

# Forest Products Industries' Economic Contributions in the Northeast and Midwest

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## Foreword

As markets have become more integrated across the world, insights into how local economies fit into larger regional markets have become increasingly important. Raw materials and manufactured products are exchanged around the world through supply chains that were unthinkable only a few years ago, making knowledge of forest product markets at varying scales more important now than it has ever been. The following regional report represents an effort of states participating in the Northeast-Midwest State Forest Alliance (NMSFA), Forest Markets and Utilization Committee (FMUC) to compile meaningful information about regional markets in the Northeastern and Midwestern United States.

This report is the result of a multi-state Landscape Scale Restoration grant from the USDA Forest Service. The grant facilitated a regional and state-by-state analysis of economic data using the IMPLAN model with the assistance of contracted services provided by Public Sector Consultants. On behalf of the FMUC, Michigan Department of Natural Resources, Forest Resources Division coordinated work on the grant project, including contracting with Public Sector Consultants for development of the methodology and analysis of the IMPLAN data, and preparation of drafts of the reports for the region- and state level reports, and the review and subsequent revision of those drafts with the assistance of the participating states. The information provided in this report will empower states to make informed decisions surrounding their forest products in a regional context and could hopefully provide new insights shaping forest landscapes that are both ecologically and economically sustainable. On behalf of the FMUC, I am proud to present the *Forest Products Industries' Economic Contributions in the Northeast and Midwest*.

Samantha Hensen

Chair, 2020

Northeast-Midwest State Foresters Alliance, Forest Markets & Utilization Committee  
New Jersey Forest Service.

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## Executive Summary

Forests are major components of the earth's natural resources and are increasingly critical to the welfare of the U.S. economy, environment, and population. To help quantify the role of the forest products industries and document the industries' economic contributions with a consistent approach, the Forest Markets & Utilization Committee of the Northeast-Midwest State Foresters Alliance secured federal funds from the U.S. Forest Service through a 2017 Landscape Scale Restoration grant. As part of the analysis, this 20-state report was published summarizing the economic contributions of forest products industries from the 20 northeastern and midwestern states, and separate state-level reports have been produced for each state within the area, and for Nebraska.

This analysis was conducted using the IMPLAN regional economic modeling system to estimate economic multipliers and contributions for a variety of industry sectors. Multipliers capture the indirect and induced economic activity generated by the re-spending of income or sales revenues in a regional economy. The analysis included industry sectors that represent a broad array of activities encompassed by agricultural and natural-resource commodity production, manufacturing, distribution, and supporting services in the regional, state, and private forestry. Economic contributions can be measured in terms of full- and part-time employment, industry output, value-added, labor income, other property income, and business taxes.

The Northeast and Midwest area boasts 175.5 million acres of forest land that cover 43 percent of its land base, with most of this forest land (94 percent) able to produce commercial timber. The majority of the area's forest land (73 percent) is privately owned, while state and local governments own approximately 19 percent, and the federal government owns about 8 percent.

## Forest Industries

In 2017, the forest products industries in the area provided direct employment to over 540,000 people, leading to \$167.0 billion in output. That same year, labor income was \$36.5 billion and value-added was \$50.6 billion. In total contributions, these industries supported 1.4 million jobs, \$92.5 billion in labor income, \$141.8 billion in value-added, and \$327.2 billion in output. Out of 5.1 million direct nonfood manufacturing jobs, 9.5 percent were in the forest products industries (e.g., one in 11 jobs). For each direct job in the forest products industries, 1.6 additional jobs were supported. For every \$1 million in direct labor income, an additional \$1.53 million in indirect and induced labor income was supported.

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

## **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 paperboard and other paper products had the highest number of direct jobs (144,442), value-added (\$18.8 billion), and direct output (\$69.9 billion).
- Wood furniture had the second highest number of direct jobs (136,021), the second highest value-added (\$9.3 billion), and the fourth highest direct output (\$23.7 billion).
- Secondary solid wood products had the third highest number of direct jobs (122,434), value-added (\$8.3 billion), and output (\$24.7 billion).
- Pulp, paper, and paperboard mills had the sixth highest number of direct jobs (38,351), the fourth highest value-added (\$6.9 billion), and the second highest direct output (\$29.6 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—Paperboard container manufacturing, wood kitchen cabinet and countertop manufacturing, commercial logging, and paper bag and coated and treated paper manufacturing were the top four sectors and had a combined total of 207,416 direct jobs, or 38 percent of direct employment.
- Labor Income—Paperboard container manufacturing, paper mills, paper bag and coated and treated paper manufacturing, and wood kitchen cabinet and countertop manufacturing had the highest labor income, totaling \$15.3 billion, or 42 percent of direct labor income.
- Value-added—Paperboard container manufacturing, paper mills, paper bag and coated and treated paper manufacturing, and sanitary paper product manufacturing had the highest value-added, totaling \$22.2 billion, or 44 percent of direct value-added.

- Output—Paperboard container manufacturing, paper mills, paper bag and coated and treated paper manufacturing, and sanitary paper product manufacturing were the top four sectors in output, totaling \$86.1 billion, or 52 percent of total direct output.

## **Northeast and Midwest States' Forest Products Industries Compared to Other Northeast and Midwest States' Industries**

The forest products industries provided more direct labor income and output than commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries (plant crop and animal). Agricultural production provided the most employment, and mining and oil and gas production had the highest value-added. Forest products industries were second in employment and value-added. Of the 16 manufacturing industries, forest products was the fifth largest in terms of employment (481,790 jobs), following food, fabricated metal, transportation equipment, and machinery. Over 8 percent of manufacturing jobs were in forest products industries.

# 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").

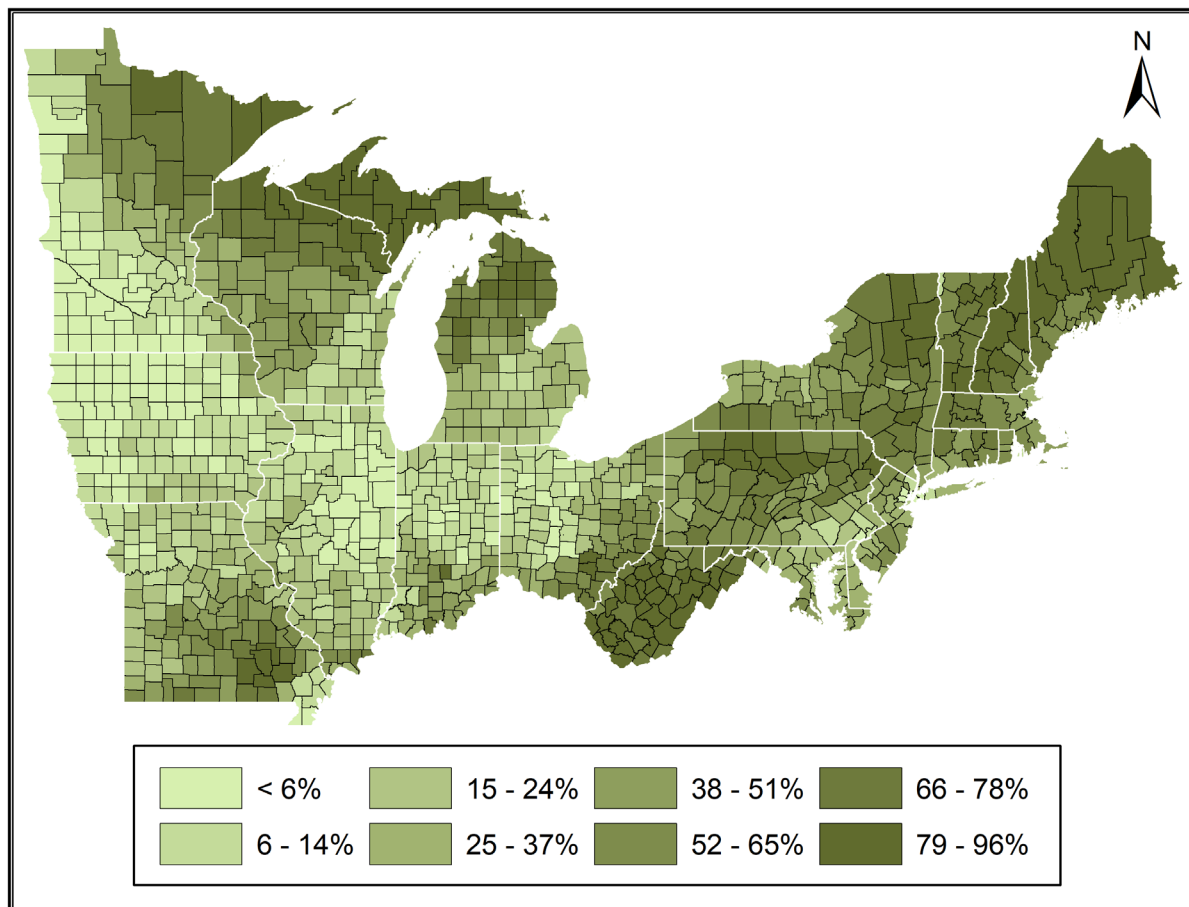
**Total effects/contributions:** The sum of direct, indirect, and induced effects.

