

# Forest Products Industries' Economic Contributions: Maine

June 2020

*Prepared by*

Public Sector Consultants  
Lansing, Michigan  
[www.publicsectorconsultants.com](http://www.publicsectorconsultants.com)

*Prepared for*

Main Department of Agriculture, Conservation and Forestry  
Augusta, Maine  
[www.maine.gov/dacf](http://www.maine.gov/dacf)

Michigan Department of Natural Resources  
Forest Resources Division  
Lansing, Michigan  
[www.michigan.gov/dnr](http://www.michigan.gov/dnr)



NORTHEAST-MIDWEST  
STATE FORESTERS  
ALLIANCE



**PUBLIC SECTOR  
CONSULTANTS**



## Foreword

Forests cover nearly 90% of Maine's land area. Private landowners manage 90% of the forested acreage, with much of it accessible to the public. Forests provide habitat for wildlife, help protect air and water quality, offer recreational opportunities, and supply raw materials for products ranging from paper to alternative fuels. Sustainable forest management supports Maine's economy, environment, and quality of life.

Forest products are the backbone of Maine's economy, particularly in the rural areas of the state. But whether you live in rural, urban, or suburban Maine, the forest economy's estimated impact of \$8.2 billion and nearly 40,000 jobs matters. Who is part of the forest economy? The loggers who run the harvesters and skidders in the forest. The truckers who move the lumber from the forest to the processors. The workers in Maine's paper mills, sawmills, board mills, and lumber companies, that turn the wood into usable products. The craftspeople who make furniture and other finished products. The thousands of accountants, mechanics, salespeople, and other support staff who support the process at every stage. Despite the challenges posed by two decades of change, Maine is still a great place for the forest industry.

Globally, paper/paperboard remains a growth industry. So why have so many pulp and paper mills closed? It's because of a fundamental change in the marketplace. Smaller mills that haven't specialized and have low production capacity have closed not only in the U.S., but in Canada and other countries. Although China has hardly any forest resources, it accounted for 26 percent of global consumption and production of paper/paperboard, and 93 percent of the growth in demand for pulp in the past decade. Massive pulp mills, some producing 2 million tons annually, are opening around the world to meet China's demand.

Maine's larger mills are diversifying as quickly as our capital-intensive industry allows. Much of the global growth is in tissue, such as toilet paper and paper towels. That's why Woodland Pulp in Baileyville invested \$120 million in two tissue machines. Markets for packaging and specialty papers are growing, too, so those products have been added in Madawaska, Skowhegan, Westbrook, Jay, and Rumford. In the solid wood sector, our sawmills are well capitalized. Irving opened its Ashland mill in 2014 because of the anticipated increase in housing starts. The Huber and Louisiana Pacific panel facilities increased staff to meet demand. Our biomass energy sector (including wood pellets) has been affected by lower costs for oil and natural gas. Loggers, landowners, and sawmills depend on biomass outlets for their sawdust and bark, so they're working together to revive these important markets.

The global economy is evolving rapidly and there are clearly many challenges ahead, but Maine's forest products industry is reinventing itself to meet them.

## Acknowledgements

This report was produced as part of a 20-state project supported by a U.S. Department of Agriculture Forest Service 2017 Landscape Scale Restoration Grant, administered by the Michigan Department of Natural Resources, Forest Resources Division on behalf of the Northeast-Midwest State Foresters Alliance Forest Markets & Utilization Committee. Don Mansius of the Maine Department of Agriculture, Conservation and Forestry contributed extensively to the Maine report, and we thank him for his contributions.

# Table of Contents

<b>Foreword</b> .....	<b>2</b>
<b>Acknowledgements</b> .....	<b>3</b>
<b>Table of Contents</b> .....	<b>4</b>
<b>Executive Summary</b> .....	<b>5</b>
<b>Glossary</b> .....	<b>8</b>
<b>Introduction</b> .....	<b>10</b>
<b>Forest Resources of Maine</b> .....	<b>10</b>
<b>Forest Products Industries</b> .....	<b>13</b>
<b>Economic Contributions of Maine’s Forest Products Industries</b> .....	<b>14</b>
Economic Contributions Defined .....	14
Economic Contribution Results.....	16
Overall Forest Products Industries .....	17
Direct and Total Contributions by Forest Product Industry Groups.....	18
Top Forest Product Sectors .....	21
Top Nonforest Industries Impacted .....	22
Neighboring States .....	22
Importance of the Forest Products Industries in Context .....	23
Supplemental Economic Contribution Information.....	25
<b>Summary</b> .....	<b>26</b>
<b>References</b> .....	<b>27</b>
<b>Appendix A: Methods and Data</b> .....	<b>28</b>
<b>Appendix B: Forest Products Industries Groupings and IMPLAN Sectors</b> .....	<b>31</b>
<b>Appendix C: Detailed Economic Contribution Results</b> .....	<b>33</b>

## Executive Summary

This report assesses broad forest conditions and economic contributions of forest products industries in Maine. It is one of 20 coordinated and comparable state reports in the northeastern and midwestern United States that provides an improved assessment of forests and the economies they support. Forest data come from the U.S. Forest Service's Forest Inventory and Analysis website, and economic data come from the 2017 Impact Analysis for Planning (IMPLAN), a commercially available economic input-output (IO) model.

Maine has 17.6 million acres of forestland covering 89 percent of its land base. Most of this forestland is productive enough to produce commercial timber. The majority of Maine's forestland is privately owned (90 percent). About 8 percent is owned by state and local government, and about 1 percent is in federal ownership.

## Economic Progress

The Forest Opportunity Roadmap – Maine, aka FOR/Maine, identified a number of recent signs of optimism and significant investment in the future of Maine's forest industry over the last several years:

- Woodland's \$150 million investment to make tissue at its Baileyville mill.
- SAPPI's \$165 million upgrade of a paper machine at its Somerset Mill in Skowhegan.
- The restart of ND Paper's tissue mills in Old Town.
- Verso Corporation's \$17 million upgrade of a paper machine at the Androscoggin Mill in Jay (now owned by Pixelle Specialty Solutions).
- A \$12 million expansion at Pleasant River Lumber's sawmill in Dover Foxcroft.
- A \$30 million biomass plant investment at Athens Energy; and,
- A \$36 million biomass plant investment in Robbins Lumber in Searsmont.

These projects support hundreds of jobs in rural communities.

## Forest Industries

Seven forest products industries are presented in this report: forestry; logging; primary solid wood products; secondary solid wood products; wood furniture; pulp, paper, and paperboard mills; and secondary paperboard and other paper products. These industries are based on 32 economic sectors used in IMPLAN, but only 29 are present in Maine.

The forest products industries in Maine provided direct employment to almost 19,000 people leading to \$5.2 billion in sales or output in 2017. Labor income was \$990.2 million and value-added was \$1.6 billion. In terms of total contributions, the industries supported almost 39,800 jobs, \$2.0 billion in labor income, \$3.2 billion in value-added, and \$8.2 billion in sales or output.

Among the top sectors (excluding forest products sectors) affected by forest products industries were wholesale and retail trade, management of companies and enterprises, restaurants, real estate, hospitals, and truck transportation. This set of sectors reflects spending by forest products companies, their suppliers, individuals.

## **Leading Forest Products Industry Groups**

Among the seven industry groups, the leading industries' rank varied by the measure chosen:

- Logging had the highest number of direct jobs (5,052), the second-highest value-added (\$305.4 million), and the fifth-highest direct output (\$416.5 million).
- Pulp, paper, and paperboard mills had the second-highest number of direct jobs (3,137), the highest value-added (\$551.5 million), and the highest direct output (\$2.3 billion).
- Primary solid wood products had the third-highest employment (2,986), third-highest value-added (\$287.0 million), and second-highest output (\$1.1 billion).
- Secondary solid wood products had the fourth-highest number of direct jobs (2,484), the fifth-highest value-added (\$132.7 million), and the fourth-highest direct output (\$445.5 million).

## **Leading Individual Forest Products Sectors**

Among the 29 forest products sectors present in Maine, the top four, by measure in order from highest to fourth highest of direct contributions, were:

- Employment - Commercial logging, paper mills, sawmills, and support activities were the top four sectors and had a combined total of over 11,300 direct jobs.
- Labor income - Paper mills, commercial logging, sawmills, and pulp mills had the highest labor income, totaling \$600.8 million.
- Value-added - Paper mills, commercial logging, sawmills, and pulp mills had the highest value-added, totaling \$995.1 million.
- Output - Paper mills, sawmills, commercial logging, and pulp mills were the top four sectors in output (or sales), totaling \$3.4 billion.

