

# Forest Products Industries' Economic Contributions: Wisconsin

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*Prepared by*

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

*Prepared for*

Wisconsin Department of Natural Resources  
Forest Resources Division  
Madison, Wisconsin  
[www.dnr.wi.gov](http://www.dnr.wi.gov)

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



**PUBLIC SECTOR  
CONSULTANTS**



## Foreword

Wisconsin's forests are a valued natural resource in the state, totaling more than 17 million acres. The protection and sustainable management of forests provide Wisconsin's citizens a wide array of ecological functions and societal benefits including clean air, clean water, and carbon sequestration. Sustainable forestry practices help ensure a consistent supply of raw material for the forestry sector, as well as an ecologically diverse and aesthetically pleasing landscape that can be enjoyed by all Wisconsinites.

In addition, forests are vital to Wisconsin's economy. Wisconsin proudly supports one of the nation's largest forest products economic sectors. Its many industries are recognized leaders in the adoption of cutting-edge technologies, products and processes. This sector is diverse, ranging from multi-national firms to many small family-owned and operated businesses. Together, these companies produce countless forest products that make our lives better while also providing tens of thousands of jobs that support many communities throughout the state.

It brings me great pleasure to present the Wisconsin Economic Industry Report. Thank you for your interest in learning about this important part of Wisconsin's history, economic prosperity, and the practice of sustainable forestry.

Mike Warnke

Forestry Deputy Division Administrator  
Wisconsin Department of Natural Resources

## Acknowledgements

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## Executive Summary

This report assesses broad forest conditions and economic contributions of Wisconsin's forest products industries. 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.

Wisconsin boasts 17 million acres of forest land that cover 49 percent of its land base, with most of this land able to produce commercial timber. The majority, 69.7 percent, is privately owned, while state and local governments own approximately 21 percent, and the federal government owns about 10 percent.

## Forest Industries

This report presents seven forest products industries, which are based on 32 economic sectors in IMPLAN:

- Forestry
- Logging
- Primary solid wood products
- Secondary solid wood products
- Wood furniture
- Pulp, paper, and paperboard mills
- Secondary paperboard and other paper products

In 2017, Wisconsin's forest products industries provided direct employment to almost 68,000 people, leading to \$25.3 billion in output. That same year, labor income was \$4.5 billion and value-added was \$7.0 billion. In total contributions, these industries supported more than 160,000 jobs, \$9.5 billion in labor income, \$15.3 billion in value-added, and \$40.0 billion in output.

Among the top sectors (excluding forest products sectors) impacted by forest products industries were wholesale trade, company management, real estate, restaurants, trucking, and hospitals. This group of sectors reflects spending by forest products companies, their suppliers, and individuals.

Wisconsin's forest products industries' total economic contribution in terms of output was nearly \$40 billion, based on direct output of \$25.3 billion. Direct jobs totaled 67,793 and were associated with this level of economic activity, and the total number of jobs supported was 160,149. Direct labor income, which includes employee compensation and proprietor income, was \$4.5 billion, or \$66,378 per job.

Total labor income—which includes income paid directly to industry employees and proprietors, their suppliers, and the other industries they support—totaled \$9.5 billion.

## Leading Forest Products Industry Groups

Among the seven industry groups, the leading industries' rank in terms of direct jobs, value-added, and direct output varied by the chosen measure:

- Secondary paperboard and other paper products had the highest number of direct jobs (19,029) and the highest direct output (\$9.3 billion).
- Secondary solid wood products had the second highest number of direct jobs (14,911) and third highest direct output (\$3.0 billion).
- Wood furniture had the third highest number of direct jobs (12,071) and the fourth highest direct output (\$2.2 billion).
- Pulp, paper, and paperboard mills had the fourth highest number of direct jobs (11,233) and the second highest direct output (\$8.5 billion).

## Leading Individual Forest Products Sectors

Among the 32 forest products sectors, the top four, by measure in order from highest to fourth highest of direct contributions, were:

- Employment—Paper mills, paperboard container manufacturing, paper bag and coated and treated paper manufacturing, and commercial logging were the top four sectors in employment and had a combined total of nearly 29,000 direct jobs.
- Labor income—Paper mills, paperboard container manufacturing, paper bag and coated and treated paper manufacturing, and commercial logging had the highest labor income, totaling \$2.3 billion.
- Value-added and output—Paper mills, paper bag and coated treated manufacturing, paperboard container manufacturing, and sanitary paper product manufacturing had the highest value-added, totaling \$4.1 billion. The same four sectors were the top four in terms of output, totaling \$16.4 billion.

## Wisconsin's Forest Products Industries Compared to Other Wisconsin 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). Overall, these industries accounted for 15.3 percent of the nonfood manufacturing jobs in Wisconsin, with agricultural production employing the most people. Approximately 13 percent of Wisconsin's nearly 480,000 direct manufacturing jobs in 2017 were in the forest products industries (i.e., one in eight manufacturing jobs).

