

2018 Economic Impact of the Aluminum Industry

Methodology and Documentation

Prepared for



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The Economic Impact of the Aluminum Industry: 2018

Executive Summary

The *2018 Economic Impact of the Aluminum Industry* estimates the economic contributions made by the aluminum industry to the U.S. economy in 2018. John Dunham & Associates (JDA) conducted this research, which was funded by the Aluminum Association (AA). This study uses standard econometric models first developed by the U.S. Forest Service, and now maintained by IMPLAN, Inc. Data came from industry sources, government publications, and Infogroup.

The aluminum industry is defined to include: Alumina refining; primary aluminum production; secondary aluminum production and alloying; manufacturing of aluminum sheet, plate, foil, extrusions, forgings, coatings, and powder; aluminum foundries; metals service centers, and wholesalers. The study measures the number of jobs in this industry, the wages paid to employees, total economic output, and federal and state business taxes generated. Not included in the study are aluminum fabricators and downstream production processes including welding and machining.

Industries are linked to each other when one industry buys from another to produce its own products. Each industry in turn makes purchases from a different mix of other industries, and so on. Employees in all industries extend the economic impact when they spend their earnings. Thus, economic activity started by the aluminum industry generates output (and jobs) in hundreds of other industries, often in sectors and states far removed from the original economic activity. The impact of supplier firms, and the “induced impact” of the re-spending by employees of industry and supplier firms, is calculated using an input/output model of the United States. The study calculates the impact on a national basis, by state, and by congressional district.

The study also estimates taxes paid by the industry and its employees. Federal taxes include industry-specific excise and sales taxes, business and personal income taxes, FICA, and unemployment insurance. Direct retail taxes include state and local sales taxes, license fees, and applicable gross receipt taxes. The aluminum industry pays real estate and personal property taxes, business income taxes, and other business levies that vary in each state and municipality. All entities engaged in business activity generated by the industry pay similar taxes.

The aluminum industry is a dynamic part of the U.S. economy, accounting for about **\$173.61 billion in total economic output** or roughly 0.88 percent of GDP.¹ Aluminum manufacturers and wholesalers directly employ 162,263 Americans in 2018. These workers earn over \$12.11 billion in wages and benefits. When supplier and induced impacts are taken into account, the aluminum industry is responsible for 692,398 jobs in the United States and \$44.42 billion in wages; as well as \$15.79 billion in direct federal, state and local taxes; not including state and local sales taxes imposed on aluminum products.

¹ Based on 2017 GDP of \$19.4 trillion. See: “Gross Domestic Product: Fourth Quarter and Annual 2017 (Second Estimate)” *Bureau of Economic Analysis*. March 7, 2018. Available at: <https://www.bea.gov/newsreleases/national/gdp/gdpnewsrelease.htm>

Summary Results

2018 Economic Impact of the Aluminum Industry measures the combined impact of the aluminum refining, processing, manufacturing, and wholesaling industry (hereafter the aluminum industry) in the United States. The industry is defined to include alumina refining; primary aluminum production; secondary aluminum production and alloying; manufacturing of aluminum sheet, plate, foil, extrusions, forgings, coatings, and powder; aluminum foundries; metals service centers, and wholesalers. The industry contributes about \$173.61 billion in total to the U.S. Economy, or 0.88 percent of GDP and impacts firms in nearly 520 sectors of the US economy through its production and distribution linkages.²

The manufacturing process, as defined in this study begins with converting mined bauxite into alumina, which is used to produce primary aluminum, as well as the processing of aluminum scrap to produce secondary aluminum. The aluminum can also be alloyed in primary or secondary processing plants. Then, through a variety of processes, aluminum is transformed into sheet, plate foil, extrusions, forgings, coatings, powder, and castings produced in foundries. Some facilities produce primary or secondary aluminum, while others manufacture aluminum products with aluminum purchased elsewhere. Together, 1,463 firms comprise the manufacturing sector of the aluminum industry, and these firms employ over 135,700 people.³