**Value-added** (also known as gross regional product, or GRP): 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 GRP.

## Introduction

Forest products industries are an integral component of the Northeast and Midwest–area economy. They provide jobs, raw materials, and finished goods that generate additional economic activity throughout the states, region, and nation. Previous studies of the industries’ economic contributions have focused mostly on individual states—either documenting the industries’ continuing recovery from the 2008–09 recession or examining the role the industries play in the statewide economy. Until now, no attempt has been made to assess the contributions of forest products industries for the Northeast and Midwest as a whole, nor to examine the interaction of those industries at the regional or national level. In part, this is due to a lack of a consistent reporting format across the Northeast and Midwest, which may be partly attributable to different states using different methods and data.

**EXHIBIT 1.** The Northeast and Midwest’s Forest Land by County, 2017



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 the 20 Northeast and Midwest states and 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 this 20-state report summarizing the economic contributions of forest products industries at a regional level. This work was supported through a 2017 Landscape Scale Restoration grant from the U.S. Forest Service.

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 the Northeast and Midwest, Forest Products Industries, and Economic Contributions of the Northeast and Midwest 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 the Northeast and Midwest

The Northeast and Midwest are rich in forest resources. In fact, trees are common throughout the area. They are in our forests, along our rivers, and in our yards. It is estimated there are over 120 billion trees in the Northeast and Midwest—almost 1,100 trees for every person. Over 40 percent of the land area is forest land (Exhibit 2). Over 164.3 million acres or 93 percent of the forest land is classified as timberland.

**Exhibit 2.** Northeast and Midwest Land Area by Land Use Type, 2017 (U.S. Forest Service)

| Land Use Type  | Acres              | Percentage    |
|----------------|--------------------|---------------|
| Forest land    | 175,502,700        | 42.7%         |
| Nonforest land | 235,769,611        | 57.3%         |
| <b>Total</b>   | <b>411,272,311</b> | <b>100.0%</b> |

The majority of the forest land—72.8 percent—is privately owned, while state and local governments and the U.S. Forest Service are the 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 have 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. State and national forests are actively managed in many areas, while resource protection is emphasized in others. Active timber management provides the principal feedstock for the region's forest products industries.

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

| Ownership Group             | Acres              | Percentage    |
|-----------------------------|--------------------|---------------|
| National Forest             | 11,948,672         | 6.8%          |
| Other federal               | 2,623,930          | 1.5%          |
| State and local governments | 33,102,595         | 18.9%         |
| Private                     | 127,827,503        | 72.8%         |
| <b>Total</b>                | <b>175,502,700</b> | <b>100.0%</b> |

The dominant forest type group in the Northeast and Midwest area is oak/hickory, followed by maple/beech/birch (Exhibit 4). Tree species with the greatest standing volume include red maple, sugar maple, northern red oak, eastern white pine, white oak, yellow poplar, eastern hemlock, and black cherry.

**Exhibit 4. Forest Land Area by Forest Type Group (2017)**

| Forest Type Group   | Acres              | Percentage    |
|---------------------|--------------------|---------------|
| Oak/hickory         | 63,457,056         | 36.2%         |
| Maple/beech/birch   | 45,237,351         | 25.8%         |
| Spruce/fir          | 15,837,907         | 9.0%          |
| Aspen/birch         | 15,611,377         | 8.9%          |
| Elm/ash/cottonwood  | 12,916,958         | 7.4%          |
| White/red/jack pine | 9,396,522          | 5.3%          |
| Other               | 13,045,529         | 7.4%          |
| <b>Total</b>        | <b>175,502,700</b> | <b>100.0%</b> |

The Northeast and Midwest are internationally known for its high-quality red and white oak and hard maple timber, which are prized for furniture manufacturing, flooring, cooperage for wine and spirits, and other durable goods like baseball bats, butcher blocks, and work surfaces. The region's diverse timber species support a variety of forest products industries, including pulp and paper manufacturing, paper and paperboard packaging, composite board (oriented strand board, particle board, and hardboard), office and institutional furniture manufacturing, hardwood- and softwood-grade lumber, structural lumber (studs), and a variety of industrial lumber and wood packaging products.

In 2017, the estimated volume of standing timber suitable for forest products (i.e., the marketable volume of growing stock) was about 294.2 billion cubic feet, or about 3.7 billion standard cords (Exhibit 5). Average annual net growth in the region exceeded annual harvest removals by a ratio of about 2.2 to 1. That is, for every cubic foot of harvesting that took place, 2.2 cubic feet of timber grew, after accounting for mortality. Average annual harvest removals of growing stock were about 2.7 billion cubic feet, or about 34.1 million cords—roughly 1 percent of standing volume.

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

| Measure                 | Total   | National Forest | Other Federal | State and Local Government | Private |
|-------------------------|---------|-----------------|---------------|----------------------------|---------|
| Net volume              | 294,176 | 22,121          | 4,755         | 56,595                     | 210,706 |
| Annual net growth       | 5,884   | 286             | 67            | 908                        | 4,624   |
| Annual harvest removals | 2,690   | 62              | 4             | 368                        | 2,257   |
| Annual mortality        | 3,019   | 263             | 61            | 623                        | 2,072   |

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 the role an industry or industries play in a regional 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, OSB [reconstituted wood products], and power plants) use wood directly from the forest, including roundwood, chips, or similar forms. Secondary industries (e.g., trusses and furniture) use one or more primary forest products (e.g., lumber and paperboard) in their manufacturing processes. Value is added as the timber is processed through primary and secondary manufacturers.

Several sectors included wood and nonwood products (e.g., institutional furniture manufacturing). Therefore, output and other measures were reduced to better reflect the wood-only component by using published government data or surveys (Gibson, Leefers, and Poudel 2020).

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, and can be constructed for different geographic areas. Within these models, various sectors have production functions that show the value of inputs used in production of outputs or commodities. Northeastern and midwestern state economies were represented by 530 sectors in 2017, the most recent year available for IMPLAN data at the time of the analysis. These sectors are based on the North American Industrial Classification System (NAICS).

