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An Economic Analysis of the U.S. Wooden Railway Tie Industry

A Report Prepared for the
Railway Tie Association

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An Economic Analysis of the U.S. Wooden Railway Tie Industry

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Abbreviations

| | |
|---------|---|
| BEA | Bureau of Economic Analysis |
| BLS | Bureau of Labor Statistics |
| CEW | Census of Employment and Wages |
| EC | Economic Census |
| GDP | Gross Domestic Product |
| INFORUM | Interindustry Forecasting at the University of Maryland |
| IO | Input-Output |
| IP | Intellectual Property |
| NAICS | North American Industry Classification System |
| NAM | National Association of Manufacturers |
| RTA | Railway Tie Association |
| VA | Value Added |

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Executive Summary

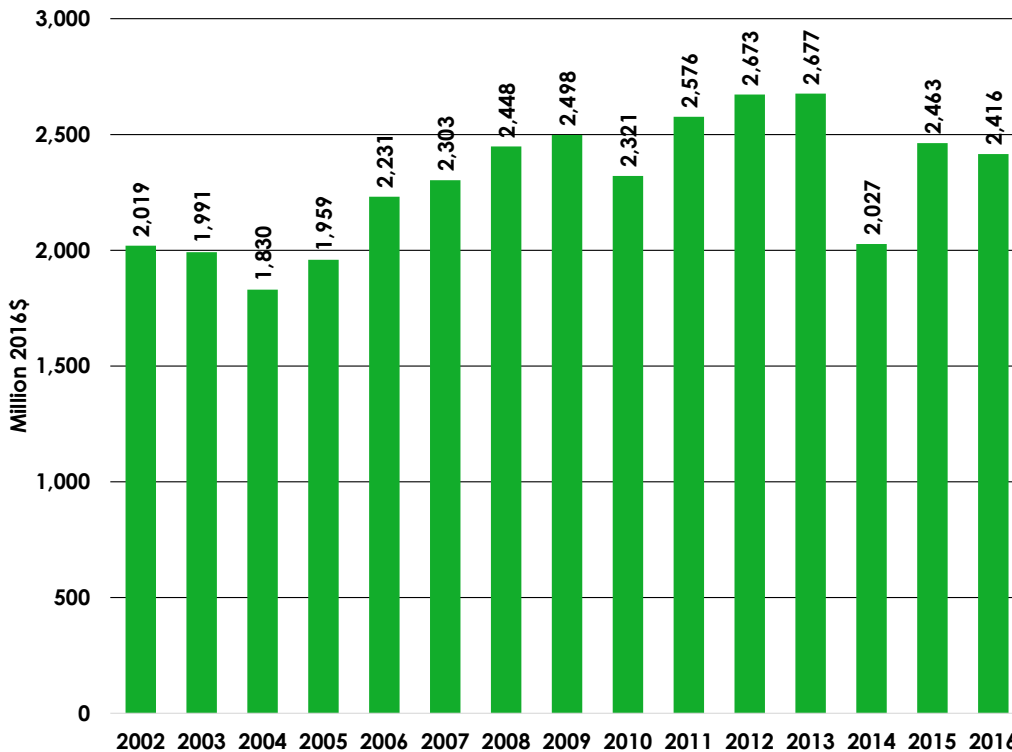
This report presents a current snapshot and summary of the recent economic evolution of the domestic wooden railway tie industry. The analysis provides information on the size, scope, and growth of the industry as a whole, along with its contributions to the U.S. economy.

The industry segments analyzed in this study include portions of:

- Sawmills (NAICS 321113)
- Wood Preservation (NAICS 321114)

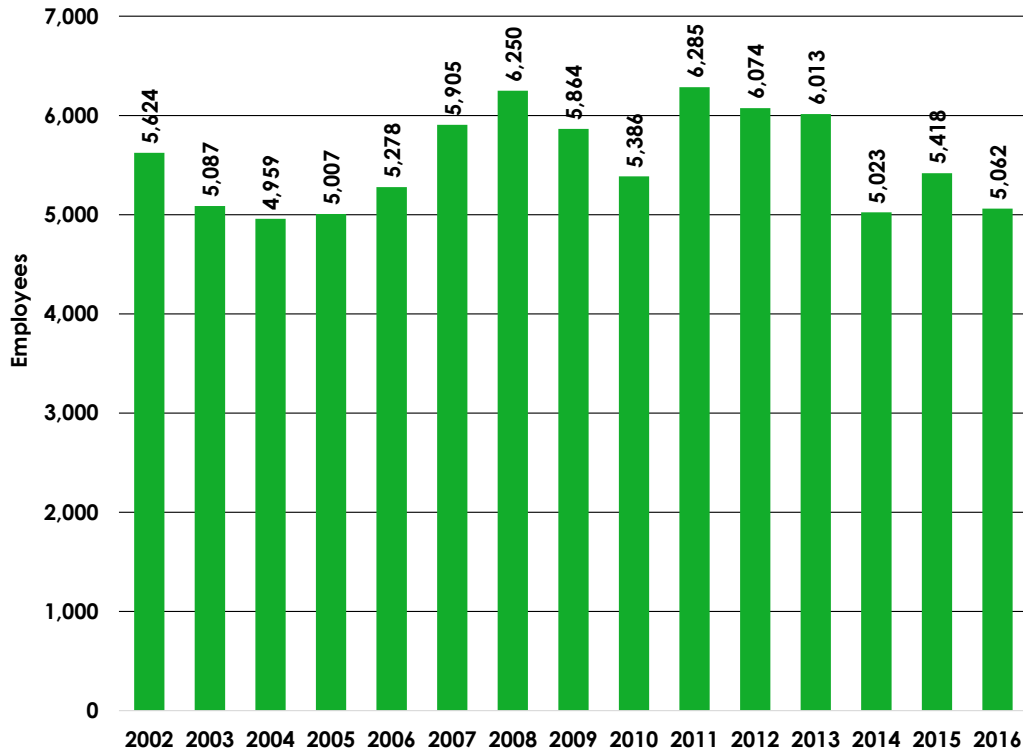
Output of RTA-related industries expanded steadily during the mid-to-late 2000s. Growth continued in the early 2010s, but endured a steep decline in 2014. Following a rally in 2015, a small dip in 2016 left output at \$2.4 billion. Between 2002 and 2016, RTA-related output grew at an average annual rate of 1.3 percent per year.

Figure E.1. Output
Units: Millions of 2016 Dollars



Employment at wooden railway tie manufacturers fluctuated considerably between 2002 and 2016. Employment declined mildly in 2012 and 2013 before dropping sharply in 2014. Performance has been mixed in the last two years, with job totals rising 7.6 percent in 2015 and declining 6.8 percent in 2016. The number of persons employed at RTA-related industries was approximately 5,060 in 2016. While job growth has been weak in recent years, it is important to note that productivity gains allow the industry to produce more output with less labor.

Figure E.2. Employment
Units: Jobs



The impact of the wooden railway tie industry extends beyond the direct economic impacts as measured by the variables described above. In this analysis, the domestic production of wooden railway ties is our starting point. This concept is called the *direct output*. This activity does not exist in isolation. Instead, it generates demand from supplier industries. These supplier industries in turn generate demand for their supplier industries. All of the output generated beyond the *direct output* is called the *indirect output*. In addition to the direct and indirect impacts, we calculate *induced output*. This represents the additional demand generated by the disposable income earned in the industry (this may be both wage income and capital income).

Associated with the output at each round of impact is the employment required in that sector to produce that output, as well as the value added or income earned. The “upstream” impacts of supplier industries are displayed below in Table E.1. Total jobs within the industry (5,062) plus upstream suppliers (13,780) plus induced jobs (10,805) came to a total of 29,647 in 2016.

Table E.1. Summary of Upstream Analysis
Units Indicated

| | Output (Million \$) | Employment (Persons) | Value Added (Million \$) | Labor Income (Million \$) |
|-----------------|------------------------|-------------------------|-----------------------------|------------------------------|
| Direct | 2,416 | 5,062 | 614 | 285 |
| Indirect | 2,811 | 13,780 | 1,351 | 883 |
| Induced | 1,752 | 10,805 | 978 | 551 |
| Total | 6,979 | 29,647 | 2,943 | 1,719 |

In addition to these upstream impacts, economic activity is generated in wholesale and retail trade (“downstream”) industries that distribute wooden railway ties. These are displayed in Table E.2. Total downstream jobs, including direct, indirect, and induced, came to 3,750 in 2016. The combined impacts are seen in Table E.3, with total upstream and downstream employment amounting to 33,397.

Table E.2. Summary of Downstream Analysis
Units Indicated

| | Output (Million \$) | Employment (Persons) | Value Added (Million \$) | Labor Income (Million \$) |
|-----------------|------------------------|-------------------------|-----------------------------|------------------------------|
| Direct | 310 | 1,304 | 207 | 107 |
| Indirect | 159 | 912 | 93 | 58 |
| Induced | 249 | 1,533 | 139 | 78 |
| Total | 718 | 3,750 | 439 | 243 |

Table E.3. Combined Summary
Units Indicated

| | Output (Million \$) | Employment (Persons) | Value Added (Million \$) | Labor Income (Million \$) |
|-------------------|------------------------|-------------------------|-----------------------------|------------------------------|
| Upstream | 6,979 | 29,647 | 2,943 | 1,719 |
| Downstream | 718 | 3,750 | 439 | 243 |
| Total | 7,698 | 33,397 | 3,382 | 1,962 |

The national level economic impacts can be seen as the sum of economic impacts at the state level. National level direct production, employment, value added, and earnings have been distributed to the state level using employment shares taken from the BLS Census of Employment and Wages (CEW), for both the upstream and the downstream analysis.

In order to calculate the indirect and induced impacts of production, we use IMPLAN’s detailed databases and economic models. IMPLAN is often used by business professionals, researchers, and elected officials to assess potential local economic impacts of various projects. We have used IMPLAN to calculate direct, indirect, and induced impacts for output, employment (jobs), total value added, and labor income.

RTA staff have identified twenty-five states of interest. The top states in terms of upstream output and employment are summarized in Tables E.4 and E.5.

