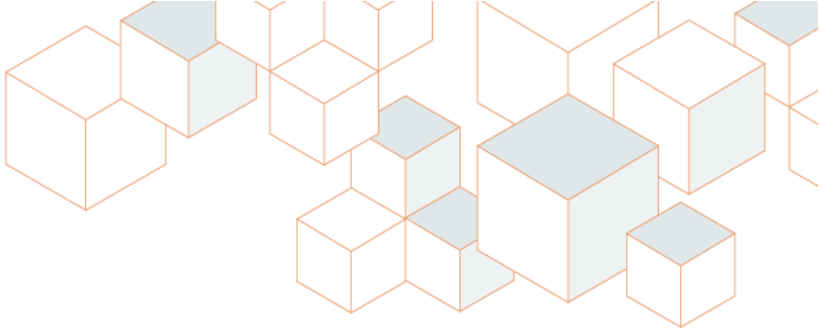

The Economic Benefits of the Pine Chemicals Industry

Economics & Statistics Department
American Chemistry Council
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Executive Summary

The pine chemical industry is one of the oldest segments of the US chemical industry and can be traced back to the Colonial times. The industry directly contributes to the US economy with $1.92 billion in shipments 19 states employing nearly 1,900 workers and a payroll of $93 million. In 2010, the pine chemical industry had exports worth $434 million and imports worth $151 million with a trade surplus of $283 million. The industry has maintained a trade surplus as far as historical records go back.

The contributions of the pine chemicals industry go well beyond its direct economic footprint. Looking upstream, the economic output of the pine chemicals industry fosters indirect economic activity through its purchases and through the payrolls paid by the industry itself and its suppliers. This in turn leads to induced economic output as well. As a result, each job in the pine chemicals industry generates an additional 9.0 jobs elsewhere in the US economy, and $4.4 billion in additional upstream output.

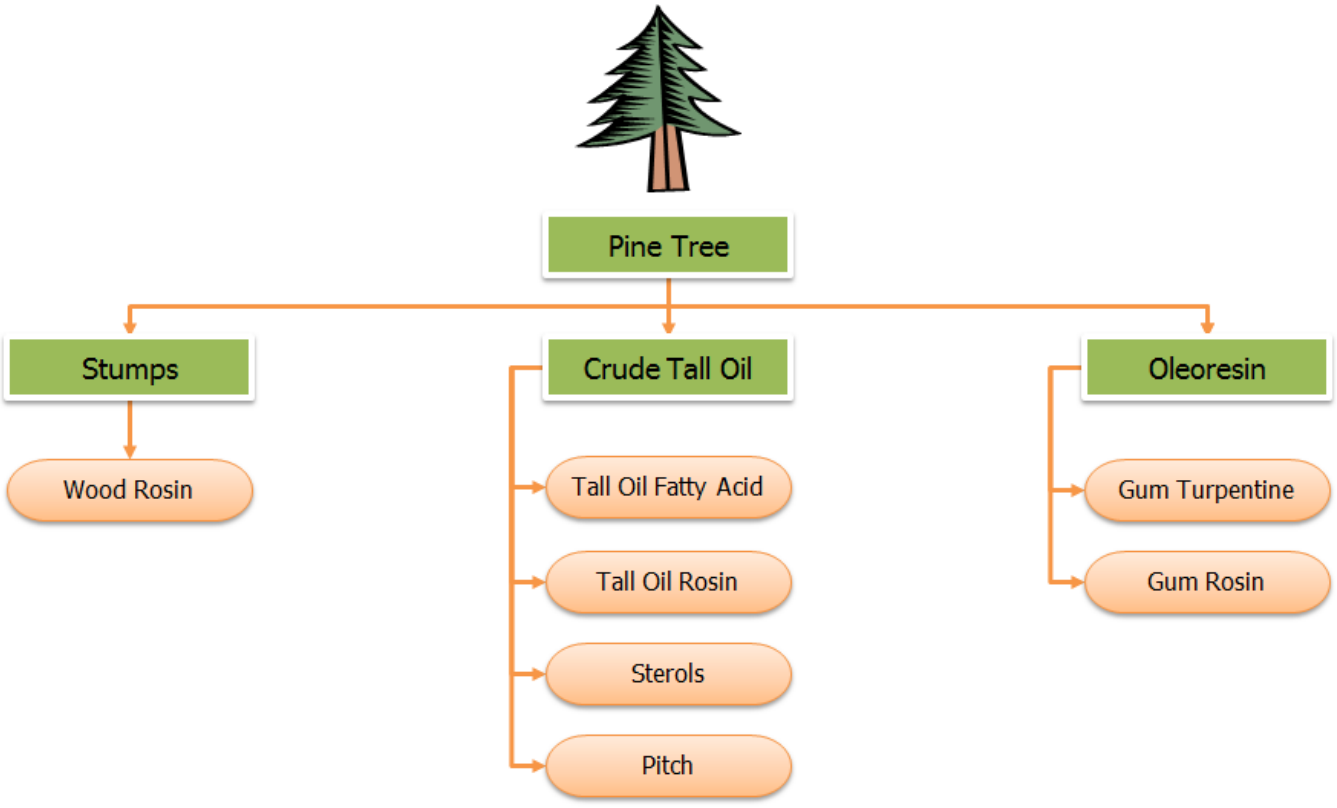
Moreover, the economic contributions of pine chemistry extend downstream too. Pine chemicals are an essential input in paints and coatings, adhesives and sealants, surfactants, printing ink, and other chemicals additives. In turn these products are used in construction, paper, cleaning products, printing and publishing and a variety of other industrial activity. The industry supports $11.2 billion in downstream economic output and 18,700 workers in “downstream” customer industries.