## **Wisconsin's Forest Products Industries Compared to Those of Michigan and Minnesota**

Forest products industries in three Great Lakes states (Wisconsin, Michigan, and Minnesota) employed more than 142,000 workers and accounted for almost \$48 billion in direct output. Wisconsin's forest products economy was the largest in the region, followed by 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 Wisconsin's economy. They provide jobs, raw materials, and finished goods that generate additional economic activity throughout the state, region, and nation. Previous studies of these industries' economic contributions have focused solely on Wisconsin—either documenting the industries' continued recovery from the 2008–09 recession or examining its role in the statewide economy. Until now, no studies have compared Wisconsin's forest industry contributions with those of adjacent states, nor have the national or regional interactions of those industries been examined. This is partially due to inconsistent reporting methods and various data sets used across the Northeast and Midwest regions.

This report compares the contributions of Wisconsin's forest products industries with those of adjacent states. It is one of 20 reports in the Northeast and Midwestern area of the United States that broadly assesses forests and their economic contributions.<sup>1</sup> In total, these documents provide a consistent reporting format, compiled using identical methods, across the northeastern and midwestern United States. Previous state-level reports in this area were not comparable because they used 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 Wisconsin, Forest Products Industries, Economic Contributions of Wisconsin's Forest Products Industries, and Summary. Due to rounding, some figures in the following tables may not sum to the exact total indicated. The appendices present the economic methods and detailed economic sector data used for this report.

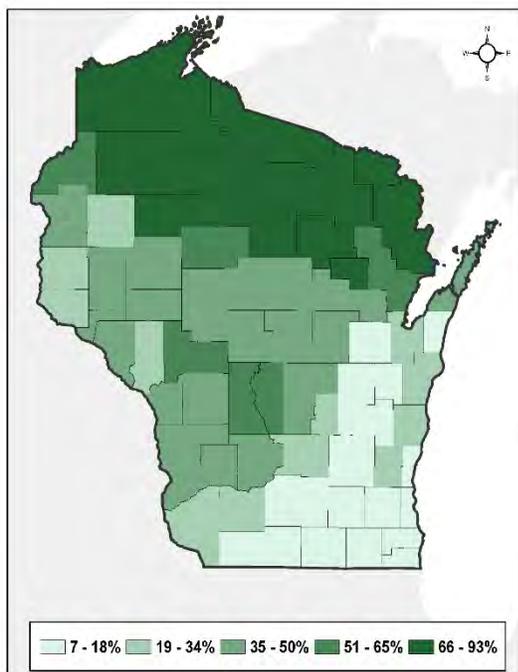
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<sup>1</sup> The interactions of these 20 states are covered in a regional report.

## Forest Resources of Wisconsin

Wisconsin's forest land comprises 49.1 percent of its total land area (Exhibits 1 and 2). By definition, forest land is land that is at least 10 percent stocked by trees of any size, including land that formerly had such tree cover and that could be naturally or artificially regenerated. It also includes land that can produce harvestable timber, as well as those less productive lands available for harvest, and those administratively reserved from timber harvesting. Forest land available for timber harvesting and productive enough to yield commercial timber is called timberland. With 16.5 million acres, Wisconsin ranks 12<sup>th</sup> in the country for amount of timberland.

**Exhibit 1.** Wisconsin's Forest Land by County, 2017



Source: U.S. Forest Service Forest Inventory and Analysis Program.

The majority of Wisconsin's forest land—69.7 percent—is privately owned, while counties, the State, and the U.S. Forest Service are major public owners (Exhibit 3). Management objectives differ among ownership groups. For example, public landowners often have revenue objectives and mandates to sustainably manage forest land. Private landowners have wide latitude in how they treat their lands—some maintain a hands-off approach, while others are more active. There are several state and federal programs designed to encourage the active management of private forest lands, as this approach is critical to Wisconsin's forest products industries. State and national forests are actively managed in many areas, while resource protection is emphasized in others.

Trees are not only common in Wisconsin’s rural forests, but also in urban forests, along waterways, and in private property. There are an estimated 11.5 billion trees in Wisconsin.

**Exhibit 2.** Wisconsin Land Area by Land Use Type, 2017

Land Use Type	Acres	Percentage
Forest land	17,024,984	49.1%
Nonforest land	17,617,308	50.9%
<b>Total</b>	<b>34,642,292</b>	<b>100.0%</b>

Source: U.S. Forest Service.