## **Economic Contributions of the Northeast and Midwest's Forest Products Industries**

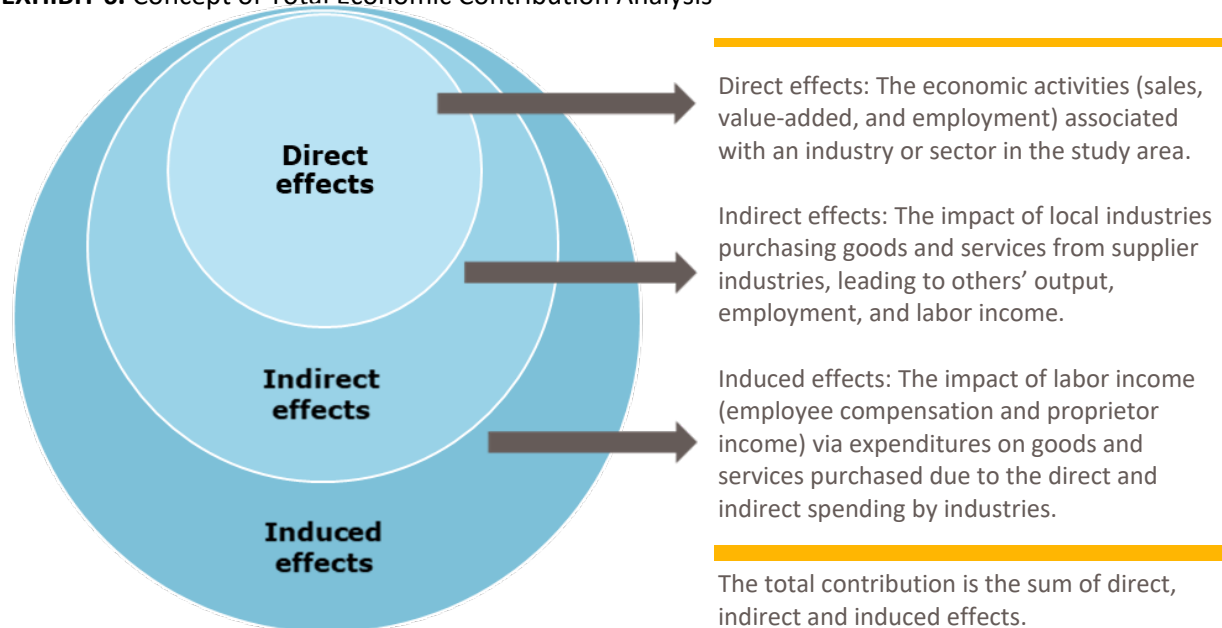
This section of the report includes four major subsections: Economic Contributions Defined, Economic Contribution Results, State Comparisons, Importance of the Forest Products Industries in Context, and Supplemental Economic Contribution Information.

### **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.

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**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 recommended by Henderson and Evans (2017) as a primary method for estimating economic contributions of forest products industries (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 Michigan, Wisconsin, and Minnesota reveals that the direct employment for 2017 was 4,487, 5,207 and 2,495 jobs, respectively. Summing the individual states' total employment contributions (direct, indirect, and induced) yields 17,556 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 larger role is due to trade, but IMPLAN does not explicitly show trade with specific states, only overall imports and exports. The regional analysis highlights the larger role of forest products industries

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

## Economic Contribution Results

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 by direct employment; the top forest sectors by direct labor income, value-added, and output; and the top nonforest products industries impacted by the forest products industries.

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 the Northeast and Midwest'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.).

### Direct and Total Contributions by Forest Products Industries

Contribution analysis provides a means to assess the role various industries play in a state's or region's economy. The Northeast and Midwest area's forest products industries' total economic contribution in terms of output was \$327.2 billion, based on direct output of \$167.0 billion (Exhibit 7). There were 542,158 direct jobs associated with this level of economic activity, and the total number of jobs supported was 1,407,634. Direct labor income, which includes employee compensation and proprietor income, was \$36.5 billion, or \$67,357 per job. Total labor income—which includes income paid directly to industry employees and proprietors, their suppliers, and the other industries they support—totaled \$92.5 billion. Direct value-added was \$50.6 billion; 0.6 percent of the Northeast and Midwest area's total GRP was associated directly with forest products industries. The percentage more than doubles to 1.8 percent when considering total value-added effects. These percentages hold for other economic measures (e.g., jobs) as well.

**EXHIBIT 7.** Region-wide Economic Contribution of the Forest Products Industries, 2017 Dollars

| Effect       | Employment       | Labor Income<br>(Thousands of<br>Dollars) | Value-added*<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|--------------|------------------|---|---|-------------------------------------|
| Direct       | 542,158          | \$36,518,137                              | \$50,553,265                              | \$167,033,817                       |
| <b>Total</b> | <b>1,407,634</b> | <b>\$92,485,367</b>                       | <b>\$141,768,969</b>                      | <b>\$327,165,824</b>                |

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

For each direct job in the forest products industries, 1.6 additional jobs were supported. For every \$1 million in direct labor income, an additional \$1.53 million in indirect and induced labor income was supported.



Most regional economies are large relative to any particular industry or group of industries. The forest products industries are no exception. In 2017, the Northeast and Midwest area's population was estimated at 127.0 million people, with total employment of 78.4 million. The gross regional product was \$8.0 trillion from among 530 economic sectors (of the possible 536 in the US). The GRP's largest component was labor income, which was \$5.0 trillion.

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

As previously noted, the 32 IMPLAN forest products sectors were combined into seven industry groups (Appendix B). Secondary paperboard and other paper products was the largest group in terms of direct employment, labor income, value-added, and output. Wood furniture was the second largest of these groups in terms of direct employment, labor income, and value-added. Forestry, which includes maple syrup production, timber tract operations, and forestry support activities, was the smallest group for all metrics.

Two groups—secondary paperboard and other paper products, and pulp, paper, and paperboard mills—accounted for over half the output of forest products industries. Over half of the forest products industries employment was in the wood furniture and secondary paperboard and other paper products.

**EXHIBIT 8.** Region-wide Direct Economic Contributions, Industry Groups, 2017

| Industry Group                                | Employment     | Labor Income<br>(Thousands of<br>Dollars) | Value-added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|---|----------------|---|--|-------------------------------------|
| Forestry                                      | 17,582         | \$605,111                                 | \$625,441                                | \$820,887                           |
| Logging                                       | 41,769         | \$2,349,855                               | \$3,366,782                              | \$4,286,672                         |
| Primary solid wood products                   | 41,560         | \$2,457,771                               | \$3,182,925                              | \$13,939,506                        |
| Secondary solid wood products                 | 122,434        | \$7,044,823                               | \$8,313,876                              | \$24,694,220                        |
| Wood furniture                                | 136,021        | \$7,844,368                               | \$9,307,465                              | \$23,743,111                        |
| Pulp, paper, and paperboard mills             | 38,351         | \$3,926,864                               | \$6,914,707                              | \$29,603,879                        |
| Secondary paperboard and other paper products | 144,442        | \$12,289,344                              | \$18,842,069                             | \$69,945,542                        |
| <b>Total</b>                                  | <b>542,158</b> | <b>\$36,518,137</b>                       | <b>\$50,553,265</b>                      | <b>\$167,033,817</b>                |

**EXHIBIT 9.** Region-wide Total Economic Contributions, Industry Groups, 2017

| Industry Group | Employment | Labor Income<br>(Thousands of<br>Dollars) | Value-Added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|----------------|------------|---|--|-------------------------------------|
| Forestry       | 16,669     | \$684,498                                 | \$857,354                                | \$1,267,775                         |
| Logging        | 23,331     | \$1,268,111                               | \$1,921,904                              | \$2,745,669                         |

| Industry Group                                | Employment       | Labor Income<br>(Thousands of<br>Dollars) | Value-Added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|---|------------------|---|--|-------------------------------------|
| Primary solid wood products                   | 108,003          | \$6,708,781                               | \$10,274,777                             | \$23,526,396                        |
| Secondary solid wood products                 | 288,927          | \$17,504,448                              | \$25,155,685                             | \$54,607,794                        |
| Wood furniture                                | 297,641          | \$17,980,467                              | \$25,692,267                             | \$53,520,259                        |
| Pulp, paper, and paperboard mills             | 164,948          | \$12,051,257                              | \$19,932,081                             | \$48,900,414                        |
| Secondary paperboard and other paper products | 508,115          | \$36,287,805                              | \$57,934,902                             | \$142,597,517                       |
| <b>Total</b>                                  | <b>1,407,634</b> | <b>\$92,485,367</b>                       | <b>\$141,768,969</b>                     | <b>\$327,165,824</b>                |

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

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, maple syrup production, 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, forest protection, maple syrup production, and support activities for forestry. Timber tract operations include establishments primarily engaged in the operation of timber tracts for the purpose of selling standing timber. Maple syrup production was one of many activities in the “all other crop farming” sector. Support activities for forestry comprise establishments primarily engaged in performing particular 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 cruising timber, wildland firefighting, forest pest control, marking boundaries, and other forest management services.