Sources: Bureau of the Census, Bureau of Labor Statistics, and American Chemistry Council

What are Pine Chemicals?

One of the oldest segments of the chemical industry, pine chemicals are a family of renewable, naturally occurring materials derived from the pine tree (genus Pinus). Pine trees originate from the northern hemisphere but are now found worldwide. Significant pine resources are found in the United States as well as Canada, Scandinavia, South America, and Asia. The first recorded use of pine pitch dates from the 4th through 2nd centuries B.C. in Greece, Asia Minor, and Egypt. Pine resins were also used as adhesives for construction purposes in the 4th century A.D. As navigation and seaborne trade grew in the Middle Ages so did the need for pine tars and pitches for caulking and weatherproofing the wooden hulls and rigging of sailing and other seagoing vessels. For this reason, pitch and turpentine are commonly-known crude products called naval stores. Other pine chemicals include tall oil, rosin, and various fatty acids. Many of these chemicals were initially developed in the 20th century.

Figure 1: Products of the Pine Chemicals Industry



Pine chemicals are derived from the distillation of oleoresin or carbonization of wood. These chemicals are largely obtained from three sources: 1) living trees; 2) dead pine stumps and logs; and 3) as by-products of sulfate (or Kraft) pulping. Most distilled products are made from gum, stumps, logs, and sulfate pulp by-products. Gum is obtained by scoring (or wounding) living trees and collecting the oleoresins. Turpentine is a volatile component of these oleoresins, and is separated via distillation. When stumps and logs are used, the oleoresin is extracted using solvents, and the turpentine is then distilled from the rosin with steam. Various

chemical processes including acidification, fractional distillation, and solvent extraction are subsequently used to refine and purify the different pine chemicals.

Most turpentine is now made as a by-product of sulfate pulping, where it is recovered during the initial steaming of the pulp with removal of relief gases. Turpentine is a minor product that is often sold to fractionators who convert the turpentine into its three major components: alpha-pinene, beta-pinene, and other terpenes. The refined turpentine is primarily sold for use as paint thinner or it is further refined. Major fractionated terpene derivatives and its uses include synthetic pine oil, beta-pinene resins, insecticides, and flavors and fragrances.