Aluminum products are further distributed by wholesalers and metals service centers. Metals service centers are *businesses that inventory and distribute metals for industrial customers and perform first-stage processing*.⁴ The aluminum industry is responsible for about 26,563 jobs at metals service centers and wholesalers.⁵

Other firms are related to the aluminum industry as suppliers. These firms produce and sell a broad range of items including machinery, tools, parts, molds, forms, and other materials needed to produce aluminum and aluminum products. In addition, supplier firms provide a broad range of services, including personnel services, financial services, advertising services, consulting services or transportation services. Finally, a number of people are employed in government enterprises responsible for the regulation of the aluminum industry. All told, we estimate that the aluminum industry is responsible for 234,834 supplier jobs. These firms generate about \$54.20 billion in economic activity.

An economic analysis of the aluminum industry will also take additional linkages into account. While it is inappropriate to claim that suppliers to the supplier firms are part of the industry being analyzed,⁶ the spending by employees of the industry, and those of supplier firms whose jobs are directly dependent on the aluminum industry, should be included. This spending on everything from housing, to food, to educational services and medical care makes up what is traditionally called the “induced impact” or multiplier effect of the aluminum industry. In other words, this spending, and the jobs it creates are induced by the manufacturing and distribution of aluminum and aluminum products. We estimate that the induced impact of the industry generates 295,301 jobs and \$48.43 billion in economic impact, for a multiplier of 0.68.⁷

² Economic sectors based on IMPLAN sectors.

³ Throughout this study, the term “firms” actually refers to physical locations. One aluminum company, for example, may have facilities in dozens of locations throughout the country. Each of these facilities is included in the 1,459 count.

⁴ “About Us,” *Metals Service Center Institute*. Available at: <https://www.msci.org/ABOUTUS.aspx>

⁵ Metals Service Centers are modeled differently in the 2016 analysis than in the 2018 and the 2013 models. In both 2018 and 2013 JDA had detailed information on metals service centers and these were modeled in the same manner as industry production facilities. In 2016, we relied on zip code based firm count and employment data supplied by Infogroup.

⁶ These firms would more appropriately be considered as part of the supplier firm’s industries.

⁷ Often economic impact studies present results with very large multipliers – as high as 4 or 5. These studies invariably include the firms supplying the supplier industries as part of the induced impact. John Dunham & Associates believes

An important part of an impact analysis is the calculation of the contribution of the industry to the public finances of the country. In the case of the aluminum industry, the traditional direct taxes paid by the firms and their employees provide \$15.79 billion in revenues to the federal, state and local governments. These figures do not include state and local sales taxes paid on aluminum products.

Table 1 below presents a summary of the total economic impact of the industry in the United States. Summary tables for each state are included in the Output Model, which is discussed in the following section.

Table 1 – Economic Contribution of the Aluminum Industry

	Direct	Supplier	Induced	Total
Jobs (FTE)	162,263	234,834	295,301	692,398
Wages	\$12,109,685,800	\$17,063,515,100	\$15,242,576,600	\$44,415,777,500
Economic Impact	\$70,990,404,600	\$54,197,064,400	\$48,426,713,300	\$173,614,182,300
Taxes				\$15,785,074,400

Output Model

John Dunham & Associates produced the Economic Impact study for the Aluminum Association (AA). The analysis consists of a number of parts, each of which will be described in the following sections of this document. These include data, models, calculations and outputs. These components were joined together into an interactive system that allows AA to examine the links between the various parts of the industry and to produce detailed output documents on an as-needed basis. As such, there is no book – no thick report – outlining the impact of the industry, but rather a system of models and equations that can be continuously queried and updated.

Economic Impact Modeling – Summary

The Economic Impact Study begins with an accounting of the direct employment in the domestic manufacture and wholesaling of aluminum and aluminum products. The data come from a variety of government and private sources.

