

# Forest Products Industries' Economic Contributions: Minnesota

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NATURAL RESOURCES



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## Foreword

This report is one of two reports generated through a U.S. Department of Agriculture Forest Service Landscape Scale restoration grant project. The first report includes a regional economic assessment that includes Minnesota, Wisconsin, Michigan, and 17 other Midwestern and Northeastern states. The second “Minnesota Forest Products Industries’ Economic Contributions” concentrates on Minnesota. It does an excellent job highlighting the forest product industries’ economic contributions to our state.

Forest products manufacturing is the fifth largest sector in Minnesota by employment. Minnesota DNR supports natural resource-based economies, managing state forest lands for multiple forest values, ensuring the maximum long-term economic return from school trust lands, and providing other economic opportunities in a manner consistent with sound natural resource conservation and management principles. The forest products economy provides landowners the management tools to support working forests across Minnesota. Additionally, forests and wood products play an increasingly important role as natural climate change solutions.

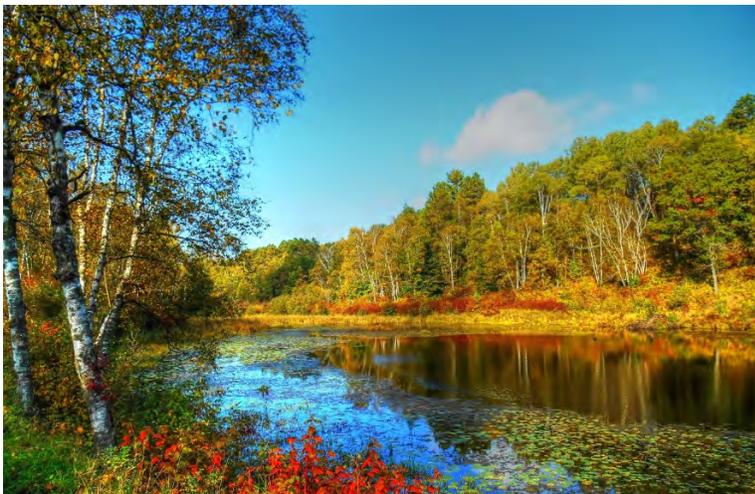
Minnesota DNR is proud to have participated in the publication of this report.

Sincerely,



Forrest Boe, State Forester

Minnesota Department of Natural Resources Division of Forestry



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## Executive Summary

This report assesses broad forest conditions and economic contributions of forest products industries in Minnesota. 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.

Minnesota boasts 17.6 million acres of forest land that covers 35 percent of its land base, with most of this forest land able to produce commercial timber. The majority, 45 percent, is privately owned, while about 39 percent is administered by state and local government, and 16 percent by the federal government.

## 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, Minnesota's forest products industries provided direct employment to approximately 34,000 people, leading to \$10.5 billion in output. That same year, labor income was \$2.4 billion and value-added was \$3.6 billion. In total contributions, these industries supported more than 78,000 jobs, \$5.1 billion in labor income, \$7.9 billion in value-added, and \$18.0 billion in output.

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

## 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 chosen measure:

- Secondary solid wood products had the highest number of direct jobs (11,288), the highest value-added (\$1.0 billion), and the second highest direct output (\$2.7 billion).
- Wood furniture had the second highest number of direct jobs (8,575), the fourth highest value-added (\$550.8 million), and the fourth highest direct output (\$1.4 billion).
- Secondary paperboard and other paper products had the third highest number of direct jobs (6,885), the second highest value-added (\$1.0 billion), and the highest output (\$3.3 billion).
- Pulp, paper, and paperboard mills had the fourth highest number of direct jobs (2,542), the third highest value-added (\$670.3 million), and the third highest direct output (\$2.2 billion).
- Primary solid wood products had the sixth highest number of direct jobs (1,489), the fifth highest value-added (\$223.4 million), and the fifth highest direct output (\$720.2 million).

## Leading Individual Forest Products Sectors

Among the 32 forest products sectors present in Minnesota, the top four, highest direct contributions, were:

- Employment — Wood windows and door manufacturing, wood kitchen cabinet and countertop manufacturing, paperboard container manufacturing, and commercial logging were the top four sectors and had a combined total of over 17,619 direct jobs.
- Labor income — Wood windows and door manufacturing, paperboard container manufacturing, wood kitchen cabinet and countertop manufacturing, and paper bag and coated and treated paper manufacturing had the highest labor income, totaling \$1.3 billion.
- Value-added — Wood windows and door manufacturing, paper mills, paperboard container manufacturing, and paper bag and coated and treated paper manufacturing had the highest value-added, totaling \$1.9 billion.
- Output — Paperboard container manufacturing, paper mills, wood windows and door manufacturing, and paper bag and coated and treated paper manufacturing were the top four sectors in output, totaling \$6.1 billion.