## **Maine's Forest Products Industries Compared to Other Maine Industries**

The forest products industries provide more direct labor income, value-added, and output than commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries (plant crop and animal). Agricultural production provided the most employment. Overall, forest products industries accounted for 24.2 percent of the nonfood manufacturing jobs in Maine. Agricultural production provided the most employment. Twenty percent of Maine's 56,000 direct manufacturing jobs in 2017 were in the forest products industries (i.e., 1 in 5 manufacturing jobs).

## **Maine’s Forest Products Industries Compared to Those of Vermont, New Hampshire, Michigan, and Wisconsin**

Forest products industries in Maine, Vermont, New Hampshire, Michigan, and Wisconsin employed 143,800 workers and accounted for \$45.7 billion in direct output. Wisconsin’s forest products economy was the largest among these states, followed by that of Michigan.

# Glossary

The following technical terms are used throughout this report when discussing forestry and economic contributions.

## Forestry Terms

**Average annual harvest removals:** The average annual merchantable volume of growing-stock trees that were live at the time of the previous inventory and were either cut and removed by direct human activity related to harvesting or died as a result of silvicultural or land-clearing activity by the time of the current inventory.

**Average annual mortality:** The average annual merchantable volume of growing-stock trees that were live at the time of the previous inventory and are dead in the current inventory.

**Average annual net growth:** The average annual change in merchantable volume of growing-stock trees, after deducting mortality volume, between inventories.

**Forest land:** Land that is at least 10 percent stocked by trees of any size, including land that formerly had such tree cover and that will be naturally or artificially regenerated. Forest land includes transition zones, such as areas between heavily forested and nonforested lands that have at least 10 percent canopy cover with live tally trees, or recently had at least 10 percent canopy cover by live tally trees based on the presence of stumps, snags or other evidence, and forest areas adjacent to urban and built-up lands, including pinyon-juniper and chaparral areas in the western U.S. and afforested areas. The minimum area for classification of forest land is one acre and 120 feet wide measured stem-to-stem from the outermost edge. Unimproved roads and trails, streams, and clearings in forest areas are classified as forest land if less than 120 feet wide.

**Growing stock:** Live trees of commercial species that meet minimum merchantability standards and only includes trees at least 5 inches in diameter at breast height. In general, these trees have at least one solid eight-foot section, are reasonably free of form defect on the merchantable bole, and at least 34 percent or more of the volume is merchantable. Excludes rough or rotten cull trees.

**Timberland:** A subset of forest land that produces or can produce crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation. (Note: Areas qualifying as timberland can produce at least 20 cubic feet per acre per year of industrial wood in natural stands. Currently inaccessible and inoperable areas are included.)

## Economic Contribution Terms

**Direct effects/contributions:** The economic activities (e.g., output, employment, labor income, and value-added) associated with an industry or sector in the study area. These can describe the current economic sectors or changes to those sectors.

**Employment:** The number of full- and part-time jobs associated with an industry.

**Indirect effects/contributions:** The impact of local industries purchasing goods and services from other industries, leading to others' outputs, employment, and labor income. This report uses "indirect effects" to refer to the combination of indirect and induced effects.

**Induced effects/contributions:** The impact of labor income (employee compensation and proprietor income) via goods and services purchased due to the direct and indirect spending by industries. For this report, induced effects are included with indirect effects and referred to as indirect effects.

**Labor income:** The dollar total of employee compensation and proprietor income; the latter is associated with self-employed individuals.

**Output:** The dollar measure of production within an area; it is also viewed as sales.

**Social Accounting Matrix (SAM) multipliers:** These multipliers are derived by dividing the sum of direct, indirect, and induced effects by the direct effects. The social accounts include payments made between households, households and government, and more. These are available for output, employment, labor income, and value-added and are used to assess effects of changes in industry activity (i.e., "ripple effects").

**Total effects/contributions:** The sum of direct, indirect, and induced effects.

**Value-added:** (also known as gross state product, or GSP): The sum of labor income, other property income (e.g., rents and profits), and indirect business taxes (e.g., excise and sales taxes). It is the difference between an industry's total output and the cost of its intermediate inputs. The sum of value-added for all economic sectors within the region equals the total GSP.

# Introduction

Forest products industries are an integral component of Maine’s economy. They provide jobs, raw materials, and finished goods that generate additional economic activity throughout the state, region, and nation. Previous studies of the industries’ economic contributions have focused solely on examining the role the industries play in Maine’s economy. Until now, no attempt has been made to compare the contributions of Maine’s forest products industries with those of nearby states, nor to examine the interaction of those industries at the regional or national level. In part, this is due to a lack of a consistent reporting format across the northeast and northcentral area, which may be partly attributable to different states using different methods and data.

To help quantify these relationships and consistently document the industries’ contributions, the Forest Markets & Utilization Committee of the Northeast—Midwest State Foresters Alliance secured federal grant funds to conduct an analysis of 20 midwestern- and northeastern—area states as well as Nebraska. As part of this work, the same project team that completed the individual state reports—comprising members of the Michigan Department of Natural Resources, Public Sector Consultants, Michigan State University forestry economics professor emeritus Larry Leefers, and state forestry experts—published a 20-state report summarizing the economic contributions of forest products industries at a regional level. The U.S. Forest Service funded this work through a 2017 Landscape Scale Restoration grant.

Much of the data used in this report were derived from the U.S. Forest Service Forest Inventory and Analysis database and from IMPLAN, a widely used economic modeling system. These data and related information are presented in four major sections: Forest Resources of Maine, Forest Products Industries, Economic Contributions of Maine’s Forest Products Industries, and Summary. Economic methods are discussed, and detailed economic sector data are presented in the appendices.

## Forest Resources of Maine

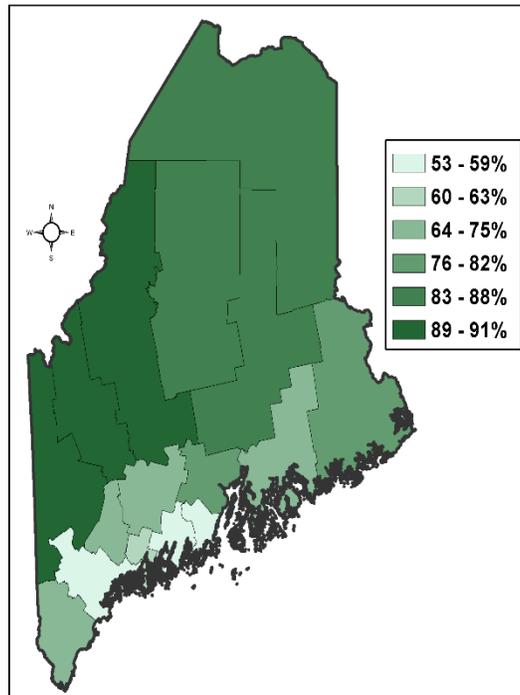
Maine is rich in forest resources. It remains the most heavily forested state in the nation percentagewise, with 89 percent of its land base in forest (17.6 million acres) (Exhibit 1). About 95 percent of the forest land is classified as timberland, meaning that it can produce harvestable timber and is not legislatively reserved from timber harvesting. Ninety percent of Maine’s forests are privately-owned, one of the highest percentages in the country.

**Exhibit 1.** Maine Land Area by Land Use Type, 2017 (U.S. Forest Service)

Land Use Type	Acres	Percentage
Forest land	17,589,532	89.2%
Nonforest land	2,128,960	10.8%
<b>Total</b>	<b>19,718,492</b>	<b>100.0%</b>

Exhibit 2 shows the percent of forest land by county throughout the state.

**Exhibit 2.** Maine’s Forest Land by County, 2017



The state of Maine and USDA Forest Service are the major public owners (Exhibit 3). Landowners pursue diverse goals. Private landowners have a wide range of objectives for owning and managing their lands—some have a hands-off approach, while others pursue active management. There are several state and federal programs designed to encourage the active management of private forestlands. The state’s public lands and national forests are actively managed in many areas, while resource protection is emphasized in others. Active timber management provides the feedstock for Maine’s forest products industries.