Out of seven industry groups, forestry was the smallest in terms of direct contributions in 2017. Direct contributions were \$820.9 million in output, 17,582 jobs, \$605.1 million in labor income, and \$625.4 million value-added. Total contributions are based, in part, on backward linkages to suppliers. Total contributions for forestry are lower than direct contributions (i.e., initial IMPLAN levels) because many of the contributions are inputs into other industries. For example, almost one-third (31 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 in Exhibit 9 underrepresent the industry's broader contributions. The same holds true for logging 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 fourth largest in terms of direct employment contribution. The direct contributions of logging were nearly \$4.3 billion in output, 41,769 jobs, \$2.3 billion in labor income, and \$3.4 billion 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 the Northeast and Midwest area, two-thirds (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 fifth largest group in terms of direct employment in the Northeast and Midwest area. Primary solid wood products include wood-based electric power generation, sawmills, wood preservation, veneer and plywood manufacturing, and reconstituted wood product manufacturing industries. The direct contributions of the group were \$13.9 billion in output, 41,560 jobs, \$2.5 billion in labor income, and \$3.2 billion in value-added. Total contributions for primary solid wood products, including direct, indirect and induced effects, were \$23.5 billion in output, 108,003 jobs, \$6.7 billion in labor income, and \$10.3 billion in value-added. Many primary solid wood products (e.g., lumber and panels) are inputs in other industries; those inputs are counted in other industries' total contributions.

### **Secondary Solid Wood Products**

Secondary solid wood products was the third largest group in terms of direct employment in the Northeast and Midwest area. 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. Mass timber, including cross-laminated timber (CLT) and glued laminated timber (glulam), is part of this industry group. Direct contributions of secondary solid wood products were \$24.7 billion in output, 122,434 in employment, \$7.0 billion in labor income, and \$8.3 billion in value-added. Total contributions were \$54.6 billion in output, 288,927 jobs, \$17.5 billion in labor income, and \$25.2 billion in value-added.

### **Wood Furniture**

Wood furniture was the second largest group in terms of direct employment in the Northeast and Midwest area. Wood furniture includes wood kitchen cabinet and countertop manufacturing;

upholstered household furniture manufacturing; nonupholstered wood household furniture manufacturing; institutional wood furniture manufacturing; wood office furniture manufacturing; custom architectural woodwork and millwork manufacturing; and showcase, partition, shelving, and locker manufacturing. Direct contributions of wood furniture were \$23.7 billion in output, 136,021 jobs, \$7.8 billion in labor income, and \$9.3 billion in value-added. Total contributions of wood furniture were \$53.5 billion in output, 297,641 jobs, \$18.0 billion in labor income, and nearly \$25.7 billion in value-added.

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

The pulp, paper, and paperboard mills industry group was the sixth largest out of the seven industry groups in terms of direct employment. The group includes pulp mills, paper mills, and paperboard mills that make paper or pulp from raw wood and from purchased pulp. The pulp, paper, and paperboard mills group's direct contributions were \$29.6 billion in output, 38,351 jobs, \$3.9 billion in labor income, and \$6.9 billion in value-added. This was the second highest output of all forest products industries. Total contributions were \$48.9 billion in output, 164,948 jobs, \$12.1 billion in labor income, and \$19.9 billion in value-added.

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

The secondary paperboard and other paper products group was the largest industry in terms of direct employment, labor income, value-added and output contributions in the Northeast and Midwest area. It provided more than a quarter of the direct employment and supported more than one-third of the total employment of the forest products industries. 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 \$69.9 billion in output, 144,442 jobs, \$12.3 billion in labor income, and \$18.8 billion in value-added. Total contributions were \$142.6 billion in output, 508,115 jobs, \$36.3 billion in labor income, and \$57.9 billion value-added.

### **Top Forest Product Sectors by Direct Employment**

Among the 32 industry sectors that comprise the seven industry groups listed above, the leading sectors varied by the contribution measure examined. Appendix C lists direct contribution estimates for each of the 32 sectors for employment, labor income, value added, and output or sales.

In terms of direct employment, the top four sectors were paperboard container manufacturing (76,914 jobs), wood kitchen cabinet and countertop manufacturing (55,097 jobs), commercial logging (41,769 jobs), and paper bag and coated and treated paper manufacturing (33,636 jobs). These sectors reflect the diversity of manufacturing in the Northeast and Midwest.

The paperboard 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 wood kitchen cabinet and countertop manufacturing sector industry comprises establishments 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 commercial logging sector was the only sector in the logging industry group, and comprises establishments primarily engaged in one or more of the following: cutting timber, cutting and transporting timber, and producing wood chips in the field. Loggers are a critical component of the forest products industries. This sector has been generally expanding since the 2008–09 recession, but many people in the forest products industries are concerned that the aging logger population, insufficient recruitment and retention, and the high cost of entry into the business may limit other industries in the future (Allred 2009; Conrad et al. 2018).

The paper bag and coated and treated paper manufacturing sector comprises establishments primarily 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; and surface coating paper or paperboard.

### **Top Forest Product Sectors by Direct Labor Income, Value Added, and Output**

The top sectors by direct labor income were Paperboard container manufacturing, paper mills, paper bag and coated and treated paper manufacturing, and wood kitchen cabinet and countertop manufacturing, totaling \$15.3 billion. The sectors with the highest value added were Paperboard container manufacturing, paper mills, paper bag and coated and treated paper manufacturing, and sanitary paper product manufacturing, totaling \$22.2 billion. In terms of output, paperboard container manufacturing again led the way, followed by paper mills, paper bag and coated and treated paper manufacturing, and sanitary paper product manufacturing, totaling \$86.1 billion.

### **Top Nonforest Industries Impacted**

The influence of the forest products industries in the Northeast and Midwest area extends beyond the 32 forest products industry sectors identified in this analysis through backward linkages through IMPLAN from the forest products industries sectors, both among themselves and also to other sectors. Through these linkages, the forest products industries also affected 277 other sectors in 2017 (counting sectors

with ten or more jobs supported), through indirect and induced spending by forest products companies, their suppliers, and individuals. The top ten sectors (excluding forest products sectors) included wholesale trade, management of companies and enterprises, real estate, restaurants, hospitals, and trucking (Exhibit 10).

These data were at an aggregate level, so 24,179 jobs in truck transportation included log trucks, delivery trucks, and office jobs for some trucking companies, among others. Notably, some trucking firms self-classify themselves in the logging sector, while others consider themselves in truck transportation.