It is sometimes mistakenly thought that initial spending accounts for all of the impact of an economic activity or a product. For example, at first glance it may appear that consumer expenditures for a product are the sum total of the impact on the local economy. However, one economic activity always leads to a ripple effect whereby other sectors and industries benefit from this initial spending. This inter-industry effect of an economic activity can be assessed using multipliers from regional input-output modeling.

The economic activities of events are linked to other industries in the state and national economies. The activities required to manufacture aluminum products generate the direct effects on the economy. Regional (or indirect) impacts occur when these activities require purchases of goods and services such as machinery or electricity from local or regional suppliers. Additional induced impacts occur when workers involved in direct and indirect activities spend their wages. The ratio between induced output and direct output is termed the multiplier.

This method of analysis allows the impact of local production activities to be quantified in terms of final demand, earnings, and employment in the states and the nation as a whole.

that this is not an appropriate definition of the induced impact and as such limits this calculation to only the effect of spending by direct and supplier employees.

Once the direct impact of the industry has been calculated, the input-output methodology discussed below is used to calculate the contribution of the supplier sector and of the re-spending in the economy by employees in the industry and its suppliers. This induced impact is the most controversial part of economic impact studies and is often quite inflated. In the case of the AA model, only the most conservative estimate of the induced impact has been used.

Model Description and Data

This analysis is based on data provided by Infogroup, the Aluminum Association, and the federal government. The analysis utilizes the IMPLAN Inc. model in order to quantify the economic impact of the aluminum industry on the economy of the United States.⁸ The model adopts an accounting framework through which the relationships between different inputs and outputs across industries and sectors are computed. This model can show the impact of a given economic decision – such as a factory opening or operating a sports facility – on a pre-defined, geographic region. It is based on the national income accounts generated by the US Department of Commerce, Bureau of Economic Analysis (BEA).⁹

Every economic impact analysis begins with a description of the industry being examined. In the case of the AA model, the aluminum industry is defined as the manufacturing and wholesaling of a wide range of aluminum and aluminum products.

The IMPLAN model is designed to run based on the input of specific direct economic factors. It uses a detailed methodology (see IMPLAN Methodology section) to generate estimates of the other direct impacts, tax impacts and supplier and induced impacts based on these entries. In the case of the AA Economic Impact Model, direct employment in the aluminum industry is the starting point for the analysis. Direct employment is based on data provided to John Dunham & Associates by Infogroup as of December 2017; and from industry data provided by AA. Infogroup data is recognized nationally as a premier source of micro industry data. This data is gathered at the facility level; therefore, a company with a manufacturing plant, warehouse and sales office would have three facilities, each with separate employment counts. Since the Infogroup data are adjusted on a continual basis, staff from John Dunham & Associates scanned the data for discrepancies. This year, for the first time, the Aluminum Association conducted a short survey of members in order to obtain facility level job counts. Member provided data is given first priority in assigning jobs to a facility, followed by Infogroup data; for facilities where neither source has employment information, median job counts are used (based on industry and state data) to fill in gaps. Employment data for metals service centers is based on the 2017 economic impact of the Metals Industry conducted by John Dunham & Associates.

Once the initial direct employment figures have been established, they are entered into a model linked to the IMPLAN database. The IMPLAN data are used to generate estimates of direct wages and output. Wages are derived from data from the U.S. Department of Labor's ES-202 reports that are used by IMPLAN to provide annual average wage and salary establishment counts, employment counts and payrolls at the county level. Since this data only covers payroll employees, it is modified to add information on independent workers, agricultural employees, construction workers, and certain government employees. Data are then adjusted to account for counties where non-disclosure rules apply. Wage data include not only cash wages, but health and life insurance payments, retirement payments and other non-cash compensation. It includes all income paid to workers by employers.

⁸ The model uses 2016 input/output accounts.

