

Forest Products Industries' Economic Contributions: New Hampshire

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Prepared by

[Public Sector Consultants](#)

Lansing, Michigan

www.publicsectorconsultants.com

Prepared for

University of New Hampshire
New Hampshire Cooperative Extension
Durham, New Hampshire
<https://extension.unh.edu>

Michigan Department of Natural Resources
Forest Resources Division
Lansing, Michigan
www.michigan.gov/dnr



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Foreword

We are pleased to release this latest report on the economic importance of New Hampshire's forest industry. This report provides a current snapshot of our forest resources, as well as the different industry groups and sectors present in the state and their relative importance to the state's overall economy. This is the latest document reporting on New Hampshire's forest industry, and is part of a larger regional project, examining the entire northeastern and midwestern United States. By using the same methodology and data sources for all states, it provides a readily accessible means for comparisons with our neighbors and across state boundaries. We hope you find the information useful and informative.

In addition to myriad other benefits, New Hampshire's bountiful forests have been, and continue to be, an integral component of the state's economy. While products and markets may change over time, the importance of productive forests remains constant. One of the most exciting aspects of the forest products economy is recent technological advances. No more are we just talking about boards and cords, but rather wood products like nanocellulose fiber and crystals, biofuels, and mass timber skyscrapers. For millennia, forest products have been an essential resource for humankind, and as science finds new uses for wood, the importance of this resource only grows.

Of course, all of these benefits are only possible with a healthy, sustainable forest resource. In New Hampshire, that resource rests primarily in the hands of private landowners. We need to ensure we have policies and incentives to sustain our state's forests, and one of the strongest incentives available is viable markets that provide private landowners with income. Our forests will continue to support many benefits to all New Hampshire citizens, so long as we do our part to keep them healthy and productive.

Brad Simpkins

Director, New Hampshire Division of Forests and Lands
State Forester

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Executive Summary

This report assesses broad forest conditions and economic contributions of forest products industries in New Hampshire. It is one of 20 coordinated and comparable state reports in the northeastern and midwestern United States that provides an improved assessment of forests and the economies they support for a single period of time across a broad geographic region.

Forest data come from the U.S. Forest Service's Forest Inventory and Analysis website. Economic data are based on 2017 Impact Analysis for Planning (IMPLAN) data, a commercially available economic input-output (IO) model. A number of economic contribution studies focusing on New Hampshire have been completed over the last few decades using consistent methodology (NEFA 2004, 2007, 2011, 2013). In contrast to this report, previous reports show trends in the state's forest industry.

New Hampshire's forest products industries are part of a much larger regional and global forest products economy. Wood flows freely across state lines and international borders. While these wood flows are complex, market pressures are not depleting New Hampshire's forest resource based on the overall growth and yield. New Hampshire grows approximately 1.9 cords for every cord harvested or otherwise lost to mortality.

In 2017, the forest products industries in New Hampshire provided direct full- and part-time employment to over 7,200 people leading to \$1.6 billion in output. Labor income was \$363.0 million and value-added was \$651.6 million. In terms of total contributions (including multiplier effects), the industries supported over 12,800 jobs, \$696.0 million in labor income, \$1.2 billion in value-added, and \$2.5 billion in sales or output.¹

Forest Conditions

New Hampshire boasts 4.7 million acres of forest land that cover 83 percent of its land base, with most of this forest land able to produce commercial timber and not reserved from harvesting by statute or administrative regulation. The majority, 72 percent, is privately owned, while state and local governments own about 10 percent and the federal government owns 18 percent.

New Hampshire's major forest type groups include northern hardwoods (i.e., maple/beech/birch), white/red/jack pine, oak/hickory, oak/pine, spruce/fir, and aspen/birch. Tree species with the greatest standing volume include eastern white pine, red maple, northern red oak, eastern hemlock, sugar maple, red spruce, yellow birch and balsam fir.

¹ Not included in the total numbers but identified in the report section titled, "Supplemental Economic Contribution Information," is \$24.3 million direct output as a result of wood heat and approximately \$3 million direct output of Christmas trees and associated products.

Average annual net growth exceeded annual harvest removals by a ratio of 1.9 to 1. Average annual harvest removals of growing stock were approximately 97.0 million cubic feet—roughly 1 percent of standing volume.

Forest Industries

This report presents seven forest products industries, which are based on 32 economic sectors in IMPLAN, 25 of which are present in New Hampshire:

- Forestry²
- Logging
- Primary solid wood products
- Secondary solid wood products
- Wood furniture
- Pulp, paper, and paperboard mills
- Secondary paperboard and other paper products

It should be noted that not all wood or refined sector manufacturing inputs (such as pulp for paper plants) come from timber harvested in New Hampshire.

In 2017, New Hampshire's forest products industries provided direct employment to more than 7,200 people, leading to \$1.6 billion in output. That same year, labor income was \$363.0 million and value-added was \$651.6 million. In total contributions, these industries supported over 12,800 jobs, \$696.0 million in labor income, \$1.2 billion in value-added, and \$2.5 billion in output.

For each direct job in the forest products industries, 0.77 additional jobs were supported. For every \$1 million in direct labor income, an additional \$0.9 million in indirect and induced labor income was supported.

Among the top sectors (excluding forest products sectors) impacted by forest products industries were wholesale and retail trade, real estate, full-service restaurants, management of companies and enterprises, limited-service restaurants, hospitals, and others. This group of sectors reflects spending by forest products companies, their suppliers, and individuals.

Leading Forest Products Industry Groups

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

² Forestry includes maple syrup production.