**EXHIBIT 10.** Direct Jobs Impacted by the Forest Products Industries Among the Northeast and Midwest’s Top Ten Non-Forest Products Industries in 2017

| IMPLAN Sector | Description                             | Jobs           |
|---------------|---|----------------|
| 395           | Wholesale trade                         | 65,721         |
| 461           | Management of companies and enterprises | 32,072         |
| 440           | Real estate                             | 31,988         |
| 501           | Full-service restaurants                | 30,374         |
| 502           | Limited-service restaurants             | 26,459         |
| 482           | Hospitals                               | 24,947         |
| 411           | Truck transportation                    | 24,179         |
| 468           | Services to buildings                   | 19,344         |
| 464           | Employment services                     | 18,978         |
| 475           | Offices of physicians                   | 13,329         |
| <b>Total</b>  | <b>NA</b>                               | <b>287,390</b> |

## State Comparisons

State-level IMPLAN analyses show the great diversity of forest products industries across the Northeast and Midwest area. States are, of course, quite diverse in many ways. For example, Vermont’s 2017 population was 623,657, whereas New York’s population was 19.8 million. Consequently, many side-by-side comparisons are driven by the overall size of the state in terms of people and economic activity. Exhibits D1 and D2 in Appendix D list direct and total contributions for each state for employment, labor income, value-added, and output. A comparison is also made between the sum of the 20 individual state report totals, and the estimates resulting from the aggregated 20-state model.

Direct employment in forest products industries ranged from 1,957 jobs in Delaware to 68,541 jobs in Pennsylvania. Six states had over 40,000 direct jobs: Pennsylvania, Wisconsin, Indiana, Ohio, New York, and Michigan. Six other states had direct employment under 10,000 jobs: Vermont, Maryland, Connecticut, New Hampshire, Rhode Island, and Delaware.

Direct employment by industry group provides additional insight regarding the distribution of industries across the region (Exhibits D3 and D4).

- For direct employment in forestry, the top states are Vermont, Maine, Pennsylvania, New York, and Michigan. Maple syrup production employment is the largest contributing sector for Vermont and New York. Support activities in forestry is the largest forestry group sector for the other states.
- For direct employment in logging, the top states are Wisconsin, Maine, Pennsylvania, Michigan, and New York; all have over 4,000 logging jobs.
- For direct employment in primary solid wood products, the top states are Pennsylvania, Michigan, Wisconsin, Indiana, and Ohio, although there is a large range in that group: Pennsylvania's 6,812 jobs is almost double Ohio's 3,178 jobs.
- For direct employment in secondary solid wood products, the top states are Pennsylvania, Wisconsin, Indiana, Ohio, and Minnesota, each with over 11,000 jobs. Pennsylvania heads the list with 18,638 jobs.
- For direct employment in wood furniture, the top states are Indiana, Ohio, Pennsylvania, Wisconsin, and New York. Indiana heads the list with over 22,000 jobs.
- For direct employment in pulp, paper, and paperboard mills, the top states are Wisconsin, New York, Michigan, Pennsylvania, and Maine. Wisconsin heads the list with over 11,000 jobs, followed by New York, which has almost 5,000 jobs.
- For direct employment in paperboard and other paper products, the top states are Pennsylvania, Wisconsin, Ohio, Illinois, and New York.

Pennsylvania is among the top five states in all seven industry groups, followed by Wisconsin (top five in six industry groups) and New York (top five in five industry groups).

Total employment contributions followed a similar pattern, with larger states having over 85,000 jobs supported by the forest products industries. Illinois joined this group with approximately 90,000 total jobs supported. The largest two states in terms of total employment contributions were Wisconsin (160,149 jobs) and Pennsylvania (152,698 jobs). Labor income, value-added, and output follow a similar pattern to that of employment.

The sum of the 20 individual state reports differs from the 20-state region model total. The maxim "the whole is greater than the sum of the parts" holds for the forest products industries in the Northeast and Midwest area. The sum of the total contributions for individual states yields 1,175,938 jobs supported, \$73.8 billion in labor income, \$111.0 billion in value-added, and \$271.0 billion in output (Exhibit D5). By looking at the "whole" 20-state area, the values increase to 1.4 million jobs supported, \$92.5 billion in labor income, \$141.8 billion in value-added, and \$327.2 billion in output. This reflects a 20 percent or greater increase for the various economic measures when compared to individual states results. This increase is due to interindustry linkages across the 20 states. This linkage is not captured when the individual states results are summed.

## 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 Northeast and Midwest states' forest products industries with others. Natural resources and agricultural industries significantly contribute to the diversity of economic activities (Exhibit 11). The forest products industries provided more direct labor income and output than the commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries comprised nearly 1 percent of the GSP in 2017. Agricultural production provided the largest amount of employment (full- and part-time), by far, of these industries, and mining and oil and gas production provided the most direct value-added.

**EXHIBIT 11.** Natural Resources and Agricultural Production Industries in the Northeast and Midwest, 2017

| Industry   | Employment       | Labor Income<br>(Thousands of<br>Dollars) | Value-added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|--|------------------|---|--|-------------------------------------|
| Forest products                                    | 542,158          | \$36,518,137                              | \$50,553,265                             | \$167,033,817                       |
| Commercial fishing, hunting,<br>and trapping       | 27,552           | \$1,408,345                               | \$1,743,915                              | \$1,999,665                         |
| Mining and oil and gas<br>production               | 241,876          | \$14,835,473                              | \$61,481,475                             | \$85,797,446                        |
| Agricultural production<br>(plant crop and animal) | 1,072,139        | \$27,684,645                              | \$49,631,488                             | \$142,689,243                       |
| <b>Total</b>                                       | <b>1,883,725</b> | <b>\$80,446,600</b>                       | <b>\$163,410,143</b>                     | <b>\$397,520,171</b>                |

Labor income per job was highest in forest products (\$67,357); mining and oil and gas had the second highest average income at \$61,335, followed by commercial fishing, hunting, and trapping (\$51,115). For agricultural production, the average income per job was \$25,822.

Most of the forest products industries are manufacturers, however the forestry, logging, and wood-based electric power generation are not. There were 5.9 million manufacturing jobs in the 20-state region in 2017. Of those, 481,790 jobs were in the forest products industries, 8.1 percent of the total. Of 16 industries, forest products manufacturing was fifth in terms of employment behind food, fabricated metal, transportation equipment, and machinery manufacturing. It was seventh in terms of labor income, value-added, and output (Exhibit 12).



**Exhibit 12.** Manufacturing Industries in the Northeast and Midwest, 2017

| <b>Manufacturing Industries</b> | <b>Employment</b> | <b>Labor Income<br/>(Thousands of<br/>Dollars)</b> | <b>Value-Added<br/>(Thousands of<br/>Dollars)</b> | <b>Output<br/>(Thousands of<br/>Dollars)</b> |
|---------------------------------|-------------------|--|---|--|
| Food                            | 786,964           | \$48,110,515                                       | \$89,279,962                                      | \$427,010,736                                |
| Fabricated metal                | 770,590           | \$55,262,862                                       | \$81,201,345                                      | \$193,059,452                                |
| Transportation equipment        | 730,204           | \$66,571,331                                       | \$121,350,931                                     | \$507,207,964                                |
| Machinery                       | 579,438           | \$51,851,543                                       | \$76,651,691                                      | \$216,314,136                                |
| Forest products                 | 481,790           | \$33,361,859                                       | \$46,119,188                                      | \$161,064,639                                |
| Plastics and rubber products    | 382,401           | \$26,353,506                                       | \$43,435,494                                      | \$130,570,527                                |
| Chemical                        | 370,049           | \$56,950,248                                       | \$157,009,695                                     | \$405,660,854                                |
| Computer and electronic product | 365,272           | \$40,011,172                                       | \$70,867,255                                      | \$171,967,446                                |
| Miscellaneous                   | 353,579           | \$30,439,345                                       | \$44,122,764                                      | \$107,965,022                                |
| Printing                        | 271,449           | \$15,966,626                                       | \$22,139,486                                      | \$46,119,717                                 |
| Primary metal                   | 221,500           | \$19,508,679                                       | \$32,654,743                                      | \$128,984,613                                |
| Electrical equipment            | 197,063           | \$18,551,800                                       | \$27,156,074                                      | \$80,481,496                                 |
| Nonmetallic mineral product     | 175,698           | \$12,227,351                                       | \$22,423,414                                      | \$58,895,457                                 |
| Textiles and apparel            | 126,492           | \$6,635,051  | \$8,512,703                                       | \$24,323,602                                 |
| Beverage and tobacco product    | 90,350            | \$6,607,292  | \$21,662,850                                      | \$61,264,815                                 |
| Petroleum and coal              | 35,256            | \$7,853,351  | \$34,687,460                                      | \$117,427,560                                |
| <b>Total</b>                    | <b>5,938,096</b>  | <b>\$496,262,530</b>                               | <b>\$899,275,055</b>                              | <b>\$2,838,318,036</b>                       |

## Supplemental Economic Contribution Information

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

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

ratios to individual states versus the 20-state region, minor differences in direct contribution results occur (less than 0.25 percent) due to rounding errors.

