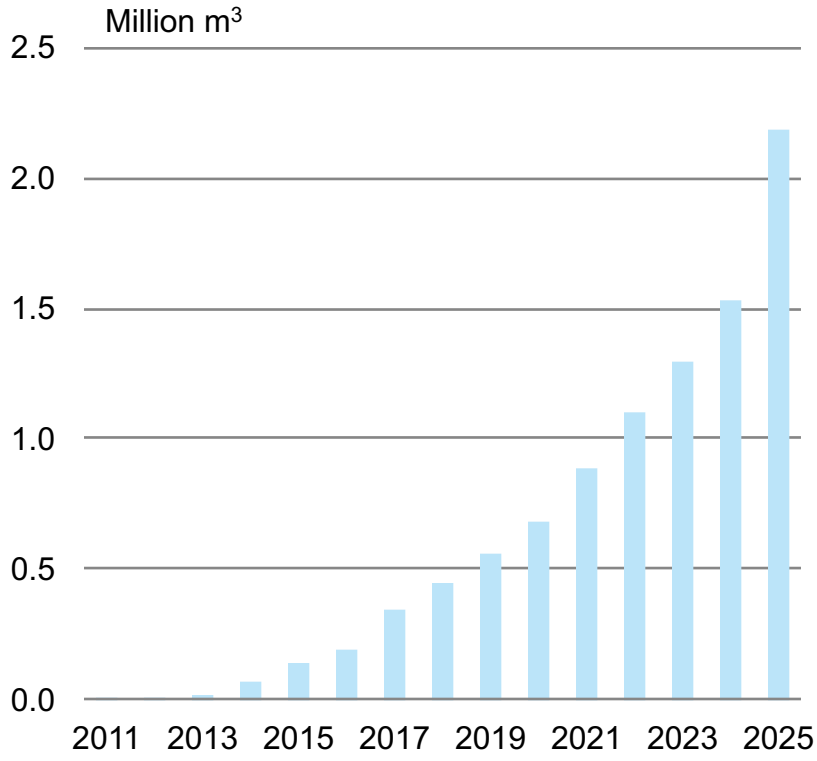
CLT DEMAND DEVELOPMENT WITH EUROPEAN GROWTH CURVE

The CLT market is 5-10 years behind Europe. If CLT were to penetrate the market as in Europe, the market potential would support several investments in the US

North America



US Northeast



POLICIES TO ENCOURAGE CLT IN THE U.S. NORTHEAST

Policy	Context and notes
Favorable building codes	• IBC 2015, soon to be adopted in the Commonwealth of Massachusetts and other states, recognizes mass timber, but only to six stories. Six to twelve stories, however, is the most likely market for mass timber, at that point surpassing stick frame and when steel is not yet competitive. Without amendments, six stories and up requires a variance. • States like Massachusetts and Maine would have to adopt amendments to the IBC 2015.
Mass timber mandates?	• It is unlikely that mandates to build with mass timber would work in the U.S. Northeast political environment, where lobbies for other building materials, such as a concrete and steel, are strong. An effort to mandate mass timber for state-owned buildings in Maine was defeated by testimony from those industries.
Mass timber incentives?	• It is possible that individual states, such as the State of Maine or the Commonwealth of Massachusetts, could add incentives to using mass timber to procurement policies.
Mill development incentives	• The U.S. Northeast has attracted investor interest in developing mills and/or fabrication facilities that can accommodate CLT. It is possible to use economic development incentives aimed at preserving or creating manufacturing through tax incentives for mill structures to encourage mill development. It is also possible to direct state procurement policies toward mass timber for public buildings, creating the demand for local mills.
CLT workforce training	• One of the barriers to mass timber use is lack of familiarity with the material among the construction trades. Local community colleges and other worker training programs have programs which could presumably accommodate training in mass timber construction.

EXISTING POLICIES WHICH COULD BE ADAPTED

The following is a review of current economic development efforts and greenhouse gas emissions reduction programs which could incentivize mass timber.

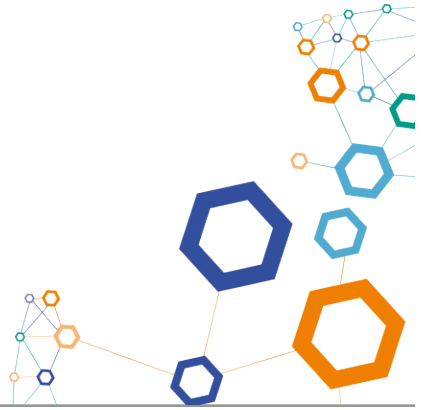
Policy/funding	Context and notes
EDAT effort, Maine	• The Economic Development Assessment Team is a federal effort to leverage multiple federal agencies to create economic development strategies for rural Maine in the wake of losses in the pulp and paper industry. This effort has resulted in $450K grant to U. Maine to develop a Mass Timber Commercialization Center, with the aim of bringing a CLT manufacturer to Maine.
Economic development	• State-based economic development incentives could also be applied. In Massachusetts, these are implemented as tax credits for manufacturing creation and retention.
Affordable housing assistance	• CLT makes sense for affordable housing, but the design costs are currently a barrier. Individual states could help subsidize the initial design process costs to assist affordable housing developers price out and design for CLT. The Commonwealth of Massachusetts Office of Housing and Economic Development has expressed interest.
Smart growth grants	• Massachusetts example: Smart Growth Housing Trust fund for facilitating smart growth housing development.
Carbon credits	• Current carbon reduction programs do not recognize materials in the building segment as a source of greenhouse gas emissions reduction. In the building sector, only energy efficiency measures are currently counted. CLT credits could be used as off-sets in the Regional Greenhouse Gas Initiative, which spans the U.S. Northeast, and could be counted toward emissions reduction targets outlined in the MA Global Warming Solutions Act.

CONCLUSIONS

CLT is seen as the engineered wood product with the most potential in terms of investment opportunity and market demand

- Engineered wood products (excl. CLT) in North America have their own specific end-uses mainly in residential construction. Demand clearly follows construction activity, whereas in Europe engineered wood products have been growing much faster than construction by substituting other products and materials. The use of glulam and CLT is more common in Europe, whereas in North America the LVL market is considerably larger.
- Current capacity for LVL, LSL, PSL and glulam is able to supply increasing demand in the near future which is expected to grow at the same pace as housing starts. Capacity also exists in or nearby the Northeast, but there are no CLT mills in the Northeast to supply anticipated growth.
- Entry barriers for CLT investment are much lower due to smaller mill size, CAPEX and raw material consumption.
  - Industrial scale CLT and glulam mills from 700,000 ft^3 or 20,000 m^3/a production
  - Structural Composite Lumber mills (LVL, LSL, PSL) typically closer to 35 million m^3 or 100,000 m^3/a production
- Most construction and industry players consider mass timber (CLT and glulam) as the most promising options in penetrating new construction segments with wood.
  - Structural Composite Lumber (LVL, LSL, PSL) are seen mainly products for low rise construction
- Wood consumption in mass timber buildings is typically double that of conventional light framing and in light framing the share of EWPs is marginal.
- The share of wood in building segments especially suitable for mass timber is low. Reaching 1% market share in the Northeast with CLT in multifamily and nonresidential construction would create 1.8 million m^3 or 50,000 m^3 demand – feasible market for 1-2 mills.

WOOD SUPPLY



TIMBERLAND BY STATE GROUPING

More than half of the timberland in New England are in Maine

Acres (000)	CT-MA-RI	NH-VT	Maine	New England
Private – Corporate	541	1,423	10,777	12,741
Private – Family	2,915	5,748	6,155	14,818
All Timberland*	4,987	9,118	17,172	31,277

As defined by the USDA Forest Inventory & Analysis Program:

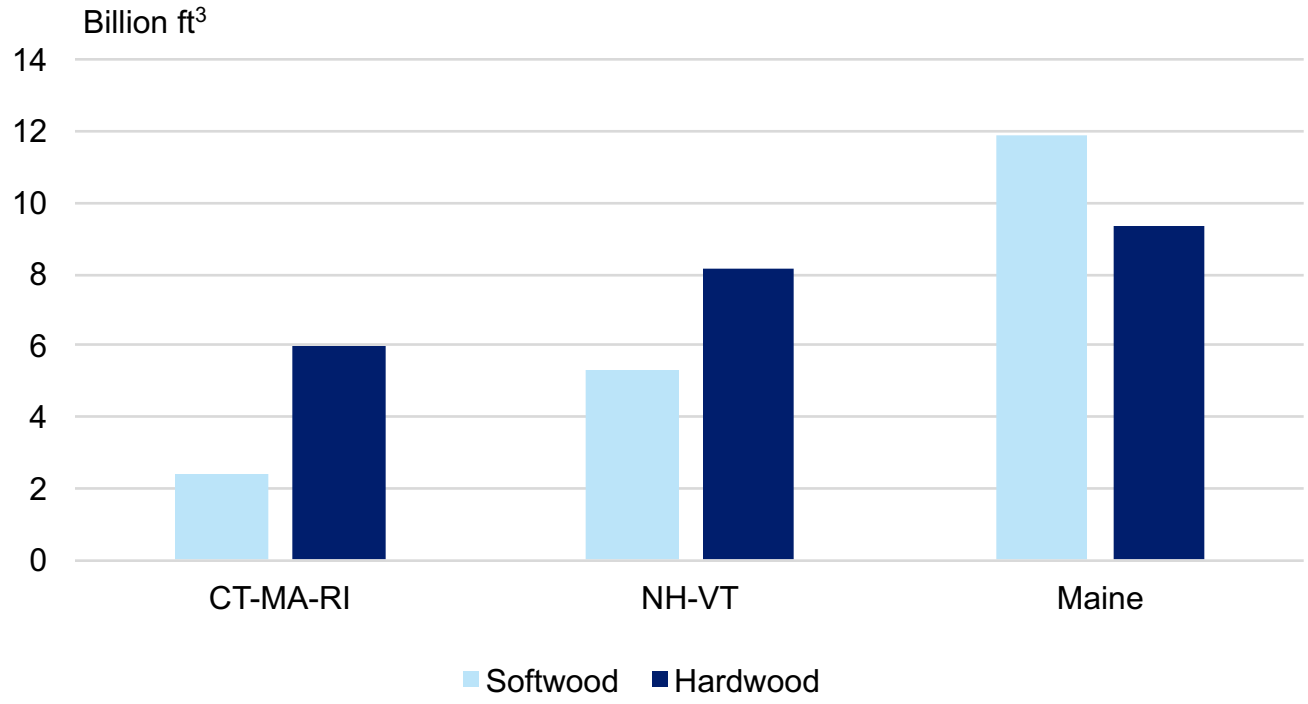
> *Timberland:* Forest land producing or capable of producing crops of industrial wood (more than 20 cubic feet per acre per year) and not withdrawn from timber utilization (formerly known as commercial forest land). http://www.fs.fed.us/ne/fia/methodology/def_qz.htm

* *All Timberland* includes land owned by federal, state and municipal governments

Data Source: AF&PA State Economic Impact summaries, August 2016, http://afandpa.org/our-industry/economic-impact

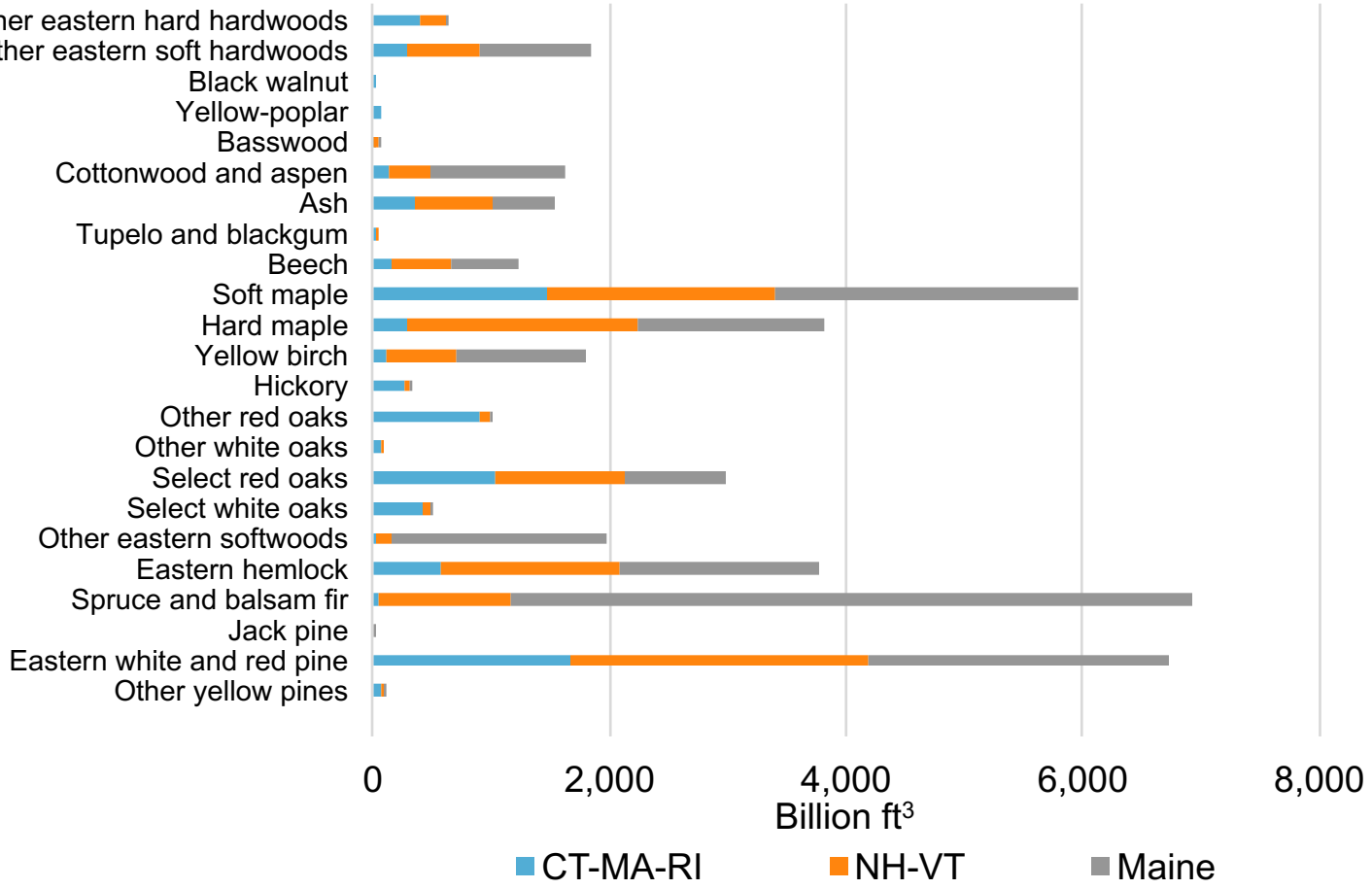
STANDING VOLUME (GROWING STOCK) BY STATE GROUP

Maine is the main source of wood in New England and the only state with a majority of softwood resources



STANDING VOLUME (GROWING STOCK) BY SPECIES GROUP

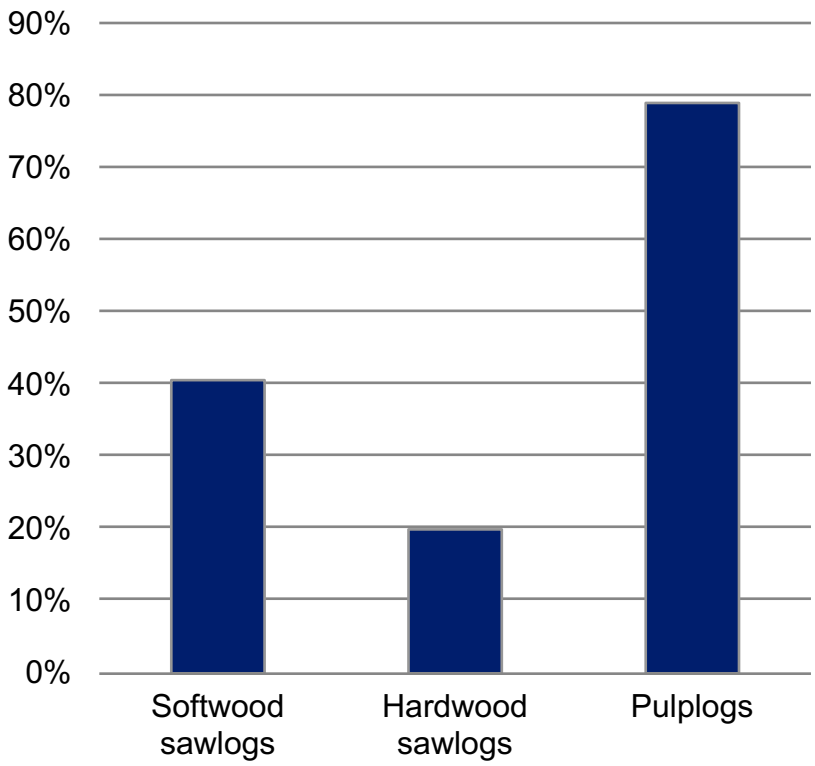
Maine has the largest resources for species favored in the lumber industry (spruce/fir and white pine)



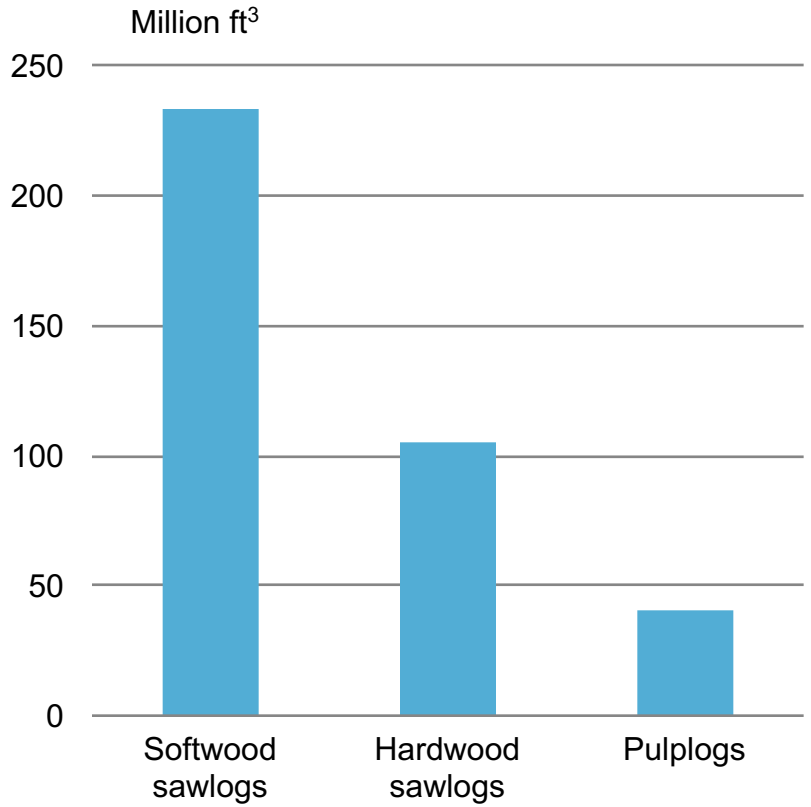
FOREST UTILIZATION IN NEW ENGLAND

There is potential to increase the use of sawlogs, but demand for pulpwood (standing and parts from the sawlogs)

Removals/Growth



Growth-Removals



RAW MATERIAL REQUIREMENT FOR CLT

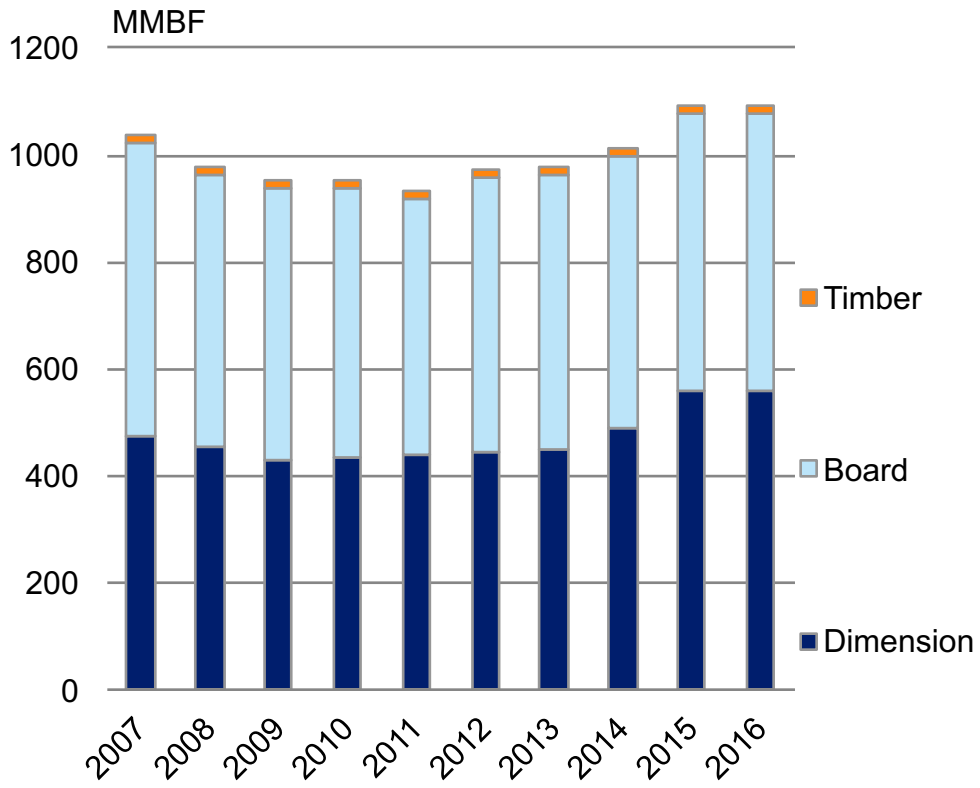
Theoretically, all eastern softwoods could be used in CLT manufacturing, but only spruce-fir is readily available

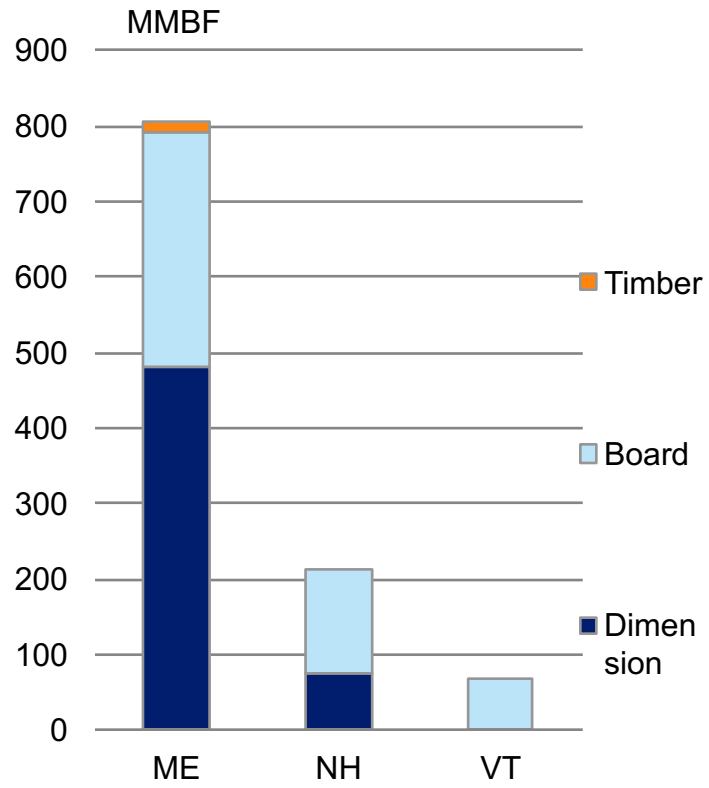
- According to the CLT handbook, the CLT standard permits the use of any softwood lumber species with minimum specific gravity (SG) of 0.35
- Lumber grade has to meet No. 3 in the parallel layers and No. 2 in the perpendicular layers
- Alternatively lumber can be Machine Stress Rated with minimum grade of 1200f-1.2 E
- All Eastern softwood species meet the specific gravity requirement, but hemlock and white pine should be cut to required dimensions and structurally graded

Species	Specific gravity	Issues
Eastern spruce	0.41	Most common structural lumber species in New England. Sawn in larger industrial scale dimension mills and transparent market exists
Balsam fir	0.36	
Eastern hemlock	0.41	Sawn mainly in small sawmills and not commonly available as structural lumber
Eastern White pine	0.36	Typically sawn in board mills and utilized for appearance applications

SOFTWOOD LUMBER CAPACITY IN NEW ENGLAND

20,000 m^3 CLT plant would require roughly 25,000 m^3 (15 million BF) of lumber which is around 3% of the current dimension lumber capacity in New England. Most of the suitable capacity is located in Maine

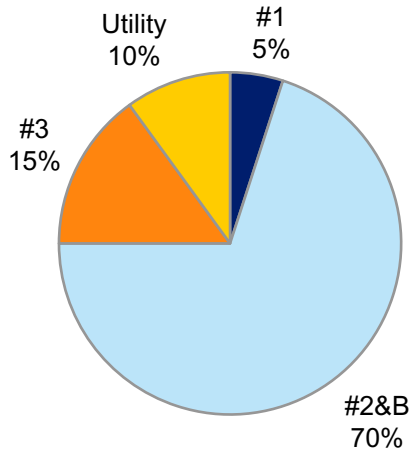




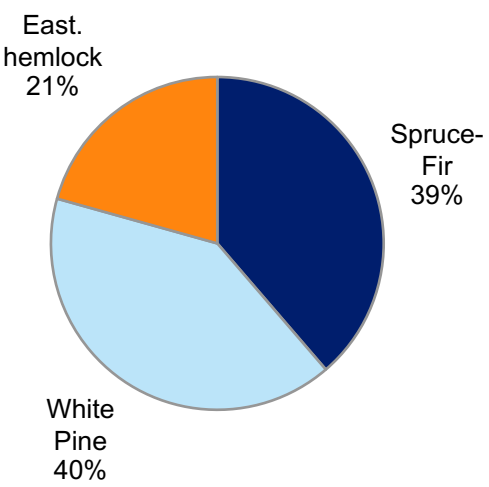
RAW MATERIAL SUITABILITY

Roughly 85% of the spruce-fir dimension lumber grades in New England are suitable for CLT production. Other species would require structural grading

Typical Grade Distrib., SF mills



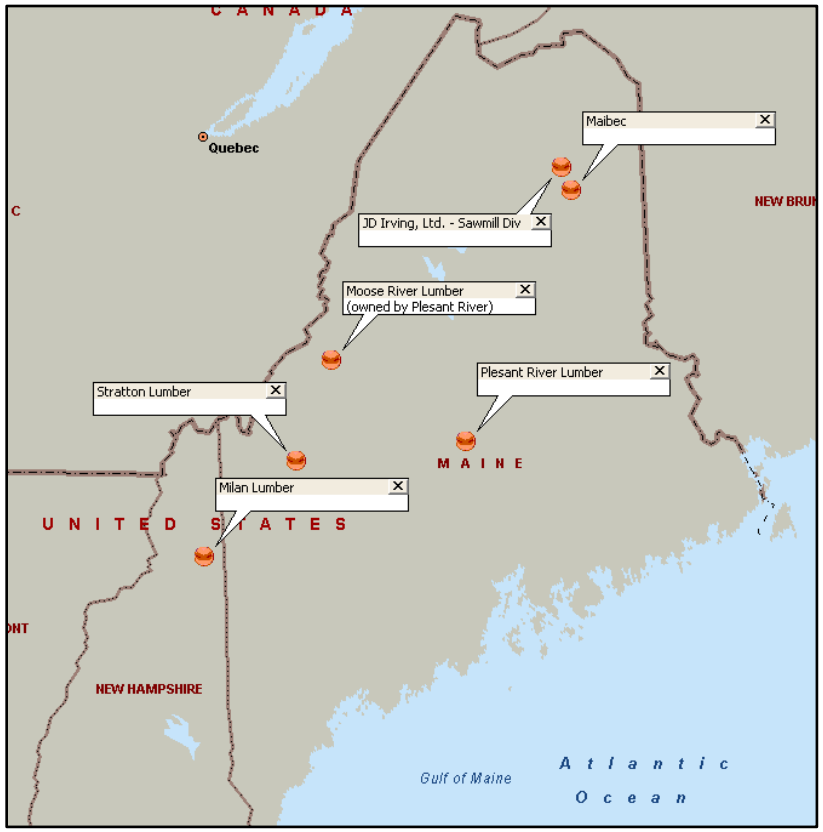
Sawlog Removals

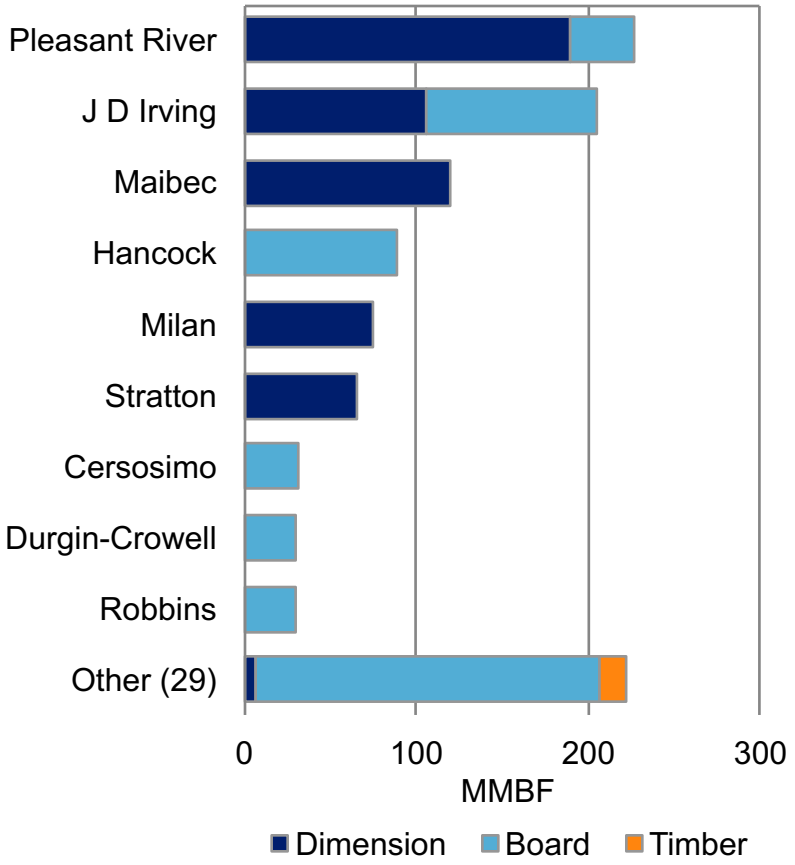


- Spruce-fir mills are in a good position to supply raw material for CLT production. SF lumber is a traded commodity.
- Products are graded for structural purposes and meet the requirements of CLT.
- A number of mills saw hemlock along with a number of other local species, often hardwood and softwood. It is common for these mills to be smaller, and many engage in custom sawing. Grading is not meeting the CLT production requirements. Part of the hemlock sawlogs are not utilized lumber production.
- White pine is used more in visual end-uses and not for structural purposes. Typically pine is sawn into 1 inch boards, which could be used in CLT made from multiple species if it were structurally graded and meeting the strength requirements.

SAWMILL INDUSTRY STRUCTURE IN NEW ENGLAND

Most of the dimension lumber is produced in Maine and in the largest sawmill companies in New England.





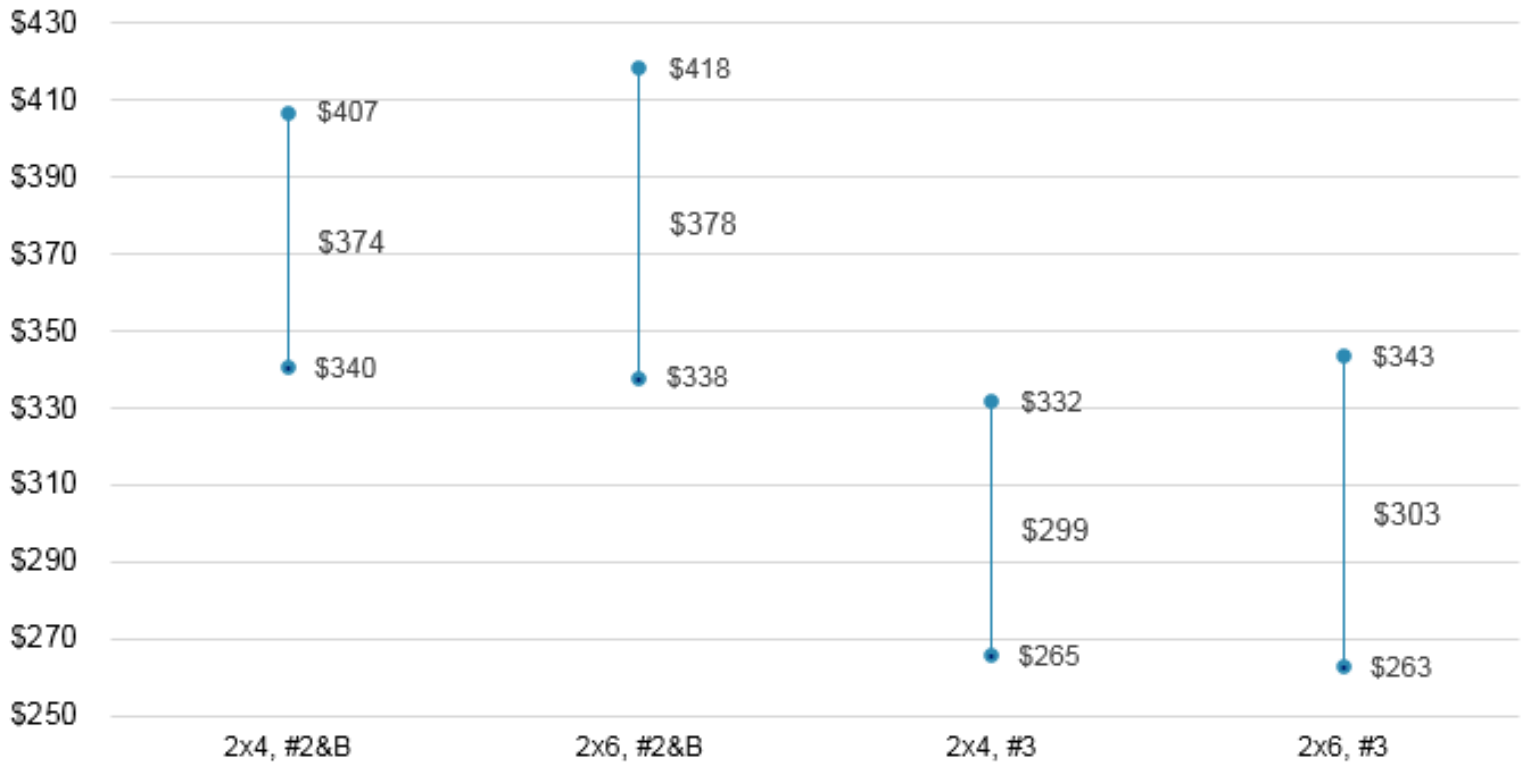
SPRUCE – FIR LUMBER PRICE, FOB MILL

Lumber prices in New England are very cyclical, similar to North America in general

Dollars per Board Foot, Grade 2 and Better, New England

PRICE RANGE – S/F FOB MILL, NEW ENGLAND

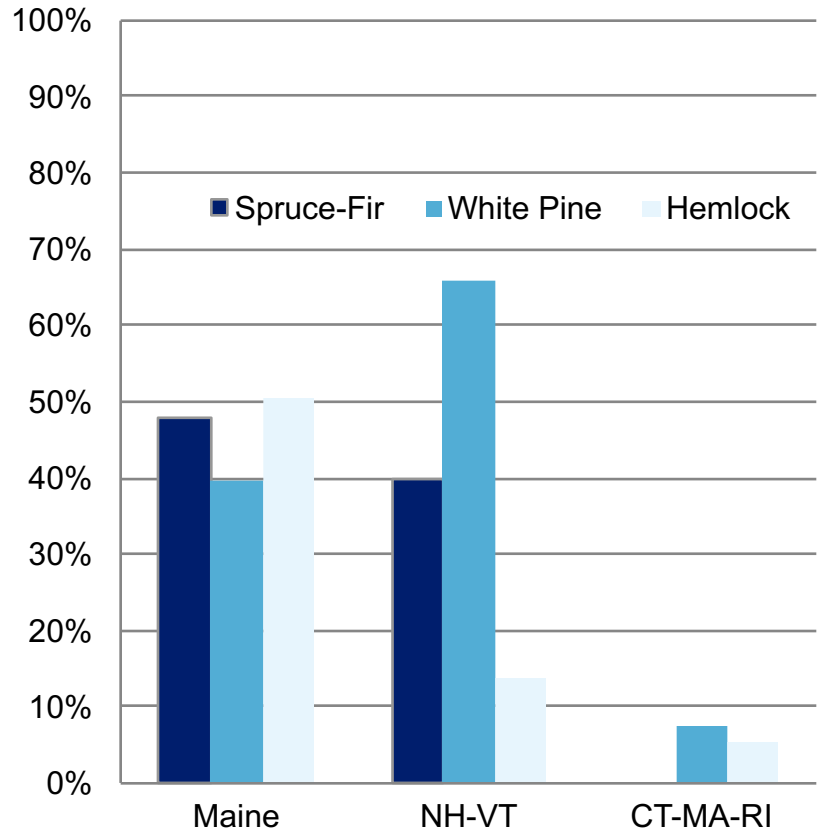
Dollars per Board Foot, mean and 1 standard deviation



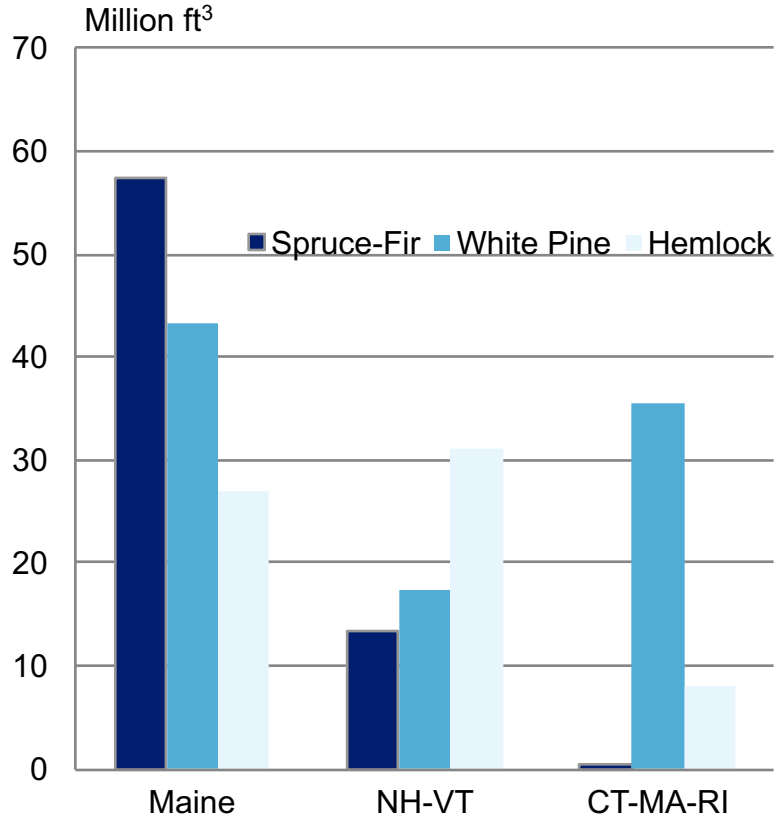
SAWLOG POTENTIAL

Theoretical potential exists for all species, but mobilization would require demand for other assortments (pulpwood and chips) and species as well

Removals/Growth



Growth-Removals

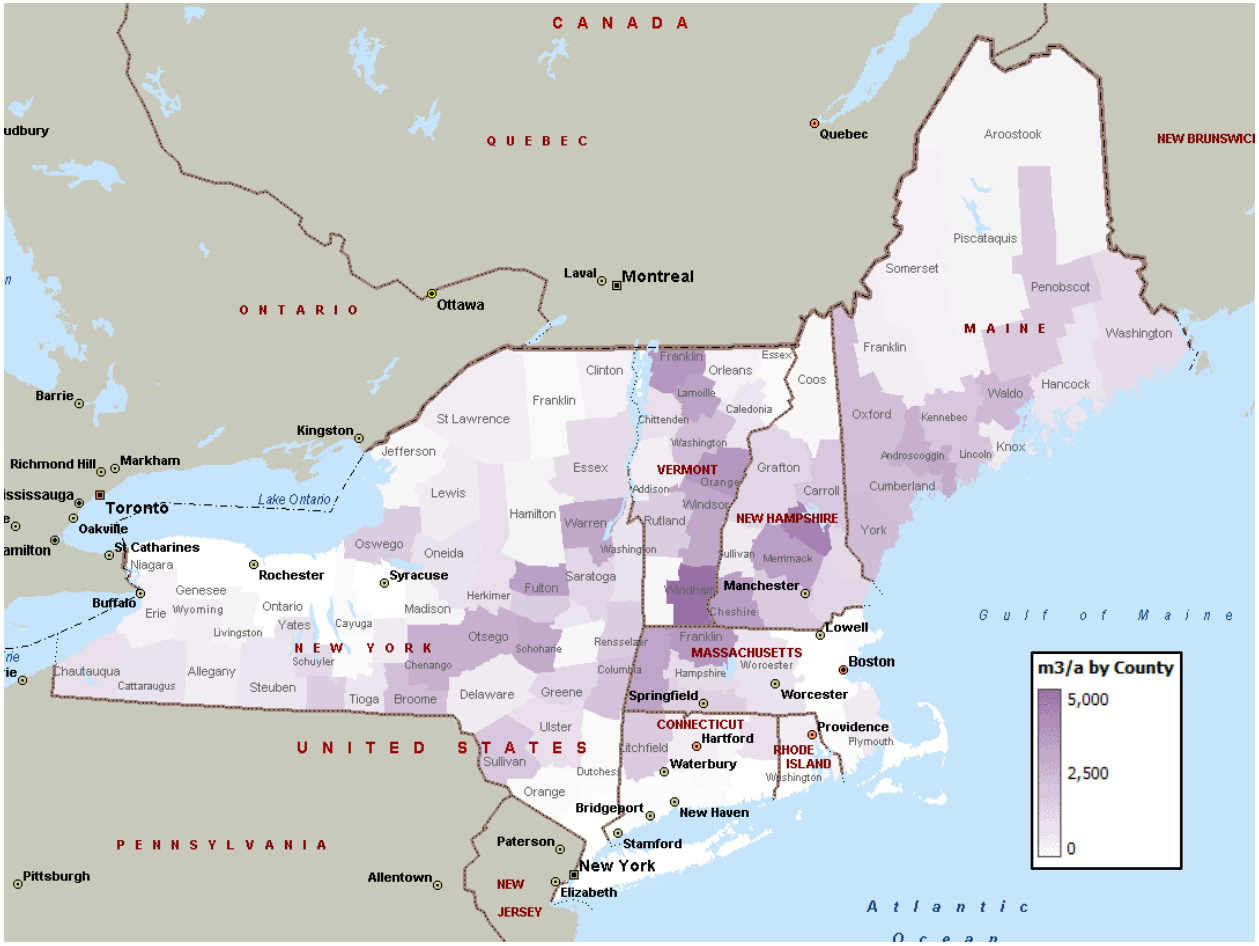


SPRUCE / FIR SAWLOG DENSITY

S/F mills suggest that there is potential for another 0.8 million m^3 (0.5 billion BF) of production in the region, constrained by residuals markets. S/F logs are mainly available around sawmilling infrastructure

EASTERN HEMLOCK SAWLOG DENSITY

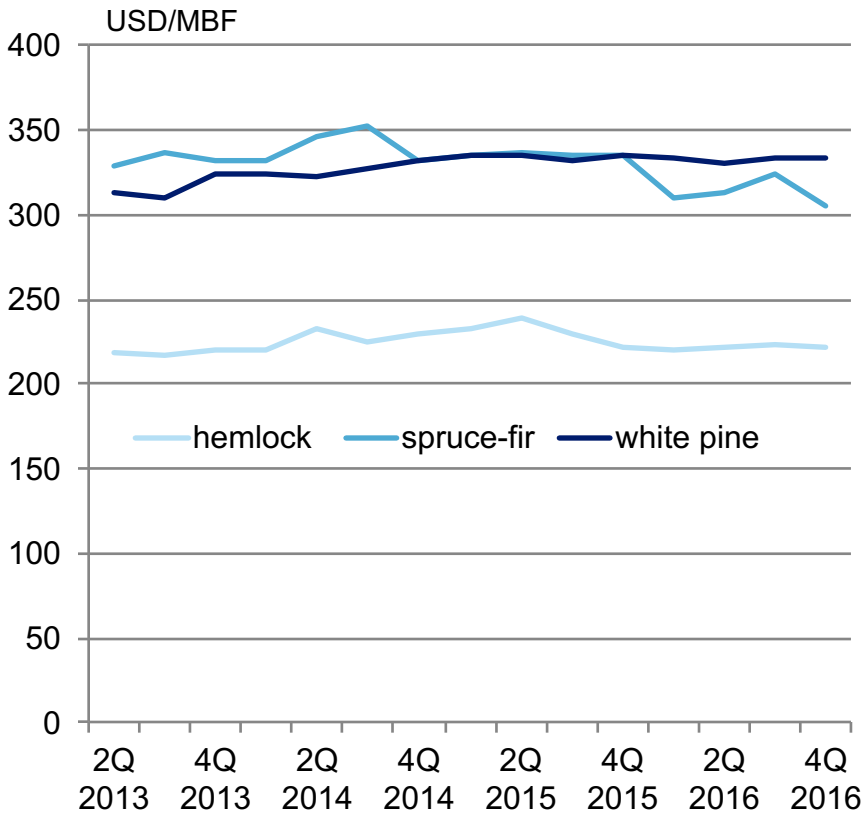
Most dense hemlock resources are in Vermont, New Hampshire and eastern Massachusetts, where the processing capacity is limited to small mills



SAWLOG AND RESIDUE PRICES DELIVERED PRICES IN NE

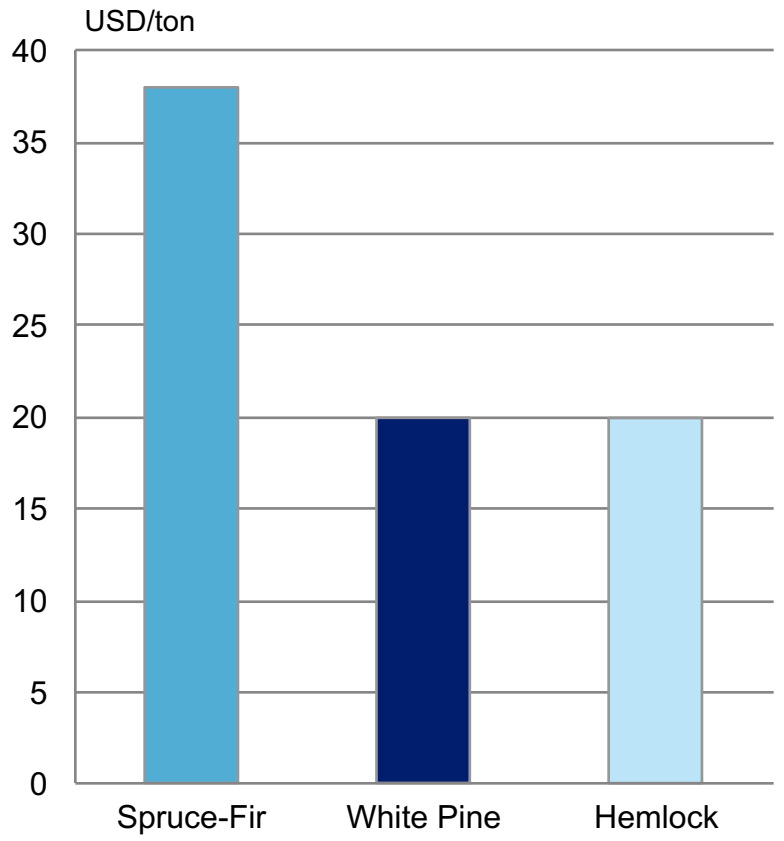
Hemlock log prices are clearly lower compared to more utilized species, because markets for lumber are smaller and fragmented

Sawlogs



Data Source: NH Timberland Owners Association

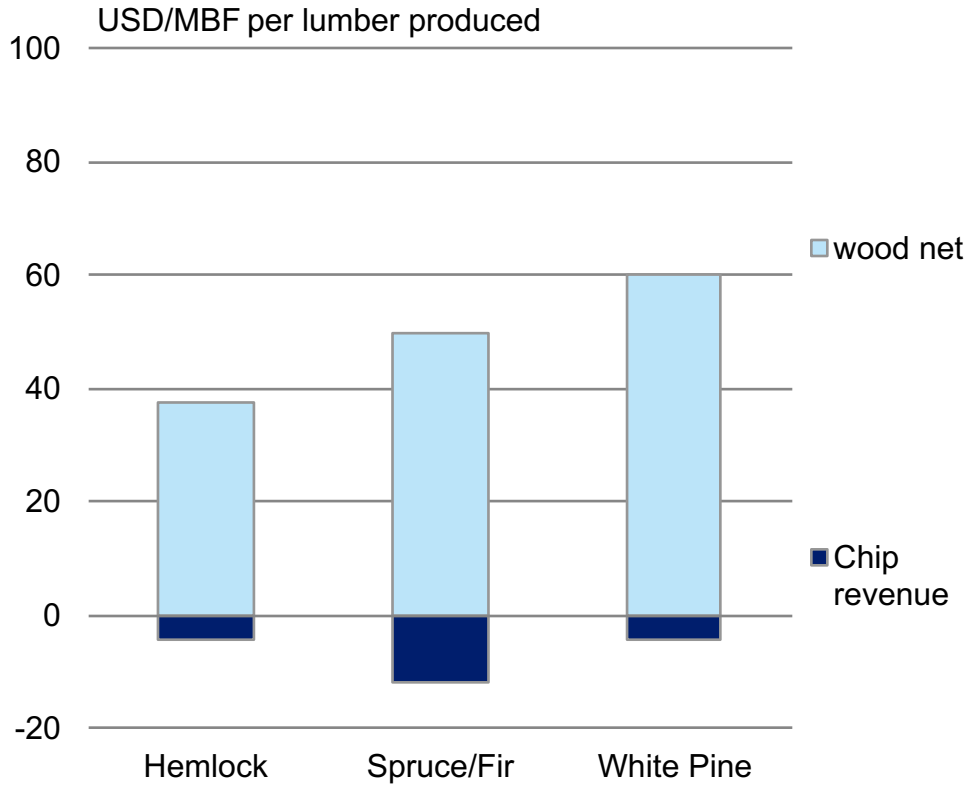
Residues



NET WOOD COST IN LUMBER PRODUCTION IN NEW ENGLAND

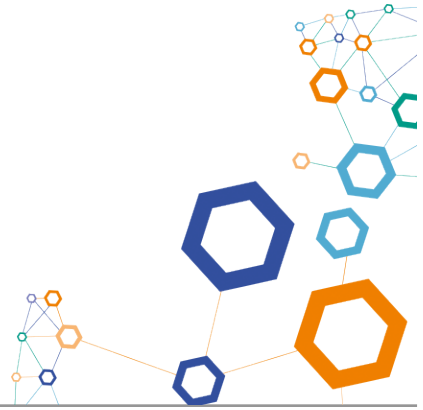
Theoretically, hemlock could be a lower cost option for CLT if produced in industrial scale mills and graded accordingly

Net cost of wood in lumber production



- Net wood cost for eastern hemlock is roughly USD 9/MBF lower compared to spruce/fir which is the structural lumber species in New England.
- Log price is significantly lower, but also the residue income due to low demand for residues – mainly for energy.
- Suitability of eastern hemlock for CLT is still unclear but being tested.
- Use of eastern hemlock in the lumber industry is marginal and utilizing it for CLT manufacturing would require mills dedicated to producing it for structurally graded lumber purposes.