## Minnesota's Forest Products Industries Compared to Other Minnesota Industries

Agricultural production industries (plant crop and animal) provide more direct labor income, value-added, and output than commercial fishing, hunting and trapping, mining and oil and gas production, and the forest products industries. Overall, the forest products industries accounted for 11 percent of the nonfood manufacturing jobs in Minnesota. Over nine percent of Minnesota's 330,000 direct manufacturing jobs in 2017 were in the forest products industries (i.e., one in 11 manufacturing jobs).

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

Forest products industries in three Great Lakes states (Minnesota, Michigan, and Wisconsin) employed over 142,000 workers and accounted for almost \$48 billion in direct output. Minnesota's forest products economy is the third largest in the region, after that of Wisconsin and 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 Minnesota's economy. They provide jobs, raw materials, and finished goods that generate additional economic activity throughout the state, region, and nation. Minnesota has long been a national leader in sustainable forestry. Its Department of Natural Resources manages 4.96 million acres, which are dual-certified by the sustainable Forestry Initiative (SFI) and the Forest Stewardship Council (FSC). The Minnesota DNR is the largest single FSC-certified land manager in the United States.

In 1995, the Minnesota Legislature passed the Sustainable Forest Resources Act (SFRA), enacting policy initiatives and programs to ensure the responsible use and sustainability of forest resources. The Minnesota Forest Resources Council (MFRC), a 17-member governor-appointed board representing a wide range of forest resource interests, was established by the SFRA. The council uses six regional landscape-level planning committees to gather input from diverse forest resource interests, then develops policy recommendations and encourages sustainable forest management policies and practices.

The SFRA also mandated the development of voluntary site-level timber harvesting and forest management guidelines, which are a set of best practices that include biomass harvesting guidelines. Minnesota was first in the nation to create biomass harvesting guidelines. The Minnesota DNR provides the SFRA-required monitoring to assess rates of guideline implementation.

In addition to these management strategies, the Minnesota Logger Education Program (MLEP) was established in 1995 to assist logging-business owners in meeting the changing demands of their profession. MLEP aids Minnesota's logging community by partnering with groups to facilitate the design, delivery, and evaluation of programs on sustainable forest management and business practices. The Sustainable Forests Education Cooperative (SFEC) was established in response to the SFRA in 1995. The SFEC has a cooperative membership of more than 40 organizations. Its purpose is to provide innovative education programs for natural resource professionals.

The MFRC model of cooperation and landscape management, best management practices and monitoring, logger education, and third-party certifications protect Minnesota's forest resources and give Minnesotans an opportunity to care for their forests, ensuring economic, ecological, and social sustainability.

This report compares the contributions of Minnesota'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 assess forests and their economic contributions. The interactions of these 20 states are covered in a regional report. 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 Minnesota, Forest Products Industries, Economic Contributions of Minnesota’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.