**Exhibit 1.** Forest Land by Ownership Group in Maine (2017)

<b>Ownership Group</b>	<b>Acres</b>	<b>Percentage</b>
National forest	61,010	0.3%
Other federal	186,146	1.1%
State and local governments	1,452,667	8.3%
Private	15,889,709	90.3%
<b>Total</b>	<b>17,589,532</b>	<b>100.0%</b>

Maine’s major forest types include northern hardwoods (maple/beech/birch), spruce/fir, aspen/birch, and pine (Exhibit 4). Tree species with the greatest standing volume include red spruce, red maple, white pine, balsam fir, northern white cedar, eastern hemlock, sugar maple, yellow birch, paper birch, and red oak. Maine is internationally known for the high quality and diversity of forest products its industry manufactures. Its forests provide the raw materials for paper, structural lumber, composite board, and hardwood lumber, among other products.

**Exhibit 2.** Forest Land Area by Forest Type Group in Maine (2017)

<b>Forest Type Group</b>	<b>Acres</b>	<b>Percentage</b>
Maple/beech/birch	7,262,432	41.3%
Spruce/fir	5,995,242	34.1%
Aspen/birch	1,815,199	10.3%
White/red/jack pine	1,190,048	6.8%
Oak/hickory	401,410	2.3%
Other	925,200	5.3%
<b>Total</b>	<b>17,589,532</b>	<b>100.0%</b>

The estimated volume of standing timber suitable for forest products was about 24.8 billion cubic feet, or about 315 million standard cords<sup>1</sup> (Exhibit 5). Average annual net growth exceeded annual harvest removals by a ratio of about 1.5 to 1. That is, for every cubic foot of harvesting that took place, 1.5 cubic feet of timber grew, after accounting for mortality. Average annual harvest removals in 2017 of growing stock were about 496 million cubic feet, or about 6.3 million cords—roughly 2 percent of standing volume.

<sup>1</sup> A standard cord is a unit of measurement for pulpwood or sawlogs, generally equivalent to a stack of wood measuring four feet wide by four feet tall by eight feet long. A stacked cord of wood typically contains about 79 cubic feet of solid wood, excluding air space.

**Exhibit 3.** Characteristics of Growing Stock in Maine, 2017 (million cubic feet)

<b>Measure</b>	<b>Total</b>	<b>National Forest</b>	<b>Other Federal</b>	<b>State and Local Government</b>	<b>Private</b>
Net volume	24,848.3	138.6	310.4	2,913.0	21,486.4
Average annual net growth	763.0	2.4	7.9	60.1	692.6
Average annual harvest removals	495.8	-	0.3	18.4	477.1
Average annual mortality	218.4	0.8	1.9	25.6	190.1

Note: Net volume is merchantable volume, in cubic feet, of growing-stock trees for timber species (trees where diameter is measured at breast height) from a 1-foot stump to a minimum 4-inch top diameter, or to where the central stem breaks into limbs all of which are less than 4.0 inches in diameter. Volume loss due to rotten, missing, and form cull has been deducted. Growing stock is defined as live trees of commercial species that meet minimum merchantability standards and only includes trees at least 5 inches in diameter at breast height. Net growth is the average annual change (gross growth minus mortality) in merchantable volume, in cubic feet, of growing-stock trees on forestland. Harvest removals are the average annual merchantable volume, in cubic feet, of growing-stock trees at the time of removal from forest land. Annual mortality is the average annual merchantable volume, in cubic feet, of growing-stock trees at the time of mortality on forest land.

## Forest Products Industries

Contribution analysis focuses on industries' role in an economy. The first step is often defining the region (e.g., a state). One of the next steps is to define exactly which economic sectors comprise the focus industries. To analyze the contributions of the forest industries, representatives from the U.S. Forest Service's northeastern and midwestern states and Nebraska selected 32 sectors by consensus for inclusion in the analysis. A description of the methods and data is presented in Appendix A. To concisely describe and communicate the economic contribution of the forest products industries, these 32 sectors were aggregated into seven broad groups (Appendix B): forestry; logging; primary solid wood products; secondary solid wood products; wood furniture; pulp, paper and paperboard; and secondary paperboard and other paper products.

In total, these sectors cover forest-specific manufacturing activities, including the conversion of trees into primary products and the manufacture of products used by other sectors and households. Primary industries (e.g., sawmills OSB [reconstituted wood products], and power plants) use wood directly from the forest, including roundwood, chips, or similar forms. Secondary industries (e.g., trusses and furniture) use one or more primary forest products (e.g., lumber and paperboard) in their manufacturing processes. Value is added as the timber is processed through primary and secondary manufacturers. Several sectors included wood and nonwood products (e.g., institutional furniture manufacturing). Therefore, output and other measures were reduced to better reflect the wood-only component by using published government data or surveys (Gibson, Leefers, and Poudel 2020).

IMPLAN was used to estimate economic contributions of the forest products industries for this report. It is a widely used input-output (IO) model that comprises economic data and software. IO models characterize financial linkages among and between sectors, households, and institutions, and can be constructed for different geographic areas. Within these models, various sectors have production functions that show the value of inputs used in production of outputs or commodities. Maine's economy was represented by 418 sectors in 2017, the most recent year available for IMPLAN data at the time of the analysis. The IMPLAN sectors are based on the North American Industrial Classification System (NAICS). IMPLAN models can be constructed for different geographic areas. State data were used in this report, but given IMPLAN's structure, sub-state and multi-state analyses can be developed.

## **Economic Contributions of Maine's Forest Products Industries**

This section of the report includes four major subsections: Economic Contributions Defined, Economic Contribution Results, Importance of the Forest Products Industries in Context, and Supplemental Economic Contribution Information.

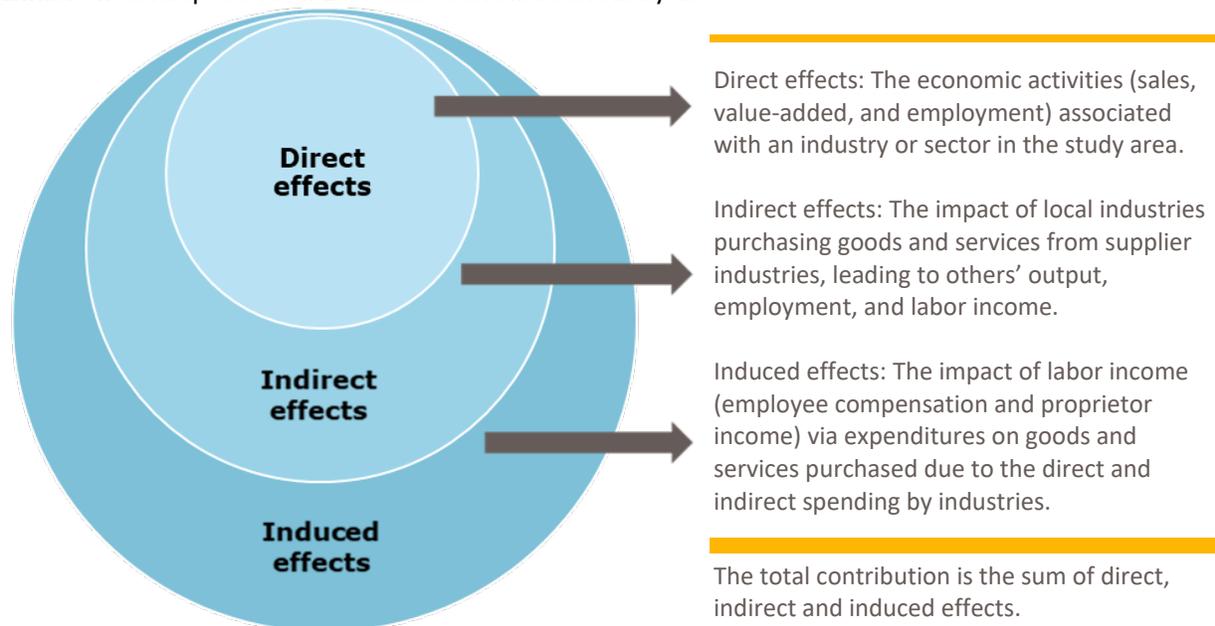
Forests and forest products industries are central for the transition to a greener and more sustainable economy. A green goods and services economy relies on the sustainable use of natural resources, and Maine's forest products industries are tightly bound to forests and the goods and ecosystem services that they provide (e.g., wildlife habitat, watershed protection, carbon sequestration, etc.).