- Logging had the highest number of direct jobs (1,732), the highest value-added (\$227.5 million), and the third highest direct output (\$265.6 million).
- Forestry, including maple syrup production, had the second highest number of direct jobs (1,250)³, yet had the lowest value-added (\$28.7 million) and output (\$35.7 million).
- Wood furniture had the third highest employment (1,181), fifth highest value-added (\$60.4 million), and sixth highest output (\$170.6 million).
- Primary Solid Wood Products had the fifth highest number of direct jobs (1,107), the second highest value-added (\$151.2 million), and the highest direct output (\$441.3 million).

Leading Individual Forest Products Sectors

Among the 25 forest products sectors present in New Hampshire, the top four, by measure in order from highest to fourth highest of direct contributions, were:

- Employment—Commercial logging, sawmills, maple syrup production, and wood kitchen cabinet and countertop manufacturing were the top four sectors and had a combined total of 3,745 direct jobs, or 51 percent of direct employment.
- Labor income—Commercial logging, sawmills, paper mills, and wood kitchen cabinet and countertop manufacturing had the highest labor income, totaling \$172.7 million, or 48 percent of direct labor income.
- Value-added—Commercial logging, wood-based electric power generation, paper mills, and sawmills had the highest value-added, totaling \$422.8 million, or 65 percent of direct value-added.
- Output—Paper mills, commercial logging, sawmills, and wood-based electric power generation were the top four sectors in output, totaling \$927.2 million, or 57 percent of total direct output.

New Hampshire's Forest Products Industries Compared to Other New Hampshire Industries

Computer and electronic product manufacturing and fabricated metal manufacturing have the greatest manufacturing contribution in New Hampshire by employment, labor income, value-added and total output. However, forest products industries provide the highest direct labor income, value-added, and output when compared to other natural resource industries in the state, (i.e., commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries [plant, crop, and animal]). Agricultural production is the greatest natural resources industry employer. Overall, the forest products industries accounted for 6.1 percent of the nonfood manufacturing jobs in New

³ Excluding maple syrup production, the forest management and forestry support sectors account for 525 jobs in New Hampshire.

Hampshire. Of New Hampshire's 73,111 direct manufacturing jobs in 2017, 4,136 were in the forest products industries (i.e., 1 in 18 manufacturing jobs).

New Hampshire's Forest Products Industries Compared to Those of Vermont, Maine, and Massachusetts

Forest products industries in New Hampshire, Vermont, Maine, and Massachusetts employed over 52,000 workers and accounted for almost \$13.6 billion in direct output. In terms of direct employment, Maine's forest products economy was the largest in the region, followed by that of Massachusetts. This order is reversed when measuring direct output. Massachusetts has the largest direct output in the region followed by Maine. New Hampshire had the lowest direct employment and the third highest output. Massachusetts has larger economic output as a result of their secondary forest products manufacturing, including paperboard manufacturing and other secondary solid wood manufacturing. Secondary manufacturing sectors do not necessarily use timber or wood raw material from Massachusetts forests.

Glossary

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

Forestry Terms

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

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

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

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

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

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

Economic Contribution Terms

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

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

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

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

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

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

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

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

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

Introduction

Forest products industries are an integral component of New Hampshire’s economy. They provide jobs, raw materials, and finished goods that generate additional economic activity throughout the state, region, and nation. This report compares the contributions of New Hampshire’s forest products industries with those of adjacent states. It is one of 20 reports in the Northeast and Midwestern area of the United States that broadly assesses forests and their economic contributions. The interactions of these 20 states are covered in a regional report. In total, these documents provide a consistent reporting format, compiled using identical methods, across the northeastern and midwestern United States. Previous state-level reports in this area were not comparable because they used different methods and data.

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

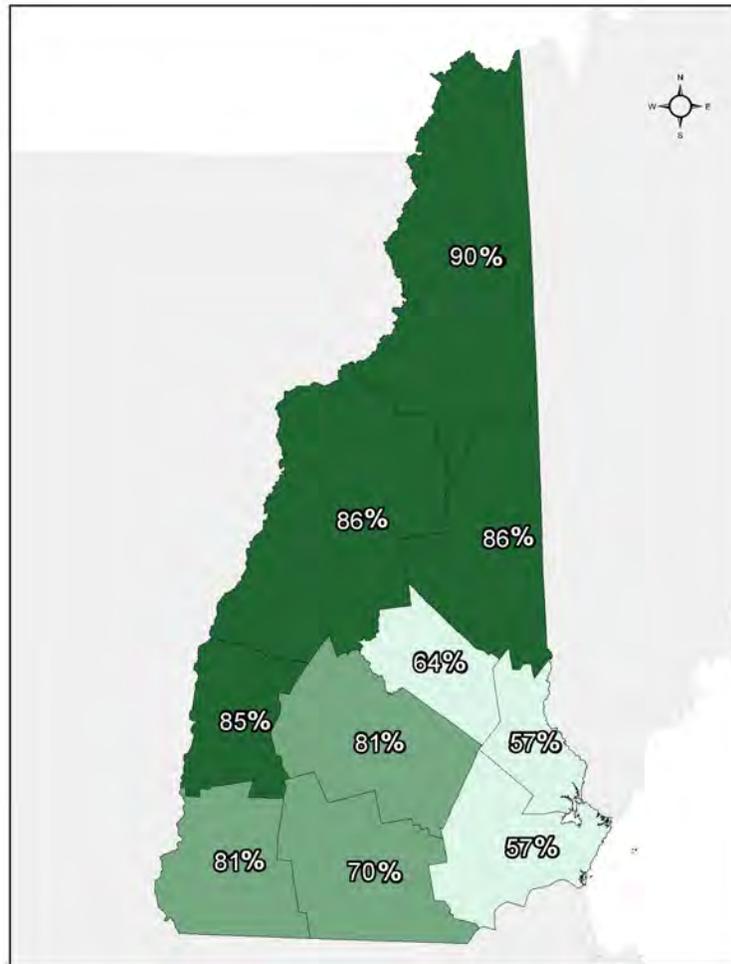
The regional approach enables economic analysis over a broad geographic area, but it lacks temporal analysis. This report uses robust data sets from a single year. To analyze long-term trends, New Hampshire has a number of economic contribution studies that occurred over the last few decades using consistent methodology (NEFA 2004, 2007, 2011, 2013).