Tall oil is obtained by treating the black liquor skimming (a by-product of sulfate pulping) with acid. It is essentially a mixture of oleic and other unsaturated fatty acids and rosin acids. More than 90% of the tall oil produced is distilled or fractionated for upgrading to fatty acid, rosin, and tall-oil pitch. The latter contains rosin anhydrides, estolides, miscellaneous hydrocarbons, and distilled tall-oil heads. The remaining crude tall oil is refined with acid or sold as crude tall oil. In its modified forms as salts, esters, and adducts, rosin is used in a variety of industrial applications. Major uses include printing inks, paper sizing, and adhesives as well as chemical intermediates, rubber, and coatings.

Carbonized products are primarily charcoal and charcoal briquettes made by distilling or partially burning wood. For the purposes of this study, these carbonized products are not included in pine chemicals. Some by-products of carbonization, however, are produced and they include distilled wood turpentine, methanol, and acetic acid. At one time, carbonization was the sole source for methanol, which was commonly referred to as wood alcohol. Phenol and creosote are other products. Other chemical products include tannin used in tanning, essential oils, and medicinals. These carbonized products are not included within this analysis of pine chemicals. Activated carbon made from wood and used mainly for emissions control, however, is included as it is produced within pine chemical facilities.

The Pine Chemical Industry

As defined in the economic nomenclature, the pine chemicals industry is not a distinct industry. Rather, pine chemicals are included as part of several different industries. The primary industry is Gum and Wood Chemicals Manufacturing (NAICS 325191) which comprises establishments primarily engaged in (1) distilling wood or gum into products, such as tall oil and wood distillates, and (2) manufacturing wood or gum chemicals, such as naval stores, natural tanning materials, and related products. Pine chemicals are also captured within All Other Basic Organic Chemical Manufacturing (NAICS 325199). For the purposes of this analysis, carbonized products such as charcoal are not included within pine chemicals industry analysis.

Table 1
Trends in US Pine Chemicals: Shipments, Trade, Employment, and Other Indicators

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Shipments (million $)	$1,095	$1,040	$1,171	$1,272	$1,406	$1,492	$1,646	$1,719	$1,631	$1,756	$1,920
Capital Expenditures (million $)	$67	$44	$34	$27	$27	$32	$41	$57	$54	$46	$51
Price Index (2007=100)	65.2	68.0	69.5	69.8	70.0	75.0	87.1	100.0	110.0	106.0	115.3
Total Employment (thousands)	2,270	2,141	1,987	2,053	2,004	1,940	1,893	1,852	1,904	1,872	1,880
Average Hourly Wage - Production Workers ($)	$18.78	$18.24	$18.71	$19.84	$19.96	$21.99	$22.53	$21.71	$22.01	$22.89	$23.58
Exports (million $)	$344	$215	$176	$190	$211	$204	$222	$266	$366	$272	$434
Imports (million $)	$74	$83	$78	$82	$89	$99	$139	$132	$136	$110	$151
Trade Surplus (million $)	$269	$132	$98	$108	$122	$105	$84	$134	$230	$162	$283
Apparent Consumption (million $)	$826	$908	$1,073	$1,164	$1,284	$1,387	$1,562	$1,585	$1,401	$1,594	$1,637

Sources: Bureau of the Census, Bureau of Labor Statistics, and American Chemistry Council

Shipments and Inventories – Based on data from the Census Bureau, US shipments of pine chemicals were $1.92 billion in 2010. This is up from $1.10 billion in 2000. Shipments present the net selling values, f.o.b. or free on board plant to the customer (after any discounts or allowances and exclusive of freight and taxes), of all products shipped from an establishment. About 30% of the value of shipments is crude tall oil. Nearly 20% is rosin, with the remaining 50% coming from refined tall oil, tall oil derivatives, distillation products, and other miscellaneous pine chemicals.

Inventories typically average 1.4 times monthly shipments and for the industry as a whole averaged over $215 million during 2010. Finished goods inventories account for about 65% of the inventories on hand, and are followed by materials and supplies inventories (at 30%) with work-in-progress accounting for the remaining 5%.