## Forest Resources of Minnesota

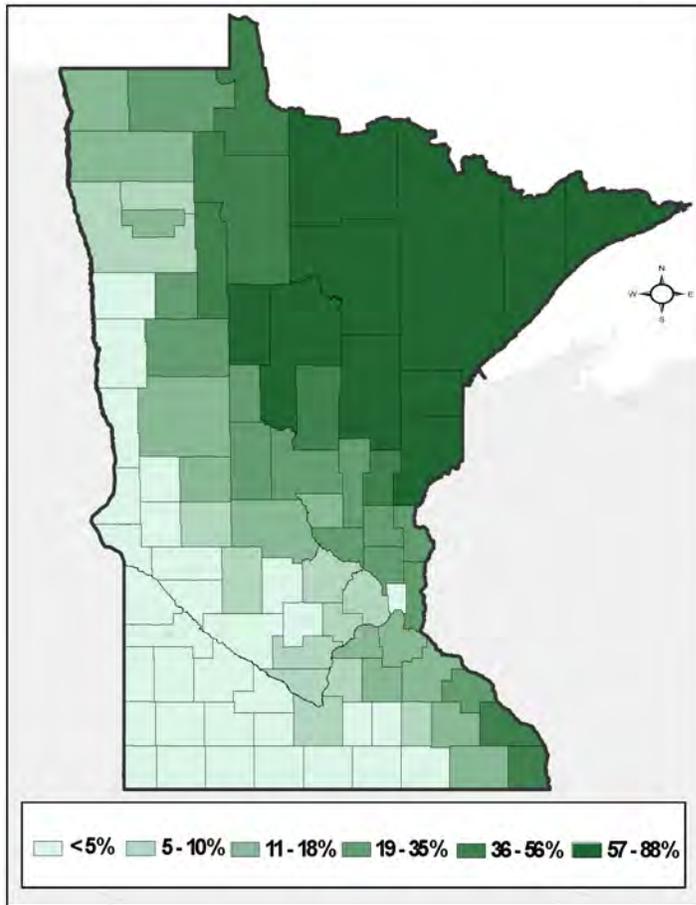
Minnesota’s forest land is concentrated in the northern and southeastern areas of the state. Of Minnesota’s total (nonwater) area, 34.8 percent is considered forest land, of which 30.7 percent is timberland (Exhibit 1). Minnesota is rich in forest resources, and Exhibit 2 shows the percent of forest land by county throughout the state. Minnesota lies at the transition of many major ecoregions including the Laurentian Mixed Forest Province, the Eastern Broadleaf Forest Province, and the Prairie Parkland Province (Bailey 1980). A substantial amount of Minnesota’s forest land was lost to agricultural and economic development near the turn of the last century. However, Minnesota has been steadily regaining forest land area as better assessment methods have been developed (Miles and Vanderschaff 2012). Of the Midwestern, New England, and Mid-Atlantic states covered by the U.S. Forest Service Northern Forest Research Station, Minnesota ranks third in forest land area, behind New York and Michigan (Oswalt et al. 2019).

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

Land Use Type	Acres	Percentage
Forest land	17,600,923	34.8%
Nonforest land	33,046,511	65.2%
<b>Total</b>	<b>50,647,434</b>	<b>100.0%</b>

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



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

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Forest land ownership is diverse in Minnesota. Of upper Midwestern states, Minnesota DNR is the largest single administrator with 4.19 million acres of forest land and 3.71 million acres of timberland (Hillard 2018). The vast majority of Minnesota forest land is publicly owned, comprising 55.1 percent of the total forest (Exhibit 3). Of that, state and local governments (counties) hold the largest share at 38.8 percent. Federal holdings include the Chippewa and Superior National Forests, as well as Voyageurs National Park and the Boundary Waters Canoe Area Wilderness (both of which are reserves). 44.9 percent — 7.9 million acres — are privately owned. However, it is important to note that this is distributed across a wide array of individual owners, including some limited ownership by either a timber investment management organization (TIMO) or a timber real estate investment trust (REIT).

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**Exhibit 3. Forest land by Ownership Group (2017)**

<b>Ownership Group</b>	<b>Acres</b>	<b>Percentage</b>
National Forest	2,604,340	14.8%
Other Federal	259,839	1.5%
State and local governments	6,835,406	38.8%
Private	7,901,338	44.9%
<b>Total</b>	<b>17,600,923</b>	<b>100.0%</b>

Minnesota has an estimated 13–14 billion live trees. Minnesota’s major forest types are aspen/birch, followed by spruce/fir (Exhibit 4). Compared to other states in the region, Minnesota has a large amount of lowland species such as elm/ash/cottonwood. The diversity of Minnesota’s forests provides opportunity and challenges for utilization. For example, until 1990, quacking aspen was a comparatively underutilized species. In its abundance, mill operators saw an opportunity. Today, quacking aspen provides about 50 percent of the total fiber harvested in the state, mainly used by the pulp and paper as well the oriented strand board (OSB) industry (Hillard 2017).

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**Exhibit 1. Forest Land Area by Forest Type Group (2017)**

<b>Forest Type Group</b>	<b>Acres</b>	<b>Percentage</b>
Aspen/birch	6,380,591	36.3%
Spruce/fir	4,297,917	24.4%
Oak/hickory	2,246,314	12.8%
Elm/ash/cottonwood	1,680,751	9.5%
Maple/beech/ birch	1,193,988	6.8%
White/red/jack pine	1,027,894	5.8%
Other	773,468	4.4%
<b>Total</b>	<b>17,600,923</b>	<b>100.0%</b>

Minnesota forests have had positive net growth for most of the last two decades (Hillard 2017). Harvest removals have been largest on public lands, followed by those on private lands. Although harvests on public land have exceeded those on private land since 2005 (Hillard 2017), there is a large amount of standing volume on private lands (Exhibit 5). The challenge for utilization is navigating the myriad motivations of thousands of private forest land owners.