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 New Hampshire, Forest Products Industries, Economic Contributions of New Hampshire’s Forest Products Industries, and Summary. Due to rounding, some figures in the following tables may not sum to the exact total indicated. The appendices present the economic methods and detailed economic sector data used for this report.

Forest Resources of New Hampshire

With 83 percent of the land base forested, New Hampshire is the second most forested state in the country by percentage (Exhibit 1 and Exhibit 2). Forest land acreage has been fairly stable since the 1990s with a modest decrease in the southeast portion of the state in the last decade (Morin and Lombard 2017).

Exhibit 1. New Hampshire's Forest Land by Percentage of County, 2017



The vast majority of land is privately owned, though municipalities, the State of New Hampshire and the U.S. Forest Service represent significant public ownership (Exhibit 3). Landowners pursue diverse goals related to both active and passive management. There are several state and federal programs designed to educate landowners and encourage active management of private forest lands where appropriate and consistent with landowner objectives. Similar to private lands, state and National Forests are managed for a range of objectives including growing high-quality timber, enhancing wildlife habitat, promoting recreation, and safeguarding sensitive areas. Forest management is the foundation for a strong forest industry and provides feedstock for some of New Hampshire's forest products industries.

Trees are abundant throughout the state. They are in our forests, along our rivers, and in urban environments. It is estimated that there are 4.3 billion trees in New Hampshire—roughly 3,200 trees for each person in the state (Morin and Lombard 2017). It boasts close to 4.5 million acres of timberland (forest lands productive enough to produce commercial timber and not reserved from harvesting by statute or administrative regulation).

Exhibit 2. New Hampshire Land Area by Land Use Type, 2017 (U.S. Forest Service)

Land Use Type	Acres	Percentage
Forest land	4,741,185	82.8%
Nonforest land	986,117	17.2%
Total	5,727,302	100%

The majority of New Hampshire's forest land is privately owned (72 percent). 10 percent is owned by state and local governments, while the remainder is in federal ownership.

Exhibit 3. Forest Land by Ownership Group in New Hampshire (2017)

Ownership Group	Acres	Percentage
National Forest & other federal	859,387	18.1%
State and local governments	451,413	9.5%
Private	3,430,385	72.4%
Total	4,741,185	100.0%

New Hampshire's major forest types include northern hardwoods (maple/beech/birch), pine (white/red/jack pine), transition hardwoods (oak/hickory and oak/pine), and spruce/fir (Exhibit 4). Tree species with the greatest standing volume include eastern white pine, red maple, northern red oak, eastern hemlock, sugar maple, red spruce, yellow birch and balsam fir. New Hampshire is internationally known for its high-quality northern red oak in the southern part of the state, and outstanding hard maple in the north.

The lumber produced in the state is prized for millwork, flooring, and furniture manufacturing among other durable goods. New Hampshire's diverse timber species support a variety of forest products industries, from forestry and commercial logging through secondary paper products manufacturing.

Exhibit 4. Forest Land Area by Forest Type Group in New Hampshire (2017)

Forest Type Group	Acres	Percentage
Maple/beech/birch	2,455,318	51.8%
White/red/jack pine	552,305	11.6%
Oak/hickory	512,672	10.8%
Spruce/fir	463,979	9.8%
Oak/pine	324,221	6.8%
Other	432,690	9.1%
Total	4,741,185	100.0%

The estimated volume of standing timber suitable for forest products (i.e., the marketable volume of growing stock) is approximately 10.1 billion cubic feet, or about 127 million standard cords⁴ (Exhibit 5). Average annual net growth exceeded annual harvest removals by a ratio of about 1.9 to 1. Average annual harvest removals of growing stock were approximately 97.0 million cubic feet, or about 1.2 million cords— roughly 1 percent of standing volume.

Exhibit 5. Characteristics of Growing Stock in New Hampshire, 2017 (million cubic feet)

Measure	Total	National Forest	Other Federal	State and Local Government	Private
Net volume	10,064.6	1,660.8	166.7	1,027.1	7,220.1
Average annual net growth	188.3	24.9	2.2	16.7	144.6
Average annual harvest removals	94.6	3.5	0.0	4.5	86.5
Average annual mortality	74.6	16.0	1.6	7.6	49.4

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

Forest Products Industries

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

- Forestry
- Logging
- Primary solid wood products
- Secondary solid wood products

⁴ A standard cord is a unit of measurement for pulpwood or sawlogs, generally equivalent to a stack of wood measuring four feet wide by four feet tall by eight feet long. A stacked cord of wood typically contains about 79 cubic feet of solid wood, excluding air space.

- Wood furniture
- Pulp, paper, and paperboard mills
- Secondary paperboard and other paper products

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

This report used IMPLAN to estimate economic contributions of the forest products industries. IMPLAN is a widely used input-output model that comprises economic data and software. IO models characterize financial linkages among and between sectors, households, and institutions. Within these models, various sectors have production functions that show the value of inputs used in production of outputs or commodities. New Hampshire's economy was represented by 421 sectors in 2017, the most IMPLAN data available at the time of the analysis. These sectors are based on the North American Industrial Classification System (NAICS). IMPLAN models can be constructed for different geographic areas.

