Forest & Wood Products Industries' Economic Contributions: Vermont

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Foreword

Vermonters depend on forests and their $2.1 billion annual economic contribution to the state's economy. Our forests provide a full range of forest products, from sawtimber and veneer to firewood and pellets to maple syrup. And yet there are many forest products and services which are much harder to value—water quality protection; flood control and resilience; wildlife habitat, biodiversity, and connectivity; clean air; and carbon sequestration. Moreover, our forests provide the natural infrastructure for our increasingly diverse outdoor recreation economy. On a landscape scale, our forests, farms, and historic human settlement patterns provide the scenic backdrop for our world-class tourism economy. Thus, Vermont's forests are our unique competitive advantage; we cannot outsource the benefits and values they produce. We are utterly dependent on our forests!

As Vermonters, we understand that one of the best ways to keep forests as forests is to promote forest health through active, thoughtful forest management. But with roughly 80 percent of the state's forests privately owned, this simply cannot happen without a vital and robust forest economy where landowners can sell the products of their forest management in a thriving marketplace, which reduces the threat of conversion of forests to non-forest use.

The forest resource and forest and wood products economy data contained in this report represent a snapshot in time. It provides a detailed view of the state of the industry as it currently exists in Vermont, but when viewed in conjunction with the forest resource data presented, it also highlights opportunities for future growth. It is my hope that this document will help to stimulate a collaborative approach to growing the forest products economy in Vermont for the benefit of both our environment and our citizens.

Michael Snyder
Commissioner

Vermont Department of Forests, Parks and Recreation

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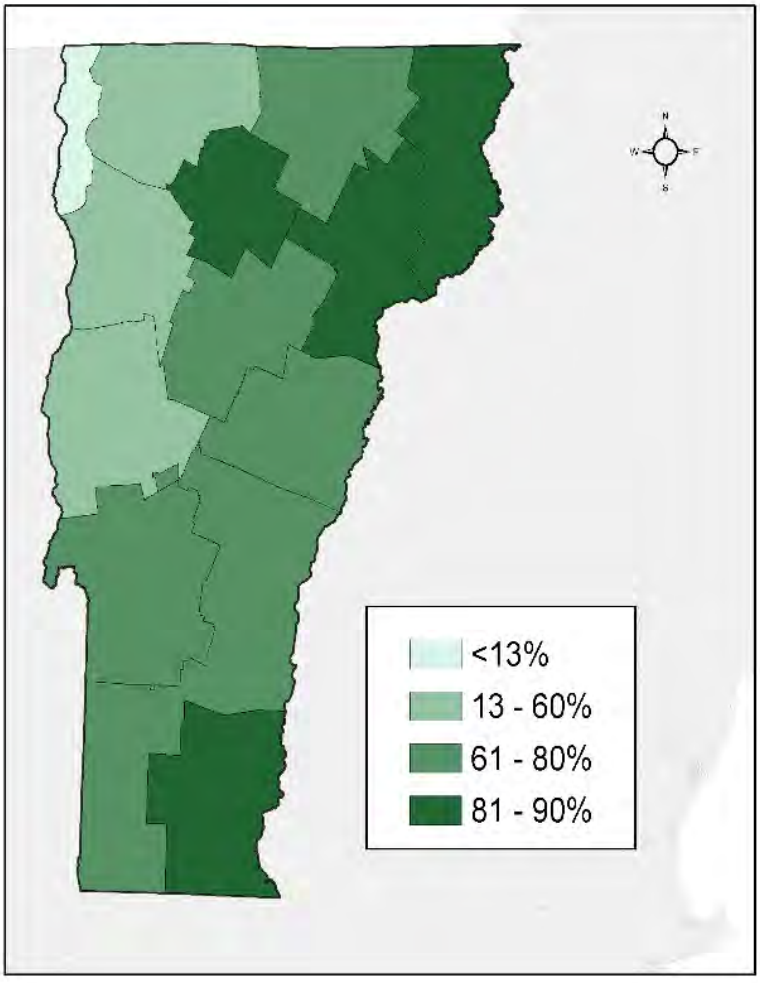
Executive Summary

This report assesses broad forest conditions and economic contributions of forest products industry in Vermont. It is one of 20 coordinated and comparable state reports prepared for states in the northeastern and midwestern United States that provides an improved assessment of forests and the economies they support. The report presents several measures of the industry's contributions to Vermont's economy including number of full- and part-time jobs, labor income, value-added (Gross State Product, abbreviated as GSP) and output (sales). Forest data come from the U.S. Forest Service's Forest Inventory and Analysis website, and economic data come from the 2017 Impact Analysis for Planning (IMPLAN), a commercially available economic input-output (IO) model.

Vermont has 4.5 million acres of forest land that cover 76 percent of its land base, with most of this forest land able to produce commercial timber. The majority, 79 percent, is privately owned, while state and local governments own about 10 percent and the federal government owns about 11 percent.

Exhibit 1. Percent Forestland by Vermont County



Vermont's forest product industries are part of a much larger regional and global forest products economy. Wood flows freely across state lines and international borders. As of 2017, slightly less than half of the sawtimber[1] harvested in Vermont is processed in-state. Vermont mills imported over 30 percent of their raw materials from surrounding states. In that year for all products, a total of 946,000 cords[2] were harvested in the state.