PRODUCTION TECHNOLOGY, COSTS AND COMPETITIVENESS



PRE-FEASIBILITY ANALYSIS OF CLT PLANT – KEY ASSUMPTIONS

Market pricing and Open competition

To be an attractive investment, any CLT plant and supplying sawmill should be profitable based on:

- Paying competitive market prices for raw material
- Achieving CLT and lumber prices on par with their competitive environment

Sawnwood pricing – Market based

- The CLT factory should target to pay the price for the cheapest suitable and available material
- The sawmills supplying the CLT plant should receive the market price

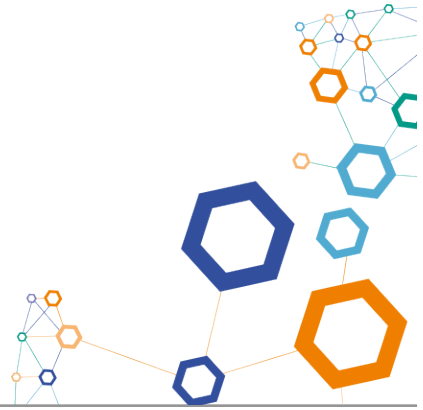
CLT pricing – Parity with import and potential local competition

- The CLT markets in Europe, and particularly in the US, are still at the early stage of their development. There is also no transparent or published information on market prices in the US
- Although much of the revenue of a CLT producer is generated from design, delivery and installation services, the production costs of any new CLT factory should be competitive against existing, and likely new competitors including:
  - Imported CLT
  - CLT production in US based on imported sawnwood
  - CLT production in US based on any alternative homegrown material (softwood)

PRE-FEASIBILITY ANALYSIS OF CLT PLANT – APPROACH

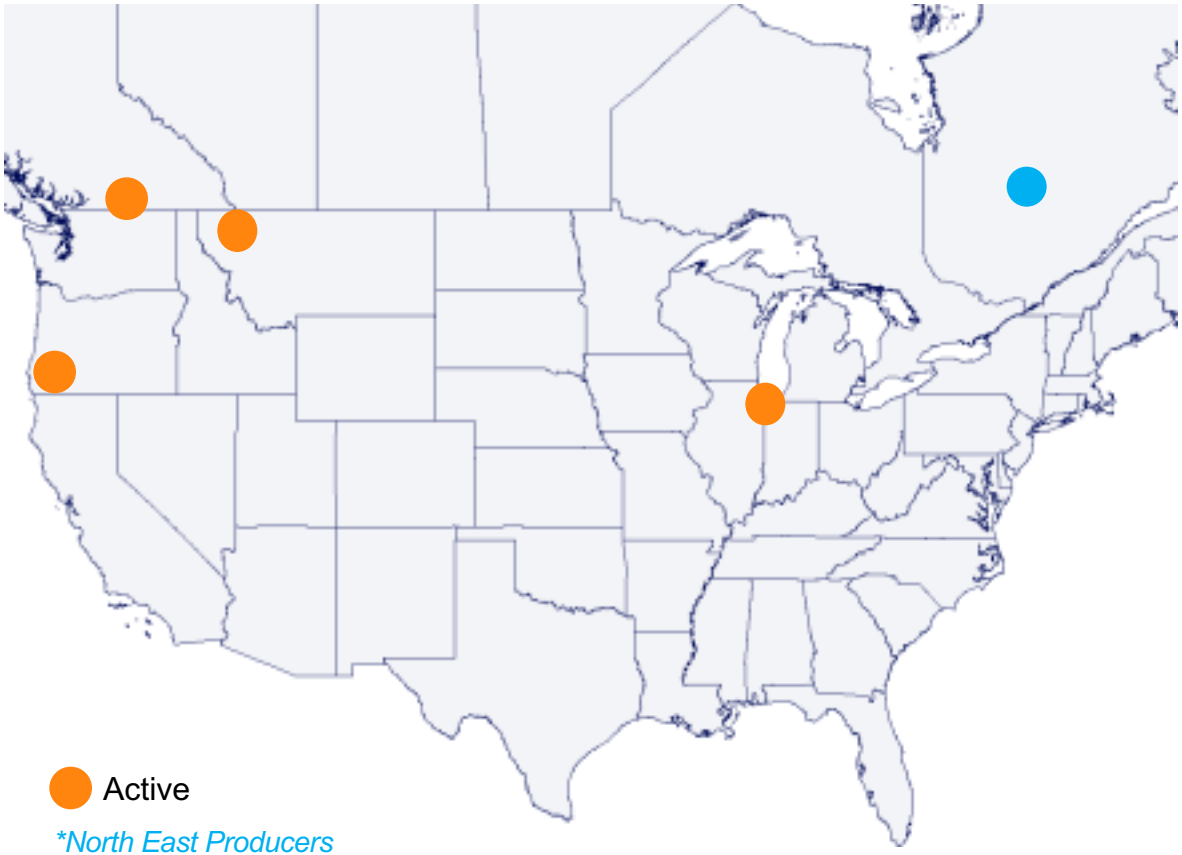
1. **Competitive environment**
   - Identification of competitors
2. **Cost competitiveness analysis**
   - Process parameters
     - Identification of key production inputs
     - Consumption of key production inputs
   - Location specific costs
     - Cost of production inputs in New England and for key competitors
     - Transport costs to Northeast US market
   - Modelling of Ex-work production costs
   - Delivered cost comparison
3. **Cash flow model**
   - Revenue based on estimated price of CLT
     - Import parity (delivered costs to Northeast)
     - Local price estimates
   - EBITDA calculation (Target Ex-work price – Modelled production costs)
   - Investment cost estimate
   - Indicative payback, IRR% & NPV

CLT – COMPETITIVE ENVIRONMENT



CLT – COMPETITIVE ENVIRONMENT – NORTH AMERICA

There are 5 operating CLT mills in North America. All but two are on the West coast. Production costs of basic CLT panels in a modern plant will be calculated based on publicly available local sawnwood prices, personnel and energy costs



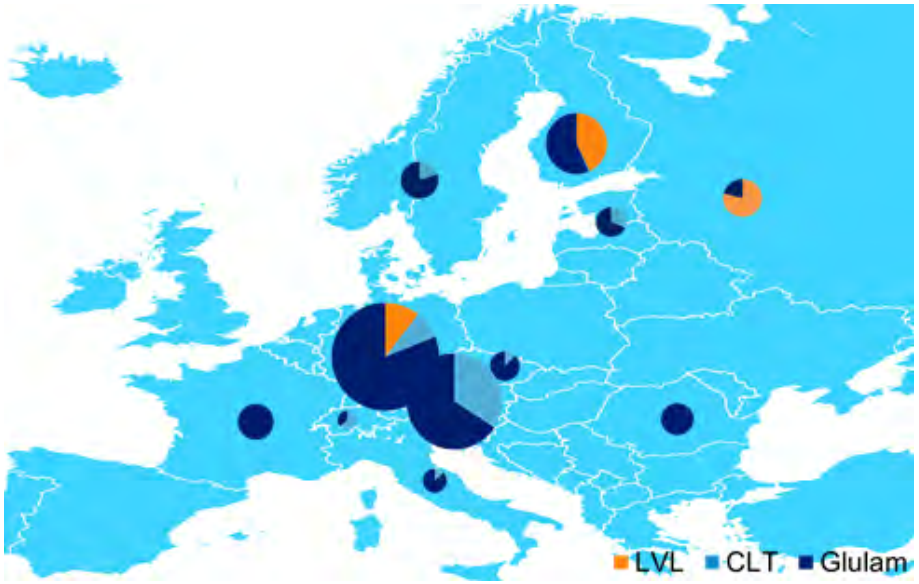
CLT Producers

- D.R. Johnson, Riddle (OR)
- Nordic, Chibougamau (PQ)
- SmartLam, Columbia Falls (MT)
- StructurLam, Penticton (BC)
- Sterling, Phoenix (IL)

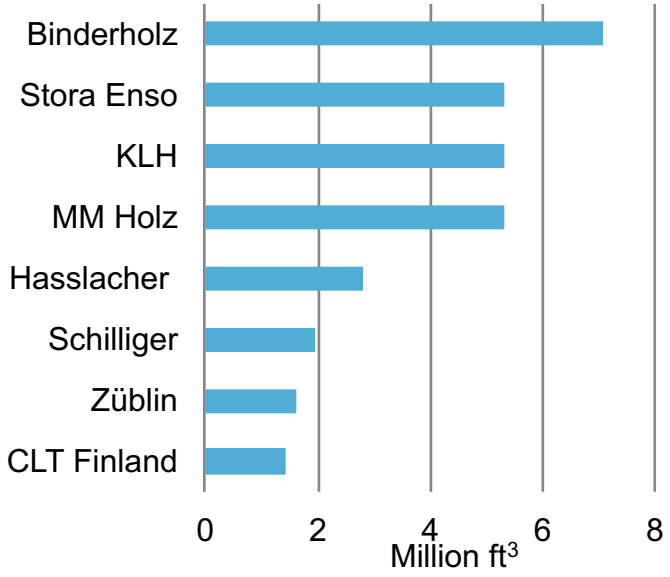
CLT – COMPETITIVE ENVIRONMENT – EUROPE

In 2015, most CLT was produced in Austria and Germany. In 2016, capacity and production increased in Sweden, Latvia and Finland. The analysis will cover Austria as the largest exporter, and Latvia and Sweden with high export potential

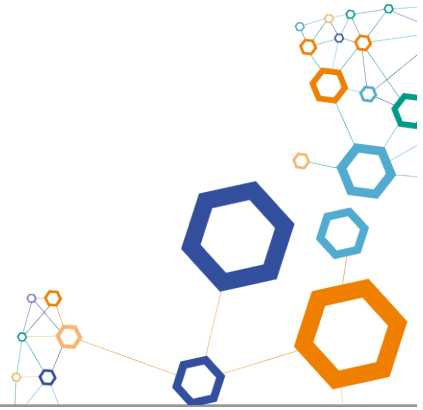
European CLT capacity in 2016



European CLT manufacturers in 2016

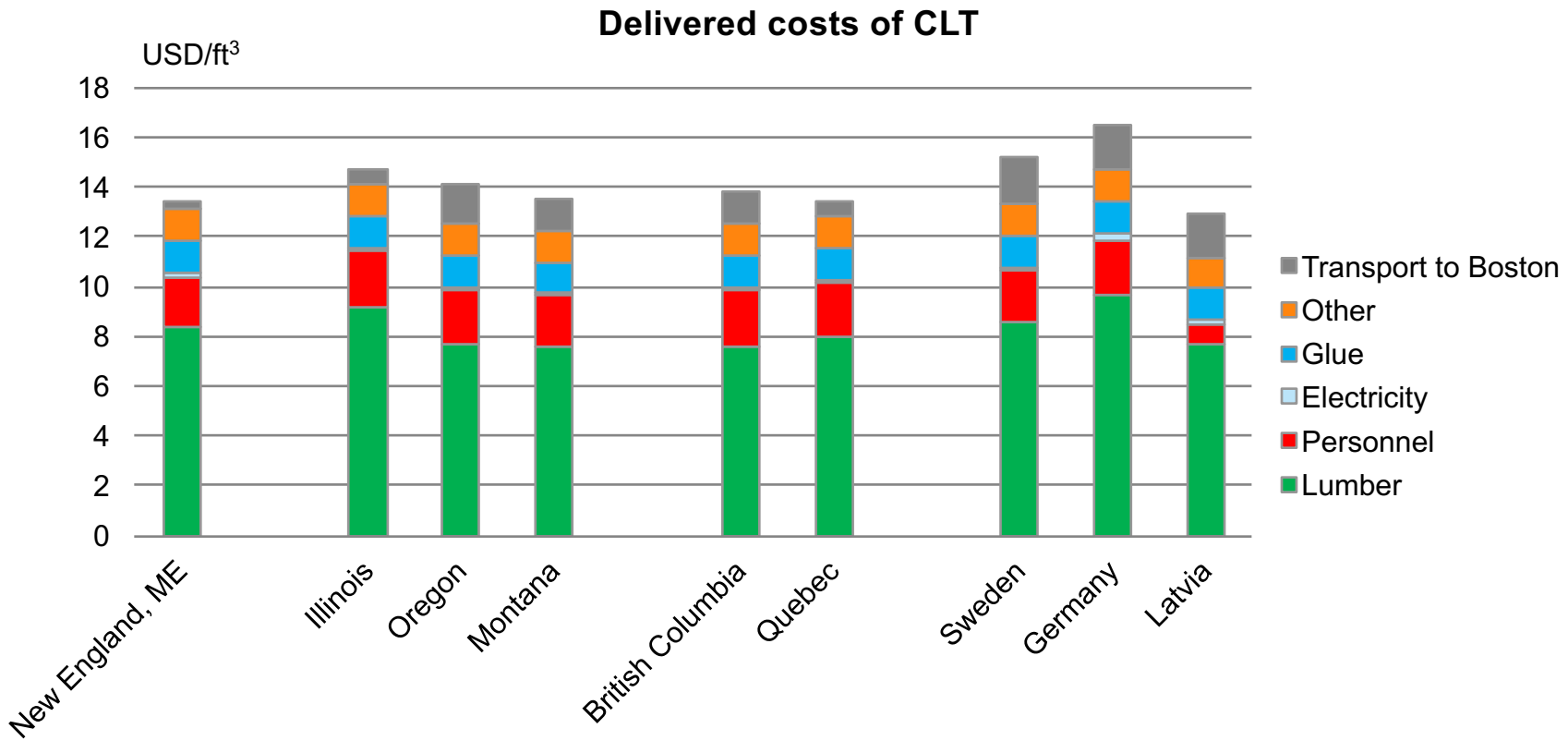


CLT – INTERNATIONAL COST COMPETITIVENESS



CLT – INTERNATIONAL COST COMPARISON

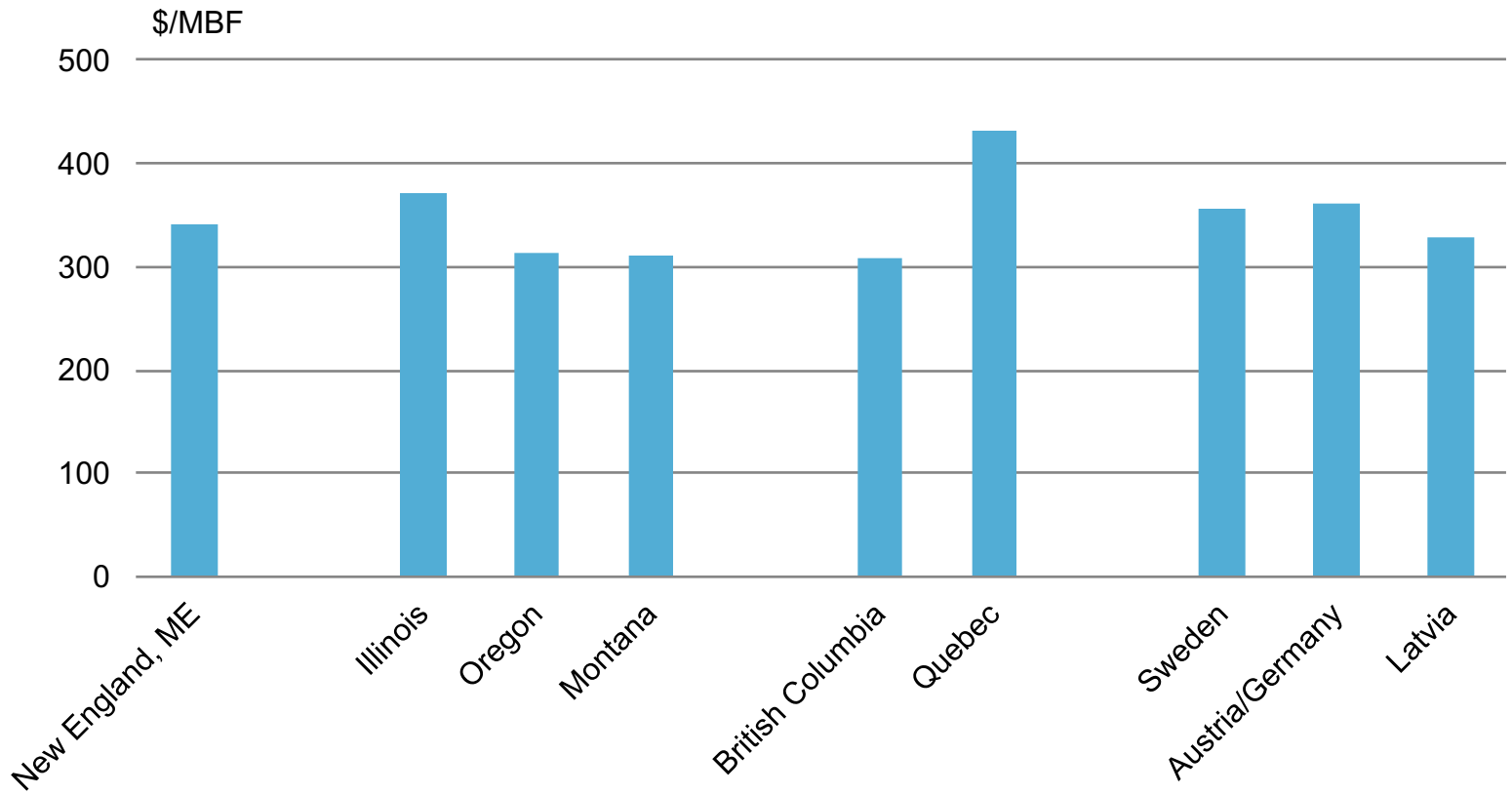
When taking into account transport costs, the costs of New England are on par with Quebec. Theoretically, imports from Latvia are competitive with the current exchange rate.



The comparison is based on similar production process and the local unit costs of production similar production inputs as presented in the next pages.

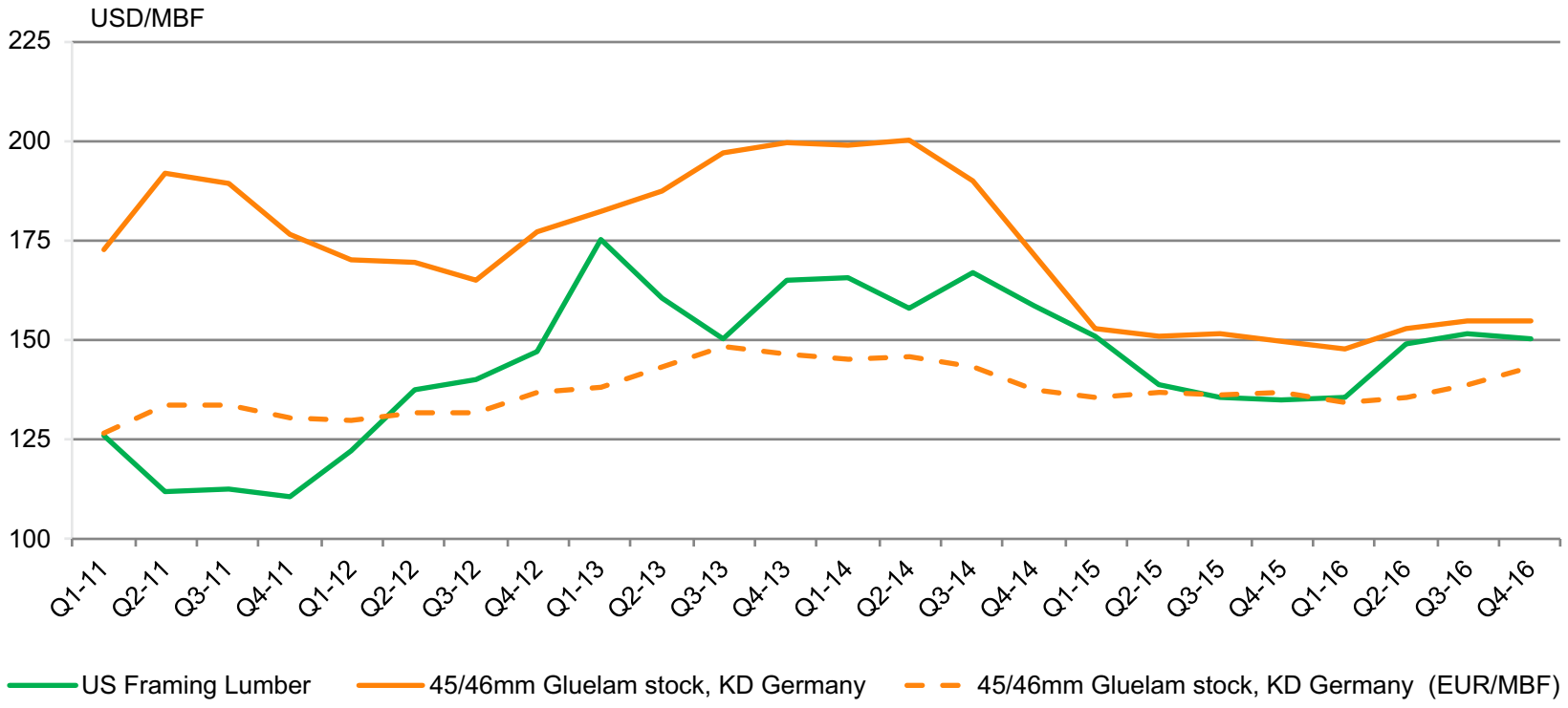
LUMBER PRICES – 4Q 2016

Lumber raw material is the biggest individual cost of CLT production. Its prices vary depending on location and can make up to a $2100/ft^3 ($60/m^3) difference between the Ex work production costs of the alternative locations



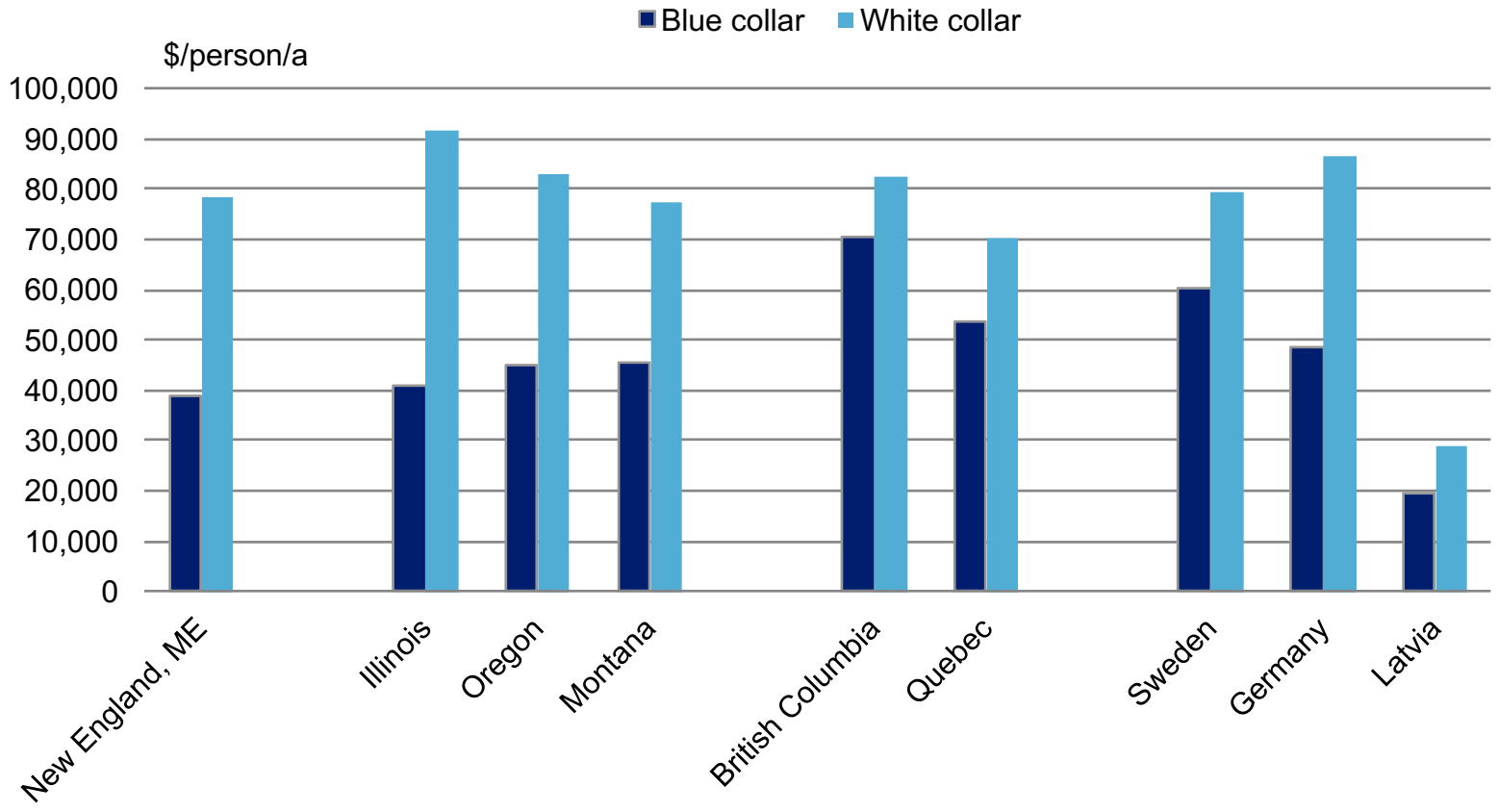
LUMBER PRICE DEVELOPMENTS

Lumber prices are cyclical. Exchange rate developments influence the competitive position of US and European CLT manufacturers. The exchange rate is currently favorable for European suppliers



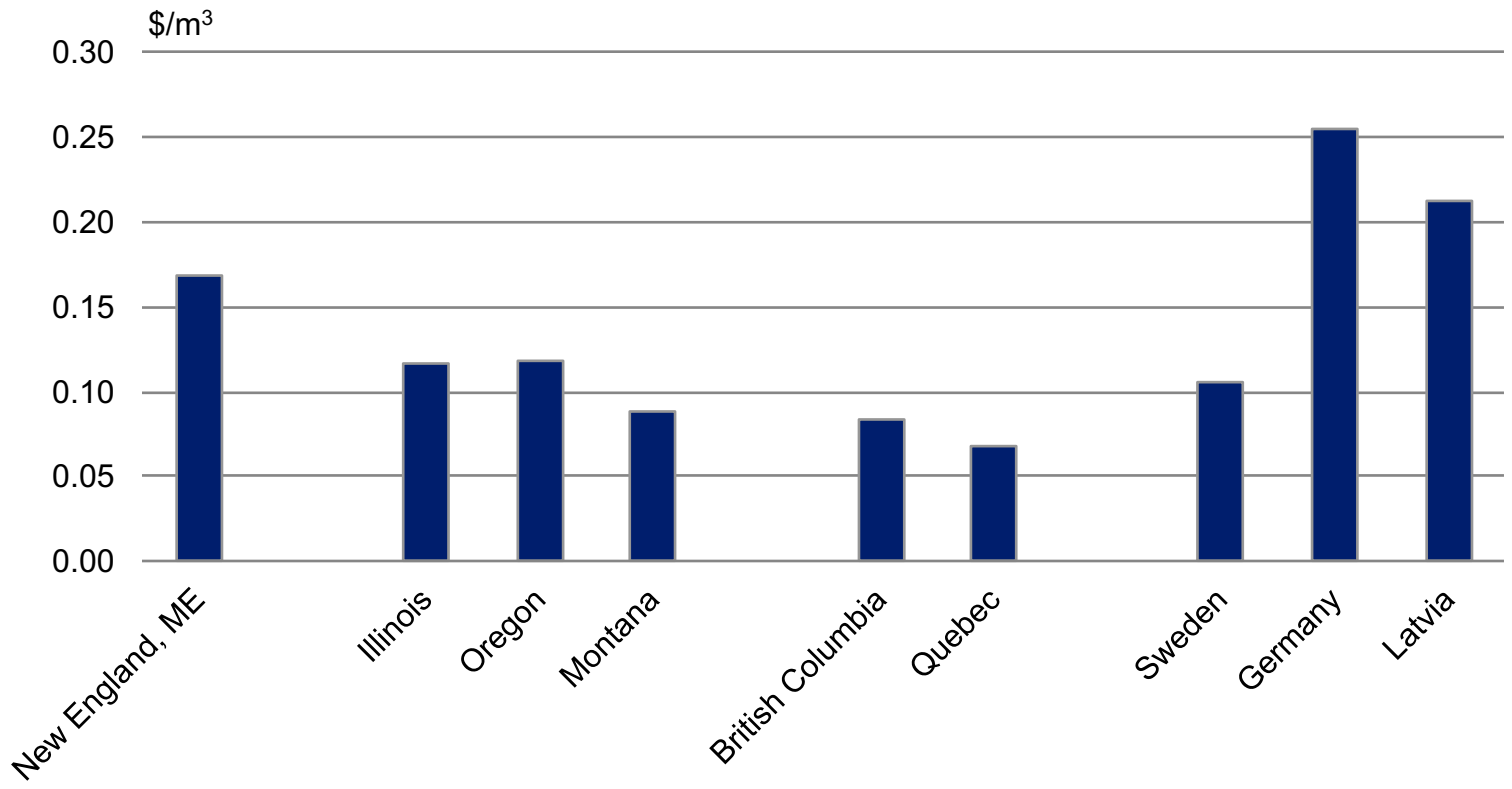
PERSONNEL COSTS

Wage rates vary and can alone make a difference of up to $50/m^3 in the Ex work production costs of CLT



ELECTRICITY COSTS

Although electricity prices in Germany are around four times of those in Quebec, it makes only $0.2/ft^3 difference in the Ex mill product cost of CLT



TRANSPORTATION OF CLT

- Due to the oversized nature of CLT panels, transport poses challenges compared to lumber and wood based panel products.
- With panels of up to 16 m in length and 2.95 m in height, regular 20’ and 40’ ISO marine containers are often too short, and/or low/narrow.
- For ocean freight, an alternative is to ship panels under 12 m in length in open top 40’ containers, and for larger panels, ship break bulk. However, break bulk is generally cost inefficient for smaller volumes (~6,500 tonnes) and large shipments (~40,000 tonnes) are needed to take full advantage.
- Internally in North America, rail and truck are the main modes of transportation for lumber products. Centrebeam flatcars, in particular, are used and have a capacity of up to 100 tonnes (220,000 lbs), and the ability to hold oversized goods.

INTERMODAL TRANSPORTATION

In shipping and logistics, intermodal transportation is the movement of goods using multiple modes of transport, such as rail and truck

- Intermodal transportation is a cost effective alternative for long distance shipping, especially longer than 500 miles (~800 km).
- Cargo is typically shipped in containers of standardised sizes, either ISO marine containers (20', 40' or 45' length) or domestic containers (48' or 53' length), and the whole container is moved from one transport mode to the next at intermodal terminals.
- In North America, containers are transported by rail either double-stacked on well cars, or single-stacked on flatcars, with or without a trailer. However, lumber and other wood products are often shipped on centrebeam flatcars of up to 73' length.
- 11 main rail networks cover North America. Two are in Canada and two are in Mexico. Nine large railroad companies are in operation in the US. The two Canadian have transnational lines.
- In the US, the rail networks split the country in two; west and east, with Chicago being the connecting hub. Therefore accessing either coast from the other requires the use of more than one railroad company, while the Canadian lines run the width of the continent. However, there are interchange points for transferring cargo from one company to a partner.

- The main North American intermodal rail companies are:
  - Canada & US North
    - Canadian National (CN)
    - Canadian Pacific Railway (CP)
  - US East
    - CSX Transportation (CSXT)
    - Norfolk Southern (NS)
  - US West
    - BNSF Railway (BNSF)
    - Union Pacific (UP)

SOURCE: Intermodal Association of North America

INTERMODAL RAIL NETWORK IN NORTH AMERICA

Nordic Structures and Sterling are particularly well-located to take advantage of the intermodal rail network to reach the east coast, while Smartlam is better situated than Structurlam and D.R. Johnson as these sites require longer drayage to access rail ramps

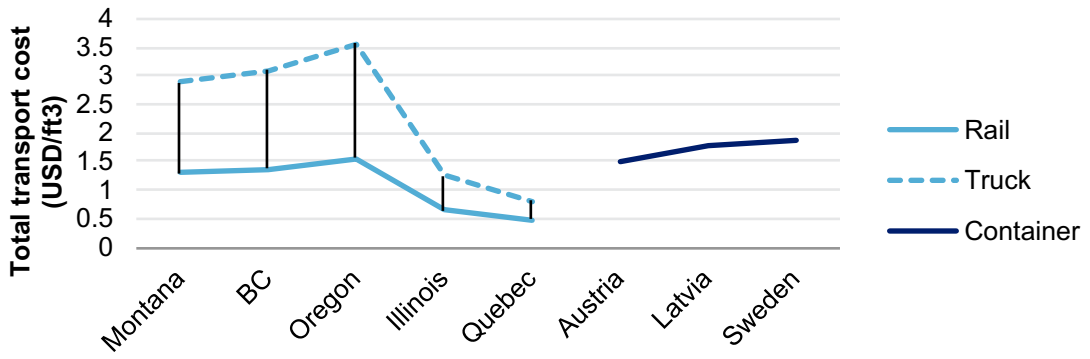
SOURCE: Intermodal Association of North America

TRANSPORT COST EXAMPLE

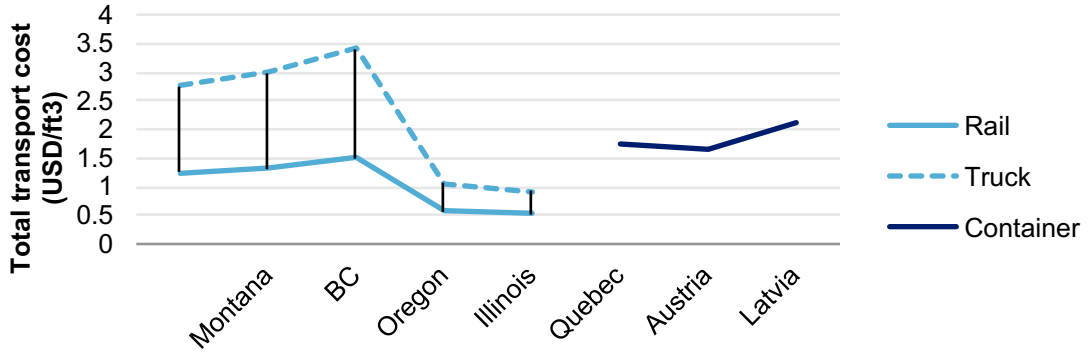
The suppliers based in Eastern Canada and the East North Central region of the US are best positioned to serve the eastern part of North America as total distance, drayage distance and change of railway increase transport costs for western mills

- Based on quotes from Union Pacific, transporting 7,000ft³ of CLT from Portland, OR, to Boston, MA, on a 22 m (73 ft) long centrebeam flatcar able to take up to 100 tons of lumber, will cost 2.1 USD/ft³.
- Additional costs come for drayage from mill site to transfer terminal, and from depot at the destination to the customer's warehouse or building site.

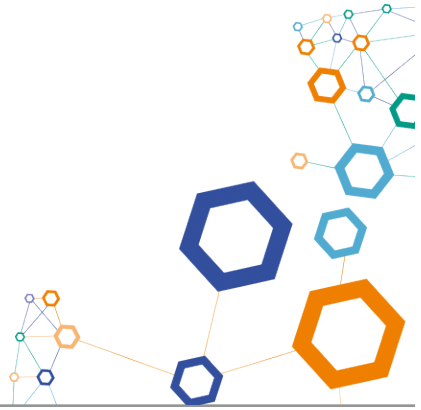
Indicative difference in transportation cost - Boston (USD/ft3)



Indicative difference in transportation cost - New York (USD/ft3)



CASH FLOW MODEL

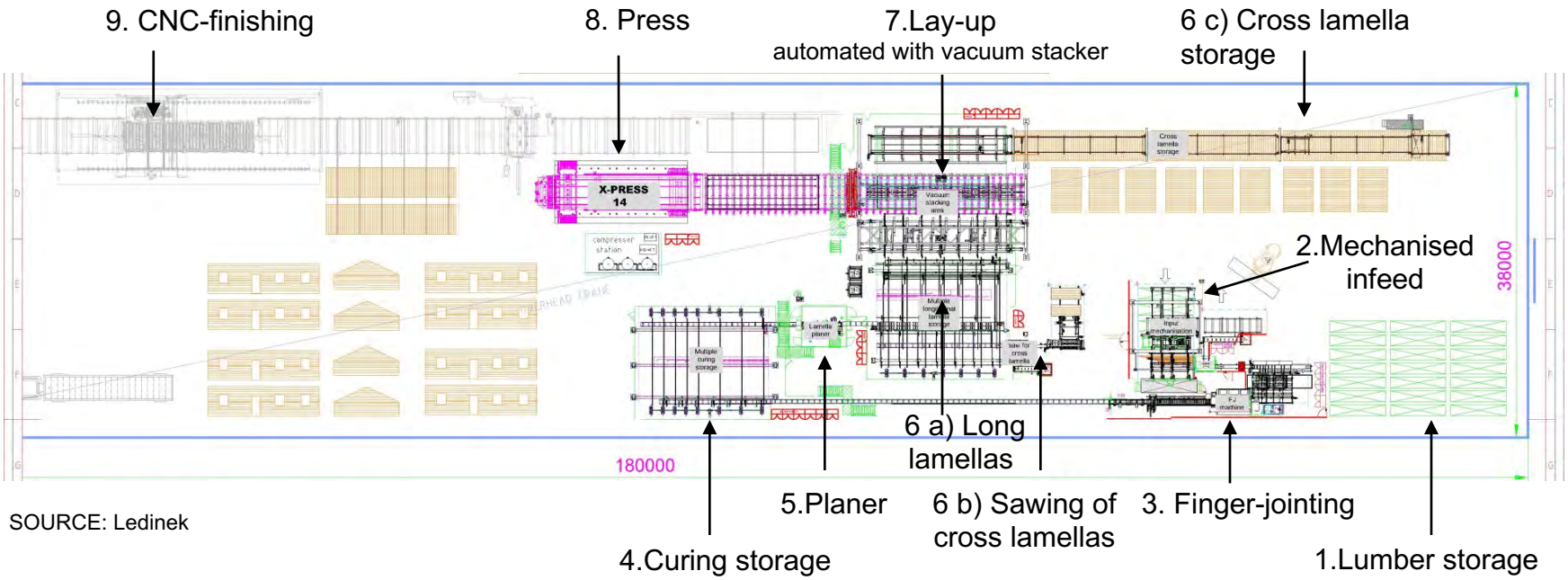


CASH FLOW ANALYSIS – METHODOLOGY AND ASSUMPTIONS

- The feasibility of a CLT mill in the Northeast US is assessed by net present value and internal rate of return calculation of projected cash flows over a period of 15 years starting with the commissioning of the plant and taking into account initial investment costs and an estimated terminal value. The cash flow is depicted in real terms, i.e. excluding inflation.
- In the absence of transparent market price information, the cash flows are calculated separately for alternative price scenarios including current import parity pricing and local price estimates.
- The production costs are modelled for a modern factory with the local unit prices of key inputs in New England, and the key assumptions are presented in the following pages.
- Flat price development in real terms is assumed in the sales income and production cost projections.
- The working capital is calculated based on typical inventory levels in the industry and payables and receivables following examples of BDC (Canadian Business Development Bank)
- The mill is expected to reach 25% output at the 1st year of construction and full production in year 4.
- The profitability is measured by the internal rate of return (IRR) which is calculated from the free cash flow before taxes and debt services.
- The payback period is calculated from the discounted cash flow.
- Value added tax is excluded.
- The investment is expected to have no residual value but the working capital is refunded in the end of the calculating period.
- The WACC% used in the calculations is 10%.
- Tax burden is set as the sum of Maine corporate income tax of 8.93% and federal income tax of 35%.

INDICATIVE LAY-OUT & SITE REQUIREMENTS

A modern automated production line would require a building of around 180 x 38 m, a site 2-3 the size of the building, office and social facilities for 20 persons (max in dayshift), and 0.8 MW installed power for the production process



SOURCE: Ledinek

CLT PLANT – PROCESS PICTURES

Infeed with vacuum de-stacker

Grading, moisture meter and defect marking

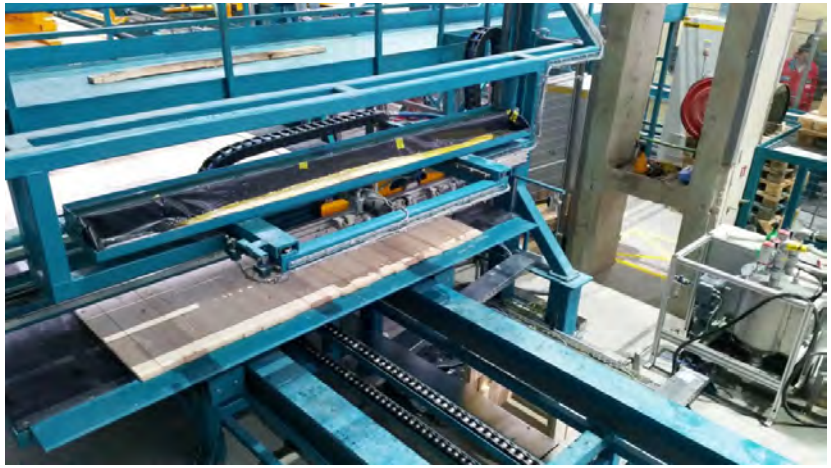
Tray buffer for long layers

Stacking for cross layers

Source: Ledinek

CLT PLANT – PROCESS PICTURES (CONT'D)

Glue application



CLT press 14m

CNC joinery center

Wide surface sanding machine

Source: Ledinek

PERSONNEL REQUIREMENTS

The personnel requirements are based on the six permanent operator (per shift) positions of the presented layout, and management, maintenance and support personnel defined by Pöyry

Personnel requirement in 2 shift operation				
Management & administration		**Production & maintenance**		
			Dayshift	2nd shift
General manager	1	In-feed & finger-jointing	1	1
Operations manager	1	Planer and lamella storage	1	1
Sales manager	1	Assembly, gluing and pressing	1	1
Structural designer (customisation)	1	Sanding	1	1
Financial controller	1	CNC machining	1	1
Administrator (logistics, invoicing etc.)	1	Material handling	1	1
Maintenance supervisor	1	Support (wrapping, stacking, waste handling)	2	2
Shift leaders	2	Mechanical maintenance	1	1
Secretary	1	Electrical & automation maintenance	1	1
Total	**10**		**10**	**10**

INVESTMENT REQUIREMENT

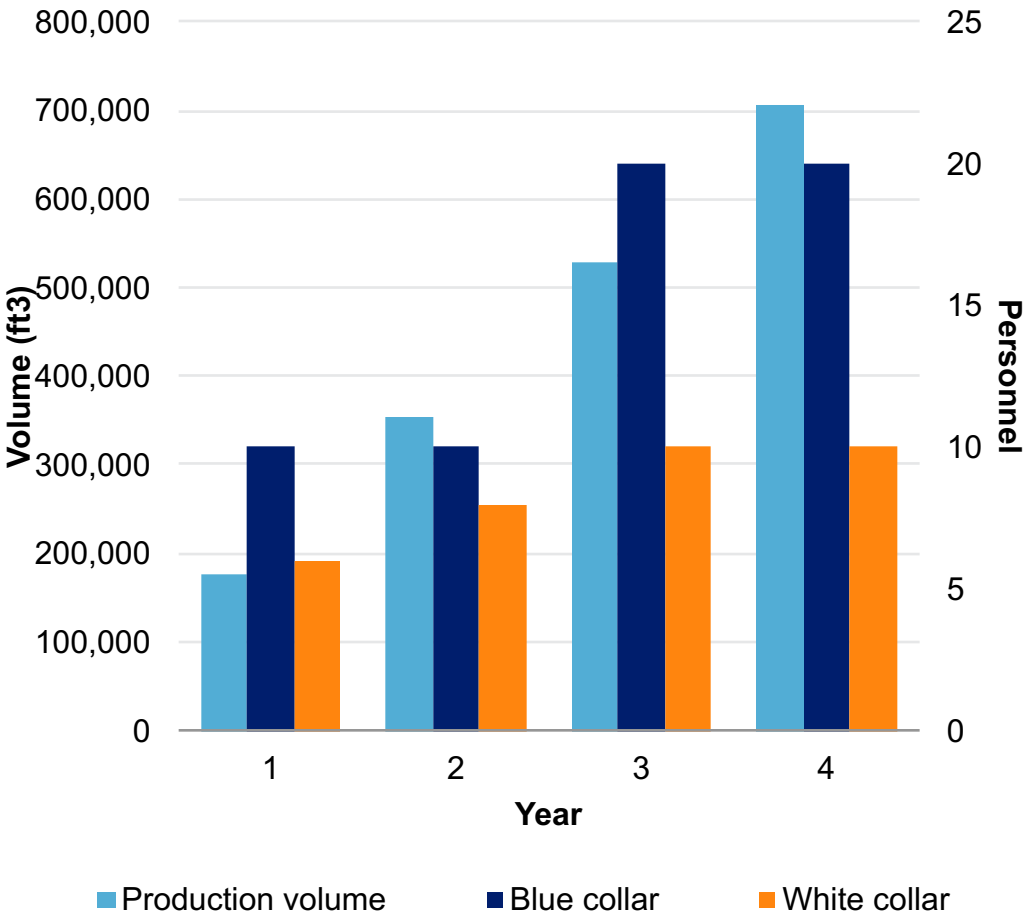
The estimate is based on budgetary quotations for main process machinery, basic engineering level construction cost estimates of other CLT and wood industry facilities, and local industrial construction benchmarks

Item	Cost, MUSD
Machinery (delivery, installation, start-up)	9
Buildings & infrastructure	9
Project management	1
Contingencies	2
TOTAL	**21**

Production process (1		Auxiliary units (2	Buildings & Infra (3
Infeed table and quality control	Horizontal press	Maintenance workshop	Production building
Cross-cutting section	Storage	Testing laboratory	Office and social facilities
Finger-jointing	Sander	Glue kitchen	Site works
Lamella planer	Cross cutting	Compressor unit	Electrification
Curing and storage area	CNC-machine	Dust removal and waste handling	HVAC
Vacuum stacking	Wrapping & packing	Material handling	Fire protection
Surface gluing			Water supply
			Drainages
1) Budgetary quotations		*2) Informal quotations & benchmarks*	*3) Advanced plans for woodworking facilities in other locations, local $/m² benchmarks*

MILL START-UP AND PRODUCTION VOLUMES

Production volume is assumed to follow a step change progression by adding shifts, increasing capacity utilization and optimizing production efficiency



- **Year 1:** Building and commissioning
  - **6-9 months:** Installation & training
  - **6-12 months:** One shift operation
- **Year 2:** Mainly one shift operation and introduction of second shift.
- **Year 3:** Two shift operation, production adjustments and optimization
- **Year 4:** Reaching full capacity

- Variable costs directly attributable to production volume is assumed to maintain the same unit rate throughout the modelled period
- Fixed costs are kept at the same level irrespective of production
- Personnel for 1st shift is included from start of year 1, and for 2nd shift from year 3

MAIN INPUTS OF THE PROFITABILITY CALCULATION

COMPONENT	Unit	Price
Wood raw material	USD / MBF	355*
Electricity	USD / kWh	0.0916
Glue	USD / kg	8.0
Production personnel	USD / a	38,995
Administrative personnel	USD / a	78,689

*) average of # 2 & 3 + 15 USD/MBF for additional drying

CONSUMPTION FIGURES	Unit	per ft^3
Wood	MBF/ ft^3	0,024 (77%)
Electricity	kWh / ft^3	1.84
Glue	kg/ ft^3	0.14

PERSONNEL	Unit	No.
Production and maintenance personnel	Prs	20
Management and administrative personnel	Prs	10
Total personnel	**Prs**	**30**

PRODUCTION COST BREAKDOWN

Once production has reached 700,000 ft^3 or 20,000m^3 p.a., costs are calculated at the below levels

Item	Unit	Cost	Unit	Cost
VARIABLE COSTS				
Wood	USD / m^3	301	USD/ft^3	8,52
Electricity	USD / m^3	6	USD/ft3	0,17
Chemicals	USD / m^3	40	USD/ft3	1,13
Other variable	USD / m^3	25	USD/ft3	0,71
Total variable costs	***USD / m^3***	**372**	**USD/ft3**	**10,53**
FIXED COSTS				
Personnel	USD / m^3	78	USD/ft3	2,21
Other fixed costs	USD / m^3	15	USD/ft3	0,42
Total fixed costs	***USD / m^3***	**93**	**USD/ft3**	**2,63**
TOTAL MANUFACTURING COSTS	***USD / m^3***	**465**	**USD/ft3**	**13,17**

PRICE SCENARIOS

In the absence of transparent market price information, different price scenarios were tested, including local price estimates and import parity cost

Local pricing

- The ex-work price of basic CLT in Eastern coast of US is estimated at 23 USD/ft^3 or 800 USD/m^3.
- Interviews of local designers, property developers and builders indicated a price range of 23-37 USD/ft^3 or 800-1300 USD/m^3 for net volumes delivered to building sites, including transport costs and compensating varying volume losses in cutting of window and door openings. The higher end includes also premium for higher finishing quality of CLT for visible uses.
- In a report of similar project in California in 2015, 21 USD/ft^3 or 740 USD/m^3 was presented as an estimate for ex work price of CLT by Beck following a cost + margin pricing approach of Canadian FP Innovations. Thereafter, sawnwood prices in the US have increased.