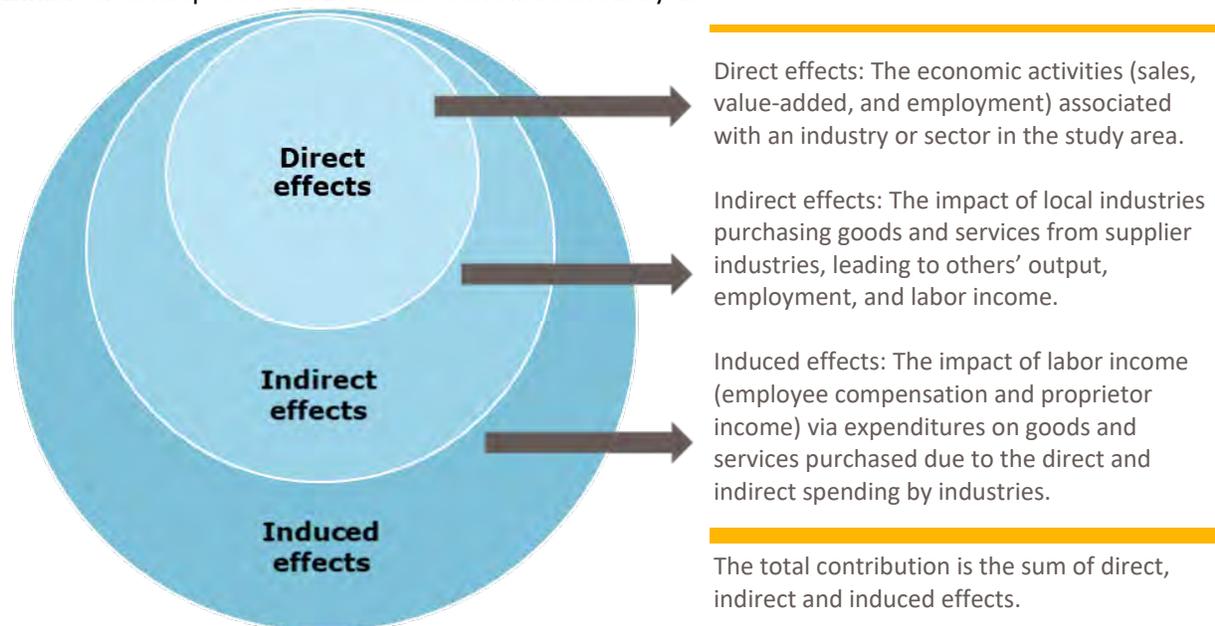
Economic Contributions of New Hampshire's Forest Products Industries

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

Economic Contributions Defined

Input-Output Analysis and IMPLAN

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

Exhibit 6. Concept of Total Economic Contribution Analysis

IO modeling using IMPLAN software and data is a conventional approach for documenting forest products industries' economic contributions. This analysis used the matrix inversion approach with external IMPLAN model adjustment as a primary method for estimating economic contributions of forest products industries in New Hampshire (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 New Hampshire, Maine, and Vermont, reveals that the direct employment for 2017 was 1,732, 5,052, and 1,737 jobs, respectively. Summing the individual state's total employment contributions (direct, indirect, and induced) yields 12,218 jobs. However, if the states are combined as one region, the total employment contribution increases to 12,325 jobs. This increase reflects less leakage and more local purchases.

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

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

Economic Contribution Results

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

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

Direct and Total Contributions by Forest Products Industries

Contribution analysis provides a means to assess the role various industries play in a state’s economy. New Hampshire forest products industries’ total economic contribution in terms of output was \$2.5 billion, based on direct output of \$1.6 billion (Exhibit 7).⁵ About 7,200 direct jobs were associated with this level of economic activity, supporting a total of 12,881 jobs. Direct labor income, which includes employee compensation and proprietor income, was \$363.0 million, or \$49,784 per job. Total labor income, which includes income paid directly to industry employees and proprietors, their suppliers, and other industries they support, totaled \$696.0 million.

Exhibit 7. Economic Contribution of Forest Products Industries in New Hampshire, 2017 Dollars

Effect	Employment	Labor Income (Thousands of Dollars)	Value-added* (Thousands of Dollars)	Output (Thousands of Dollars)
Direct	7,289	\$362,982	\$651,642	\$1,620,412
Total	12,881	\$695,988	\$1,168,016	\$2,485,618

* Value-added in IMPLAN is equivalent to GSP.

Each direct job in the forest products industries supported 0.77 additional jobs, and every \$1 million in direct labor income supported an additional \$0.9 million in indirect and induced labor income.

⁵ Per footnote one: Not included in the total numbers but identified in the report section titled, “Supplemental Economic Contribution Information,” is \$24.3 million direct output as a result of wood heat and approximately \$3 million direct output of Christmas trees and associated products.

Most state economies are large relative to any particular industry or group of industries. The forest products industries are no exception. In 2017, New Hampshire’s population was estimated at 1.3 million people, with total employment of 882,654. The gross state product was \$81.5 billion from 421 economic sectors (of the possible 536 in the US). The GSP’s largest component was labor income, which was \$53.2 billion. Direct value-added for forest products industries was \$651.6 million; 0.8 percent of New Hampshire’s total GSP. The percentage almost doubles to 1.4 percent when considering total value-added effects. These percentages hold for other economic measures (e.g., jobs) as well.

Direct and Total Contributions by Forest Product Industry Groups

As previously noted, the 32 IMPLAN forest products sectors were combined into seven industry groups (Appendix B). In New Hampshire, logging was the largest of these groups in terms of direct employment and value-added, and primary solid wood products was the largest in terms of labor income and output (Exhibit 8). Forestry had the second largest direct employment; secondary solid wood products had the second largest labor income; primary solid wood products had the second largest value-added; and pulp, paper, and paperboard mills had the second largest output. Forestry, which includes maple syrup production, forest management, and forestry support activities, was the smallest in terms of value-added and output.