The forest and wood products industries in Vermont provided direct employment to over 9,100 people (including maple syrup production) leading to $1.4 billion in output, in 2017. Labor income was $291.5 million and value-added was $393.4 million. In terms of total contributions[3] (including multiplier effects), the industry supported over 13,800 jobs, $521.9 million in labor income, $770.8 million in value-added, and $2.1 billion in output (Exhibit 2).

This report presents seven forest products industry sectors, which are based on 32 economic sectors in IMPLAN, 26 of which are present in Vermont:

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

While maple syrup production is typically considered an agricultural industry, this report includes information on the maple industry because of its importance as a forest-based crop in Vermont.

[1] Sawtimber: Portion of a tree suitable for processing into lumber or veneer.

[2] Volume for all products converted to cords. A standard cord of wood typically contains about 79 cubic feet of solid wood, excluding air space.

[3] Contributions can be viewed in terms of value-added (GSP), output, employment, and/or labor income. Value-added is commonly used to describe the economic contributions of an industry. It is a conservative measure of economic contributions. Value-added is the difference between an industry's output or sales 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, etc.) 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 the gross state product (GSP). Another measure of economic contribution is industry output or sales. For example, if a log is sold to a sawmill that sells boards, both sales are counted as part of the overall region's sales or output—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.

Exhibit 2. Jobs and Gross Output of Forest-based Manufacturing Sectors in Vermont, 2017

Industry Group	Jobs	Output (Millions of Dollars)
Forestry (excluding maple syrup)*	706	$22.3
Maple syrup	2,636	$53.5
Logging	1,737	$91.0
Primary solid wood products	941	$306.0
Secondary solid wood products	1,053	$218.0
Wood Furniture	1,318	$173.7
Pulp, paper, and paperboard mills	641	$447.4
Secondary paperboard and other paper products	76	$32.1
Sum of Direct Contributions	**9,107**	**$1,370.9**
Total Contributions (with Multipliers)	**13,816**	**$2,057.0**

*Note: Elsewhere in this report the maple syrup industry is included in the forestry industry group.

Overall, in Vermont, forest and wood products industries provide more direct labor income, value-added, and output than agricultural production industries (plant crop and animal). Forest and wood products industries (including maple syrup production) accounted for 5.7 percent of the nonfood manufacturing jobs in Vermont. Agricultural production provided the most employment. Over 12 percent of Vermont's 33,000 direct manufacturing jobs in 2017 were in the forest and wood products industries (i.e., one in eight manufacturing jobs).

When viewed regionally, forest and wood products industries in Vermont, New Hampshire, Massachusetts, New York, and Maine employed over 95,500 workers and accounted for almost $27.0 billion in direct output. New York's forest products economy was the largest in the region in terms of direct employment, followed by that of Maine.

Introduction

Vermont is known as the Green Mountain State and is defined by its forests. We have much to be thankful for when it comes to Vermont's forests—they provide a multitude of benefits. This forested ecosystem forms the basis for biological diversity, natural communities, wildlife habitats, scenic landscapes, and recreational opportunities. As a natural resource, forests support a diverse forest products industry and provide an economic base for employment, tourism, and recreation. Livable communities and our quality of life depend on healthy, sustainable forests. Sustainable forests begin with healthy forests, which have the capacity for self-renewal of their ecological productivity, diversity, complexity, and resiliency. A healthy forest can meet the needs of present generations without compromising the needs of future generations.

Vermont's forests provide jobs and raw materials that are turned into finished goods that generate additional economic activity throughout the state, region, and nation. Previous studies of Vermont's forest products industries' economic contributions have focused primarily on Vermont and surrounding states but have not examined the interaction of those industries at the large regional or national level. In part, this is due to a lack of a consistent reporting format 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, a 20-state report was published for the region summarizing the economic contributions of forest and wood products industries from the 20 northeastern and midwestern states, and separate state-level reports have been produced for each state within the region, and for Nebraska. This work was funded by the U.S. Forest Service through a 2017 Landscape Scale Restoration grant.

Much of the data used in this report were derived from the U.S. Forest Service Forest Inventory and Analysis database and from IMPLAN, a widely used economic modeling system. These data and related information are presented in three major sections: Forest Resources of Vermont, Forest and Wood Products Industries and the Economic Contributions of the Forest and Wood Products Industries to Vermont's Economy. 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 Vermont

Vermont's forests cover 4,494,000 acres of land; equal to 76 percent of the state (Exhibit 3). While the level was relatively steady from the 1980's through the early 2000's, Vermont's forest land area has decreased slightly since 2012 (Morin et al. 2020).

Exhibit 3. Vermont Land Area by Land Use Type, 2017 (U.S. Forest Service)

Land Use Type	Acres	Percentage
Forest land	4,494,125	76%
Nonforest land	1,442,108	24%
Total land area	**5,916,233**	**100%**

Private ownerships make up 79 percent of Vermont's forest land ownership (Exhibit 4). The Green Mountain National Forest has two large blocks of land in Vermont, and the State of Vermont and numerous municipalities own many parcels of forests and parks, which account for the remaining 21 percent of the forest.