Import parity

- The average CLT price in Europe is ~ 16 USD/ft^3, 500 EUR/m^3 or ~550 USD/m^3 at current exchange rate, and transport cost to the Northeast US of 1.8-2.1 USD/ft^3 or 65-75 USD/m^3.
- This leads to a 17.6 USD/ft^3 or 620 USD/m^3 import parity cost in the US, which is used as the lowest price scenario.

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 %	NPV (15 a)
Local pricing	15.1%	6.4 MUSD
Import parity price	2.9%	-7.7 MUSD
Brownfield integration (* Local pricing	40.3%	16.5 MUSD
Brownfield integration (* Import parity price	14.9%	2.4 MUSD

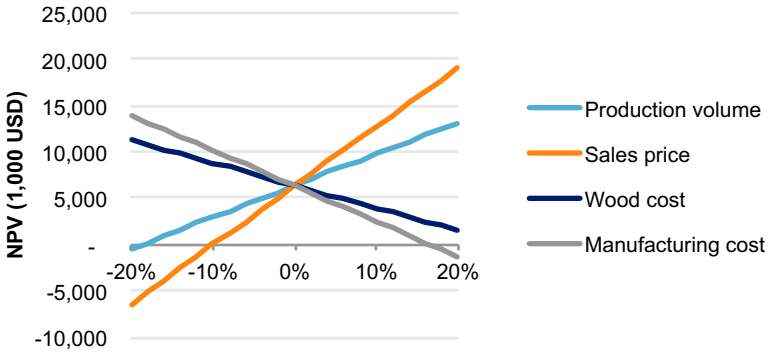
*) Existing building and infrastructure, existing lamella production, investment 7 MUSD investment in manual technology (+50% production & maintenance personnel) and modifications of buildings

SENSITIVITY ANALYSIS – LOCAL PRICING SCENARIO

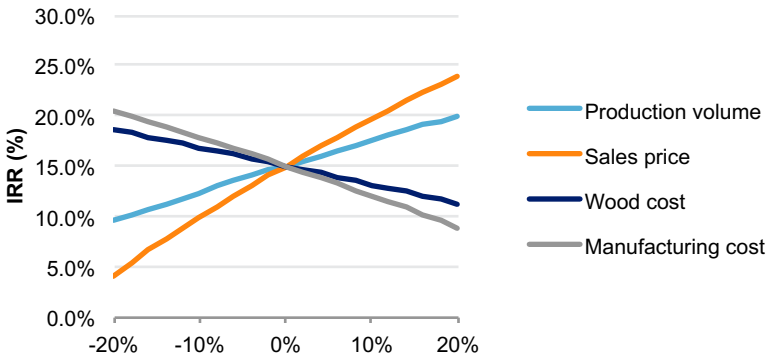
The project will have a positive net present value given a local pricing scenario for reasonable fluctuations in sales price, and production volume and costs

- The local pricing scenario is based on a price for CLT set independently of the European market at 22.7 USD/ft^3 or 800 USD/m^3 and a 4 year ramp-up period of production volume
- For this scenario, the net present value of the investment will be positive unless sales price drop over 10%
- Production volume and wood and manufacturing costs has less impact on the project value and changes in excess of 20% is needed to push for a negative project value
- 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

NPV sensitivity



IRR sensitivity

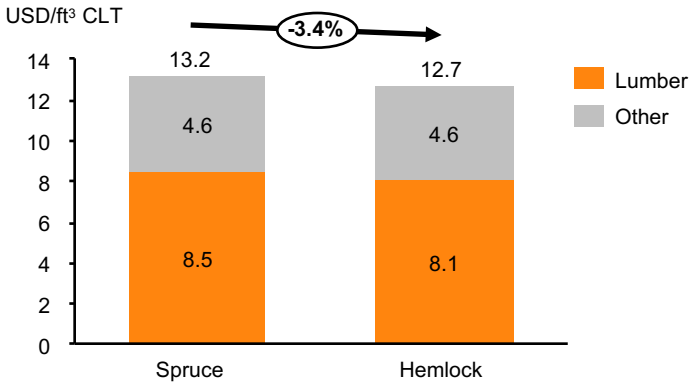


PROJECT VALUE – HEMLOCK RAW MATERIAL

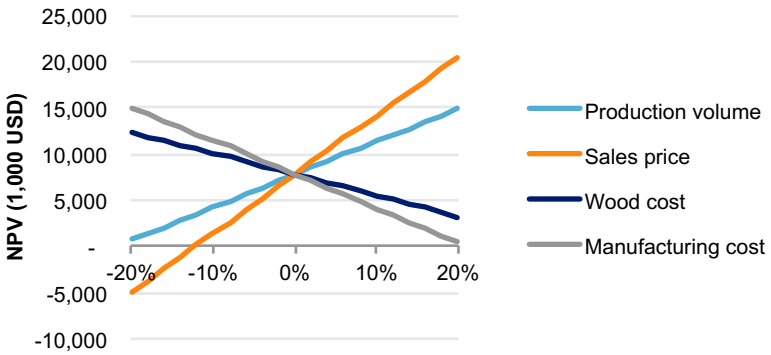
Given a 13 USD/m³ (8.5/MBF) lower price for hemlock compared to spruce, a 3.4% lower total production cost and a 22% higher NPV can be achieved

- Hypothetical use of hemlock instead of spruce for CLT, provided equal production costs, will reduce the lumber cost by 8.5 USD/MBF
- Lowering the wood cost by 3.4% per finished CLT, leads to an increased NPV of 7.8 MUSD, up 1.4 MUSD from 6.4 MUSD
- IRR is also improve, increasing 1%-point from 15.1% to 16.1%
- The lower wood cost and resulting higher NPV also causes the overall sensitivity of the project to decrease somewhat

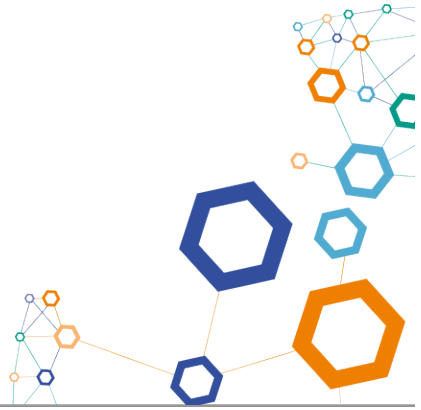
Cost structure of spruce vs hemlock based CLT



NPV sensitivity

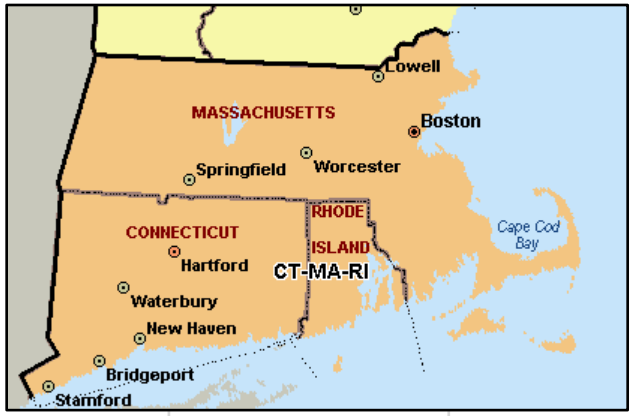


APPENDIX – FOREST RESOURCES



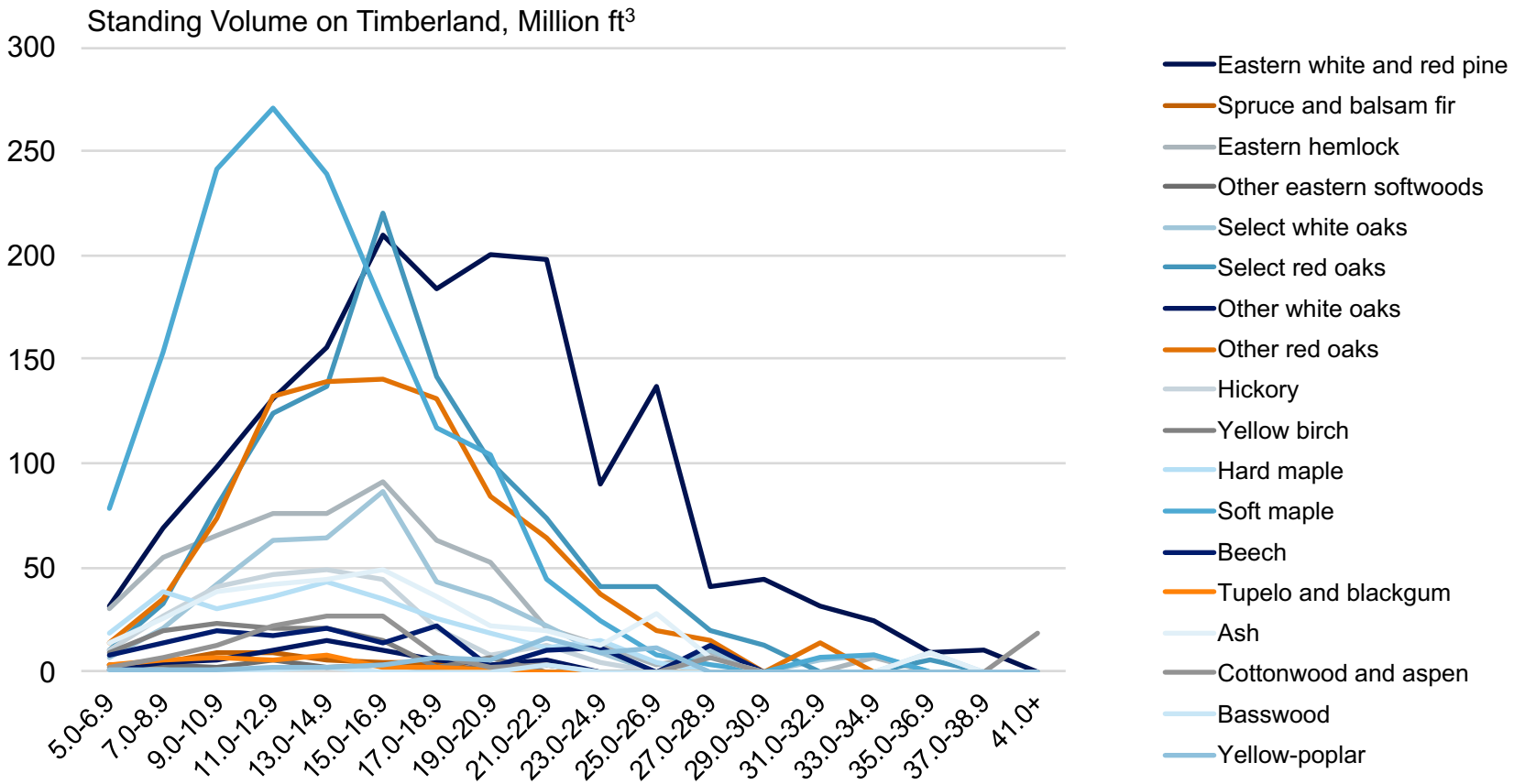
STANDING VOLUME (GS) BY SPECIES GROUP

Connecticut, Massachusetts and Rhode Island



DIAMETER DISTRIBUTION (DBH - INCHES) OF MAJOR SPECIES GROUPS

Connecticut-Massachusetts-Rhode Island

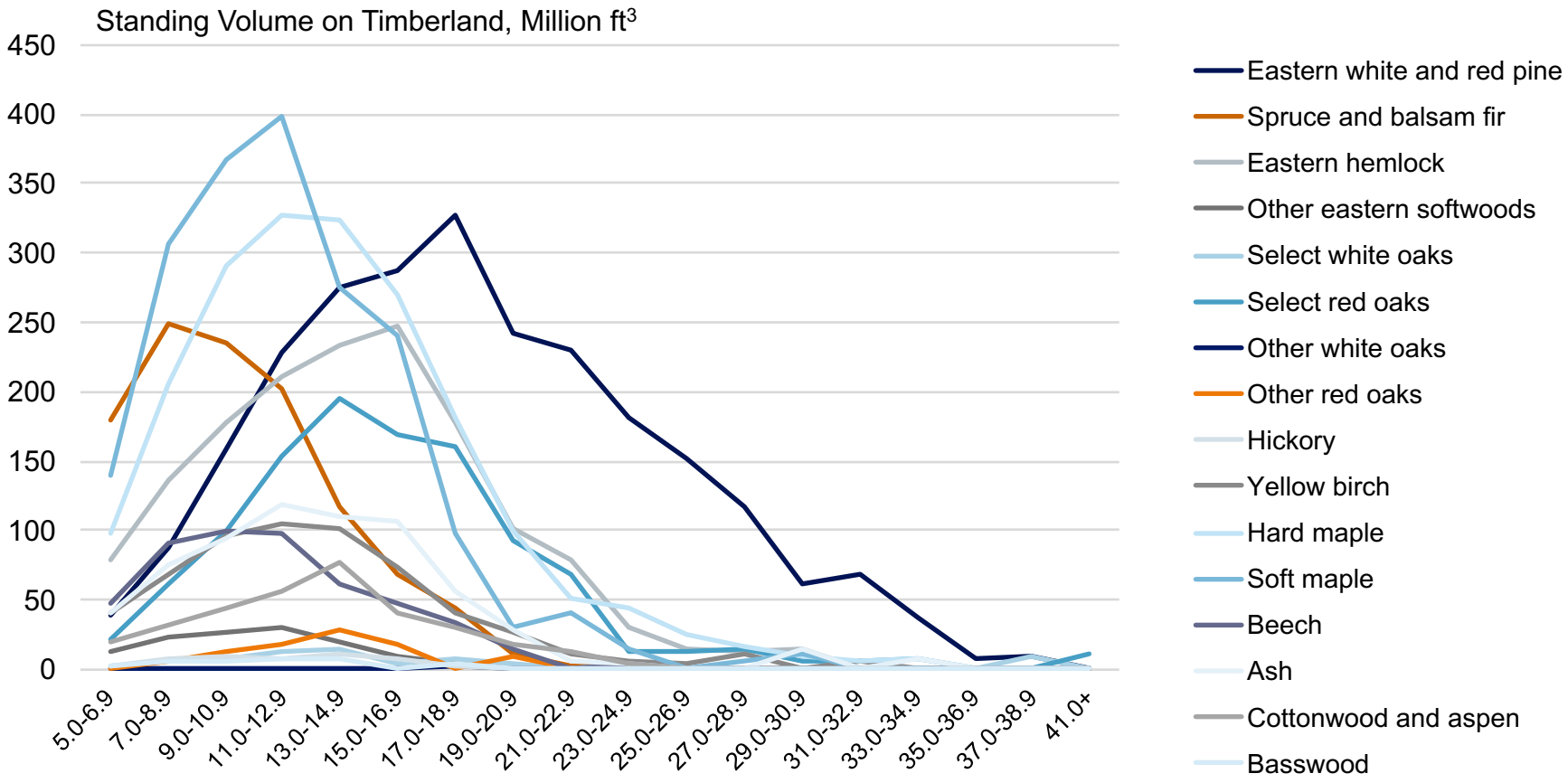


STANDING VOLUME (GS) BY SPECIES GROUP

New Hampshire and Vermont

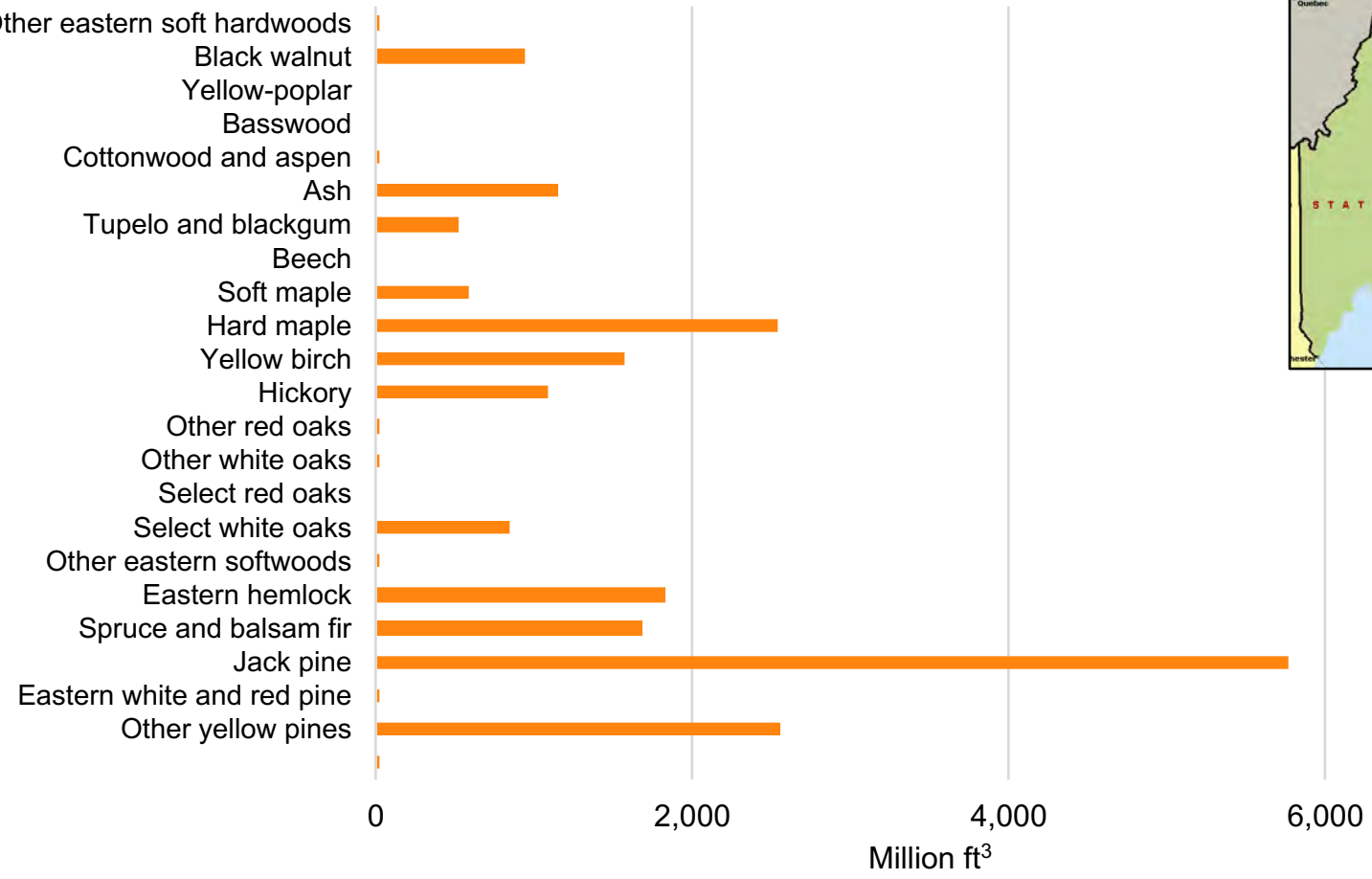
DIAMETER DISTRIBUTION (DBH - INCHES) OF MAJOR SPECIES GROUPS

New Hampshire - Vermont



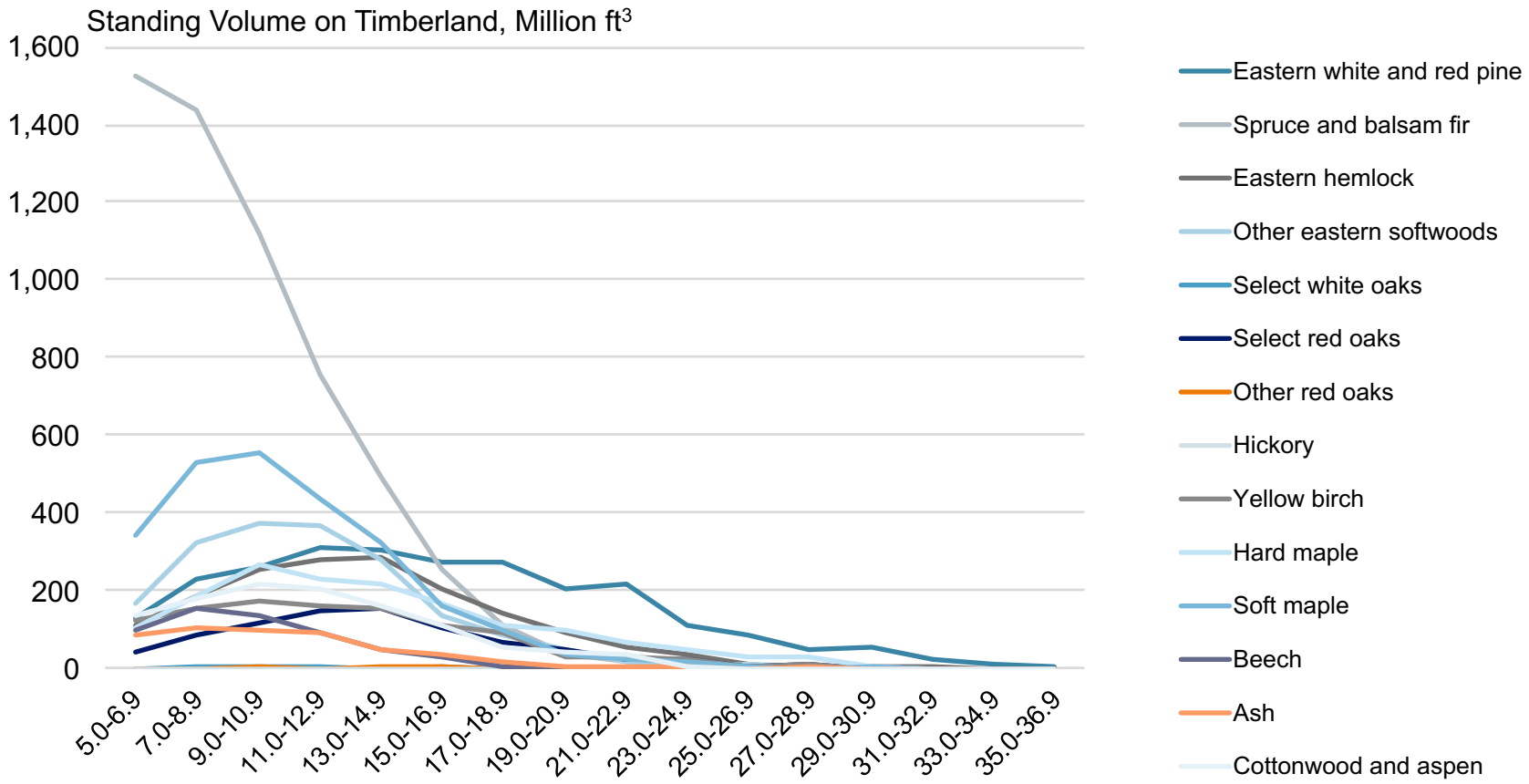
STANDING VOLUME (GS) BY SPECIES GROUP

Maine



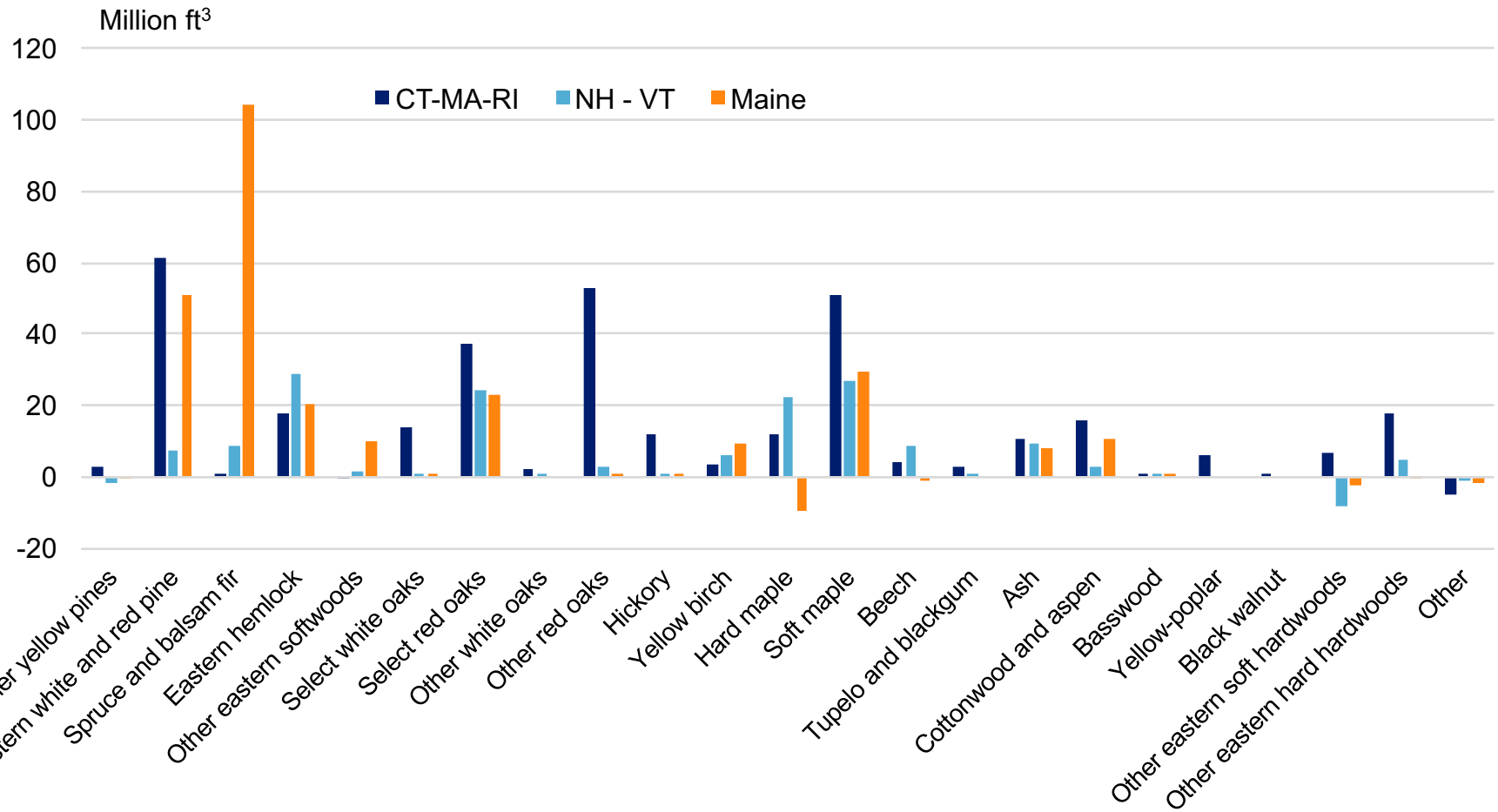
DIAMETER DISTRIBUTION (DBH - INCHES) OF MAJOR SPECIES GROUPS

Maine



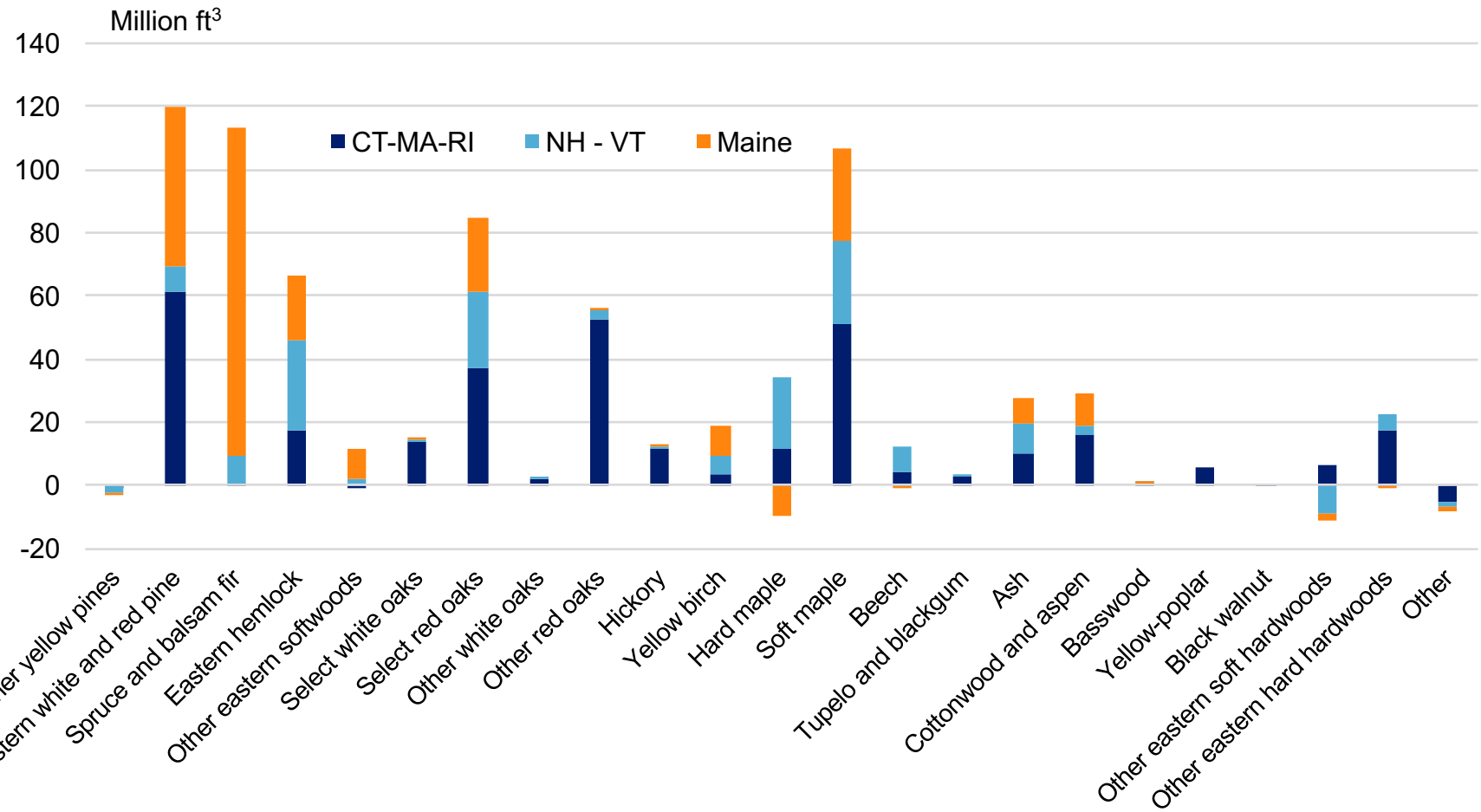
NET GROWTH LESS REMOVALS

by Species Group



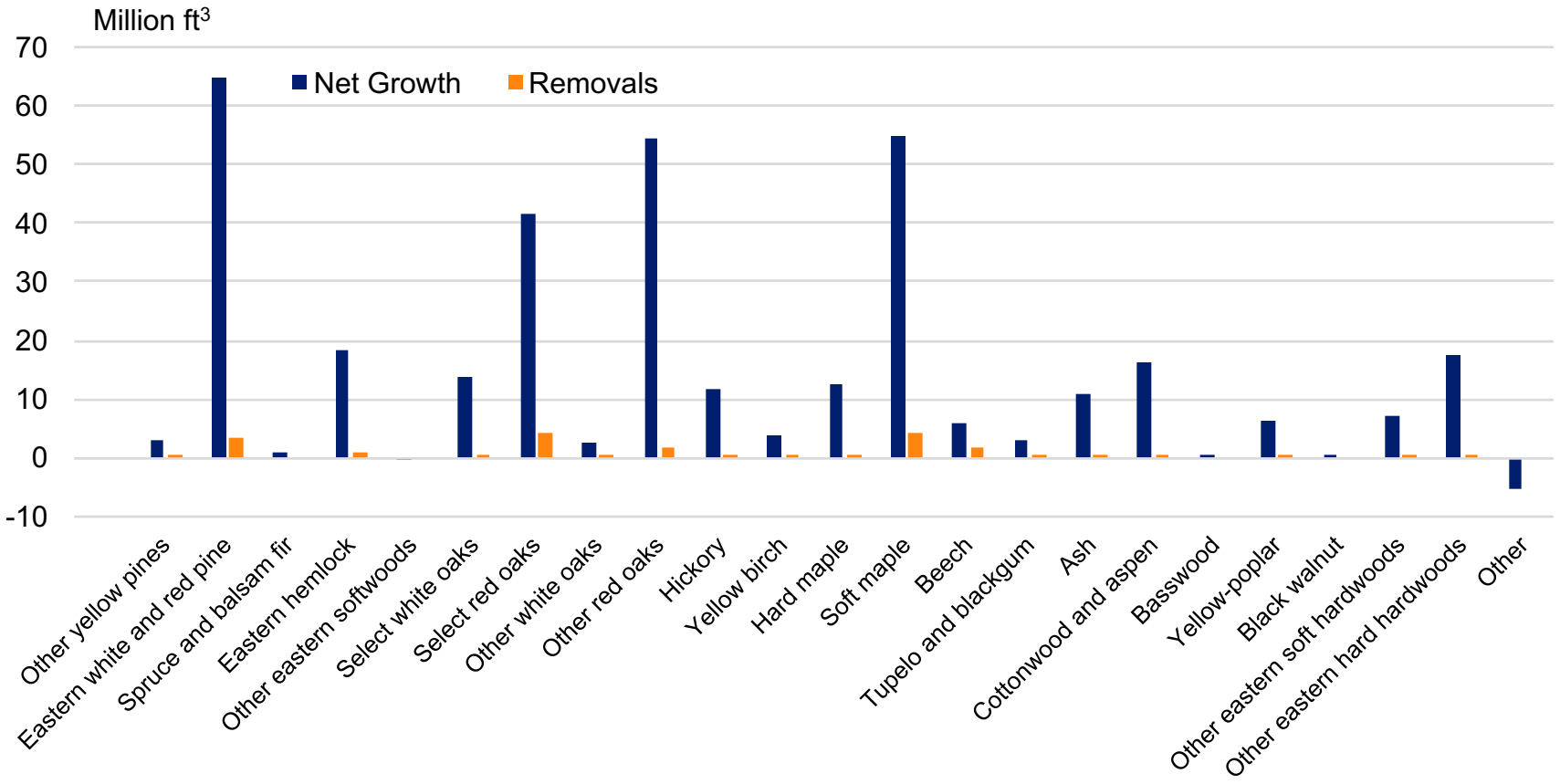
NET GROWTH LESS REMOVALS

by Species Group



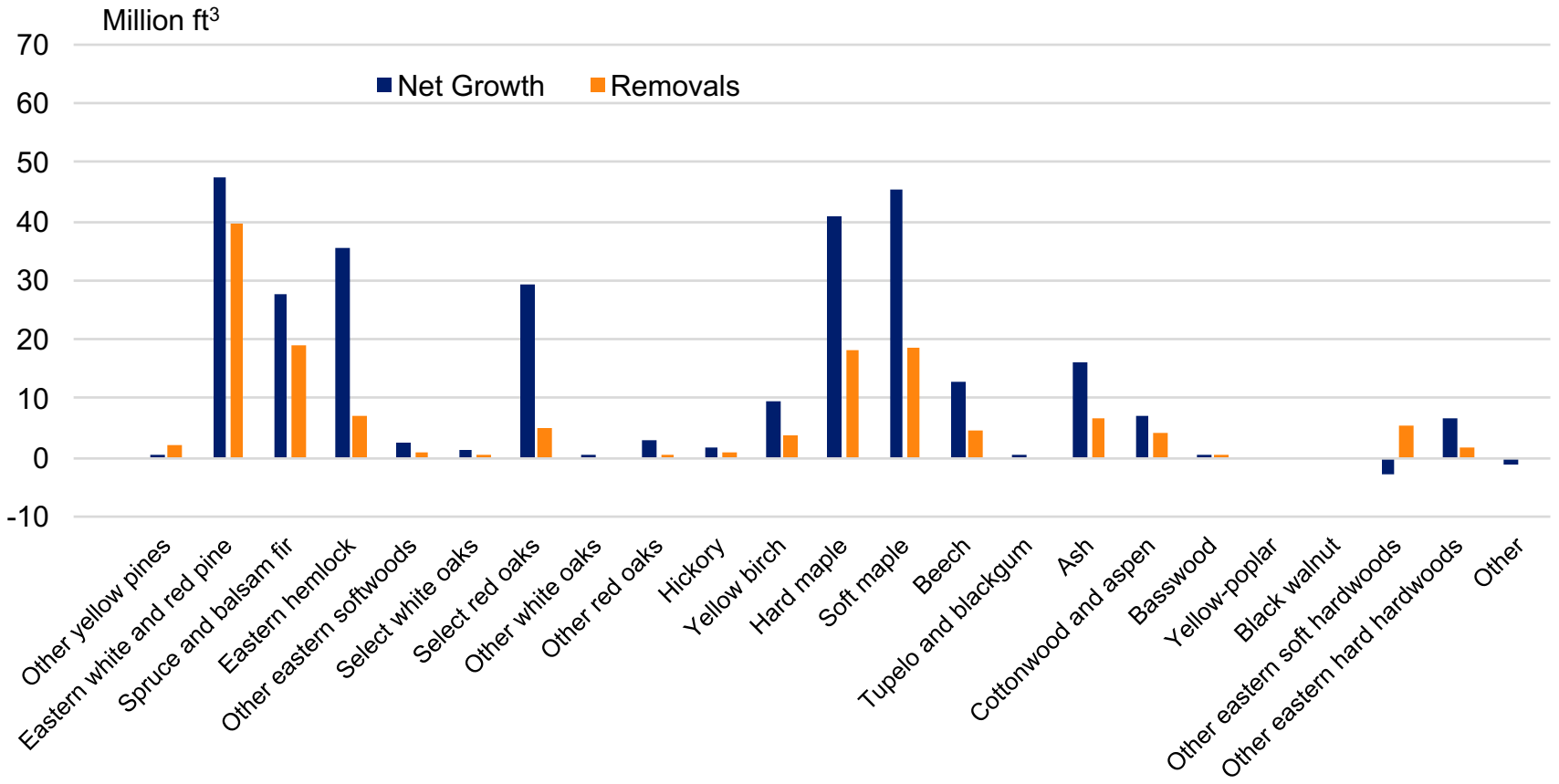
NET GROWTH AND REMOVALS BY SPECIES GROUP

Connecticut - Massachusetts - Rhode Island



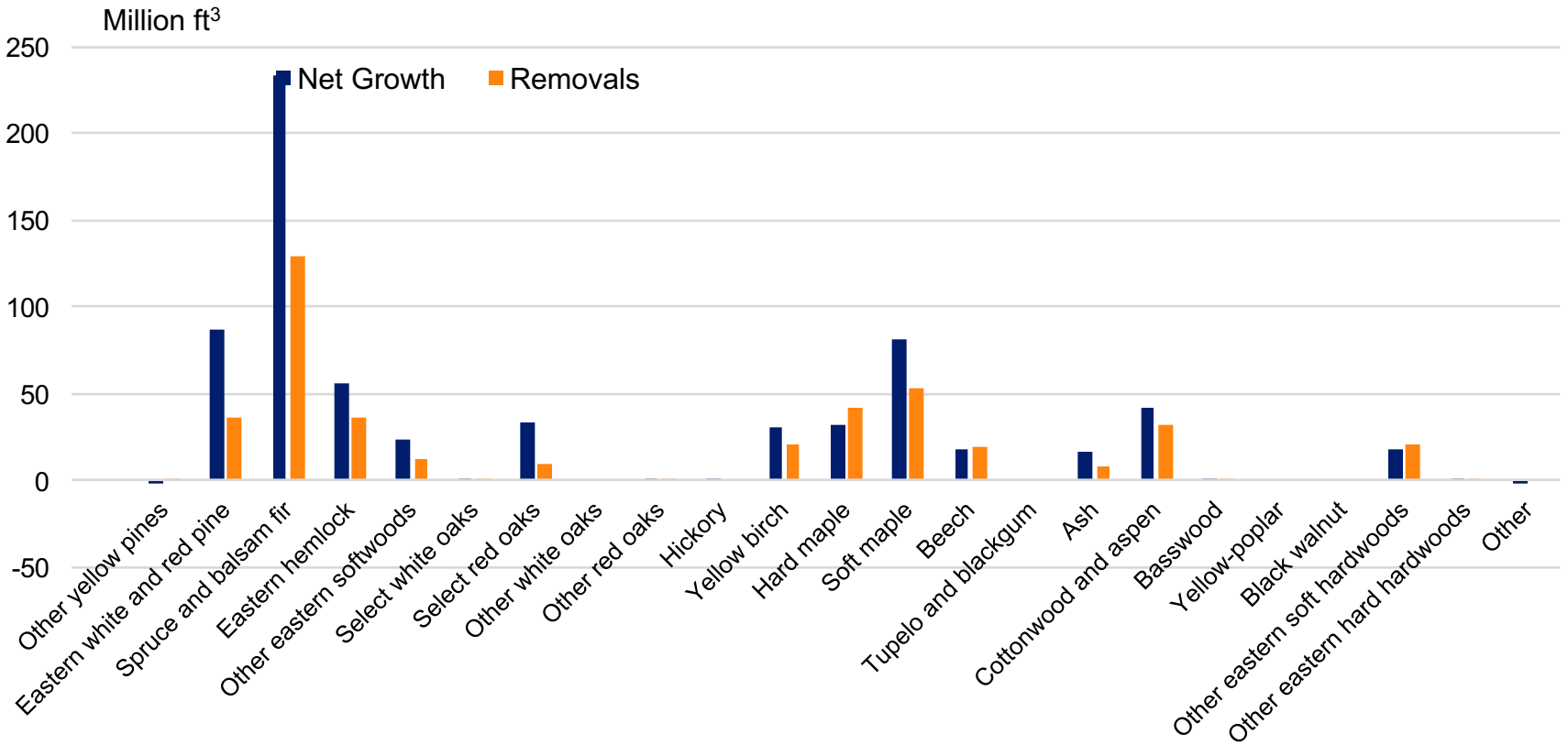
NET GROWTH AND REMOVALS BY SPECIES GROUP

New Hampshire - Vermont



NET GROWTH AND REMOVALS BY SPECIES GROUP

Maine



Appendix II: Sewall Wood Supply Report to FOR/Maine

SEWALL

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REPORT

Maine Wood Volume and Projection Study

Prepared for:

FOR/Maine

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TABLE OF CONTENTS

APPENDIX

LIST OF FIGURES

LIST OF TABLES

1. EXECUTIVE SUMMARY

The State of Maine is going through significant change in its forest industry. A consortium of forest industry organizations are working together to develop a long-term vision and roadmap for the Maine forest products sector. A first step in that journey is to have a current inventory and projections for major commercial species groupings on which to base their planning. This study addresses that need.

Maine's timberlands were aggregated into four primary owner types: Large Private (or corporate) landowners, smaller private landowners , Federal lands (National Forest, Department of Defense and Other Federal), and Other Public (State, County/Municipal and Local Government). Table 1.1 depicts the acreage breakdown by ownership category.

Table 1.1. Timberland Acreage by Ownership Type

Owner Type	Timberland Acres	Percent
Federal	67,162	0.4%
Other Public	929,045	5.5%
Large Private	9,021,940	53.9%
Small Private	6,734,227	40.2%

Table 1.2 depicts the acreage breakdown by megaregion.

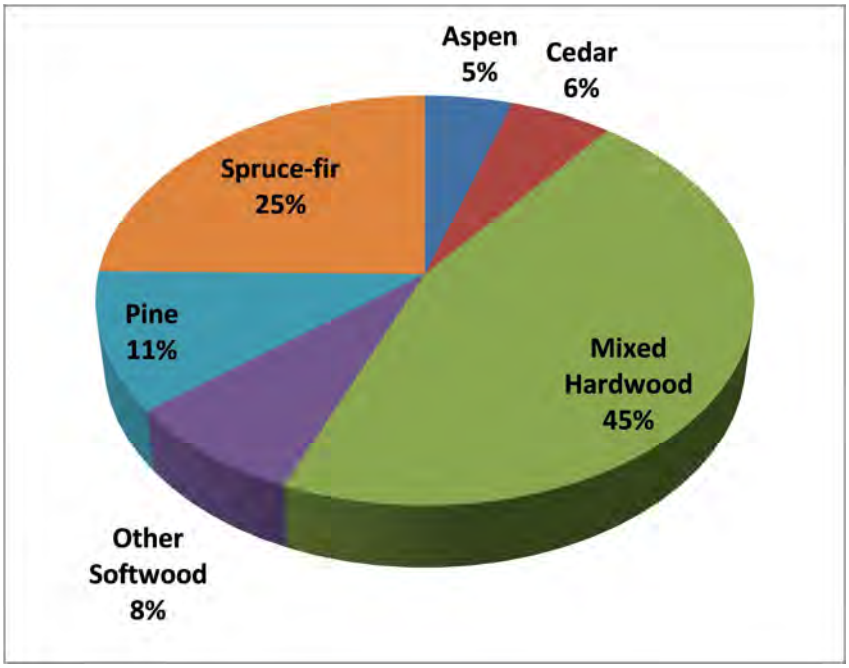
Table 1.2. Timberland Acreage by Megaregion

Megaregion	Acres	Percent
Northern	8,157,711	48.7%
Eastern	4,184,743	25.0%
Southern	2,260,165	13.5%
Western	2,149,755	12.8%

It should be noted that approximately half of the timberlands is in the Northern region, one-quarter in the Eastern megaregion and about an eighth in each of the Southern and Western megaregions.

SUMMARY BY SPECIES GROUP

Figure 1.1. Relative Size of Resource by Species Group



While FIA data is the best basis to form our current inventory, it is important to note it is backward looking. Each of the five years of 2012-2016 represents 20% of the dataset, so average inventory is 4.5 years old as of the writing of this report. Modeling is our best predictor of the future, but it also has limitations as applied over an area as large and diverse as the State. For these reasons, the authors recommend utilizing the data in broad strokes. It is reliable at the State and sometimes megaregion levels. It can assess and predict large trends, but no individual numbers should be taken as fact. They are as close an estimate as the sample and modeling allow.

In addition to analyzing the FIA data and trends, Sewall biometricians modeled the timberlands forward for 50 years in ten periods of five years each. Bothe the FIA and modeled summary results are presented for each species group.

Table 1.3. Summary Table of Model Results – First 25 years

	25-year Modeling (Run3)		
	Green tons/year (thousands)		
Species	Modeled Maximum	Discounted	Estimated 2017
Dense Hardwood	9,240	7,391	6200*
Aspen	1,042	1,027	900
Spruce-fir	5,915	5,751	3,200
Pine	1,714	1,664	1,100
Other Softwood	1,418	1,363	750
Cedar	259	249	200
* Commercial consumption of 5,200 plus 1,000 of unreported fuel wood			

Spruce-fir data analysis reveals a resource that has begun an impressive rebound as the large acreage established after the prior spruce budworm outbreak reaches merchantability. There is a marked contrast between the negative annual dynamics in 2008 vs. strongly positive in 2016; significant gains in inventory have already been measured. These gains will continue, and accelerate. At the same time, spruce-fir pulpwood consumption has declined by one million tons per year to an estimated 2.1 million tons/year. Fifty-year modeling predicts that the total spruce-fir available for harvest could increase sustainably by 84% to 5.9 million green tons/year for the next 25 years and then increase to 7.6 million GT/year in years 26-50.[1] Of the species groups examined, the spruce-fir resource offers the most significant potential for industry expansion for both pulpwood and sawable material.

Mixed Dense Hardwood presents two different resource pictures by landowner type. On large landholdings, the FIA inventory volume has declined in recent decades. However, the most recent data shows sharply higher annual growth rates and somewhat reduced harvesting. As a result of intensive even-aged management from the 1930s through the 1990s, the age class structure has a strong pipeline of stands entering merchantable size in the peak growth years. On industry lands, a resource recovery phase for mixed hardwood has begun. At current consumption levels, the inventory should gradually rise over the next two decades. Current levels of commercial utilization (estimated 5.2 million tons/year)[2] will be supported, and there will be some room for a degree of expansion over time. The resource on Small Private lands is characterized by mature stands, slower growth, and lower levels of utilization. Based on current trends, the growth rates will continue to slow, average tree size will increase, and the proportion of sawlogs to pulpwood will rise.