Second, for sector 47, electric power generation–biomass, some IMPLAN employment figures are inconsistent based on prior knowledge and other government sources for this sector. In total, eight of the 20 states in the Northeast and Midwest had wood-based electric power generation; initial IMPLAN values included 15 states. To assess their 2017 employment, most states surveyed their power facilities. As a result, the updated direct employment figure (decreased from 1,924 to 1,017) was used in IMPLAN analysis; other sector metrics were 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 inserted into IMPLAN.

## Summary

Over the last 20 years, individual states located in the Northeast and Midwest 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 the Northeast and Midwest area for 2017, as well as a baseline report for future analyses. State data were used in this report, but given IMPLAN's structure, substate and multistate analyses can be developed. However, future analyses may again require funding from the U.S. Forest Service or other institutions for assessments across multiple states. Methods used in developing this report are consistent across the region. There were 542,158 direct jobs in the forest products industries, and overall, approximately 1.4 million jobs were supported. Direct labor income was \$36.5 billion with total labor income at approximately \$92.5 billion. Direct value-added was \$50.6 billion, and the total contribution for value-added was \$141.8 billion. Finally, direct output was \$167.0 billion with a total contribution of nearly \$327.2 billion in output. Similar report findings are available for individual states in the area (Appendix D).

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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-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 GRP.

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

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

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

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

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

| IMPLAN Sector | Sector Name        |
|---------------|--------------------|
| 16            | Commercial logging |

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

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

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

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

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



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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<br>(Thousands of<br>Dollars) | Value-added*<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|--|---------------|---|---|-------------------------------------|
| Forestry, forest products, and timber tract production | 3,616         | \$234,632                                 | \$243,097                                 | \$337,832                           |
| Support activities for forestry                        | 7,724         | \$323,801                                 | \$312,630                                 | \$342,278                           |
| Maple syrup production                                 | 6,241         | \$46,678                                  | \$69,714                                  | \$140,777                           |
| <b>Subtotal</b>  | <b>17,582</b> | <b>\$605,111</b>                          | <b>\$625,441</b>                          | <b>\$820,887</b>                    |

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

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

| Sector             | Employment    | Labor Income<br>(Thousands of<br>Dollars) | Value-added*<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|--------------------|---------------|---|---|-------------------------------------|
| Commercial logging | 41,769        | \$2,349,855                               | \$3,366,782                               | \$4,286,672                         |
| <b>Subtotal</b>    | <b>41,769</b> | <b>\$2,349,855</b>                        | <b>\$3,366,782</b>                        | <b>\$4,286,672</b>                  |

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

| Sector                                   | Employment    | Labor Income<br>(Thousands of<br>Dollars) | Value-added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|--|---------------|---|--|-------------------------------------|
| Electric power generation—biomass        | 1,017         | \$201,311                                 | \$441,854                                | \$861,618                           |
| Sawmills                                 | 27,370        | \$1,429,290                               | \$1,569,084                              | \$7,599,193                         |
| Wood preservation                        | 2,562         | \$158,139                                 | \$267,954                                | \$1,489,713                         |
| Veneer and plywood manufacturing         | 6,488         | \$351,315                                 | \$407,900                                | \$1,761,382                         |
| Reconstituted wood product manufacturing | 4,123         | \$317,716                                 | \$496,132                                | \$2,227,600                         |
| <b>Subtotal</b>                          | <b>41,560</b> | <b>\$2,457,771</b>                        | <b>\$3,182,925</b>                       | <b>\$13,939,506</b>                 |

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

| <b>Sector</b>                                      | <b>Employment</b> | <b>Labor Income<br/>(Thousands of<br/>Dollars)</b> | <b>Value-added<br/>(Thousands of<br/>Dollars)</b> | <b>Output<br/>(Thousands of<br/>Dollars)</b> |
|--|-------------------|--|---|--|
| Engineered wood member and truss manufacturing     | 12,127            | \$705,516  | \$764,839   | \$2,713,765                                  |
| Wood windows and doors manufacturing               | 27,202            | \$1,778,963  | \$2,204,174                                       | \$6,485,174                                  |
| Cut stock, resawing lumber, and planing            | 3,922             | \$214,591  | \$272,198   | \$905,581                                    |
| Other millwork, including flooring                 | 17,815            | \$1,017,883  | \$1,237,412                                       | \$3,728,438                                  |
| Wood container and pallet manufacturing            | 31,072            | \$1,579,164  | \$1,747,691                                       | \$4,914,537                                  |
| Manufactured home (mobile home) manufacturing      | 5,661             | \$365,254  | \$502,110   | \$1,441,302                                  |
| Prefabricated wood building manufacturing          | 8,825             | \$506,785  | \$552,328   | \$1,555,266                                  |
| All other miscellaneous wood product manufacturing | 15,809            | \$876,668  | \$1,033,123                                       | \$2,950,156                                  |
| <b>Subtotal</b>                                    | <b>122,434</b>    | <b>\$7,044,823</b>                                 | <b>\$8,313,876</b>                                | <b>\$24,694,220</b>                          |

**Exhibit 1. Direct Economic Contributions, Wood Furniture Detail, 2017**

| <b>Sector</b>  | <b>Employment</b> | <b>Labor Income<br/>(Thousands of<br/>Dollars)</b> | <b>Value-added<br/>(Thousands of<br/>Dollars)</b> | <b>Output<br/>(Thousands of<br/>Dollars)</b> |
|--|-------------------|--|---|--|
| Wood kitchen cabinet and countertop manufacturing        | 55,097            | \$2,933,008  | \$3,251,378                                       | \$8,230,428                                  |
| Upholstered household furniture manufacturing            | 11,114            | \$602,629  | \$710,590   | \$2,263,821                                  |
| Nonupholstered wood household furniture manufacturing    | 17,427            | \$857,995  | \$1,030,227                                       | \$2,353,457                                  |
| Institutional wood furniture manufacturing               | 11,358            | \$759,397  | \$880,838   | \$2,319,927                                  |
| Wood office furniture manufacturing                      | 12,287            | \$795,565  | \$1,173,834                                       | \$2,882,595                                  |
| Custom architectural woodwork and millwork manufacturing | 11,621            | \$816,357  | \$928,136   | \$2,033,061                                  |
| Showcase, partition, shelving, and locker manufacturing  | 17,116            | \$1,079,418  | \$1,332,462                                       | \$3,659,822                                  |
| <b>Subtotal</b>  | <b>136,021</b>    | <b>\$7,844,368</b>                                 | <b>\$9,307,465</b>                                | <b>\$23,743,111</b>                          |