Credit: Erica Housekeeper for the Vermont Sustainable Jobs Fund (VSJF), reproduced by permission of Christine McGowen

Exhibit 4. Forest Land by Ownership Group in Vermont, in Acres (2017)

Ownership Group	Acres	Percentage
National forest	451,259	10.0%
Other federal	50,844	1.1%
State and local governments	435,071	9.7%
Private	3,556,951	79.2%
Total	**4,494,125**	**100.0%**

Sugar maple is the most common tree species in Vermont by volume, followed by red maple and eastern hemlock. During the five-year period from 2012–2017, yellow birch, white ash and balsam fir experienced the most significant volume increases while paper birch experienced a substantial decrease.

In terms of number of trees, American beech accounts for nearly 16 percent of the stems, followed by sugar maple, balsam fir, and red maple.

Exhibit 5. Forest land Area by Forest Type Group in Vermont (2017)

Forest Type Group	Acres	Percentage
Maple/beech/birch	3,176,032	70.7%
White/red/jack pine	394,359	8.8%
Spruce/fir	312,397	7.0%
Aspen/birch	221,494	4.9%
Oak/hickory	154,949	3.4%
Other	234,894	5.2%
Total	**4,494,125**	**100.0%**

Overall, the volume of trees continues to increase, and net growth continues to exceed the harvest annually, by a ratio of 2:1 (Exhibit 6). Simultaneously, the average age class of Vermont's forests is increasing, and as a result, the average net annual growth rate is slowing.

Exhibit 6. Characteristics of Growing Stock in Vermont, 2017 (million cubic feet)

Measure	Total	National Forest	Other Federal	State and Local Government	Private
Net volume	9,248.7	971.4	132.2	892.3	7,252.9
Average annual net growth	165.5	10.7	1.6	9.9	143.3
Average annual harvest removals	72.5	2.0	0.0	2.3	68.2
Average annual mortality	81.6	8.1	1.2	11.1	61.1

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

Vermont's Forest Products Industries

Vermont's forest products are synonymous with high quality. From forest to finished product, the state enjoys a reputation of growing, harvesting, processing and crafting products of exceptional quality. The sugar maple, the state's most abundant hardwood species, has a well-deserved international reputation for high quality and bright color, but our forests support a wide variety of diverse markets and products. From the spruce/fir forests of the Northeast Kingdom to the mixed hardwood forests of the Green Mountain chain and the impressive stands of white pine in the Connecticut River Valley, Vermont's forests provide raw materials for a wide variety of products and producers within Vermont and across the region.

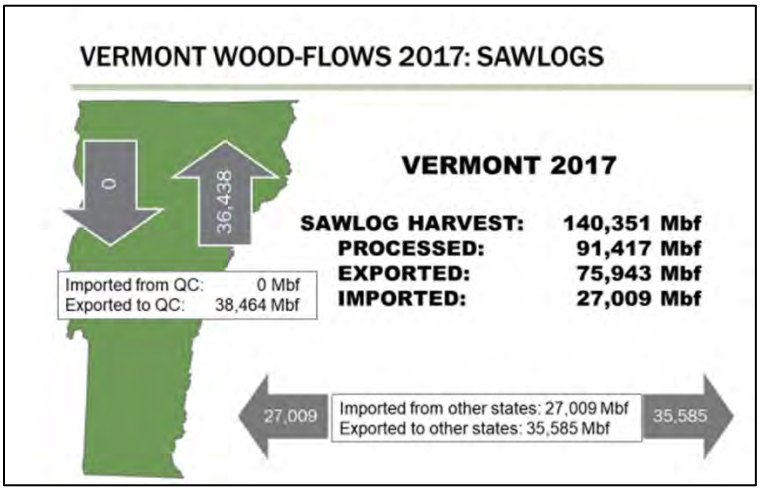
Sawmill photo courtesy of Vermont Department of Forests, Parks, and Recreation, and used by permission of Paul Frederick.

Vermont's forest product industries are a part of a much larger regional and global forest products economy. Wood flows freely across state lines and international borders. As of 2017, slightly less than half of the sawtimber was harvested and processed in Vermont, and Vermont sawmills imported over 30 percent of their raw materials from surrounding states. In that year for all products, a total of 946,000 cords[4] were harvested in the state.

[4] All product volumes converted to cords.

Primary wood producers in Vermont range in size from part-time portable sawmills to multi-national corporations with thousands of employees across many states. These companies supply hardwood and softwood lumber and veneer for everything from local construction and woodworking shops to overseas export markets. Likewise, the state's secondary manufacturers and woodworkers work in businesses ranging in size from one-person shops to furniture companies with a worldwide presence, adding value to that raw material and supporting our working landscape.

Exhibit 7. Vermont Wood-flows 2017: Sawlogs



Note regarding the abbreviations: QC is Quebec and Mbf is 1,000 board feet.
Graphic: Vermont Department of Forests, Parks, and Recreation. Used by permission of Paul Frederick.

A significant proportion of Vermont's low-grade harvest is exported from the state for processing. There are no pulp mills in the state, so all of Vermont's pulpwood harvest is exported to mills in New York, Maine, and Quebec for processing. In 2017, Vermont produced in excess of 148,000 cords of pulpwood for these markets.