### **Economic Contributions Defined**

#### **Input-Output Analysis and IMPLAN**

Forest products industries influence the economy in three ways: direct effects (when industries sell commodities in response to demand), indirect effects (as suppliers to directly impacted sectors), and induced effects (household spending by employees in directly and indirectly impacted sectors) (Exhibit 6). The total economic contribution is the value of production required to meet all the needs stemming from the initial activity—in this case, forest product-related purchases.

---

**Exhibit 4. Concept of Total Economic Contribution Analysis**

IO modeling using IMPLAN software and data is a conventional approach for documenting forest products industries' economic contributions. This analysis used the matrix inversion approach with external IMPLAN model adjustment as a primary method for estimating economic contributions of forest products industries in Maine (Gibson, Leefers, and Poudel 2020). Major economic indicators generated by IMPLAN include employment (full- and part-time jobs), labor income, total output, and value-added.

### Interaction Between State and Regional Analyses

IMPLAN models are based on interactions across the economy. One important aspect of these interactions is whether commodities are sourced locally or imported. In smaller areas (e.g., counties), fewer commodities are sourced locally. As a result, leakages occur when purchases are made—that is, fewer dollars stay in the local economy.

Larger economies have fewer leakages and more commodities are sourced locally. For example, an examination of the logging industries (IMPLAN sector 16) in Maine, New Hampshire, and Vermont, reveals that the direct employment for 2017 was 5,052, 1,732, and 1,737 jobs, respectively. Summing the individual state's total employment contributions (direct + indirect + induced) yields 12,218 jobs. However, if the states are combined as one region, the total employment contribution increases to 12,325 jobs. This increase reflects less leakage and more local purchases.

The larger role is due to trade, but IMPLAN does not explicitly show trade with specific states, only overall imports and exports. The regional analysis highlights the larger role of forest products industries

in the region's economy. Consequently, the state-level analyses underestimate the actual contributions from a regional perspective.

## Economic Contribution Results

The FOR/Maine coalition was created with support from the U.S. Economic Development Administration, and is working to diversify the state's wood products businesses, attract capital investments, and develop greater economic prosperity for communities impacted by recent mill closures.

In September 2018, FOR/Maine announced an action plan to grow Maine's forest economy from its current level to \$12 billion by 2025. The Roadmap outlines how the industry will achieve the projected growth, much of it coming from new markets. The sector will build on traditional strengths like saw logs and paper and add new layers of innovative products – including eco-friendly chemicals, bio-degradable plastics, and medical and technical products made from nanocellulose – many of which can be made from the residuals of other wood manufacturing processes, and mass timber building materials such as cross-laminated Timber (CLT).

The Roadmap culminates two years of coordinated research and strategy development, informed by extensive data, global benchmarking, and industry expertise. It reveals Maine's competitiveness in new global markets, and outlines five goals and 17 matched strategies to realize the opportunity, and build a more diverse \$12 billion forest economy annually:

- Goal 1: Invest, Innovate, Grow – Sustain and grow Maine's existing and emerging forest products economy, reaching \$12 billion in economic impact by 2025. This includes attracting investment in the forest products industry, marketing Maine's bioeconomy to national and global audiences, and accelerating innovation in forest products and applications to leverage Maine's leadership position within the industry.
- Goal 2: Manage Sustainably – Manage the wood resource using sustainable and responsible forest management practices. This is informed by accurate and current data about Maine's forests.
- Goal 3: Develop Workforce – Prepare workforce for the future of the forest products economy. This entails making sure that current workers have the skills they need, and that Maine is positioned to attract and prepare the necessary workforce for emerging products and new opportunities.
- Goal 4: Support Communities – Increase prosperity in Maine forest economy communities, especially those in rural areas and those affected by mill closures. This involves coordinated efforts across local, regional, state, and federal entities to attract capital investment.
- Goal 5: Coordinate & Persist – Organize the forest products industry with committed public sector partners, including the University of Maine, to implement the vision and goals. This

requires a sustained, collaborative, and coordinated effort across local, regional, state, and federal entities.

FOR/Maine also is working closely with leadership in forest communities, including the six towns in Maine that have had mills close in recent years. The coalition is actively involved in efforts to diversify economic opportunities for these communities, supporting efforts to redevelop mill sites, provide more resources for brownfield cleanup and improve broadband access in rural areas.

In this section, direct and total economic contributions are presented for all forest products industries combined along with direct and total contributions by industry groups (e.g., logging, furniture, etc.). In addition, the top forest industry sectors and the top industries affected by the forest products industries are identified. Finally, comparisons are made with forest industries in nearby states and with other natural resources industries and manufacturing industries within the state.

### Overall Forest Products Industries

Contribution analysis provides a means to assess the role various industries play in a state’s economy. Maine forest products industries’ total economic contribution in terms of output was \$8.2 billion, based on direct output of \$5.2 billion (Exhibit 7). About 19,000 direct jobs were associated with this level of economic activity, supporting a total of 39,742 jobs. Direct labor income, which includes employee compensation and proprietor income, was \$990.2 million, or \$52,427 per job. Total labor income, which includes income paid directly to industry employees and proprietors, their suppliers, and other industries they support, totaled nearly \$2.0 billion.

**Exhibit 7.** Economic Contribution of Forest Products Industries in Maine, 2017 Dollars

Effect	Employment	Labor Income (Thousands of Dollars)	Value-added* (Thousands of Dollars)	Output (Thousands of Dollars)
Direct	18,887	\$990,184	\$1,589,980	\$5,236,715
Total	39,742	\$1,951,150	\$3,190,147	\$8,165,119

\* Value-added in IMPLAN is equivalent to GSP.

Each direct job in the forest products industries supported 1.1 additional jobs, and every \$1 million in direct labor income supported an additional \$970 thousand in indirect and induced labor income.

Most state economies are large relative to any particular industry or group of industries. The forest products industries are no exception. In 2017, Maine’s population was estimated at 1.3 million people, with total employment of 832,880. The gross state product (also known as value added) was \$62.4 billion from 418 economic sectors (of the possible 536 in the U.S.). The GSP’s largest component was labor income, which was \$40.2 billion.

Direct value-added for forest products industries was \$1.6 billion, 2.6 percent of Maine’s total GSP, nearly doubling to 5.1 percent when considering total value-added effects. These percentages hold for other economic measures (e.g., jobs) as well.

### Direct and Total Contributions by Forest Product Industry Groups

As previously noted, the 32 IMPLAN forest products sectors were combined into seven industry groups (Appendix B). In Maine, logging was the largest of these groups in terms of direct employment (Exhibit 8). Pulp, paper, and paperboard mills was the second largest in direct employment and the largest in terms of labor income, value-added, and output. Primary solid wood products was the third largest group in terms of direct employment and value-added, and the second largest in terms of labor income and output. Forestry, which includes maple syrup production, timber tract operations, and forestry support activities, was the smallest group for labor income, value-added, and output.

Two groups—pulp, paper and paperboard mills and secondary paperboard and other paper products—accounted for over half the output (sales) of forest products industries. Forty-five percent of the forest products industries employment was in the wood furniture and secondary manufacturing groups.

**Exhibit 5.** Direct Economic Contributions in Maine, Industry Groups, 2017

Industry Group	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	2,326	\$60,352	\$60,048	\$84,542
Logging	5,052	\$159,369	\$305,440	\$416,480
Primary solid wood products	2,986	\$172,074	\$286,996	\$1,066,877
Secondary solid wood products	2,484	\$110,389	\$132,658	\$445,458
Wood furniture	1,590	\$73,792	\$91,498	\$252,539
Pulp, paper, and paperboard mills	3,137	\$321,265	\$551,459	\$2,340,964
Secondary paperboard and other paper products	1,312	\$92,942	\$161,880	\$629,856
<b>Total</b>	<b>18,887</b>	<b>\$990,184</b>	<b>\$1,589,980</b>	<b>\$5,236,715</b>

For the following sector-specific discussions, refer to Exhibit 8 for direct contribution details and Exhibit 9 for total contribution details. See Appendix C for detailed economic measures for industry groups and their component sectors.