⁹ RIMS II is a product developed by the U.S. Department of Commerce, Bureau of Economic Analysis as a policy and economic decision analysis tool. IMPLAN was originally developed by the US Forest Service, the Federal Emergency Management Agency and the Bureau of Land Management. It was converted to a user-friendly model by the Minnesota IMPLAN Group in 1993.

Total output is the value of production by industry in a given state. It is estimated by IMPLAN from sources similar to those used by the BEA in its RIMS II series. Where no Census or government surveys are available, IMPLAN uses models such as the Bureau of Labor Statistics' growth model to estimate the missing output.

The model also includes information on income received by the Federal, state and local governments, and produces estimates for the following taxes at the Federal level: Corporate income; payroll, personal income, estate and gift, and excise taxes, customs duties; and fines, fees, etc. State and local tax revenues include estimates of: Corporate profits, property, sales, severance, estate and gift and personal income taxes; licenses and fees and certain payroll taxes.

While IMPLAN is used to calculate the state level impacts, Infogroup data provide the basis for Congressional district level estimates. Publicly available data at the county and Congressional district level is limited by disclosure restrictions, especially for smaller sectors of the economy. Our model therefore uses actual physical location data provided by Infogroup in order to allocate jobs – and the resulting economic activity – by physical address or when that is not available, zip code. For zips entirely contained in a single congressional district, jobs are allocated based on the percentage of total sector jobs in each zip. For zips that are broken by congressional districts, allocations are based on the percentage of total jobs physically located in each segment of the zip. Physical locations are based on either actual address of the facility, or the zip code of the facility, with facilities placed randomly throughout the zip code area. All supplier and indirect jobs are allocated based on the percentage of a state's employment in that sector in each of the districts. Again, these percentages are based on Infogroup data.

Data and Modeling Considerations When Comparing 2018 with Earlier Studies

The models developed by JDA for the Aluminum Association in 2013 and 2016 are based on the same methodology and generally similar data as that constructed for 2018. Over time, additional data has become available and JDA has refined its data classification policies. In addition, there are some modeling differences between each year's model that can lead to inconsistencies when the data are compared to each other.

1. In both 2018 and 2013, JDA had access to detailed locational data on metals service centers. These data were not available in 2016, therefore, the locations of metals service centers were modeled based on data from Infogroup at the zip code level. The number of centers and employment was assumed to be evenly distributed across the physical area of each zip code.
2. In 2018, a more detailed census of Aluminum Association members identified a number of specific firms and locations that had previously been modeled as aluminum manufacturers, but which were better categorized as downstream manufacturers and fabricators. In all, 39 of these firms were identified and removed. Table 2 presents the job trends by industry, from 2013 to present. It also presents revised estimates of 2013 and 2016 numbers to give a better representation of the trends underlying the industry.
3. Each of the Aluminum Association Economic Impact Studies has been conducted using a different year's IMPLAN model – the 2013 study used 2012 IMPLAN data, the 2016 model relied on 2014 data, and the most recent relies on 2016 data (the latest available at the time the model was constructed). Each year's model has different multipliers associated with it, reflecting the realities of the general economy at that point in time. This leads to variability in supplier and induced jobs. In particular, the 2014 data tables were restructured to include nearly 100 more

economic sectors than the 2012 tables.

4. In addition to these modeling changes, JDA switched data providers from Dun & Bradstreet to Infogroup. While there are good and bad attributes to both of these data sets, and we firmly believe that the Infogroup data are as good if not more accurate than D&B, there will be differences in definitional and collection techniques that could be reflected in the final job numbers.