With no in-state pulping capacity, wood fuel is an important market for low-grade wood and plays a significant role in Vermont's energy portfolio. During the 2018–2019 heating season, over a third of Vermont's households used cordwood as a heating source, and wood heat in the institutional and commercial sectors consumed nearly 79,000 green tons[5] of wood chips in 2016. Approximately 21 percent of the state's thermal energy is generated by wood. Vermont is also home to two wood-fired electrical generating stations which account for nearly one-fifth of the state's in-state electrical generation (U.S. Energy Information Administration 2019).

[5] A green ton is 2,000 pounds of fresh-cut woody material at a "green" moisture content.

Economic Contributions of the Forest and Wood Products Industries to Vermont's Economy

This report used IMPLAN to estimate economic contributions[6] of the forest products industries. IMPLAN is a widely used input-output (IO) model that is comprised of 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. Vermont's economy was represented by 380 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).

Vermont's forest products and maple syrup industries' total economic contribution in terms of output was $2.1 billion in 2017, based on direct output of $1.4 billion (Exhibit 8). Approximately 9,100 direct jobs were associated with this level of economic activity, and the total number of jobs supported was 13,816. Direct labor income, which includes employee compensation and proprietor income, was $291.5 million, or $32,000 per job. Total labor income, which includes income paid directly to industry employees and proprietors, their suppliers, and other industries they support, totaled $522.0 million.

Exhibit 8. Economic Contribution of the Forest Products Industries* in Vermont, 2017 Dollars

Effect	Employment	Labor Income (Thousands of Dollars)	Value-added** (Thousands of Dollars)	Output (Thousands of Dollars)
Direct	9,107	$291,472	$393,406	$1,370,850
Total	13,816	$521,860	$770,800	$2,057,036

*In this report, the forest products industries, and specifically the Forestry industry group, include maple syrup production.
**Value-added in IMPLAN is equivalent to GSP.

Each direct job in the forest and wood products industries supported 0.52 additional jobs, and every $1 million in direct labor income supported an additional $0.79 million in indirect and induced labor

[6] Contributions can be in terms of value-added (GSP), output, employment, and/or labor income. Value-added is commonly used to describe the economic contributions of an industry. It is a conservative measure of economic contributions. Value-added is the difference between an industry's output or sales 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, etc.) 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 the gross state product (GSP). Another measure of economic contribution is industry output or sales. For example, if a log is sold to a sawmill that sells boards, both sales are counted as part of the overall region's sales or output—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.

income. Most state economies are large relative to any particular industry or group of industries. The forest and wood products industries are no exception. In 2017, Vermont's population was estimated at 623,700 people, with total employment of 436,200. The gross state product (also known as value-added) was $32.6 billion from 380 economic sectors (of the possible 536 in the US). The GSP's largest component was labor income, which was $21.5 billion.

Direct value-added for forest and wood products industries was $393.4 million, 1.21 percent of Vermont's total GSP, increasing to 2.36 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 (only 26 of which were present in Vermont) were combined into seven industry groups (Appendix B). In Vermont, forestry was the largest of these groups in terms of direct employment, but sixth in labor income, value-added, and output, largely due to the maple syrup industry's inclusion in this group (Exhibit 9). Logging was the second largest group in terms of direct employment and labor income, fifth largest in terms of value-added and output. Two groups—pulp, paper and paperboard mills and primary solid wood products—accounted for over half the output of forest products industries. Half of forest products industries employment was in the forestry and logging groups.

Exhibit 9. Direct Economic Contributions in Vermont, Industry Groups, 2017

Industry Group	Employment*	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry**	3,342	$34,873	$43,968	$75,732
Logging	1,737	$50,332	$52,799	$90,979
Primary solid wood products	941	$47,374	$79,769	$305,966
Secondary solid wood products	1,053	$45,676	$75,042	$217,960
Wood furniture	1,318	$58,983	$57,502	$173,733
Pulp, paper, and paperboard mills	641	$49,841	$78,548	$474,397
Secondary paperboard and other paper products	76	$4,393	$5,779	$32,082
Total	**9,107**	**$291,472**	**$393,406**	**$1,370,850**

*Full- and part-time jobs
**Includes maple syrup production.

Exhibit 10. Total Economic Contributions in Vermont, Industry Groups, 2017

Industry Group*	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forestry**	3,200	$40,576	$58,092	$100,986
Logging	1,099	$32,015	$39,369	$67,766
Primary solid wood products	2,701	$115,348	$179,645	$462,769
Secondary solid wood products	1,973	$87,577	$140,978	$343,448
Wood furniture	2,084	$94,278	$115,223	$280,370
Pulp, paper, and paperboard mills	2,601	$143,615	$225,169	$757,808
Secondary paperboard and other paper products	158	$8,451	$12,324	$43,890
Total	**13,816**	**$521,860**	**$770,800**	**$2,057,036**

*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.
**The forestry group also includes maple syrup production.

For the following sector-specific discussions, refer to Exhibit 9 for direct contribution details and Exhibit 10 for total contribution details. See Appendix C for detailed economic measures for industry groups and their component sectors.

Forestry

The forestry group includes timber tract operations and support activities for forestry. In this analysis maple syrup production was also included in the forestry group. Timber tract operations include 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.

Photo courtesy of Vermont Department of Forests, Parks, and Recreation, and used by permission of Paul Frederick.