Table E.4. Top Upstream Output Effects by State
Units Million \$

| | Output (Million \$) | | | Total |
|---------|---------------------|----------|---------|-------|
| | Direct | Indirect | Induced | |
| Oregon | 200.3 | 130.8 | 55.4 | 386.5 |
| Georgia | 144.8 | 95.7 | 46.8 | 287.3 |
| Alabama | 157.5 | 89.6 | 37.6 | 284.7 |

Table E.5. Top Upstream Employment Effects by State
Units Jobs

| State | Employment (Number of Jobs) | | | Total |
|---------|-----------------------------|----------|---------|-------|
| | Direct | Indirect | Induced | |
| Oregon | 413 | 767 | 426 | 1,606 |
| Alabama | 329 | 579 | 293 | 1,201 |
| Georgia | 279 | 543 | 342 | 1,163 |

1. Introduction

This report presents a current snapshot and summary of the recent economic evolution of the domestic wooden railway tie industry. The analysis provides information on the size, scope, and growth of the industry as a whole, along with its contributions to the U.S. economy.

The industry segments analyzed in this study include portions of:

- Sawmills (NAICS 321113)
- Wood Preservation (NAICS 321114)

Direct Impacts, 2016
Output: \$2.4 billion
Employment: 5,062 jobs

Total direct output of these focus industries amounted to \$2.4 billion in 2016. This activity supported roughly 5,062 jobs and generated \$614 million of value added, including \$285 million of labor compensation.

Together with upstream suppliers and downstream distributors, the wooden railway tie industry accounts for \$7.7 billion in output and nearly 33,400 U.S. jobs.

Total Impacts, 2016
Output: \$7.7 billion
Employment: 33,397 jobs

Important economic trends and developments impacting this industry are primarily:

- **General Economic Health** – Strong economic performance helps both consumers and businesses. Sales to other industries, particularly railroad transportation, account for the vast majority of wooden railway ties. A recession or economic slowdown would result in reduced revenues for manufacturers.
- **Trade Policy** – Escalating tensions with trading partners could negatively impact domestic markets. Tariffs have the potential to hurt some U.S. manufacturers and eat away at domestic consumers' purchasing power.
- **Infrastructure Investment** – An uptick in infrastructure investment, especially in rail transportation infrastructure, would benefit the wooden railway tie industry.

2. Industry Overview

This section describes recent industry patterns of the RTA focus industries. This portion of the analysis utilizes the Inforum Iliad (Interindustry Large-scale Integrated And Dynamic) model of the United States. The Iliad model includes a database of output, employment, value added, and other concepts at a level of 352 producing sectors, which is approximately 5- to 6-digit NAICS detail in most cases.

All of the data present in this report represents the RTA share of the relevant industries in the model. The Iliad sector named 'Sawmills and Wood Preservation', encompasses both 'Sawmills' (NAICS 321113) and 'Wood Preservation' (NAICS 321114).

2.1 Output

Output, in economic terms, refers to the total value of all goods and services produced by an industry. Figure 1 shows historical output from 2002 to 2016. Data underlying this graph are in Table 1.

Output of wooden railway ties increased steadily between 2005 and 2009, ultimately reaching \$2.5 billion. Effects of the Great Recession were felt in 2010, as output contracted 7.4 percent. Output rebounded a year later, growing by 10.5 percent. Moderate expansion continued for two additional years, but momentum could not be sustained. RTA-related output fell from \$2.7 billion in 2013 to \$2.0 billion in 2014, a decline of 27.8 percent. The railway tie industry's output grew 19.5 percent in 2015, rising to \$2.5 billion. Output levels fell by 1.9 percent in 2016 and finished the year at \$2.4 billion. Between 2002 and 2016, RTA-related output increased by an average annual rate of 1.3 percent.

Direct output in RTA-related industries exceeded \$2.4 billion in 2016.

Real output can be decomposed into the distribution of output to other industries and to final demand. Figure 2 shows the distribution of total RTA-related output in 2016. The overwhelming majority of sales are made to other industries. Sales to other industries constitute intermediate demand; all other sales are final demand. Relevant final demand categories for this industry include inventory change (\$21.3 million) and net exports (-\$279.8 million). Please note that the sum of the columns (intermediate demand and final demand) in Figure 2 total \$2,416 million and match the 2016 output displayed in Table 1.

Figure 1. Output

Units: Millions of 2016 Dollars

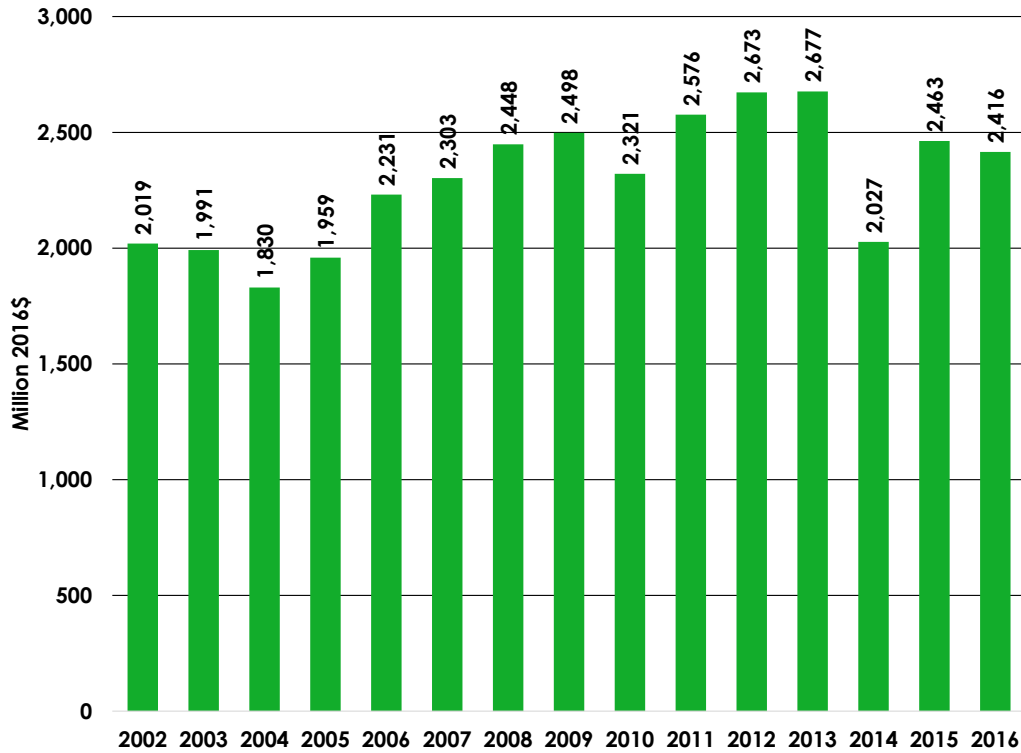
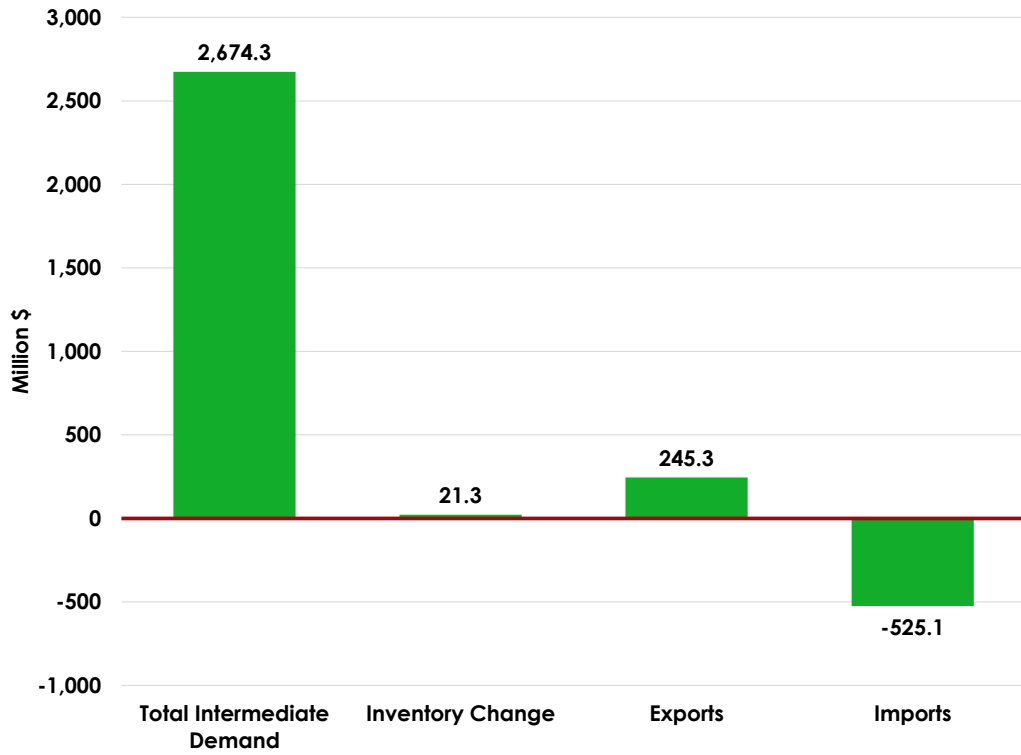


Table 1. Output

Units: Millions of 2016 Dollars

| | Level | Growth Rate |
|------|-------|-------------|
| 2002 | 2,019 | |
| 2003 | 1,991 | -1.4% |
| 2004 | 1,830 | -8.5% |
| 2005 | 1,959 | 6.8% |
| 2006 | 2,231 | 13.0% |
| 2007 | 2,303 | 3.1% |
| 2008 | 2,448 | 6.1% |
| 2009 | 2,498 | 2.0% |
| 2010 | 2,321 | -7.4% |
| 2011 | 2,576 | 10.5% |
| 2012 | 2,673 | 3.7% |
| 2013 | 2,677 | 0.2% |
| 2014 | 2,027 | -27.8% |
| 2015 | 2,463 | 19.5% |
| 2016 | 2,416 | -1.9% |

Figure 2. Distribution of Output in 2016, RTA Product Scope
Units: Millions of Dollars



2.2 Employment

Total direct employment is shown in Figure 3. Employment data and growth rates are available in Table 2.