#### Forestry

The forestry group includes timber tract operations and support activities for forestry. Timber tract operations include establishments primarily engaged in the operation of timber tracts for the purpose of selling standing timber. Support activities for forestry comprise establishments primarily engaged in

performing support activities related to timber production, wood technology, forestry economics and marketing, and forest protection. These establishments may provide support activities for forestry, such as estimating timber, forest firefighting, forest pest control, treating burned forests from the air for reforestation or on an emergency basis, and consulting on wood attributes and reforestation.

Out of seven industry groups, forestry is the smallest in terms of direct contributions in 2017. Direct contributions were \$84.5 million in output, 2,326 jobs, \$60.4 million in labor income, and \$60.0 million value-added. In most cases, value-added is greater than labor income, one of the value-added components. Often, this situation does not hold for agricultural sectors due to farm subsidies, which show up as “negative taxes.” Sector 19, support activities for agriculture and forestry, reflected this for Maine in 2017, leading to the smaller value-added. Total contributions are based, in part, on backward linkages to suppliers. Total contributions for forestry can be lower than direct contributions (i.e., initial IMPLAN levels) because many of the contributions are inputs into other industries. For example, 27 percent of forestry jobs are counted as contributions in other industries, mostly logging and primary solid wood products (e.g., sawmills). Hence, the total contributions displayed in Exhibit 9 underrepresent the industry’s broader contributions—reporting total contributions for forestry is somewhat misleading because much of the forestry total contribution effects are hidden in the total contributions of other industries. The same holds true for logging below.

**Exhibit 6.** Total Economic Contributions in Maine, Industry Groups, 2017

<b>Industry Group*</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Forestry	3,029	\$57,572	\$68,717	\$105,378
Logging	4,266	\$139,231	\$252,220	\$370,721
Primary solid wood products	8,158	\$390,994	\$663,383	\$1,635,916
Secondary solid wood products	4,850	\$222,635	\$316,275	\$793,135
Wood furniture	2,769	\$128,435	\$181,813	\$420,799
Pulp, paper, and paperboard mills	13,299	\$817,036	\$1,375,874	\$3,892,638
Secondary paperboard and other paper products	3,372	\$195,248	\$331,865	\$946,532
<b>Total</b>	<b>39,742</b>	<b>\$1,951,150</b>	<b>\$3,190,147</b>	<b>\$8,165,119</b>

\*Forestry and logging are reported in this table, but most of their contributions are as indirect inputs or intermediate inputs used for production in the other five industry groups.

### Logging

The logging industry group contains establishments primarily engaged in one or more of the following: cutting timber, cutting and transporting timber, and producing wood chips in the field. Logging was the largest in terms of direct employment. The direct contributions of logging were \$416.5 million in output,

5,052 jobs, \$159.4 million in labor income, and \$305.4 million in value-added. Most logging activity is an input into production in other industries, especially for manufacturing primary solid wood products (e.g., lumber), paper, and paperboard. In Maine, 42 percent of logging jobs are included in the total contributions of other industries. As with forestry, logging's total contributions are underrepresented due to their inclusion in other industries.

### **Primary Solid Wood Products**

The primary solid wood products industry group was the third largest group in terms of direct employment in Maine. Primary solid wood products sectors include wood-based electric power generation, sawmills, wood preservation, veneer and plywood manufacturing, and reconstituted and wood product manufacturing industries. The direct contributions of the group were \$1.1 billion in output, 2,986 jobs, \$172.1 million in labor income, and \$287.0 million in value-added. Total contributions for primary solid wood products, including direct, indirect, and induced effects, were \$1.6 billion in output, 8,158 jobs, \$391.0 million in labor income, and \$663.4 million in value-added. Many primary solid wood products (e.g., lumber and panels) are inputs in other industries, which are counted in other industries' total contributions.

### **Secondary Solid Wood Products**

Secondary solid wood products was the fourth largest group in terms of direct employment in Maine. This group contains engineered wood member and truss manufacturing; wood windows and doors manufacturing; cut stock, resawing lumber, and planing; other millwork, including flooring, wood container, and pallet manufacturing; manufactured home (mobile home) manufacturing; prefabricated wood building manufacturing; and all other miscellaneous wood product manufacturing. Direct contributions of secondary solid wood products were \$445.5 million in output, 2,484 jobs, \$110.4 million in labor income, and \$132.7 million in value-added. Total contributions were \$793.1 million in output, 4,850 jobs, \$222.6 million in labor income, and \$316.3 million in value-added.

### **Wood Furniture**

Wood furniture was the sixth-largest group in terms of direct employment in Maine. Wood furniture includes wood kitchen cabinet and countertop manufacturing; upholstered household furniture manufacturing; nonupholstered wood household furniture manufacturing; institutional wood furniture manufacturing; wood office furniture manufacturing; custom architectural woodwork and millwork manufacturing; and showcase, partition, shelving, and locker manufacturing. Direct contributions of wood furniture were \$252.5 million in output, 1,590 jobs, \$73.8 million in labor income, and \$91.5 million in value-added. Total contributions of wood furniture were \$420.8 million in output, 2,769 jobs, \$128.4 million in labor income, and \$181.8 million in value-added.

### **Pulp, Paper, and Paperboard Mills**

The pulp, paper, and paperboard mills industry group was the second largest in terms of direct employment in Maine. The group includes pulp mills, paper mills, and paperboard mills that make paper or pulp from raw wood and from purchased pulp. The pulp, paper, and paperboard mills group's direct contributions were \$2.3 billion in output, 3,137 jobs, \$321.3 million in labor income, and \$551.5 million in value-added. Total contributions were \$3.9 billion in output, 13,299 jobs, \$817.0 million in labor income, and \$1.4 billion in value-added.

### **Secondary Paperboard and Other Paper Products**

The secondary paperboard and other paper products group was the smallest in terms of direct employment in Maine. The group comprises paper and paperboard manufacturing, paper bag and coated and treated paper manufacturing, stationery product manufacturing, sanitary paper product manufacturing, and all other converted paper product manufacturing. Facilities in this group manufacture products from purchased pulp, paper, paperboard, or recycled materials. The direct contributions in 2017 were \$629.9 million in output, 1,312 jobs, \$92.9 million in labor income, and \$161.9 million in value-added. Total contributions were \$946.5 in output, 3,372 jobs, \$195.2 million in labor income, and \$331.9 million value-added.

### **Top Forest Product Sectors**

In terms of jobs, the four largest forest products sectors are commercial logging (5,052 jobs), paper mills (2,503 jobs), sawmills (2,230 jobs), and support activities for forestry (1,590 jobs). These sectors reflect the diversity of manufacturing in the state (Appendix C).

The commercial logging sector has establishments primarily engaged in one or more of the following: cutting timber, cutting and transporting timber, and producing wood chips in the field. Loggers are a critical component of the forest products industries. Many people in the forest products industries are concerned that the aging logger population, insufficient recruitment and retention, and the high cost of entry into the business may limit other industries in the future (Allred, 2009; Conrad et al., 2018).

The paper mills sector comprises establishments primarily engaged in manufacturing paper (except newsprint and uncoated groundwood paper) from pulp. These establishments may manufacture or purchase pulp. In addition, the establishments may also convert the paper that they make.

The sawmills sector comprises establishments primarily engaged in sawing dimension lumber, boards, beams, timbers, poles, ties, shingles, shakes, siding, and wood chips from logs or bolts. Sawmills may plane the rough lumber that they make with a planing machine to achieve smoothness and uniformity of size. Sawmills are distributed in all parts of the state; some specialize in selected species and products.

Support activities for forestry comprises establishments primarily engaged in performing support activities related to timber production, wood technology, forestry economics and marketing, and forest

protection. These establishments may provide support activities for forestry, such as estimating timber, forest firefighting, forest pest control, and consulting on wood attributes and reforestation.

In terms of labor income, paper mills, commercial logging, sawmills, and pulp mills had the highest labor income, totaling \$600.8 million. They also had the highest value-added, totaling \$995.1 million, and output, totaling \$3.4 billion.