Exhibit 8. Direct Economic Contributions in New Hampshire, Industry Groups, 2017

Industry Group	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	1,250	\$31,586	\$28,655	\$35,685
Logging	1,732	\$58,933	\$227,514	\$265,556
Primary solid wood products	1,107	\$74,477	\$151,205	\$441,289
Secondary solid wood products	1,170	\$66,404	\$85,063	\$229,118
Wood furniture	1,181	\$64,282	\$60,358	\$170,622
Pulp, paper, and paperboard mills	389	\$38,080	\$60,568	\$287,943
Secondary paperboard and other paper products	460	\$29,220	\$38,278	\$190,198
Total	7,289	\$362,982	\$651,642	\$1,620,412⁶

⁶ As stated in footnote one: Not included in the total numbers but identified in the report section titled, “Supplemental Economic Contribution Information,” is \$24.3 million direct output as a result of wood heat and approximately \$3 million direct output of Christmas trees and associated products.

Exhibit 9. Total Economic Contributions in New Hampshire, Industry Groups, 2017

Industry Group*	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry	1,247	\$35,739	\$39,566	\$54,880
Logging	1,801	\$67,212	\$207,579	\$257,422
Primary solid wood products	3,068	\$182,376	\$343,292	\$725,522
Secondary solid wood products	2,239	\$128,437	\$183,313	\$398,114
Wood furniture	2,019	\$112,065	\$134,693	\$297,675
Pulp, paper, and paperboard mills	1,461	\$105,043	\$166,006	\$467,952
Secondary paperboard and other paper products	1,045	\$65,117	\$93,567	\$284,053
Total	12,881	\$695,988	\$1,168,016	\$2,485,618

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

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 maple syrup production, forest management, and support activities for forestry. Maple syrup production is a small part of all other miscellaneous crop farming; for this report, sales data from the National Agricultural Statistics Service (NASS) annual survey of maple syrup producers were used. Timber tract operations, establishments primarily engaged in the operation of timber tracts for the purpose of selling standing timber, and support activities for forestry such as estimating timber; forest firefighting; forest pest control; treating burned forests from the air for reforestation or on an emergency basis; and consulting on wood attributes and reforestation related to timber production, wood technology, forestry economics and marketing, and forest protection.

Out of seven industry groups, forestry was the second largest in terms of direct contributions in 2017. Direct contributions were \$35.7 million in output, 1,250 jobs, \$31.6 million in labor income, and \$28.7 million value-added. Total contributions are based, in part, on backward linkages to suppliers. In most cases, value-added is greater than labor income, one of the value-added components. Often, this situation does not hold for agricultural sectors due to farm subsidies, which show up as “negative taxes.” Sector 19, support activities for agriculture and forestry reflects this for New Hampshire in 2017 leading to the smaller value-added. Total contributions for forestry can be lower than direct

contributions (i.e., initial IMPLAN levels) because many of the contributions are inputs into other industries. For example, 16 percent of forestry jobs are counted as contributions in other industries, mostly logging and primary solid wood products (e.g., sawmills). Hence, the total contributions displayed in Exhibit 9 underrepresent the industry's broader contributions—reporting total contributions for forestry is somewhat misleading because much of the forestry total contribution effects are hidden in the total contributions of other industries. The same holds true for logging below.

Logging

The logging industry group contains establishments primarily engaged in one or more of the following: harvesting timber, harvesting and transporting roundwood timber, and producing wood chips in the field. Logging had the largest direct employment among the forest industry groups. The direct contributions of logging were \$265.6 million in output, 1,732 jobs, \$58.9 million in labor income, and \$227.5 million in value-added. Most logging activity is an input into production in other industries, especially for manufacturing primary solid wood products (e.g., lumber), paper, and paperboard. In New Hampshire, 24 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 New Hampshire. Primary solid wood products sectors include wood-based electric power generation, sawmills, wood preservation, veneer and plywood manufacturing, and reconstituted and wood product manufacturing industries. The direct contributions of the group were \$441.3 million in output, 1,107 jobs, \$74.5 million in labor income, and \$151.2 million in value-added. Total contributions for primary solid wood products, including direct, indirect and induced effects, were \$725.5 million in output, 3,068 jobs, \$182.4 million in labor income, and \$343.3 million in value-added. Many primary solid wood products (e.g., lumber and panels) are inputs in other industries, which counted in other industries' total contributions.

Secondary Solid Wood Products

Secondary solid wood products was the fourth largest group in terms of direct employment in New Hampshire. This group contains engineered wood member and truss manufacturing; wood windows and doors manufacturing; cut stock, resawing lumber, and planing; other millwork, including flooring, wood container, and pallet manufacturing; manufactured home (mobile home) manufacturing; prefabricated wood building manufacturing; and all other miscellaneous wood product manufacturing. Direct contributions of secondary solid wood products were \$229.1 million in output, 1,170 jobs, \$66.4 million in labor income, and \$85.1 million in value-added. Total contributions were \$398.1 million in output, 2,239 jobs, \$128.4 million in labor income, and \$183.3 million in value-added.

Wood Furniture

Wood furniture was the third largest group in terms of direct employment in New Hampshire. 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 \$170.6 million in output, 1,181 jobs, 64.3 million in labor income, and \$60.4 million in value-added. Total contributions of wood furniture were \$297.7 million in output, 2,019 jobs, \$112.1 million in labor income, and \$134.7 million in value-added.

Pulp, Paper, and Paperboard Mills

The pulp, paper, and paperboard mills industry group was the smallest in terms of direct employment in New Hampshire. The group includes pulp mills, paper mills, and paperboard mills that make paper or pulp from raw wood and from purchased pulp. New Hampshire no longer has any pulp and paper mills, so this sector shows stand-alone paper mills that use pulp from pulp mills in the region and elsewhere. The pulp, paper, and paperboard mills group's direct contributions were \$287.9 million in output, 389 jobs, \$38.1 million in labor income, and \$60.6 million in value-added. Total contributions were \$468.0 million in output, 1,461 jobs, \$105.0 million in labor income, and \$166.0 million in value-added.