Like most manufacturing industries, the railway tie industry was not immune to the Great Recession. Employment levels among RTA-related industries were roughly 6,250 as of 2008. Two straight years of sizable job losses followed, including an 8.5 percent reduction in 2010. A year later, industry employment levels surged by 15.4 percent and approached 6,300 persons. This gain was short-lived, however, and three additional years of job cuts followed. Performance has been mixed in the last two years, with job totals rising 7.6 percent in 2015 and slipping 6.8 percent in 2016. The number of persons employed at RTA-related industries reached 5,062 in 2016.

Direct employment in RTA-related industries has trended downwards in recent years, but productivity gains are encouraging. Employment approached 5,100 jobs in 2016.

While job gains have been slight in recent years, it is important to note that labor productivity has been growing. Firms are able to achieve increasing levels of output using less labor. Labor productivity increased at an average rate of 2.2 percent per year between 2007 and 2016. This performance compares favorably to the overall economy.

Figure 3. Employment
Units: Jobs

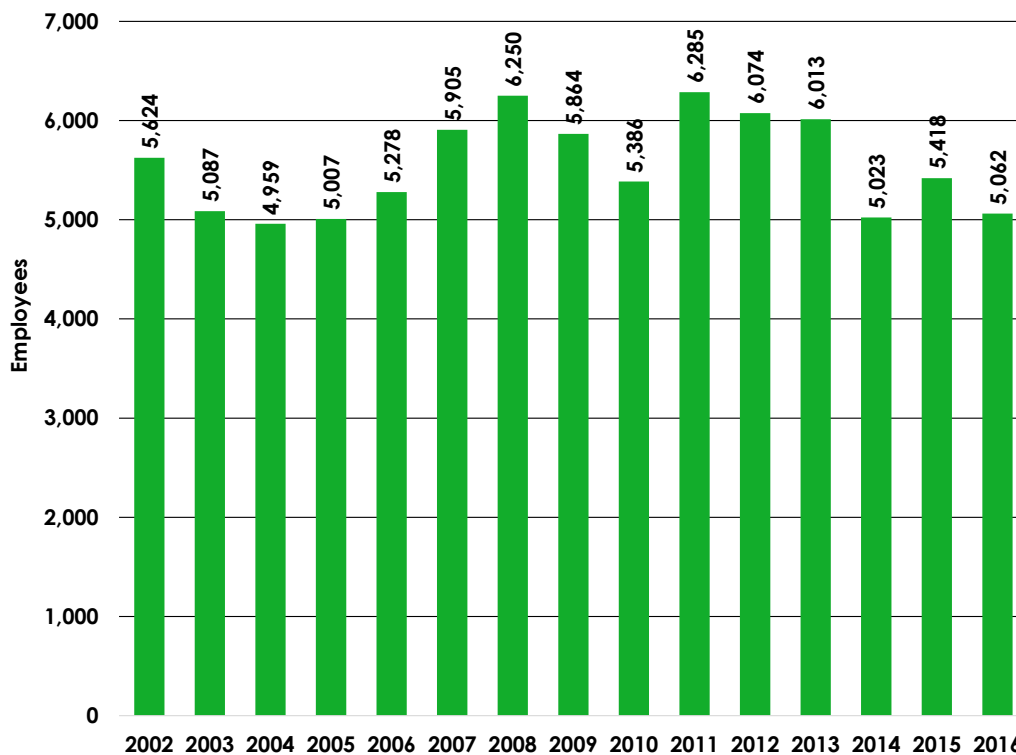


Table 2. Employment by Industry Segment
Units: Jobs

| | Level | Growth Rate |
|------|-------|-------------|
| 2002 | 5,624 | |
| 2003 | 5,087 | -10.0% |
| 2004 | 4,959 | -2.5% |
| 2005 | 5,007 | 1.0% |
| 2006 | 5,278 | 5.3% |
| 2007 | 5,905 | 11.2% |
| 2008 | 6,250 | 5.7% |
| 2009 | 5,864 | -6.4% |
| 2010 | 5,386 | -8.5% |
| 2011 | 6,285 | 15.4% |
| 2012 | 6,074 | -3.4% |
| 2013 | 6,013 | -1.0% |
| 2014 | 5,023 | -18.0% |
| 2015 | 5,418 | 7.6% |
| 2016 | 5,062 | -6.8% |

2.3 Value Added

Value added represents the enhancement a manufacturer provides (ex: assembly) to a product before offering it to the end consumer. Put another way, value added is the difference between total revenue of an industry and the cost of intermediate inputs. Components of value added include employee labor compensation, taxes on production and imports, and gross operating surplus (profits). Value added can be thought of as the industry's contribution to overall GDP.

Figure 4 displays total value added of RTA-related activity. Levels and annual growth rates are provided in Table 3.

*RTA direct value added
approached \$614 million in 2016.*

RTA-related total value added rose by an average of 9.6 percent annually between 2004 and 2009, ultimately reaching \$512.3 million. This robust growth could not be sustained and value added slipped 9.4 percent in 2010 and 3.0 percent in 2011. Value added growth among railway tie producers was volatile between 2012 and 2015, including a surge of 32.3 percent in 2012 and a 23.4 percent decline in 2014. Most recently, value added rose 13.7 percent in 2015 and declined 1.6 percent in 2016. RTA-related value added finished the period at \$613.8 million. Despite the unstable value-added performance in recent years, gains averaged 4.8 percent per year between 2002 and 2016.

Figure 4. Value Added
Units: Millions of Dollars

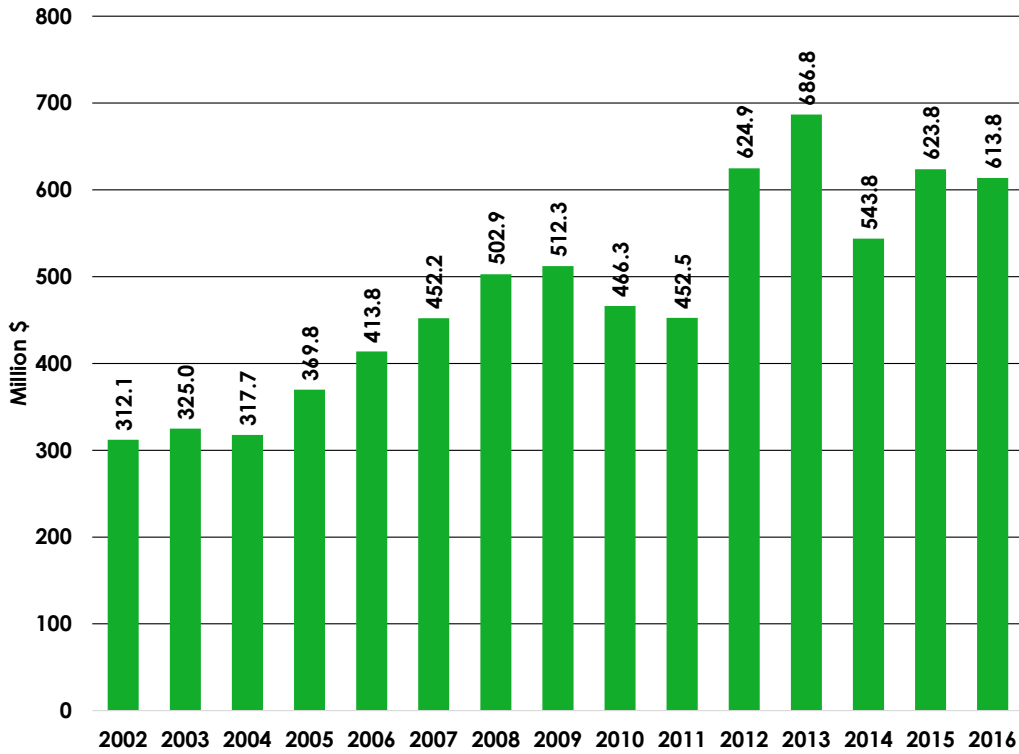


Table 3. Value Added
Units: Millions of Dollars

| Year | Level | Growth Rate |
|------|-------|-------------|
| 2002 | 312.1 | |
| 2003 | 325.0 | 4.1% |
| 2004 | 317.7 | -2.3% |
| 2005 | 369.8 | 15.2% |
| 2006 | 413.8 | 11.2% |
| 2007 | 452.2 | 8.9% |
| 2008 | 502.9 | 10.6% |
| 2009 | 512.3 | 1.9% |
| 2010 | 466.3 | -9.4% |
| 2011 | 452.5 | -3.0% |
| 2012 | 624.9 | 32.3% |
| 2013 | 686.8 | 9.5% |
| 2014 | 543.8 | -23.4% |
| 2015 | 623.8 | 13.7% |
| 2016 | 613.8 | -1.6% |

2.4 Labor Compensation

Labor compensation, a component of value added¹, is the sum of salary/wages and supplements. Supplements can take the form of employer contributions for employee pensions and insurance funds (ex: health insurance) and employer contributions for government social insurance (ex: social security).

Figure 5 illustrates the total labor compensation of RTA-related activity. Additional details, including growth rates, are provided in Table 4.

In general, labor compensation has followed a similar path as overall value added. Compensation grew for five consecutive years, including double digit growth in both 2006 and 2007.

Compensation levels reached a relative peak of \$298.6 billion in 2008. Some gains were erased by recession era losses in 2009 and 2010. However, labor compensation of RTA-related employees surged 19.2 percent in 2011, rising to \$308.9 million. Following a 12.0 percent decline in 2014, compensation rose by 10.2 percent a year later. Compensation levels dipped 6.3 percent in 2016, finishing the year at \$285 million.

Labor compensation of RTA-related employees reached \$285 million in 2016.

Labor compensation's share of total value added was approximately 46 percent in 2016. Taxes on production and imports and gross operating surplus (profits) make up the remainder of total value added.

¹ Value added is the sum of Labor compensation, Gross operating surplus, and Taxes on Production and imports less subsidies. Either or both of the latter two categories can be negative, which results in Labor compensation greater than value added.