**Exhibit 3.** Forest Land by Ownership Group in Wisconsin, in Acres, 2017

Ownership Group	Acres	Percentage
National forest and other federal	1,620,463	9.5%
State	1,171,387	6.9%
County and municipal	2,370,827	13.9%
Private	11,862,307	69.7%
<b>Total</b>	<b>17,024,984</b>	<b>100.0%</b>

Wisconsin’s major forest types include oak/hickory, maple/beech/birch, and aspen/birch. Other forest types include elm/ash/cottonwood, pine, and spruce/fir (Exhibit 4). Tree species with the greatest standing volume include sugar maple, red maple, red oak, white pine, red pine, quaking aspen, and American basswood—each with more than one billion cubic feet of volume in growing-stock trees.

**Exhibit 4.** Forest Land Area by Forest Type Group in Wisconsin, 2017

Forest Type Group	Acres	Percentage
Oak/hickory	4,437,727	26.1%
Maple/beech/birch	3,815,526	22.4%
Aspen/birch	2,979,004	17.5%
Elm/ash/cottonwood	1,782,473	10.5%
White/red/jack pine	1,741,191	10.2%
Spruce/fir	1,402,095	8.2%
Other	866,969	5.1%
<b>Total</b>	<b>17,042,985</b>	<b>100.0%</b>

The estimated volume of standing timber suitable for forest products (i.e., the marketable volume of growing stock) was about 22.8 billion cubic feet (Exhibit 5).<sup>2</sup> Average annual net growth exceeded annual harvest removals by a ratio of about 2:1. That is, for every cubic foot of harvesting that takes place, two cubic feet of timber grows after accounting for mortality. Average annual harvest removals of growing stock were about 292.0 million cubic feet, or about 3.7 million cords—roughly 1.3 percent of standing volume.

**Exhibit 5.** Characteristics of Growing Stock in Wisconsin, 2017 (million cubic feet)

Measure	National Forest and Other				
	Total	Federal	County and Municipal	State	Private
Net volume	22,757.1	2,766.6	2,698.3	1,249.6	15,719.9
Average annual net growth	575.5	49.2	75.5	32.5	418.2
Average annual harvest removals	292.0	11.1	55.6	78.5	202.4
Average annual mortality	251.0	31.7	31.6	20.2	167.4

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

Wisconsin is internationally known for its pulp and paper industry, which has led the nation in paper production for over 60 years. In addition, Wisconsin has a diverse wood manufacturing sector, recognized for its high-quality hardwood and softwood resources. The state's managed timber species support a variety of forest products industries, including flooring and cabinet manufacturing; pulp, paper, and paperboard production; composite board (oriented strand board, particle board, and strand-based siding), structural lumber, hardwood grade lumber, and a variety of industrial lumber and wood packaging products.

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 products industries, representatives from the

<sup>2</sup> A standard cord is a unit of measurement for pulpwood or saw logs, 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.

U.S. Forest Service’s Northeastern Area 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 mills
- 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, reconstituted wood products [such as oriented strand board], 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).

This report used IMPLAN to estimate economic contributions of the forest products industries. IMPLAN is a widely used input-output model that comprises economic data and software. IO models characterize financial linkages among and between sectors, households, and institutions. Within these models, various sectors have production functions that show the value of inputs used in production of outputs or commodities. In 2017, 494 sectors represented Wisconsin’s economy. These 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, substate and multistate analyses can be developed.

## **Economic Contributions of Wisconsin’s Forest Products Industries**

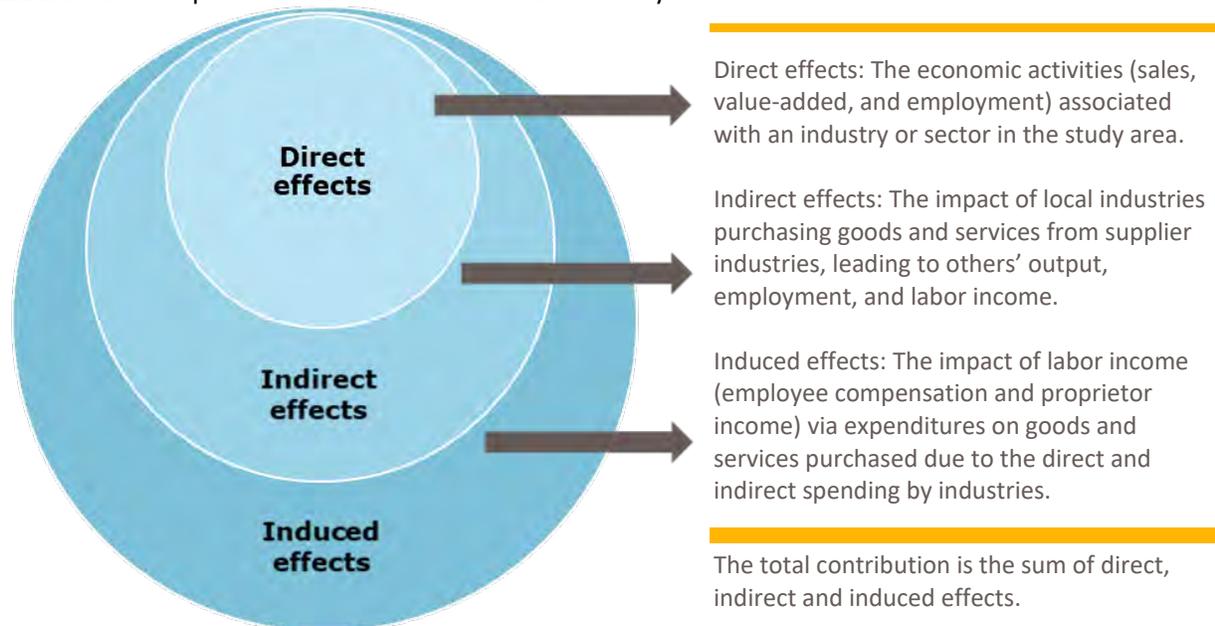
This section of the report includes four major subsections: Economic Contributions Defined, Economic Contribution Results, Importance of the Forest Products Industries in Context, and Supplemental Economic Contribution Information.