**Top Nonforest Industries Impacted**

Contribution analysis using IMPLAN relies on backward linkages from forest products industries sectors among themselves and to other sectors in Maine. Including the 29 forest products industries present in Maine, 147 sectors were impacted in 2017 (counting sectors with ten or more jobs supported). The top ten sectors (excluding forest products sectors) included wholesale trade, management of companies and enterprises, full-service restaurants, real estate, hospitals, and trucking (Exhibit 10). This set of sectors reflects indirect and induced spending by forest products companies, their suppliers, and individuals.

These data were at an aggregate level, so 635 jobs in truck transportation included log trucks, delivery trucks, and office jobs for some trucking companies, among others. Six of these sectors were among the top ten sectors in the state of Maine (hospitals were number two followed by real estate and full-service restaurants—each had over 25,000 jobs).

**Exhibit 7.** Direct Jobs Impacted by the Forest Products Industries Among Maine’s Top Ten Non-Forest Products Industries in 2017

Sector	Description	Jobs
395	Wholesale trade	1,697
461	Management of companies and enterprises	982
501	Full-service restaurants	757
440	Real estate	706
482	Hospitals	652
411	Truck transportation	635
502	Limited-service restaurants	533
468	Services to buildings	525
62	Maintenance and repair construction of nonresidential structures	505
400	Retail - Food and beverage stores	340
<b>Total</b>	<b>NA</b>	<b>7,332</b>

**Neighboring States**

The northeastern and midwestern states of Maine, Vermont, New Hampshire, Michigan, and Wisconsin are important for forest products. Forest products industries employ 143,821 workers across these

states and account for \$45.7 billion in direct output (Exhibits 11 and 12). Wisconsin had the largest forest products economy with 67,793 direct jobs and output in excess of \$25 billion. Maine’s industry was about half the size of Wisconsin’s and Maine was approximately one-fifth of Wisconsin’s direct output. The three largest industry groups, each with over 26,000 employees, were secondary paperboard and other paper products, wood furniture, and secondary solid wood products.

**Exhibit 8.** Forest Products Industries Direct Employment in Maine, Vermont, New Hampshire, Michigan, and Wisconsin, 2017

<b>Industry</b>	<b>Maine</b>	<b>Vermont</b>	<b>New Hampshire</b>	<b>Michigan</b>	<b>Wisconsin</b>
Forestry	2,326	3,342	1,250	1,321	778
Logging	5,052	1,737	1,732	4,487	5,207
Primary solid wood products	2,986	941	1,107	4,768	4,564
Secondary solid wood products	2,484	1,053	1,170	7,048	14,911
Wood furniture	1,590	1,318	1,181	10,837	12,071
Pulp, paper, and paperboard mills	3,137	641	389	3,186	11,233
Secondary paperboard and other paper products	1,312	76	460	9,099	19,029
<b>Sum of Direct Contributions</b>	<b>18,887</b>	<b>9,107</b>	<b>7,289</b>	<b>40,746</b>	<b>67,793</b>

**Exhibit 12.** Forest Products Industries Direct Output in Maine, Vermont, New Hampshire, Michigan, and Wisconsin, 2017

<b>Industry</b>	<b>Maine (Thousands of Dollars)</b>	<b>Vermont (Thousands of Dollars)</b>	<b>New Hampshire (Thousands of Dollars)</b>	<b>Michigan (Thousands of Dollars)</b>	<b>Wisconsin (Thousands of Dollars)</b>
Forestry	\$84,542	\$75,732	\$35,685	\$62,158	\$33,960
Logging	\$416,480	\$90,979	\$265,556	\$280,775	\$489,763
Primary solid wood products	\$1,066,877	\$305,966	\$441,289	\$1,689,173	\$1,630,002
Secondary solid wood products	\$445,458	\$217,960	\$229,118	\$1,420,592	\$3,041,763
Wood furniture	\$252,539	\$173,733	\$170,622	\$2,239,587	\$2,174,899
Pulp, paper, and paperboard mills	\$2,340,964	\$474,397	\$287,943	\$2,493,853	\$8,562,915
Secondary paperboard and other paper products	\$629,856	\$32,082	\$190,198	\$3,996,111	\$9,349,409
<b>Sum of Direct Contributions</b>	<b>\$5,236,715</b>	<b>\$1,370,850</b>	<b>\$1,620,412</b>	<b>\$12,182,249</b>	<b>\$25,282,710</b>

## Importance of the Forest Products Industries in Context

To provide some context regarding the relative importance of the forest products industries, it is useful to compare the contribution of Maine’s forest products industries with those of other industries.

Natural resources and agricultural industries make important contributions to the diversity of economic activities reflected in Maine’s \$62.4 billion GSP (Exhibit 13). The forest products industries provide more direct labor income, value-added, and output than commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries. Maine’s forest products industries comprised 2.5 percent of the GSP in 2017. Agricultural production provided the largest amount of employment (full- and part-time) of these industries.

**Exhibit 9.** Natural Resources and Agricultural Production Industries in Maine, 2017

<b>Industry</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Forest products	18,887	\$990,184	\$1,589,980	\$5,236,715
Commercial fishing, hunting, and trapping	6,898	\$550,644	\$683,432	\$763,396
Mining and oil and gas production	1,094	\$16,864	\$32,492	\$125,885
Agricultural production (plant crop and animal)	23,010	\$864,334	\$1,194,003	\$1,782,646
<b>Total</b>	<b>49,889</b>	<b>\$2,422,026</b>	<b>\$3,499,907</b>	<b>\$7,908,642</b>

Labor income per job was highest in commercial fishing, hunting, and trapping (\$79,827) and lowest in mining, and oil and gas production (\$15,415). For agricultural production, the average per job was \$37,563; forest products had the second highest average income at \$52,427.

Most of the forest products industries are manufacturers, however, the forestry, logging, and biomass power groups are not. In 2017, there were nearly 56,000 manufacturing jobs in Maine with 11,322 in the forest products industries, 20.2 percent of the total. Of sixteen industries, forest products manufacturing was first in terms of employment, followed by transportation equipment, food, fabricated metal, and textiles and apparel manufacturing. It was second in terms of labor income, and first in value-added and output (Exhibit 14).

**Exhibit 10. Manufacturing Industries in Maine, 2017**

<b>Manufacturing Industries</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Forest products	11,322	\$758,926	\$1,140,116	\$4,574,135
Transportation equipment	9,839	\$820,104	\$956,204	\$3,220,886
Food	7,233	\$302,606	\$484,359	\$2,628,853
Fabricated metal	5,258	\$317,405	\$540,559	\$1,209,942
Textiles and apparel	4,353	\$193,058	\$227,175	\$860,375
Miscellaneous	2,717	\$112,658	\$145,267	\$581,633
Chemical	2,310	\$317,262	\$590,861	\$1,854,791
Machinery	2,294	\$162,836	\$213,841	\$730,311
Plastics and rubber products	2,167	\$122,340	\$244,203	\$731,909
Printing	1,940	\$88,852	\$114,734	\$288,472
Beverage and tobacco product	1,867	\$130,018	\$371,708	\$1,224,163
Computer and electronic product	1,809	\$154,940	\$364,842	\$835,904
Nonmetallic mineral product	1,703	\$88,144	\$131,905	\$452,112
Electrical equipment	463	\$33,776	\$24,202	\$144,842
Petroleum and coal	408	\$46,693	\$153,691	\$1,122,643
Primary metal	285	\$13,792	\$22,284	\$114,134
<b>Total</b>	<b>55,967</b>	<b>\$3,663,410</b>	<b>\$5,725,950</b>	<b>\$20,575,104</b>

## Supplemental Economic Contribution Information

The report by Gibson, Leefers, and Poudel provides a detailed discussion of which sectors were included and excluded from this analysis (2020). Most economic data used in this report were derived from IMPLAN, with two notable exceptions.

First, for most of the partial sectors (Appendix B), ratios of published government data were used to identify a portion of the industry that would be treated as forest products. In cases where only part of an IMPLAN sector was associated with forest products, analysts faced three options. The most conservative option was to include only sectors viewed as 100 percent in forest products, excluding sectors where only part produced forest products. At the other end of the spectrum, analysts could have focused on sectors producing any forest products at all, even if the forest products represented a small part of total output. Between these extremes, analysts could choose a third option—selecting the portion of a sector that produced forest products and include only that portion, mindful to include a means for assessing the magnitude of that portion. That is the approach used in this report.