The pine chemicals industry is a materials-intensive industry. Purchased raw materials represent 49% of the value of shipments. Fuel and power (including purchased electricity) is another important cost element, accounting for 4% while payroll accounts for 5% of the value of shipments. IT, communications, repair and maintenance, professional and technical, and other purchased services account for 8% of the value of shipments, with depreciation accounting for 3% and other expenses 6%.

Table 2
US Pine Chemical Facilities, Employment, and Payroll by State

State	Facilities	Employees
Alabama	1	38
Arkansas	1	196
Delaware	1	20
Florida	5	255
Georgia	3	478
Illinois	1	36
Kentucky	1	11
Louisiana	1	280
Maine	1	9
Mississippi	1	17
New Jersey	3	60
North Carolina	1	28
Ohio	1	27
Oklahoma	1	35
Oregon	1	24
Pennsylvania	1	28
South Carolina	1	286
Texas	1	16
Virginia	1	36
Total	27	1,880

Facilities – The pine chemicals industry in the United States is comprised of 27 production facilities in 19 states[1]. Most of these facilities, however, are small. Few employ more than 100 people. With five facilities, Florida has the most, followed by Georgia and New Jersey, with each having three facilities. Table 2 presents the number of facilities and employees by state[2].

Employment – Due to the capital-intensive nature of pine chemicals, the direct employment footprint is modest. In 2010, the pine chemicals industry employed 1,880 people at 27 production facilities in 19 states. In 2000, the industry employed 2,270 people. From Table 2 it is clear that Arkansas, Florida, Georgia, Louisiana and South Carolina have the largest number of pine chemicals employees.

Production workers account for 77% of the workforce. These include plant operators, repair and related occupations, as well as various trade and craft, and supervisors. Continuing improvement in the automation of production processes has been a leading contributor to an estimated 1.9% per year improvement in productivity from 2000 to 2010. Most plants in the pine chemistry industry are continuous in nature, often operating around the clock.

[1] Production facilities (also known as manufacturing establishments) can contain more than one production plant, or process unit.
[2] The data is derived from public sources.

Because of the highly technical nature of the industry's operations and products, technical services provided to customers are important factors. The pine chemicals industry employs chemical engineers, other engineers, chemists, other scientists, IT professionals, technicians, other technical support personnel, finance professionals, marketing and sales staff, and management.

Payroll – With 1,880 employees, the pine chemical industry has approximately a $93 million payroll. Payroll is equivalent to 5% of the value of shipments. As with employment, the overall impact of the industry's payroll is much larger.

The complex nature of pine chemistry requires certain skills, and trained and educated workers. In other areas, the need for chemists, chemical engineers, and other technically trained personnel continues to mount. In addition to salaries and wages reflecting occupational knowledge intensity, the business of chemistry can also provide benefits to its employees. These include legally mandated expenditures, and may include voluntary programs, including profit-sharing and other compensation, vacation and other leave, health and life insurance, stock purchase plans, pensions, 401-K contributions, and others. In addition to salaries and wages, these typically can add a third or more to the cost of compensation.

International Trade – Prior to the American Revolution, some pine chemicals were a leading export of the Southern colonies. This tradition has continued and in 2010 the industry exported $434 million in pine chemicals, equivalent to 24% of shipments. Depending upon the strength of the US dollar and overseas economies, the export share of shipments has ranged from 15% to 35%.

In 2010, the United States imported $151 million in pine chemicals, the equivalent of 10% of apparent consumption of pine chemistry. Apparent consumption is defined as shipments less exports plus imports. Depending upon the strength of the US dollar and the US economy, the import share of apparent consumption has ranged from 2% to 10%.

With exports of $434 million and imports of $151 million in 2010, the United States had a trade surplus in pine chemicals trade of $283 million. The industry has maintained a trade surplus as far as historical records go back[3]. This historic trade surplus can help offset trade deficits in other industries.

Capital Spending – In 2010, the pine chemicals industry invested $51 million in new plants and equipment, this is equivalent to about 3% of the value of shipments[4]. Depending upon the stage of the capital investment cycle, pine chemicals industry investment in new plants and equipment ranges from 2% to 6% of shipments. In recent years, depreciation has exceeded new capital investment across the industry.