**Exhibit 2.** Direct Economic Contributions, Pulp, Paper, and Paperboard Mills Detail, 2017

| <b>Sector</b>    | <b>Employment</b> | <b>Labor Income<br/>(Thousands of<br/>Dollars)</b> | <b>Value-added<br/>(Thousands of<br/>Dollars)</b> | <b>Output<br/>(Thousands of<br/>Dollars)</b> |
|------------------|-------------------|--|---|--|
| Pulp mills       | 1,107             | \$126,477  | \$163,576   | \$733,215                                    |
| Paper mills      | 30,459            | \$3,100,221  | \$5,586,217                                       | \$23,391,072                                 |
| Paperboard mills | 6,785             | \$700,165  | \$1,164,913                                       | \$5,479,591                                  |
| <b>Subtotal</b>  | <b>38,351</b>     | <b>\$3,926,864</b>                                 | <b>\$6,914,707</b>                                | <b>\$29,603,879</b>                          |

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

| <b>Sector</b>  | <b>Employment</b> | <b>Labor Income<br/>(Thousands of<br/>Dollars)</b> | <b>Value-added<br/>(Thousands of<br/>Dollars)</b> | <b>Output<br/>(Thousands of<br/>Dollars)</b> |
|--|-------------------|--|---|--|
| Paperboard container manufacturing                   | 76,914            | \$6,283,901  | \$8,407,846                                       | \$36,256,762                                 |
| Paper bag and coated and treated paper manufacturing | 33,636            | \$3,007,404  | \$4,457,117                                       | \$15,583,060                                 |
| Stationery product manufacturing                     | 10,085            | \$746,504  | \$1,145,782                                       | \$3,885,470                                  |
| Sanitary paper product manufacturing                 | 13,628            | \$1,401,699  | \$3,734,063                                       | \$10,851,410                                 |
| All other converted paper product manufacturing      | 10,179            | \$849,836  | \$1,097,261                                       | \$3,368,840                                  |
| <b>Subtotal</b>                                      | <b>144,442</b>    | <b>\$12,289,344</b>                                | <b>\$18,842,069</b>                               | <b>\$69,945,542</b>                          |

## Appendix D: Additional Regional Tables

**Exhibit D1.** Compilation of State-level Direct Contributions

| State                          | Employment     | Labor Income<br>(Thousands of<br>Dollars) | Value-added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|--------------------------------|----------------|---|--|-------------------------------------|
| Connecticut                    | 7,730          | \$612,313                                 | \$673,015                                | \$2,415,490                         |
| Delaware                       | 1,957          | \$172,281                                 | \$277,321                                | \$811,193                           |
| Illinois                       | 38,554         | \$2,751,641                               | \$3,631,953                              | \$12,863,371                        |
| Indiana                        | 50,093         | \$3,124,900                               | \$4,046,325                              | \$12,883,498                        |
| Iowa                           | 17,834         | \$1,118,759                               | \$1,828,168                              | \$4,978,201                         |
| Maine                          | 18,887         | \$990,184                                 | \$1,589,980                              | \$5,236,715                         |
| Maryland                       | 8,813          | \$589,530                                 | \$730,098                                | \$2,633,880                         |
| Massachusetts                  | 16,083         | \$1,548,080                               | \$1,441,125                              | \$5,354,786                         |
| Michigan                       | 40,746         | \$2,674,987                               | \$3,481,716                              | \$12,182,249                        |
| Minnesota                      | 34,055         | \$2,367,350                               | \$3,578,890                              | \$10,503,265                        |
| Missouri                       | 25,699         | \$1,466,242                               | \$2,336,133                              | \$6,985,972                         |
| New Hampshire                  | 7,289          | \$362,982                                 | \$651,642                                | \$1,620,412                         |
| New Jersey                     | 18,702         | \$1,550,628                               | \$1,908,904                              | \$6,720,879                         |
| New York                       | 43,024         | \$3,270,371                               | \$3,783,648                              | \$13,484,023                        |
| Ohio                           | 54,445         | \$3,690,189                               | \$4,649,464                              | \$16,111,539                        |
| Pennsylvania                   | 68,541         | \$4,631,225                               | \$7,477,831                              | \$22,419,639                        |
| Rhode Island                   | 3,035          | \$180,616                                 | \$229,666                                | \$929,557                           |
| Vermont                        | 9,107          | \$291,472                                 | \$393,406                                | \$1,370,850                         |
| West Virginia                  | 10,108         | \$520,228                                 | \$747,027                                | \$2,214,972                         |
| Wisconsin                      | 67,793         | \$4,517,367                               | \$7,065,287                              | \$25,282,710                        |
| <b>20-state region (sum)</b>   | <b>542,494</b> | <b>\$36,431,345</b>                       | <b>\$50,521,600</b>                      | <b>\$167,003,201</b>                |
| <b>20-state region (model)</b> | <b>542,158</b> | <b>\$36,518,137</b>                       | <b>\$50,553,265</b>                      | <b>\$167,033,817</b>                |

Note: The numbers in the table are the results of 20 individual state models, the sum of which is indicated by the “20-state region (sum)” total. A total region model was also calculated, the total of which is represented by the “20-state region (model)” total, and these values match the estimates given in the body of this report. The difference between the 20-state region sum and model reflects interstate economic activity not captured in the individual state models. The use of ratios applied for partial sectors at the state versus regional level lead to small differences in direct effect results (less than 0.25 percent).

**Exhibit D2.** Compilation of State-level Total Contributions

| State                          | Employment       | Labor Income<br>(Thousands of<br>Dollars) | Value-added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|--------------------------------|------------------|---|--|-------------------------------------|
| Connecticut                    | 16,141           | \$1,224,699                               | \$1,637,604                              | \$3,957,671                         |
| Delaware                       | 4,003            | \$291,789                                 | \$485,356                                | \$1,147,886                         |
| Illinois                       | 90,102           | \$5,995,900                               | \$8,994,987                              | \$21,851,360                        |
| Indiana                        | 96,444           | \$5,522,457                               | \$7,982,412                              | \$19,935,504                        |
| Iowa                           | 33,656           | \$1,880,743                               | \$3,116,328                              | \$7,285,278                         |
| Maine                          | 39,742           | \$1,951,150                               | \$3,190,147                              | \$8,165,119                         |
| Maryland                       | 18,046           | \$1,162,355                               | \$1,675,631                              | \$4,200,375                         |
| Massachusetts                  | 37,806           | \$3,102,352                               | \$3,806,318                              | \$9,225,714                         |
| Michigan                       | 91,176           | \$5,477,204                               | \$7,987,222                              | \$20,196,166                        |
| Minnesota                      | 78,465           | \$5,098,267                               | \$7,893,811                              | \$18,036,983                        |
| Missouri                       | 53,862           | \$2,961,633                               | \$4,759,704                              | \$11,292,249                        |
| New Hampshire                  | 12,881           | \$695,988                                 | \$1,168,016                              | \$2,485,618                         |
| New Jersey                     | 41,942           | \$3,186,935                               | \$4,477,820                              | \$10,894,609                        |
| New York                       | 86,775           | \$6,537,990                               | \$9,049,965                              | \$21,792,352                        |
| Ohio                           | 124,692          | \$7,516,031                               | \$11,069,310                             | \$27,365,814                        |
| Pennsylvania                   | 152,698          | \$9,874,890                               | \$15,782,426                             | \$36,469,069                        |
| Rhode Island                   | 6,372            | \$375,000                                 | \$548,657                                | \$1,462,615                         |
| Vermont                        | 13,816           | \$521,860                                 | \$770,800                                | \$2,057,036                         |
| West Virginia                  | 17,171           | \$853,058                                 | \$1,311,223                              | \$3,229,881                         |
| Wisconsin                      | 160,149          | \$9,528,567                               | \$15,295,296                             | \$39,996,566                        |
| <b>20-state region (sum)</b>   | <b>1,175,938</b> | <b>\$73,758,866</b>                       | <b>\$111,003,033</b>                     | <b>\$271,047,864</b>                |
| <b>20-state region (model)</b> | <b>1,407,634</b> | <b>\$92,485,367</b>                       | <b>\$141,768,969</b>                     | <b>\$327,165,824</b>                |

Note: The numbers in the table are the results of 20 individual state models, the sum of which is indicated by the “20-state region (sum)” total. A total region model was also calculated, the total of which is represented by the “20-state region (model)” total, and these values match the estimates given in the body of this report. The difference between the 20-state region sum and model reflects interstate economic activity not captured in the individual state models. The much larger 20-state region model results reflect the interstate economic activity not reflected in individual state models.