[1] No impact of the budworm was programmed in.
[2] 6.2 million green tons/year if we assume 1 million tons of unreported firewood.

Modeling predicts that the forest resource can theoretically sustain a cut as high as 9.2 million tons/year, a 78% increase over reported current harvest; 48% increase if one factors in the estimated million tons of firewood that is not reported annually. This number however includes harvest (at growth rates) from all lands, and includes all commercial dense-hardwood species.

Pine has shown relatively strong gains in total inventory and has very positive current annual dynamics. Pine pulpwood utilization has declined in recent years to an estimated 1.1 million tons/year. There is current opportunity for pulpwood utilization, and the next decade should see resource inventory gains for both pulpwood and sawlogs. Because the majority of inventory is in the Western, Southern, and Eastern Megaregions, pine is situated on small landownerships. Subject to the challenges of working with these smaller landowners, the pine resource offers immediate and sustained capacity for a moderate to strong degree of industry expansion using pulpwood and sawlogs. Fifty-year modeling predicts an annual sustainable harvest level of up to 1.7 million tons, a 56% increase over 2017 estimated harvest. Again, this number implies that all landowners are willing to harvest at a rate of annual growth, and all commercial species of pine are included.

Other Softwood inventory, which is primarily hemlock pulpwood, is level to slightly gaining across the past two decades. With very recent declines in utilization by pulp mills (total estimated harvest of 750,000 tons/year), the annual dynamics are now such that we should see even stronger gains in inventory in the next decade. The hemlock resource offers immediate and sustained capacity for a moderate degree of industry expansion. Modeling predicts an available supply to allow a harvest level of 1.42 million tons/year starting immediately. This is an 89% increase over 2017 estimated harvest levels. Older hemlock tends to develop ring shake, which prevents it from being sawn; however, no deduction has been made for this in the report.

Aspen total inventory is level to slightly declining. The acreage of aspen forest cover type has been declining for two decades; the age class structure indicates that this trend will continue. A majority of the aspen volume is now a minor component of mixed hardwood or other stands and too scattered to economically harvest on its own, which means that the harvest of aspen is limited by the level of mixed hardwood harvest. The estimated 2017 harvest of 900,000 tons/year roughly equals growth. Modeling indicates a slight opportunity for an increased harvest with a sustainable level just greater than 1.0 million tons/year, if 100% of that growth is harvested. Therefore, aspen resource offers no significant opportunity for industry expansion.

Cedar is a small resource with stands widely scattered across the northern two-thirds of the State. The statistics on annual growth and removals are weak. The strongest measure, total inventory, is declining. There is an unusually wide gap between reported harvest and measured harvest, implying that small operators or individuals do most of the harvesting. Modeling results are also the least certain of the species groups – they depict an average sustainable level of 258,800 tons/year over the next 50 years. Because of the scattered nature of stands and accessibility issues, we report that the cedar resource offers no significant opportunity for industry expansion.

This report was prepared by Sewall using Federal funds under award number 01 69 14749 from the Economic Development Agency of the United States Department of Commerce. The statements, findings, conclusions and recommendations are those of the author(s) and do not necessarily reflect the views of the Economic Development Agency or the United States Department of Commerce.

SUMMARY BY MEGAREGION

Table 1.4. Resource Potential for Industry Expansion by Megaregion and Species Group

Species Group	Reource Potential by Megaregion				Historical End Uses (WPR %s)
	Northern	Eastern	Western	Southern	
Aspen	Weak	Weak	Weak	Weak	Pulpwood and OSB
Cedar	Weak	Weak	Weak	Weak	Specialty Products
Mixed Hardwood	Weak	Moderate	Weak	Weak	80% Pulpwood, 20% Sawlogs
Other Softwood	Weak	Moderate	**Strong**	Moderate	83% Pulpwood, 17% Sawlogs
Pine	Weak	**Strong**	Moderate	Moderate	30% Pulpwood, 70% Sawlogs
Spruce-fir	**Very Strong**	**Very Strong**	**Strong**	Weak	33% Pulpwood, 67% Studwood/Logs

Figure 1.2. Megaregions

2. INTRODUCTION

BACKGROUND AND PURPOSE

The State of Maine is going through significant change in its forest industry. A consortium of forest industry organizations are working together to develop a long-term vision and roadmap for the Maine forest products sector. A first step in that journey is to assess current inventory conditions and develop projections for major commercial species groupings on which to base their planning. Sewall was awarded the task for these wood fiber inventory analyses and projections, and this study presents the results of that work.

METHODOLOGY - CURRENT

This "current-state" resource supply analysis is based on the USDA Forest Service Forest Inventory and Analysis (FIA) database, which is in turn built on a set of permanent sample plots with a density targeted at one plot per 6,000 forested acres. In recent decades, the FIA program team in Maine has remeasured 20% of the plots each year. Each remeasured plot provides new inventory and a measure of average net annual growth since the last measurement (normally five years). If harvesting has occurred on the plot, then average annual removals are calculated. Because harvesting does not occur on more than a small percentage of plots each year, average annual removals is the weakest of the estimates, and is reliable only for large areas.

Forests are complex, dynamic systems that respond over decades to harvesting and other loss or disturbance. To understand the future trajectory of a particular timber resource, it is best to use a series of snapshots at different points in time.

In the present study, we use the 2008 FIA dataset as the first observation. Because of the five-year remeasurement cycle, the 2008 data actually reflects inventory conditions in 2005-2006, and average growth and removals across the period 2000 to 2008.

We use the most current measurement year available, 2016, for the second observation. Again, the inventory actually reflects conditions in 2013-2014, and growth and removals across the period 2008 to 2016.

FIA identifies the county in which each plot falls; this information was used to separate data into megaregions. Plots on Other Public lands are also identified, but no distinction between ownership classes of private lands is provided. Exact plot locations are not released; the agency shifts the location data a kilometer or so in random directions and sometimes swaps data between plots. The Sewall team relied on an overlay of a proprietary

Sewall GIS database to identify plots on large landholdings in Maine. For timberland areas of two million acres or more (333 plots), such as the zones in this study and the large landholdings (as a single group), the "edge effects" of plots falling in the wrong polygon are not serious enough to prevent meaningful study.

FIA growing stock volumes on timberland are in units of cubic feet of wood in the main stem only. We used the following conversion factors to estimate tons of delivered roundwood:

Aspen 26.9 tons per MCF	Cedar 20.0 tons per MCF
Mixed Hardwood 33.8 tons per MCF	Other Softwood 27.1 tons per MCF
Pine 25.3 tons per MCF	Spruce-fir 24.7 tons per MCF

Estimates of estimated 2017 harvest and the methodology can be seen in section 4 of this report.

METHODOLOGY - MODELING APPROACH

Sewall used biological data on the State's forest resources from FIA, widely used growth models[3], and software for harvest scheduling/optimization (Woodstock), to study the supply of the commercial species groups across the four megaregions of the State over the next five decades (ten periods of five years each).

Growth models were used to develop a set of yield tables for use in the Woodstock model. Yields were developed for the major forest types considering the various silvicultural practices commonly applied across the region. Silvicultural practices included two stage shelterwood system, and clearcutting. Planting was allowed on Large Private ownership, while the majority of areas were assumed to regenerate naturally, as is commonly the case across the Northern Forest.

The yields were incorporated into Woodstock, which can be used to develop harvest schedules that optimize a desired objective subject to user-specified constraints. It can be applied in a manner that seeks not only to build a harvest schedule, but also to determine the highest level that the objective can reach. By setting the maximization of harvest volume across the modeling period as the objective, we were able to use Woodstock to test the productive capacity of the forest given its initial condition, subject to constraints that reflect real-world conditions and trends.

[3] Forest Vegetation Simulator, or FVS. The Fiber model was applied for certain conditions where FVS was not appropriate.

It is important to note that during the modeling phase, Sewall did not limit the full growing capacity of the timberlands within the constraints described in the Appendix. The reader should therefore view the initial modeled results as the theoretical maximum available. Post modeling, the sponsor team recommended the following discounts: 100% of Federal land unavailable for commercial harvest (all species), 30% of Other Public lands unavailable (all species), and on Small Private Timberlands a division by megaregion for hardwood only: 50% of hardwood unavailable in the Sothern megaregion, and 20% unavailable in the remaining three megaregions. These discounted volumes are reported at the end of each species section.

Three runs were made with the model, as follows:

1. Base run: maintain constant harvest levels
    a. Harvest stays the same as estimated for 2017
    b. Inventories by species group were non-declining (except for cedar)
    c. Inventories at end of the study period had to be greater than or equal to starting inventories
2. Maximize harvest volumes while sustaining inventory over the study period
    a. Harvest levels in the first year were set to the 2017 estimated levels and then allowed to increase/decrease within reasonable constraints reflecting likely expansion in harvest and demand capacity
    b. Inventories allowed to increase/decrease throughout the study period
    c. Inventories at end of study period had to be greater than or equal to starting inventories
3. Non-declining harvest levels, while sustaining starting inventories
    a. Harvest levels in first year greater than or equal to harvest level estimated for 2017
    b. Harvest levels allowed to increase, but not decrease over the study period
    c. Inventories allowed to increase/decrease throughout the study period
    d. Inventories at end of study period had to be greater than or equal to starting inventories

Run1 and Run3 produced salient results which are reported in this report. Run2 was interesting from an academic standpoint because it often gave a slightly higher overall volume of harvest. That said, it did this by fairly significant swings in harvest levels over the ten five-year periods which does not represent how industry would operate. For this reason we minimized reporting on the results of Run2.

Modeling assumptions and constraints can be viewed in the Appendix.

MIX BY LANDOWNERSHIP

Large landownerships make up the majority of timberland in Maine (54%, yet consistently in our modeling only supply the heaviest harvest volume in two species groups (spruce-fir and cedar). Smaller private landowners make up the second largest category; Other Public is third and the Federal lands are the smallest group. Table 2.1 depicts the percentage of average harvest over the 50–year modeling period from each ownership type.

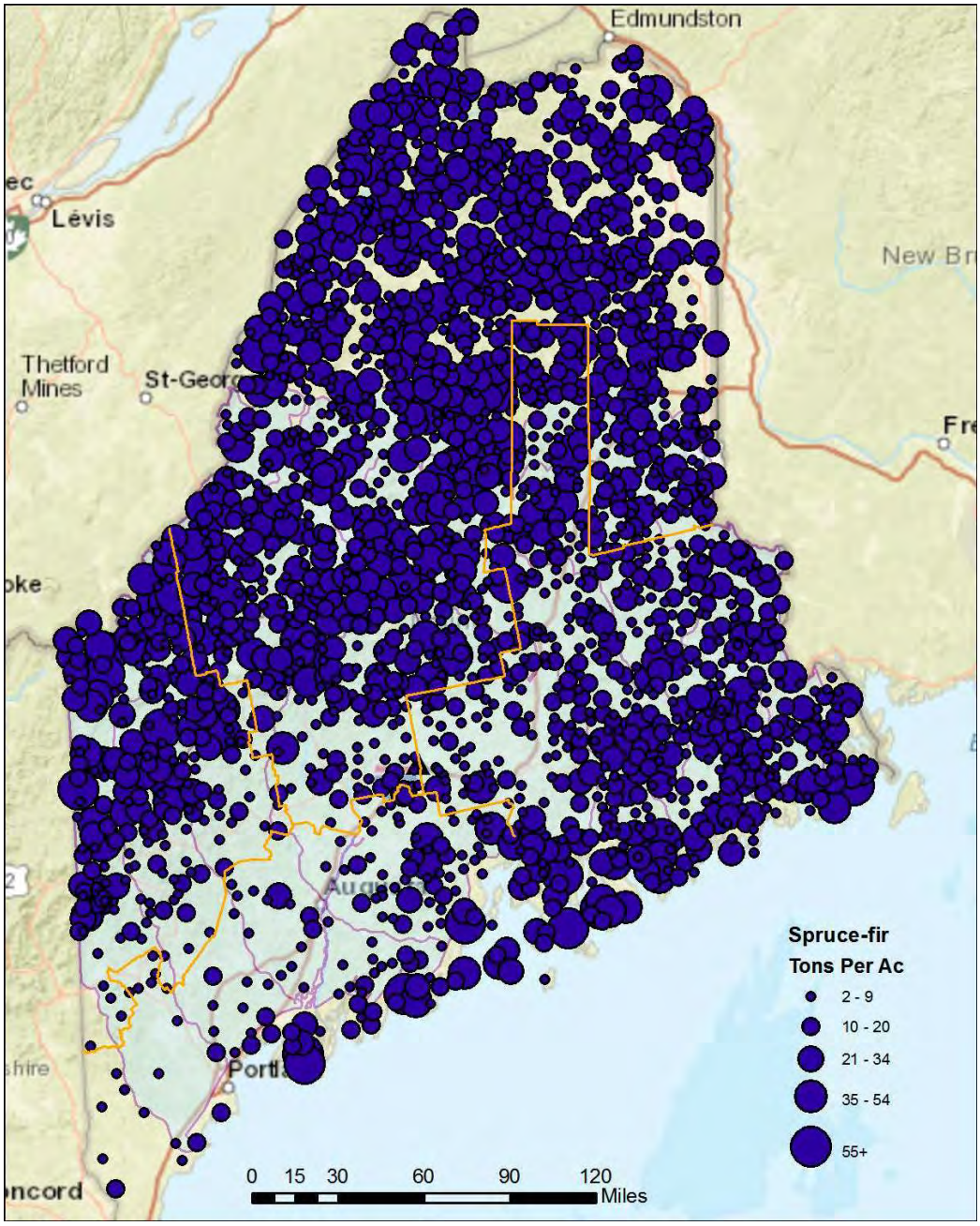
Table 2.1. Predicted Percentage of Average Harvest by Ownership Type and Species Group (50 year projection – Run3).

	Species Group					
Owner	Spruce Fir	Pine	Other Softwood	Cedar	Dense Hardwood	Aspen
Federal	0%	0%	2%	0%	0%	0%
Large Private	66%	19%	32%	50%	46%	36%
Other Public	6%	7%	3%	13%	6%	4%
Small Private	28%	74%	63%	37%	48%	60%

3. MAINE'S TIMBER RESOURCE: CURRENT STATUS, RECENT AND FUTURE TRENDS

SPRUCE-FIR – CURRENT

Figure 3.1. Spruce-fir Volume Per Acre on Approximate FIA Plot Locations



Spruce-fir is primarily a northern and eastern resource in Maine. The distribution is characterized by a very pronounced gap extending about 65 miles inland from the coast beginning in the Bangor area and continuing to the southern tip of the State. Historically, the reported harvest has been 67% studwood or sawlogs, and 33% pulpwood. When now-common studwood specifications are applied to the FIA tree list (inventory) the product

mix is 70% studwood/sawlogs and 30% pulpwood[4]. If a small log mill definition is utilized, then 98% of the FIA volumes reported are sawable product.[5] These percentages might be slightly overstated as the FIA data often fails to capture stem form or quality issues.

Table 3.1. Spruce-fir Inventory Trend

Region	Million Tons		Change
	2008	2016	
Eastern	36.6	41.6	14%
Northern	85.1	91.8	8%
Southern	8.2	9.3	14%
Western	17.7	19.6	11%
Total	**147.5**	**162.2**	**10%**

Landowner Type	Million Tons		Change
	2008	2016	
Lg Private	92.3	98.2	6%
Public	9.6	14.3	49%
Sm Private	45.7	49.7	9%
Total	**147.5**	**162.2**	**10%**

One-fourth of all commercial timber volume in the State is spruce-fir, which is primarily (82%) in the Northern and Eastern megaregions. Statewide, the inventory expanded 10% in eight years. The expansion occurred across all regions and owners.

Table 3.2. Spruce-fir Growth and Removals (Thousand Tons)

Annual Average for the Period 2000 - 2008							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	965	1,082	0.9	Lg Private	2,531	3,212	0.8
Northern	2,414	3,026	0.8	Public	183	327	0.6
Southern	1	54	0.0	Sm Private	940	1,041	0.9
Western	273	419	0.7				
Total	**3,653**	**4,580**	**0.8**	**Total**	**3,653**	**4,580**	**0.8**

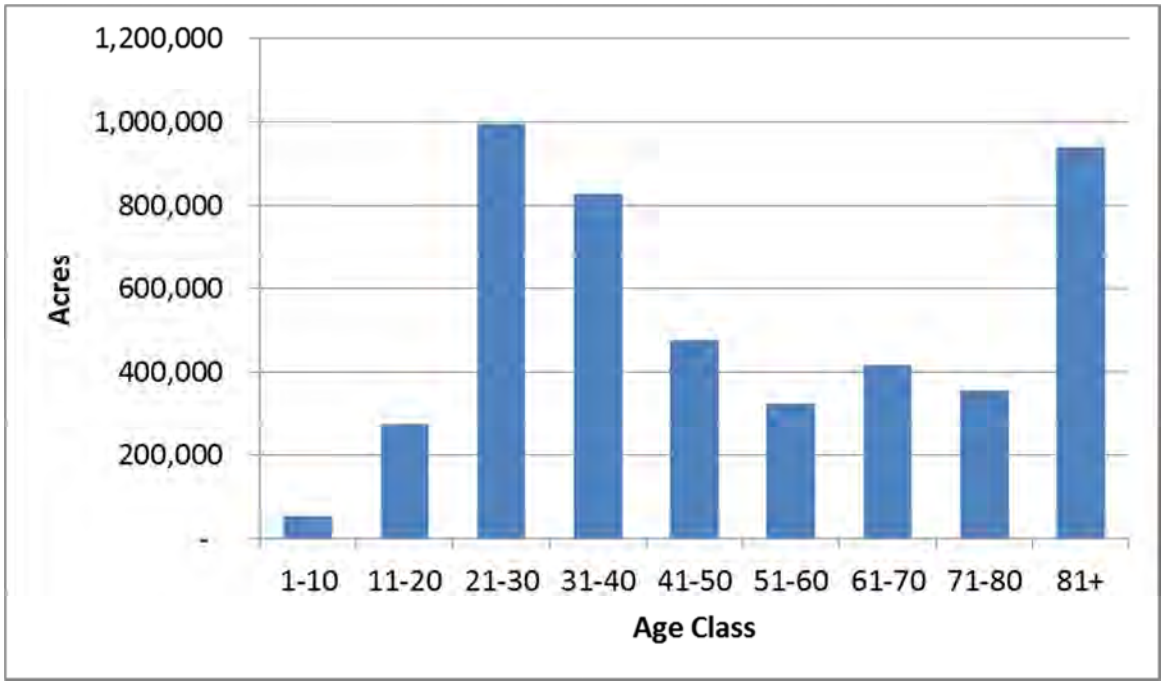
Annual Average for the Period 2008 - 2016							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	1,542	630	2.4	Lg Private	4,407	2,629	1.7
Northern	4,233	2,487	1.7	Public	432	309	1.4
Southern	196	71	2.8	Sm Private	1,791	825	2.2
Western	658	574	1.1				
Total	**6,629**	**3,763**	**1.8**	**Total**	**6,629**	**3,763**	**1.8**

[4] Studwood specifications vary slightly among mills and over time. For this first product definition, Sewall looked at all FIA trees 7.0" dbh and greater. The tree was characterized as studwood if it had a 7" dbh, was at least 16'6" long from stump to a 5.0" top diameter - outside bark.

[5] For this definition, the sponsor team gave Sewall the following definition: all FIA trees 5" dbh and greater. 5" dbh log, minimum 8'6" long to a 4" top diameter – outside bark. This is the definition of bole volume utilized by the US Forest Service in FIA. Sewall applied a 2% discount for (tree bole) form.

Spruce-fir saw the most dramatic change in annual dynamics of all species groups. Annual growth increased by more than 80%, while removals declined. The combination led to an increase in the growth/drain ratio from 0.8 to 1.8. This change is a good illustration of the fact that the growth to removals ratio will vary widely over time for a sustainably managed resource that has a "bulgy" age class distribution rather than textbook area regulation (where every age class is the roughly the same acreage).

Figure 3.2. Age Class Distribution of Spruce-fir Forest Cover Types



The spruce-fir age class distribution has a pronounced bulge at age 21-40, which is the result of the late 1970s and early 1980s spruce budworm outbreak. Mainly due to this bulge, the next two decades should see continued increases in annual growth.

Table 3.3. Spruce-fir Growth to Removals Ratio Using Estimated 2017 Removals

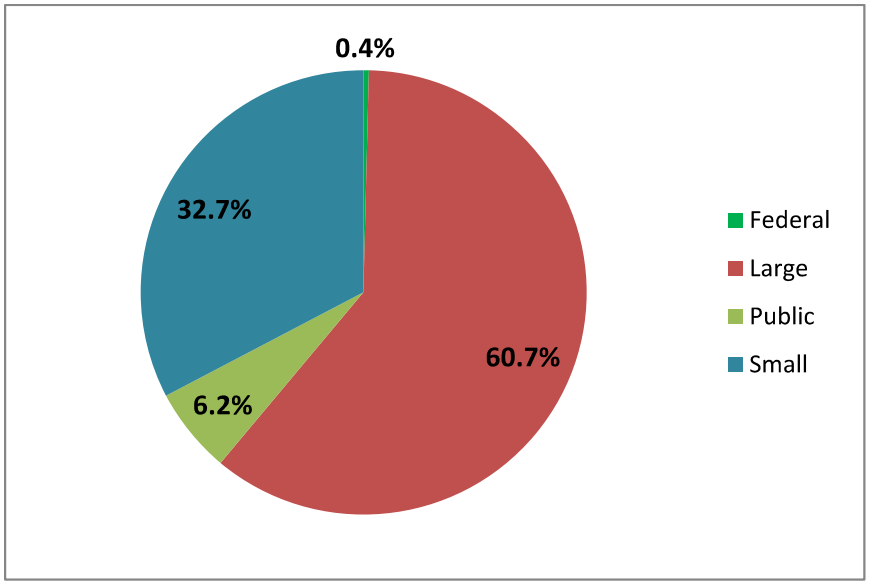
Annual Growth vs. Estimated 2017 Removals			
Region	**Annual Growth**	**Annual Removals**	**G/R**
Eastern	1,542	536	2.9
Northern	4,233	2,115	2.0
Southern	196	60	3.3
Western	658	488	1.3
Total	**6,629**	**3,200**	**2.1**

With estimated 2017 removals, the spruce-fir annual dynamics are even more positive. If this level of removals continues, the next decade should see strong gains in total inventory Statewide, with the strongest (proportionally) in the Eastern region. If all landowners could be enticed to harvest growth, the FIA data would indicate there is a sustainable additional 3.4 million tons/year available Statewide.

SPRUCE-FIR - MODELED FORWARD

In the base scenario (constant harvest levels), the percentage of potential harvest of spruce-fir over the 50-year period is about 61% Large Private owners, one-third Small Private timberlands, 6% from Other Public lands and less than 1% from Federal lands (Figure 3.3). This makes sense since the largest volumes of spruce-fir are in the northern and eastern portions of the State where Large Private landowners are prevalent.

Figure 3.3. Run1, Distribution of Average 50-year Modeled Harvest of Spruce-fir Across Landowner Types

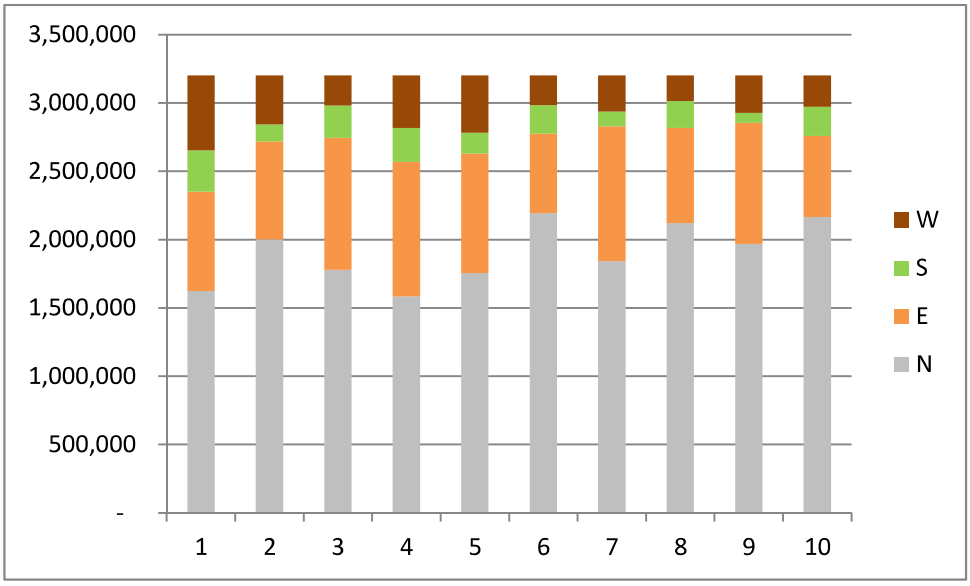


In both of the subsequent model runs (where harvest is maximized) these percentages change to 66% (Large Private) and 28% (Small Private); with Other Public and Federal staying relatively constant (at 6% and 0.3%, respectively).

Modeled harvest levels of 3.2 million green tons remain fairly consistently distributed among the megaregions (Figure 3.4), with the harvest greatest (average = 59%) in the north, 25% in the east, 10% in the west and 6% in the south.

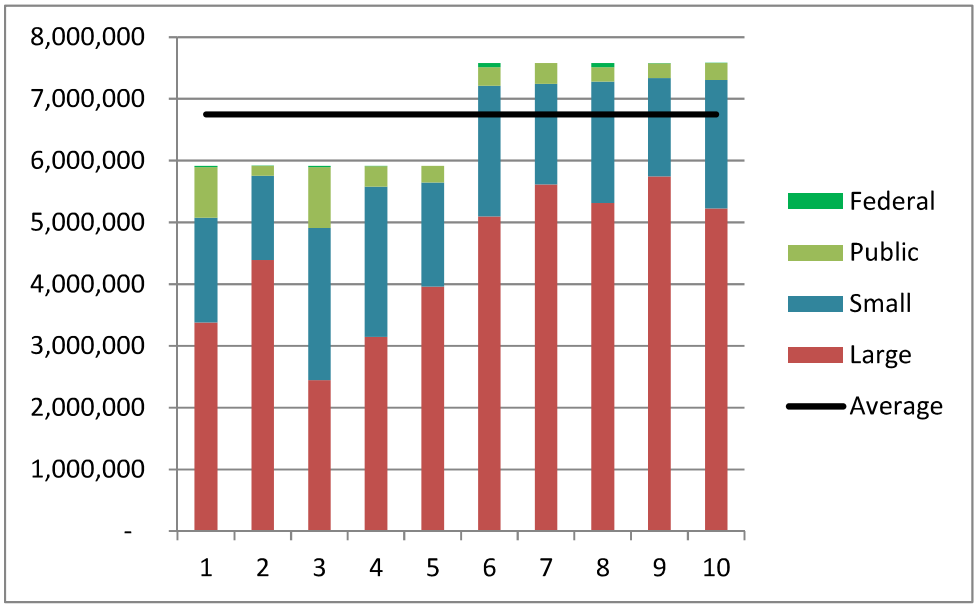
Modeled inventory of spruce-fir grows to 2.4 times current inventory if the harvest level is held at estimated 2017 levels of 3.2 million tons.

Figure 3.4. Run1, 50-year Harvest of Spruce-fir Across Megaregions



If the model is programmed to maximize harvest in a non-declining manner (Run 3– Figure 3.5) then the model will immediately harvest at a rate of 5.9 million tons and hold that through period 5 (25 years). In period 6 (2043-2047), the modeled harvest increases to 7.6 million tons/year. This biological capacity represents increases over 2017 estimated harvest levels of 84% and 137%, respectively.

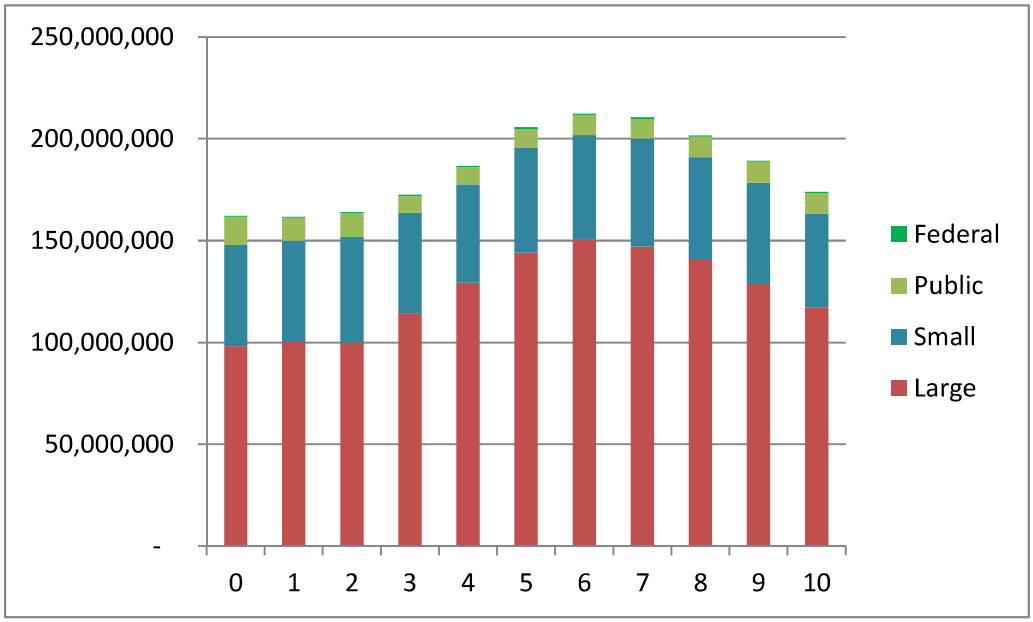
Figure 3.5. Run3, 50-year Harvest of Spruce-fir by Landowner Type



The average biological capacity over the 50 years is 6.75 million tons per year in this scenario, versus 7.75 million when the model is allowed to optimize harvest without the non-declining constraint.

In Run3, in order to accomplish this high level of non-declining spruce-fir harvest, the model builds inventory through period 6 and then brings it back to starting values in periods 8-10 Figure 3.6).

Figure 3.6. Run3, 50-year Inventory of Spruce-fir by Landowner Type

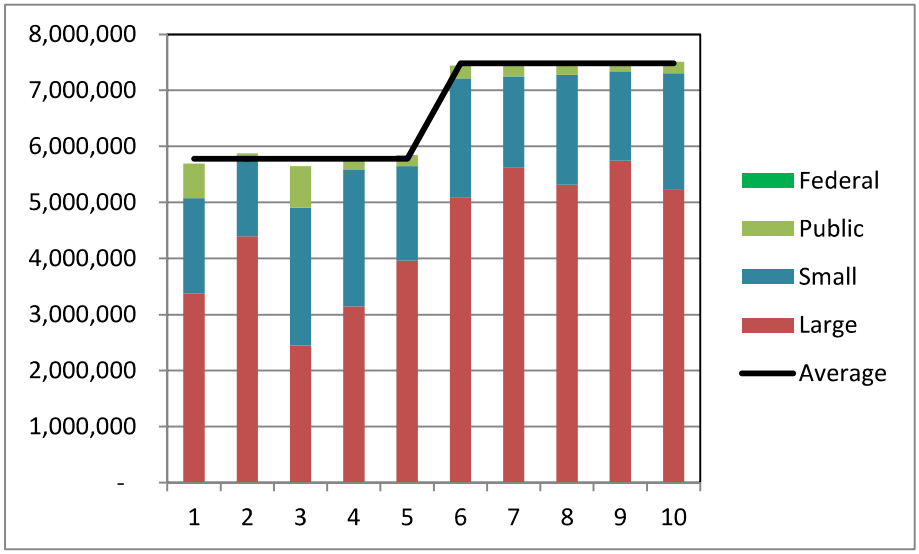


There are apt to be numerous readers that will want to discount Federal, Other Public and Small Private harvests to less than modeled growth on harvestable acres. For illustration purposes we discounted harvest/biological levels as follows:

- Federal -100%
- Other Public - 30%
- Small Private (dense hardwood only)- 20% Eastern, Western and Northern megaregions, 50% in Southern megaregion
- Large Private - 0%

This still allows an increased harvest level of spruce-fir of 5.8 million tons/year over the next 25 years and 7.5 million tons/year in years 26-50 (Figure 3.7).

Figure 3.7. Run3, 50-year Inventory of Spruce-fir by Landowner Type, with Discounts



As reported above, the current mix of spruce-fir inventory is anywhere from 70% to 98% sawable material depending on the mill specs for roundwood. Utilizing the 70% sawable material level, and the discounted harvest percentages yields the 50-year average potential harvest levels in Table 3.4.

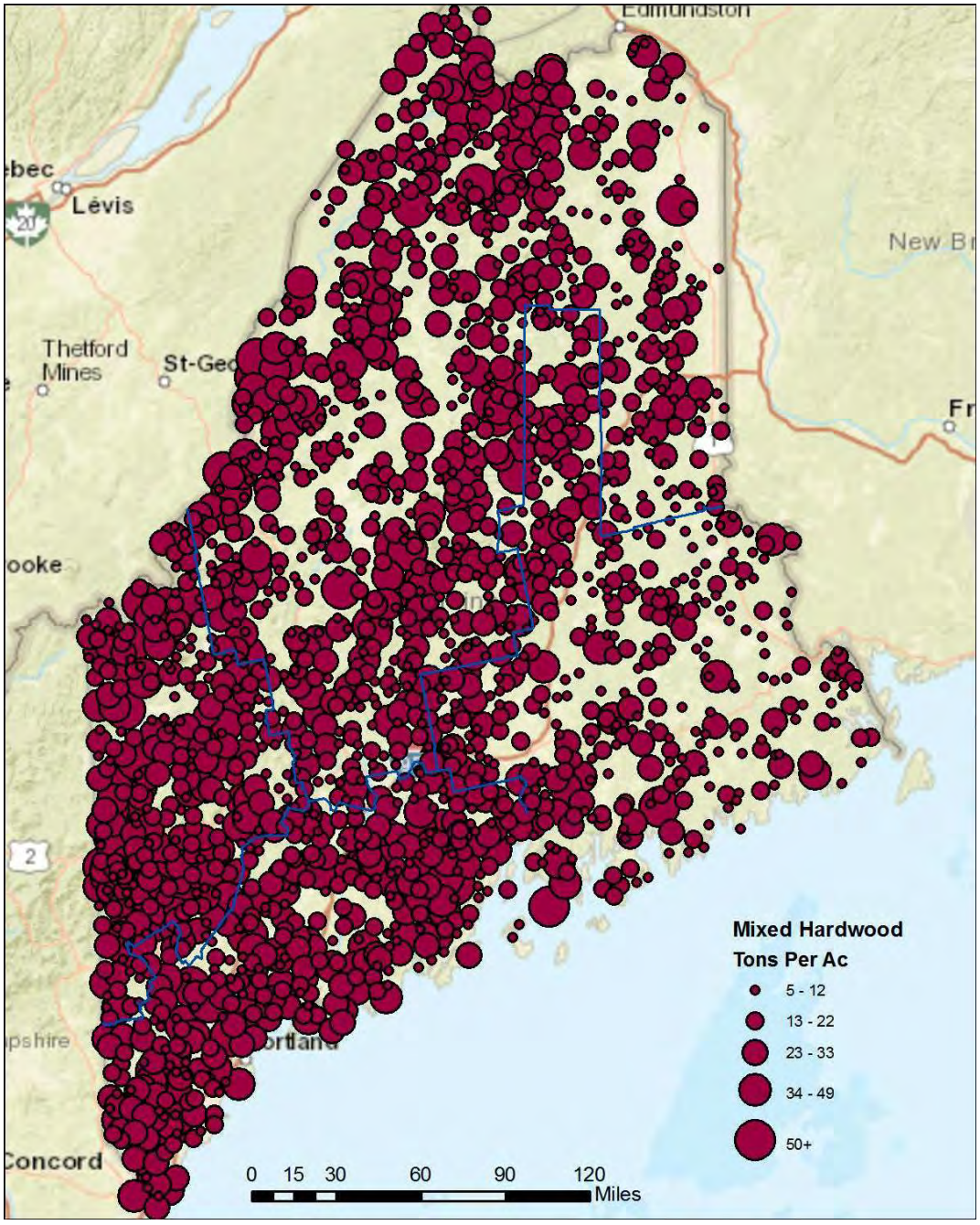
Table 3.4. Run3, Discounted Modeled Potential Harvest Levels of Spruce-fir in Maine

Studwood Specifications	7" dbh - 16'6" min to a 5.0 top		5" dbh - 8'6" min to a 4.0 top	
Period	Year 1-25	Year 26-50	Year 1-25	Year 26-50
Pulp Only (GT/year)	1,733,122	2,244,564	115,541	149,638
Sawable (GT/year)	4,043,952	5,237,317	5,661,533	7,332,244

Sewall anticipates that the percentage of sawable timber will increase as the spruce-fir forest matures, but product merchandizing was not part of the scope, so better predictions of product mix are left to a phase II deliverable.

MIXED DENSE HARDWOOD – CURRENT

Figure 3.8. Mixed Dense Hardwood Volume Per Acre on Approximate FIA Plot Locations



Mixed dense hardwood[6] (hardwood) and spruce-fir together make up 70% of the volume in the State. Hardwood is more highly concentrated in the south and west, where spruce-fir is more concentrated. The harvest volume is typically 80% pulpwood, with approximately one million tons per year of reported sawlog harvest since 2000.[7]

Table 3.5. Mixed Dense Hardwood Inventory Trend

Region	Million Tons		Change
	2008	2016	
Eastern	52.7	50.5	-4%
Northern	132.5	117.5	-11%
Southern	65.6	72.9	11%
Western	62.9	58.3	-7%
Total	**313.7**	**299.2**	**-5%**

Landowner Type	Million Tons		Change
	2008	2016	
Lg Private	149.6	129.0	-14%
Public	20.1	24.0	19%
Sm Private	144.0	146.2	2%
Total	**313.7**	**299.2**	**-5%**

The group of hardwood is by far the largest species group at 46% of all tree volume. Eastern, Northern, and Western megaregions saw a decline in inventory, while gains were recorded in the Southern megaregion. Inventory showed a marked decline on Large Private lands, and a slight increase on Small Private.

Table 3.6. Mixed Dense Hardwood Growth and Removals (Thousand Tons)

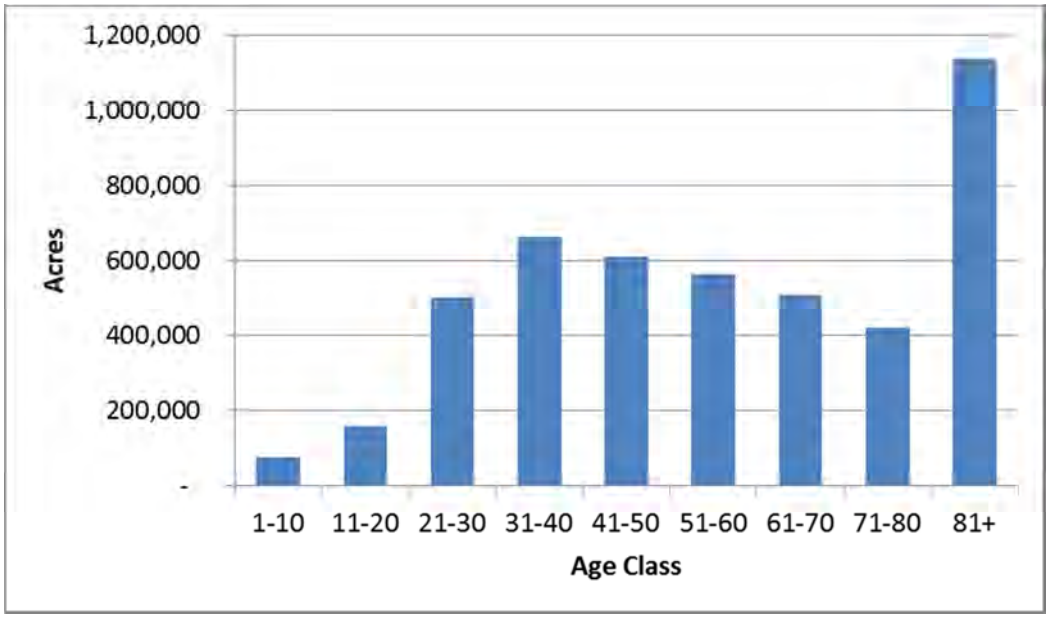
Annual Average for the Period 2000 - 2008							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	1,193	1,351	0.9	Lg Private	2,501	4,423	0.6
Northern	2,340	3,919	0.6	Public	377	451	0.8
Southern	2,024	643	3.1	Sm Private	3,907	2,257	1.7
Western	1,228	1,218	1.0				
Total	**6,785**	**7,131**	**1.0**	**Total**	**6,785**	**7,131**	**1.0**

Annual Average for the Period 2008 - 2016							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	1,529	1,313	1.2	Lg Private	3,368	4,536	0.7
Northern	3,308	3,889	0.9	Public	560	369	1.5
Southern	2,215	921	2.4	Sm Private	4,504	2,505	1.8
Western	1,379	1,288	1.1				
Total	**8,431**	**7,410**	**1.1**	**Total**	**8,431**	**7,410**	**1.1**

[6] Excludes aspen species group
[7] Maine Wood Processor Report (WPR) – figure 4.3

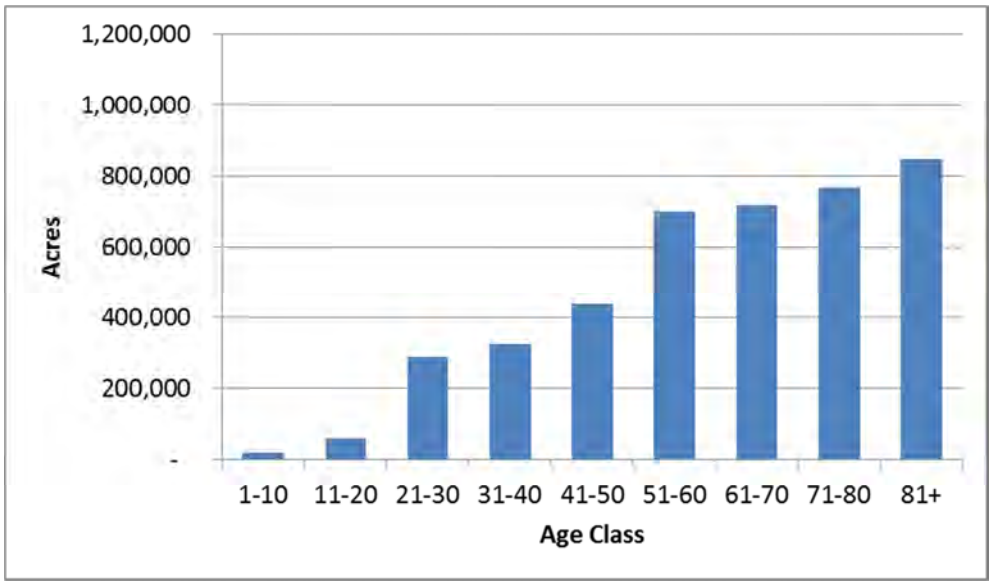
In spite of overall rising removals, the Statewide growth to removals ratio for hardwood has improved slightly. The most striking change is the 25% increase in average annual growth, which implies a significant acreage maturing from juvenile into volume-bearing, higher growth rate stands. While both owner classes showed improvement, the annual dynamics are quite different on Large Private lands (ratio 0.7) vs. Small Private (1.8).

Figure 3.9. Age Class Distribution of Hardwood Cover Types on Large Private Lands



With the exception of the larger age 81+ class and the smaller acreage less than age 21, the age distribution of hardwood on Large Private landowners is level (regulated) to slightly "bulgy" at age 35 (Figure 3.9). The distribution reflects a history of intensive management across a period 20 to 80 years ago, from 1936 through 1996. Since that time, more reliance on selective harvesting has reduced the pipeline of young stands. With this distribution, we see lower inventories than in the past, but higher growth rates which are likely to persist for the next few decades.

Figure 3.10. Age Class Distribution of Hardwood Cover Types on Small Private Lands



Somewhat in contrast to hardwood on Large Private lands, the age class distribution on Small Private lands is more "right-side-heavy" (Figure 3.10). Younger cohorts exist, but they represent a smaller proportion of all acreage. This tends to reinforce the theory that not all landowners are harvesting on their lands.

Table 3.7. Mixed Hardwood Growth to Removals Ratio Using Estimated 2017 Removals

Annual Growth vs. Estimated 2017 Removals			
Region	**Annual Growth**	**Annual Removals**	**G/R**
Eastern	1,529	921	1.7
Northern	3,308	2,729	1.2
Southern	2,215	646	3.4
Western	1,379	904	1.5
Total	**8,431**	**5,200**	**1.6**

Hardwood removals have been reduced in very recent years with the closure and curtailment of some pulp mill operations. When 2017 estimated removals are weighed against annual growth, we see a relatively healthy ratio of 1.6. If Sewall's best estimate of under-reported firewood is added in, the ratio is 1.4. Growth rates will continue to rise, and, absent any new consumption, the total hardwood inventory will show significant gains. Even the Northern region, where the inventory declines have been the steepest, should see a turnaround to inventory gain under these conditions.

Table 3.8. Mixed Dense Hardwood Growth to Removals Using Estimated 2017 Removals by Landowner Type

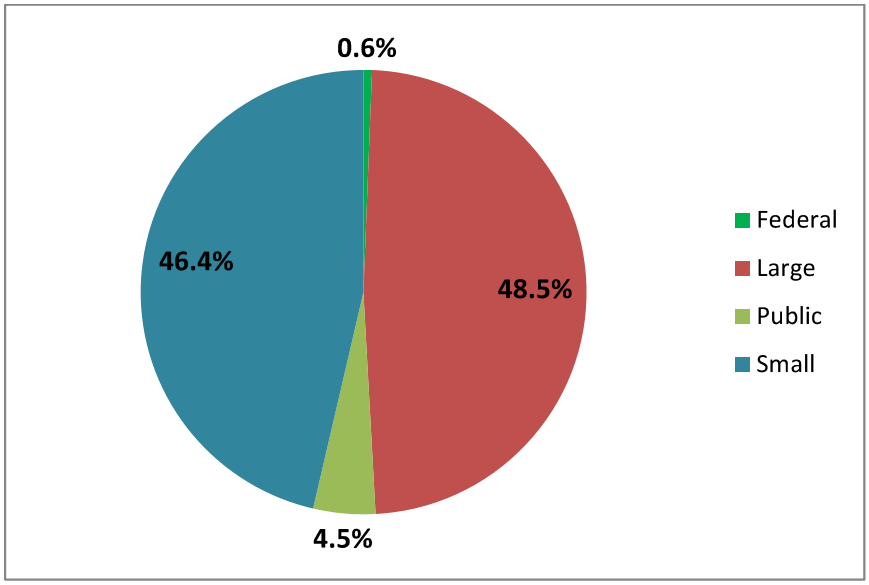
Annual Growth vs. Estimated 2017 Removals			
Region	**Annual Growth**	**Annual Removals**	**G/R**
Lg Private	3,368	3,183	1.1
Public	560	259	2.2
Sm Private	4,504	1,758	2.6
Total	**8,431**	**5,200**	**1.6**

When 2017 estimated removals are allocated to landowner classes based on historic proportions of removals, even the Large Private landowner class has a (barely) positive ratio, which is in contrast to the experience of the past two decades. Note however, that most of the available excess growth is on the Small Private lands, and to a lesser extent the Other Public lands (combined just over 3 million tons/year). If we assume that the majority of under-reported fuel usage is from the Small Private lands, then that ratio is 1.7.

MIXED DENSE HARDWOOD - MODELED FORWARD

In the base scenario (constant harvest levels), the percentage of potential harvest of dense hardwood over the five decade period is about evenly distributed between Large Private (industrial) owners, and Small Private timberlands, with 4.5% from Other Public lands and less than 1% from Federal lands (Figure 3.11).

Figure 3.11. Run1, Distribution of Average 50-year Modeled Harvest of Mixed Dense Hardwoods Across Landowner Types

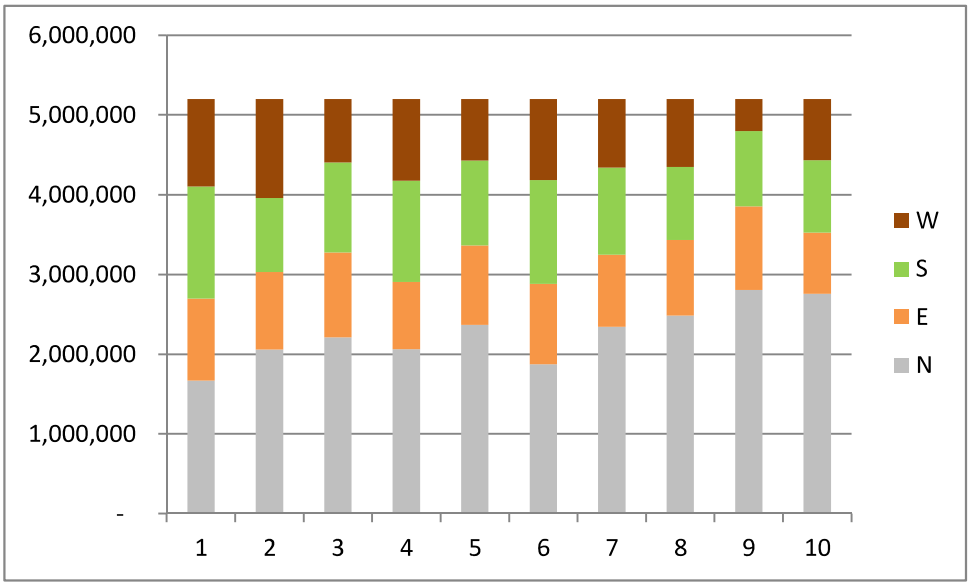


In Run3 (maximizing harvest) these percentages remain within 1% of the base run.