**Exhibit 5.** Characteristics of Growing Stock in Minnesota on Forest Land, 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	17,527.4	3,088.4	349.0	5,856.5	8,233.5
Average annual net growth	410.4	48.1	6.8	148.0	207.5
Average annual harvest removals	185.4	10.1	-	96.7	78.7
Average annual mortality	277.3	63.1	5.5	90.1	118.5

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 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 (IO) 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, 500 sectors represented Minnesota's economy. These sectors are based on the North American Industrial Classification System (NAICS).

IMPLAN models can be constructed for different geographic areas.

## **Economic Contributions of Minnesota'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.

As part of the regional, national, and international wood trade, Minnesota has experienced changing demands for traditional forest products, due in part to the changing demand for printing and writing paper products, increased globalization, the 2008 recession, and new levels of housing starts. For the last 20–30 years, industry has focused on pulp and paper production, and during that time, the primary feedstock changed from spruce to aspen. The 2008 recession amplified the loss of paper mills, machines, and several engineered wood product facilities. This change has proved an opportunity to support, diversify, and strengthen the forest products industry by examining the next generation of wood products that are climate-friendly alternatives to steel, concrete, and petroleum-based fuels and chemicals.

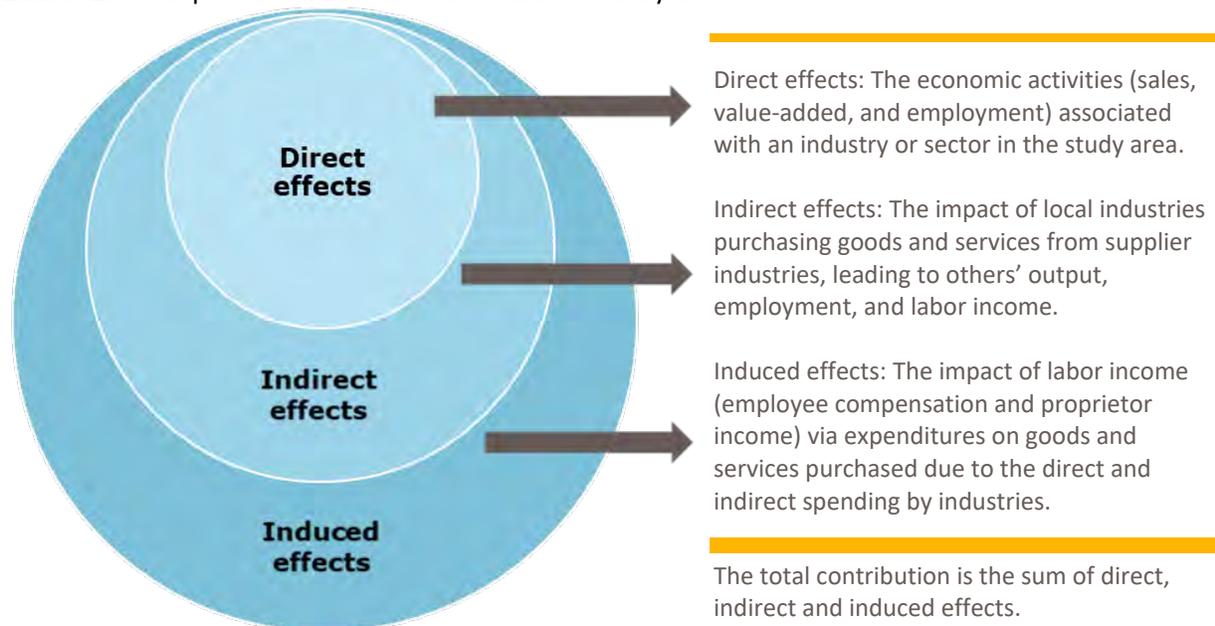
With billions of dollars in direct and indirect effects, the forest products industry is a major contributor to the Minnesota economy. The forest products industry supports jobs and forest owners by bringing money into rural areas. Nearly 300 Minnesota cities sell goods and services to the forest products industry. Statewide forest products manufacturing facilities sustain and enrich local communities by providing jobs, expanding the tax base, and enhancing infrastructure. The forest products industry is Minnesota's fifth largest manufacturing sector by employment.

## 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 2.** 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 Minnesota (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 Minnesota, Michigan, and Wisconsin, reveals that the direct employment for 2017 was 2,495; 4,487; and 5,207 jobs, respectively. Summing the individual states' total employment contributions (direct, indirect, and induced effects) 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 Minnesota'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.).

### **Direct and Total Contributions by 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, Minnesota's population was estimated at 5.6 million people, with total employment of 3.8 million. The gross state product (GSP), also known as value-added, was \$361.7 billion from the 500 economic sectors present in Minnesota (of the possible 536 in the U.S.). The GSP's largest component was labor income, which was \$229.9 billion.