## 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 6.** 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 Wisconsin (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 Wisconsin, Michigan, and Minnesota reveals that the direct employment for 2017 was 5,207, 4,487, and 2,495 jobs, respectively. Summing the individual states' total employment contributions (direct, indirect, and induced) yields 17,555 jobs. However, if the states are combined as one region, the total employment contribution increases to 17,803 jobs. This increase reflects less leakage and more local purchases.

The regional analysis highlights the larger role of forest products industries in the region's economy. The larger role is due to trade, but IMPLAN does not explicitly show trade with specific states, only overall imports and exports. Consequently, the state-level analyses underestimate the actual contributions from a regional perspective.

## **Economic Contribution Results**

This section presents direct and total contributions for all forest products industries, direct and total contributions by forest product industry groups (e.g., logging, furniture, etc.), the top forest products sectors, and the top nonforest products sectors affected by the forest products industries. Finally, this section compares forest industries in nearby states, other natural resources industries, and manufacturing industries within the state.

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 Wisconsin's forest products industries are tightly bound to forests and the goods and ecosystem services they provide (e.g., wildlife habitat, watershed protection, carbon sequestration, etc.).

### **Overall Forest Products Industries**

Contribution analysis provides a means to assess the role various industries play in a state's economy. Most state economies are large relative to any industry or group of industries, and the forest products industries are no exception.

In 2017, Wisconsin's population was estimated at nearly 5.8 million people, with total employment of 3.7 million. The gross state product (GSP), also known as value-added, was \$324 billion from 494 economic sectors (of the possible 536 in the U.S.). The GSP's largest component was labor income, which was \$199.2 billion.

Wisconsin's forest products industries' total economic contribution in terms of output was nearly \$40 billion, based on a direct output of \$25.2 billion (Exhibit 7). Direct jobs associated with this level of economic activity totaled 67,793, and the total number of jobs supported was 160,149. Direct labor income, which includes employee compensation and proprietor income, was \$4.5 billion, or \$66,378 per job. Total labor income—which includes income paid directly to industry employees and proprietors, their suppliers, and the other industries they support—totaled \$9.5 billion. Direct value-added for forest

products industries was \$7.1 billion: 2.2 percent of Wisconsin’s GSP. This percentage more than doubles to 4.7 percent when considering total value-added effects. These percentages hold for other economic measures (e.g., jobs) as well.

Each direct job in the forest products industries supported 1.37 additional jobs, and every \$1 million in direct labor income supported an additional \$1.11 million in indirect and induced labor income.

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**Exhibit 1.** Economic Contribution of Forest Products Industries in Wisconsin, 2017 Dollars

<b>Effect</b>	<b>Employment</b>	<b>Labor Income (Thousands of Dollars)</b>	<b>Value-added* (Thousands of Dollars)</b>	<b>Output (Thousands of Dollars)</b>
Direct	67,793	\$4,517,367	\$7,065,287	\$25,282,710
<b>Total</b>	<b>160,149</b>	<b>\$9,528,567</b>	<b>\$15,295,296</b>	<b>\$39,996,566</b>

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

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

In Wisconsin, secondary paperboard and other paper products was the largest of the seven industry groups in direct employment, labor income, and value-added. Pulp, paper, and paperboard mills was the second largest group in labor income, value-added, and output. Secondary solid wood products was the second largest group in direct employment and third largest in output. Forestry (including maple syrup production, timber tract operations, and forestry support activities) was the smallest group for all metrics.

Two groups—pulp, paper, and paperboard mills and secondary paperboard and other paper products—accounted for more than half of forest products industries’ output. Approximately two-thirds of forest products industries employment was in the wood furniture and secondary manufacturing groups.