Figure 5. Labor Compensation
Units: Millions of Dollars

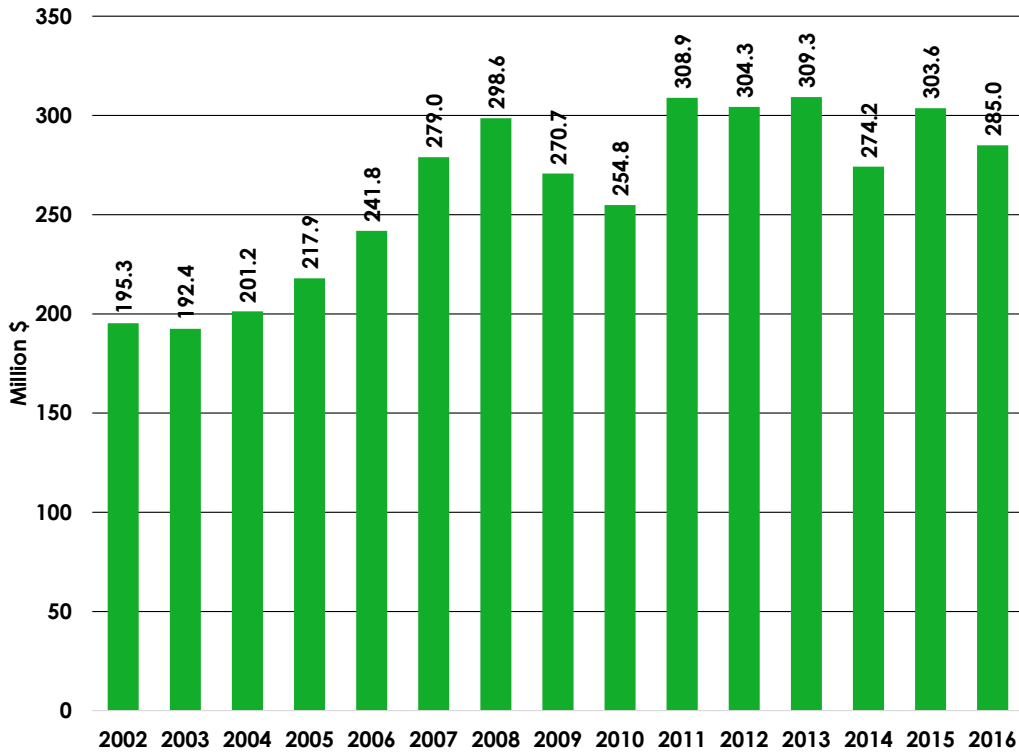


Table 4. Labor Compensation
Units: Millions of Dollars

| Year | Level | Growth Rate |
|------|-------|-------------|
| 2002 | 195.3 | |
| 2003 | 192.4 | -1.5% |
| 2004 | 201.2 | 4.5% |
| 2005 | 217.9 | 8.0% |
| 2006 | 241.8 | 10.4% |
| 2007 | 279.0 | 14.3% |
| 2008 | 298.6 | 6.8% |
| 2009 | 270.7 | -9.8% |
| 2010 | 254.8 | -6.1% |
| 2011 | 308.9 | 19.2% |
| 2012 | 304.3 | -1.5% |
| 2013 | 309.3 | 1.6% |
| 2014 | 274.2 | -12.0% |
| 2015 | 303.6 | 10.2% |
| 2016 | 285.0 | -6.3% |

3. National Economic Impact Analysis

The impact of the wooden railway tie industry certainly extends beyond the direct economic impacts as measured by the variables presented in the industry overview in the previous section. Jobs are also supported in supplier (“upstream”) industries that provide components, materials, energy, and various services to the railway tie industry, as well as the transportation and trade industries that distribute these inputs. In addition to these upstream impacts, jobs are supported in wholesale and retail trade (“downstream”) industries that distribute RTA member company products.

3.1 Upstream Analysis

Table 5 is an example of the type of information that can be extracted from the input-output (IO) framework of the Inforum *Iliad* model. This table shows the top 20 elements in the *column* of the IO table. A column of the IO table shows the suppliers to the industry. Another way to think of it is the combination of inputs purchased to produce that industry’s products.

Table 5 shows the purchases made by the “Sawmills and wood preservation” industry. This industry includes production of both railway ties and other milled wood products (ex: beams and boards). This level of IO granularity is the most detailed made available by BEA. These represent the intermediate inputs used to create the final product. The first column displays the rank and the next two columns show the NAICS code(s) and title of each supplying industry. The fourth column lists the share of total output. Total output of each industry is the sum of all purchases from other industries, plus value added. In the case of “Sawmills and wood preservation”, intermediate inputs accounted for 72.3 percent of total input value, while value added made up the remaining 27.7 percent.

The largest amount of purchases were from the “Forestry and logging” industry. This sector provides the raw lumber used to produce wooden railway ties. The second largest purchase was from other establishments within the “Sawmills and wood preservation” industry. The third largest purchase is from “Wholesale trade”. This represents the trade margins paid on inputs from suppliers to the “Sawmills and wood preservation” industry. “Management of companies and enterprises” provide strategic planning and other organizational resources. “Truck transportation” and “Rail transportation” make up the fifth and sixth largest suppliers to the “Sawmill and wood preservation” industry. These two industries help move goods along the supply chain. Positions 7 and 8, meanwhile, are chemical industries which supply important inputs needed to preserve rail ties.

Each of the industries listed in Table 5 also provide employment, generate value added, and require supplies from other industries. For most supplier industries, a certain share is imported. This imported share does not contribute to the generation of U.S. income, jobs, and production.

Table 5. Top Upstream Suppliers to Sawmills and Wood Preservation (NAICS 3211) in 2016
Units: Percent of Total Output

| Rank | NAICS | Industry Title | Share |
|------|-----------|--|---------------|
| 1 | 113 | Forestry and logging | 29.5% |
| 2 | 3211 | Sawmills and wood preservation | 16.8% |
| 3 | 42 | Wholesale trade | 7.2% |
| 4 | 55 | Management of companies and enterprises | 3.2% |
| 5 | 484 | Truck transportation | 2.6% |
| 6 | 482 | Rail transportation | 1.1% |
| 7 | 32518 | Other basic inorganic chemicals | 1.0% |
| 8 | 32519 | Other basic organic chemicals | 0.9% |
| 9 | 2211 | Electric power generation, transmission, and distribution | 0.8% |
| 10 | 5617 | Services to buildings and dwellings | 0.6% |
| 11 | 5412 | Accounting, tax preparation, bookkeeping, and payroll services | 0.6% |
| 12 | 2212 | Natural gas distribution | 0.5% |
| 13 | 5182 | Data processing, hosting, and related services | 0.5% |
| 14 | 7222 | Limited-service restaurants | 0.4% |
| 15 | 23 | Nonresidential maintenance and repair | 0.3% |
| 16 | 5411 | Legal services | 0.3% |
| 17 | 32411 | Petroleum refineries | 0.3% |
| 18 | 5413 | Architectural, engineering, and related services | 0.3% |
| 19 | 5418 | Advertising, public relations, and related services | 0.3% |
| 20 | 521, 5221 | Monetary authorities and depository credit intermediation | 0.2% |
| | | Other purchases from upstream suppliers | 4.9% |
| | | Value Added | 27.7% |
| | | Total Output | 100.0% |

In this analysis, the domestic production, also called the *direct output*, of industry segments serves as our starting point. From this, we derive the inputs of the supplier industries, stripping off an estimated share of imports, and allocating a certain amount to value added. These supplier industries in turn generate demand for their supplier industries. The process continues back to each stage of supplier, with imports and value added removed in each step. At some point, the additional calculated supplier input becomes vanishingly small. All of the output generated beyond the *direct output* is called the *indirect output*.

Associated with direct output is the employment required in that sector to produce its output, as well as the value added or income earned. Part of this value added is labor income. The *indirect output* also generates employment, value added, and labor income. Table 6 and Figure 6 show the results of the upstream analysis, providing a summary of total direct and indirect output, employment, value added, and labor income.

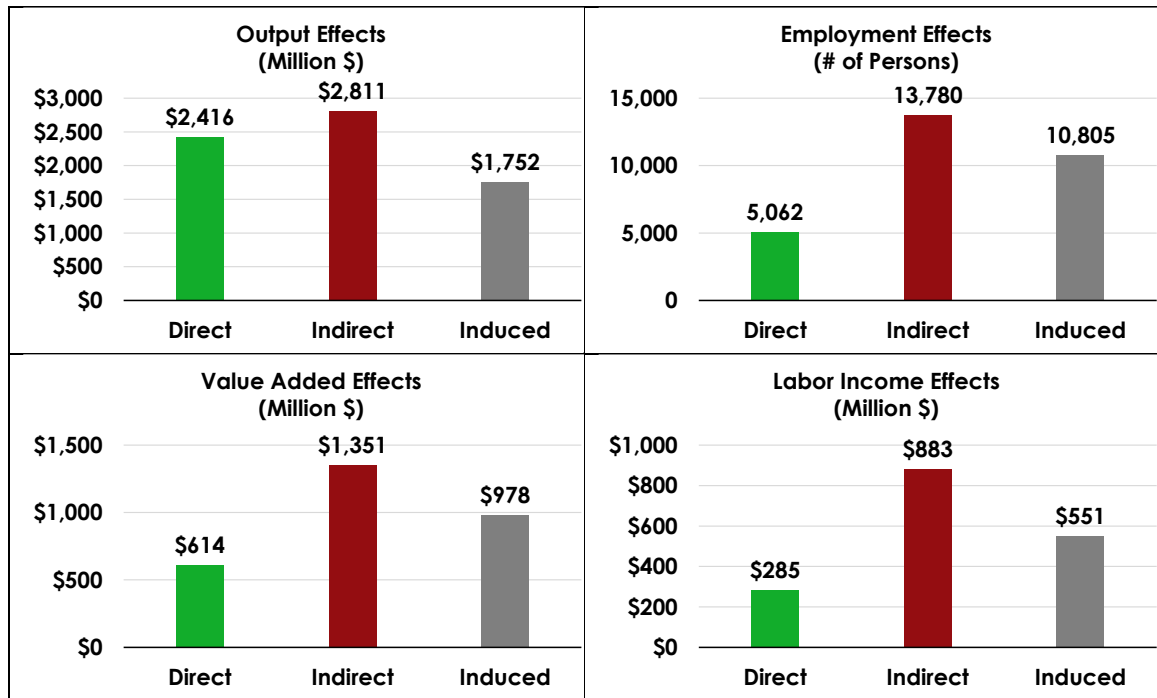
Table 6. Summary of Upstream Analysis
Units Indicated

| | Output (Million \$) | Employment (Persons) | Value Added (Million \$) | Labor Income (Million \$) |
|--------------|------------------------|-------------------------|-----------------------------|------------------------------|
| Direct | 2,416 | 5,062 | 614 | 285 |
| Indirect | 2,811 | 13,780 | 1,351 | 883 |
| Induced | 1,752 | 10,805 | 978 | 551 |
| Total | 6,979 | 29,647 | 2,943 | 1,719 |

Direct output, which is the starting point, was supplied by RTA and industry experts. In 2016, this is estimated to be approximately \$2.4 billion dollars. Direct employment totaled 5,062 jobs. Value added generated was about \$614 million, and of this, about \$285 million was labor income. This is all shown in the first row of Table 6. From the second row, we can see that indirect output amounted to an additional \$2.8 billion, generating 13,780 jobs, \$1.4 billion in value added, and \$883 million in labor income.