Secondary Paperboard and Other Paper Products

The secondary paperboard and other paper products group was the sixth largest in terms of direct employment in New Hampshire. 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 \$190.2 million in output, 460 jobs, \$29.2 million in labor income, and \$38.3 million in value-added. Total contributions were \$284.1 million in output, 1,045 jobs, \$65.1 million in labor income, and \$93.6 million value-added.

Top Forest Product Sectors

Among the 25 industry sectors in New Hampshire that comprise the seven industry groups listed above, the leading sectors varied by the contribution measure examined. In terms of direct jobs, the four largest forest products sectors are commercial logging (1,732 jobs), sawmills (763 jobs), maple syrup production (724 jobs), and wood kitchen cabinet and countertop manufacturing (527 jobs). These sectors reflect the diversity of forest-based employment opportunities in the state.

The commercial logging sector has establishments primarily engaged in one or more of the following: harvesting timber, harvesting and transporting timber, and whole tree chipping in the field. Loggers are a critical component of the forest products industries. Many people in the forest products industries are

concerned that the aging logger population, insufficient recruitment and retention, and the high cost of entry into the business may limit other industries in the future (Allred, 2009; Conrad et al., 2018).

The sawmills sector comprises establishments primarily engaged in sawing dimension lumber, boards, beams, timbers, poles, ties, shingles, shakes, siding, and wood chips from logs or bolts. Sawmills may dry the rough green lumber in dry kilns and/or plane the rough lumber that they make to achieve smoothness and uniformity of size.

The maple syrup production sector is only a portion of IMPLAN sector 10, all other miscellaneous crop farming. This sector comprises establishments primarily engaged in one of the following: 1) growing crops (except oilseeds and/or grains; vegetables and/or melons; fruits and/or tree nuts; greenhouse, nursery, and/or floriculture products; tobacco; cotton; sugarcane; hay; sugar beets; or peanuts); 2) growing a combination of crops [except a combination of oilseed(s) and grain(s); and a combination of fruit(s) and tree nut(s)], with no one crop or family of crops accounting for one-half of the establishment's agricultural production (i.e., value of crops for market); or 3) gathering tea or maple sap.

The wood kitchen cabinet and countertop manufacturing sector 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.

In terms of labor income, commercial logging, sawmills, paper mills, and wood kitchen cabinet and countertop manufacturing had the highest labor income, totaling \$172.7 million. Commercial logging, wood-based electric power generation, paper mills, and sawmills had the highest value-added, totaling \$442.8 million. For output (or sales), Paper mills, commercial logging, sawmills, and wood-based electric power generation were the top four sectors, totaling \$927.2 million.

Top Nonforest Industries Impacted

Contribution analysis using IMPLAN relies on backward linkages from forest products industries sectors among themselves and to other sectors in New Hampshire. Including the 25 forest products industries present in New Hampshire, 117 sectors were impacted in 2017 (counting sectors with ten or more jobs supported). The top ten sectors (excluding forest products sectors) included wholesale and retail trade, restaurants, real estate, and management companies and enterprises (Exhibit 10). This set of sectors reflects indirect and induced spending by forest products companies, their suppliers, and individuals.

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

Sector	Description	Jobs
395	Wholesale trade	539
501	Full-service restaurants	246
440	Real estate	237
461	Management of companies and enterprises	186
502	Limited-service restaurants	184
482	Hospitals	172
400	Retail—food and beverage stores	123
62	Maintenance and repair construction of nonresidential structures	122
468	Services to buildings	120
460	Marketing research and all other miscellaneous professional, scientific, and technical services	113
Total	NA	2,042

Neighboring States

New Hampshire and the surrounding states of Vermont, Maine, and Massachusetts are important for forest products. As noted previously, harvested wood flows across the Canadian and state borders to supply the industries. Forest products industries employ over 52,000 workers across these states and account for almost \$13.5 billion in direct output (Exhibits 11 and 12). Maine had the largest forest products economy in terms of direct employment with 20,119 direct jobs and sales in excess of \$5.2 billion. Massachusetts follows with the second largest direct employment, followed by Vermont and New Hampshire respectively. Massachusetts had the largest forest products economy in terms of direct output, totaling \$5.4 billion. Maine, New Hampshire, and Vermont followed, respectively. The three largest industry groups, each with over 7,900 employees, were logging, forestry, and secondary paperboard and other paper products.

Excluding maple syrup production, the forestry and forestry support sectors account for 525 jobs in New Hampshire, 705 jobs in Vermont, 1,759 jobs in Maine, and 660 jobs in Massachusetts.

Exhibit 11. Forest Products Industries Direct Employment in New Hampshire, Vermont, Maine, and Massachusetts, 2017

Industry	New Hampshire	Vermont	Maine	Massachusetts
Forestry	1,250	3,342	3,558	1,030
Logging	1,732	1,737	5,052	835
Primary solid wood products	1,107	941	2,986	300
Secondary solid wood products	1,170	1,053	2,484	2,790
Wood furniture	1,181	1,318	1,590	3,195
Pulp, paper, and paperboard mills	389	641	3,137	1,845
Secondary paperboard and other paper products	460	76	1,312	6,087
Sum of direct contributions	7,289	9,107	20,119	16,083