Minnesota's forest products industries' total economic contribution in terms of output was \$18 billion, based on direct output of \$10.5 billion (Exhibit 7). Direct jobs associated with this level of economic activity totaled 34,055, and the total number of jobs supported was 78,465. Direct labor income, which includes employee compensation and proprietor income, was \$2.4 billion, or \$69,515 per job. Total labor income — which includes income paid directly to industry employees and proprietors, their suppliers, and the other industries they support — totaled \$5.1 billion. Direct value-added for forest

products industries was \$3.6 billion; 1 percent of Minnesota’s total GSP. When total value-added effects are considered, the percentage more than doubles to 2.2 percent. These percentages hold for other economic measures (e.g., jobs) as well.

For each direct job in the forest products industries, 1.3 additional jobs were supported. For every \$1 million in direct labor income, an additional \$1.15 million in indirect and induced labor income was supported.

**Exhibit 3.** Region-wide Economic Contribution of Forest Products Industries, 2017 Dollars

<b>Effect</b>	<b>Employment</b>	<b>Labor Income (Dollars)</b>	<b>Value-added* (Dollars)</b>	<b>Output (Dollars)</b>
Direct	34,055	\$2,367,350	\$3,578,890	\$10,503,265
<b>Total</b>	<b>78,465</b>	<b>\$5,098,267</b>	<b>\$7,893,811</b>	<b>\$18,036,983</b>

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

### **Contributions by Forest Product Industry Groups**

As previously noted, the 32 IMPLAN forest products sectors were combined into seven industry groups (Appendix B). In Minnesota, secondary solid wood products was the largest of these groups in terms of direct employment, labor income, and value-added. Wood furniture was the second largest group in terms of direct employment, the third largest in terms of direct labor income, and fourth largest in terms of direct value-added and output. Forestry (including maple syrup production, timber tract operations [e.g., managing and harvesting standing timber], and forestry support activities) was the smallest group for all metrics.

Two groups, secondary solid wood products and wood furniture, accounted for over half the direct employment of the forest products industries.

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

Industry Group	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	782	\$24,391	\$25,912	\$35,376
Logging	2,495	\$54,797	\$86,138	\$140,983
Primary solid wood products	1,489	\$127,083	\$223,354	\$720,227
Secondary solid wood products	11,288	\$830,622	\$1,023,619	\$2,651,642
Wood furniture	8,575	\$468,103	\$550,837	\$1,419,961
Pulp, paper, and paperboard mills	2,542	\$270,012	\$670,335	\$2,185,705
Secondary paperboard and other paper products	6,885	\$592,342	\$998,697	\$3,349,371
<b>Total</b>	<b>34,055</b>	<b>\$2,367,350</b>	<b>\$3,578,890</b>	<b>\$10,503,265</b>

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

Industry Group*	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	721	\$27,241	\$32,709	\$46,792
Logging	1,144	\$31,412	\$50,007	\$83,752
Primary solid wood products	4,507	\$280,373	\$474,112	\$1,102,903
Secondary solid wood products	24,895	\$1,633,149	\$2,291,774	\$4,867,317
Wood furniture	16,265	\$919,698	\$1,252,136	\$2,665,189
Pulp, paper, and paperboard mills	11,627	\$833,013	\$1,550,964	\$3,732,687
Secondary paperboard and other paper products	19,307	\$1,373,381	\$2,242,108	\$5,538,343
<b>Total</b>	<b>78,465</b>	<b>\$5,098,267</b>	<b>\$7,893,811</b>	<b>\$18,036,983</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, establishments primarily engaged in the operation of timber tracts for the purpose of selling standing timber, and 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 related to timber production, wood technology, forestry economics and marketing, and forest protection. Maple syrup production is a small part of All Other Miscellaneous Crop Farming; data for this report is from the National Agricultural Statistics Service (NASS) annual survey of maple syrup producers.

Out of seven industry groups, forestry was the smallest in terms of direct contributions in 2017. Direct contributions were nearly \$35.4 million in output, 782 jobs, \$24.4 million in labor income, and \$25.9 million in value-added. Total contributions are based, in part, on backward linkages to suppliers. Total contributions for forestry can be less than direct contributions (i.e., initial IMPLAN levels) because many of the contributions are inputs into other industries. For example, nearly one-third (28 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. The same holds true for logging in the following section.