RTA-related activity helped support over \$2.8 billion in upstream indirect output and nearly 13,800 upstream jobs.

Figure 6. Upstream Analysis
Units Indicated



In addition to the direct and indirect impacts, we have calculated *induced output*. This represents the additional demand generated by the disposable income earned in the industry (this may be both wage income and capital income). We estimate the mix of consumer goods and services purchased by this income, and calculate the output, employment, value added, and labor income associated with this induced output. This is shown in the third row of Table 6. The total impacts are summarized in the fourth row. For example, the total upstream direct, indirect, and induced employment comes to 29,647 jobs.

Note that Table 6 shows only a summary of results. Each industry has its particular employment to output ratio, value added to output ratio, and labor income to output ratio. For example, a dollar of output generated in the retail trade industry creates more jobs than a dollar in the automobile manufacturing industry. The latter industry, on the other hand, generates more capital income per dollar of output. The individual footprint of any given industry is a result of several factors:

- The distribution of purchases from supplier industries, and the purchases from their suppliers, etc.
- The labor/output, value added/output, and labor income/output ratios in each industry.
- The import share of each industry.

3.2 Downstream Analysis

In addition to jobs, value added, and output in the supplier industries, some portion of economic activity in the wholesale and retail trade industries is due to sales of RTA-related products. This impact, which is often termed the “downstream” impact, also has *direct*, *indirect*, and *induced* components.

The IO framework includes estimates of *margins* on each transaction. These may be wholesale and retail markups, the cost necessary to bring the product to its final users. Looking across the row of the IO table shows the distribution of buyers of each product. Table 7 shows the largest elements of such distribution by industry segment.

Table 7. Sawmills and Wood Preservation (NAICS 32111) Sales to Other Sectors

| Rank | NAICS | Industry Title | % of Intermediate Sales |
|------|--------------|--|-------------------------|
| 1 | 3211 | Sawmills and wood preservation | 15.2% |
| 2 | 32191 | Millwork | 10.0% |
| 3 | 32192, 32199 | All other wood products | 9.1% |
| 4 | 3212 | Veneer, plywood, and engineered wood products | 7.6% |
| 5 | 23 | Single-family residential structures | 6.6% |
| 6 | 32212, 32213 | Paper and paperboard mills | 6.2% |
| 7 | 482 | Rail transportation | 4.7% |
| 8 | 23 | Nonresidential maintenance and repair | 4.1% |
| 9 | 23 | Other residential structures | 3.8% |
| 10 | 23 | Educational and vocational structures | 3.7% |
| 11 | 23 | Other nonresidential structures | 2.7% |
| 12 | 33712 | Household and institutional furniture | 2.3% |
| 13 | 33711 | Wood kitchen cabinet and countertops | 2.3% |
| 14 | 32211 | Pulp mills | 2.3% |
| 15 | 23 | Commercial structures, including farm structures | 1.9% |
| 16 | 33721 | Office furniture (including fixtures) | 1.8% |
| 17 | 7221 | Full-service restaurants | 1.2% |
| 18 | 23 | Health care structures | 1.1% |
| 19 | 23 | Residential maintenance and repair | 1.0% |
| 20 | 23 | Power and communication structures | 0.9% |
| | | All other sectors | 11.5% |
| | | Total Intermediate Demand | 100.0% |

Most of these purchasing industries buy products through wholesale dealers. A small amount of purchases from this industry are made through retail trade. For the downstream analysis, we calculated intermediate and final sales by each of the industry segments. Next, we calculated the wholesale and retail margins associated with these sales. The total margins were taken as *direct output* for the downstream analysis.

Table 8 and Figure 7 show a summary of the direct, indirect, and induced impacts arising from downstream sales. The first row of the table shows direct output at \$310 million. This is the total wholesale and retail margins associated with sales of RTA-related manufacturing activity. Wholesale and retail trade employment due to this activity is 1,304 persons. Direct value added and labor income are \$207 million and \$107 million, respectively.

As in the upstream supplier analysis, downstream impacts also lead to indirect and induced output, and their associated employment, value added, and labor income. These are shown in the second and third rows of Table 8, with the total of direct, indirect, and induced at the bottom.

Total downstream effects generate \$718 million in output and 3,750 jobs.

Table 8. Summary of Downstream Analysis
Units Indicated

| | Output (Million \$) | Employment (Persons) | Value Added (Million \$) | Labor Income (Million \$) |
|-----------------|------------------------|-------------------------|-----------------------------|------------------------------|
| Direct | 310 | 1,304 | 207 | 107 |
| Indirect | 159 | 912 | 93 | 58 |
| Induced | 249 | 1,533 | 139 | 78 |
| Total | 718 | 3,750 | 439 | 243 |

Figure 7. Downstream Analysis
Units Indicated

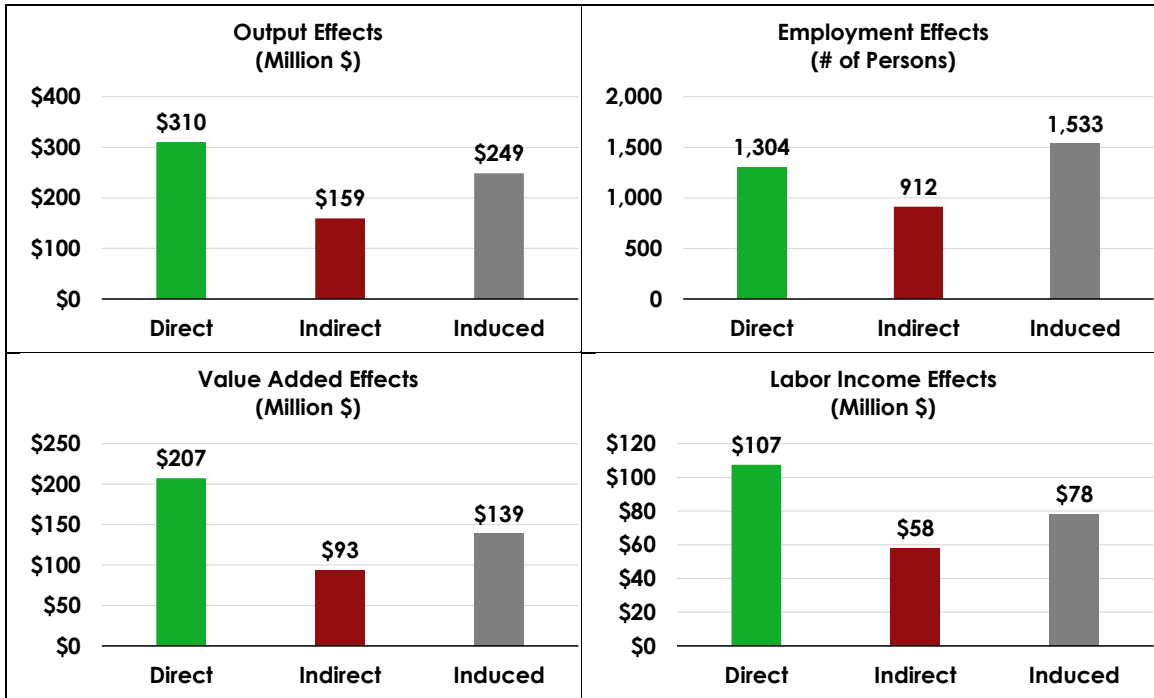


Table 9 shows the combined results from the upstream and downstream analysis. Total national employment from upstream and downstream output amounts to almost 33,400 jobs. Total output, meanwhile, sums to \$7.7 billion.

Table 9. Combined Summary
Units Indicated

| | Output (Million \$) | Employment (Persons) | Value Added (Million \$) | Labor Income (Million \$) |
|--------------|------------------------|-------------------------|-----------------------------|------------------------------|
| Upstream | 6,979 | 29,647 | 2,943 | 1,719 |
| Downstream | 718 | 3,750 | 439 | 243 |
| Total | 7,698 | 33,397 | 3,382 | 1,962 |

4. *State-Level Economic Impact Analysis*

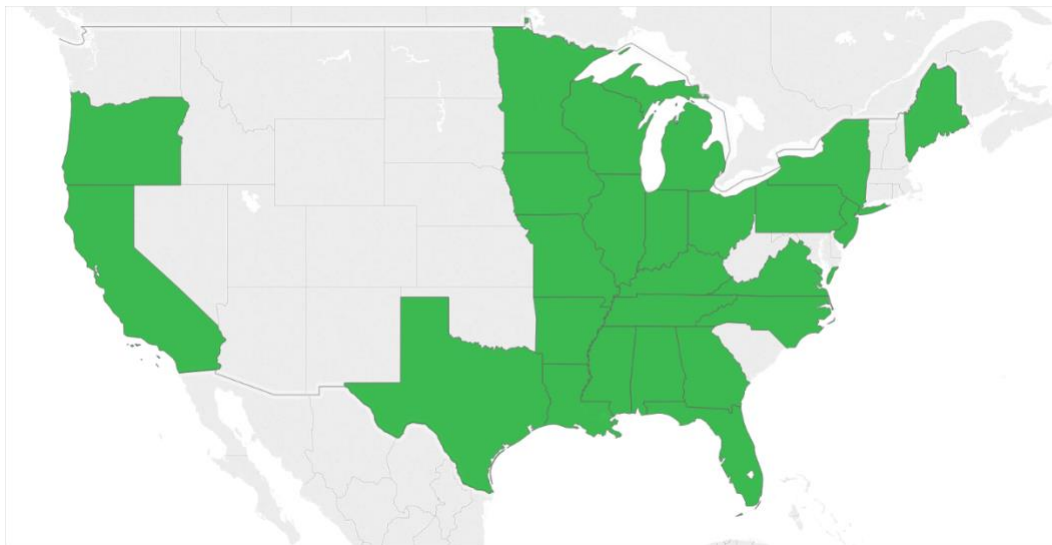
The national level economic impacts described in section 3 can be seen as the sum of economic impacts at the state level. National level direct production have been distributed to the state level using employment shares taken from the BLS Census of Employment and Wages (CEW), for both the upstream and the downstream analysis. Next, IMPLAN's database was used to calculate direct employment, value-added, and labor compensation.