Harvest levels of 5.2 million green tons in Run1 remain fairly consistently distributed among the megaregions (Figure 3.12), with the modeled harvest greatest (average = 44%) in the north, 18% in the east, 17% in the west and 21% in the south.

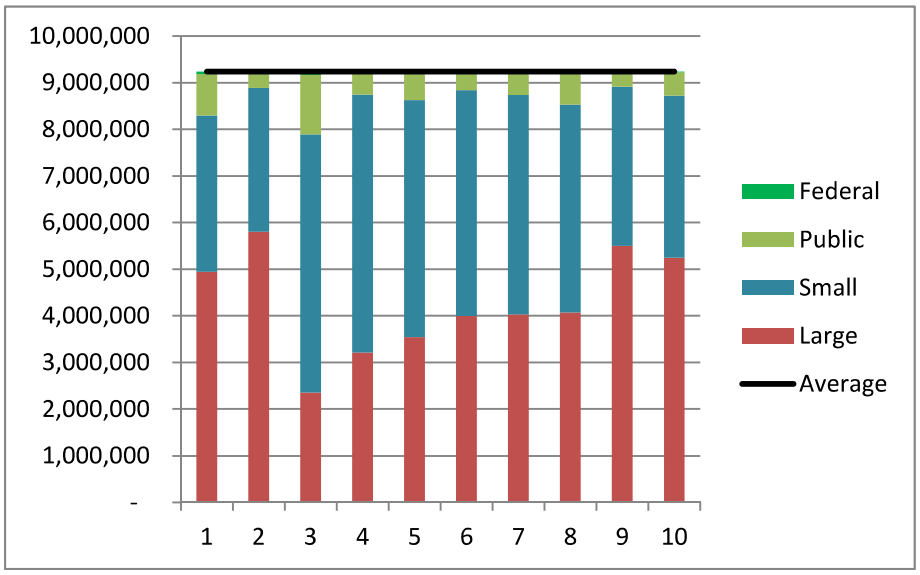
Inventory of hardwood models to 1.6 times the current inventory if the harvest level is held at 2017 estimated commercial levels of 5.2 million tons.

Figure 3.12. Run1, 50-year Distribution of Modeled Harvest of Mixed Dense Hardwoods Across Megaregions



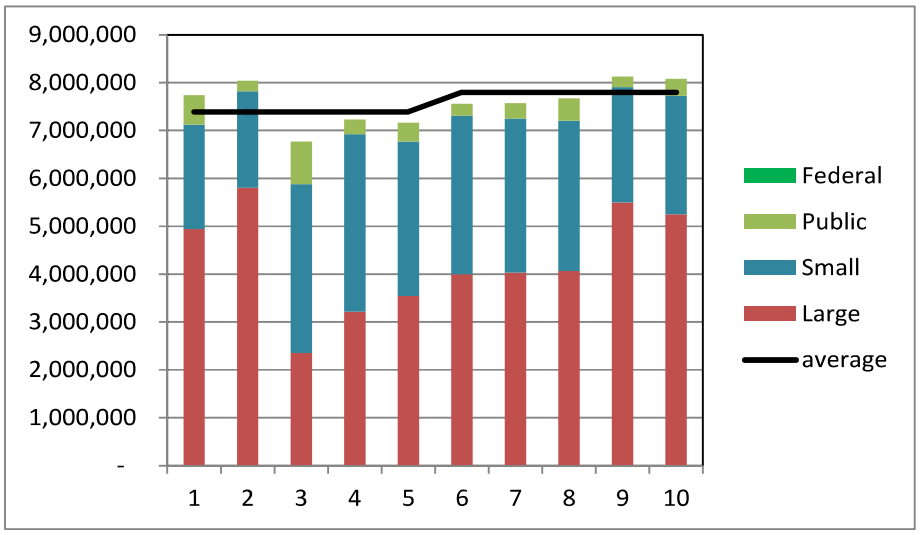
As the objective function of the model is programmed to maximize harvest in a non-declining manner (Run3) it will immediately harvest at a rate of 9.2 million tons and hold that through the entire 50 years (Figure 3.13). This biological capacity represents increases over 2017 estimated commercial harvest levels of 78%. This reduces to a 48% increase if we assume 1 million tons of under-reported fuel wood annually.

Figure 3.13. Run3, Modeled, Non-declining, 50-year Harvest of Mixed Dense Hardwood by Landowner Type



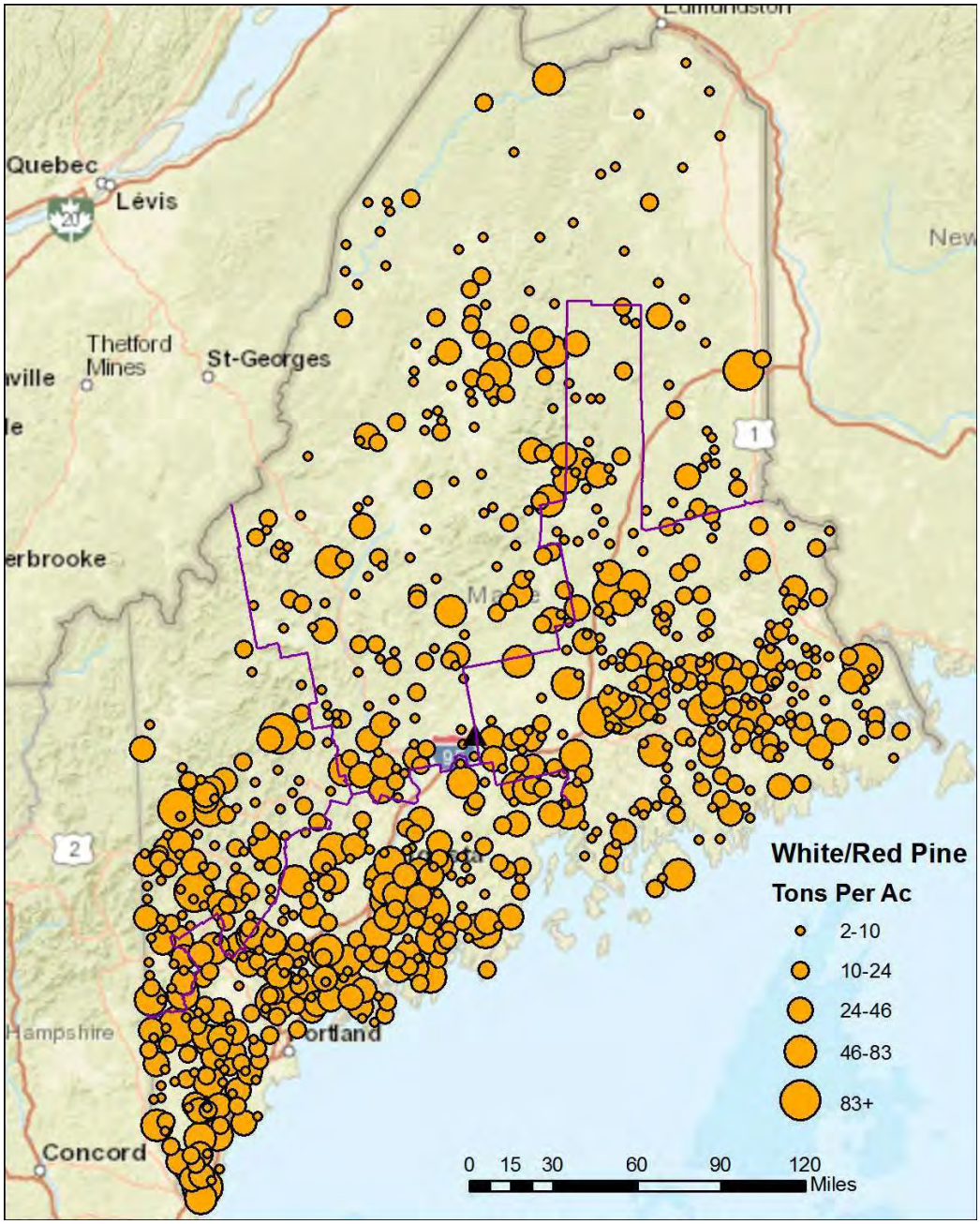
Utilizing the same discounting factors for percentage of harvestable acres that might be available to the market over the 50-year cycle (Federal -100%, Other Public - 30%, Small Private – hardwood only of 50% in Southern megaregion and 20% in other megaregions) still allows an increase harvest level of hardwood to 7.4 million tons/year over the next 25 years and 7.8 million tons/year in years 26-50 (Figure 3.14). At these discounted levels 39% of projected harvested dense hardwood (2.9 million tons/year) would still need to come from Small Private lands.

Figure 3.14. Run3, Modeled, Non-declining, 50-year Harvest of Mixed Dense Hardwood by Landowner Type, With Discounts



PINE CURRENT

Figure 3.15. Pine Volume Per Acre on Approximate FIA Plot Locations



The pine resource is heaviest in a band within 30-40 miles of the coast, and common in the range of 40 to 70 miles, but then rare further inland and north. Historically, 70% of all pine harvest has been used for lumber production, with 30% used as pulpwood.

Table 3.9. Pine Inventory Trend

Region	Million Tons		Change
	2008	2016	
Eastern	14.8	18.4	24%
Northern	11.2	13.2	18%
Southern	30.2	30.2	0%
Western	9.2	9.8	7%
Total	**65.4**	**71.6**	**10%**

Landowner Type	Million Tons		Change
	2008	2016	
Lg Private	12.4	15.6	26%
Public	3.6	5.7	58%
Sm Private	49.4	50.4	2%
Total	**65.4**	**71.6**	**10%**

Pine has roughly twice the volume of aspen or cedar and represents 11% of all merchantable commercial volume. Two-thirds of the volume is in the Eastern and Southern Megaregions. Due to its coastal and southerly location, it is largely (70%) on Small Private lands. Statewide, the total pine inventory has expanded since 2008. The pace of increase is higher on Large Private lands than on Small Private, and also especially evident in the Eastern region..

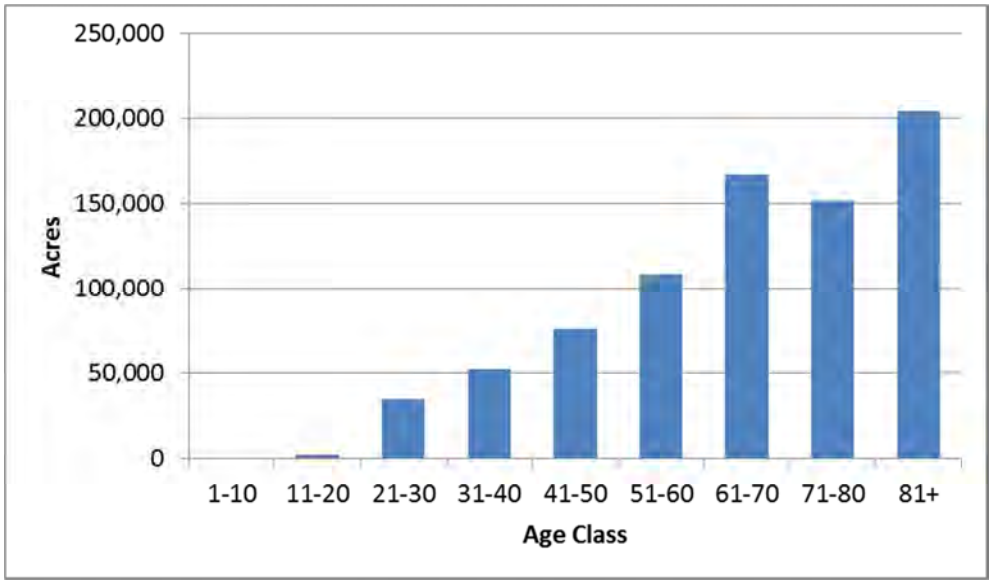
Table 3.10. Pine Growth and Removals (Thousand Tons)

Annual Average for the Period 2000 - 2008							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	627	225	2.8	Lg Private	651	254	2.6
Northern	454	179	2.5	Public	69	43	1.6
Southern	774	517	1.5	Sm Private	1,427	916	1.6
Western	292	293	1.0				
Total	**2,146**	**1,213**	**1.8**	**Total**	**2,146**	**1,213**	**1.8**

Annual Average for the Period 2008 - 2016							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	824	178	4.6	Lg Private	776	210	3.7
Northern	565	238	2.4	Public	103	-	
Southern	690	455	1.5	Sm Private	1,444	906	1.6
Western	244	245	1.0				
Total	**2,323**	**1,116**	**2.1**	**Total**	**2,323**	**1,116**	**2.1**

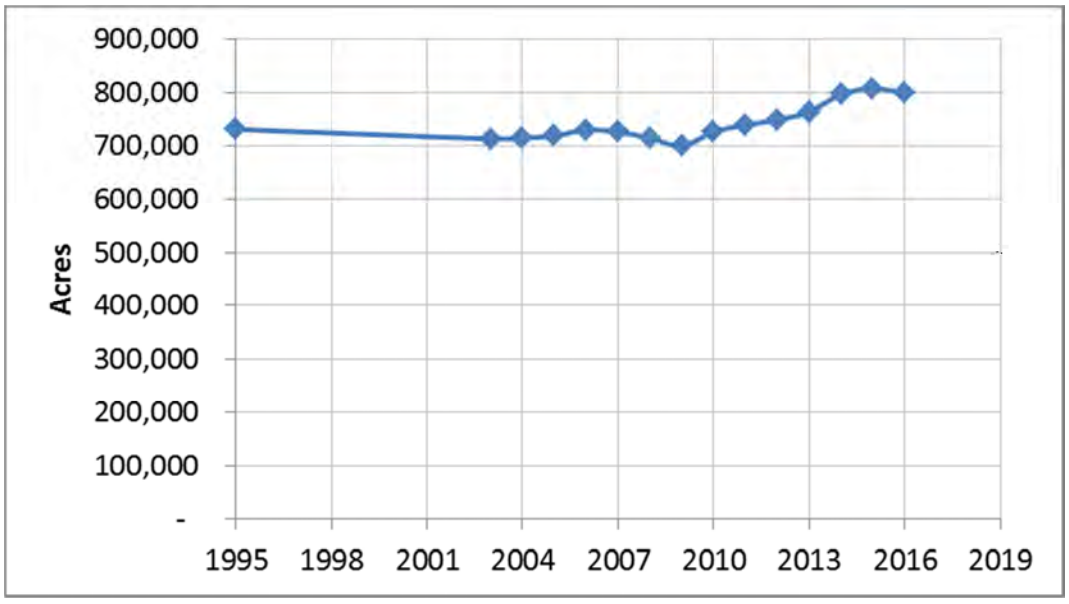
For pine, when sampling error is taken in to account, both growth and removals were essentially unchanged, and the growth/removal ratio remained in the vicinity of 2.0, which is consistent with gains in total inventory that were observed.

Figure 3.16. Age Class Distribution of Pine Forest Cover Types – All Owners



Half of the pine volume in Maine is found in stands that are classified as pine forest cover types. The remainder of the pine volume is in other softwood or hardwood stands. The age class distribution for the pine cover type is skewed to the right toward mature stands (Figure 3.16). Only 11% of the acreage is younger than age 41. Half of all trees are 16.0" or greater in diameter.

Figure 3.17. Acres of Pine Forest Cover Types Since 1995



The acreage classified as white or red pine cover type has shown some modest gains since 2008 (Figure 3.17). White pine survives to 150+ years and the increase in acreage is probably due to other species being removed or declining in proportion, leaving white pine as dominant (and sometimes as seeding shelterwoods).

Table 3.11. Pine Growth to Removals Ratio Using Estimated 2017 Removals

Annual Growth vs. Estimated 2017 Removals			
Region	**Annual Growth**	**Annual Removals**	**G/R**
Eastern	824	176	4.7
Northern	565	235	2.4
Southern	690	448	1.5
Western	244	241	1.0
Total	**2,323**	**1,100**	**2.1**

Pine is the one case where our estimate of 2017 estimated removals is very close to the FIA average for the period 2008 to 2016. Hence the comparison with growth is the same.

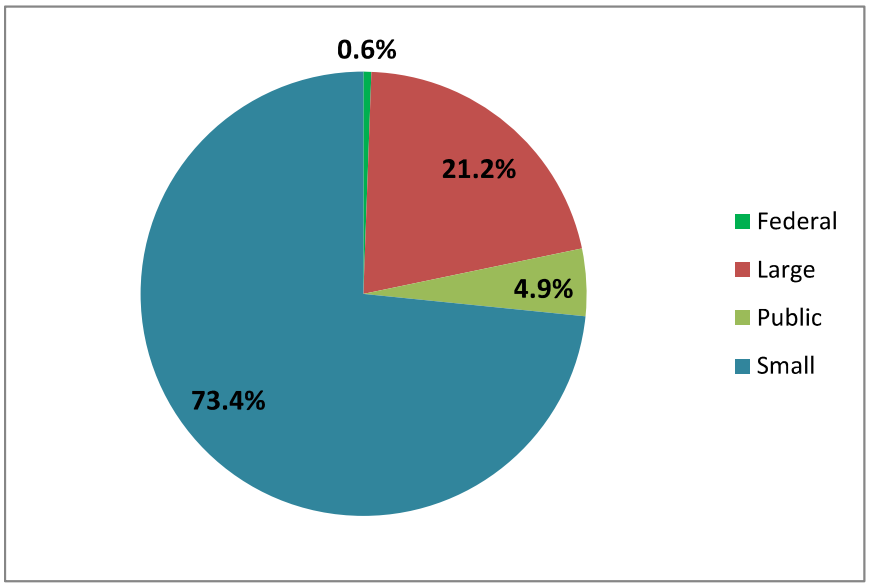
Approximately 70% of the pine volume in FIA inventory is in sawlog trees with a diameter at breast height of 11"+. Sewall discounts this down by 10% due to pulp volume likely in the tops due to weevil damage. At 60%, this indicates a potential[8] additional sustainable harvest of 734,000 tons of sawlogs and 490,000 tons of pine pulpwood.

PINE - MODELED FORWARD

In the base scenario with harvest levels equal to the estimated 2017 cut, the percentage of potential harvest of pine over the next five decade period is heavily weighted to the smaller private timberlands at 73%, with 21% from Large Private landowners, 5% off Other Public lands and less than 1% from Federal lands (Figure 3.18).

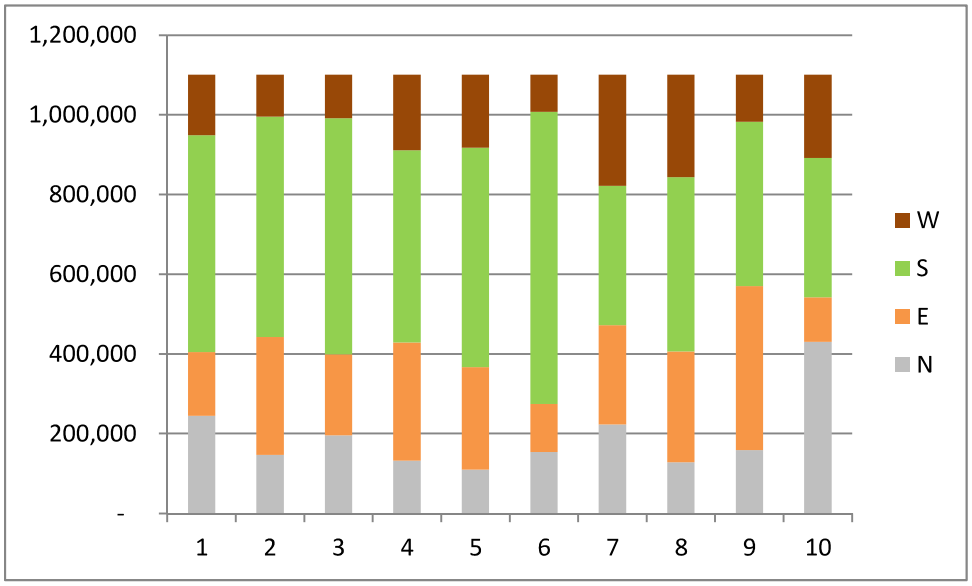
[8] Assumes all landowners would harvest the equivalent of growth.

Figure 3.18. Run1, Distribution of Average 50-year Modeled Harvest of Pine Across Landowner Types



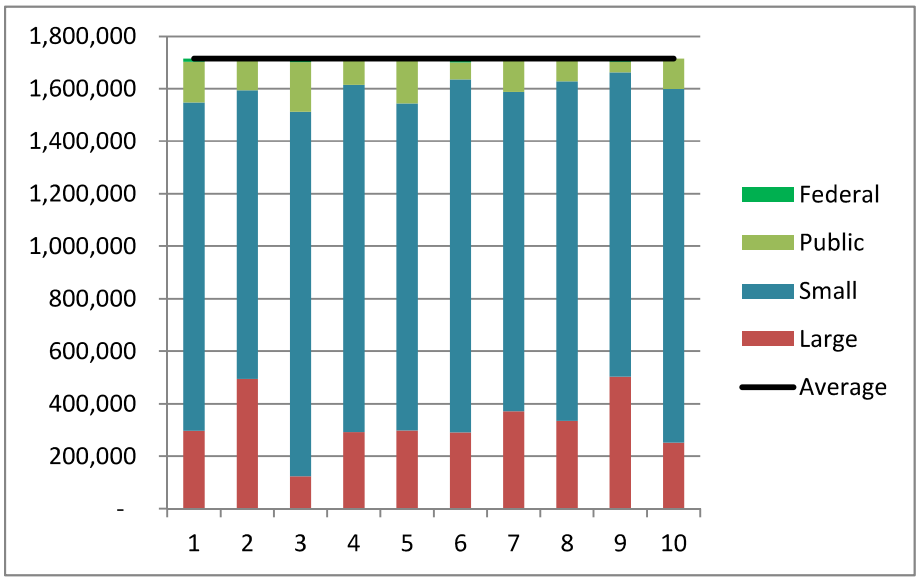
In Runs 2 and 3, these percentages remain within 1-2% of the base run.
Modeled harvest levels of 1.1 million green tons fluctuate in distribution among the megaregions (Figure 3.19), with the average 50-year harvest as follows: 45% in the Southern megaregion, 22% in the Eastern, 18% in the Northern and 15% in the Western.

Figure 3.19. Run1, 50-year Distribution of Modeled Harvest of Pine Across Megaregions



Modeled inventory of pine increases by 1.4 times the current inventory under this base scenario (harvest of 1.1 million tons/year).

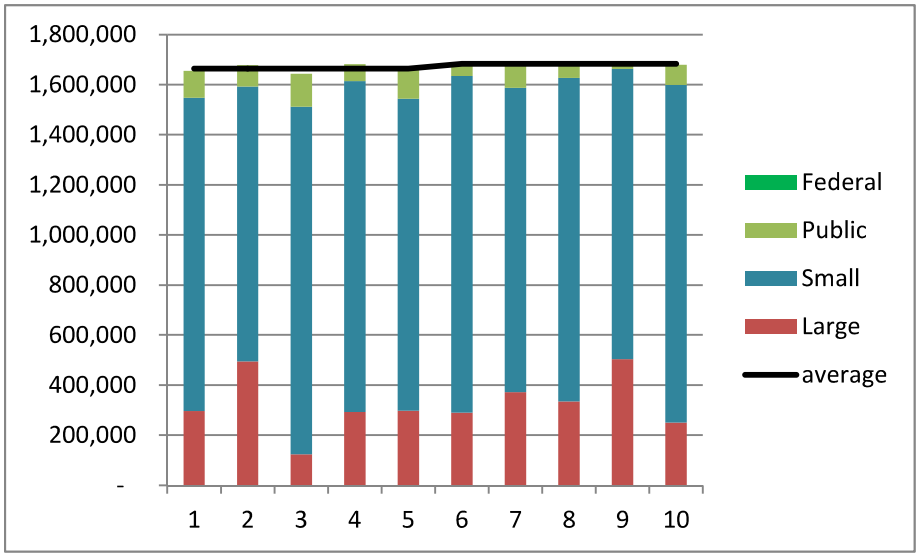
Figure 3.20. Run3, 50-year Harvest of Pine by Landowner Type



In Run3, as the model is programmed to maximize harvest in a non-declining manner than it immediately selects an annual harvest level of 1.71 million tons (Figure 3.20) and holds that through the modeled period. This biological capacity represents increases over 2017 estimated harvest levels of 56%.

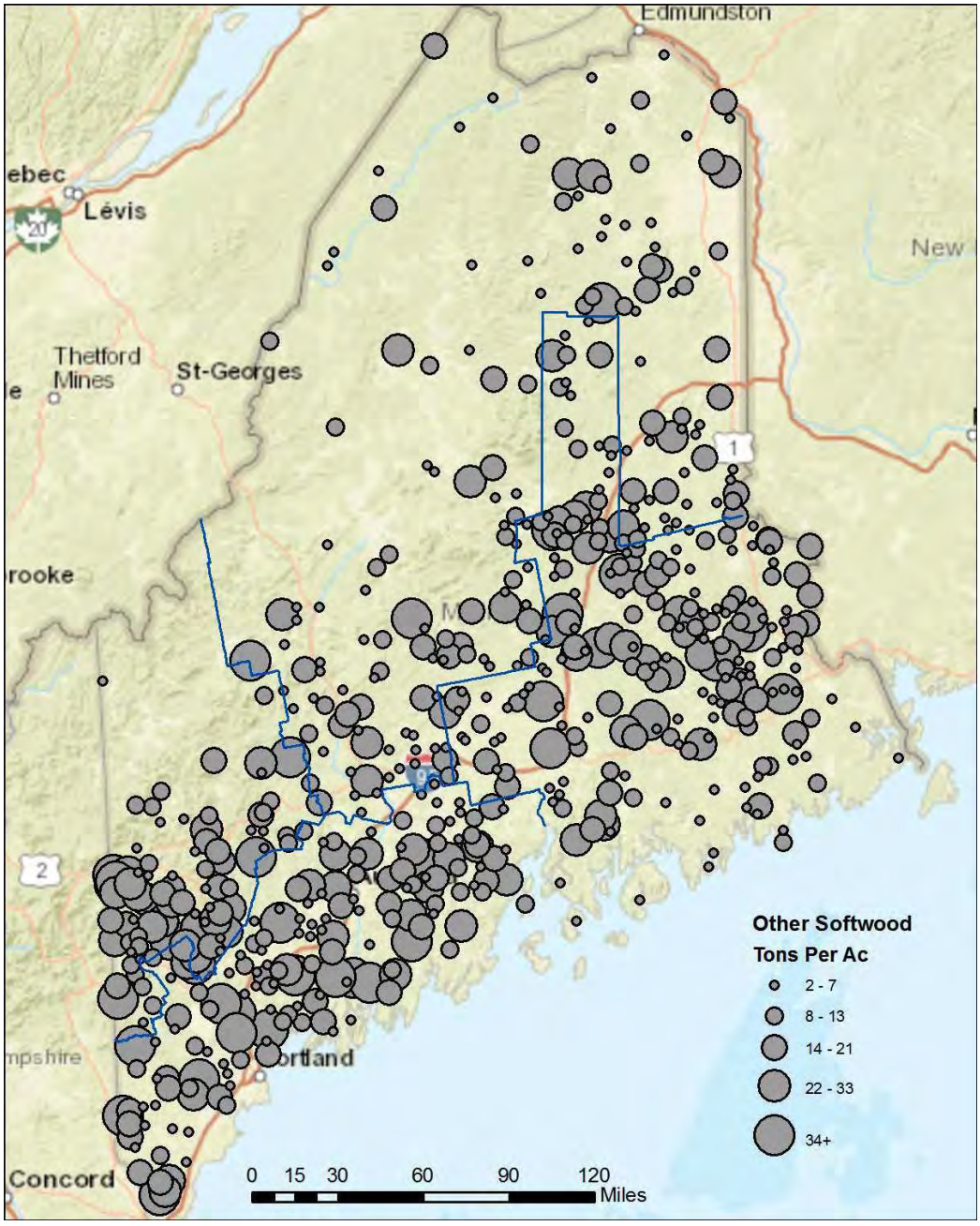
Utilizing the same discounting factors of Federal -100%, and Other Public - 30%, the model nets out to a harvest level of 1.7 million tons/year (Figure 3.21) or 150% of estimated 2017 estimated harvest levels. At this level of harvest, 76% of the volume is modeled off Small Private lands (1.27 million tons/year), so the pine availability is heavily tied to Small Private landowners' willingness to harvest.

Figure 3.21. Run3, 50-year Harvest of Pine by Landowner Type, With Discounts



OTHER SOFTWOOD (PRIMARILY HEMLOCK) – CURRENT

Figure 3.22. Other Softwood Volume Per Acre on Approximate FIA Plot Locations



The distribution of Other Softwood (92% hemlock) is similar to that of white pine, with the exception of the lower portions of the Eastern region, where it is light. The reported harvest is 83% pulpwood, with recent years' sawlog harvest at about 150,000 tons per year.

Table 3.12. Other Softwood Inventory Trend

Region	Million Tons		Change
	2008	2016	
Eastern	17.7	18.8	6%
Northern	11.2	10.5	-6%
Southern	14.9	14.8	-1%
Western	8.1	8.9	11%
Total	**51.8**	**53.0**	**2%**

Landowner Type	Million Tons		Change
	2008	2016	
Lg Private	19.5	19.8	1%
Public	2.2	3.0	41%
Sm Private	30.1	30.1	0%
Total	**51.8**	**53.0**	**2%**

Other Softwood is 92% eastern hemlock, the remainder being tamarack and larch. The inventory is essentially unchanged.

Table 3.13. Other Softwood Growth and Removals (Thousand Tons)

Annual Average for the Period 2000 - 2008							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	585	396	1.5	Lg Private	565	607	0.9
Northern	264	345	0.8	Public	29	29	1.0
Southern	441	133	3.3	Sm Private	917	313	2.9
Western	222	74	3.0				
Total	**1,512**	**948**	**1.6**	**Total**	**1,512**	**948**	**1.6**

Annual Average for the Period 2008 - 2016							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	700	429	1.6	Lg Private	611	467	1.3
Northern	206	152	1.4	Public	80	20	4.1
Southern	462	430	1.1	Sm Private	947	607	1.6
Western	271	82	3.3				
Total	**1,638**	**1,093**	**1.5**	**Total**	**1,638**	**1,093**	**1.5**

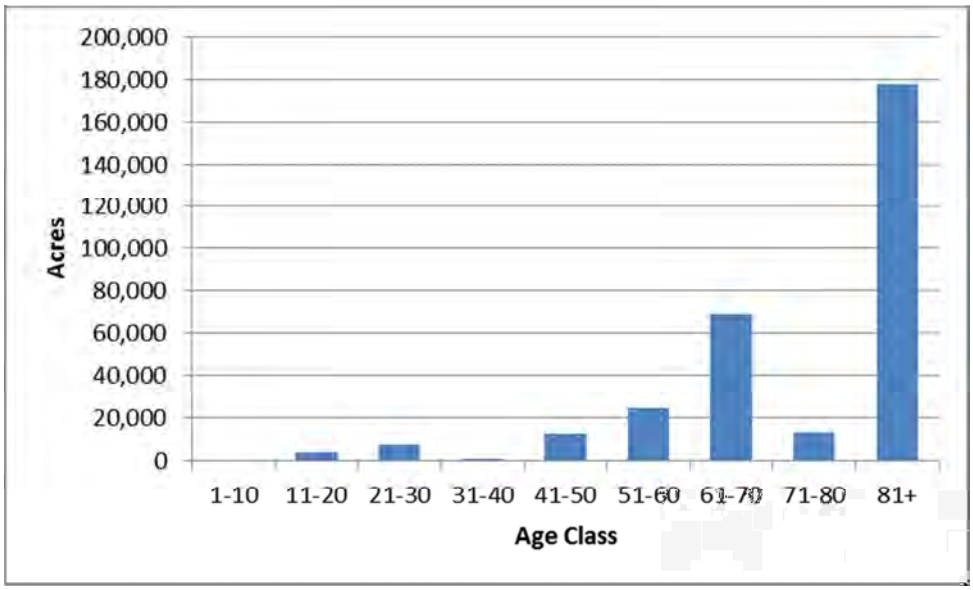
As with aspen, cedar, and pine, removals estimates for Other Softwood are subject to large sampling errors. Growth is the more reliable indicator. Annual growth was level to slightly higher, indicating a stable resource trajectory, neither expanding nor contracting.

Table 3.14. Other Softwood Growth to Removals Ratio Using Estimated 2017 Removals

Annual Growth vs. Estimated 2017 Removals			
Region	**Annual Growth**	**Annual Removals**	**G/R**
Eastern	700	295	2.4
Northern	206	104	2.0
Southern	462	295	1.6
Western	271	56	4.8
Total	**1,638**	**750**	**2.2**

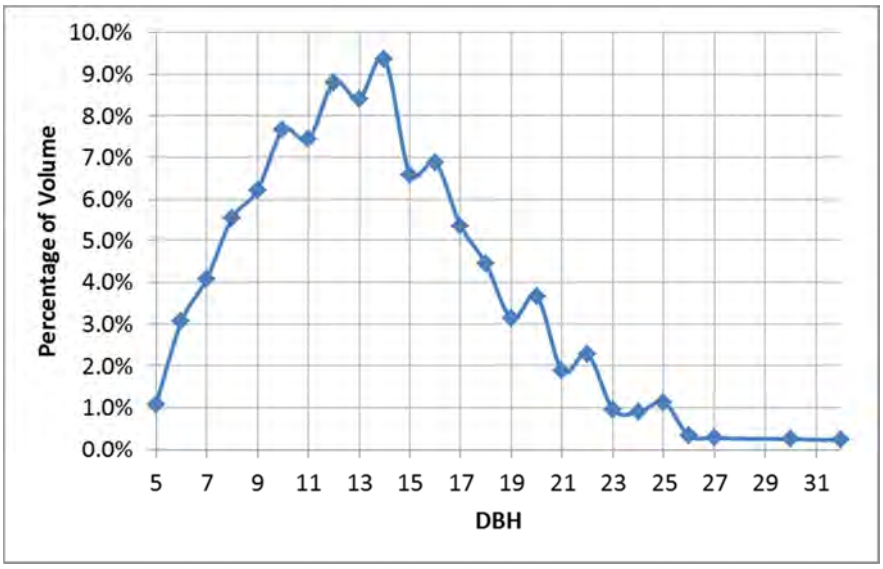
Because removals have declined recently due primarily to lower use by pulp mills, the Other Softwood resource balance is now strongly positive (Figure 3.14). Inventories will show some gains in the next decade. If all lands would be harvested at a rate equal to growth, FIA data would predict that there is a sustainable additional 888,000 tons/year available.

Figure 3.23. Age Class Distribution of Hemlock Forest Cover Type



Most of the State's Other Softwood volume occurs as a minority component of other forest cover types. Only 21% of hemlock is found in hemlock forest cover type, and often occurs in mixed stands with red spruce. The modest acreage of hemlock forest cover type is dominated by stands age 81 and older (Figure 3.23).

Figure 3.24. Hemlock Volume by Diameter Class

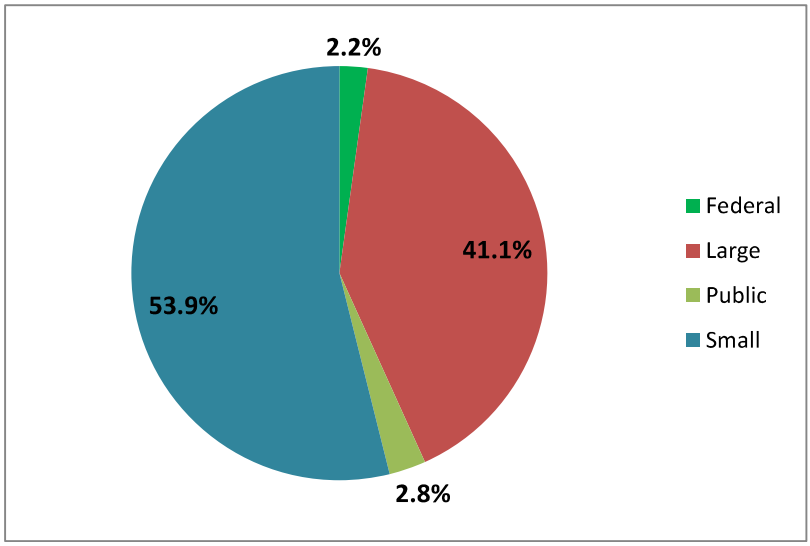


The distribution of hemlock volume is about one-third trees of 11 inches or less, one-third trees 12 to 15 inches, and one-third trees 16 inches or greater (Figure 3.24). Older, larger hemlock trees often have limited value for sawn products due to ring shake.

OTHER SOFTWOOD (PRIMARILY HEMLOCK) - MODELED FORWARD

In the base scenario with harvest levels equal to the 2017 estimated cut, the percentage of potential harvest of Other Softwood over the five decade period is weighted to the smaller private timberlands at 54%, with 41% from Large Private landowners, 3% from Other Public lands and 2% from Federal lands (Figure 3.25).

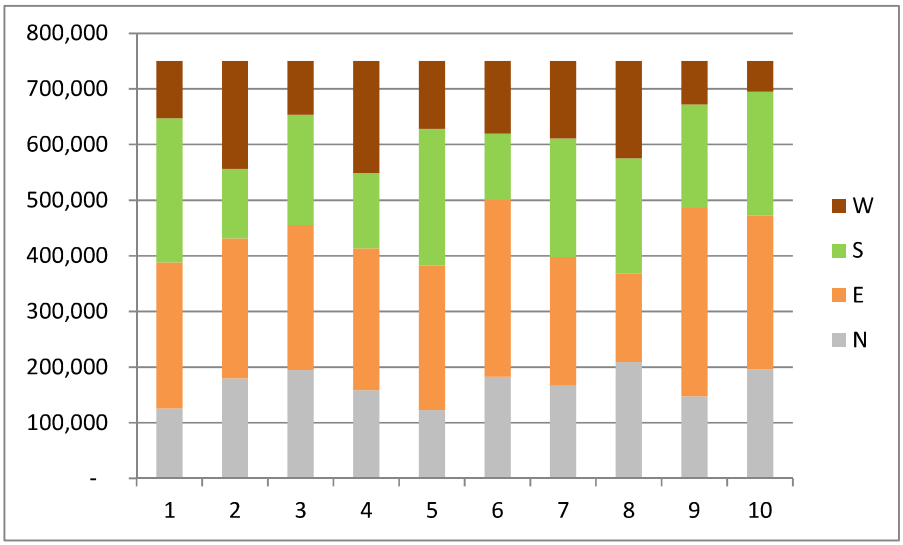
Figure 3.25. Run1, Distribution of Average 50-year Modeled Harvest of Other Softwood Across Landowner Types



In both of the runs where harvest is maximized, the percentage of Small Private harvest increases to 63% and Large Private decreases to 31-32%.

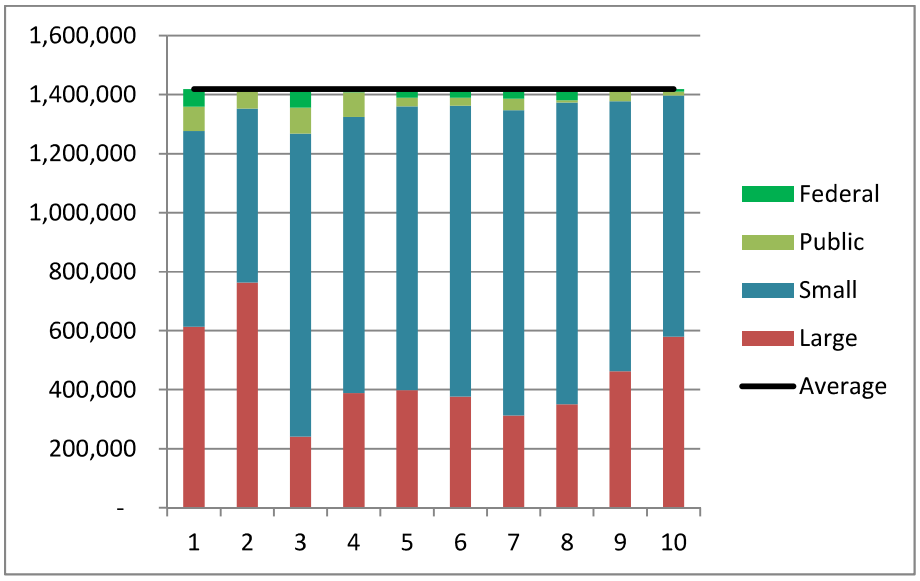
Modeled harvest levels of 750,000 green tons per year are fairly consistently distributed among the megaregions, with the average 50-year harvest as follows: 35% in the Eastern Megaregion, 26% in the Southern, 22% in the Northern and 17% in the Western (Figure 3.26).

Figure 3.26. Run1, 50-year Distribution of Modeled Harvest of Other Softwood Across Megaregions



Modeled inventory of Other Softwood increases by 36% under this base scenario (harvest level of 750,000 tons/year).

Figure 3.27. Run3, 50-year Harvest of Other Softwood by Landowner Type

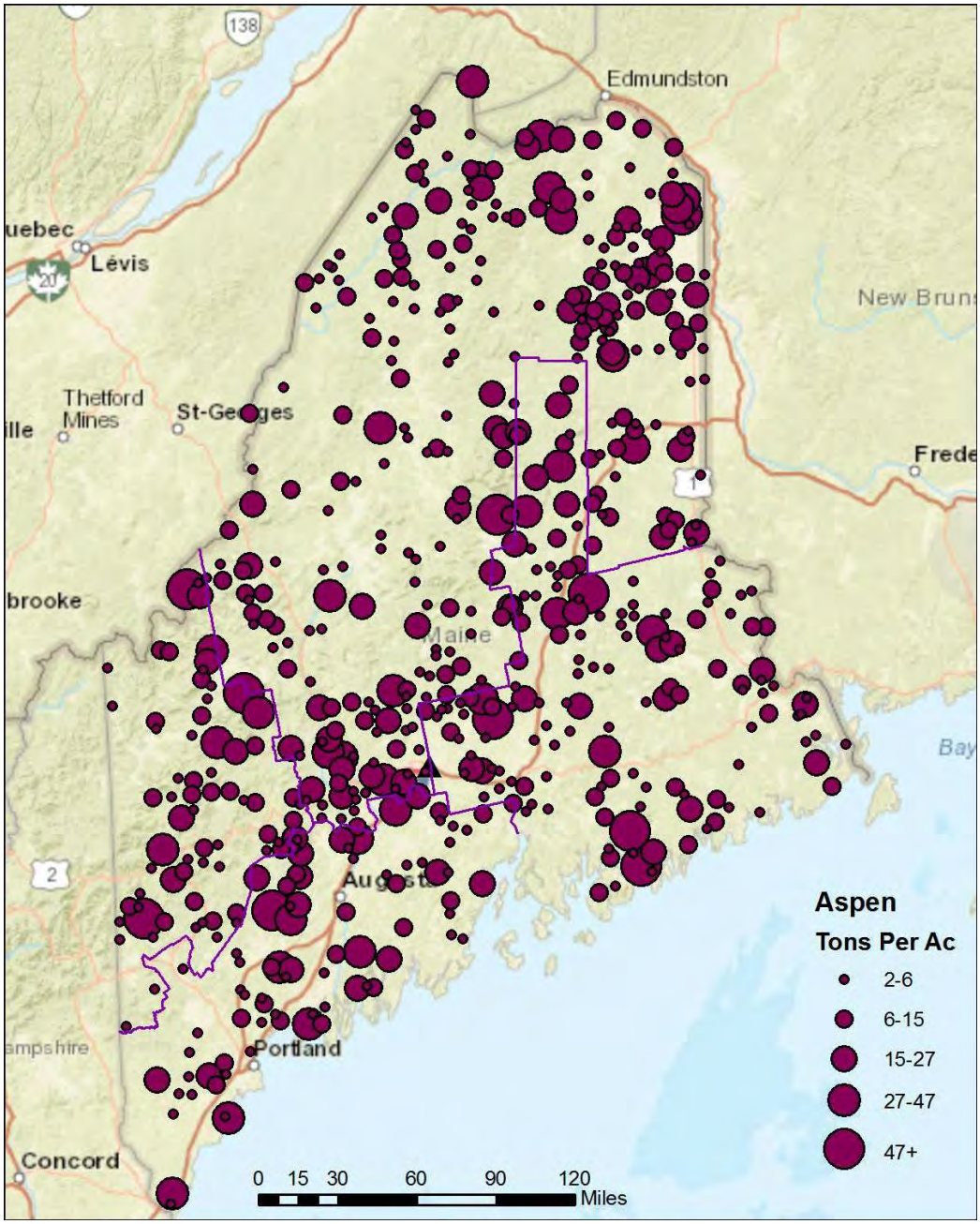


When programmed to maximize harvest in a non-declining manner (Run3 - Figure 3.27), the model selects an annual harvest level of 1.42 million tons and holds that through the study period. This biological capacity represents increases over 2017 estimated harvest levels of 89% (an additional annual volume of 670,000 tons/year).

Utilizing the discounting factors for percentage of harvestable acres that might not be available to the market over the 50-year cycle (Federal -100%, Other Public - 30%) results in an average harvest level of 1.38 million tons/year (or 84% higher than 2017 estimated harvest levels). These harvest volumes still require harvesting an average of 894,000 tons/year from Small Private lands (or more than the total 2017 estimated harvest).

ASPEN – CURRENT

Figure 3.28. Aspen Volume Per Acre on Approximate FIA Plot Locations



Aspen occurs in low concentrations across the entire State. Pure stands follow severe disturbance such as intense wildfire. A series of fires and an abandonment of farmland led to the somewhat higher density of aspen in the northern megaregion. Nearly all of the harvest volume is used as pulpwood or for oriented strand board (OSB).

Table 3.15. Aspen Inventory Trend

Region	Million Tons		Change
	2008	2016	
Eastern	7.3	7.2	-1%
Northern	15.8	15.1	-4%
Southern	4.7	5.2	10%
Western	4.6	4.4	-3%
Total	**32.4**	**31.9**	**-1%**

Landowner Type	Million Tons		Change
	2008	2016	
Lg Private	12.8	11.7	-8%
Public	1.2	1.7	36%
Sm Private	18.3	18.5	1%
Total	**32.4**	**31.9**	**-1%**

Approximately half of all aspen volume is in the Northern region, where the aspen inventory is declining. Statewide, the total volume is essentially unchanged. It is the smallest of the species groups at 4.9% of merchantable commercial volume. It is declining on Large Private lands, while stable on Small Private, and gaining on Other Public lands.

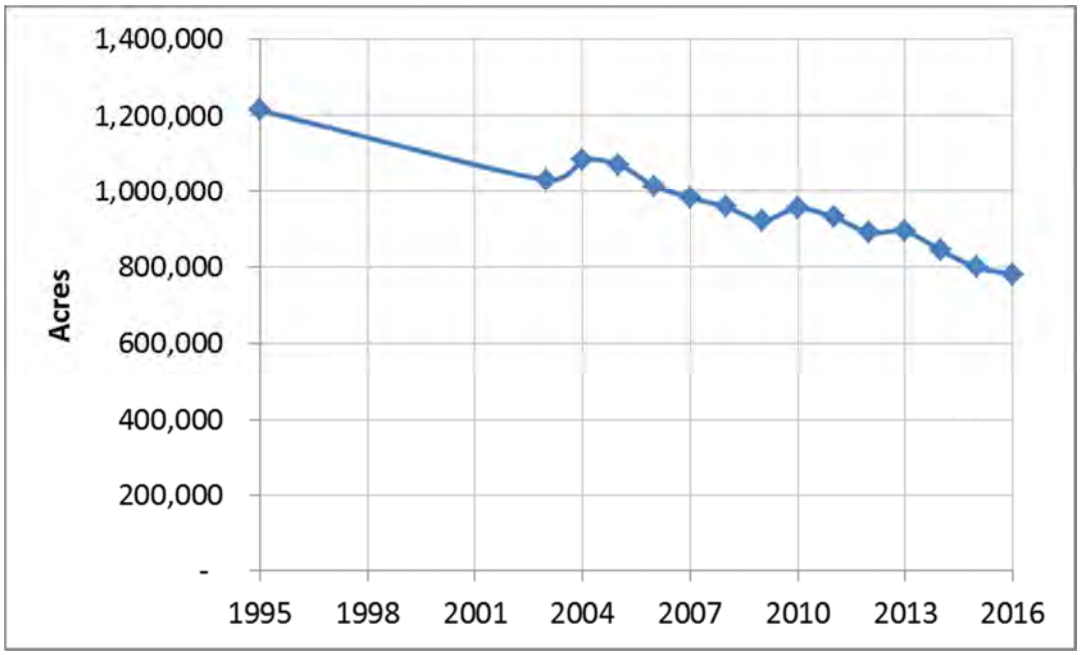
Table 3.16. Aspen Growth and Removals (Thousand Tons)

Annual Average for the Period 2000 - 2008							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	217	317	0.7	Lg Private	366	650	0.6
Northern	500	685	0.7	Public	23	101	0.2
Southern	93	106	0.9	Sm Private	520	536	1.0
Western	100	179	0.6				
Total	**909**	**1,287**	**0.7**	**Total**	**909**	**1,287**	**0.7**

Annual Average for the Period 2008 - 2016							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	250	227	1.1	Lg Private	455	508	0.9
Northern	606	698	0.9	Public	52	59	0.9
Southern	102	69	1.5	Sm Private	608	625	1.0
Western	157	198	0.8				
Total	**1,115**	**1,192**	**0.9**	**Total**	**1,115**	**1,192**	**0.9**

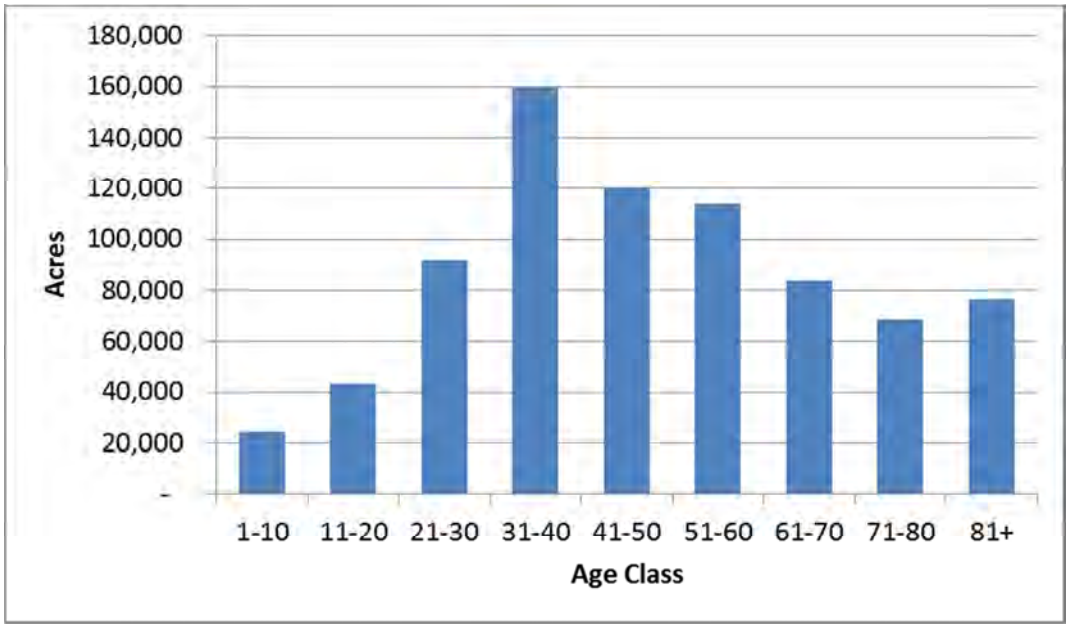
Aspen annual dynamics improved slightly, but the ratio remains below 1.0 which is consistent with level to declining inventory.