**Exhibit 8.** Direct Economic Contributions in Wisconsin, Industry Groups, 2017

Industry Group	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	778	\$27,804	\$28,337	\$33,960
Logging	5,207	\$314,614	\$375,323	\$489,763
Primary solid wood products	4,564	\$274,920	\$412,685	\$1,630,002
Secondary solid wood products	14,911	\$704,408	\$1,002,107	\$3,041,763
Wood furniture	12,071	\$656,930	\$750,659	\$2,174,899
Pulp, paper, and paperboard mills	11,233	\$1,013,060	\$1,962,788	\$8,562,915
Secondary paperboard and other paper products	19,029	\$1,525,630	\$2,533,388	\$9,349,409
<b>Total</b>	<b>67,793</b>	<b>\$4,517,366</b>	<b>\$7,065,287</b>	<b>\$25,282,711</b>

**Exhibit 9.** Total Economic Contributions in Wisconsin, Industry Groups, 2017

Industry Group*	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	359	\$19,958	\$22,399	\$29,440
Logging	2,263	\$122,218	\$162,405	\$234,494
Primary solid wood products	10,573	\$604,925	\$933,271	\$2,317,949
Secondary solid wood products	29,153	\$1,456,706	\$2,220,184	\$5,249,986
Wood furniture	22,231	\$1,175,623	\$1,610,503	\$3,752,512
Pulp, paper, and paperboard mills	43,254	\$2,801,737	\$4,801,691	\$13,336,723
Secondary paperboard and other paper products	52,317	\$3,347,400	\$5,544,843	\$15,075,460
<b>Total</b>	<b>160,150</b>	<b>\$9,528,567</b>	<b>\$15,295,296</b>	<b>\$39,996,564</b>

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

Note: Column totals in this exhibit and total contributions in Exhibit 8 are not identical due to rounding errors of less than 0.1 percent.

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, maple syrup production, and support activities for forestry. Timber tract operations include establishments that primarily sell 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, firefighting, controlling pests, 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 was the smallest in terms of direct contributions in 2017. Direct contributions were \$33.9 million in output, 778 jobs, \$27.8 million in labor income, and \$28.3 million in value-added. Total contributions are partly based 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, approximately two-thirds (67 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. In other words, 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 in the section below.

## **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 third smallest in terms of direct employment. The direct contributions of logging were \$489.7 million in output, 5,207 jobs, \$314.6 million in labor income, and \$182.1 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 Wisconsin, 72 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 sixth largest group in terms of direct employment in Wisconsin. 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 \$1.6 billion in output, 4,564 jobs, \$274.9 million in labor income, and \$412.7 million in value-added. Total contributions for primary solid wood products, including direct, indirect and induced effects, were \$2.31 billion in output, 10,573 jobs, \$604.9 million in labor income, and \$933.2 million in value-added. Many primary solid wood products

(e.g., lumber and panels) are inputs in other industries, which counted in other industries' total contributions.

### **Secondary Solid Wood Products**

Secondary solid wood products was the second largest group in terms of direct employment in Wisconsin. The 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 this group were \$3 billion in output, 14,911 jobs, \$704.4 million in labor income, and \$1 billion in value-added. Total contributions were \$5.2 billion in output, 29,153 jobs, \$1.46 billion in labor income, and \$2.2 billion in value-added.

### **Wood Furniture**

Wood furniture was the third largest group in terms of direct employment in Wisconsin. Wood furniture includes the manufacturing of wood kitchen cabinets and countertops; upholstered household furniture; nonupholstered wood household furniture; institutional wood furniture; wood office furniture; custom architectural woodwork and millwork; and showcases, partitions, shelving, and lockers. Direct contributions of wood furniture were \$2.1 billion in output, 12,071 jobs, \$656.9 million in labor income, and \$750.7 million in value-added. Total contributions of wood furniture were \$3.8 billion in output, 22,231 jobs, \$1.2 billion in labor income, and \$1.6 billion in value-added.

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

The pulp, paper, and paperboard mills industry group was the fourth largest group in terms of direct employment in Wisconsin. The group includes pulp, paper, and paperboard mills that make paper or pulp from raw wood and from purchased pulp. This group's direct contributions were \$8.6 billion in output, 11,233 jobs, \$1 billion in labor income, and \$2 billion in value-added. Total contributions were \$13.3 billion in output, 43,254 jobs, \$2.8 billion in labor income, and \$4.8 billion in value-added.

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

The secondary paperboard and other paper products group was the largest in terms of direct employment in Wisconsin. 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 \$9.3 billion in output, 19,029 jobs, \$1.5 billion in labor income, and \$2.5 billion in value-added. Total contributions were \$15.1 billion in output, 52,317 jobs, \$3.3 billion in labor income, and \$5.5 billion in value-added.