Direct contributions were $75.7 million in output, 3,342 jobs, $34.9 million in labor income, and $44.0 million value-added. Total contributions are based, in part, on backward linkages to suppliers. Total contributions for forestry can be lower than direct contributions

(i.e., initial IMPLAN levels) because many of the contributions are inputs into other industries. For example, 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 8 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.

Maple Syrup Production

Maple syrup is an important forest-based crop in Vermont. In fact, Vermont is the leading producer of maple syrup in the United States, accounting for 46 percent of US production in 2017 (Exhibit 11). Because of the regional nature of the overall analysis and the varying degree of importance of the industry across the 20-state region, maple syrup production was included in the forestry industry grouping. The maple syrup production sector is only a portion of IMPLAN sector 10, all other miscellaneous crop farming (NAICS 111998).

Exhibit 11. Maple Syrup Estimated Employment, Production, and Output, 2017

State	Estimated Employment*	Production (Thousands of Gallons)	Output (Thousands of Dollars)
Vermont	2,636	1,980	$53,460
New York	1,275	760	$29,640
Maine	567	709	$23,893
Wisconsin	240	200	$6,280
New Hampshire	724	154	$6,699
Pennsylvania	127	139	$4,768
Michigan	238	110	$5,632
Massachusetts	370	84	$4,217
Ohio	149	80	$3,080
Connecticut	71	20	$1,244
Minnesota	19	14	$932
Indiana	19	12	$602
West Virginia	42	9	$330
United States	6,241	4,271	$140,777

*Estimated employment is based on the ratio of maple syrup sales to all other crop farming sales for each state. The states listed in the exhibit are the only ones engaged in maple syrup production and are referred to collectively as the United States at the bottom of the table. The sum of employment for the states does not equal the U.S. estimated employment.
Note: For production and output value figures, see NASS 2018. For estimated employment, see Gibson et al. 2020.

Most sectors in the forest and wood products industries are completely counted within the industries, but several sectors (including maple syrup production) are not. These are treated as partial sectors in this report. Within the IMPLAN modeling framework, the relationships among sectors are defined by mathematical production functions derived from national-level relationships. Hence, the sawmill sector relies on logging, trucking and many more sectors for inputs. For maple syrup production, the production function is for all other miscellaneous crop farming. Maple syrup production includes the gathering, concentrating, and reducing of maple sap.

Given the importance of maple syrup production in Vermont, a single-industry contribution analysis was completed (Exhibit 12). For Vermont, the National Agricultural Statistical Service (NASS) estimated $53.5 million in maple syrup direct output in 2017; over 2600 jobs were estimated for this output level (NASS 2018). These direct-effect figures are slightly under the lower bound presented in *The Economic Contribution of the Maple Syrup Industry* (Becot et al. 2015), but maple syrup output does vary annually.

Exhibit 12. Vermont Economic Contribution of Maple Syrup Production, 2017 Dollars

Effect	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Direct	2,636	$17,188	$25,908	$53,460
Total	2,986	$29,785	$46,501	$87,188

Based on this analysis, the maple production industry supported 2,636 jobs and $53.5 million in output in 2017. It is the leading forest products sector, in terms of number of jobs, in Vermont.

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 second largest in terms of direct employment. The direct contributions of logging were $91.0 million in output, 1,737 jobs, $50.3 million in labor income, and $52.8 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 Vermont, 57 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.

Photo courtesy of Vermont Department of Forests, Parks, and Recreation, and used by permission of Paul Frederick.

Primary Solid Wood Products

The primary solid wood products industry group was the fifth largest group in terms of direct employment in Vermont. 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 $306.0 million in output, 941 jobs, $47.4 million in labor income, and $79.8 million in value-added. Total contributions for primary solid wood products, including direct, indirect and induced effects, were $463.0 million in output, 2,701 jobs, $115.3 million in labor income, and $179.6 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 Vermont. The group contains engineered wood member and truss manufacturing; wood windows and doors manufacturing; cut stock, resawing lumber, and planing; other millwork, including flooring, wood container, and pallet manufacturing; manufactured home (mobile home) manufacturing; prefabricated wood building manufacturing; and all other miscellaneous wood product manufacturing. Direct contributions of secondary solid wood products were $218.0 million in output, 1,053 jobs, $45.7 million in labor income, and $75.0 million in value-added. Total contributions were $343.5 million in output, 1,973 jobs, $87.6 million in labor income, and $141.0 million in value-added.

Wood Furniture

Wood furniture was the third largest group in terms of direct employment in Vermont. Wood furniture includes wood kitchen cabinet and countertop manufacturing; upholstered household furniture manufacturing; non-upholstered 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 $173.7 million in output, 1,318 jobs, $59.0 million in labor income, and $57.5 million in value-added. Total contributions of wood furniture were $280.4 million in output, 2,084 jobs, $94.3 million in labor income, and $115.2 million in value-added.

Credit: Erica Housekeeper for the Vermont Sustainable Jobs Fund (VSJF), reproduced by permission of Christine McGowen

Pulp, Paper, and Paperboard Mills

The pulp, paper, and paperboard mills industry group ranked sixth in terms of direct employment in Vermont. The group includes pulp mills, paper mills, and paperboard mills that make paper or pulp from raw wood and from purchased pulp. While there are no pulp mills located in Vermont, there are several smaller paper or paperboard mills which utilize market pulp and/or recycled paper in their production processes. The pulp, paper, and paperboard mills group's direct contributions were $474.4 million in output, 641 jobs, $49.8 million in labor income, and $78.6 million in value-added. Total contributions were $757.8 million in output, 2,601 jobs, $143.6 million in labor income, and $225.2 million in value-added.