## **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 nearly \$141.0 million in output, 2,495 jobs, \$54.8 million in labor income, and \$86.1 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 Minnesota, 65 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 Minnesota. 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 \$720.2 million in output, 1,489 jobs, \$127.1 million in labor income, and \$223.4 million in value-added. Total contributions for primary solid wood products, including direct, indirect, and induced effects, were \$1.1 billion in output, 4,507 jobs, \$280.4 million in labor income, and \$474.1 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 largest group in terms of direct employment in Minnesota. This group contains the manufacturing of engineered wood members and trusses; wood windows and doors cut stock, resawing lumber, and planing; other millwork, including flooring, wood container, and pallets manufacturing; manufactured home (mobile home) and prefabricated wood building construction; and all other miscellaneous wood product fabrication. Direct contributions of secondary solid wood products were \$2.7 billion in output, 11,288 jobs, \$830.6 million in labor income, and \$1.0 billion in value-added. Total contributions were \$4.9 billion in output, 24,895 jobs, \$1.6 billion in labor income, and \$4.9 billion in value-added.

### **Wood Furniture**

Wood furniture was the second largest group in terms of direct employment in Minnesota. Wood furniture includes the manufacturing of wood kitchen cabinet and countertops; upholstered household furniture; non-upholstered 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 \$1.4 billion in output, 8,575 jobs, \$468.1 million in labor income, and \$550.8 million in value-added. Total contributions of wood furniture were \$2.7 billion in output, 16,265 jobs, \$919.7 million in labor income, and \$1.3 billion in value-added.

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

The pulp, paper, and paperboard mills industry group was the fourth largest in terms of direct employment in Minnesota. The group includes pulp mills, paper mills, and paperboard mills. This group's direct contributions were \$2.2 billion in output, 2,542 jobs, \$270 million in labor income, and \$670.3 million in value-added. Total contributions were \$3.7 billion in output, 11,627 jobs, \$833 million in labor income, and \$3.7 billion in value-added.

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

The secondary paperboard and other paper products group was the third largest in terms of direct employment in Minnesota. 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 \$3.3 billion in output, 6,885 jobs, \$592.3 million in labor income, and \$998.7 million in value-added. Total contributions were \$5.5 billion in output, 19,307 jobs, \$1.4 billion in labor income, and \$2.2 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 wood windows and door manufacturing (5,728 jobs), wood kitchen cabinet and countertop manufacturing (5,711 jobs), paperboard container manufacturing (3,685 jobs), and commercial logging (2,495 jobs). These sectors reflect the diversity of manufacturing in the state.

The wood windows and door manufacturing sector comprises establishments primarily engaged in manufacturing window and door units; sash, window and door frames; and doors from wood or wood clad with metal or plastics.

The wood kitchen cabinet and countertop manufacturing sector encompasses companies primarily engaged in manufacturing wood or plastics laminated on wood kitchen cabinets, bathroom vanities, and countertops (except freestanding). The cabinets and counters may be made on a stock or custom basis.

The paperboard container manufacturing sector includes enterprises 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 commercial logging industry sector companies 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, wood windows and door manufacturing, paperboard container manufacturing, wood kitchen cabinet and countertop manufacturing, and paper bag and coated and treated paper manufacturing had the highest labor income, totaling \$1.3 billion. Wood windows and door manufacturing, paper mills, paperboard container manufacturing, and paper bag and coated and treated paper manufacturing had the highest value-added, totaling \$1.9 billion. These four sectors also had the highest output, totaling \$6.1 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 Minnesota. Including the 32 forest products industries, 189 sectors were impacted in 2017 (counting sectors with ten or more jobs supported). The top ten sectors (excluding forest products sectors) included wholesale trade, real estate, restaurants, trucking, and hospitals (Exhibit 10). This set of sectors reflect spending by companies and individuals.

These data were at an aggregate level, so 1,302 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 Minnesota, with wholesale trade being number one, followed by employment and payroll of local government education and real estate — each had over 130,000 jobs.

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

<b>IMPLAN Sector</b>	<b>Description</b>	<b>Jobs</b>
395	Wholesale trade	3,580
461	Management of companies and enterprises	1,691
501	Full-service restaurants	1,644
440	Real estate	1,609
502	Limited-service restaurants	1,521
482	Hospitals	1,323
411	Truck transportation	1,302
464	Employment services	962
468	Services to buildings	865
460	Marketing research and all other miscellaneous professional, scientific, and technical services	805
<b>Total</b>	<b>NA</b>	<b>15,302</b>

### Neighboring States

The Lake States area (Minnesota, Michigan, and Wisconsin) is an important region for forest products. Forest products industries employ more than 142,000 workers across the region and account for almost \$48.0 billion in direct output (Exhibits 11 and 12). Wisconsin had the largest forest products economy with 67,793 direct jobs and sales 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 Minnesota, Michigan, and Wisconsin, 2017