Figure 3.29. Acreage of Aspen Forest Cover Type Since 1995



The aspen forest cover type has declined since 1995 (Figure 3.29), losing about 19,000 acres per year. If the trend continues, by 2020 there will be only about 60% of the 1995 acreage remaining. Across the same time period, the *total volume* of aspen has remained fairly constant, however, in 1995, 60% of the aspen volume was in aspen stands while today 60% of the aspen volume is mixed in stands of other cover types.

Figure 3.30. Age Class Distribution of Aspen Forest Cover Type



Aspen has a weak "pipeline" of stands age 30 or younger, which make up only 20% of the acreage (Figure 3.30). The decline in the total acreage is likely to continue.

Table 3.17. Aspen Growth to Removals Ratio Using Estimated 2017 Removals

Annual Growth vs. Estimated 2017 Removals			
Region	**Annual Growth**	**Annual Removals**	**G/R**
Eastern	250	172	1.5
Northern	606	527	1.2
Southern	102	52	2.0
Western	157	149	1.1
Total	**1,115**	**900**	**1.2**

Based on the estimate of 2017 removals, the aspen growth to removals ratio is about 1.2. Absent new demand, the aspen inventory will remain constant in the near term. However, the shift from its occurrence in pure stands of aspen to a minor component of other forest cover types will continue. If all landowners harvested growth, FIA data would predict there is a mild sustainable increase of 215,000 tons available Statewide.

ASPEN - MODELED FORWARD

In all three modeled scenarios, the percentage of modeled potential harvest of aspen over the five decade period is greatest on Small Private timberlands (59-60%), then Large Private timberlands (35-36%), with 4.5-4.8% from Other Public lands and less than 0.5% from Federal lands (Figure 3.31).

Harvest levels of 900,000 green tons are modeled to come from the Northern megaregion at 49%, followed by Eastern at 22%, Southern at 16%, and lastly by the Western megaregion at 13% (Figure 3.32).

Inventory of aspen models to 111% of the current inventory if the harvest level is held at 2017 estimated levels of 900,000 tons/year.

Figure 3.31. Run1, Distribution of Average 50-year Modeled Harvest of Aspen Across Landowner Types

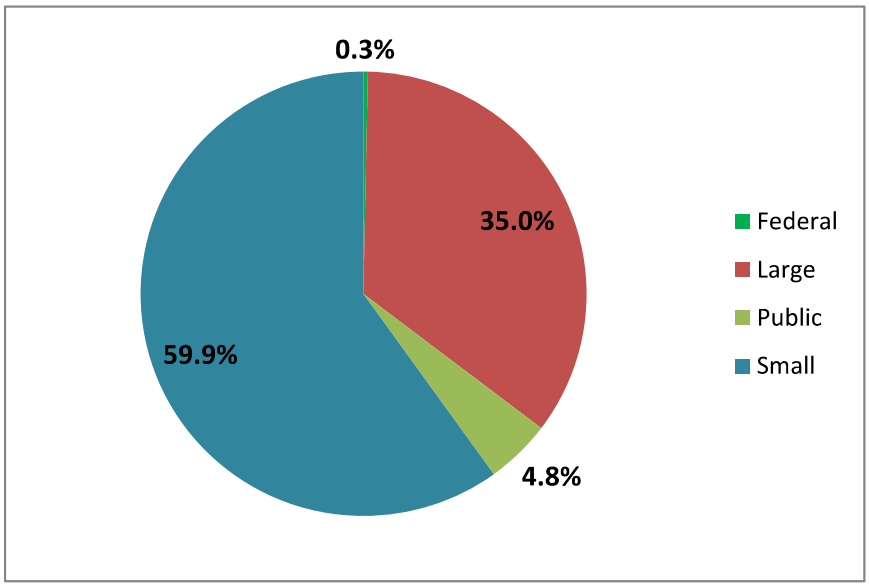


Figure 3.32. Run1, 50-year Distribution of Modeled Harvest of Aspen Across Megaregions

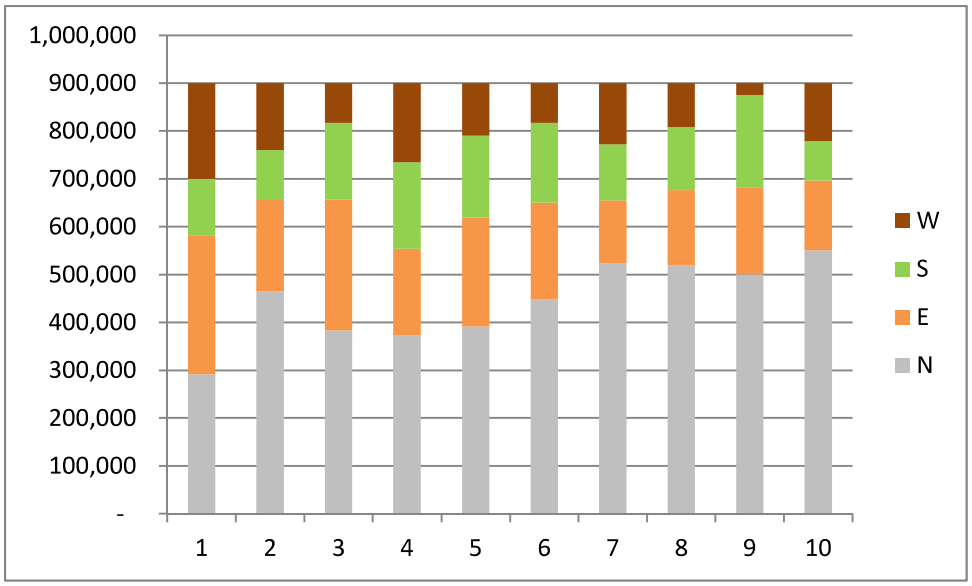
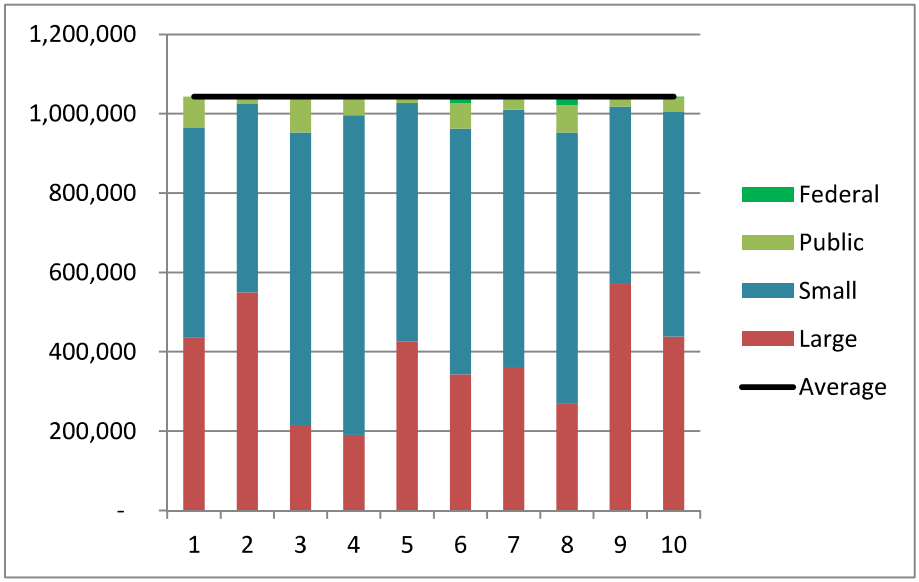


Figure 3.33. Run3, 50-year Harvest of Aspen by Landowner Type

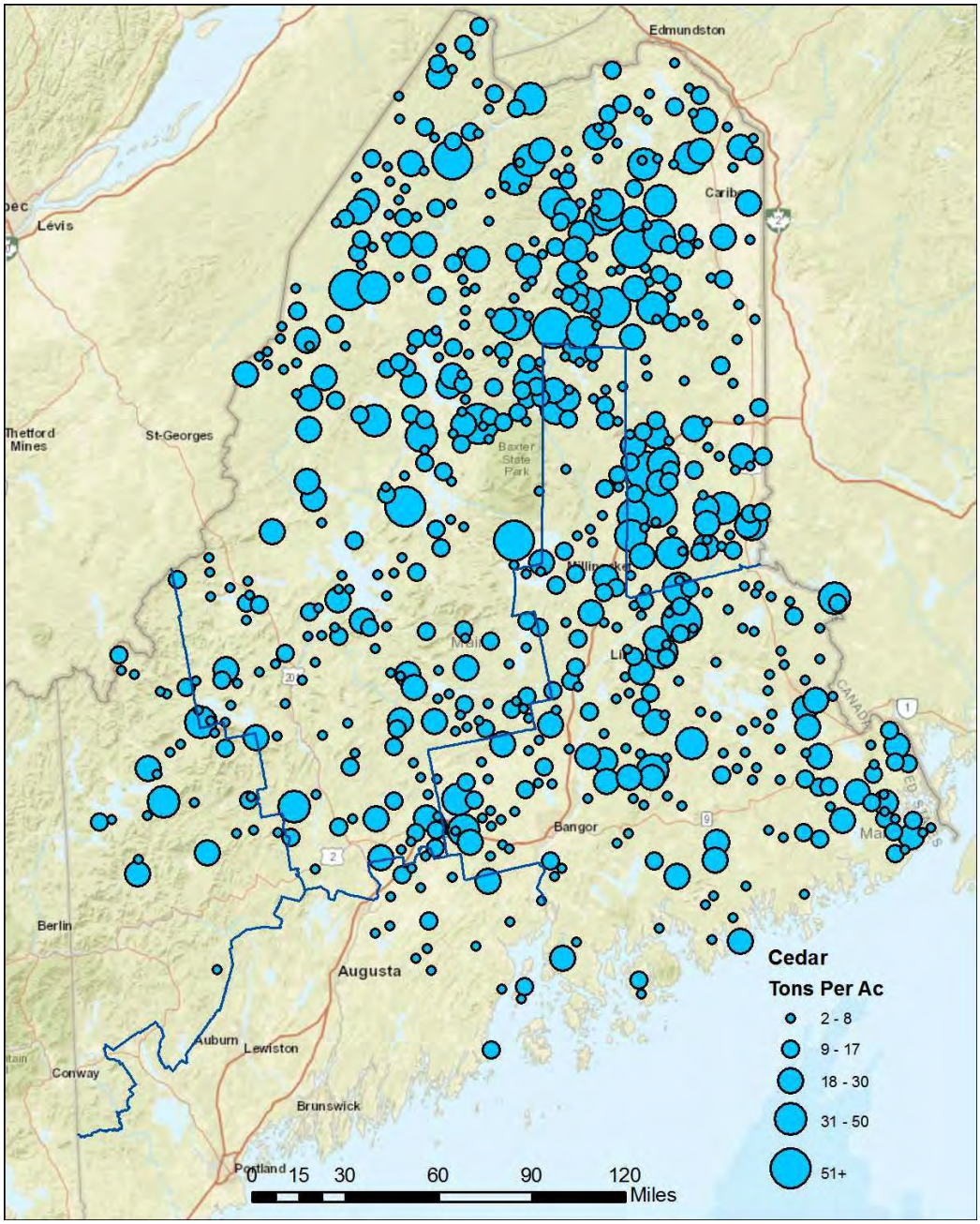


As the objective function of the model is programmed to maximize harvest in a non-declining manner (Run3 – Figure 3.33), it will select and hold a harvest rate of just over 1 million tons/year. This modeled biological capacity represents increases over 2017 estimated harvest levels, but given the statistical accuracy of the modeling we recommend thinking about it as sustainable at 2017 rates of harvest.

Utilizing the same discounting factors for percentage of harvestable acres that might be available to the market over the 50-year cycle (Federal -100%, Other Public - 30%) still allows an increased harvest level of aspen to 1 million tons/year over the next 50 years. At these discounted levels over 60% of the projected harvested aspen (611,000 tons/year) would still need to come from Small Private lands.

CEDAR – CURRENT

Figure 3.34. Cedar Volume Per Acre on Approximate FIA Plot Locations



For the most part, cedar was not observed on the FIA plots south of Augusta, and is weaker in the western portions than in the eastern. Where it occurs, it is with stands widely scattered in low concentrations. All of the harvest volume is used for specialty products (fencing, cedar homes, shingles, etc.).

Table 3.18. Cedar Inventory Trend

Region	Million Tons		Change
	2008	2016	
Eastern	10.7	10.3	-4%
Northern	26.0	24.7	-5%
Southern	0.6	0.7	14%
Western	1.5	1.5	-2%
Total	**38.8**	**37.2**	**-4%**

Landowner Type	Million Tons		Change
	2008	2016	
Lg Private	24.3	22.0	-9%
Public	2.8	4.0	40%
Sm Private	11.7	11.2	-4%
Total	**38.8**	**37.2**	**-4%**

Nearly all cedar (94%) is in the Northern and Eastern Regions, where cedar inventory is declining. The decline is more rapid on Large Private lands than on Small Private lands. Cedar barely edges out aspen as the second smallest species group in volume.

Table 3.19. Cedar Growth and Removals (Thousand Tons)

Annual Average for the Period 2000 - 2008							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	189	150	1.3	Lg Private	324	332	1.0
Northern	375	313	1.2	Public	40	6	6.3
Southern	2	-		Sm Private	216	136	1.6
Western	14	12	1.2				
Total	**581**	**474**	**1.2**	**Total**	**581**	**474**	**1.2**

Annual Average for the Period 2008 - 2016							
Region	Annual Growth	Annual Removals	G/R	Landowner Type	Annual Growth	Annual Removals	G/R
Eastern	120	71	1.7	Lg Private	236	175	1.3
Northern	283	177	1.6	Public	42	7	6.1
Southern	13	2	6.3	Sm Private	158	106	1.5
Western	19	38	0.5				
Total	**435**	**288**	**1.5**	**Total**	**435**	**288**	**1.5**

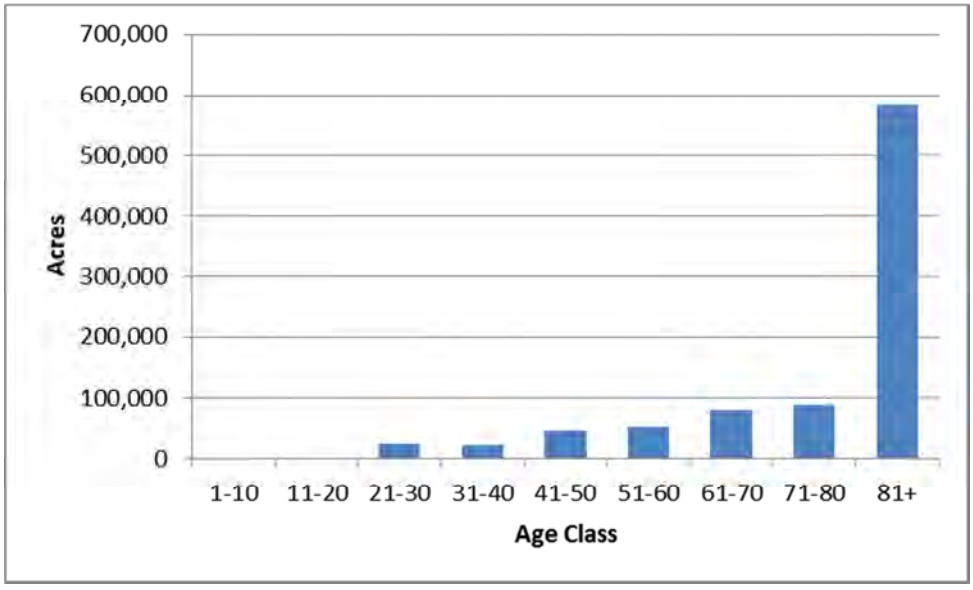
Cedar removals are so low that the FIA estimates for less than the entire State are unreliable, and as a result the growth-to-removals ratio is also statistically unreliable. Annual growth is a stronger measure, and it declined by 25%, indicating a resource that is shrinking or aging or both.

Table 3.20. Cedar Growth to Removals Ratio Using Estimated 2017 Removals

Annual Growth vs. Estimated 2017 Removals			
Region	**Annual Growth**	**Annual Removals**	**G/R**
Eastern	120	49	2.4
Northern	283	123	2.3
Southern	13	1	9.1
Western	19	27	0.7
Total	**435**	**200**	**2.2**

The current utilization of cedar is uncertain since only 30% of the FIA measured removals are reported by the Maine Forest Service[9]. Removals have shown a steady decline over time, while annual growth and total inventory have also declined. In spite of the calculated growth to removals ratio, the weight of the evidence is that the cedar will continue a gradual decline.

Figure 3.35. Age Class Distribution of Cedar Stands



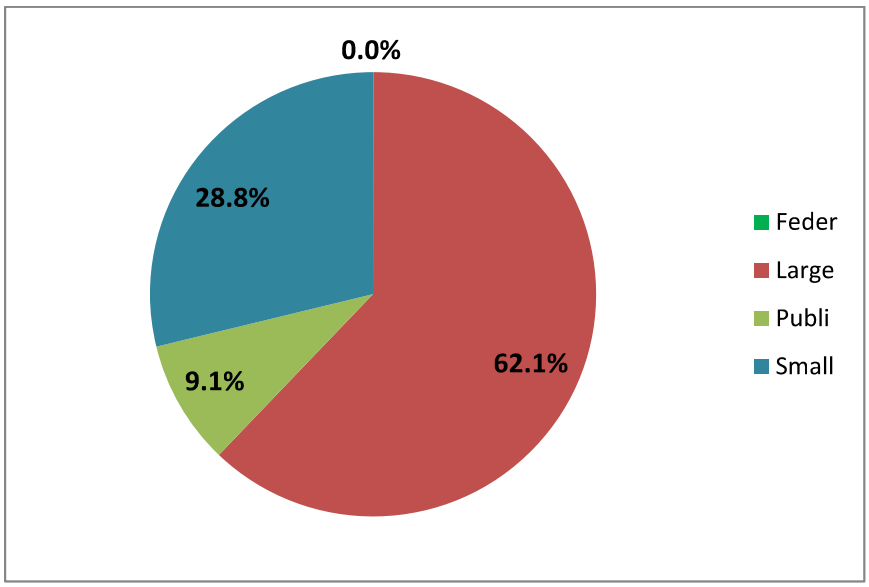
A majority (60%) of cedar volume is found in areas classified as cedar forest cover type. Nearly the entire acreage of cedar cover type has been classified as age 81 or older (Figure 3.35). No significant pipeline of younger stands exists.

[9] Figure 4.2

CEDAR - MODELED FORWARD

In the base scenario with harvest levels equal to the estimated 2017 harvest, the percentage of potential harvest of cedar over the five decade period is heavily weighted to the larger private timberlands at 62%, with 29% from Small Private landowners, 9% off Other Public lands and only 0.02% from Federal lands (Figure 3.36).

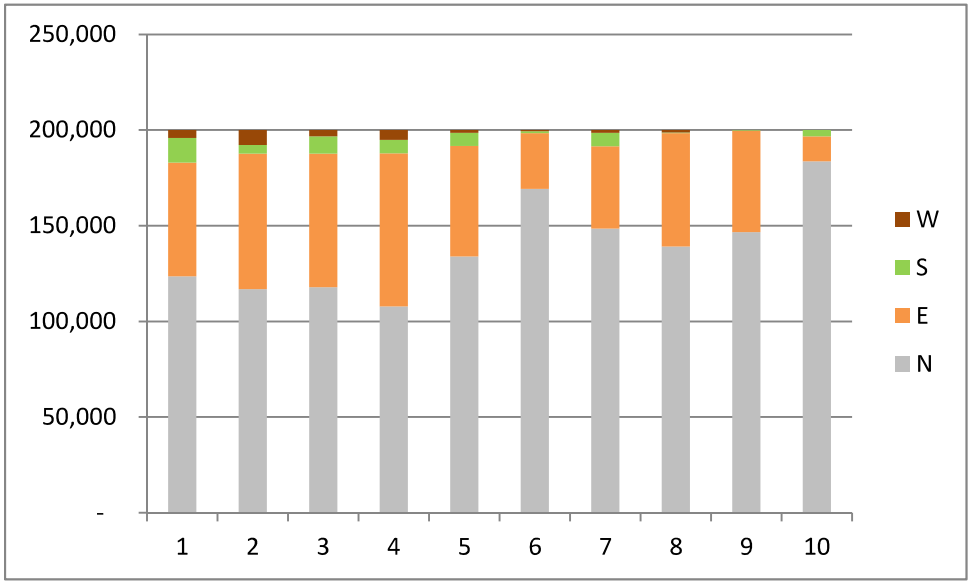
Figure 3.36. Run1, Distribution of Average 50-year Modeled Harvest of Cedar Across Landowner Types



In Runs 2 and 3, these percentages change more than any other species. Large landowner harvests fluctuate from 58% to 74%; Small Private from 19% to 36% and Other Public from 5% to 9%.

Average modeled distribution of harvest levels of 200,000 green tons are 69% in the Northern megaregion, 27% in the Eastern, 3% in the Southern and 1% in the Western (Figure 3.37).

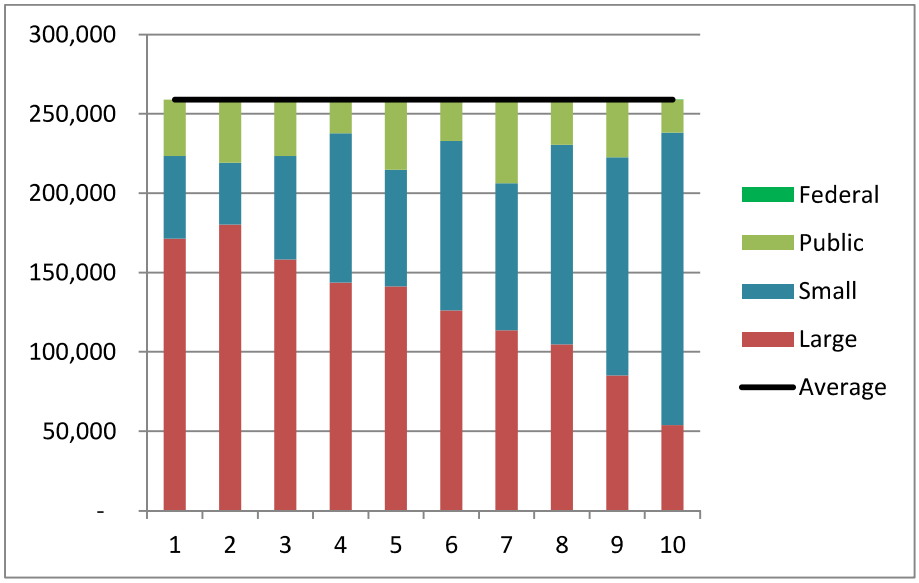
Figure 3.37. Run1, 50-year Distribution of Modeled Harvest of Cedar Across Megaregions



Inventory of cedar decreases by 5% under this base scenario.

As the model is programmed in Run3 to maximize harvest in a non-declining manner (Figure 3.38), it immediately selects an annual harvest level of 258,800 tons and holds that through the modeled study period. This biological capacity represents increases over estimated 2017 harvest levels but because of the statistical accuracy of the model we recommend thinking about it as sustainable at the present levels of harvest.

Figure 3.38. Run3, Modeled, Non-declining, 50-year Harvest of Cedar by Landowner Type



Utilizing the same discounting factors of Federal -100%, and Other Public - 30%, the model nets out to a harvest level of 250,000 tons/year. As with pine, any increase in cedar harvesting would have to involve a greater percentage of Small Private landowners over time.

4. DERIVATION OF ESTIMATED 2017 (BASE LEVEL) DEMAND

For most species groups, the Maine Forest Service Wood Processor Report (WPR) reported harvest is below the levels observed on FIA's 5-year revisited plots (table 4.1). The exception is pine; it is frankly puzzling why pine would be over-reported. It's possible that some of the survey respondents are submitting hemlock or mixed softwood purchases under the "White and Red Pine" column, or perhaps failing to distinguish volume from New Hampshire.

For aspen, WPR requests information only on pure loads. Apparently, about half of all aspen is delivered as a minor component of mixed hardwood.

Table 4.1. FIA vs. WPR[10] Harvest Levels and 2017 Harvest Estimate by Species Group

Species Group	Annual Average 2008-16		Ratio WPR/FIA	WPR 2016	Sewall Estimate 2017	Notes
	FIA	WPR				
Aspen	1,192	619	0.52	705	900	WPR covers only pure loads
Cedar	288	83	0.29	72	200	Both FIA and WPR are trending down
Hardwood	7,410	5,263	0.71	5,439	5,200	2017 harvest 6,200 with firewood
Other Softwood	1,093	861	0.79	612	750	Recent reductions
Pine	1,116	1,322	1.18	1,107	1,100	Not sure why greater in WPR than FIA
Spruce-fir	3,763	3,000	0.80	2,737	3,200	Recent reductions

Dense hardwood has the largest variance between FIA removals and WPR reported harvest. While there is scant data on the utilization of firewood/pellets in the State, the data points to it being somewhere between 1.0 and 1.3 million tons/year.[11] This indicates that the WPR may be under reporting firewood/pellet usage by as much as a million tons. For purposes of the modeling, Sewall utilized our best estimate of commercial usage, and made mention of the additional residential demand in the commentary.

Cedar is significantly under-reported. The difference may be smaller operators and individuals who are not included in the survey. Also, the FIA of removals estimate is weak due to sampling error on such a small resource.

With the general relationship between reported and "actual," and knowledge of very recent changes that were not fully apparent in the 2016 WPR, Sewall has proposed base level harvest rates that we believe reflect the state of the industry today. For modeling purposes, Sewall representatives made an estimate between the two data sources.

[10] Wood Processor Report, compiled annually by the Maine Forest Service.

[11] A State Planning Office report in 1999 pegged the estimate at 1.2 million tons. Sewall estimates utilizing the 2016 US census report household data came up with between 1.0 and 1.3 million tons/year, depending on the severity of the winter.

The series of charts that follow show the history of the WPR reported harvest for each species group.

Figure 4.1. Aspen WPR Harvest Since 2000

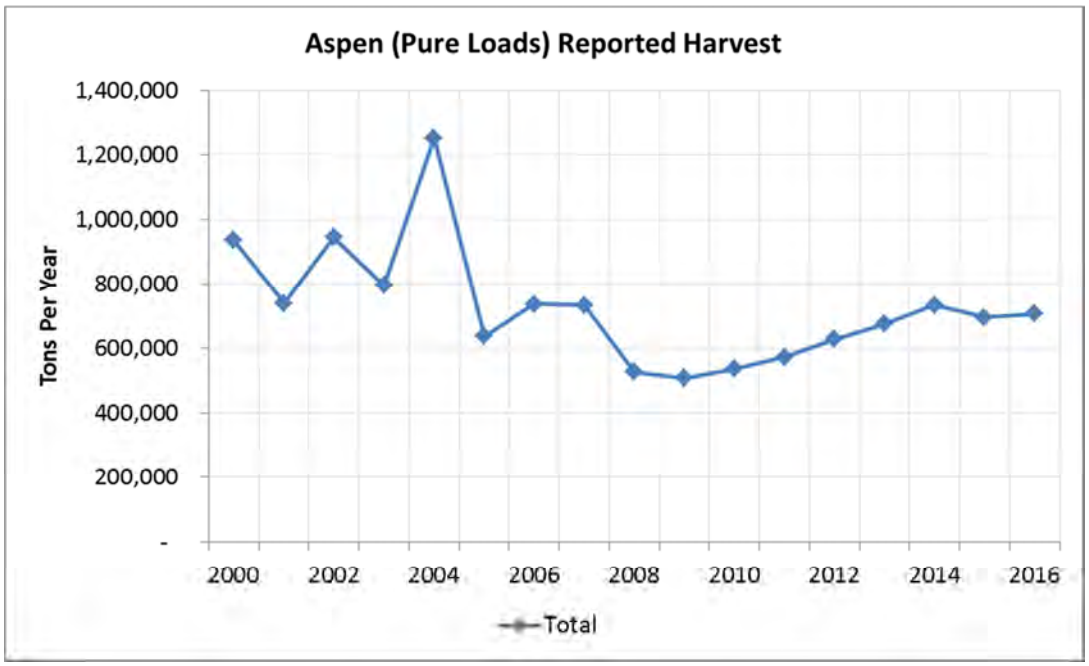


Figure 4.2. Cedar WPR Harvest Since 2000

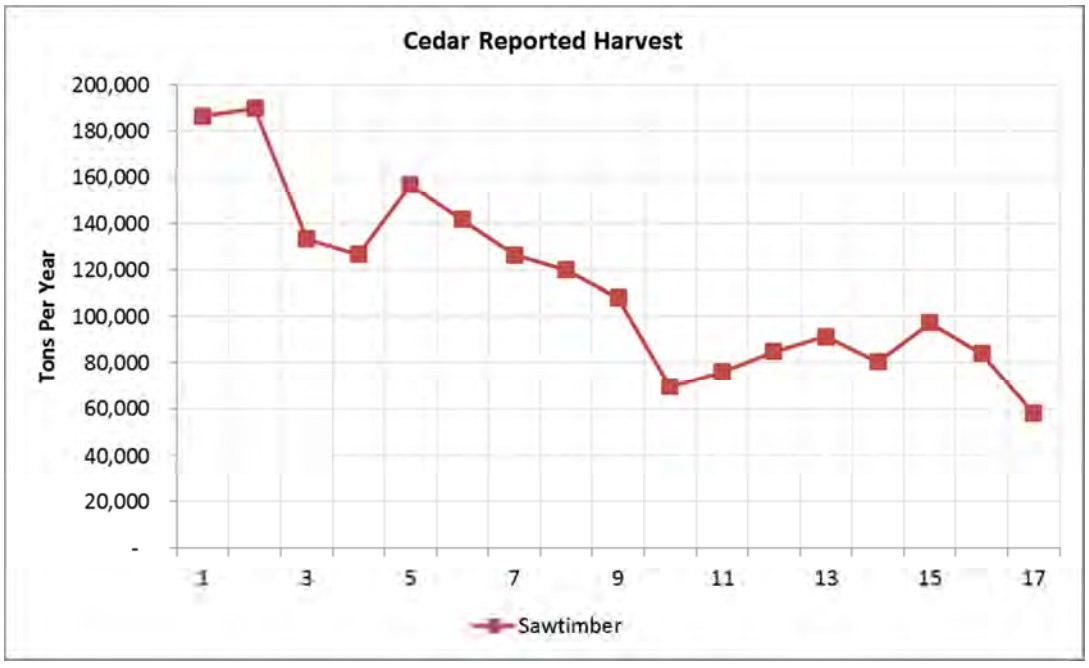


Figure 4.3. Mixed Hardwood WPR Harvest Since 2000

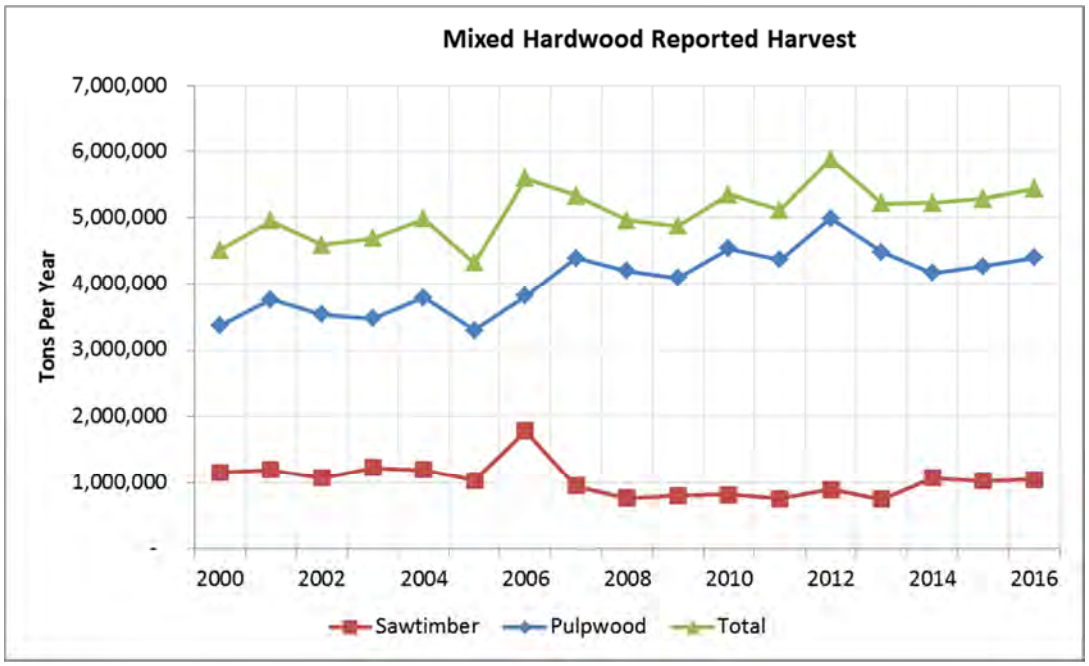


Figure 4.4. Other Softwood WPR Harvest Since 2000

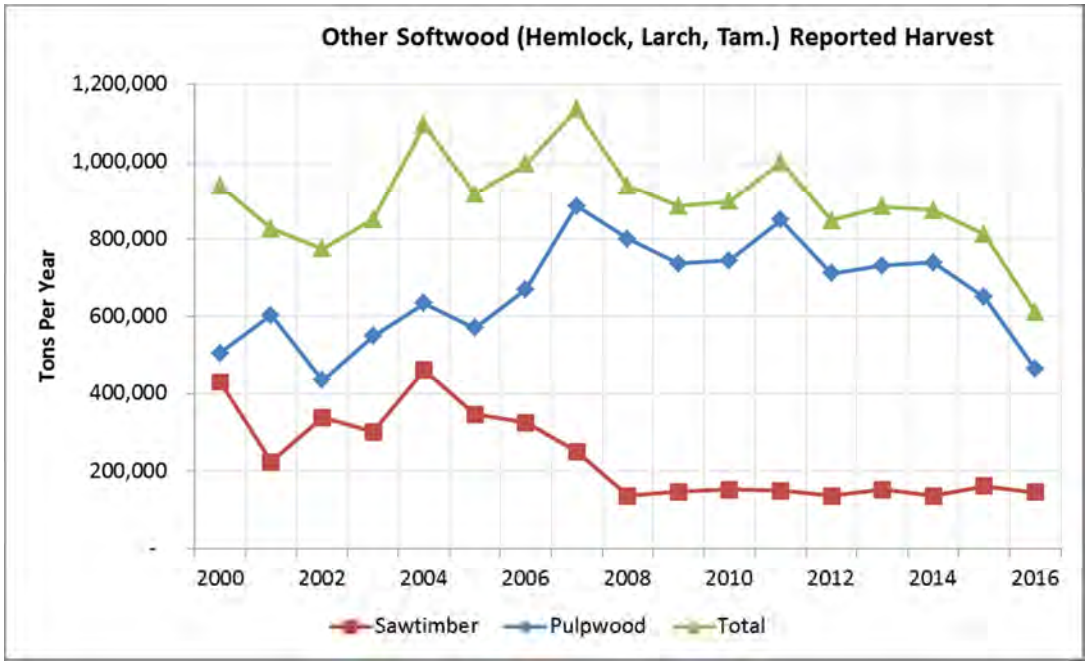


Figure 4.5. White and Red Pine WPR Harvest Since 2000

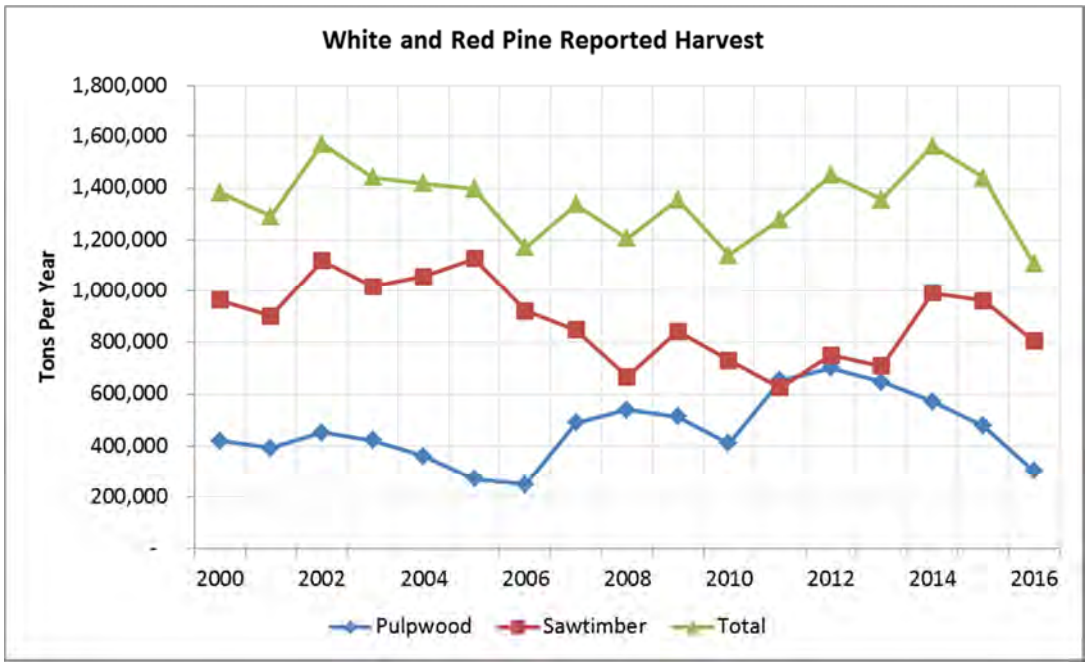
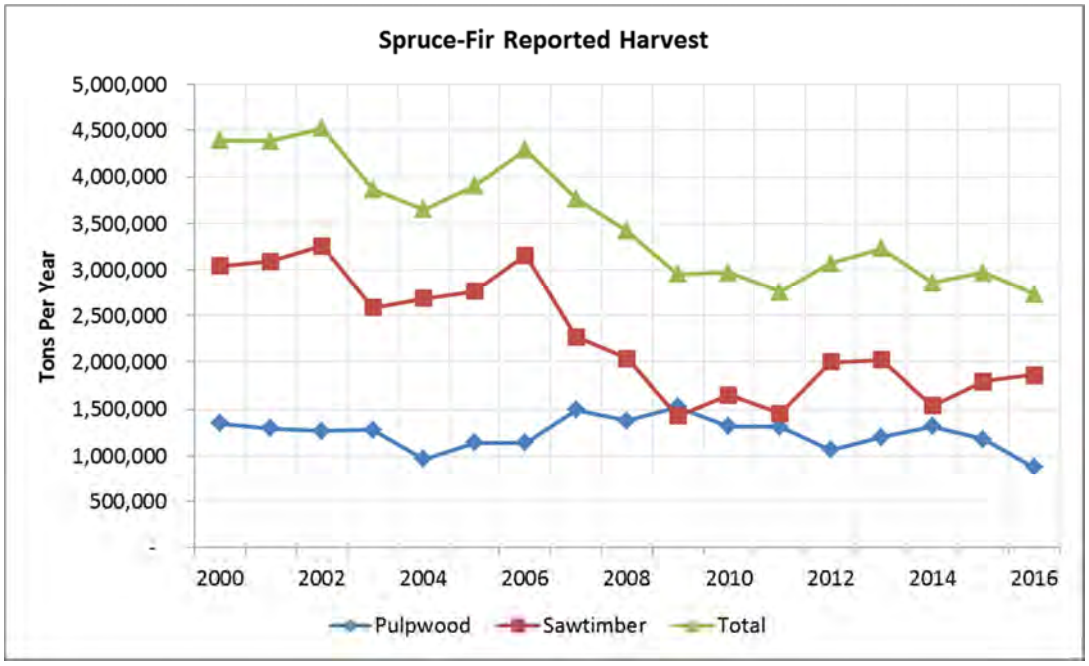


Figure 4.6. Spruce-fir WPR Harvest Since 2000



Appendix A
Modeling Assumptions

APPENDIX - MODELING ASSUMPTIONS

AREA FILE DEVELOPMENT (THEME ATTRIBUTE ASSIGNMENT)

Theme 1 – Plot/Condition. Concatenation of Plot and Condition codes to create a unique ID. 3,498 unique values.

Theme 2 – County Name.

Theme 3 – Forest type. Used FORTYPCD (algorithm based). If an assignment was not made based on FORTYPCD then FLDTYPCD was used in an effort to make an assignment.

Theme 3 Forest Type	Code	Forest type / type group
Cedar	126	Tamarack
	127	Northern white cedar
Hemlock	105	Hemlock
IntHdwd		Elm / ash / cottonwood group
	701	Black ash / American elm / red maple
	705	Sycamore / pecan / American elm
	706	Sugarberry / hackberry / elm / green ash
	707	Silver maple / American elm
	708	Red maple / lowland
		Aspen / birch group
	901	Aspen
	902	Paper birch
	903	Gray birch
	904	Balsam poplar
	905	Pin cherry
LAPlt	385	Introduced larch
NonStock	999	Nonstocked
NSPlt	384	Norway spruce
Oak		Oak / hickory group
	503	White oak / red oak / hickory
	505	Northern red oak
	514	Southern scrub oak
	516	Cherry / white ash / yellow-poplar
	517	Elm / ash / black locust
	519	Red maple / oak
OakPine		Oak / pine group
	401	Eastern white pine / northern red oak / white ash
	409	Other pine / hardwood
Pine		White / red / jack pine group
	102	Red pine
	103	Eastern white pine
	104	Eastern white pine / eastern hemlock
	167	Pitch pine
SF		Spruce / fir group
	121	Balsam fir
	122	White spruce
	123	Red spruce
	124	Red spruce / balsam fir
	125	Black spruce
TolHdwd		Maple / beech / birch group
	801	Sugar maple / beech / yellow birch
	805	Hard maple / basswood
	809	Red maple / upland
Code 962 Other Hardwoods assigned based on Field Type Code		

Theme 4 – Owner Class – combination of owner code and owner size.

Owner Class	Owner Size (from Sewall)	Owner (from FIA)
Federal	Any	National Forest
Federal	Any	Dept of Defense
Federal	Any	National Forest
Federal	Any	Other Federal
LargePrivate	Large	Private
Other Public	Any	State
Other Public	Any	County and Municipal
Other Public	Any	Other local govt
SmallPrivate	Small	Private

Theme 5 – Basal area/acre class. Calculated from the plot data on all live stems 1.0"+ DBH.

Basal Area Class	Basal Area Range
VH	≥ 150
H	100 to < 150
M	60 to <100
L	30 to <60
VL	< 30

Theme 6 – Operability. If the slope code (on the plot header) was ≥ 40 then the Plot/Condition was assigned to "Inop." Else assigned to "Op." FIA plot/conditions with a slope code >= 40 were identified as inoperable. No harvest activity is allowed in inoperable. The area identified as inoperable is 229,014 acres.

Theme 7 – Status. If STORGCD = 1 then assigned to "Planted." Else "Natural."

Theme 8 – Harvest Status. Used by Woodstock to keep track of treatments. All plot/conditions assigned to "NA" at this point.

Woodstock age (5 year age class) was assigned as wk_age = INT(STDAGE/5) + 1.

Clean up items: If wk_age = 0 then wk_age = 1 (can't have age 0 in the Woodstock area file). Also if theme 3 = "NonStocked" and theme7 = "Natural" then theme 3 = "IntHdwd."

Next, excluding theme6 = "Inop," 5% of each plot/condition with theme7 = "Natural" was assigned a theme 6 value of "Zone." For zones 5% of the non-planted operable acres were assigned to zoned. In other words, none of the planted area was zoned and 5% of the remaining area were classified as zoned. This created 808,794 acres of zoned area. The zoned area could be harvested via the shelterwood system just like the operable non-zoned area, but we included a constraint that no more than 5% of the zoned area could be harvested in a 5-year period. So in the 10 period run (50 years), half of the zoned area gets harvested.
A DBF file was output for input to Woodstock.

Yield Curve Generation

We used 3 models. The models were FVS (northeast variant), Fiber, and GNY. All yield curve sets are 5-year periodic.

FVS was used for all plot/conditions where theme 5 values are not equal to"VL." Fiber was used for all plot/conditions where theme 5 = "VL" and theme 7 = "Natural." GNY was used for all plot/conditions where theme 5 = "VL" and theme 7 = "Planted."

Each plot/condition was grown separately in FVS. Data were input as 1 acre fixed radius plots with trees expanded to per acre values. Data input for the trees were trees/acre, species code, DBH, height, and tree class code (growing stock, rough cull, rotten cull). Site index and site index species were input on the plot header record. Not all plot/conditions have a site index. In the cases that site index was missing a substitution was made utilizing the weighted average site index by theme 3. The breakpoint between large and small trees was set at 5 inches.

FVS was run using 5 year reporting periods for 60 years.

Volume/basal area ratios (tons/square foot) were developed by individual species. These ratios were used to predict weight (using the predicted DBH and trees/acre) for each growing stock tree projected. Next, species were grouped into the Woodstock yield species groups and weights were summed by theme 1 (plot/condition), species group, and projection year. Yield projections were created by initializing the yield projection with the inventory value for the species group in the plot/condition, then incrementing the inventory value with the difference between predicted weights from one period to the next. This was repeated for each year of the projection. Woodstock formatted yield curve sets were created.

For the Fiber-based yield curves, individual yields by plot/condition were not made. Average weight by species group and forest type was calculated and used to initialize the yield projections. Fiber runs on file at Sewall were used to create the yield projections in the same manner as the FVS runs. That is, the difference in weight between projection years was applied to the initial weight by species group. There are 8 Fiber yield curve sets (Fiber yields were not made for theme 3 values "LAPlt,""NSPLT,",or "NonStock"). We arbitrarily assigned the beginning age of each yield set at 3 periods of age and reset the wk_age values in the area file for these classes to 3.

For the GNY projections we created 3 yield curve sets; Plant_SP (planted spruce), Plant_PI (planted pine), and Plant_LA (planted larch). The only difference between these sets is the conversion used from cubic feet to tons (we only used one GNY run to make the 3 yield sets). We used GNY projections that we had on file. We used Land Capability 7 projections.

Appendix III: USFS Report – Forests of Maine 2017

USDA United States Department of Agriculture

RESOURCE UPDATE FS-160

Forests of Maine, 2017

This publication provides an overview of the forest resources in Maine based upon inventories conducted by the USDA Forest Service, Forest Inventory and Analysis (FIA) program of the Northern Research Station. Information about the national and regional FIA program is available online at www.fia.fs.fed.us.

Since 1999, FIA has implemented an annual inventory in the State and currently measures 20 percent of the sample plots each year. For the 2017 inventory, estimates for current variables, such as area, volume, and biomass, are based on 3,526 plots inventoried from 2013-2017. Change variables, such as net growth, removals, and mortality, are based on 3,495 plots inventoried in 2008-2012 and resampled in 2013-2017. Estimates from earlier annual and periodic inventories are included for comparison.

See Bechtold and Patterson (2005) and O'Connell et al. (2017) for definitions and technical details.

Additional data and reports are available online (www nrs fs fed.us/fia/data-tools/state-reports/ME). A complete set of inventory tables is available at https://doi.org/10.2737/FS-RU-160.

Overview

Maine contains an estimated 17.6 million acres of forest land (Table 1) and covers 89.1 percent of the land area in the State. Most of the forest land, 95.3 percent, is classified as timberland, meaning that it exceeds a minimum level of productivity and is not legislatively reserved from timber harvesting.