Secondary Paperboard and Other Paper Products

The secondary paperboard and other paper products group was the smallest in terms of direct employment in Vermont. 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 $32.1 million in output, 76 jobs, $4.4 million in labor income, and $5.8 million in value-added. Total contributions were $43.9 billion in output, 158 jobs, $8.5 million in labor income, and $12.3 million value-added.

Top Nonforest Industries Impacted

Contribution analysis using IMPLAN relies on backward linkages from forest and wood products industries sectors among themselves and to other sectors in Vermont. Including the 26 forest products industries, 114 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, hospitals, and maintenance and repair construction of nonresidential structures (Exhibit 13). This set of sectors reflects indirect and induced spending by forest products companies, their suppliers, and individuals.

These data were at an aggregate level, so 108 jobs in truck transportation included log trucks, delivery trucks, and office jobs for some trucking companies, among others. Five of these sectors were among the top ten sectors in the state of Vermont (hospitals and real estate were second and third in the state—each had over 14,000 jobs).

Exhibit 13. Direct Jobs Impacted by the Forest Products Industries Among Vermont's Top Ten Non-Forest Products Industries in 2017*

Sector	Description	Jobs
395	Wholesale trade	406
501	Full-service restaurants	187
440	Real estate	166
482	Hospitals	147
62	Maintenance and repair construction of nonresidential structures	147
468	Services to buildings	137
485	Individual and family services	118
502	Limited-service restaurants	114
411	Truck transportation	108
461	Management of companies and enterprises	96
Sum of Top Ten Industries	**NA**	**1,627**
Total Jobs in Affected Industries	**NA**	**18,410**

*Including maple syrup production

Neighboring States

Vermont, New Hampshire, Massachusetts, New York, and Maine are part of an important region for forest products. Forest and wood products industries in the region employed 95,621 workers and account for $27.1 billion in direct output (Exhibits 14 and 15). New York had the largest forest products economy with 43,024 direct jobs and output in excess of $13 billion.

The two largest industry groups within the region, each with over 18,000 employees, were wood furniture and secondary paperboard and other paper products.

Exhibit 14. Forest and wood Products Industries Direct Employment in Vermont, New Hampshire, Massachusetts, New York, and Maine, 2017

Industry	Vermont	New Hampshire	Massachusetts	New York	Maine
Forestry*	3,342	1,250	1,030	1,658	3,558
Logging	1,737	1,732	835	4,013	5,052
Primary solid wood products	941	1,107	300	2,861	2,986
Secondary solid wood products	1,053	1,170	2,790	7,113	2,484
Wood furniture	1,318	1,181	3,195	11,791	1,590
Pulp, paper, and paperboard mills	641	389	1,845	4,898	3,137
Secondary paperboard and other paper products	76	460	6,087	10,689	1,312
Sum of Direct Contributions	**9,107**	**7,289**	**16,083**	**43,024**	**20,119**

* Includes maple syrup production

Exhibit 15. Forest and Wood Products Industries Direct Output in Vermont, New Hampshire, Massachusetts, New York, and Maine, 2017

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

*Includes maple syrup production

Industry	Vermont (Thousands of Dollars)	New York (Thousands of Dollars)	Maine (Thousands of Dollars)
Forestry*	$75,732	$48,511	$84,542
Logging	$90,979	$265,205	$416,480
Primary solid wood products	$305,966	$895,177	$1,066,877

Industry	Vermont (Thousands of Dollars)	New York (Thousands of Dollars)	Maine (Thousands of Dollars)
Secondary solid wood products	$217,960	$1,346,545	$445,458
Wood furniture	$173,733	$1,956,501	$252,539
Pulp, paper, and paperboard mills	$474,397	$3,620,763	$2,340,964
Secondary paperboard and other paper products	$32,082	$5,351,321	$629,856
Sum of Direct Contributions	**$1,370,850**	**$13,484,023**	**$5,236,715**

*Includes maple syrup production

Importance of the Forest and Wood Products Industries in Context

To help contextualize the relative importance of the forest and wood products industries, it is useful to compare the contribution of Vermont's forest and wood products industries with others. Natural resources and agricultural industries significantly contribute to the diversity of economic activities reflected in Vermont's $32.6 billion GSP (Exhibit 16). The forest and wood products industries provide more direct labor income, value-added, and output than commercial fishing, hunting, and trapping; mining and oil and gas production; and agricultural production industries. Vermont's forest and wood products industries comprised 1.2 percent of the GSP in 2017. Agricultural production provided the largest amount of employment (full- and part-time) of these industries.

Exhibit 16. Natural Resources and Agricultural Production Industries in Vermont, 2017

Industry	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Forest & wood products*	9,107	$291,472	$393,406	$1,370,850
Commercial fishing, hunting, and trapping	72	$123	$460	$564
Mining, and oil and gas production**	1,190	$48,502	$299,698	$396,414
Agricultural production (plant crop and animal)	9,860	$151,487	$304,909	$884,188
Total	**20,229**	**$491,584**	**$998,473**	**$2,652,016**

*Includes maple syrup production
**quarrying, mining, and petroleum/coal manufacturing

Labor income per job is highest in mining and oil and gas production ($40,772) and lowest in commercial fishing, hunting, and trapping ($1,694). For agricultural production, the average per job is $15,363; forest products has the second highest average income at $32,006.