Second, for sector 47, electric power generation–biomass, the IMPLAN employment figures appeared high based on prior knowledge of this sector. Project partners at the state of Maine provided updated direct employment figures, which decreased from 238 to 187 jobs. The updated figure was used in IMPLAN analysis; other sector metrics were increased proportionally.

Wood is used in many other products not covered by the 29 sectors highlighted in this report. For example, boats, blinds, musical instruments, burial caskets, organic chemicals, and pharmaceuticals may use wood directly or as an extract. However, the wood-only component of these product groups is difficult to quantify and was unable to be included in this report. Surveys could be designed and conducted to determine the forest products component of these sectors. In practice, the production functions, employment, output, and other metrics would need to be compiled and inserted into IMPLAN.

## Summary

Over the last 20 years, individual states located in the midwestern and northeastern area of the United States have conducted statewide economic contributions studies of the forest products industries. However, these studies differed in approach, data used, and measures reported. Developing a consistent approach required funding that spanned multiple states. The Forest Markets & Utilization Committee of the Northeast—Midwest State Foresters Alliance secured grant funds through the Landscape Scale Restoration Program within the U.S. Forest Service, Eastern Region, State and Private Forestry to support investigation of the economic contributions of the forest products industry in the 20 northeastern and midwestern states and Nebraska. To that end, the Michigan Department of Natural Resources Forest Resources Division (serving as the lead on the grant project) contracted with Public Sector Consultants to facilitate discussions among the project partner states and to reach consensus on an appropriate analysis methodology and report template for both the regional and state reports, in addition to conducting the analysis.

This report serves as a snapshot of economic contributions of the forest products industries in Maine for 2017, as well as a baseline report for future analyses. State data were used in this report, but given IMPLAN's structure, substate and multistate analyses can be developed. However, future analyses may again require funding from the U.S. Forest Service or other institutions for assessments across multiple states. Methods used in developing this report are consistent across the region. There were 18,887 direct jobs in the forest products industries, and overall, 39,742 jobs were supported. Direct labor income was \$990.2 million with total labor income at \$2.0 billion. Direct value-added was \$1.6 billion, and the total contribution for value-added was \$3.2 billion. Finally, direct output was \$5.2 billion with a total contribution of \$8.2 billion in output. Similar report findings are available from other states in the region and are summarized in a regional report.

## References

- Allred, Shorna B. 2009. "Logging Firm Succession and Retention." *Forest Products Journal* 59(6): 31–26.
- Butler, Brett J. 2018. [\*Forests of Maine, 2017\*](#). Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. <https://doi.org/10.2737/FS-RU-160>
- Conrad, IV, Joseph L., W. Dale Greene, and Patrick Hiesl. 2018. "A Review of Changes in US Logging Businesses 1980s–Present." *Journal of Forestry* 116(3): 291–303.
- Gibson, Melissa, Larry Leefers, and Jagdish Poudel. 2020. *Forest Products Industry Regional Economic Analysis: Methods*. Lansing: Public Sector Consultants.
- Henderson, James and Garen Evans. 2017. [\*Single and Multiple Industry Economic Contribution Analysis Using IMPLAN\*](#). Starkville: Mississippi State University Forest and Wildlife Research Center. Accessed October 11, 2019. [https://www.fwrc.msstate.edu/pubs/implan\\_2017.pdf](https://www.fwrc.msstate.edu/pubs/implan_2017.pdf)
- Parajuli, Rajan, James Henderson, Shaun Tanger, Omkar Joshi, and Ram Dahal. November 2018. "[Economic Contribution Analysis of the Forest-product Industry: A Comparison of the Two Methods for Multisector Contribution Analysis Using IMPLAN](#)." *Journal of Forestry* 116(6): 513–519. <https://doi.org/10.1093/jofore/fvy047>
- United States Department of Agriculture Forest Service. 2019. "[Forest Inventory EVALIDator](#)." *United States Department of Agriculture Forest Service Forest Inventory and Analysis Program*. Accessed October 22, 2019. <http://apps.fs.usda.gov/Evalidator/evalidator.jsp>

## Appendix A: Methods and Data

### Input-Output Analysis: IMPLAN

Several key decisions related to methods were developed through a consensus process (Gibson, Leefers, and Poudel 2020). The project team, in consultation with the states, made consensus decisions regarding the modeling method for estimating economic contributions, the forest products sectors to include in analysis (either in total or in part), the IMPLAN year for reporting results, and the use of an analysis spreadsheet for consistent reporting.

The economic contributions of the region and each state's forest products industries relied on 2017 IMPLAN software and data. IMPLAN is a widely used economic IO model that focuses on interdependence among various producing and consuming sectors in the economy. IMPLAN has 536 industry sectors for the 2017 data set and is based on the NAICS. IMPLAN data are compiled and linked by the IMPLAN software (Version 3.1.1001.12); data come from various government agencies, including the U.S. Census Bureau, the U.S. Bureau of Labor Statistics, and the U.S. Bureau of Economic Analysis. Economic measures in IMPLAN include employment, labor income, value-added, output, and others. More detailed information on data sources is available at [the IMPLAN website](#).

Wassily Leontief developed IO modeling in the mid-20th century. Impact analysis examines the effects of changes in demand in a regional economy, while contribution analysis can evaluate the role of several related sectors in a region. IMPLAN provides the software and data to conduct such analyses. Each sector has a production function tracing the backward linkages (i.e., suppliers) to other sectors. Various sectors produce commodities (e.g., the logging sector produces logs). Leakages (e.g., foreign and domestic imports/exports) to and from other regions are also modeled. Social accounting flows among industries, households, government, and capital are included in IMPLAN.

The analysis process begins with creating an IMPLAN model. One or more geographic areas (e.g., counties or states) are selected as the region. Then, models are run through the creation of multipliers. This report uses Social Accounting Matrix (SAM) multipliers. Next, activities are selected to estimate either economic impacts or contributions. For example, analysts can estimate the impacts of expanding or contracting industries. In the case of contribution analysis, it is important to ensure that the level of production does not exceed the actual level of production in the region. Contribution analysis essentially counters the effects of the multipliers.

Contributions can be in terms of value-added, output, employment, and/or labor income. Value-added is commonly used to describe an industry's economic contributions and is a conservative measure of these contributions. Value-added is the difference between an industry's output, and the costs of intermediate inputs. When a sawmill sells a board, the value of the log and other inputs is not counted in value-added because they were counted when produced by loggers and others. Thus, only new additions to value (e.g., labor income) are included. Labor income is the major component of value-

added and includes employee compensation and proprietor income. Value-added, summed across all sectors, is equal to GSP.

Another measure of economic contribution is industry output. For example, if a log is sold to a sawmill that sells boards, both sales are counted as part of the overall region's output, as they are important economic activities. Another measure, employment, includes both full- and part-time jobs. As the number of sectors in an analysis increases, there can be overlap in the number of part-time jobs across sectors.

## Methods

IMPLAN estimates economic impacts (i.e., effects of economic changes) and contributions (i.e., effects of existing industries). Two methods for multisector economic contribution analysis are available (Parajuli et al., 2018), both requiring significant data manipulation.

The first method customizes the IMPLAN model by changing selected endogenous tables, whereas the second method adjusts input values based on matrix inversion prior to analysis. In method one, the changes are internal to IMPLAN and difficult to monitor from a quality control perspective.

Method two relies mostly on spreadsheet-based manipulation and is easier to monitor. When the contribution analysis is completed, direct effects from the IMPLAN sectors of interest equal the amounts shown in IMPLAN's "Industry Detail" table, and the total contributions (direct plus indirect plus induced) are estimated. Both methods prevent over reporting of total effects, which can occur if standard economic impact analysis is used when contribution analysis results are desired.

IMPLAN was designed for economic impact analysis. Multipliers ensure that the ripple effect manifests across the economy. A portion of those effects often involve self-purchases within the sector of interest. That is, if the output from the logging sector is \$1 million in a local economy, the economic impact of \$1 million in sales would be greater than that amount due to self-purchases. The contribution methods are designed to yield the \$1 million direct contribution and its associated effects. Put simply, the amount of sales (direct contribution) estimated cannot exceed the amount that actually exists. Methods one and two accomplish this.