IMPLAN is also used to calculate the indirect and induced impacts of production. IMPLAN is often used by business professionals, researchers, and elected officials to assess potential local economic impacts of various projects. We have used IMPLAN to calculate direct, indirect, and induced upstream impacts for output, employment (jobs), total value added, and labor income. These impacts have been calculated for both the upstream and downstream impacts of RTA-related activity.

RTA staff have identified twenty-five states of interest. These include the following:

- Alabama
- Arkansas
- California
- Florida
- Georgia
- Illinois
- Indiana
- Iowa
- Kentucky
- Louisiana
- Maine
- Michigan
- Minnesota
- Mississippi
- Missouri
- New Jersey
- New York
- North Carolina
- Ohio
- Oregon
- Pennsylvania
- Tennessee
- Texas
- Virginia
- Wisconsin

Figure 8. RTA State Focus



4.1 Upstream Output Impacts

Oregon was the highest-ranking state for total RTA-related upstream impacts, with \$200.3 million in direct impacts and \$386.5 million in total impacts. Georgia came in second with \$144.8 million and \$287.3 million in direct and total impacts, respectively. Alabama ranked third, with total upstream impacts of \$284.7 million.

Table 10. Upstream Output Impacts by State

Units: Million \$

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|----------------|----------------|------------------|-----------------|---------------|
| Alabama | 157.5 | 89.6 | 37.6 | 284.7 |
| Arkansas | 134.9 | 79.9 | 28.1 | 242.9 |
| California | 100.5 | 64.5 | 30.1 | 195.1 |
| Florida | 74.0 | 50.6 | 27.4 | 152.0 |
| Georgia | 144.8 | 95.7 | 46.8 | 287.3 |
| Illinois | 12.6 | 6.4 | 3.6 | 22.5 |
| Indiana | 47.6 | 22.7 | 11.2 | 81.6 |
| Iowa | 11.4 | 4.9 | 2.4 | 18.6 |
| Kentucky | 66.1 | 39.7 | 16.2 | 122.0 |
| Louisiana | 48.4 | 25.6 | 10.8 | 84.9 |
| Maine | 47.9 | 32.3 | 14.0 | 94.3 |
| Michigan | 58.4 | 39.4 | 21.1 | 118.9 |
| Minnesota | 26.6 | 13.6 | 8.2 | 48.4 |
| Mississippi | 107.2 | 57.4 | 19.3 | 183.9 |
| Missouri | 30.4 | 20.8 | 9.5 | 60.7 |
| New Jersey | 2.0 | 1.0 | 0.5 | 3.6 |
| New York | 39.1 | 26.1 | 11.7 | 77.0 |
| North Carolina | 137.9 | 84.6 | 37.4 | 259.8 |
| Ohio | 34.9 | 22.9 | 11.8 | 69.6 |
| Oregon | 200.3 | 130.8 | 55.4 | 386.5 |
| Pennsylvania | 93.9 | 64.8 | 32.5 | 191.2 |
| Tennessee | 51.6 | 31.0 | 13.5 | 96.1 |
| Texas | 87.9 | 60.7 | 28.7 | 177.2 |
| Virginia | 109.7 | 57.6 | 25.2 | 192.5 |
| Wisconsin | 62.5 | 33.6 | 15.7 | 111.9 |
| Other States | 527.7 | 1,655.1 | 1,233.3 | 3,416.2 |
| U.S. TOTAL | 2,415.8 | 2,811.5 | 1,752.0 | 6,979.3 |

4.2 Upstream Employment Impacts

Table 11 shows upstream employment impacts for each state. Oregon was again the leader for upstream employment impacts, with 413 direct and 1,606 total jobs. This time Alabama came in second, with 329 direct upstream jobs and 1,201 total jobs. Georgia upstream employment was similar, with 279 direct and 1,163 total jobs.

Table 11. Upstream Employment Impacts by State
Units: Jobs

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|----------------|----------------|------------------|-----------------|---------------|
| Alabama | 329 | 579 | 293 | 1,201 |
| Arkansas | 271 | 458 | 222 | 951 |
| California | 212 | 335 | 188 | 735 |
| Florida | 170 | 304 | 200 | 673 |
| Georgia | 279 | 543 | 342 | 1,163 |
| Illinois | 29 | 34 | 24 | 87 |
| Indiana | 110 | 134 | 86 | 330 |
| Iowa | 26 | 30 | 18 | 75 |
| Kentucky | 154 | 239 | 125 | 518 |
| Louisiana | 99 | 163 | 86 | 347 |
| Maine | 106 | 222 | 109 | 437 |
| Michigan | 141 | 239 | 157 | 536 |
| Minnesota | 55 | 83 | 59 | 197 |
| Mississippi | 211 | 383 | 157 | 751 |
| Missouri | 70 | 118 | 71 | 259 |
| New Jersey | 5 | 5 | 4 | 14 |
| New York | 102 | 141 | 74 | 317 |
| North Carolina | 280 | 506 | 278 | 1,064 |
| Ohio | 83 | 125 | 86 | 294 |
| Oregon | 413 | 767 | 426 | 1,606 |
| Pennsylvania | 209 | 341 | 229 | 778 |
| Tennessee | 115 | 186 | 99 | 400 |
| Texas | 195 | 337 | 197 | 729 |
| Virginia | 210 | 320 | 177 | 707 |
| Wisconsin | 135 | 207 | 119 | 461 |
| Other States | 1,056 | 6,981 | 6,979 | 15,016 |
| U.S. TOTAL | 5,062 | 13,780 | 10,805 | 29,647 |

4.3 Upstream Value Added Impacts

Table 12 shows the upstream value added impacts. Oregon again ranked in the top three, with \$52.4 million in direct value added impacts and \$151.2 million total. Georgia followed close behind, with \$123.4 million in total value added and \$46.2 million in direct value added impacts. North Carolina ranked third, with \$38.6 million and \$102.6 million in direct and total value added impacts, respectively.

Table 12. Upstream Value Added Impacts by State
Units: Million \$

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|----------------|----------------|------------------|-----------------|---------------|
| Alabama | 40.4 | 40.7 | 20.9 | 101.9 |
| Arkansas | 39.0 | 38.8 | 15.8 | 93.6 |
| California | 24.3 | 35.7 | 18.4 | 78.4 |
| Florida | 12.8 | 27.1 | 15.7 | 55.6 |
| Georgia | 46.2 | 49.8 | 27.4 | 123.4 |
| Illinois | 2.4 | 3.6 | 2.2 | 8.2 |
| Indiana | 8.4 | 11.0 | 6.5 | 25.9 |
| Iowa | 2.1 | 2.5 | 1.3 | 5.9 |
| Kentucky | 10.9 | 18.9 | 9.0 | 38.9 |
| Louisiana | 13.3 | 12.5 | 6.2 | 31.9 |
| Maine | 9.9 | 14.5 | 8.1 | 32.4 |
| Michigan | 7.4 | 19.7 | 12.1 | 39.3 |
| Minnesota | 7.1 | 7.3 | 4.7 | 19.0 |
| Mississippi | 32.6 | 25.5 | 10.4 | 68.5 |
| Missouri | 5.5 | 10.5 | 5.5 | 21.5 |
| New Jersey | 0.3 | 0.6 | 0.3 | 1.2 |
| New York | 1.6 | 14.7 | 7.6 | 24.0 |
| North Carolina | 38.6 | 42.4 | 21.5 | 102.6 |
| Ohio | 5.2 | 12.2 | 6.9 | 24.3 |
| Oregon | 52.4 | 66.5 | 32.4 | 151.2 |
| Pennsylvania | 19.4 | 34.4 | 19.5 | 73.3 |
| Tennessee | 10.7 | 15.2 | 7.8 | 33.6 |
| Texas | 18.3 | 32.0 | 16.5 | 66.8 |
| Virginia | 36.6 | 30.1 | 15.1 | 81.8 |
| Wisconsin | 14.9 | 16.5 | 9.1 | 40.5 |
| Other States | 153.7 | 768.3 | 677.1 | 1,599.0 |
| U.S. TOTAL | 613.8 | 1,350.9 | 978.0 | 2,942.7 |

4.4 Upstream Labor Income Impacts

Table 13 shows direct, indirect, induced, and total upstream labor income impacts by state. Oregon was first in total upstream labor income impacts at \$87.5 million. Georgia was second, at \$65.0 million, and last was Alabama, with \$60.7 million in total upstream labor income impacts.