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

Industry	New Hampshire (Thousands of Dollars)	Vermont (Thousands of Dollars)	Maine (Thousands of Dollars)	Massachusetts (Thousands of Dollars)
Forestry	\$35,685	\$75,732	\$84,542	\$58,990
Logging	\$265,556	\$90,979	\$416,480	\$126,321
Primary solid wood products	\$441,289	\$305,966	\$1,066,877	\$104,095
Secondary solid wood products	\$229,118	\$217,960	\$445,458	\$533,076
Wood furniture	\$170,622	\$173,733	\$252,539	\$546,528
Pulp, paper, and paperboard mills	\$287,943	\$474,397	\$2,340,964	\$1,247,694
Secondary paperboard and other paper products	\$190,198	\$32,082	\$629,856	\$2,738,083
Sum of direct contributions	\$1,620,412	\$1,370,850	\$5,236,715	\$5,354,786

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 New Hampshire’s forest products industries with others. Natural resources and agricultural industries significantly contribute to the diversity of economic activities reflected in New Hampshire’s \$81.5 billion GSP. The forest products industries provide more direct labor income, value-added, and output than the commercial fishing, hunting, and trapping and mining and oil and gas production⁷ (e.g., sand and gravel mining, stone mining and quarrying, etc.); and agricultural production industries. New Hampshire’s forest products industries comprised 0.8 percent of the GSP in 2017. Agricultural production provided the largest amount of employment (full- and part-time) of these industries.

Exhibit 13. Natural Resources and Agricultural Production Industries in New Hampshire, 2017

Industry	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forest products	7,289	\$362,982	\$651,642	\$1,620,412
Commercial fishing, hunting, and trapping	221	\$8,170	\$10,766	\$10,905
Mining and oil and gas production	1,493	\$43,874	\$57,701	\$182,983
Agricultural production (plant crop and animal)	7,465	\$151,748	\$361,476	\$546,811
Total	16,468	\$566,773	\$1,081,586	\$2,361,110

Labor income per job was highest in forest products (\$49,798) and lowest in agricultural production (\$20,329). For commercial fishing, hunting, and trapping, the average per job was \$36,968; mining and oil and gas production had the third highest average income at \$29,379.

Most of the forest products industries are manufacturers, however, the forestry, logging, and biomass power groups are not. Hence, they are not included in the manufacturing totals. There were over 73,000 manufacturing jobs in New Hampshire in 2017 with 4,136 in the forest products industries, 5.7 percent of the total. Of 16 industries, forest products manufacturing was seventh in terms of employment behind computer and electronic products, fabricated metal, machinery, plastics and rubber products, miscellaneous, and food manufacturing. It was seventh in terms of labor income, ninth in terms of value-added, and tenth in terms of output (Exhibit 14).

⁷ Oil and gas contributions may include landfill methane projects, not necessarily traditional oil and natural gas wells.

Exhibit 14. Manufacturing Industries in New Hampshire, 2017

Manufacturing Industries	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Computer and electronic product	14,390	\$1,679,849	\$2,249,710	\$5,840,621
Fabricated metal	12,356	\$890,208	\$1,445,670	\$3,261,678
Machinery	6,727	\$633,478	\$866,605	\$2,094,85
Plastics and rubber products	5,649	\$398,538	\$520,888	\$1,789,578
Miscellaneous	4,970	\$426,595	\$499,356	\$1,416,848
Food	4,435	\$223,139	\$455,139	\$1,906,555
Forest products	4,136	\$252,899	\$314,584	\$1,167,290
Electrical equipment	4,130	\$384,344	\$716,697	\$2,041,373
Textiles and apparel	3,079	\$223,499	\$219,803	\$812,427
Printing	2,894	\$81,285	\$207,081	\$461,055
Primary metal	2,405	\$175,849	\$216,611	\$1,008,314
Transportation equipment	2,328	\$201,669	\$275,310	\$1,182,395
Nonmetallic mineral product	2,222	\$182,682	\$264,681	\$714,835
Chemical	1,987	\$200,672	\$393,045	\$1,378,296
Beverage and tobacco product	1,148	\$77,416	\$219,022	\$628,796
Petroleum and coal	256	\$37,174	\$103,137	\$241,243
Total	73,111	\$6,069,295	\$8,967,341	\$25,946,156

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. Two exceptions are notable.

First, for most of the partial sectors (Appendix B), ratios of published government data were used to identify a portion of the industry that would be treated as forest products. In cases where only part of an IMPLAN sector was associated with forest products, analysts faced three options. The most conservative option was to include only sectors viewed as 100 percent in forest products, excluding sectors where only part produced forest products. At the other end of the spectrum, analysts could have focused on sectors producing any forest products at all, even if the forest products represented a small

part of total output. Between these extremes, analysts could choose a third option—selecting the portion of a sector that produced forest products and include only that portion, mindful to include a means for assessing the magnitude of that portion. That is the approach used in this report.

Second, for sector 47, electric power generation—biomass, the IMPLAN employment figures appeared high in some states and low in others based on prior knowledge of this sector. Project partners at the state of New Hampshire provided updated direct employment figures, which increased from 106 to 172 jobs. The updated figure was used in IMPLAN analysis; other sector metrics were increased proportionally.

Wood is used in many other products not covered by these 25 sectors highlighted in this report. For example, boats, blinds, musical instruments, burial caskets, organic chemicals, and pharmaceuticals may use wood directly or as an extract. However, the wood-only component of these product groups is difficult to quantify and was unable to be included in this report. Surveys could be designed and conducted to determine the forest products component of these sectors. In practice, the production functions, employment, output, and other metrics would need to be compiled and inserted into IMPLAN.

Supplemental New Hampshire Sectors or Products

Wood Heat

New Hampshire has a long history of using wood for heating. However, there are not annual wood heating surveys or data sets that provide a comprehensive overview of wood consumption and associated economic output in the state. Based on New Hampshire Department of Revenue Administration report of cut data, an analysis of 2015 non-residential biomass heating plants, and expert opinion (Charlie Niebling, pers. comm.; NH Wood Energy Council 2015; NH Department of Revenue Administration 2020), direct output for New Hampshire wood heat is estimated to be \$24.3 million.