Capital spending is largely comprised of machinery and equipment, which typically account for about 85% of the industry's capital investment. Capital expenditures for buildings and other structures account for the remaining 15%.

[3] US Census Bureau
[4] US Census Bureau

Somewhat capital-intensive, the gross value of depreciable assets is generally equivalent to about 85% of the value of industry shipments. The replacement value of these assets, however, is likely a multiple of shipments.

Upstream Pine Chemical Supplier Economic Impact

The economic contributions of the pine chemicals industry are numerous, though often overlooked in traditional analyses that consider only the direct jobs and output of the industry. In addition to the jobs created directly by the industry, additional jobs are supported by the pine chemicals industry and by the subsequent expenditure-induced activity. The pine chemical industry paid its employees' wages and salaries and purchased supplies and services (including transportation, contract workers, warehousing, maintenance, accounting, etc.). These supplier businesses, in turn, made purchases and paid their employees, thus the pine chemical industry generates several rounds of economic spending and re-spending.

In addition to the direct effects of the U.S. pine chemicals industry, the indirect and induced effects on other sectors of the economy can also be quantified. The economic impact of an industry is generally manifested through four channels:

- Direct impacts - such as the employment, output and fiscal contributions generated by the sector itself
- Indirect impacts - employment and output supported by the sector via purchases from its supply chain
- Induced impacts - employment and output supported by the spending of those employed directly or indirectly by the sector
- Spillover (or catalytic) impacts - the extent to which the activities of the relevant sector contribute to improved productivity and performance in other sectors of the economy

This report presents the economic contributions related to the first three channels. Spillover (or catalytic) effects do occur from pine chemistry, but these positive externalities are difficult to quantify and thus were not examined in the analysis.

To estimate the economic impacts from the U.S. pine chemicals industry, the IMPLAN[5] model was used. The IMPLAN model is an input-output model based on a social accounting matrix that incorporates all flows within an economy. The IMPLAN model includes detailed flow information for 440 industries. As a result, it is possible to estimate the economic impact of a change in final demand for an industry at a relatively fine level of granularity. For a single change in final demand (i.e., change in industry spending), IMPLAN can generate estimates of the direct, indirect and induced economic impacts. Direct impacts refer to the response of the economy to the change in the final demand of a given industry to those directly involved in the activity. Indirect impacts (or supplier impacts) refer to the response of the economy to the change in the final demand of the industries that are dependent on the direct spending industries for their input. Induced impacts refer to the response of the economy to changes in household expenditure as a result of labor income generated by the direct and indirect effects.

[5] MIG, Inc., IMPLAN System (data and software), 502 2nd Street, Suite 301, Hudson, WI 54016 www.implan.com

Table 3
Upstream Economic Impact of the Pine Chemicals Industry

Impact Type	Employment	Payroll ($ Million)	Output ($ Billion)
Direct	1,880	$92.9	$1.9
Indirect	8,846	$622.2	$3.2
Induced	8,150	$380.8	$1.2
Total	**18,875**	**$1,096.0**	**$6.3**

The output and employment generated by the pine chemicals industry is significant. The $1.9 billion industry directly generated 1,880 jobs and $92.9 million in payroll in 2010. But the full economic impact of the industry goes well beyond the direct jobs and output. Businesses in the pine chemicals industry purchase raw materials, services, and other products throughout the supply chain. Thus, an additional 8,846 indirect jobs are supported by US pine chemicals manufacturing. Finally, the wages earned by workers in the pine chemicals industry and throughout the supply chain are spent on household purchases and taxes generating an additional 8,150 payroll-induced jobs. All told, the $1.9 billion in pine chemicals output generates a total of $6.3 billion in output and 18,875 jobs with a payroll of nearly $1.1 billion.