Most of the forest and wood products industries are manufacturers, however the forestry, logging, and biomass power are not. There were nearly 33,000 manufacturing jobs in Vermont in 2017. 3,970 were in the forest and wood products industries, 12.1 percent of the total. Of 16 industries, forest and wood products manufacturing was third in terms of employment behind food manufacturing and computer and electronic product manufacturing. It was fourth in terms of labor income and third in value-added and output (Exhibit 17).

Exhibit 17. Manufacturing Industries in Vermont, 2017

Manufacturing Industries	Employment	Labor Income (Thousands of Dollars)	Value-added (Thousands of Dollars)	Output (Thousands of Dollars)
Food	6,810	$367,425	$452,873	$3,928,550
Computer and electronic product	4,327	$466,813	$546,038	$1,908,934
Forest & wood products	3,970	$201,229	$277,018	$1,160,578
Machinery	2,756	$212,777	$235,977	$741,847
Miscellaneous	2,266	$112,020	$152,304	$585,907
Fabricated metal	2,079	$125,556	$168,956	$436,278
Transportation equipment	1,791	$167,285	$160,044	$915,548
Nonmetallic mineral product	1,726	$102,531	$129,010	$360,061
Chemical	1,392	$110,363	$141,683	$1,074,270
Printing	1,300	$63,509	$79,488	$190,699
Plastics and rubber products	1,237	$80,391	$115,812	$371,609
Electrical equipment	1,194	$91,589	$122,284	$419,640
Beverage and tobacco product	1,011	$52,393	$125,199	$459,451
Textiles and apparel	776	$30,015	$40,144	$130,384
Primary metal	136	$12,203	$19,326	$101,333
Petroleum and coal**	64	$6,894	$25,049	$55,507
Total	**32,835**	**$2,202,992**	**$2,791,205**	**$12,840,596**

**Quarrying, mining, and petroleum/coal

Summary

This report serves as a snapshot of economic contributions of the forest and wood products industries in Vermont 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.

IN Vermont, there were 9,107 direct jobs in the forest products industries, and overall, 13,816 jobs were supported. Direct labor income was $291.5 million with total labor income at $521.9 million. Direct value-added was $393.4 million, and the total contribution for value-added was $770.8 million. Finally, direct output was $1.4 billion with a total contribution of $2.1 billion in output. Similar report findings are available from other states in the region and are summarized in a regional report.

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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").

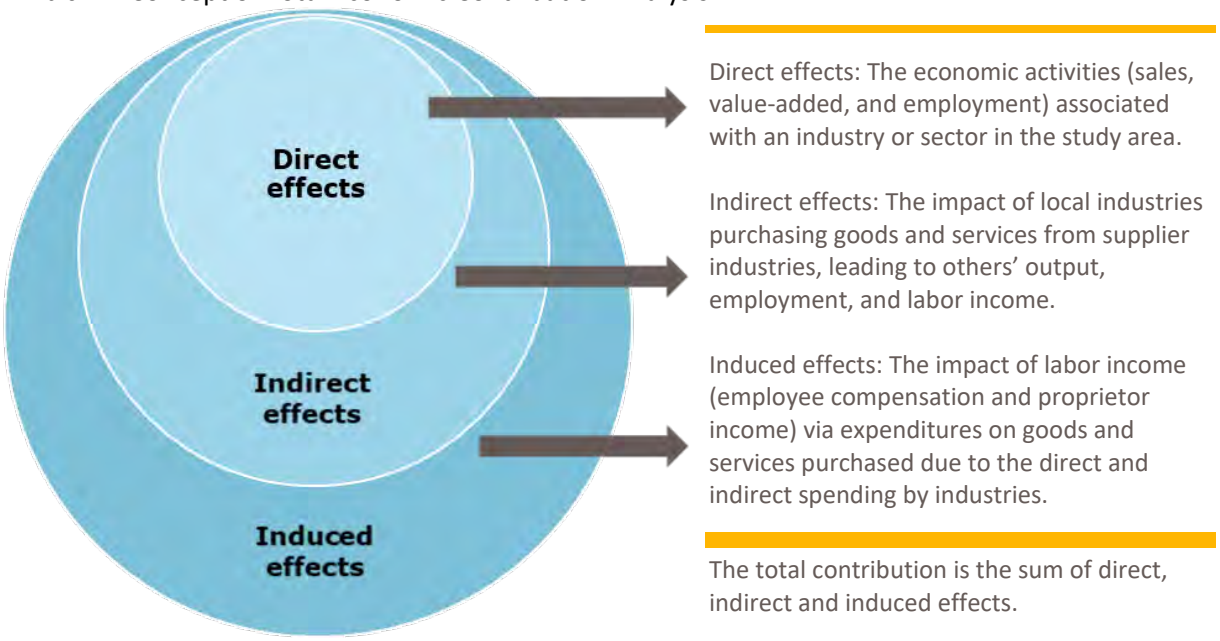
Total effects/contributions: The sum of direct, indirect, and induced effects.