**Exhibit D3.** State Direct Employment by Forestry, Logging, Primary Solid Wood Products, and Secondary Solid Wood Products Industry Groups, 2017

| State         | Forestry      | Logging       | Primary Solid Wood Products | Secondary Solid Wood Products |
|---------------|---------------|---------------|-----------------------------|-------------------------------|
| Connecticut   | 90            | 569           | 276                         | 1,268                         |
| Delaware      | 88            | 29            | 60                          | 355                           |
| Illinois      | 499           | 705           | 1,201                       | 6,304                         |
| Indiana       | 356           | 1,422         | 3,485                       | 12,572                        |
| Iowa          | 94            | 610           | 590                         | 9,038                         |
| Maine         | 2,326         | 5,052         | 2,986                       | 2,484                         |
| Maryland      | 140           | 648           | 643                         | 2,167                         |
| Massachusetts | 1,030         | 835           | 300                         | 2,790                         |
| Michigan      | 1,321         | 4,487         | 4,768                       | 7,048                         |
| Minnesota     | 782           | 2,495         | 1,489                       | 11,288                        |
| Missouri      | 536           | 2,270         | 3,053                       | 5,989                         |
| New Hampshire | 1,250         | 1,732         | 1,107                       | 1,170                         |
| New Jersey    | 459           | 139           | 297                         | 2,664                         |
| New York      | 1,658         | 4,013         | 2,861                       | 7,113                         |
| Ohio          | 596           | 3,069         | 3,178                       | 12,516                        |
| Pennsylvania  | 1,865         | 4,740         | 6,812                       | 18,638                        |
| Rhode Island  | 8             | 92            | 112                         | 455                           |
| Vermont       | 3,342         | 1,737         | 941                         | 1,053                         |
| West Virginia | 701           | 1,919         | 2,836                       | 2,613                         |
| Wisconsin     | 778           | 5,207         | 4,564                       | 14,911                        |
| <b>Total</b>  | <b>17,919</b> | <b>41,770</b> | <b>41,559</b>               | <b>122,436</b>                |

**Exhibit D4.** State Direct Employment by Wood Furniture; Pulp, Paper, and Paperboard Mills; and Paperboard and Other Paper Products Industry Groups, 2017

| State         | Wood Furniture | Pulp, Paper, and<br>Paperboard Mills | Paperboard and<br>Other Paper Products |
|---------------|----------------|--------------------------------------|--|
| Connecticut   | 2,535          | 828                                  | 2,164                                  |
| Delaware      | 436            | 0                                    | 988                                    |
| Illinois      | 10,808         | 1,081                                | 17,956                                 |
| Indiana       | 22,062         | 1,202                                | 8,995                                  |
| Iowa          | 3,751          | 63                                   | 3,688                                  |
| Maine         | 1,590          | 3,137                                | 1,312                                  |
| Maryland      | 2,506          | 800                                  | 1,909                                  |
| Massachusetts | 3,195          | 1,845                                | 6,087                                  |
| Michigan      | 10,837         | 3,186                                | 9,099                                  |
| Minnesota     | 8,575          | 2,542                                | 6,885                                  |
| Missouri      | 7,063          | 460                                  | 6,329                                  |
| New Hampshire | 1,181          | 389                                  | 460                                    |
| New Jersey    | 5,106          | 281                                  | 9,756                                  |
| New York      | 11,791         | 4,898                                | 10,689                                 |
| Ohio          | 14,904         | 2,211                                | 17,971                                 |
| Pennsylvania  | 13,720         | 3,186                                | 19,581                                 |
| Rhode Island  | 1,045          | 138                                  | 1,186                                  |
| Vermont       | 1,318          | 641                                  | 76                                     |
| West Virginia | 1,527          | 232                                  | 281                                    |
| Wisconsin     | 12,071         | 11,233                               | 19,029                                 |
| <b>Total</b>  | <b>136,021</b> | <b>38,353</b>                        | <b>144,441</b>                         |



**Exhibit D5.** 20 Direct and Total Contributions for the Sum of the 20 Individual State Reports and for the Aggregated 20-state Model

| State                   | Effect | Employment | Labor Income<br>(Thousands of<br>Dollars) | Value-added<br>(Thousands of<br>Dollars) | Output<br>(Thousands of<br>Dollars) |
|-------------------------|--------|------------|---|--|-------------------------------------|
| 20-state region (sum)   | Direct | 542,494    | \$36,431,345                              | \$50,521,600                             | \$167,003,201                       |
| 20-state region (sum)   | Total  | 1,175,938  | \$73,758,866                              | \$111,003,033                            | \$271,047,864                       |
| 20-state region (model) | Direct | 542,158    | \$36,518,137                              | \$50,553,265                             | \$167,033,817                       |
| 20-state region (model) | Total  | 1,407,634  | \$92,485,367                              | \$141,768,969                            | \$327,165,824                       |

The use of ratios applied for partial sectors at the state versus regional level lead to small differences in direct effect results (less than 0.25 percent). The much larger 20-state region model results reflect the interstate economic activity not reflected in individual state models (Appendix E).

## Appendix E: List of State Reports

Public Sector Consultants, Douglas Emmerthal and Nicholas Zito. 2020. *Forest Products Industries' Economic Contributions: Connecticut*. Lansing: Public Sector Consultants.

Public Sector Consultants, Sam Topper and Michael Valenti. 2020. *Forest Products Industries' Economic Contributions: Delaware*. Lansing: Public Sector Consultants.

Public Sector Consultants, Illinois Forestry Development Council, and Paul Deizman. 2020. *Forest Products Industries' Economic Contributions: Illinois*. Lansing: Public Sector Consultants.

Public Sector Consultants, Jeff Settle, and Joey Gallion. 2020. *Forest Products Industries' Economic Contributions: Indiana*. Lansing: Public Sector Consultants.

Public Sector Consultants and Aron Flickinger. 2020. *Forest Products Industries' Economic Contributions: Iowa*. Lansing: Public Sector Consultants.

Public Sector Consultants and Donald Mansius. 2020. *Forest Products Industries' Economic Contributions: Maine*. Lansing: Public Sector Consultants.

Public Sector Consultants and Daniel R. Rider. 2020. *Forest Products Industries' Economic Contributions: Maryland*. Lansing: Public Sector Consultants.

Public Sector Consultants and Sean Mahoney. 2020. *Forest Products Industries' Economic Contributions: Massachusetts*. Lansing: Public Sector Consultants.

Leefers, Larry, Jagdish Poudel, David Neumann, and Public Sector Consultants. 2020. *Forest Products Industries' Economic Contributions: Michigan*. Lansing: Public Sector Consultants.

Public Sector Consultants, Kristen Bergstrand, Scott Burns and Scott Hillard. 2020. *Forest Products Industries' Economic Contributions: Minnesota*. Lansing: Public Sector Consultants.

Public Sector Consultants and Mike Morris. 2020. *Forest Products Industries' Economic Contributions: Missouri*. Lansing: Public Sector Consultants.

Public Sector Consultants and Adam Smith. 2020. *Forest Products Industries' Economic Contributions: Nebraska*. Lansing: Public Sector Consultants.

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