Table 4 presents the upstream employment and payroll impacts for major pine chemicals producing states. For each individual state, the IMPLAN model estimates the economic impact *within* each state. As a result, the economic activity generated *outside* a particular state from the spending by the pine chemicals industry or from workers spending their earnings is not captured in the state-level analysis. For example, the pine chemicals industry in Florida may generate economic impact in Alabama. Those impacts are not captured in the estimates for Florida, but they are captured in the estimates for the US as a whole.

Table 4
Upstream Employment Impact of the Pine Chemicals Industry by State

	Direct	Indirect	Induced	Total
Arkansas	196	202	106	504
Florida	255	438	302	995
Georgia	478	726	530	1,734
Louisiana	280	593	341	1,214
New Jersey	60	162	93	315
South Carolina	286	819	538	1,643
Other States	325	518	375	1,218
Out of State[6]	n/a	5,388	5,866	11,253
Total US	1,880	8,846	8,150	18,875

[6] A portion of the output generated in each state is spent outside the state to purchase supplies, services, etc. In a similar fashion, a portion of a worker's payroll is spent outside the state.

Downstream Pine Chemical End-Use Markets Economic Impact

A large number of industries purchase products and services from pine chemistry industry and, therefore, directly depend upon the pine chemicals industry. In addition to the standard analysis using input-output analysis to trace relationships among supplier (or upstream) industries, we also examine customer (or downstream) industries that produce products that use pine chemicals as their raw material.

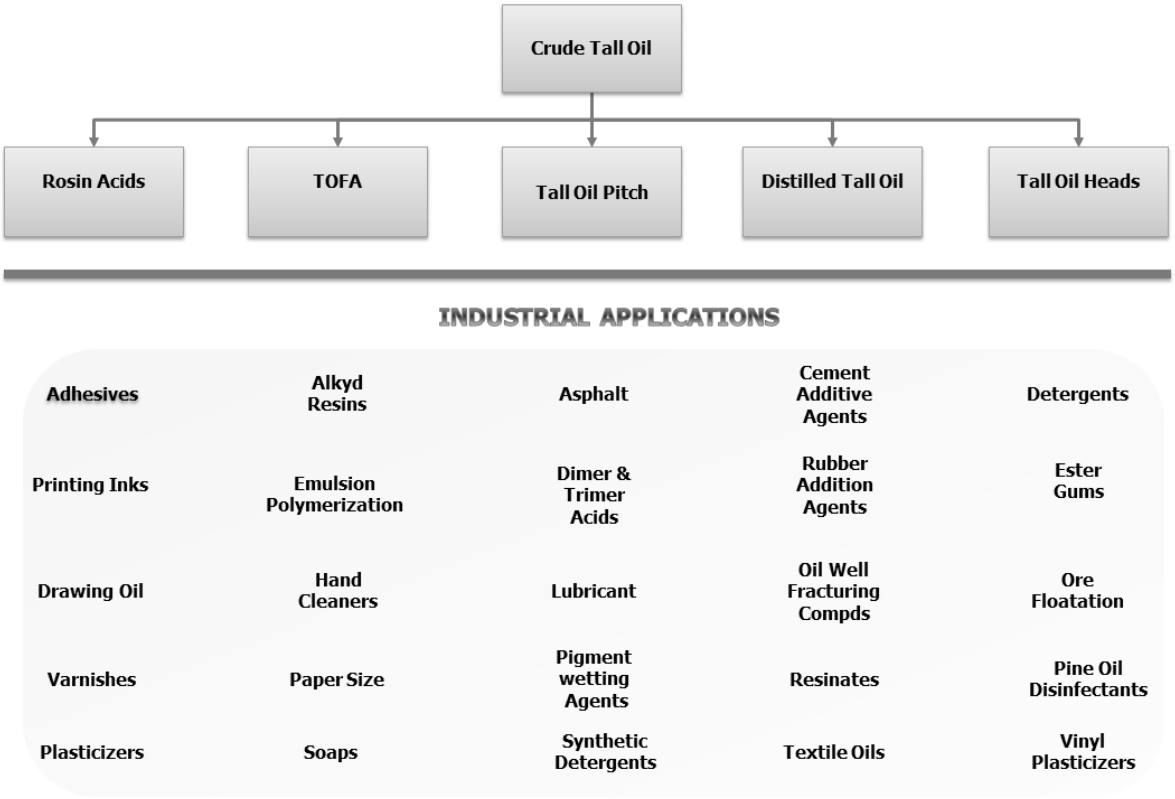
Table 5
Industries that use U.S. Pine Chemicals, 2010