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

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

<b>Industry</b>	<b>Minnesota (Thousands of Dollars)</b>	<b>Michigan (Thousands of Dollars)</b>	<b>Wisconsin (Thousands of Dollars)</b>
Forestry	\$35,376	\$62,158	\$33,960
Logging	\$140,983	\$280,775	\$489,763
Primary solid wood products	\$720,227	\$1,689,173	\$1,630,002
Secondary solid wood products	\$2,651,642	\$1,420,592	\$3,041,763
Wood furniture	\$1,419,961	\$2,239,587	\$2,174,899
Pulp, paper, and paperboard mills	\$2,185,705	\$2,493,853	\$8,562,915
Secondary paperboard and other paper products	\$3,349,371	\$3,996,111	\$9,349,409
<b>Sum of direct contributions</b>	<b>\$10,503,265</b>	<b>\$12,182,249</b>	<b>\$25,282,710</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 Minnesota's forest products industries with others. Natural resources and agricultural industries significantly contribute to the diversity of economic activities reflected in Minnesota's \$361.7 billion GSP. The forest products industries provide more direct labor income, value-added, and output than the commercial fishing, hunting, and trapping, and the mining and oil and gas production industries combined. Minnesota's forest products industries comprised 1 percent of the GSP in 2017. Agricultural production provided the largest amount of employment (full- and part-time) of these industries.

**Exhibit 13.** Natural Resources and Agricultural Production Industries in Minnesota, 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	34,055	\$2,367,350	\$3,578,890	\$10,503,265
Commercial fishing, hunting, and trapping	1,066	\$9,137	\$33,027	\$33,391
Mining and oil and gas production	10,476	\$574,139	\$2,534,922	\$3,854,872
Agricultural production (plant crop and animal)	93,066	\$2,913,940	\$5,324,318	\$17,953,495
<b>Total</b>	<b>138,663</b>	<b>\$5,864,566</b>	<b>\$11,471,157</b>	<b>\$32,345,023</b>

Labor income per job is highest in forest products (\$69,515) and lowest in commercial fishing, hunting, and trapping (\$8,571). For agricultural production, the average per job is \$31,310; mining and oil and gas production has the second highest average income at \$54,805.

Most of the forest products industries are manufacturers; however, the forestry and logging groups are not. In 2017, there were over 330,000 manufacturing jobs in Minnesota, of which 30,600 (9.3 percent) were in the forest products industries. Of 16 manufacturing industries, forest products was fifth in employment, trailing food, fabricated metal, computer and electronic product, and machinery. It was sixth in labor income and seventh in value-added and output (Exhibit 14).

**Exhibit 14. Manufacturing Industries in Minnesota, 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>
Food	52,507	\$3,514,059	\$5,758,721	\$30,586,159
Fabricated metal	44,247	\$3,231,484	\$4,461,447	\$10,394,030
Computer and electronic products	40,832	\$4,941,023	\$8,759,353	\$21,788,993
Machinery	32,976	\$2,902,048	\$4,191,619	\$11,896,706
Forest products	30,600	\$2,268,936	\$3,397,365	\$10,183,549
Miscellaneous	28,815	\$2,574,111	\$4,535,478	\$10,364,585
Printing	23,691	\$1,608,501	\$2,080,387	\$4,156,717
Plastics and rubber products	16,477	\$1,162,832	\$1,759,860	\$5,463,803
Chemical	11,159	\$1,678,730	\$3,110,329	\$9,902,311
Transportation equipment	11,029	\$744,662	\$1,886,290	\$6,438,220
Nonmetallic mineral products	10,785	\$572,973	\$1,181,612	\$3,204,807
Electrical equipment	8,381	\$743,214	\$1,214,409	\$3,363,953
Primary metal	6,160	\$490,601	\$632,272	\$2,290,398
Textiles and apparel	5,628	\$233,241	\$441,878	\$1,109,087
Beverage and tobacco products	4,422	\$315,161	\$759,788	\$2,537,913
Petroleum and coal	2,214	\$722,758	\$3,572,974	\$11,794,305
<b>Total</b>	<b>329,922</b>	<b>\$27,704,334</b>	<b>\$47,743,783</b>	<b>\$145,475,535</b>

## Supplemental Economic Contribution Information

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

Exception one, 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 first, most conservative option was to include in the analysis only sectors that produce only forest products and exclude sectors that do not solely produce forest products. The second option was to include sectors producing any forest products, even if the product is a small part of total output. The third option was to assess what portion of a sector 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 is relevant to 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 Minnesota provided updated direct employment figures, which decreased jobs from 265 to 179. The updated figure was used in IMPLAN analysis; other sector metrics decreased proportionally.