Table 13. Upstream Labor Income Impacts by State
Units: Million \$

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|----------------|----------------|------------------|-----------------|---------------|
| Alabama | 21.6 | 28.0 | 11.2 | 60.7 |
| Arkansas | 13.1 | 24.6 | 8.3 | 45.9 |
| California | 11.3 | 23.1 | 10.3 | 44.6 |
| Florida | 8.9 | 17.9 | 8.6 | 35.4 |
| Georgia | 17.4 | 33.0 | 14.6 | 65.0 |
| Illinois | 1.5 | 2.3 | 1.2 | 5.0 |
| Indiana | 6.0 | 7.6 | 3.7 | 17.2 |
| Iowa | 1.5 | 1.6 | 0.7 | 3.9 |
| Kentucky | 8.3 | 12.9 | 5.0 | 26.2 |
| Louisiana | 5.4 | 8.2 | 3.4 | 16.9 |
| Maine | 5.9 | 10.3 | 4.3 | 20.4 |
| Michigan | 9.9 | 13.9 | 6.8 | 30.6 |
| Minnesota | 3.8 | 5.0 | 2.8 | 11.6 |
| Mississippi | 10.6 | 16.5 | 5.3 | 32.4 |
| Missouri | 3.4 | 7.2 | 3.0 | 13.6 |
| New Jersey | 0.3 | 0.4 | 0.2 | 0.9 |
| New York | 6.6 | 10.2 | 4.3 | 21.0 |
| North Carolina | 14.1 | 28.3 | 11.6 | 54.0 |
| Ohio | 4.3 | 8.3 | 3.7 | 16.3 |
| Oregon | 22.8 | 46.1 | 18.6 | 87.5 |
| Pennsylvania | 11.6 | 24.3 | 11.2 | 47.1 |
| Tennessee | 5.5 | 9.7 | 4.7 | 19.9 |
| Texas | 10.8 | 19.6 | 9.4 | 39.8 |
| Virginia | 12.3 | 20.1 | 8.1 | 40.5 |
| Wisconsin | 7.1 | 11.4 | 5.0 | 23.5 |
| Other States | 61.2 | 492.8 | 384.9 | 938.9 |
| U.S. TOTAL | 285.0 | 883.3 | 550.6 | 1,718.9 |

4.5 Downstream Output Impacts

California was the highest-ranking state for total RTA-related downstream impacts, with \$69.3 million in total impacts. Texas came in second with \$54.6 million in total downstream output. Florida ranked third, with total downstream impacts of \$34.8 million.

Table 14. Downstream Output Impacts by State

Units: Million \$

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|----------------|----------------|------------------|-----------------|---------------|
| Alabama | 3.9 | 1.2 | 1.3 | 6.5 |
| Arkansas | 2.5 | 0.7 | 0.7 | 3.9 |
| California | 37.8 | 15.2 | 16.3 | 69.3 |
| Florida | 18.0 | 7.8 | 8.9 | 34.8 |
| Georgia | 11.5 | 4.4 | 5.2 | 21.1 |
| Illinois | 15.9 | 5.6 | 7.5 | 29.0 |
| Indiana | 6.3 | 1.9 | 2.3 | 10.5 |
| Iowa | 3.5 | 1.1 | 1.2 | 5.8 |
| Kentucky | 4.0 | 1.2 | 1.2 | 6.4 |
| Louisiana | 3.8 | 1.2 | 1.3 | 6.2 |
| Maine | 1.1 | 0.4 | 0.4 | 1.8 |
| Michigan | 9.1 | 3.1 | 3.9 | 16.1 |
| Minnesota | 7.0 | 2.7 | 3.5 | 13.1 |
| Mississippi | 1.8 | 0.5 | 0.5 | 2.8 |
| Missouri | 6.4 | 2.3 | 2.8 | 11.6 |
| New Jersey | 11.3 | 3.9 | 4.9 | 20.1 |
| New York | 17.8 | 6.1 | 6.5 | 30.4 |
| North Carolina | 9.7 | 3.5 | 4.1 | 17.3 |
| Ohio | 12.5 | 4.8 | 5.7 | 22.9 |
| Oregon | 4.0 | 1.5 | 1.6 | 7.1 |
| Pennsylvania | 11.6 | 4.1 | 5.3 | 21.0 |
| Tennessee | 6.4 | 2.1 | 2.5 | 11.0 |
| Texas | 30.7 | 10.6 | 13.3 | 54.6 |
| Virginia | 5.9 | 2.1 | 2.2 | 10.2 |
| Wisconsin | 6.5 | 2.3 | 2.6 | 11.5 |
| Other States | 61.4 | 69.0 | 142.9 | 273.4 |
| U.S. TOTAL | 310.4 | 159.4 | 248.6 | 718.4 |

4.6 Downstream Employment Impacts

Table 15 shows downstream employment impacts for each state. California lead in downstream employment impacts, with 155 direct and 342 total jobs. Texas came in second, with 114 direct downstream jobs and 272 total downstream jobs. Florida upstream employment was third, with 79 direct and 197 total jobs.

Table 15. Downstream Employment Impacts by State
Units: Jobs

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|-------------------|----------------|------------------|-----------------|---------------|
| Alabama | 19 | 9 | 10 | 38 |
| Arkansas | 10 | 5 | 6 | 21 |
| California | 155 | 86 | 102 | 342 |
| Florida | 79 | 53 | 65 | 197 |
| Georgia | 48 | 29 | 38 | 115 |
| Illinois | 62 | 33 | 51 | 146 |
| Indiana | 29 | 14 | 18 | 60 |
| Iowa | 17 | 8 | 9 | 33 |
| Kentucky | 17 | 9 | 10 | 36 |
| Louisiana | 17 | 8 | 10 | 35 |
| Maine | 5 | 3 | 3 | 11 |
| Michigan | 39 | 20 | 29 | 88 |
| Minnesota | 31 | 17 | 25 | 72 |
| Mississippi | 9 | 4 | 4 | 17 |
| Missouri | 29 | 15 | 21 | 65 |
| New Jersey | 43 | 22 | 32 | 98 |
| New York | 71 | 32 | 41 | 144 |
| North Carolina | 44 | 24 | 30 | 99 |
| Ohio | 57 | 31 | 42 | 130 |
| Oregon | 19 | 10 | 12 | 41 |
| Pennsylvania | 49 | 24 | 37 | 110 |
| Tennessee | 27 | 14 | 19 | 59 |
| Texas | 114 | 67 | 92 | 272 |
| Virginia | 25 | 13 | 16 | 54 |
| Wisconsin | 31 | 15 | 20 | 66 |
| Other States | 260 | 347 | 793 | 1,400 |
| U.S. TOTAL | 1,304 | 912 | 1,533 | 3,750 |

4.7 Downstream Value Added Impacts

Table 16 shows the downstream value added impacts for our states of interest. California again came in first place, with \$25.5 million in direct value added impacts and \$45.1 million in total downstream value added. Texas followed close behind, with \$21.6 million in direct value added and \$35.5 million in total value added impacts. Florida ranked third, with \$11.8 million and \$21.4 million in direct and total value added impacts, respectively.

Table 16. Downstream Value Added Impacts by State

Units: Million \$

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|----------------|----------------|------------------|-----------------|---------------|
| Alabama | 2.4 | 0.7 | 0.7 | 3.8 |
| Arkansas | 1.6 | 0.4 | 0.4 | 2.4 |
| California | 25.5 | 9.6 | 10.0 | 45.1 |
| Florida | 11.8 | 4.5 | 5.1 | 21.4 |
| Georgia | 7.7 | 2.6 | 3.0 | 13.4 |
| Illinois | 11.0 | 3.5 | 4.5 | 19.1 |
| Indiana | 4.0 | 1.1 | 1.3 | 6.5 |
| Iowa | 2.2 | 0.6 | 0.7 | 3.5 |
| Kentucky | 2.6 | 0.7 | 0.7 | 4.0 |
| Louisiana | 2.4 | 0.7 | 0.7 | 3.8 |
| Maine | 0.7 | 0.2 | 0.2 | 1.1 |
| Michigan | 6.1 | 1.8 | 2.2 | 10.1 |
| Minnesota | 4.6 | 1.6 | 2.0 | 8.1 |
| Mississippi | 1.1 | 0.3 | 0.3 | 1.7 |
| Missouri | 4.1 | 1.4 | 1.6 | 7.1 |
| New Jersey | 7.9 | 2.5 | 3.0 | 13.4 |
| New York | 12.1 | 4.1 | 4.2 | 20.4 |
| North Carolina | 6.2 | 2.1 | 2.3 | 10.6 |
| Ohio | 8.0 | 2.8 | 3.3 | 14.1 |
| Oregon | 2.5 | 0.9 | 0.9 | 4.3 |
| Pennsylvania | 7.8 | 2.6 | 3.2 | 13.5 |
| Tennessee | 4.3 | 1.2 | 1.5 | 7.0 |
| Texas | 21.6 | 6.2 | 7.7 | 35.5 |
| Virginia | 3.9 | 1.3 | 1.3 | 6.6 |
| Wisconsin | 4.1 | 1.3 | 1.5 | 6.9 |
| Other States | 41.0 | 38.7 | 76.2 | 155.9 |
| U.S. TOTAL | 207.4 | 93.4 | 138.8 | 439.5 |

4.8 Downstream Labor Income Impacts

Table 17 shows downstream labor income impacts by state. California was first in total upstream labor income impacts at \$24.2 million. Texas was second, at \$18.5 million, and last was New York with \$11.6 million in total downstream labor income impacts.

Table 17. Downstream Labor Income Impacts by State
Units: Million \$

| State | Direct Impacts | Indirect Impacts | Induced Impacts | Total Impacts |
|----------------|----------------|------------------|-----------------|---------------|
| Alabama | 1.3 | 0.4 | 0.4 | 2.1 |
| Arkansas | 0.7 | 0.2 | 0.2 | 1.2 |
| California | 12.6 | 6.1 | 5.6 | 24.2 |
| Florida | 5.9 | 2.7 | 2.8 | 11.5 |
| Georgia | 4.0 | 1.6 | 1.6 | 7.2 |
| Illinois | 5.7 | 2.2 | 2.5 | 10.4 |
| Indiana | 2.1 | 0.7 | 0.8 | 3.6 |
| Iowa | 1.2 | 0.4 | 0.4 | 1.9 |
| Kentucky | 1.2 | 0.4 | 0.4 | 2.0 |
| Louisiana | 1.2 | 0.4 | 0.4 | 2.0 |
| Maine | 0.3 | 0.1 | 0.1 | 0.6 |
| Michigan | 3.2 | 1.1 | 1.2 | 5.6 |
| Minnesota | 2.7 | 1.1 | 1.2 | 4.9 |
| Mississippi | 0.5 | 0.2 | 0.1 | 0.8 |
| Missouri | 2.3 | 0.8 | 0.9 | 4.0 |
| New Jersey | 4.4 | 1.6 | 1.8 | 7.8 |
| New York | 6.7 | 2.6 | 2.3 | 11.6 |
| North Carolina | 3.4 | 1.3 | 1.3 | 5.9 |
| Ohio | 4.3 | 1.7 | 1.8 | 7.8 |
| Oregon | 1.4 | 0.5 | 0.5 | 2.5 |
| Pennsylvania | 4.2 | 1.6 | 1.8 | 7.6 |
| Tennessee | 2.1 | 0.8 | 0.9 | 3.8 |
| Texas | 10.2 | 3.9 | 4.4 | 18.5 |
| Virginia | 2.1 | 0.8 | 0.7 | 3.6 |
| Wisconsin | 2.3 | 0.8 | 0.8 | 3.9 |
| Other States | 21.4 | 23.7 | 43.2 | 88.4 |
| U.S. TOTAL | 107.4 | 57.9 | 78.1 | 243.5 |

5. Summary and Main Findings

This study has defined the scope of the wooden railway tie industry to include portions of the sawmill and wood preservation industries. After consultation with RTA and industry experts, we have estimated the appropriate size of the overall industry and compiled recent historical data on output, employment, value added, and labor income.