Industry	Shipments ($ millions)	Employment (thousands)	Payroll ($ millions)	Value-Added ($ millions)
Pine Chemicals	**1,920**	**1,880**	**$93**	**$783**
Downstream Customers				
Paints & Coatings	$2,573	4,398	$273	$1,272
Adhesives & Sealants	$1,935	3,847	$254	$869
Surfactants	$1,579	831	$62	$396
Printing Ink	$1,248	2,744	$170	$534
Other Chemical Additives	$3,879	6,847	$451	$1,910
Total – Downstream Customers	**$11,213**	**18,666**	**$1,210**	**$4,981**
Multiplier - Downstream/Pine Chemicals	5.8	9.9	13.0	6.4

Primary end-use customers are manifold. Most notable is the paint and coatings industry where pine chemicals are used in alkyd paints and as curing additives. Adhesives and sealants represent another major end-use and there, pine chemicals are used in tape, bookbinding, non-wovens, electronics, and construction adhesive tackifiers and can-end sealants. Pine chemicals are also used in surfactants for detergents; primarily ethoxylates. Pine chemicals are also used in gravure, lithography, and flexography ink binders for magazines, packaging, and plastic bags. Finally, pine chemicals are used in a variety of chemical additives, including fuel; metalworking; lubricants and other additives; PVC stabilizers and plasticizers; flavor and fragrances; paper sizes; food additives; cosmetic additives; seed coatings; and other specialties.

Figure 3 illustrates some of the downstream industrial applications of pine chemicals. The economic activity associated with these downstream customer industries has been extensive. In 2010, pine chemicals supported an additional $11.2 billion in economic output, as well as an additional $5.0 billion in value-added contributions. These customers employ nearly 19,000 people whose payroll is $1.2 billion. Moreover, these direct customer industries supply products that are used in a wide variety of industries, including cosmetics and toiletries, paper, printing and publishing, food products, plastics products and others used in broad sectors of the economy, including building and construction, services, and others. Although challenging to measure, the support that pine chemicals provide to the broader US economy has been extensive.

Figure 3: Pine Chemicals: Downstream Industrial Applications



Conclusion

The analysis presented in this study by ACC describes the significant and extensive contributions of the pine chemical industry to the US economy. All told, the pine chemicals industry generated a total[7] of $6.3 billion in output, approximately 19,000 good jobs, and $1.1 billion in annual salaries and wages in 2010. Furthermore, the downstream customer industries supply products that are used in a wide variety of industries and broader sectors of the economy, including building and construction, among others. The analysis presented here illustrates the extensive role and support that pine chemicals have provided and can continue to provide the broad U.S. economy.

[7] "Total" represents the sum of direct, indirect, and induced (upstream) effects.

The Pine Chemicals Sector Group

The purpose of the American Chemistry Council (ACC) Pine Chemicals Sector Group is to promote and advance the interests of the pine chemicals sector (Sector). The Sector Group is established as a self-funded consortium within ACC's Chemical Products and Technology Division.

Members of the Pine Chemicals Sector Group:

- MeadWestvaco Corporation
- Arizona Chemical Company, LLC
- Georgia-Pacific Chemicals, LLC

Economics and Statistics Department

The Economics & Statistics Department provides a full range of statistical and economic advice and services for ACC and its members and other partners. The group works to improve overall ACC advocacy impact by providing statistics on American Chemistry as well as preparing information about the economic value and contributions of American Chemistry to our economy and society. They function as an in-house consultant, providing survey, economic analysis and other statistical expertise, as well as monitoring business conditions and changing industry dynamics. The group also offers extensive industry knowledge, a network of leading academic organizations and think tanks, and a dedication to making analysis relevant and comprehensible to a wide audience.

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