Wood is used in many other products not covered by these 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 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 Minnesota for 2017, as well as a baseline report for future analyses. State data were used in this report, but given IMPLAN’s structure, sub-state and multi-state 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. In Minnesota, there were 34,055 direct jobs in the forest products industries, and overall, 78,465 jobs were supported. Direct labor income was \$2.4 billion, with total labor income at \$5.1 billion. Direct value-added was \$3.6 billion, and the total contribution for value-added was \$7.9 billion. Finally, direct output was \$10.5 billion with a total contribution of \$18.1 billion in output. Similar report findings are available from other states in the region and are summarized in a regional report.

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## 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 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 and Wood Products Industries Groupings and IMPLAN Sectors

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### 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.

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### Exhibit B2. Logging 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 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 Mills 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	270	\$4,634	\$6,020	\$13,088
Support activities for forestry	493	\$19,471	\$19,462	\$21,356
Maple syrup production	19	\$286	\$430	\$932
<b>Subtotal</b>	<b>782</b>	<b>\$24,391</b>	<b>\$25,912</b>	<b>\$35,376</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	2,495	\$54,797	\$86,138	\$140,983
<b>Subtotal</b>	<b>2,495</b>	<b>\$54,797</b>	<b>\$86,138</b>	<b>\$140,983</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	179	\$19,226	\$69,476	\$143,357
Sawmills	492	\$36,865	\$39,948	\$148,274
Wood preservation	190	\$17,157	\$31,667	\$122,500
Veneer and plywood manufacturing	189	\$13,758	\$15,736	\$55,181
Reconstituted wood product manufacturing	439	\$40,076	\$66,527	\$250,915
<b>Subtotal</b>	<b>1,489</b>	<b>\$127,083</b>	<b>\$223,354</b>	<b>\$720,227</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	1,058	\$69,132	\$74,618	\$244,668
Wood windows and door manufacturing	5,728	\$442,093	\$565,701	\$1,467,074
Cut stock, resawing lumber, and planing	62	\$6,183	\$7,024	\$17,024
Other millwork, including flooring	851	\$58,508	\$74,559	\$193,584
Wood container and pallet manufacturing	1,510	\$100,164	\$113,498	\$267,390
Manufactured home (mobile home) manufacturing	566	\$31,299	\$49,105	\$142,947
Prefabricated wood building manufacturing	479	\$34,095	\$37,528	\$91,984
All other miscellaneous wood product manufacturing	1,034	\$89,148	\$101,586	\$226,970
<b>Subtotal</b>	<b>11,288</b>	<b>\$830,622</b>	<b>\$1,023,619</b>	<b>\$2,651,642</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	5,711	\$291,365	\$327,137	\$843,260
Upholstered household furniture manufacturing	19	\$821	\$960	\$3,670
Nonupholstered wood household furniture manufacturing	195	\$5,941	\$7,529	\$22,357
Institutional wood furniture manufacturing*	637	\$48,851	\$57,736	\$138,509
Wood office furniture manufacturing	590	\$31,080	\$47,970	\$130,070
Custom architectural woodwork and millwork	505	\$33,528	\$39,237	\$87,221
Showcase, partition, shelving, and locker manufacturing*	916	\$56,515	\$70,267	\$194,874
<b>Subtotal</b>	<b>8,573</b>	<b>\$468,103</b>	<b>\$550,837</b>	<b>\$1,419,961</b>

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**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	12	\$3,665	\$4,368	\$10,763
Paper mills	1,940	\$202,234	\$507,421	\$1,641,381
Paperboard mills	590	\$64,112	\$158,546	\$533,561
<b>Subtotal</b>	<b>2,542</b>	<b>\$270,012</b>	<b>\$670,335</b>	<b>\$2,185,705</b>

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**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	3,685	\$305,480	\$462,814	\$1,797,129
Paper bag and coated and treated paper manufacturing	2,379	\$216,228	\$408,557	\$1,195,576
Stationery product manufacturing	680	\$60,678	\$105,955	\$290,661
Sanitary paper product manufacturing	44	\$3,459	\$12,590	\$35,789
All other converted paper product manufacturing	96	\$6,496	\$8,781	\$30,217
<b>Subtotal</b>	<b>6,884</b>	<b>\$592,341</b>	<b>\$998,697</b>	<b>\$3,349,372</b>

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

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