## Top Forest Product Sectors

Among the 32 industry sectors that comprise the seven industry groups listed above, the leading sectors varied by the contribution measure examined. In terms of direct jobs, the four largest forest products sectors are paper mills (10,477 jobs), paperboard container manufacturing (7,192 jobs), paper bag and coated and treated paper manufacturing (6,120 jobs), and commercial logging (5,207 jobs). These sectors reflect the diversity of Wisconsin's manufacturing sector.

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

The paperboard and container manufacturing sector comprises establishments primarily engaged in converting paperboard into containers without manufacturing paperboard. These establishments use corrugating, cutting, and shaping machinery to form paperboard into containers. Products made by these establishments include boxes, corrugated sheets, pads, pallets, paper dishes, fiber drums, and reels.

The paper bag and coated and treated paper manufacturing industry comprises establishments engaged in one or more of the following:

- Cutting and coating paper and paperboard
- Cutting and laminating paper, paperboard, and other flexible materials (except plastics film to plastics film)
- Manufacturing bags, multiwall bags, sacks of paper, metal foil, coated paper, laminates, or coated combinations of paper and foil with plastics film
- Manufacturing laminated aluminum and other converted metal foils from purchased foils
- Surface coating paper or paperboard

The commercial logging sector has establishments primarily engaged in one or more of the following activities: cutting timber, cutting and transporting timber, and producing wood chips in the field. Loggers are a critical component of the forest products industries.

In terms of direct labor income, paper mills, paperboard container manufacturing, paper bag and coated and treated paper manufacturing, and commercial logging had the highest labor income, totaling \$2.3 billion. Papermills, paper bag and coated treated manufacturing, paperboard container manufacturing, and sanitary paper product manufacturing, had the highest value-added, totaling \$4.1 billion. For output, the same four sectors were the top four in terms of output, totaling \$16.4 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 Wisconsin. Including the 32 forest products industries, 213 sectors were impacted in 2017 (counting sectors with ten or more jobs supported). The top ten sectors (excluding forest products sectors) included real estate, restaurants, trucking, hospitals, and wholesale trade (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 the 3,295 jobs in truck transportation included log trucks, delivery trucks, and office jobs for some trucking companies, among others.

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**Exhibit 10.** Direct Jobs Impacted by the Forest Products Industries Among Wisconsin’s Top Ten Non-Forest Products Industries in 2017

<b>IMPLAN Sector</b>	<b>Description</b>	<b>Jobs</b>
395	Wholesale trade	8,639
461	Management of companies and enterprises	4,736
501	Full-service restaurants	3,676
411	Truck transportation	3,295
502	Limited-service restaurants	3,241
440	Real estate	3,150
482	Hospitals	2,867
464	Employment services	2,404
468	Services to buildings	2,364
62	Maintenance and repair construction of nonresidential structures	1,638
<b>Total</b>		<b>36,010</b>

## Neighboring States

The Lake States area (Wisconsin, Michigan, and Minnesota) is an important region for forest products. Forest products industries employ more than 142,000 workers across the region and account for almost \$48 billion in direct output (Exhibits 11 and 12). Wisconsin had the largest forest products economy, with nearly 68,000 direct jobs and output in excess of \$25 billion. Minnesota’s industry was about half the size of Wisconsin’s. Michigan falls between the two. The three largest industry groups, each with over 31,000 employees, were secondary paperboard and other paper products, secondary solid wood products, and wood furniture.

**Exhibit 11.** Forest Products Industries Direct Employment in Wisconsin, Minnesota, and Michigan, 2017

<b>Industry</b>	<b>Wisconsin</b>	<b>Minnesota</b>	<b>Michigan</b>
Forestry	778	782	1,321
Logging	5,207	2,495	4,487
Primary solid wood products	4,564	1,489	4,768
Secondary solid wood products	14,911	11,288	7,048
Wood furniture	12,071	8,575	10,837
Pulp, paper, and paperboard mills	11,233	2,542	3,186
Secondary paperboard and other paper products	19,029	6,885	9,099
<b>Sum of direct contributions</b>	<b>67,793</b>	<b>34,056</b>	<b>40,746</b>

**Exhibit 12.** Forest Products Industries Direct Output in Wisconsin, Minnesota, and Michigan, 2017

<b>Industry</b>	<b>Wisconsin (Thousands of Dollars)</b>	<b>Minnesota (Thousands of Dollars)</b>	<b>Michigan (Thousands of Dollars)</b>
Forestry	\$33,960	\$35,376	\$62,158
Logging	\$489,763	\$140,983	\$280,775
Primary solid wood products	\$1,630,002	\$720,227	\$1,689,173
Secondary solid wood products	\$3,041,763	\$2,651,642	\$1,420,592
Wood furniture	\$2,174,899	\$1,419,961	\$2,239,587
Pulp, paper, and paperboard mills	\$8,562,915	\$2,185,705	\$2,493,853
Secondary paperboard and other paper products	\$9,349,409	\$3,349,371	\$3,996,111
<b>Sum of direct contributions</b>	<b>\$25,282,711</b>	<b>\$10,503,265</b>	<b>\$12,182,249</b>

## Importance of the Forest Products Industries in Context

To help contextualize the relative importance of the forest products industries, it is useful to compare the contribution of Wisconsin's forest products industries with others (Exhibit 13). Natural resources and agricultural industries significantly contribute to the diversity of economic activities reflected in Wisconsin's \$324.1 billion GSP. The forest products industries provide more direct labor income, value-added, and output than the commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries combined. Wisconsin's industries comprised 2.2 percent of the GSP in 2017. Agricultural production provided the largest amount of employment (full- and part-time), by far, of these industries.