The matrix inversion approach relies on developing a detailed social accounting matrix (SAM) output multiplier for each sector in the forest products industries. Hence, a 32x32 matrix is developed with the diagonal yielding a value close to 1.0 for the detailed multipliers relating each row-column sector to itself (e.g., logging to logging, sawmills to sawmills, etc.). The actual matrix can be developed in several ways. For example, the SAM matrix can be exported from IMPLAN and narrowed down to the appropriate row and columns for the forest products industries. Then, it can be used to develop detailed multipliers via matrix inversion. Alternatively, detailed multipliers can be exported and rearranged into a 32x32 matrix. The approach used in this report was to rely on a matrix developed by IMPLAN staff for

the state. Then, the matrix was inverted and multiplied the initial IMPLAN output values for forest industries sectors to yield inputs for IMPLAN analysis.

## Appendix B: Forest Products Industries Groupings and IMPLAN Sectors

### Exhibit B1. Forestry Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
10	Maple syrup production*
15	Forestry, forest products, and timber tract production
19	Support activities for forestry*

Note: Sectors with an “\*” indicate that only a portion of the sector is included in the forest products industries.

### Exhibit B2. Logging Industry Grouping and IMPLAN Sector

IMPLAN Sector	Sector Name
16	Commercial logging

### Exhibit B3. Primary Solid Wood Products Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
47	Electric power generation—biomass*
134	Sawmills
135	Wood preservation
136	Veneer and plywood manufacturing
138	Reconstituted wood product manufacturing

Note: Sectors with an “\*” indicate that only a portion of the sector is included in the forest products industries.

### Exhibit B4. Secondary Solid Wood Products Industry Grouping and IMPLAN Sectors

IMPLAN Sector	Sector Name
137	Engineered wood member and truss manufacturing
139	Wood windows and doors manufacturing
140	Cut stock, resawing lumber, and planing
141	Other millwork, including flooring
142	Wood container and pallet manufacturing
143	Manufactured home (mobile home) manufacturing
144	Prefabricated wood building manufacturing
145	All other miscellaneous wood product manufacturing

---

**Exhibit B5. Wood Furniture Industry Grouping and IMPLAN Sectors**

<b>IMPLAN Sector</b>	<b>Sector Name</b>
368	Wood kitchen cabinet and countertop manufacturing
369	Upholstered household furniture manufacturing
370	Nonupholstered wood household furniture manufacturing
372	Institutional wood furniture manufacturing*
373	Wood office furniture manufacturing
374	Custom architectural woodwork and millwork manufacturing
376	Showcase, partition, shelving, and locker manufacturing*

Note: Sectors with an “\*” indicate that only a portion of the sector is included in the forest products industries.

---

---

**Exhibit B6. Pulp, Paper, and Paperboard Mills Industry Grouping and IMPLAN Sectors**

<b>IMPLAN Sector</b>	<b>Sector Name</b>
146	Pulp mills
147	Paper mills
148	Paperboard mills

---

**Exhibit B7. Secondary Paperboard and Other Paper Products Industry Grouping and IMPLAN Sectors**

<b>IMPLAN Sector</b>	<b>Sector Name</b>
149	Paperboard container manufacturing
150	Paper bag and coated and treated paper manufacturing
151	Stationery product manufacturing
152	Sanitary paper product manufacturing
153	All other converted paper product manufacturing

## Appendix C: Detailed Economic Contribution Results

### Direct Economic Contribution by IMPLAN Sector

**Exhibit C1.** Direct Economic Contributions, Forestry Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry, forest products, and timber tract production	169	\$5,805	\$6,058	\$10,494
Support activities for forestry	1,590	\$45,595	\$44,052	\$50,155
Maple syrup production	567	\$8,953	\$9,937	\$23,893
<b>Subtotal</b>	<b>2,326</b>	<b>\$60,352</b>	<b>\$60,048</b>	<b>\$84,542</b>

**Exhibit C2.** Direct Economic Contributions, Logging Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Commercial logging	5,052	\$159,369	\$305,440	\$416,480
<b>Subtotal</b>	<b>5,052</b>	<b>\$159,369</b>	<b>\$305,440</b>	<b>\$416,480</b>

**Exhibit C3.** Direct Economic Contributions, Primary Solid Wood Products Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Electric power generation—biomass	187	\$11,536	\$84,375	\$161,559
Sawmills	2,230	\$120,135	\$138,203	\$629,511
Wood preservation	103	\$6,145	\$11,558	\$60,579
Veneer and plywood manufacturing	159	\$9,463	\$11,604	\$44,755
Reconstituted wood product manufacturing	308	\$24,794	\$41,257	\$170,472
<b>Subtotal</b>	<b>2,986</b>	<b>\$172,074</b>	<b>\$286,996</b>	<b>\$1,066,877</b>

**Exhibit C4.** Direct Economic Contributions, Secondary Solid Wood Products Detail, 2017

<b>Sector</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Engineered wood member and truss manufacturing	200	\$11,464	\$13,049	\$45,252
Wood windows and doors manufacturing	270	\$14,266	\$17,807	\$60,346
Cut stock, resawing lumber, and planing	91	\$3,999	\$5,662	\$20,329
Other millwork, including flooring	103	\$3,871	\$4,971	\$19,341
Wood container and pallet manufacturing	449	\$18,324	\$21,294	\$67,014
Manufactured home (mobile home) manufacturing	-	-	-	-
Prefabricated wood building manufacturing	382	\$17,365	\$19,316	\$62,677
All other miscellaneous wood product manufacturing	989	\$41,099	\$50,559	\$170,500
<b>Subtotal</b>	<b>2,484</b>	<b>\$110,389</b>	<b>\$132,658</b>	<b>\$445,458</b>

**Exhibit 11.** Direct Economic Contributions, Wood Furniture Detail, 2017

<b>Sector</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Wood kitchen cabinet and countertop manufacturing	369	\$12,666	\$14,523	\$47,889
Upholstered household furniture manufacturing	17	\$805	\$969	\$3,370
Nonupholstered wood household furniture manufacturing	402	\$14,487	\$19,220	\$49,781
Institutional wood furniture manufacturing	259	\$20,122	\$24,611	\$57,375
Wood office furniture manufacturing	8	\$297	\$466	\$1,608
Custom architectural woodwork and millwork manufacturing	290	\$15,473	\$18,743	\$46,349
Showcase, partition, shelving, and locker manufacturing	244	\$9,943	\$12,966	\$46,167
<b>Subtotal</b>	<b>1,590</b>	<b>\$73,792</b>	<b>\$91,498</b>	<b>\$252,539</b>

**Exhibit 12.** Direct Economic Contributions, Pulp, Paper, and Paperboard Mills Detail, 2017

<b>Sector</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Pulp mills	634	\$64,024	\$88,926	\$415,447
Paper mills	2,503	\$257,241	\$462,533	\$1,925,517
Paperboard mills	-	-	-	-
<b>Subtotal</b>	<b>3,137</b>	<b>\$321,265</b>	<b>\$551,459</b>	<b>\$2,340,964</b>

**Exhibit C7.** Direct Economic Contributions, Secondary Paperboard and Other Paper Products Detail, 2017

<b>Sector</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Paperboard container manufacturing	332	\$21,943	\$30,028	\$150,115
Paper bag and coated and treated paper manufacturing	104	\$7,011	\$10,284	\$44,714
Stationery product manufacturing	-	-	-	-
Sanitary paper product manufacturing	394	\$33,566	\$83,635	\$289,583
All other converted paper product manufacturing	482	\$30,421	\$37,933	\$145,445
<b>Subtotal</b>	<b>1,312</b>	<b>\$92,942</b>	<b>\$161,880</b>	<b>\$629,856</b>

Note: Value-added in IMPLAN is equivalent to gross state product.

## U.S. Forest Service Nondiscrimination Statement

“In accordance with Federal law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, this institution is prohibited from discriminating on the basis of race, color, national origin, sex, age, disability, and reprisal or retaliation for prior civil rights activity. (Not all prohibited bases apply to all programs.)

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible State or local Agency that administers the program or USDA’s TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information is also available in languages other than English.

To file a complaint alleging discrimination, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at [http://www.ascr.usda.gov/complaint\\_filing\\_cust.html](http://www.ascr.usda.gov/complaint_filing_cust.html) , or at any USDA office or write a letter addressed to USDA and provided in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250- 9410; (2) fax: (202) 690-7442; or (3) email: [program.intake@usda.gov](mailto:program.intake@usda.gov).

This institution is an equal opportunity provider.”