Total RTA-related activity, as measured by output, expanded steadily through the mid-to late 2000s, but endured a sizable decline in 2010 as a result of the Great Recession. The industry quickly gained traction in 2011, posting growth of 10.5 percent. Output declined sharply in 2014, falling by 27.8 percent. The rail tie industry rebounded in 2015 and grew by 19.5 percent. In 2016, output dipped by 1.9 percent to finish the year at \$2.4 billion. RTA-related output grew by an average annual rate of 1.3 percent between 2002 and 2016.

Employment among railway tie manufacturers contracted during the Great Recession, falling 6.4 percent in 2009 and 8.5 percent in 2010. By the end of the recession employment dropped to 5,386. Losses were erased in 2011, when employment grew by 15.4 percent. Following three consecutive years of job cuts, employment grew by 7.6 percent in 2015. The number of persons employed at RTA-related industries totaled 5,062 in 2016.

In 2016, RTA-related direct output totaled \$2.4 billion and supported over 5,000 jobs.

The domestic wooden railway tie industry is tightly interwoven with other manufacturing sectors and several service sectors that supply important materials, components and parts, as well as financial, IP, management, and transportation services. RTA-related activity accounted for \$2.4 billion in direct output in 2016, creating 5,062 jobs. Reliance on suppliers in other sectors generates an additional 13,780 jobs. Finally, induced impacts of spending of earnings in the direct and indirect sectors contributed to an additional 10,805 jobs, bringing the total upstream jobs impact addressed in this study to 29,647. Total output, including direct, indirect, and induced impacts, approached \$7.0 billion

Downstream analysis addresses the question of output and jobs generated in the distribution of wooden railway ties through wholesale and retail outlets. Total direct trade output is the margin or markup earned on sales. This is estimated to be \$310 million in 2016, which supports 1,304 direct jobs. An additional 912 jobs are supported indirectly and 1,533 jobs are created by induced output. The total downstream jobs impact is estimated at 3,750.

Total RTA-related activity, including both upstream suppliers and downstream distributors, accounts for \$7.7 billion in output and nearly 33,400 jobs.

Combining the upstream and downstream impacts results in a total output impact of \$7.7 billion and nearly 33,400 jobs.

The state-level analysis was performed using IMPLAN databases and economic impact models. The BLS Census of Employment and Wages (CEW) was used to obtain employment distributions by state to estimate the direct state-level output impacts.

Both the state-level upstream and downstream analyses sum to the results derived at the national level. Of the states analyzed, Oregon accounted for the most upstream output (\$386.5 million) and the greatest number of jobs (1,606). Georgia was ranked second in total output (\$287.3 million) and third in jobs (1,163). Alabama's upstream activity, meanwhile, was ranked third in output (\$284.7 million) and second in employment (1,201). North Carolina and Arkansas also ranked highly in terms of upstream activity.

Downstream economic impacts, including both retail and wholesale, are typically correlated with regional population and economic activity. The top state for total RTA-related downstream impacts was California, with \$69.3 million in output and 342 jobs. Texas ranked second in both output (\$54.6 million) and employment (272). Florida's downstream activity ranked third, and amounted to \$34.8 million in output and 197 jobs.

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Appendix A – Data Sources and Methodology

A.1 Data Sources

Inforum relies on a variety of data sources to build its models and produce impact studies. This study primarily relied on IMPLAN's database and economic impact models. Other important sources of data include the Census Bureau, the Bureau of Economic Analysis (BEA), and the Bureau of Labor Statistics (BLS). Table A.1 reviews the main data sources used to support this analysis.

Table A.1. Main Data Sources Used for this Study

| Agency or Source | Survey or Publication | Frequency | Economic Variables Available |
|------------------|--------------------------------|--------------|---|
| IMPLAN | IMPLAN Online | Annual | Output, Employment, Value Added, Labor Compensation, Industry Multipliers |
| Census Bureau | Annual Survey of Manufacturers | Annual | Establishments, Employment, Industry and Product Shipments, Value Added, Payroll, Investment, Inventories |
| Census Bureau | USA Trade | Annual | Exports and Imports |
| BEA | Benchmark Input-Output Table | Quinquennial | Make and Use Tables, 2007 had 393 Commodities |
| BEA | Gross Output by Industry | Annual | 393 Industries, Real, Nominal and Price |
| BEA | Annual Input-Output Tables | Annual | Make and Use Tables, Consumption and Investment Bridges, 71 Industries, 74 Commodities |
| BLS | CEW | Annual | Employment, Wages |

Industry data on output, employment, value added, and other variables are organized according to the North American Industry Classification System (NAICS). The first version of NAICS was released for 1997, and since then there have been four more versions, for the years 2002, 2007, 2012, and 2017. Current Economic Census and annual data are for the most part published according to the 2012 NAICS. However, the most recent Benchmark IO table is for 2007, and this is published according to the 2007 version of the NAICS.

Table A.2. Illustration of NAICS 2012

| 2012 NAICS | Product or industry title |
|-------------------|---------------------------------------|
| 32 | Manufacturing (31-33) |
| 321 | Wood product manufacturing |
| 3211 | Sawmills and Wood Preservation |
| 32111 | Sawmills and Wood Preservation |
| 321113 | Sawmills |
| 321114 | Wood Preservation |

NAICS is a hierarchical system. All codes beginning with '31-33' are part of Manufacturing, which includes codes 31, 32 and 33. More digits indicate finer levels of detail. For example, within NAICS 33 there are 8 3-digit codes. The code 333 includes all Machinery manufacturing. Within manufacturing as a whole, there are 21 3-digit sub-sectors, 86 4-digit industry groups, 180 5-digit industries, and 270 6-digit industries. At the 6-digit level, the NAICS classifications for the U.S., Canada, and Mexico are consistent.

A.2 Methodology for the National Economic Impact Analysis

The primary tool used for the national economic impact analysis is the IMPLAN² system. IMPLAN is comprised of detailed databases, multipliers, and economic models. IMPLAN covers over 500 unique industries and contains data on output, employment, value added, labor compensation, and other economic indicators. IMPLAN is often used by business professionals, researchers, and elected officials to assess potential local economic impacts of various projects.

IMPLAN is based on the 2007 Benchmark Input-Output table produced by the Bureau of Economic Analysis (BEA).³ From the benchmark make and use tables, an industry by industry domestic (not including imports) direct requirements matrix is derived at the national level.

The economic impact analysis consists of several parts:

1. *Upstream analysis* – This traces the impact of a given producing industry on supplier industries, including the suppliers to those suppliers. For each industry, calculations are made on output, jobs, earnings, and value added impacts.
2. *Downstream analysis* – This traces the impact of purchases of products through wholesale and retail trade distribution channels. The input-output table is used to estimate the distribution and total level of wholesale and retail trade activity generated through the distribution of a given product. The Inforum Iliad model and its associated databases were utilized to calculate retail and wholesale margins of focus industries. These margins serve as the 'direct output' of downstream analyses.
3. *Induced analysis* – This additional level of impact comes about through the earnings generated in the upstream or downstream industries. It represents the impact of consumer spending from the capital and labor earnings in these industries.

The analysis is done for 2016, and all results are in 2016 dollars. The impact analysis begins with the national output of each industry segment. In the first iteration, all supplier industries' output is calculated, using the input-output coefficients from the column of the matrix. Note that not all of the output of the focus industry goes to domestic suppliers. Some is supplied by imports, which are calculated in each iteration according to the average import share of that industry. Some of the output is paid out in value added. Both imports and value added can be thought of as leakages that reduce the total output required from domestic suppliers. In each subsequent iteration, the suppliers to the previous round of suppliers are calculated. Because of the leakages just described, the amount necessary to supply each further round becomes smaller and smaller. At some point, the additional supplier output is very small, and the process converges.

Associated with each round of direct and supplier (indirect) output are the employment, earnings and value added necessary to supply that output. When the solution has completed, the model shows the total direct, indirect, and induced effects, as well as detailed impacts by industry.

² See www.implan.com for more detailed descriptions of IMPLAN databases and models.

³ See <https://www.bea.gov/newsreleases/industry/io/ionewsrelease.htm>, and accompanying materials on the BEA website.

A.3 Methodology for the State-Level Analysis

The first step in preparing the state-level analysis was to derive shares of production by state for each of the producing industry segments and for the downstream wholesale and retail industries. National level *direct* production is then allocated to the state level using employment shares taken from the BLS *Census of Employment and Wages (CEW)*⁴, for both the upstream and the downstream analysis.

In order to calculate the indirect and induced impacts of production, we use the IMPLAN system. National industry relationships are converted to a regional level using region-specific information on trade flows, employment, and differences in the ratio of value added to output. This results in an input-output matrix which is more representative of the target state, metro area, or other defined region. When calculating indirect and induced impacts, IMPLAN makes use of *Regional Purchase Coefficients (RPC's)*. These RPC's measure the proportion of activity that is sourced from within the state or region which is the focus of the study. Products sourced from outside the state do not provide any indirect or induced spending impacts.

Upon purchasing an IMPLAN package, it is accessed via the web. For this project, we used the packages consisting of State Total Files. As mentioned above, national level direct output is shared to the states using BLS CEW data, to obtain the state-level direct output drivers. IMPLAN is then used to calculate indirect and induced output, employment, value added and earnings.

⁴ See BLS (2017) for more information on the CEW.