**Exhibit 13.** Natural Resources and Agricultural Production Industries in Wisconsin, 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	67,793	\$4,517,367	\$7,065,287	\$25,282,710
Commercial fishing, hunting, and trapping	1,119	\$1,696	\$8,196	\$10,017
Mining and oil and gas production	6,892	\$296,876	\$1,835,354	\$2,352,225
Agricultural production (plant crop and animal)	101,839	\$3,143,708	\$4,952,806	\$12,799,922
<b>Total</b>	<b>177,643</b>	<b>\$7,959,647</b>	<b>\$13,861,643</b>	<b>\$40,444,874</b>

Labor income per job is highest in forest products (\$66,635) and lowest in commercial fishing, hunting, and trapping (\$1,515). For agricultural production, the average income per job is \$30,869; mining and oil and gas has the second highest average income at \$43,077.

Most of the forest products industries are manufacturers; however, the forestry, logging, and biomass power groups are not. In 2017, there were approximately 480,000 manufacturing jobs in Wisconsin, of which 61,682 (12.9 percent) were in the forest products industries. Of 16 manufacturing industries, forest products was fourth in employment, labor income, and value-added, and third in output; it trailed fabricated metal, food, and machinery manufacturing (Exhibit 14).

**Exhibit 14.** Manufacturing Industries in Wisconsin, 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>
Fabricated metal	75,474	\$5,180,804	\$6,883,851	\$18,040,269
Food	73,183	\$4,839,200	\$8,376,880	\$46,672,068
Machinery	64,673	\$5,234,205	\$7,884,439	\$25,052,659
Forest products	61,682	\$4,115,505	\$6,576,315	\$24,621,670
Plastics and rubber products	33,000	\$2,139,364	\$3,349,550	\$10,859,745
Printing	30,384	\$1,838,925	\$2,443,776	\$5,158,422
Transportation equipment	26,908	\$1,708,239	\$4,127,042	\$15,249,500
Electrical equipment	23,727	\$2,403,527	\$3,668,386	\$9,857,660
Miscellaneous	20,315	\$1,291,193	\$1,705,272	\$4,992,812
Chemical	17,158	\$1,942,241	\$4,280,426	\$14,776,431
Computer and electronic product	16,236	\$1,468,898	\$2,759,756	\$7,451,485
Primary metal	15,887	\$1,211,523	\$1,866,000	\$5,226,872
Nonmetallic mineral product	10,276	\$662,676	\$1,880,149	\$4,055,305
Textiles and apparel	5,810	\$272,812	\$372,301	\$1,219,724
Beverage and tobacco product	4,672	\$294,353	\$841,799	\$2,506,531
Petroleum and coal	474	\$64,386	\$415,405	\$1,652,237
<b>Total</b>	<b>479,859</b>	<b>\$34,667,851</b>	<b>\$57,431,347</b>	<b>\$197,393,390</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.

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 had three options. The most conservative option was to include only sectors that produce only forest products; sectors that do not solely produce forest products would be excluded from the analysis. The second option was to include sectors producing any forest products, even if the product is a small portion of total output. The third option was to assess what portion of a sector is produced a forest product and to include only that portion. Of course, some means for assessing the magnitude of the portion was needed. This third option was the approach used in this report.

The second exception regards sector 47, electric power generation—biomass. Based on the project team’s previous knowledge of this sector, the IMPLAN employment figures appeared high. Project partners at the State of Wisconsin provided updated direct employment figures for this sector, which decreased jobs from 215 to 126. The updated figure was used for the IMPLAN analysis; other sector metrics increased proportionally.

Wood is used in several other products not covered by the 32 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 not 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 entered 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 Northeast-Midwest State Foresters Alliance Forest Markets & Utilization Committee 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 Wisconsin 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 if multistate results are desired. Methods used in developing this report are consistent across the region. In Wisconsin, there were 67,793 direct jobs in the forest products industries, and overall, 160,149 jobs were supported. Direct labor income was \$4.5 billion, with total labor income at \$9.5 billion. Direct value-added was \$7.1 billion, and the total contribution for value-added was \$15.3 billion. Finally, direct output was \$25.3 billion with a total contribution of \$40.0 billion in output. Similar report findings are available from other states in the region and are summarized in a regional report.