Nonresidential heating (i.e. commercial, institutional, or industrial applications) direct output is approximately \$5.8 million based on the most recent study available (NH Wood Energy Council 2015).

Direct output of residential wood heating is approximately 18.5 million. This reflects stumpage sold as fuelwood and estimated wood pellet sales (Charlie Niebling, pers. comm.).⁸

⁸ The New Hampshire Department of Revenue Administration report of cut data shows the equivalent of 56,686 cords of firewood cut in 2017. \$150 per cord is used as an average sales price per cord. This represents \$8.5 million of direct output.

\$8.8–\$11.8 million of direct output is associated with wood pellet residential heating (i.e., 32,000–42,500 tons of bulk and retail wood pellets with an average delivered retail value of about \$275 per ton).

Christmas Trees

Christmas trees are an important agricultural crop frequently associated with New Hampshire's land base (i.e. forestry sector). There are an estimated 200 Christmas tree farms throughout New Hampshire. According to the 2017 National Agricultural Statistics Service and the New Hampshire Department of Agriculture, New Hampshire sold over \$3 million of cut Christmas trees in addition to evergreen product sales associated with these operations. Additional evergreen product sales include wreaths, roping, and fragrance products (NASS 2017, NH Department of Agriculture 2020).

Summary

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

This report serves as a snapshot of economic contributions of the forest products industries in New Hampshire 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 7,289 direct jobs in New Hampshire's forest products industries, and overall, 12,881 jobs were supported. Direct labor income was \$363.0 million with total labor income at \$696.0 million. Direct value-added was \$651.6 million, and the total contribution for value-added was \$1.2 billion. Finally, direct output was \$1.6 billion with a total contribution of \$2.5 billion in output. Similar report findings are available from other states in the region and are summarized in a regional report.

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Appendix A: Methods and Data

Input-Output Analysis: IMPLAN

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

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

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

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

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

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

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

Methods

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

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

Method two relies mostly on spreadsheet-based manipulation and is easier to monitor. When the contribution analysis is completed, direct effects from the IMPLAN sectors of interest equal the amounts shown in IMPLAN's "Industry Detail" table, and the total contributions (direct plus indirect plus induced) are estimated. Both methods prevent 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

Exhibit B5. Wood Furniture Industry Grouping and IMPLAN Sectors

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

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

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

IMPLAN Sector	Sector Name
146	Pulp mills
147	Paper mills
148	Paperboard mills

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

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

Appendix C. Detailed Economic Contribution Results

Direct Economic Contribution by IMPLAN Sector

Exhibit C1. Direct Economic Contributions, Forestry Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry, forest products, and timber tract production	50	\$1,785	\$1,027	\$2,348
Support activities for forestry	475	\$27,517	\$24,814	\$26,637
Maple syrup production	724	\$2,284	\$2,814	\$6,699
Subtotal	1,250	\$31,586	\$28,655	\$35,685

Exhibit C2. Direct Economic Contributions, Logging Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Commercial logging	1,732	\$58,933	\$227,514	\$265,556
Subtotal	1,732	\$58,933	\$227,514	\$265,556

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

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Electric power generation—biomass	172	\$19,564	\$80,888	\$151,881
Sawmills	763	\$44,443	\$53,804	\$221,844
Wood preservation	31	\$1,812	\$3,967	\$18,638
Veneer and plywood manufacturing	110	\$6,545	\$8,457	\$31,382
Reconstituted wood product manufacturing	32	\$2,113	\$4,089	\$17,545
Subtotal	1,107	\$74,477	\$151,205	\$441,289

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

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Engineered wood member and truss manufacturing	11	\$471	\$567	\$2,262
Wood windows and doors manufacturing	84	\$4,616	\$6,112	\$19,297
Cut stock, resawing lumber, and planing	-	-	-	-
Other millwork, including flooring	238	\$15,305	\$22,248	\$55,476
Wood container and pallet manufacturing	143	\$5,865	\$7,109	\$21,720
Manufactured home (mobile home) manufacturing	-	-	-	-
Prefabricated wood building manufacturing	382	\$25,819	\$29,938	\$73,297
All other miscellaneous wood product manufacturing	313	\$14,330	\$19,089	\$57,065
Subtotal	1,170	\$66,404	\$85,063	\$229,118

Exhibit 15. Direct Economic Contributions, Wood Furniture Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Wood kitchen cabinet and countertop manufacturing	527	\$31,229	\$29,811	\$77,423
Upholstered household furniture manufacturing	-	-	-	-
Nonupholstered wood household furniture manufacturing	305	\$13,119	\$11,856	\$35,019
Institutional wood furniture manufacturing	67	\$3,663	\$3,453	\$11,978
Wood office furniture manufacturing	-	-	-	-
Custom architectural woodwork and millwork manufacturing	180	\$12,075	\$11,414	\$28,513
Showcase, partition, shelving, and locker manufacturing	102	\$4,196	\$3,823	\$17,690
Subtotal	1,181	\$64,282	\$60,358	\$170,622

Exhibit 16. Direct Economic Contributions, Pulp, Paper, and Paperboard Mills Detail, 2017

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Pulp mills	-	-	-	-
Paper mills	389	\$38,080	\$60,568	\$287,943
Paperboard mills	-	-	-	-
Subtotal	389	\$38,080	\$60,568	\$287,943

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

Sector	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Paperboard container manufacturing	172	\$10,781	\$14,109	\$76,444
Paper bag and coated and treated paper manufacturing	230	\$14,330	\$19,255	\$95,326
Stationery product manufacturing	11	\$642	\$848	\$3,816
Sanitary paper product manufacturing	-	-	-	-
All other converted paper product manufacturing	47	\$3,467	\$4,067	\$14,612
Subtotal	460	\$29,220	\$38,278	\$190,198

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

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