On the forest land in Maine, there are an estimated 23.9 billion live trees ≥1 in d.b.h. (Table 1). These trees have a total above ground biomass of 713.8 million tons and, looking at trees ≥5 in d.b.h., a total net volume of 27.3 billion ft^3. The ratio of net growth to removals is 1.4:1. Selected statistics are also provided in Table 1 for growing-stock trees, which are a subset of all live trees ≥5 in d.b.h. and meet specific merchantability requirements.

Table 1.—Maine forest statistics, 2017 and 2012. Volume estimates are for trees ≥5 in diameter at breast height (d.b.h.). Number of trees and biomass estimates are for trees ≥1 in d.b.h. Sampling errors and error bars shown in tables and figures in this report represent 68-percent confidence intervals.

	2017 estimate	Sampling error (%)	2012 estimate	Sampling error (%)	Change since 2012 (%)
Forest Land					
Area (thousand acres)	17,590	0.4	17,638	0.4	-0.3
Number of live trees ≥1 in d.b.h. (million trees)	23,922	1.5	24,294	1.5	-1.5
Live tree aboveground biomass (thousand oven-dry tons)	713,751	0.9	684,641	1.0	4.3
Net volume of live trees ≥5 in d.b.h. (million ft^3)	27,329	1.2	26,030	1.2	5.0
Annual net growth of live trees ≥5 in d.b.h. (thousand ft^3/yr)	802,412	1.7	726,696	2.2	10.4
Annual mortality of live trees ≥5 in d.b.h. (thousand ft^3/yr)	263,784	3.4	303,657	3.1	-13.1
Annual harvest removals of live trees ≥5 in d.b.h. (thousand ft^3/yr)	567,063	5.5	613,368	5.1	-7.5
Annual other removals of live trees ≥5 in d.b.h. (thousand ft^3/yr)	3,271	47.1	9,469	38.4	-65.5
Timberland					
Area of timberland (thousand acres)	16,764	0.5	17,005	0.5	-1.4
Number of live trees ≥1 in d.b.h. (million trees)	22,780	1.5	23,464	1.6	-2.9
Live tree aboveground biomass (thousand oven-dry tons)	675,326	1.0	659,561	1.0	2.4
Net volume of live trees ≥5 in d.b.h. (million ft^3)	25,720	1.3	24,999	1.2	2.9
Net volume of growing-stock trees ≥5 in d.b.h. (million ft^3)	23,367	1.3	23,376	1.3	-0.0
Annual net growth of growing-stock trees ≥5 in d.b.h. (thousand ft^3/yr)	736,301	1.6	675,627	2.0	9.0
Annual mortality of growing-stock trees ≥5 in d.b.h. (thousand ft^3/yr)	204,960	3.7	229,044	3.4	-10.5
Annual harvest removals of growing-stock trees ≥5 in d.b.h. (thousand ft^3/yr)	495,730	5.5	540,378	5.2	-8.3
Annual other removals of growing-stock trees ≥5 in d.b.h. (thousand ft^3/yr)	6,475	53.1	17,429	41.7	-62.8

Forest Area

Maine's forest land area has not substantially changed since 2012 (Fig. 1). An estimated 89.1 percent of the forest land is privately owned, 9.6 percent is publicly owned, and the remainder is owned by Native American tribes (Fig. 2).

Currently, 34.7, 36.5, and 28.5 percent of the timberland in Maine is in large, medium, and small stand sizes, respectively (Fig. 3).

The most common forest-type group is maple/beech/birch, representing 41.3 percent of Maine's forest land area (Fig. 4). The next most common forest-type groups are spruce/fir, aspen/birch, and white/red/jack pine.

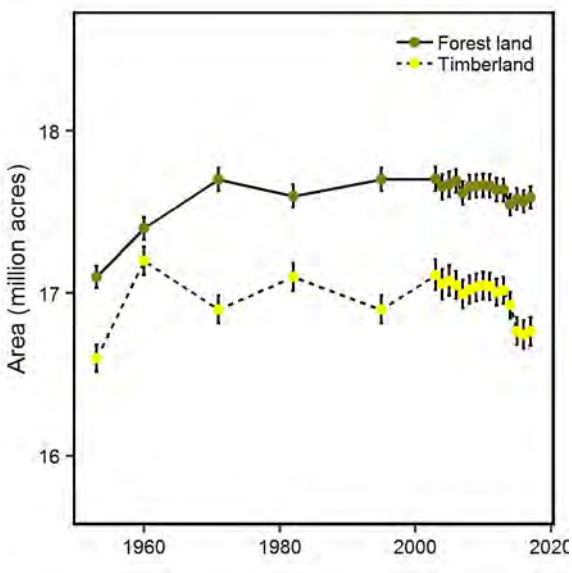


Figure 1.—Area of forest land and timberland, Maine.

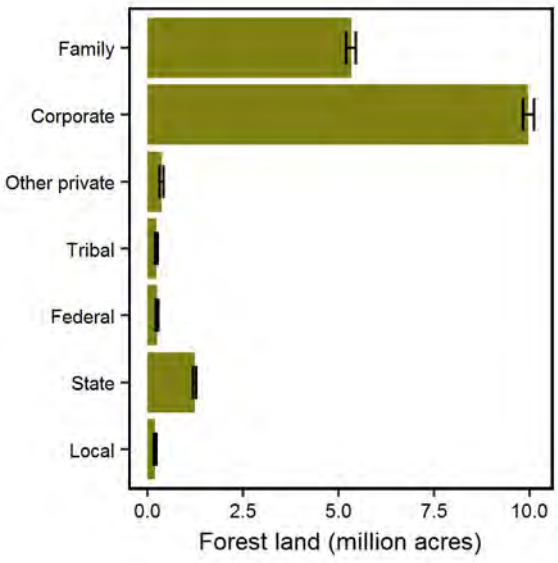


Figure 2.—Area of forest land by ownership group, Maine, 2017.

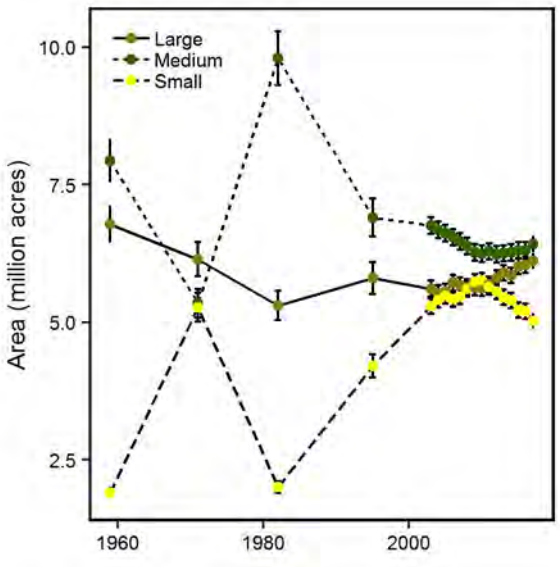


Figure 3.—Area of timberland by stand-size class, Maine.

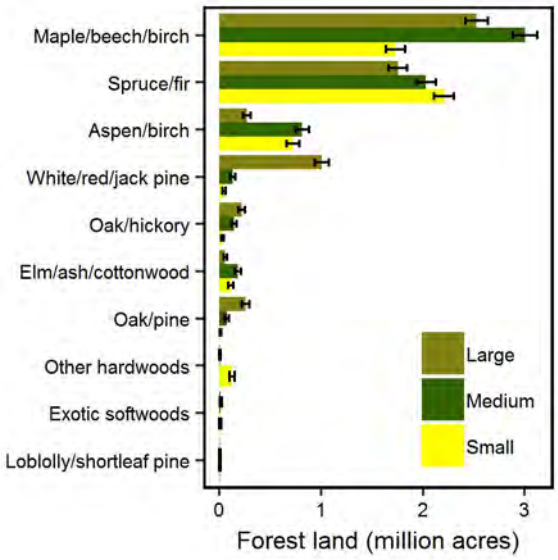


Figure 4.—Area of forest land by forest-type group and stand-size class, Maine, 2017.
Stand-size classes: Small-dominated by trees $<$5.0 in d.b.h.; Medium-dominated by trees 5.0 to 8.9 in d.b.h. for softwoods and 5.0 to 10.9 inches d.b.h. for hardwoods; Large-dominated by trees $\geq$9.0 in for softwoods and 11.0 in d.b.h. for hardwoods.

Forest Composition

Maine's forests contain a wide variety of tree species with over 55 species sampled in 2017. This composition looks different depending on whether the number or volume of trees are examined.

In terms of volume, red spruce is the most common tree in Maine followed by red maple and eastern white pine (Table 2). Collectively, the 10 most voluminous tree species account for 83.2 percent of the total volume of live trees on forest land in Maine. Of these species, balsam fir, northern red oak, and eastern white pine showed the most substantial increases in volume since 2012.

In terms of number of trees, balsam fir is the most numerous species in Maine with 36.0 percent of the tree stems in the State (Fig. 5). Other common species include red maple, red spruce, American beech, and paper birch. The ten most common species, in terms of numbers of stems, account for 84.9 percent of the trees in the State.

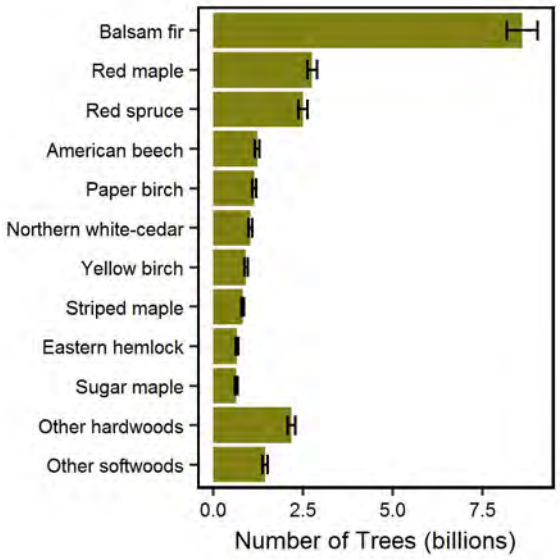


Figure 5.—Number of trees ≥ 1 in d.b.h. by species, Maine, 2017.

Table 2.—Net volume and percent change in net volume on forest land; sawtimber volume and percent change on timberland, Maine, 2017 (top 10 species by net volume).

Rank	Species	Volume of live trees on forest land (million ft^3)	Sampling error (%)	Change since 2012 (%)	Volume of sawtimber trees on timberland (million board ft)	Sampling error (%)	Change since 2012 (%)
1	Red spruce	3,429.2	3.9	11.4	8,105.9	4.9	5.0
2	Red maple	3,274.1	2.8	0.8	4,640.9	5.1	-5.4
3	Eastern white pine	3,190.3	5.0	11.4	11,106.6	5.6	6.8
4	Balsam fir	2,892.1	2.8	21.3	2,939.0	4.9	10.9
5	Northern white-cedar	2,193.4	5.1	-2.0	4,458.8	6.2	-8.0
6	Eastern hemlock	2,054.8	5.3	2.3	5,662.8	6.3	-1.4
7	Sugar maple	1,891.1	5.8	-6.4	4,685.6	7.6	-15.0
8	Yellow birch	1,685.2	3.9	3.6	3,181.9	6.6	-10.3
9	Paper birch	1,114.0	4.4	-2.5	982.9	8.4	-15.3
10	Northern red oak	1,019.0	6.6	13.2	2,928.8	8.3	19.9
	Other softwood	1,545.9	6.1	4.8	3,482.3	8.3	7.2
	Other hardwood	3,040.0	3.4	-0.1	4,981.0	5.8	-4.4
	All species	27,329.1	1.3	5.0	57,156.5	1.9	-0.4

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Northern FIA: http://nrs.fs.fed.us/fia/

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Appendix IV: MFS 2017 Silvicultural Activities Report

2017
Silvicultural Activities Report

including Annual Report on Clearcutting and Precommercial Activities

Compiled from the 2017 Landowner Reports and other survey instruments.
Data collected under the provisions of 12 MRS §8885

Published: September 12, 2018

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Report Highlights

Harvesting and Land Use Change

- **335,624 acres were harvested in 2017, a decrease of 2% from 341,318 acres in 2016.**
- **309,159 acres were partially harvested (partial and shelterwood totals) in 2017, a 2% decrease from 316,890 acres in 2016.**
- **The number of harvests reported decreased from 4,665 to 4,275.**

Clearcutting:

1. **The total area clearcut increased 8% from 20,971 acres in 2016 to 22,722 acres in 2017. Clearcutting amounted to 6.8% of total harvested acres.**
2. **Landowners owning more than 100,000 acres in Maine created 94% of all clearcut acreage (21,235 acres).**
3. **Average clearcut size in 2017 was 29 acres. Landowners owning more than 100,000 acres had an average clearcut size of 36 acres. Landowners owning less than 100,000 acres had an average clearcut size of 14 acres. 24 clearcuts larger than 75 acres were created in 2017.**
4. **The primary silvicultural reason for clearcutting reported by large landowners was the removal of poor quality, intolerant, under stocked, short lived or mature overstories where the retention of the residual overstory trees is not justified for further increase in value, as a source of seed, or for protection of the new stand.**

Land Use Changes:

- **Harvesting to convert land from forest management to some other land use increased 8% from 3,457 acres in 2016 to 3,743 acres in 2017.**

Precommercial Silvicultural Activities

Herbicide Use:

- **Site preparation decreased -59%, from 2,247 acres in 2016 to 932 acres in 2017.**
- **To release crop trees from competing vegetation decreased -13%, from 13,464 acres in 2016 to 11,769 acres in 2017.**

Timber Stand Improvement (TSI):

- **Precommercial thinning of young stands with spacing saws increased 136%, from 3,724 acres in 2016 to 8,791 acres in 2017.**

  83% of the acreage was done by landowners owning more than 100,000 acres (7,297 acres).

Planting:

- **Tree planting increased 11%, from 6,677 acres in 2016 to 7,430 acres in 2017.**

  98% of the planting acreage was by landowners owning more than 100,000 acres (7,314 acres).

Forester Involvement

- **In 2017, licensed foresters supervised harvesting on 260,584 acres, compared to 258,506 acres in 2016.**

78% of all harvest acres in 2017 had a licensed forester involved; an increase from 2016 (76% involvement).

Licensed Forester supervision occurred on 32% (620 out of 1,968 harvests) of the harvests on non-industrial family forests (<= 100 acres) in 2017. This is the same percentage as in 2016 (721 out of 2,240 harvests).

2017 Harvesting Activities

Commercial Harvest Information by Landowner Size and Type		Acres						
			Shelterwood					
OwnershipType	Ownership Size	Partial Harvests	Initial or Intermediate Entry	Final Entry	Total Shelterwood	Clearcut	Land Use Change	Total Harvest
Forest Industry Woodlands	1 to 100 acres	22	60	0	60	0	13	95
	101 to 1,000 acres	23	0	0	0	0	0	23
	1,001 to 100,000 acres	5,686	329	94	423	46	100	6,255
	100,000 + acres	11,264	15,009	18,885	33,894	7,593	0	52,751
	SubTotal	**16,995**	**15,398**	**18,979**	**34,377**	**7,639**	**113**	**59,124**
Investor Timberlands	1 to 100 acres	0	0	0	0	0	0	0
	101 to 1,000 acres	0	0	0	0	0	0	0
	1,001 to 100,000 acres	816	362	1,788	2,150	32	0	2,998
	100,000 + acres	16,626	6,027	24,579	30,606	5,807	0	53,039
	SubTotal	**17,442**	**6,389**	**26,367**	**32,756**	**5,839**	**0**	**56,037**
Non-Industrial Land	1 to 100 acres	36,371	2,431	3,866	6,297	346	1,297	44,311
	101 to 1,000 acres	45,026	3,838	4,965	8,803	335	1,333	55,497
	1,001 to 100,000 acres	22,822	5,867	6,910	12,777	698	647	36,944
	100,000 + acres	15,208	17,497	26,651	44,148	7,791	6	67,153
	SubTotal	**119,427**	**29,633**	**42,392**	**72,025**	**9,170**	**3,283**	**203,905**
Other Woodlands (Govt, etc.)	1 to 100 acres	391	4	0	4	10	56	461
	101 to 1,000 acres	1,258	74	0	74	10	73	1,415
	1,001 to 100,000 acres	1,670	916	417	1,333	10	52	3,065
	100,000 + acres	8,502	2,026	879	2,905	44	166	11,617
	SubTotal	**11,821**	**3,020**	**1,296**	**4,316**	**74**	**347**	**16,558**
2017 Totals:		**165,685**	**54,440**	**89,034**	**143,474**	**22,722**	**3,743**	**335,624**
Percent of 2017 Harvest		**49.37%**	**16.22%**	**26.53%**	**42.75%**	**6.77%**	**1.12%**	**100.00%**
2016 Totals:		**175,057**	**47,645**	**94,188**	**141,833**	**20,971**	**3,457**	**341,318**
Percent Change from 2016 to 2017:		**-5%**	**14%**	**-5%**	**1%**	**8%**	**8%**	**-2%**

2017 Precommercial Activities and Professional Assistance

OwnershipType	Ownership Size	Precommercial Activities by Landowner Size and Type — Acres — Herbicide Use — Site Prep	Herbicide Use — Release	TSI	Tree Planting		Number of Reported Harvests	Licensed Forester Involvement by Landowner Size and Type — Number of Harvests	Total Acres	
Forest Industry Woodlands	1 to 100 acres	0	0	0	0		4	3	75	
	101 to 1,000 acres	0	0	0	0		1	1	23	
	1,001 to 100,000 acres	0	0	0	0		35	18	1,311	
	100,000 + acres	0	10,428	7,035	4,530		110	89	52,538	
	Subtotal	**0**	**10,428**	**7,035**	**4,530**		**150**	**111**	**53,947**	
Investor Timberlands	1 to 100 acres	0	0	0	0		0	0	0	
	101 to 1,000 acres	0	0	0	0		0	0	0	
	1,001 to 100,000 acres	0	0	0	0		10	10	2,998	
	100,000 + acres	426	307	250	93		129	128	51,627	
	Subtotal	**426**	**307**	**250**	**93**		**139**	**138**	**54,625**	
Non-Industrial Land	1 to 100 acres	0	81	158	50		1,968	620	17,408	
	101 to 1,000 acres	29	50	572	24		1,247	503	28,599	
	1,001 to 100,000 acres	0	4	764	22		367	252	26,294	
	100,000 + acres	477	773	0	2,691		270	248	64,596	
	Subtotal	**506**	**908**	**1,494**	**2,787**		**3,852**	**1,623**	**136,897**	
Other Woodlands (Govt, etc.)	1 to 100 acres	0	0	0	0		19	9	297	
	101 to 1,000 acres	0	0	0	20		33	25	1,266	
	1,001 to 100,000 acres	0	20	0	0		24	21	3,013	
	100,000 + acres	0	106	12	0		58	55	10,539	
	Subtotal	**0**	**126**	**12**	**20**		**134**	**110**	**15,115**	
2017 Totals:		**932**	**11,769**	**8,791**	**7,430**		**4,275**	**1,982**	**260,584**	**335,624**
2016 Totals:		**2,247**	**13,464**	**3,724**	**6,677**		**4,665**	**2,172**	**258,506**	**341,318**
Change from 2016 to 2017:		**-59%**	**-13%**	**136%**	**11%**		**-8%**	**-9%**	**1%**	

Statewide Total Harvest acres from previous page

Definitions:

Ownership Type

Forest Industry Land: **Woodlands owned by a forest products industry; usually most of the wood harvested is used by that industry.**

Investor Timberlands: **Woodlands owned by organizations, including Timberland Investment Management Organizations (TIMOs) and Real Estate Investment Trusts (REITs) that hold timberland assets as fiduciaries for the benefit of others.**

Non-Industrial Land: **Woodlands privately owned but NOT by a forest industry. These include private individuals and other non-forest product industries.**

Other woodlands: **Woodlands owned by other entities not listed above -- including local, state, federal, or tribal governments.**

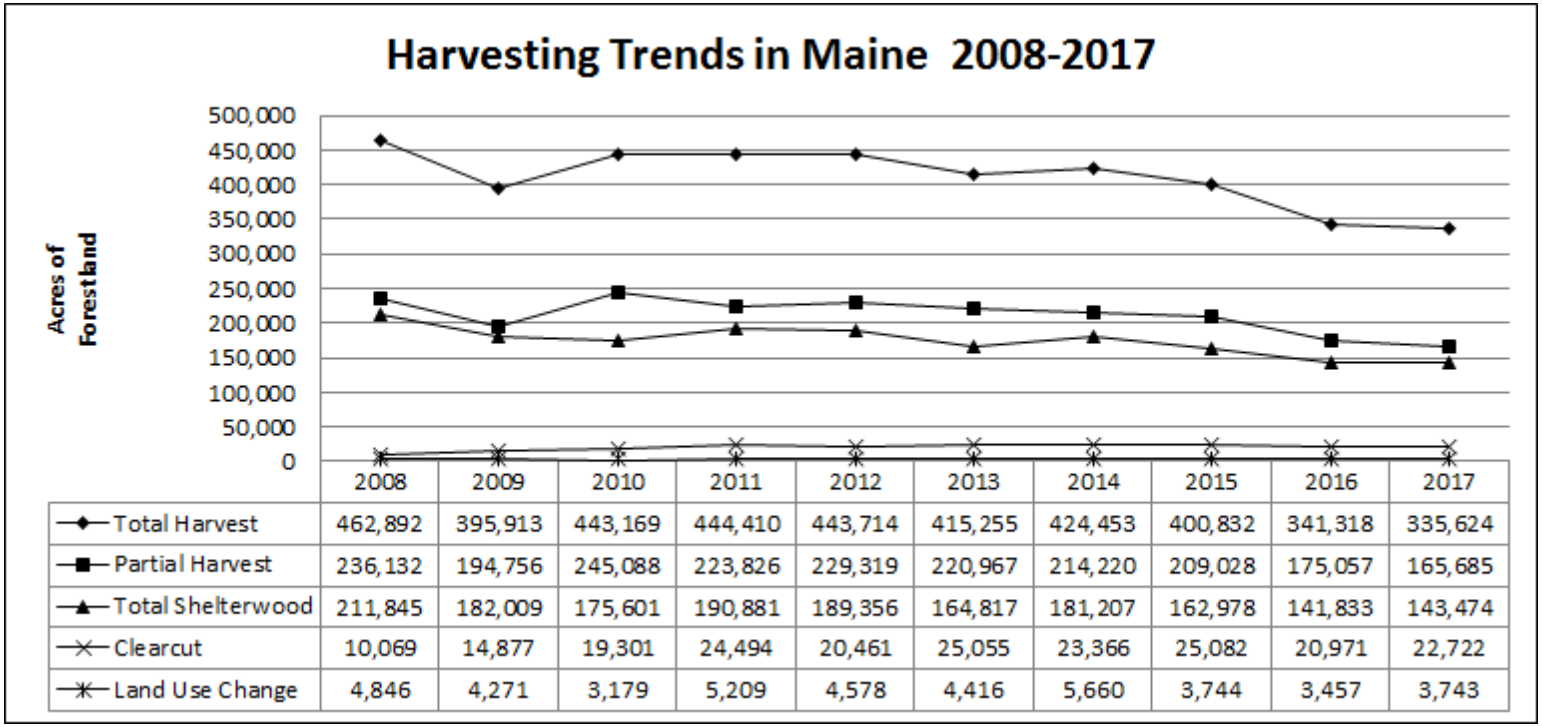
Types of Harvests

Partial Harvest: **Harvest where trees are removed individually or in small (<5 acre) patches.**

Shelterwood: **Harvest of mature trees from a forest site in two or more stages. The first stage removes only a portion of the trees to allow establishment of regeneration before the remaining trees are removed in subsequent harvest.**

Clearcut: **Harvest on a site larger than 5 acres that results in a residual basal area of acceptable growing stock trees >4.5" DBH of less than 30 square feet per acre, unless after harvesting the site has a well-distributed stand of acceptable growing stock 3 feet tall for softwood and 5 feet for hardwoods (Overstory Removal). Refer to the latest copy of the Maine Forest Service Rules Chapter 20 for additional information. It can be found on the Maine Forest Service website at http://www.state.me.us/doc/mfs/rules_regs/index.htm**

Change of Land Use: **Harvest conducted to convert forestland to another land use such as house lots, farm pastures, etc.**



	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Total Harvest	462,892	395,913	443,169	444,410	443,714	415,255	424,453	400,832	341,318	335,624
Partial Harvest	236,132	194,756	245,088	223,826	229,319	220,967	214,220	209,028	175,057	165,685
Total Shelterwood	211,845	182,009	175,601	190,881	189,356	164,817	181,207	162,978	141,833	143,474
Clearcut	10,069	14,877	19,301	24,494	20,461	25,055	23,366	25,082	20,971	22,722
Land Use Change	4,846	4,271	3,179	5,209	4,578	4,416	5,660	3,744	3,457	3,743

2017 Annual Report on Clearcutting and Precommercial Activities

Compiled from the 2017 Landowner Reports and other survey instruments. Data collected under the provisions of the Forest Resources Assessment Program, 12 MRS § 8878-A

	Large Landowners (own >100,000 acres)										All Other Landowners				All Landowners
	Precommercial Activities Acres		Clearcuts > 75 acres in size		Purpose for Clearcut (see explanation below) Acres						Acres				
													Clearcut		Acres
County	TSI	Planted	#	Acres	1	2	3	4	Sub Total	Avg. Size	TSI	Planted	Sub Total	Avg. Size	Clearcut
Androscoggin	0	0	0	0	0	0	0	0	0	0	10	0	53	11	53
Aroostook	5,291	4,451	0	0	7,037	23	223	0	7,283	34	20	20	213	11	7,496
Cumberland	0	0	0	0	0	0	0	0	0	0	0	0	37	9	37
Franklin	0	47	11	2,140	2,409	225	908	0	3,542	49	66	0	62	9	3,604
Hancock	0	0	0	0	182	0	0	0	182	30	44	0	231	14	413
Kennebec	0	0	0	0	0	0	0	0	0	0	402	0	12	6	12
Knox	0	0	0	0	0	0	0	0	0	0	2	0	30	8	30
Lincoln	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0
Oxford	649	79	8	1,512	1,315	716	796	0	2,827	38	30	42	99	16	2,926
Penobscot	576	93	0	0	724	0	0	0	724	48	37	36	20	5	744
Piscataquis	531	465	0	0	452	44	424	379	1,299	22	21	5	15	15	1,314
Sagadahoc	0	0	0	0	0	0	0	0	0	0	0	0	7	2	7
Somerset	0	2,179	4	441	3,662	0	258	1,236	5,156	22	49	6	529	35	5,685
Waldo	0	0	0	0	36	0	0	0	36	12	0	7	35	9	71
Washington	250	0	1	101	186	0	0	0	186	37	750	0	76	13	262
York	0	0	0	0	0	0	0	0	0	0	57	0	68	11	68
State Total:	**7,297**	**7,314**	**24**	**4,194**	**16,003**	**1,008**	**2,609**	**1,615**	**21,235**	**36**	**1,494**	**116**	**1,487**	**14**	**22,722**

Purposes for creating clearcut:

1. Removal of poor quality, intolerant, under stocked, short lived or mature overstories where the retention of the residual overstory trees is not justified for further increase in value, as a source of seed, or for protection of the new stand.
2. Ecologically appropriate improvement or creation of wildlife habitat.
3. Removal of stands that, if partially harvested according to accepted silvicultural practice, are at high risk for windthrow due to factors such as soils, rooting depth, crown ratio or stem quality.
4. Harvesting of an existing plantation or other forest stand established by or previously treated with precommercial silvicultural activities.

Maine Forest Service District Foresters

Be Woods Wise!
Practical advice for your land and trees from the Maine Forest Service.

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Appendix V: MFS 2017 Stumpage Report

2017
STUMPAGE PRICES
By Maine County/Unit

Compiled from the 2017 Landowner Reports.
Data collected under the provisions of Title 12 MRS §8886

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We help you make informed decisions about Maine's forests.

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- **The market values listed in this report represent prices paid to Maine landowners in 2017. Prices have changed since then.**
- **The 2016 average prices for each product and species are included for reference.**
- **Wood markets are volatile. Current prices will vary.**
- **See Factors Influencing Stumpage Prices of Forest Products on the inside front cover.**
- **Call 1-800-367-0223 if you have questions about this report or to locate your local Maine Forest Service District Forester.**

These stumpage prices are based on reports from 2017 and are the most recent available. HOWEVER, prices can change significantly within weeks or months due to market conditions. This report gives a profile of roundwood prices in Maine. Values are offered as a guide to help individuals assess the fair market value of their standing trees. The average price for a county should not be applied as the exact value for a particular tract. These prices primarily reflect common wood utilization standards and markets. Wood that can be marketed locally and/or includes specialty products may in some cases increase returns to landowners. The best way for private landowners to determine current stumpage values and available wood markets is to consult with a Licensed Forester before harvesting.

About the 2017 Stumpage Price Report

What is the purpose of this report

This report lists the stumpage prices paid to Maine landowners during the calendar year 2017. This information is intended to give landowners a profile of timber prices in Maine.

How was this information collected

The Maine Forest Service (MFS) collects information on timber harvesting through notification and landowner reporting. The price information contained in this report is based on approximately 1,823 landowner reports received by the MFS that reported having a stumpage sale in 2017.

What is the purpose of the Annual Landowner Reports?

Each year, the MFS collects information from forest landowners regarding the stumpage prices, volume of timber harvested, and harvest acreage in Maine.

This confidential information is used for three primary purposes:

- **to calculate valuations for lands enrolled in the Tree Growth Tax Program,**
- **to publish stumpage price descriptive statistics, in a format that maintains landowner confidentiality, and**
- **to quantify harvest area and forest management techniques.**

Report Summary:

There were more stumpage sales reported in 2017 (1,823) than in 2016 (1,700). Stumpage prices for a majority of product categories declined statewide.

To improve the consistency of published stumpage price information, the eight smaller Maine counties were combined into their respective Forest Inventory and Analysis (FIA) Unit as follows:

Capital Area Unit - Kennebec, Knox, Lincoln, and Waldo counties

Casco Bay Unit - Androscoggin, Cumberland, Sagadahoc, and York counties

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This report is arranged so you can look up stumpage prices by county or unit. Stumpage prices are organized into eight product categories:

Biomass	**Pulpwood**
Boltwood	**Sawlogs**
Firewood	**Studwood**
Palletwood	**Veneer**

The statistics includes:

average stumpage price

minimum stumpage price

maximum stumpage price

number of reports used to calculate the average

Because the number of reports for individual products/counties varies widely comparisons with neighboring counties or units may be useful.

If there are three or fewer reports for a product and species in one county or unit, the price statistics are not reported for that county, but are included on the State Summary page. Species not listed for a product indicate that no reports were filed for that product and species combination.

FACTORS INFLUENCING STUMPAGE PRICES OF FOREST PRODUCTS

Stumpage prices on a given timber harvest are influenced by a number of factors including but not limited to the following:

- **Volume to be cut per acre or total harvest volume**
- **Average size of trees to be cut**
- **Mix of species to be harvested**
- **Percentage of pulpwood and sawlogs**
- **Log quality**
- **Logging terrain**
- **Distance to public roads**
- **Type of logging equipment**
- **TIme of year**
- **Landowner needs or special requirement**
- **Market demand**
- **Distance to market**
- **Involvement of a licensed forester**
- **Landowner knowledge of market value**
- **Sale by competitive bid**
- **Type of harvest: i.e., partial or clearcut**
- **Regulatory constraints**
- **High stumpage prices - exercise caution as price may be**

Any one of the above factors can have a significant effect on stumpage prices for a species, while another factor may have an insignificant effect in a particular area. Under certain circumstances reasonable prices may occur outside the given ranges within this report.

DEFINITIONS AND NOTES

Average: The average price (or mean) is calculated by multiplying the corresponding volume by the stumpage price for each species and product reported by woodland owners. These are added together and divided by the sum of all the volumes (reported with corresponding stumpage prices) for that product and species.

This is a weighted average.

Biomass: Above ground portion of tree that is chipped on site, usually the whole tree but sometimes only the tops and branches.

Board: 1" thick piece of lumber 3" to 12" wide and 8' through 16' long

Board foot: A wood volume measurement unit equal to a piece of wood 1" thick by 12" long by 12" wide.

Boltwood: A short log of a length suitable for manufacturing turned forest products (i.e. dowels, toothpicks) or peeling veneer.

Conversions: For converting different units of volume, a conversion table is shown on the last page of this report.

Cords (cds): (MFS Rules Chapter 20 definition). A cord is a unit of measure of wood products 4 feet wide, 4 feet high, and 8 feet long, or its equivalent, containing 128 cubic feet when the wood is ranked and well stowed. Any voids that will accommodate a stick, log or bolt of average dimensions to those in the pile shall be deducted from the measured volume.

Dimension Lumber: timbers 2" x 3" through 2" x 12" and 8' through 16' in length

Max(imum): The maximum price is the highest price reported.

(MBF) One thousand board feet. For stumpage purposes, MBF is usually determined based on log scale, not on actual recovery of lumber.

Min(imum): The minimum price is the lowest price reported.

Palletwood: A low grade sawlog intended to be sawn into lumber for making pallets or landscaping ties.

Pulpwood: Wood used to produce fiber for making paper. Though reported to the MFS in two different units (tons and pounds), the stumpage price report converts pulpwood volumes to tons. For conversions, see back page of this report.

Reports (# of Rpts): The number of reports upon which the statistics were calculated. If there were three or fewer reports for a product and species in one county, the price statistics are not reported at the county level (to preserve confidentiality). There may be a statewide price however.

Sawlog: A log suitable for production of boards and dimensional lumber. For some sales, prices for sawlogs are seperated by grade as well as spieces.

Scale: The measurement of sawlogs, pulpwood, or other wood products, usually by a licensed wood scaler or scaling facility. Also a standard by which wood products are measured.

Species: **Common Names for some specie**

Aspen:	**poplar, popple**
Red Maple:	**white maple, soft maple**
Sugar Maple:	**rock maple, hard maple**
White Birch:	**paper birch**

Studwood: Sawlogs intended to be sawn into dimensional lumber.

Stumpage: The value of standing trees. (MFS Rules Chapter 20 Definition) Typically, stumpage is the value paid by a contractor to the landowner for some or all of the standing trees in the landowner's woodlot or a designated harvest area. Stumpage prices are negotiable and should be agreed upon in advance. Written (or occasionally verbal) contracts then assure the contractor (i.e. purchaser of stumpage) of the right to harvest and remove the trees, possibly with certain conditions relating to method of payment, timing of harvest, necessary improvements, and protection of other resources. Stumpage is often determined and paid based on measure, or scale, of the harvested wood's volume and quality, by a state licensed wood scaler or scaling facility.

Veneer: wood peeled, sawn, or sliced into sheets of a given constant thickness.

IMPORTANT NOTES ON STUMPAGE PRICES

These stumpage prices are based on reports from 2017 and are the most recent available. HOWEVER, prices can change significantly within weeks or months due to market conditions. This report gives a profile of roundwood prices in Maine. Values are offered as a guide to help individuals assess the fair market value of their standing trees. The average price for a county should not be applied as the exact value for a particular tract. These prices primarily reflect common wood utilization standards and markets. Wood that can be marketed locally and/or includes specialty products may in some cases increase returns to landowners. The best way for private landowners to determine current stumpage values and available wood markets is to consult with a licensed forester before harvesting.

The sawlog prices published in this report combine all grades of sawlog for a given species. Prices of sawlogs can vary by hundreds of dollars based upon the quality, or grade, of the sawlog. Sawlog quality is determined during the log scaling and grading process. Log scaling is the process of measuring how much volume there is in a sawlog. Items such as log length, diameter, heart discoloration, and amount of defect, such as sweep and crook, will determine the volume and grade of the sawlog.

Typically, sawlogs that are larger, straighter, and have fewer knots are graded higher and have higher value. Individual mills establish their own specifications and pricing for each grade. It is wise to get the latest grade specifications and price before harvesting logs for a particular mill.

Proper preparation of a sawlog, starting from how the tree is initially cut down to how it is bucked once it is down, can have a big impact on how much money that sawlog is worth.

A licensed forester can help you achieve the best value for the wood you are harvesting. Contact the Maine Forest Service to locate licensed foresters in your area.

SUMMARY PAGE - ALL COUNTIES

Stumpage Prices paid to Maine Forest Landowners in 2017

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.51	$0.38	$4.76	658	*$1.90*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	$102	$80	$130	10	*$130*
White Birch	$129	$25	$250	179	*$171*
Yellow Birch	$138	$25	$194	20	*$143*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$22	$5	$45	608	*$24*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$79	$9	$255	572	*$83*
Softwood	$46	$10	$207	446	*$53*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$1	$25	377	*$11*
Cedar	$15	$0.86	$20	77	*$9*
Hemlock	$4	$0.50	$13	346	*$5*
Mixed Hardwood	$7	$0.46	$28	1,249	*$8*
Red Pine	$7	$1	$14	16	*$7*
Spruce & Fir	$5	$0.50	$18	343	*$7*
White Pine	$3	$0.20	$9	383	*$3*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$169	$45	$450	510	*$184*
Aspen/Poplar	$78	$25	$205	64	*$102*
Beech	$94	$20	$260	33	*$107*
Cedar	$136	$20	$212	151	*$116*
Hemlock	$58	$15	$152	398	*$71*
Red Oak	$293	$33	$582	572	*$283*
Red Pine	$64	$15	$190	91	*$41*
Red/White Maple	$135	$30	$344	503	*$155*
Spruce & Fir	$122	$25	$285	550	*$109*
Sugar Maple	$183	$35	$502	482	*$204*
White Birch	$158	$30	$350	479	*$195*
White Oak	$162	$20	$400	61	*$167*
White Pine	$171	$20	$365	976	*$169*
Yellow Birch	$163	$30	$400	446	*$200*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$12	$2	$36	202	*$11*
Spruce & Fir	$22	$3	$36	452	*$23*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$419	$25	$800	21	*$391*
Aspen/Poplar	$104	$55	$162	10	*No Price*
Beech	*				*No Price*
Red Oak	$687	$200	$1,150	294	*$630*
Red/White Maple	$463	$150	$867	16	*$512*
Sugar Maple	$792	$200	$1,313	227	*$894*
White Birch	$591	$225	$1,015	195	*$580*
White Oak	$344	$242	$625	6	*$451*
Yellow Birch	$960	$275	$1,338	203	*$1,012*

SUMMARY PAGE - ALL COUNTIES

* For species with less than 3 reports, refer to either a) the statewide summary page, b) adjacent counties, and/or 3) last year's price to get an indication of typical prices.

AROOSTOOK

Stumpage Prices paid to Maine Forest Landowners in 2017

These stumpage prices are based on reports from 2017 and are the most recent available. HOWEVER, prices can change significantly within weeks or months due to market conditions. This report gives a profile of roundwood prices in Maine. Values are offered as a guide to help individuals assess the fair market value of their standing trees. The average price for a county should not be applied as the exact value for a particular tract. These prices primarily reflect common wood utilization standards and markets. Wood that can be marketed locally and/or includes specialty products may in some cases increase returns to landowners. The best way for private landowners to determine current stumpage values and available wood markets is to consult with a licensed forester before harvesting.

BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.51	$0.50	$4.25	73	*$2.26*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*$123*
White Birch	$118	$75	$155	19	*$184*
Yellow Birch	*				*No Price*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$23	$10	$40	55	*$26*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$44	$13	$90	24	*$30*
Softwood	$71	$68	$75	11	*$75*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$1	$19	97	*$11*
Cedar	$17	$9	$18	26	*$16*
Hemlock	$4	$3	$6	10	*$7*
Mixed Hardwood	$7	$0.46	$28	127	*$8*
Red Pine	*				*No Price*
Spruce & Fir	$7	$3	$16	31	*$13*
White Pine	*				*No Price*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$153	$92	$286	48	*$216*
Aspen/Poplar	$63	$25	$80	5	*No Price*
Beech	*				*No Price*
Cedar	$139	$84	$190	54	*$119*
Hemlock	$58	$50	$72	10	*$82*
Red Oak	$117	$33	$170	21	*No Price*
Red Pine	*				*No Price*
Red/White Maple	$134	$33	$261	42	*$104*
Spruce & Fir	$119	$56	$153	42	*$109*
Sugar Maple	$164	$73	$345	67	*$174*
White Birch	$146	$51	$330	47	*$150*
White Oak	*				*No Price*
White Pine	$159	$48	$188	16	*$165*
Yellow Birch	$145	$81	$343	59	*$200*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$12	$2	$33	113	*$11*
Spruce & Fir	$21	$3	$36	192	*$22*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*No Price*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	$900	$333	$1,246	61	*$943*
White Birch	$701	$225	$1,015	45	*$671*
White Oak	*				*No Price*
Yellow Birch	$1,103	$333	$1,338	57	*$1,205*

AROOSTOOK

* For species with less than 3 reports, refer to either a) the statewide summary page, b) adjacent counties, and/or 3) last year's price to get an indication of typical prices.

CAPITAL AREA (KENNEBEC, KNOX, LINCOLN, AND WALDO COUNTIES)

Stumpage Prices paid to Maine Forest Landowners in 2017

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.61	$0.50	$4.76	110	*$1.77*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*$123*
Red/White Maple	*				*No Price*
Sugar Maple	*				*No Price*
White Birch	$121	$40	$200	32	*$136*
Yellow Birch	*				*No Price*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$20	$9	$40	139	*$23*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$79	$15	$250	103	*$96*
Softwood	$46	$10	$100	91	*$49*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$4	$14	34	*$9*
Cedar	$10	$8	$14	4	*No Price*
Hemlock	$4	$1	$10	46	*$4*
Mixed Hardwood	$6	$2	$20	207	*$8*
Red Pine	*				*$4*
Spruce & Fir	$5	$1	$15	49	*$7*
White Pine	$3	$0.20	$8	84	*$3*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$171	$80	$345	71	*$164*
Aspen/Poplar	$106	$25	$138	10	*$86*
Beech	$119	$30	$150	4	*$110*
Cedar	*				*$67*
Hemlock	$54	$15	$100	100	*$67*
Red Oak	$291	$146	$510	114	*$263*
Red Pine	$35	$20	$110	8	*$77*
Red/White Maple	$132	$40	$260	66	*$127*
Spruce & Fir	$102	$40	$168	115	*$96*
Sugar Maple	$249	$79	$457	52	*$250*
White Birch	$140	$56	$350	74	*$166*
White Oak	$187	$80	$400	7	*$154*
White Pine	$159	$25	$365	213	*$157*
Yellow Birch	$159	$30	$350	47	*$168*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$6	$5	$18	8	*$9*
Spruce & Fir	$10	$3	$18	25	*$12*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$434	$320	$735	4	*$418*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	$700	$275	$1,015	60	*$658*
Red/White Maple	*				*$424*
Sugar Maple	$502	$200	$1,000	13	*$678*
White Birch	$607	$250	$700	13	*$635*
White Oak	*				*No Price*
Yellow Birch	$421	$350	$690	9	*$465*

CAPITAL AREA (KENNEBEC, KNOX, LINCOLN, AND WALDO COUNTIES)

* For species with less than 3 reports, refer to either a) the statewide summary page, b) adjacent counties, and/or 3) last year's price to get an indication of typical prices.

CASCO BAY (ANDROSCOGGIN, CUMBERLAND, SAGADAHOC, AND YORK COUNTIES)

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.45	$0.38	$3.50	231	*$1.63*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*No Price*
White Birch	$89	$25	$100	10	*$84*
Yellow Birch	*				*No Price*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$23	$5	$40	188	*$23*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$66	$10	$255	175	*$88*
Softwood	$47	$10	$207	157	*$48*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$4	$20	46	*$11*
Cedar	*				*No Price*
Hemlock	$4	$0.50	$11	109	*$4*
Mixed Hardwood	$7	$1	$20	274	*$8*
Red Pine	*				*No Price*
Spruce & Fir	$4	$2	$11	16	*$4*
White Pine	$3	$0.50	$8	141	*$3*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$176	$50	$350	100	*$165*
Aspen/Poplar	$84	$80	$115	4	*No Price*
Beech	*				*$65*
Cedar	*				*No Price*
Hemlock	$57	$15	$110	144	*$65*
Red Oak	$305	$73	$582	225	*$299*
Red Pine	$59	$15	$190	37	*$49*
Red/White Maple	$154	$30	$344	105	*$140*
Spruce & Fir	$119	$30	$225	112	*$137*
Sugar Maple	$231	$35	$452	75	*$258*
White Birch	$131	$30	$300	97	*$121*
White Oak	$143	$20	$300	37	*$123*
White Pine	$179	$20	$332	315	*$178*
Yellow Birch	$143	$40	$355	69	*$183*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	*				*$8*
Spruce & Fir	*				*No Price*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*$540*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	$709	$300	$1,150	136	*$659*
Red/White Maple	*				*No Price*
Sugar Maple	$637	$400	$900	11	*$733*
White Birch	$442	$270	$950	10	*$572*
White Oak	*				*No Price*
Yellow Birch	$555	$375	$930	9	*$474*

CASCO BAY (ANDROSCOGGIN, CUMBERLAND, SAGADAHOC, AND YORK COUNTIES)

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FRANKLIN

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$2.20	$0.50	$3.00	18	*$2.96*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*$118*
White Birch	$121	$58	$174	18	*$117*
Yellow Birch	*				*No Price*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$23	$12	$36	31	*$23*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$91	$9	$200	40	*$97*
Softwood	$46	$30	$94	14	*$52*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$10	$7	$18	27	*$13*
Cedar	*				*No Price*
Hemlock	$6	$3	$9	21	*$6*
Mixed Hardwood	$8	$5	$20	81	*$8*
Red Pine	*				*$8*
Spruce & Fir	$4	$2	$10	30	*$6*
White Pine	$4	$2	$9	24	*$4*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$170	$82	$350	39	*$187*
Aspen/Poplar	$120	$47	$205	11	*$134*
Beech	$113	$25	$220	4	*$87*
Cedar	$55	$50	$75	4	*$37*
Hemlock	$51	$30	$95	15	*$60*
Red Oak	$242	$75	$489	25	*$227*
Red Pine	$84	$45	$99	5	*No Price*
Red/White Maple	$140	$30	$250	40	*$189*
Spruce & Fir	$104	$25	$168	39	*$113*
Sugar Maple	$223	$50	$464	41	*$243*
White Birch	$201	$80	$300	45	*$208*
White Oak	*				*No Price*
White Pine	$141	$70	$200	42	*$139*
Yellow Birch	$198	$71	$250	41	*$205*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$14	$10	$15	4	*No Price*
Spruce & Fir	$24	$16	$32	12	*$28*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$295	$220	$550	6	*$282*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	$584	$265	$750	8	*$528*
Red/White Maple	$293	$200	$400	4	*No Price*
Sugar Maple	$689	$452	$1,029	16	*$658*
White Birch	$535	$225	$700	17	*$483*
White Oak	*				*No Price*
Yellow Birch	$586	$320	$949	17	*$857*

FRANKLIN

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HANCOCK

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$0.99	$0.50	$1.00	8	*$1.42*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*No Price*
White Birch	$157	$86	$175	12	*$157*
Yellow Birch	*				*$97*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$21	$5	$45	35	*$26*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$63	$40	$115	11	*$84*
Softwood	$28	$10	$75	18	*$55*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$3	$10	15	*$11*
Cedar	$6	$4	$18	4	*$4*
Hemlock	$1	$0.50	$2	4	*$4*
Mixed Hardwood	$8	$2	$11	55	*$10*
Red Pine	*				*No Price*
Spruce & Fir	$4	$2	$18	33	*$4*
White Pine	$3	$2	$8	6	*$4*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$147	$60	$160	8	*$162*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Cedar	$90	$81	$150	5	*$112*
Hemlock	$55	$46	$120	8	*$80*
Red Oak	$240	$100	$300	12	*$184*
Red Pine	*				*No Price*
Red/White Maple	$142	$60	$185	18	*$124*
Spruce & Fir	$97	$40	$150	23	*$96*
Sugar Maple	$182	$150	$222	9	*$231*
White Birch	$110	$80	$250	10	*$154*
White Oak	*				*No Price*
White Pine	$169	$40	$250	43	*$172*
Yellow Birch	$169	$120	$200	13	*$193*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$13	$4	$21	9	*$11*
Spruce & Fir	$17	$6	$27	49	*$21*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*No Price*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	$464	$325	$600	7	*$396*
Red/White Maple	*				*No Price*
Sugar Maple	*				*$806*
White Birch	$628	$595	$760	4	*No Price*
White Oak	*				*No Price*
Yellow Birch	$772	$600	$836	6	*No Price*

HANCOCK

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OXFORD

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.35	$0.50	$4.00	72	*$2.18*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*$183*
White Birch	$61	$25	$155	13	*$79*
Yellow Birch	$194	$194	$194	9	*$158*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$23	$8	$40	50	*$22*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$122	$15	$250	104	*$107*
Softwood	$48	$25	$100	60	*$58*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$1	$25	35	*$12*
Cedar	*				*No Price*
Hemlock	$5	$1	$13	70	*$5*
Mixed Hardwood	$7	$3	$17	128	*$9*
Red Pine	*				*No Price*
Spruce & Fir	$5	$2	$12	28	*$9*
White Pine	$4	$1	$8	63	*$4*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$185	$85	$450	67	*$173*
Aspen/Poplar	$163	$40	$205	17	*$155*
Beech	$40	$20	$150	9	*$41*
Cedar	*				*No Price*
Hemlock	$62	$25	$150	56	*$67*
Red Oak	$283	$75	$575	96	*$308*
Red Pine	$74	$25	$96	22	*$74*
Red/White Maple	$148	$40	$310	74	*$180*
Spruce & Fir	$99	$55	$285	72	*$88*
Sugar Maple	$196	$100	$502	60	*$265*
White Birch	$142	$50	$340	78	*$181*
White Oak	$147	$50	$200	13	*$106*
White Pine	$193	$25	$283	126	*$179*
Yellow Birch	$185	$80	$400	60	*$220*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	*				*$4*
Spruce & Fir	*				*No Price*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*No Price*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	$711	$200	$1,099	61	*$687*
Red/White Maple	*				*No Price*
Sugar Maple	$771	$400	$1,100	24	*$903*
White Birch	$625	$360	$720	28	*$771*
White Oak	*				*No Price*
Yellow Birch	$881	$275	$1,124	29	*$1,035*

OXFORD

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PENOBSCOT

Stumpage Prices paid to Maine Forest Landowners in 2017

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.94	$0.50	$3.18	69	*$1.53*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*No Price*
White Birch	$136	$100	$210	33	*$175*
Yellow Birch	*				*No Price*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$21	$8	$39	47	*$19*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$98	$15	$225	38	*$57*
Softwood	$64	$10	$75	39	*$43*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$6	$16	58	*$12*
Cedar	$16	$4	$20	25	*$16*
Hemlock	$3	$0.54	$6	44	*$4*
Mixed Hardwood	$9	$2	$22	156	*$11*
Red Pine	$9	$3	$14	4	*No Price*
Spruce & Fir	$5	$0.50	$16	59	*$7*
White Pine	$3	$0.50	$4	26	*$3*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$177	$53	$320	70	*$188*
Aspen/Poplar	$122	$75	$153	8	*$94*
Beech	*				*$47*
Cedar	$111	$20	$212	30	*$101*
Hemlock	$74	$35	$152	32	*$100*
Red Oak	$194	$86	$335	18	*$141*
Red Pine	$32	$15	$85	9	*No Price*
Red/White Maple	$139	$34	$301	51	*$141*
Spruce & Fir	$106	$37	$150	37	*$96*
Sugar Maple	$211	$56	$362	61	*$273*
White Birch	$186	$70	$276	21	*$196*
White Oak	*				*No Price*
White Pine	$179	$57	$260	74	*$172*
Yellow Birch	$199	$70	$375	54	*$211*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$14	$2	$29	50	*$10*
Spruce & Fir	$23	$4	$34	97	*$23*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*No Price*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	$347	$260	$587	6	*$305*
Red/White Maple	*				*No Price*
Sugar Maple	$762	$400	$1,149	33	*$954*
White Birch	$590	$400	$892	25	*$623*
White Oak	*				*No Price*
Yellow Birch	$828	$350	$972	18	*$793*

PENOBSCOT

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PISCATAQUIS

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$2.16	$0.40	$4.25	25	*$1.23*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*No Price*
White Birch	$148	$68	$250	15	*$189*
Yellow Birch	$115	$111	$145	4	*$125*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$19	$10	$31	21	*$23*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$54	$11	$146	25	*$70*
Softwood	$34	$11	$73	16	*$20*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$10	$4	$18	20	*$11*
Cedar	*				*$15*
Hemlock	$3	$2	$7	9	*$5*
Mixed Hardwood	$7	$1	$18	70	*$6*
Red Pine	*				*No Price*
Spruce & Fir	$6	$1	$12	29	*$10*
White Pine	$3	$1	$4	9	*$2*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$159	$65	$255	48	*$176*
Aspen/Poplar	$87	$70	$100	5	*$135*
Beech	$136	$34	$148	6	*$24*
Cedar	$140	$50	$183	41	*$119*
Hemlock	$52	$40	$121	6	*$92*
Red Oak	$171	$100	$486	28	*$234*
Red Pine	$75	$50	$108	4	*$67*
Red/White Maple	$94	$30	$239	41	*$108*
Spruce & Fir	$121	$50	$173	38	*$105*
Sugar Maple	$171	$73	$468	46	*$176*
White Birch	$114	$58	$350	45	*$162*
White Oak	*				*No Price*
White Pine	$134	$41	$234	48	*$157*
Yellow Birch	$187	$57	$344	38	*$199*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$19	$8	$34	4	*$22*
Spruce & Fir	$25	$15	$36	29	*$23*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*No Price*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*$806*
Sugar Maple	$805	$437	$1,313	36	*$915*
White Birch	$619	$388	$787	31	*$678*
White Oak	*				*No Price*
Yellow Birch	$733	$292	$1,011	30	*$795*

PISCATAQUIS

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SOMERSET

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BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.64	$0.50	$4.25	39	*$2.61*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*No Price*
White Birch	$151	$46	$180	23	*$180*
Yellow Birch	*				*No Price*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$19	$10	$27	19	*$24*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$73	$16	$225	47	*$81*
Softwood	$41	$15	$95	34	*$57*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$10	$6	$15	35	*$11*
Cedar	$2	$0.86	$7	6	*$13*
Hemlock	$4	$2	$10	28	*$5*
Mixed Hardwood	$8	$0.70	$15	120	*$8*
Red Pine	*				*No Price*
Spruce & Fir	$5	$1	$10	43	*$8*
White Pine	$3	$1	$6	28	*$4*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$165	$45	$249	53	*$178*
Aspen/Poplar	$98	$70	$100	4	*$91*
Beech	$117	$50	$200	5	*$184*
Cedar	$111	$75	$140	9	*$105*
Hemlock	$53	$25	$109	21	*$61*
Red Oak	$275	$128	$365	30	*$180*
Red Pine	$71	$50	$90	4	*$49*
Red/White Maple	$134	$56	$300	56	*$107*
Spruce & Fir	$164	$28	$182	65	*$145*
Sugar Maple	$233	$75	$475	59	*$243*
White Birch	$203	$35	$325	58	*$170*
White Oak	*				*No Price*
White Pine	$136	$27	$245	87	*$134*
Yellow Birch	$141	$63	$253	55	*$149*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$28	$11	$36	5	*$30*
Spruce & Fir	$24	$8	$30	11	*$23*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*No Price*
Aspen/Poplar	$106	$100	$162	4	*No Price*
Beech	*				*No Price*
Red Oak	$631	$450	$850	13	*$777*
Red/White Maple	*				*No Price*
Sugar Maple	$731	$400	$1,200	23	*$789*
White Birch	$551	$350	$900	20	*$599*
White Oak	*				*No Price*
Yellow Birch	$795	$275	$1,100	24	*$851*

SOMERSET

* For species with less than 3 reports, refer to either a) the statewide summary page, b) adjacent counties, and/or 3) last year's price to get an indication of typical prices.