## References

- 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. October 31, 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/evaluator.jsp>
- Watson, Philip, Joshua Wilson, Dawn Thilmany, and Susan Winter. 2007. "[Determining Economic Contributions and Impacts: What Is the Difference and Why Do We Care?](#)" *The Journal of Regional Analysis and Policy* 37(2): 1–15. Accessed March 12, 2020. [https://www.researchgate.net/publication/280717869\\_Determining\\_Economic\\_Contributions\\_and\\_Impacts\\_What\\_is\\_the\\_difference\\_and\\_why\\_do\\_we\\_care](https://www.researchgate.net/publication/280717869_Determining_Economic_Contributions_and_Impacts_What_is_the_difference_and_why_do_we_care)

## 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-20<sup>th</sup> 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 overreporting 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 detailed SAM output multipliers 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

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### Exhibit B1. Forestry Products 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.

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

IMPLAN Sector	Sector Name
16	Commercial logging

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### 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.

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### 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

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**Exhibit B5. Wood Furniture Products 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.

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

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

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**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	62	\$3,778	\$3,876	\$5,495
Support activities for forestry	476	\$21,036	\$20,358	\$22,185
Maple syrup production	240	\$2,990	\$4,103	\$6,280
<b>Subtotal</b>	<b>778</b>	<b>\$27,804</b>	<b>\$28,337</b>	<b>\$33,960</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	5,207	\$314,614	\$375,323	\$489,763
<b>Subtotal</b>	<b>5,207</b>	<b>\$314,614</b>	<b>\$375,323</b>	<b>\$489,763</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	126	\$59,444	\$85,312	\$137,318
Sawmills	2,195	\$88,150	\$111,297	\$594,836
Wood preservation	189	\$11,510	\$31,532	\$121,576
Veneer and plywood manufacturing	1,283	\$62,354	\$76,599	\$344,240
Reconstituted wood product manufacturing	772	\$53,463	\$107,945	\$432,032
<b>Subtotal</b>	<b>4,565</b>	<b>\$274,921</b>	<b>\$412,685</b>	<b>\$1,630,002</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	1,119	\$54,079	\$59,641	\$239,459
Wood windows and doors manufacturing	5,196	\$277,279	\$396,958	\$1,214,733
Cut stock, resawing lumber, and planing	335	\$16,959	\$31,653	\$85,673
Other millwork, including flooring	2,206	\$97,571	\$157,037	\$465,545
Wood container and pallet manufacturing	2,854	\$112,454	\$148,988	\$439,883
Manufactured home (mobile home) manufacturing	193	\$9,138	\$17,807	\$49,876
Prefabricated wood building manufacturing	1,073	\$53,292	\$64,794	\$186,683
All other miscellaneous wood product manufacturing	1,935	\$83,636	\$125,229	\$359,912
<b>Subtotal</b>	<b>14,911</b>	<b>\$704,408</b>	<b>\$1,002,107</b>	<b>\$3,041,764</b>

**Exhibit C5. 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	3,130	\$142,164	\$155,826	\$438,715
Upholstered household furniture manufacturing	3,738	\$204,273	\$232,459	\$754,815
Nonupholstered wood household furniture manufacturing	687	\$27,394	\$33,296	\$85,432
Institutional wood furniture manufacturing	2,818	\$186,684	\$213,793	\$570,844
Wood office furniture manufacturing	185	\$9,408	\$13,337	\$39,024
Custom architectural woodwork and millwork manufacturing	529	\$30,120	\$34,151	\$84,449
Showcase, partition, shelving, and locker manufacturing	984	\$56,886	\$67,797	\$201,620
<b>Subtotal</b>	<b>12,071</b>	<b>\$656,929</b>	<b>\$750,659</b>	<b>\$2,174,899</b>

**Exhibit C6.** 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	39	\$4,876	\$6,508	\$26,411
Paper mills	10,477	\$941,801	\$1,829,759	\$7,953,933
Paperboard mills	717	\$66,383	\$126,521	\$582,571
<b>Subtotal</b>	<b>11,233</b>	<b>\$1,013,060</b>	<b>\$1,962,788</b>	<b>\$8,562,915</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	7,192	\$579,894	\$772,259	\$3,376,300
Paper bag and coated and treated paper manufacturing	6,120	\$498,348	\$773,403	\$2,797,646
Stationery product manufacturing	852	\$59,001	\$87,612	\$319,152
Sanitary paper product manufacturing	2,910	\$248,224	\$718,595	\$2,238,599
All other converted paper product manufacturing	1,955	\$140,164	\$181,519	\$617,712
<b>Subtotal</b>	<b>19,029</b>	<b>\$1,525,631</b>	<b>\$2,533,388</b>	<b>\$9,349,409</b>

Note: Value-added in IMPLAN is equivalent to GSP.

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