Table 2 – Aluminum Industry Employment by Sector: 2013R, 2016R, and 2018 Models

	2013 (revised)	2016 (revised)	growth 2013 - 2016	2018 (final)	growth 2016 - 2018	growth 2013 - 2018
Primary	12,787	4,879	-61.8%	4,192	-14.1%	-67.2%
Secondary	9,428	9,507	0.8%	10,412	9.5%	10.4%
Sheet+Extrusions	61,806	62,327	0.8%	64,306	3.2%	4.0%
Foundry	36,484	42,117	15.4%	42,614	1.2%	16.8%
Forging	10,328	10,462	1.3%	10,888	4.1%	5.4%
Coating	2,814	3,132	11.3%	3,288	5.0%	16.8%
MSC	23,142	24,631	6.4%	26,563	7.8%	14.8%
Total Direct	156,789	157,054	0.2%	162,263	3.3%	3.5%

The 2018 Aluminum Association model reflects the best data and modeling techniques available now and should provide a very accurate measure of the economic foot print of the industry today. Any errors are unintentional and are strictly those of John Dunham & Associates and should not reflect on the quality of data provided by the Aluminum Association.

IMPLAN Methodology¹⁰

Francoise Quesnay one of the fathers of modern economics, first developed the analytical concept of inter-industry relationships in 1758. The concept was actualized into input-output analysis by Wassily Leontief during the Second World War, an accomplishment for which he received the 1973 Nobel Prize in Economics.

Input-Output analysis is an econometric technique used to examine the relationships within an economy.

It captures all monetary market transactions for consumption in a given period and for a specific geography. The IMPLAN model uses data from many different sources – as published government data series, unpublished data, sets of relationships, ratios, or as estimates. The Minnesota IMPLAN group gathers this data, converts it into a consistent format, and estimates the missing components.

There are three different levels of data generally available in the United States: Federal, state and county.

Most of the detailed data are available at the county level, but there are many issues with disclosure – especially in the case of smaller industries. IMPLAN overcomes these disclosure problems by combining a large number of datasets and by estimating those variables that are not found from any of them. The data is then converted into national input-output matrices (Use, Make, By-products, Absorption and Market Shares) as well as national tables for deflators, regional purchase coefficients and margins.

The IMPLAN Make matrix represents the production of commodities by industry. The Bureau of Economic Analysis (BEA) Benchmark I/O Study of the US Make Table forms the bases of the IMPLAN

¹⁰ This section is paraphrased from IMPLAN Professional: Users Guide, Analysis Guide, Data Guide, Version 2.0, MIG, Inc., June 2000.

model. The Benchmark Make Table is updated to current year prices, and rearranged into the IMPLAN sector format. The IMPLAN Use matrix is based on estimates of final demand, value-added by sector and total industry and commodity output data as provided by government statistics or estimated by IMPLAN. The BEA Benchmark Use Table is then bridged to the IMPLAN sectors. Once the re-sectoring is complete, the Use Tables can be updated based on the other data and model calculations of interstate and international trade.

In the IMPLAN model, as with any input-output framework, all expenditures are in terms of producer prices. This allocates all expenditures to the industries that produce goods and services. As a result, all data not received in producer prices is converted using margins which are derived from the BEA Input-Output model. Margins represent the difference between producer and consumer prices. As such, the margins for any good add to one. If, for example, 10 percent of the consumer price of sheet metal is from the purchase of aluminum, then the aluminum margin would be 0.1.

Deflators, which account for relative price changes during different time periods, are derived from the Bureau of Labor Statistics (BLS) Growth Model. The 224 sector BLS model is mapped to the 536 sectors of the IMPLAN model. Where data are missing, deflators from BEA's Survey of Current Businesses are used.

Finally, the Regional Purchase Coefficients (RPCs) – essential to the IMPLAN model – must be derived. IMPLAN is derived from a national model, which represents the “average” condition for a particular industry. Since national production functions do not necessarily represent particular regional differences, adjustments need to be made. Regional trade flows are estimated based on the Multi-Regional Input-Output Accounts, a cross-sectional database with consistent cross interstate trade flows developed in 1977. These data are updated and bridged to the 536 sector IMPLAN model.

Once the databases and matrices are created, they go through an extensive validation process. IMPLAN builds separate state and county models and evaluates them, checking to ensure that no ratios are outside of recognized bounds. The final datasets and matrices are not released before extensive testing takes place.