WASHINGTON

Stumpage Prices paid to Maine Forest Landowners in 2017

These stumpage prices are based on reports from 2017 and are the most recent available. HOWEVER, prices can change significantly within weeks or months due to market conditions. This report gives a profile of roundwood prices in Maine. Values are offered as a guide to help individuals assess the fair market value of their standing trees. The average price for a county should not be applied as the exact value for a particular tract. These prices primarily reflect common wood utilization standards and markets. Wood that can be marketed locally and/or includes specialty products may in some cases increase returns to landowners. The best way for private landowners to determine current stumpage values and available wood markets is to consult with a licensed forester before harvesting.

BIOMASS (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$1.09	$1.00	$2.00	13	*$2.20*

BOLTWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	*				*No Price*
Cedar	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	*				*No Price*
White Birch	$121	$72	$125	4	*$108*
Yellow Birch	*				*No Price*

FIREWOOD (per cord)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
All Species	$26	$13	$39	23	*$28*

PALLETWOOD (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Hardwood	$68	$40	$77	5	*$63*
Softwood	$28	$20	$75	6	*$36*

PULPWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Aspen/Poplar	$9	$5	$12	10	*$9*
Cedar	*				*$13*
Hemlock	$2	$1	$3	5	*$6*
Mixed Hardwood	$10	$4	$15	31	*$10*
Red Pine	*				*No Price*
Spruce & Fir	$6	$2	$13	25	*$9*
White Pine	*				*$3*

SAWLOGS (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	$174	$97	$175	6	*$177*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Cedar	$81	$50	$113	4	*$86*
Hemlock	$48	$30	$83	6	*$53*
Red Oak	*				*$239*
Red Pine	*				*No Price*
Red/White Maple	$130	$87	$194	10	*$152*
Spruce & Fir	$103	$70	$150	7	*$82*
Sugar Maple	$202	$45	$405	12	*$270*
White Birch	$109	$100	$135	4	*$207*
White Oak	*				*No Price*
White Pine	$152	$50	$188	12	*$148*
Yellow Birch	$195	$80	$333	10	*$172*

STUDWOOD (per ton)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Other Species	$9	$6	$11	4	*$6*
Spruce & Fir	$16	$8	$24	35	*$17*

VENEER (per MBF)	2017 AVERAGE	MIN	MAX	# OF RPTS	*2016 AVG:*
Ash	*				*No Price*
Aspen/Poplar	*				*No Price*
Beech	*				*No Price*
Red Oak	*				*No Price*
Red/White Maple	*				*No Price*
Sugar Maple	$406	$372	$736	7	*No Price*
White Birch	*				*No Price*
White Oak	*				*No Price*
Yellow Birch	$649	$411	$976	4	*$814*

WASHINGTON

* For species with less than 3 reports, refer to either a) the statewide summary page, b) adjacent counties, and/or 3) last year's price to get an indication of typical prices.

Conversion Table
Cord/Weight Equivalents
for various Maine Commercial Tree Species

These conversions are used by the Maine Forest Service.
Users of this report may wish to confirm the conversion rate(s) used by individual mills and/or contractors who purchase wood.

These conversions factors are handy for making estimates and for forest inventory purposes, but are advisory only. The weight of a particular volume of wood varies greatly by species, time of year and other factors.

It is illegal in Maine to convert from one system of measurement to another for the basis of payment (e.g. convert a mill payment for pulpwood in dollars per ton to a landowner payment in dollars per cord).

Species	Cords	Tons	Pounds
Spruce Fir	1	2.1	4,200
White Pine	1	2.15	4,300
Red Pine	1	2.15	4,300
Hemlock	1	2.4	4,800
Cedar	1	1.7	3,400
Tamarack (Larch)	1	2.4	4,800
Beech	1	2.25	4,500
White Birch	1	2.25	4,500
Yellow Birch	1	2.7	5,400
Sugar Maple	1	2.7	5,400
Red Maple	1	2.25	4,500
White Oak	1	2.7	5,400
Red Oak	1	2.7	5,400
Ash	1	2.25	4,500
Aspen/Poplar	1	2.15	4,300
Softwood	1	2.3	4,600
Hardwood	1	2.7	5,400
Mixed Wood	1	2.3	4,600

For purposes of comparing volumes, a rough conversion of 1 MBF = 2 cords is commonly used.

Maine Forest Service District Foresters

Be Woods Wise!
Practical advice for your land and trees from the Maine Forest Service.

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Appendix VI: MFS 2017 Wood Processor Report

2017 Wood Processor Report

Including Import and Export Information

Compiled from 2017 Wood Processor Reports
pursuant to 12 M.R.S. § 8884
Published: June 18, 2018

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We help you make informed decisions about Maine's Forests

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What is the purpose of the Wood Processor Report?

Each year, the Maine Forest Service collects information from Maine primary wood processors regarding the volume of wood processed in Maine. Information is also collected for volumes imported into Maine or exported from Maine.

This report summarizes, for 2017, the volume of wood harvested in Maine, processed by Maine mills, and imported into or exported from Maine.

Wood flow data is summarized for sawlogs, pulpwood, biomass chips, other miscellaneous products, and imports and exports.

How was this information collected?

In 2017, the Maine Forest Service received wood processor reports from 126 primary processing mills (sawmills, pulp and paper mills), 44 portable sawmills, 86 firewood dealers, 121 loggers and brokers who may have exported wood, 27 concentration yards, and 8 mills that burn some form of wood for energy. Volume information contained in these individual reports is confidential and by law shall not be made public, except that summary reports may be published using aggregated data which does not reveal the activities of an individual person or firm (12 M.R.S. §8884, sub-§3, "Forest Landowner and Wood Processor Reporting Requirements").

Interpreting Harvest, Export, Import, and Processed by the Maine Forest Products Industry

Maine wood processed

wood that is harvested in Maine and used by a Maine primary processing facility.

Exported from Maine without processing

wood that is harvested in Maine and exported out of state without processing by a Maine mill.

Imported from out of state

wood that is imported from out of state (not harvested in Maine) and processed by a Maine mill.

Total processed by Maine Forest Products Industry

total volume of wood processed in Maine, regardless of origin.

Definitions and Notes

1. **Biomass Chips:**
   produced in the woods by chipping any or all of the following: tree limbs and tops, cull trees, and smaller trees not suitable for higher value products. Usually used as energy fuel, biomass chips may also be used for sludge composting, playground padding, and mulch.
2. **Bole/Stem Pulp Chips:**
   produced in the woods by chipping the lower portion of the tree. These chips are not free of bark, but are suitable for use in pulp mills.
3. **Cords (cds):**
   a stack of fuel wood, pulpwood, or other material that measures 4 x 4 x 8 feet, or 128 cubic feet.
4. **Construction and Demolition Waste (C and D Waste):**
   ground up wooden debris left over from construction and demolition that is burned by wood to energy facilities.
5. **Firewood:** roundwood that is burned for home heating.
6. **Hog Fuel:**
   any woody residue produced from mills, such as sawdust, bark or shavings, and used as energy fuel.
7. **Pellets:**
   wood fuel generally made from dried wood fiber compressed into uniform diameter for burning.
8. **Pulpwood:**
   roundwood that is used for the production of wood pulp. Generally sold as tree length, 16', 8' or 4' len
9. **Sawlogs:**
   a log that meets minimum standards of diameter, length, and defect, intended for sawing into boards or lumber. Includes sawlogs, studwood, pallet logs, boltwood, and veneer logs.
10. **Sawmill residues:**
    clean, pulp-quality chips made from debarked slabs and edgings at sawmills. Used by pulp and paper mills to produce wood pulp.
11. **Thousand Board Feet (MBF):**
    One thousand board feet. One board foot is the amount of wood contained in an unfinished board 1" thick, 12" long, and 12" wide.

Report Highlights

- Maine's forest products industry consumed 12.8 million green ton equivalents in 2017, down from 13.1 million green ton equivalents in 2016. Seventy eight percent of the processing total (10.0 million green ton equivalents) was harvested in Maine, while 22% (2.8 million green ton equivalents) was imported.
- Maine landowners harvested 12.3 million green ton equivalents of wood in 2017, down from 2016 (12.8 million green ton equivalents). Nineteen percent (2.3 million green ton equivalents) of the 2017 harvest was exported, same as 2016 (2.3 million green ton equivalents).
- Maine's pulp and paper producers processed 6.5 million green tons of pulpwood, down .7 million tons (10%) from 2016 consumption. Seventy-five percent of the pulpwood originated from Maine's forests; 25% was imported.
- Biomass harvesting volume was 2.4 million tons in 2017, up from 2016 (2.2 million tons). Biomass energy facilities consumed 2.3 million tons in 2017, up 11% from 2016 (2.0 million tons). Eighty-seven percent originated from Maine's forests; 13% was imported.
- Maine's sawlog processing in 2017 was 0.86 billion board feet, same as 2016 (0.86 billion board feet).
- Maine's forest products industry imported 2.8 million green tons during 2017, compared to 2.6 million tons in 2016. 2.3 million green tons were exported in 2017, same as 2016 (2.3 million tons).

SAWLOGS

2017 Wood flow in Maine as reported to the Maine Forest Service (in MBF)

County	Spruce and Fir	White and Red Pine	Hemlock	Cedar	Other Softwood	Total Softwood	Beech	White Birch	Yellow Birch	Sugar Maple	Red Maple	Oak	Ash	Aspen	Other Hardwood	Total Hardwood	Total Sawlogs
ANDROSCOGGIN	2,202	8,197	442	1	0	10,842	100	120	389	475	357	759	425	186	0	2,811	13,653
AROOSTOOK	133,340	1,572	2	12,834	112	147,860	1,014	4,100	3,899	11,757	7,830	15	801	55,121	371	84,908	232,768
CUMBERLAND	254	16,055	1,300	0	0	17,609	161	235	213	109	402	860	446	255	0	2,681	20,290
FRANKLIN	6,601	7,539	442	416	13	15,011	322	1,613	480	1,482	637	1,069	744	312	49	6,708	21,719
HANCOCK	10,353	10,424	489	93	0	21,359	2	483	254	702	264	332	382	9	832	3,260	24,619
KENNEBEC	912	14,104	2,484	71	17	17,588	341	993	1,440	852	625	1,394	490	462	2	6,599	24,187
KNOX	416	2,819	234	0	0	3,469	0	76	1	1	3	62	8	1	0	152	3,621
LINCOLN	536	5,964	1,108	14	0	7,622	7	96	29	54	45	110	52	2	0	395	8,017
OXFORD	27,185	29,556	2,180	0	0	58,921	753	1,391	1,143	2,086	699	2,647	836	120	23	9,698	68,619
PENOBSCOT	36,316	14,375	10,370	1,874	0	62,935	60	1,960	1,471	2,860	576	628	866	5,642	631	14,694	77,629
PISCATAQUIS	23,471	4,537	244	149	22	28,423	702	1,777	2,588	7,649	1,460	855	1,414	11	468	16,924	45,347
SAGADAHOC	22	2,509	103	0	0	2,634	15	16	24	13	14	81	2	0	0	165	2,799
SOMERSET	28,674	13,275	688	355	58	43,050	1,222	2,981	2,190	1,945	1,371	2,453	1,082	289	107	13,640	56,690
WALDO	2,278	8,288	439	253	3	11,261	47	418	26	106	530	1,609	166	87	0	2,989	14,250
WASHINGTON	20,664	3,538	103	42	4	24,351	52	141	210	477	178	84	240	1,868	680	3,930	28,281
YORK	149	18,878	1,039	6	0	20,072	145	79	39	30	259	1,627	107	95	0	2,381	22,453
Maine wood processed:	293,373	161,630	21,667	16,108	229	493,007	4,943	16,479	14,396	30,598	15,250	14,585	8,061	64,460	3,163	171,935	664,942
Exported from Maine without processing:	169,385	23,344	3,021	19,028	70	214,848	467	2,061	11,266	11,680	4,326	13,923	7,058	100	23,624	74,505	289,353
Total harvested from Maine forests:	462,758	184,974	24,688	35,136	299	707,855	5,410	18,540	25,662	42,278	19,576	28,508	15,119	64,560	26,787	246,440	954,295
Imported from out of state:	49,900	77,203	528	624	0	128,255	231	7,069	952	2,417	2,481	215	395	46,420	8,475	68,655	196,910
Total processed by Maine Forest Products Industry:	343,273	238,833	22,195	16,732	229	621,262	5,174	23,548	15,348	33,015	17,731	14,800	8,456	110,880	11,638	240,590	861,852

Notes:

1. Sawlogs include logs, veneer, boltwood, studwood, palletwood, etc. Green tons converted to MBF @ 5 green tons = 1 MBF.

2. Other Softwood includes larch, pitch pine, and others.

3. Sawlog volumes reported here are log volumes as scaled when delivered to the mill.
Mill overrun (the ability to produce more lumber than scaled due to technoloigcal advances) generally results in output figures significantly higher than reported here. (Spruce Fir sawlog mill overrun volume calculated at 405,761 MBF)

PULPWOOD

2017 Wood flow in Maine as reported to the Maine Forest Service (in Green Tons), including both solid wood and bole/stem pulp chips (Totals do not add up due to rounding)

County	Spruce and Fir	White and Red Pine	Hemlock	Cedar	Other Softwood	Total Softwood	Aspen	Other Hardwood	Total Hardwood	Mixed Wood	Total Pulpwood	SAWMILL RESIDUE *Green Tons*
ANDROSCOGGIN	137	3,648	5,671	0	14,516	23,972	2,441	63,562	66,003	0	89,975	17,514
AROOSTOOK	*	*	*	0	2,366	7,289	966	713,530	714,496	0	721,785	22,000
CUMBERLAND	890	30,020	12,919	0	15,284	59,113	2,313	41,014	43,327	0	102,440	10,791
FRANKLIN	58,665	5,722	13,801	0	12,398	90,586	17,475	375,140	392,615	0	483,201	27,362
HANCOCK	15,384	960	4,223	0	24,540	45,107	8,729	137,443	146,172	0	191,279	12,451
KENNEBEC	2,666	7,721	5,840	0	33,128	49,355	5,903	100,418	106,321	0	155,676	6,211
KNOX	1,608	438	969	0	5,494	8,509	658	24,468	25,126	0	33,635	0
LINCOLN	445	8,445	4,629	0	15,394	28,913	741	37,369	38,110	0	67,023	0
OXFORD	24,618	86,174	44,752	0	27,722	183,266	16,518	436,956	453,474	0	636,740	28,993
PENOBSCOT	32,300	1,236	22,283	0	18,732	74,551	24,229	406,858	431,087	0	505,638	13,776
PISCATAQUIS	62,105	1,624	11,615	0	12,728	88,072	13,265	488,969	502,234	0	590,306	38,381
SAGADAHOC	234	842	1,785	0	9,290	12,151	1,434	16,697	18,131	0	30,282	0
SOMERSET	145,669	20,740	6,977	0	21,127	194,513	32,078	530,862	562,940	0	757,453	31,084
WALDO	6,743	24,291	3,740	0	8,482	43,256	5,089	89,918	95,007	0	138,263	49
WASHINGTON	8,662	*	1,521	0	6,180	18,204	5,212	227,811	233,023	0	251,227	0
YORK	*	13,075	16,750	0	12,345	42,877	2,871	71,219	74,090	0	116,967	11,247
Maine wood processed:	365,727	206,806	157,475	0	239,726	969,734	139,922	3,762,234	3,902,156	0	4,871,890	219,859
Exported from Maine without processing:	231,293	220	793	0	49,840	282,146	28,628	302,637	331,265	0	613,411	17,825
Total harvested from Maine forests:	597,020	207,026	158,268	0	289,566	1,251,880	168,550	4,064,871	4,233,421	0	5,485,301	237,684
Imported from out of state:	201,835	46,291	33,032	0	22,650	303,808	106,549	1,200,922	1,307,471	0	1,611,279	133,690
Total processed by Maine Forest Products Industry:	567,562	253,097	190,507	0	262,376	1,273,542	246,471	4,963,156	5,209,627	0	6,483,169	353,549

Sawmill residues are clean, pulp-quality wood chips made from slabs and edgings at sawmills. The volume is reported here as an additional input to the pulp and paper mills and pellet mills. Sawmill residues are a by-product of the sawing process, and are not included as additional harvest volumes from Maine's forests.

Pulpwood Notes:

**** Due to a limited number of reports, data could not be displayed but is included in the totals.***

1. Other Softwood is comprised of bole chips of which specific species information was not collected.
2. Aspen volumes are based upon pure loads.
3. Other Hardwood is comprised of all hardwood species except aspen sold in pure loads.

2017 Wood Flow in Maine as reported to the Maine Forest Service (in Green Tons)

County	BIOMASS CHIPS	Further utilization of wood already tallied. HOG FUEL	C AND D WASTE	FIREWOOD / PELLET* CORDS
Androscoggin	69,807	18,411	8,850	4,285
Aroostook	457,746	219,122	0	5,935
Cumberland	153,242	18,401	0	2,048
Franklin	237,410	47,864	2,654	6,145
Hancock	32,519	15,170	0	263
Kennebec	112,001	15,698	0	4,266
Knox	14,378	1,611	0	288
Lincoln	34,712	4,080	0	685
Oxford	152,420	193,510	0	5,390
Penobscot	215,070	8,225	0	12,115
Piscataquis	39,714	52,670	0	13,677
SAGADAHOC	11,242	1,784	0	477
Somerset	127,665	33,687	418	33,361
Statewide*	0	0	0	4,957
Waldo	64,488	18,128	0	2,552
Washington	74,386	4,611	0	678
York	160,646	8,343	0	2,973
Maine wood processed:	1,957,446	661,315	11,922	100,095
Exported from Maine without processing:	393,022	349,097	0	1,171
Total harvested from Maine Forests:	2,350,468	1,010,412	11,922	101,266
Imported from out of state:	299,112	191,869	38,224	5,136
Total processed by Maine Forest Products Industry:	2,256,558	853,184	50,146	105,231

*Volumes reported with no indication of originating county were identified as Statewide volume.

Wood Imports and Exports

Import Origins	Export Destinations
States:	**States:**
Connecticut	Indiana
Massachusetts	Massachusetts
New Hampshire	Michigan
New York	New Hampshire
Rhode Island	New York
Vermont	Vermont
Provinces:	**Provinces:**
New Brunswick	New Brunswick
Nova Scotia	Quebec
Quebec	**Countries:**
Countries:	China
Estonia	Thailand

***** This is the tenth Wood Processor Report to separately report firewood as a new product. Report forms were sent to known firewood dealers. In the past some firewood was uniquely identified and reported to MFS as an export, and MFS grouped these minor volumes into the pulpwood product. This by no means a complete accounting of the volume of processed firewood merchandized, sold, or distributed within Maine, or as an export or import. The only previous estimation of annual firewood consumption is a survey conducted by the State Planning Office in the early 1990's. That survey estimated an annual processing, sale, distribution and consumption of 400,000 cords. MFS will continue to improve its survey methods in order to obtain a consistent and reliable estimate of annual firewood processing.

In addition, this is the tenth year we have received reports from Maine's pellet mills. We have included reported volumes for pellet production under this section also.

SUMMARY **2017 Wood flow in Maine as reported to the Maine Forest Service**

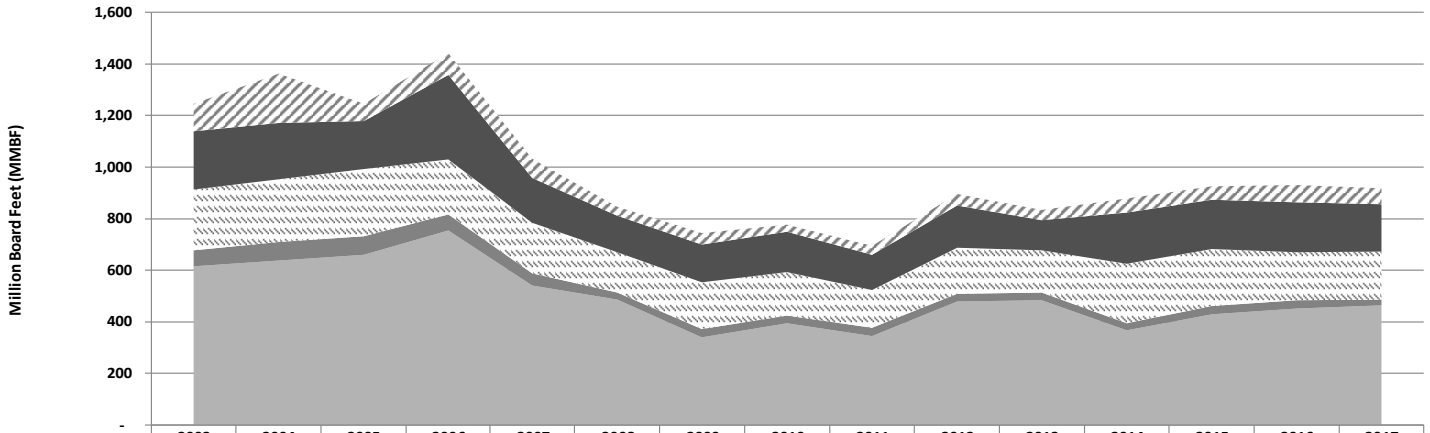
Product	Harvest, Export, Import, Instate Processing	Total Volume in 2017	Total Volume in Green Tons
Sawlogs (in MBF) 1 MBF = 1,000 board feet	a. Maine wood processed	664,942	2,904,281
	b. Exported from Maine without processing	289,353	1,281,010
	c. Total harvested from Maine forests (a+b=c)	954,295	4,185,292
Note on conversions: *see conversion table at the end of report*	d. Imported from out of state	196,910	856,726
	f. Total processed by Maine Forest Products Industry (a+d=e)	861,852	3,761,007
Pulpwood (in green tons)	a. Maine wood processed	4,871,890	4,871,890
	b. Exported from Maine without processing	613,411	613,411
	c. Total harvested from Maine forests (a+b=c)	5,485,301	5,485,301
	d. Imported from out of state	1,611,279	1,611,279
	f. Total processed by Maine Forest Products Industry (a+d=e)	6,483,169	6,483,169
Biomass Chips (in green tons)	a. Maine wood processed	1,957,446	1,957,446
	b. Exported from Maine without processing	393,022	393,022
	c. Total harvested from Maine forests (a+b=c)	2,350,468	2,350,468
	d. Imported from out of state	299,112	299,112
	f. Total processed by Maine Forest Products Industry (a+d=e)	2,256,558	2,256,558
Firewood / Pellets (in cords)	a. Maine wood processed	100,095	250,238
	b. Exported from Maine without processing	1,171	2,928
	c. Total harvested from Maine forests (a+b=c)	101,266	253,165
Note on conversion: *1 cord = 2.5 green tons*	d. Imported from out of state	5,136	12,840
	f. Total processed by Maine Forest Products Industry (a+d=e)	105,231	263,078
Totals (in green tons)	a. Maine wood processed		9,983,855
	b. Exported from Maine without processing		2,290,371
	c. Total harvested from Maine forests (a+b=c)		12,274,226
	d. Imported from out of state		2,779,957
	f. Total processed by Maine Forest Products Industry (a+d=e)		12,763,811

Wood Harvesting Trends (2003-2017)

The Maine Forest Service has been collecting data on volume of wood harvested since the late 1940's. The following three charts illustrate wood harvesting trends over the past 15 years.

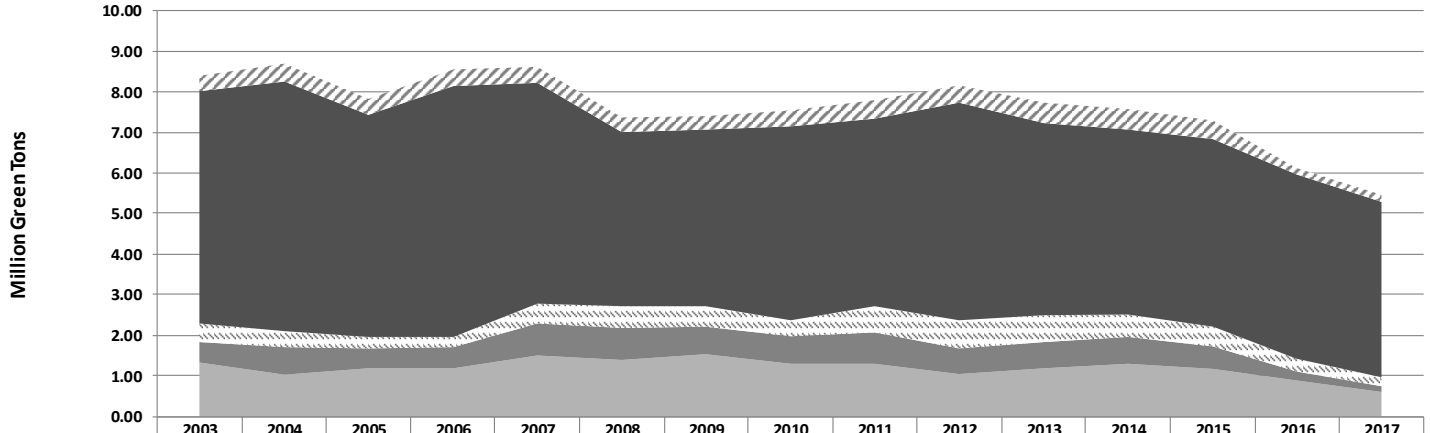
The two graphs to the right show the harvest volumes for selected species for sawlogs and pulpwood. These volumes include exported volumes.

Sawlog harvest levels of selected species in Maine (2003 - 2017)



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Aspen	106	193	65	81	76	35	42	29	31	46	40	54	53	69	65
Other Hardwood	227	219	190	329	174	141	147	151	139	164	115	197	189	194	182
White/Red Pine	237	246	262	214	197	155	184	170	146	179	165	231	224	187	185
Hemlock	59	68	70	64	45	26	30	31	31	28	31	28	32	30	25
Spruce/Fir	616	638	658	751	541	486	340	394	346	478	482	367	427	452	463

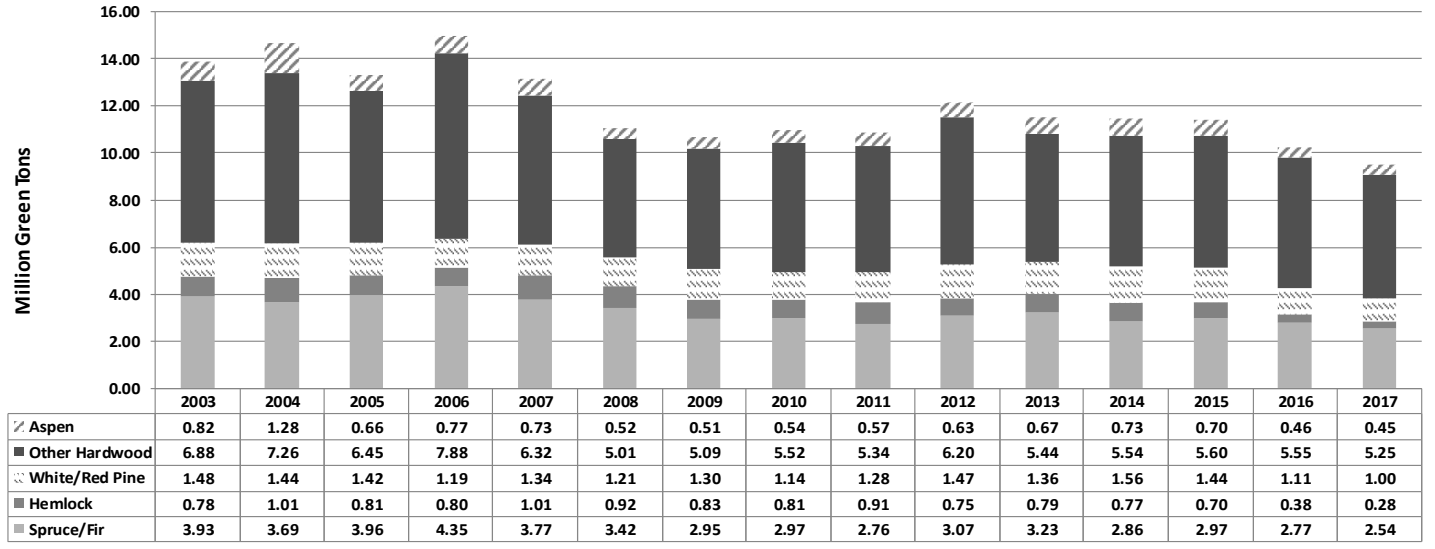
Pulpwood harvest levels of selected species in Maine (2003 - 2017)



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Aspen	0.36	0.45	0.39	0.42	0.41	0.37	0.33	0.41	0.44	0.43	0.50	0.50	0.47	0.17	0.17
Other Hardwood	5.72	6.15	5.47	6.18	5.43	4.29	4.34	4.75	4.63	5.36	4.74	4.54	4.62	4.55	4.32
White/Red Pine	0.45	0.39	0.29	0.27	0.49	0.54	0.51	0.41	0.65	0.70	0.65	0.57	0.48	0.30	0.21
Hemlock	0.50	0.69	0.47	0.49	0.80	0.79	0.69	0.66	0.76	0.61	0.64	0.64	0.55	0.23	0.16
Spruce/Fir	1.34	1.01	1.20	1.19	1.49	1.38	1.52	1.32	1.31	1.06	1.20	1.32	1.18	0.87	0.60

Wood Harvesting Trends (2003-2017)

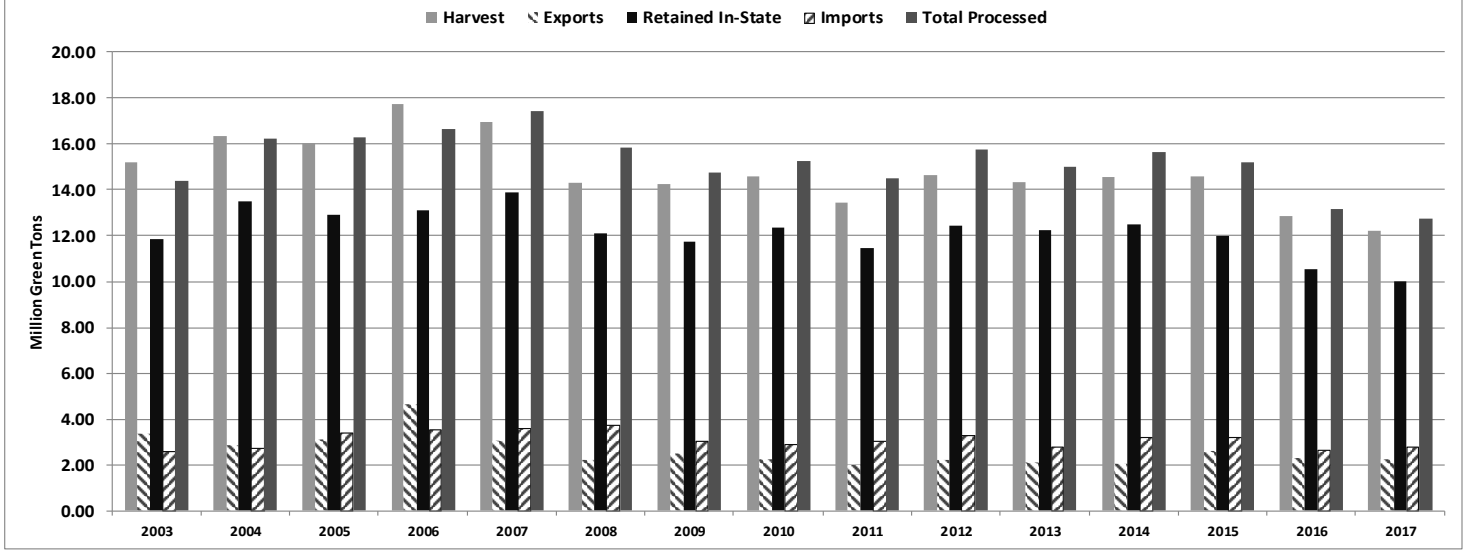
The graph to the right shows the volumes for commercially important species.



	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Aspen	0.82	1.28	0.66	0.77	0.73	0.52	0.51	0.54	0.57	0.63	0.67	0.73	0.70	0.46	0.45
Other Hardwood	6.88	7.26	6.45	7.88	6.32	5.01	5.09	5.52	5.34	6.20	5.44	5.54	5.60	5.55	5.25
White/Red Pine	1.48	1.44	1.42	1.19	1.34	1.21	1.30	1.14	1.28	1.47	1.36	1.56	1.44	1.11	1.00
Hemlock	0.78	1.01	0.81	0.80	1.01	0.92	0.83	0.81	0.91	0.75	0.79	0.77	0.70	0.38	0.28
Spruce/Fir	3.93	3.69	3.96	4.35	3.77	3.42	2.95	2.97	2.76	3.07	3.23	2.86	2.97	2.77	2.54

Statewide Wood Flows (2003-2017)

The graph to the right shows the volumes of forest products being exported from Maine, imported into Maine, and processed within



Conversion Table
MBF/Weight Equivalents
for various Maine Commercial Tree Species

These conversions are used by the Maine Forest Service.
Users of this report may wish to confirm the conversion rate(s) used by individual mills and/or contractors who purchase wood.

Species	MBF	Tons
Spruce Fir	1	4.2
White Pine	1	4.3
Red Pine	1	4.3
Hemlock	1	4.8
Cedar	1	3.4
Tamarack (Larch)	1	4.8
Beech	1	4.5
White Birch	1	4.5
Yellow Birch	1	5.4
Sugar Maple	1	5.4
Red Maple	1	4.5
White Oak	1	5.4
Red Oak	1	5.4
Ash	1	4.5
Aspen/Poplar	1	4.3
Softwood	1	4.6
Hardwood	1	5.4
Mixed Wood	1	4.6

For purposes of comparing volumes, a rough conversion of 1 MBF = 2 cords is commonly used.

These conversions factors are handy for making estimates and for forest inventory purposes, but are advisory only. The weight of a particular volume of wood varies greatly by species, time of year and other factors.

It is illegal in Maine to convert from one system of measurement to another for the basis of payment (e.g. convert a mill payment for pulpwood in dollars per ton to a landowner payment in dollars per cord).

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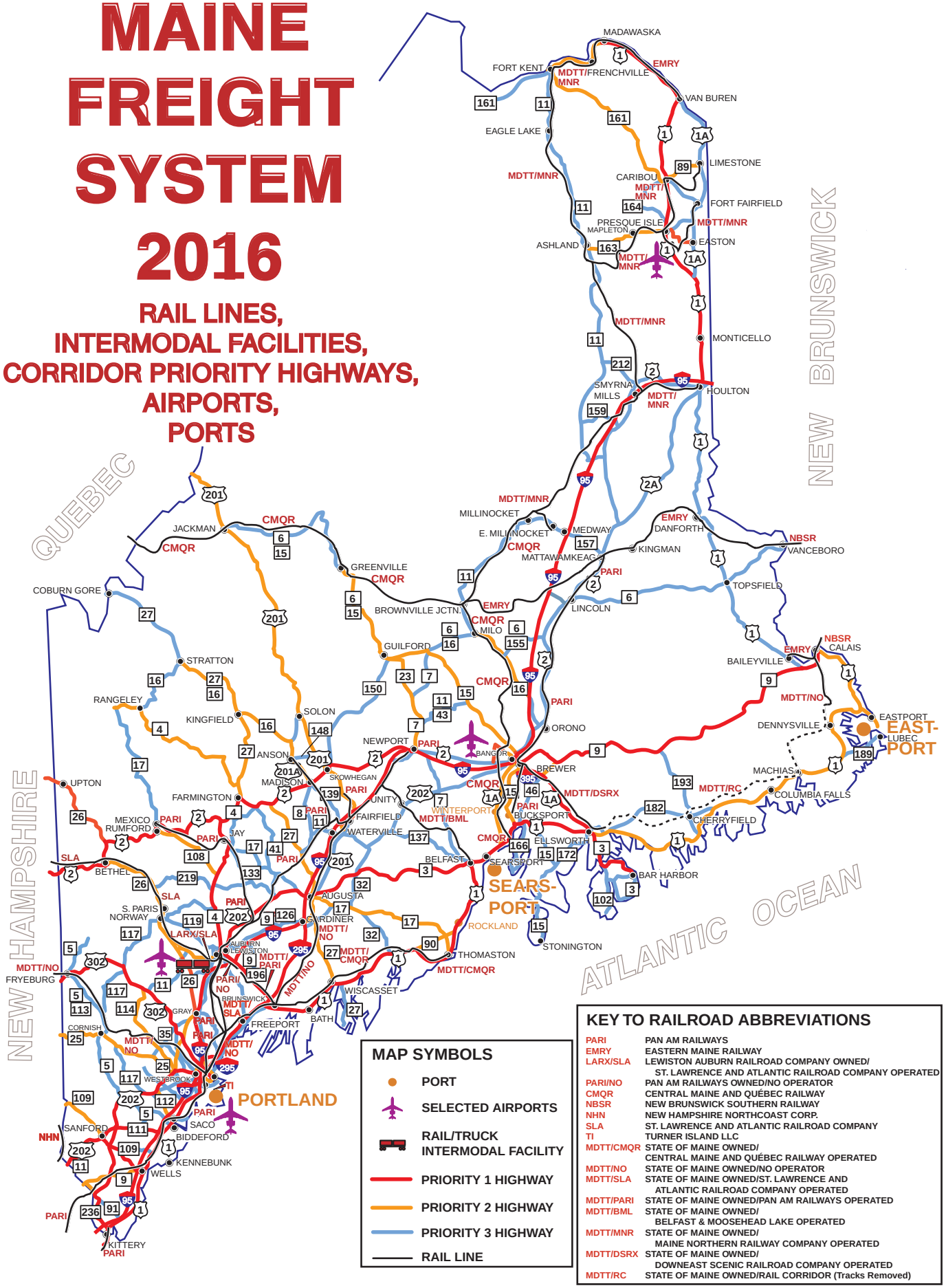
Appendix VII: MDOT Infrastructure Maps

MAINE FREIGHT SYSTEM 2016

RAIL LINES, INTERMODAL FACILITIES, CORRIDOR PRIORITY HIGHWAYS, AIRPORTS, PORTS



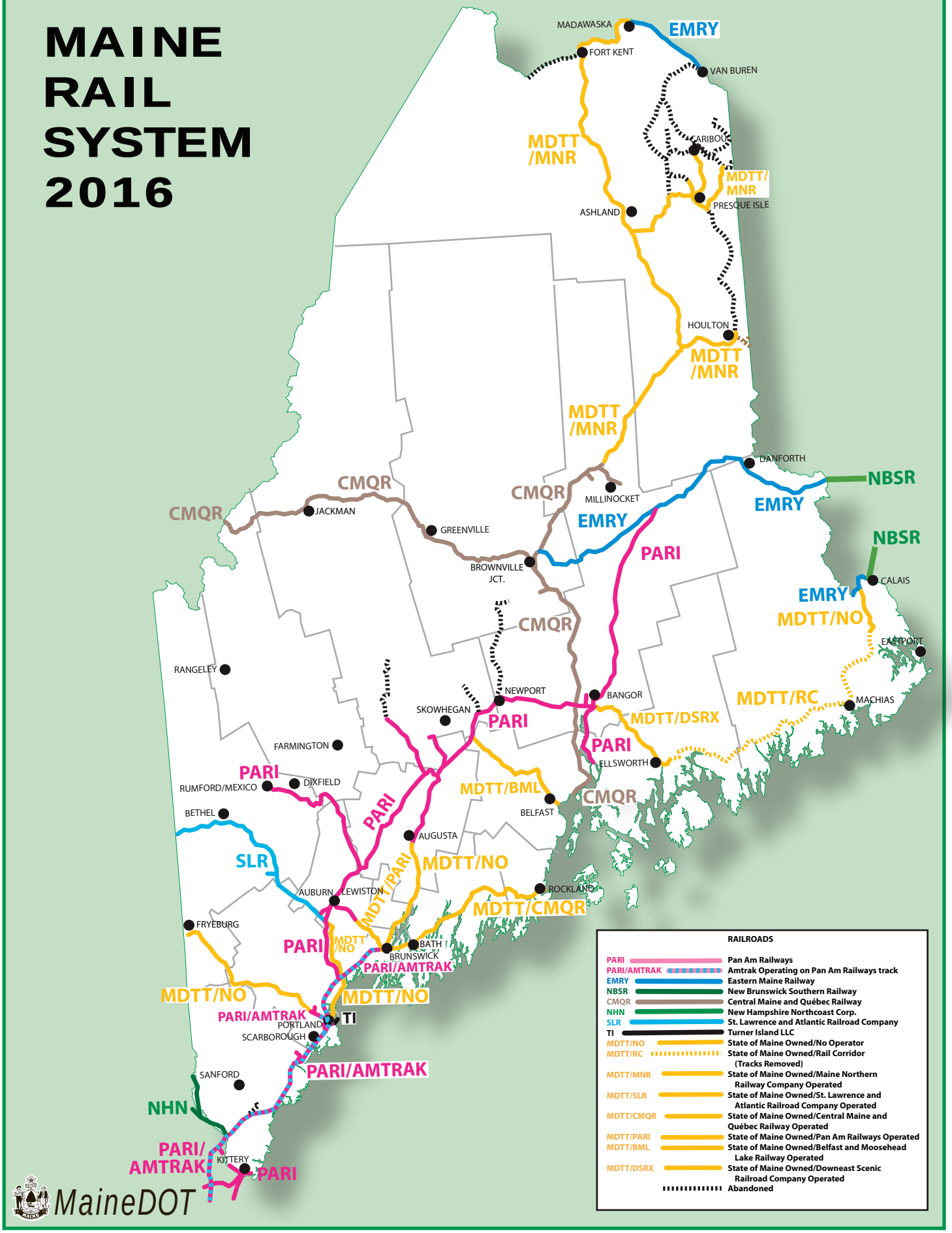
MAP SYMBOLS

- PORT
- SELECTED AIRPORTS
- RAIL/TRUCK INTERMODAL FACILITY
- PRIORITY 1 HIGHWAY
- PRIORITY 2 HIGHWAY
- PRIORITY 3 HIGHWAY
- RAIL LINE

KEY TO RAILROAD ABBREVIATIONS

PARI	PAN AM RAILWAYS
EMRY	EASTERN MAINE RAILWAY
LARX/SLA	LEWISTON AUBURN RAILROAD COMPANY OWNED/ ST. LAWRENCE AND ATLANTIC RAILROAD COMPANY OPERATED
PARI/NO	PAN AM RAILWAYS OWNED/NO OPERATOR
CMQR	CENTRAL MAINE AND QUÉBEC RAILWAY
NBSR	NEW BRUNSWICK SOUTHERN RAILWAY
NHN	NEW HAMPSHIRE NORTHCOAST CORP.
SLA	ST. LAWRENCE AND ATLANTIC RAILROAD COMPANY
TI	TURNER ISLAND LLC
MDTT/CMQR	STATE OF MAINE OWNED/ CENTRAL MAINE AND QUÉBEC RAILWAY OPERATED
MDTT/NO	STATE OF MAINE OWNED/NO OPERATOR
MDTT/SLA	STATE OF MAINE OWNED/ST. LAWRENCE AND ATLANTIC RAILROAD COMPANY OPERATED
MDTT/PARI	STATE OF MAINE OWNED/PAN AM RAILWAYS OPERATED
MDTT/BML	STATE OF MAINE OWNED/ BELFAST & MOOSEHEAD LAKE OPERATED
MDTT/MNR	STATE OF MAINE OWNED/ MAINE NORTHERN RAILWAY COMPANY OPERATED
MDTT/DSRX	STATE OF MAINE OWNED/ DOWNEAST SCENIC RAILROAD COMPANY OPERATED
MDTT/RC	STATE OF MAINE OWNED/RAIL CORRIDOR (Tracks Removed)

MAINE RAIL SYSTEM 2016



MaineDOT