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.

Appendix A: Methods and Data[7]

Forest and wood 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 the directly and indirectly impacted sectors) (Exhibit A1). 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 A1. Concept of Total Economic Contribution Analysis



Input-Output Analysis: IMPLAN

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, the project team, in consultation with representatives of the states, selected 32 sectors by consensus for inclusion in the analysis. A description of the methods and data follows.

[7] This appendix contains information located in the Forest Products Industries section of other state reports.

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

While it is not considered a wood product, the report also includes information on the maple industry because of its importance as a forest-based crop in Vermont.

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 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. Vermont's economy was represented by 380 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).

IMPLAN models can be constructed for different geographic areas. State data were used in this report, but given IMPLAN's structure, substate and multistate analyses can be developed.

Economic Contributions Defined

Input-Output Analysis and IMPLAN

IO modeling using IMPLAN software and data is a conventional approach for documenting the economic contribution of forest and wood products industries. IMPLAN is commercially available and widely used by government, academia, and businesses.

This analysis uses 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 and wood products industries in Vermont (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.

It follows that larger economies have fewer leakages and more commodities are sourced locally. For example, an examination of the logging industries (IMPLAN sector 16) in Maine, New Hampshire, and Vermont, reveals that the direct employment for 2017 was 5,052, 1,732, and 1,737 jobs, respectively. Summing the individual state's total employment contributions (direct, indirect, 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 and wood products industries in the region's economy. Consequently, the state-level analyses underestimate the actual contributions from a regional perspective.

Several key decisions related to methods were developed through a consensus process (Gibson, Leefers, and Poudel 2020). Consensus decisions were made 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 and wood products industries relied on 2017 IMPLAN software and data. IMPLAN is a widely used economic IO model that focuses on the 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.

The economic contributions of the forest and wood products industries serve as a snapshot of direct economic activity associated with given industries and other economic activities linked to those industries. Economic contributions are defined as “the changes in a region’s existing economy that can be attributed to a given industry” (Watson et al. 2007). Hence, economic contributions define the role of an industry within a state or region. Several terms are used to describe economic effects, as shown in the glossary.

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.

Supplemental Economic Contribution Information

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

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

Second, for sector 47, electric power generation–biomass, the IMPLAN employment figures appeared low based on prior knowledge of this sector. As a result, six facilities were surveyed to assess their 2017 employment. The updated direct employment figure (increased from 9 to 58) was used in IMPLAN analysis; other sector metrics were increased proportionally.

Wood is used in many other products not covered by the 26 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.

Appendix B: Forest and Wood 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	67	$1,993	$2,155	$3,918
Support activities for forestry	638	$15,692	$15,906	$18,355
Maple syrup production	2,636	$17,188	$25,908	$53,460
Subtotal	**3,342**	**$34,873**	**$43,968**	**$75,732**

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	1,737	$50,332	$52,799	$90,979
Subtotal	**1,737**	**$50,332**	**$52,799**	**$90,979**

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	58	$5,038	$19,621	$43,561
Sawmills	638	$28,548	$38,964	$179,582
Wood preservation	40	$1,443	$4,954	$23,948
Veneer and plywood manufacturing	204	$12,346	$16,229	$58,875
Reconstituted wood product manufacturing	-	-	-	-
Subtotal	**941**	**$47,374**	**$79,769**	**$305,966**

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	-	-	-	-
Wood windows and doors manufacturing	283	$14,826	$23,560	$68,070
Cut stock, resawing lumber, and Planing	45	$1,184	$2,666	$9,921
Other millwork, including flooring	198	$8,630	$15,854	$43,565
Wood container and pallet manufacturing	53	$1,292	$1,894	$7,293
Manufactured home (mobile home) manufacturing	40	$1,559	$3,587	$10,195
Prefabricated wood building manufacturing	161	$8,224	$10,646	$28,970
All other miscellaneous wood product manufacturing	273	$9,961	$16,835	$49,947
Subtotal	**1,053**	**$45,676**	**$75,042**	**$217,960**

Exhibit 1. 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	207	$8,180	$8,175	$26,838
Upholstered household furniture manufacturing	38	$1,008	$1,002	$6,293
Nonupholstered wood household furniture manufacturing	869	$38,770	$37,627	$103,580
Institutional wood furniture manufacturing	6	$181	$182	$897
Wood office furniture manufacturing	46	$2,171	$2,071	$8,514
Custom architectural woodwork and millwork manufacturing	39	$1,850	$1,848	$5,601
Showcase, partition, shelving, and locker manufacturing	113	$6,822	$6,597	$22,009
Subtotal	**1,318**	**$58,983**	**$57,502**	**$173,733**

Exhibit 2. 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	231	$17,505	$28,436	$163,375
Paperboard mills	410	$32,336	$50,112	$311,022
Subtotal	**641**	**$49,841**	**$78,548**	**$474,397**

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	38	$2,264	$2,885	$16,707
Paper bag and coated and treated paper manufacturing	38	$2,128	$2,894	$15,376
Stationery product manufacturing	-	-	-	-
Sanitary paper product manufacturing	-	-	-	-
All other converted paper product manufacturing	-	-	-	-
Subtotal	**76**	**$4,393**	**$5,779**	**$32,082**

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

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