2016 Economic Impact of the Aluminum Industry

Methodology and Documentation

Prepared for

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The Economic Impact of the Aluminum Industry: 2016

Executive Summary

The *2016 Economic Impact of the Aluminum Industry* estimates the economic contributions made by the aluminum industry to the U.S. economy in 2016. John Dunham & Associates (JDA) conducted this research, which was funded by the Aluminum Association (AA). This work uses standard econometric models first developed by the U.S. Forest Service, and now maintained by IMPLAN Group, LLC. Data came from industry sources, government publications, and Dun & Bradstreet, Inc.

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 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 **$186.16 billion in total economic output** or roughly 1.02 percent of GDP.[1] Aluminum manufacturers and wholesalers directly employed 160,888 Americans in 2016. These workers earned over $12.11 billion in wages and benefits. When supplier and induced impacts are taken into account, the aluminum industry is responsible for 712,904 jobs in the United States and $45.87 billion in wages; as well as $18.57 billion in direct federal, state and local taxes; not including state and local sales taxes imposed on aluminum products.

[1] Based on 2015 GDP of $18.2 trillion. See: "Gross Domestic Product: Fourth Quarter and Annual 2015 (Third Estimate)" *Bureau of Economic Analysis.* March 25, 2016. Available at: https://www.bea.gov/newsreleases/national/gdp/gdpnewsrelease.htm

Summary Results

The Aluminum Industry Economic Impact Study 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 $186.16 billion in total to the U.S. Economy, or 1.02 percent of GDP and, through its production and distribution linkages, impacts firms in 514 sectors of the US economy.[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, 1,455 firms comprise the manufacturing sector of the aluminum industry, and these firms employ over 136,255 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 over 24,633 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 260,557 supplier jobs. These firms generate about $62.50 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

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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 1,455 count.

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

5 Metals Service Centers are modeled differently in this analysis when compared to the 2013 model. In 2013 JDA had detailed information on metals service centers and these were modeled in the same manner as industry production facilities. In 2016, we have relied on zip code based firm count and employment data supplied to JDA by Infogroup, the leading provider of business and consumer data for the top search engines and leading in-car navigation systems in North America. Infogroup gathers data from a variety of sources, by sourcing, refining, matching, appending, filtering, and delivering the best quality data. The data is then verified at the rate of almost 100,000 phone calls per day to ensure absolute accuracy.

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

induced impact of the industry generates 291,459 jobs and $48.57 billion in economic impact, for a multiplier of 0.65.[7]

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 $18.57 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)	160,888	260,557	291,459	712,904
Wages	$12,105,994,500	$18,679,386,600	$15,085,209,100	$45,870,590,200
Economic Impact	$75,083,608,300	$62,503,284,800	$48,570,732,300	$186,157,625,400
Taxes				$18,565,490,700

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.

[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 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.

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.

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 Dun & Bradstreet, Inc. (D&B, Inc.), Infogroup, the Aluminum Association, and the federal government. The analysis utilizes IMPLAN Group, LLC's 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 Group 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 a base starting point for the analysis. Direct employment is based on data provided to John Dunham & Associates by D&B, Inc. as of January 2016; and from industry data provided by AA. D&B data is recognized nationally as a premier source of micro industry data. The D&B database contains information on over 17 million businesses in the United States.[10] It is used extensively for credit reporting, and according to the vendor, encompasses about 98 percent of all business enterprises in the country. 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 D&B data are adjusted on a continual basis, staff from John Dunham & Associates scanned the data for discrepancies. In addition, for cases where employment data for AA member firms were available, D&B employment figures were replaced with those from AA. . Employment data for metals service centers come from Infogroup, the leading provider of business and consumer data for the top search engines and leading in-car navigation systems in North America. Infogroup gathers data from a variety of sources, by sourcing, refining, matching, appending, filtering, and delivering the best quality data. The data is then verified at the rate of almost 100,000 phone calls per day to ensure absolute accuracy.

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8 The model uses 2014 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.

10 The D&B information database updates over 1 million times a day, over 350 million payment experiences are processed annually, and over 110 million phone calls are made to businesses. In addition, D&B uses a patented matching technology and over 2,000 information computer validations to ensure a high standard of data quality.

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.

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.

Differences between the 2013 and 2016 Aluminum Association Models

The models developed by JDA for the Alumium Association in 2013 and 2016 are based on the same methodology and generally similar data. There have been some adjustments to account for data availability and learnings between the two different studies.

First, in 2013, JDA had access to detailed 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.

Second, in working with staff at AA, JDA discovered that a number of individual facilities that had been modeled as secondary production and alloying were in-fact engaged in primary aluminum production and other secondary processing activities. These 6 firms have been reallocated in the 2016 model accounting for a difference of 3,835 jobs between these sectors. Table 2 on the following page details the job count by sector for the two models. The 2013 revised column reflects the change to the 2013 job counts that would be expected from attributing the six production locations to the correct aluminum sector.

Table 2 – Aluminum Industry Employment by Sector, 2013 (Revised) and 2016 Models

	Jobs 2016	Jobs 2013	Jobs Change	Output 2016	Output 2013	Output Change
Alumina Refining/Primary Aluminum	5,379	12,787	(7,408)	$4,477,358,200	$7,138,035,472	($2,660,677,272)
Secondary Production/Alloying	11,747	11,538	209	$11,109,387,000	$9,404,145,137	$1,705,241,863
Sheet, Plate, Foil, Extrusions, Coatings	67,155	62,465	4,690	$38,028,464,400	$34,153,159,464	$3,875,304,936
Foundries	41,552	36,484	5,068	$10,176,795,700	$7,193,039,581	$2,983,756,119
Forgings	10,422	10,328	94	$5,205,421,800	$2,840,436,050	$2,364,985,750
Metal Service Centers	24,633	23,142	1,491	$6,086,181,200	$3,797,773,733	$2,288,407,467
Direct	160,888	156,744	4,144	$75,083,608,300	$64,526,589,437	$10,557,018,863
Supplier	260,557	200,415	60,142	$62,503,284,800	$41,037,056,263	$21,466,228,537
Induced	291,459	320,784	(29,325)	$48,570,732,300	$47,093,872,731	$1,476,859,569
Total	712,904	677,944	34,960	$186,157,625,400	$152,657,518,431	$33,500,106,969

Finally, the 2016 AA Impact Model uses the 2014 IMPLAN input-output accounts (the latest currently available). This differs from the 2013 study which relied on the 2012 tables. Estimates for supplier and induced activities in the 2012 tables were extremely modest, reflecting the economic weakness at that time. Since then, there has been some recovery in economic activity, and the supplier and induced linkages for not only the aluminum industry but for all industries are significantly larger than in 2012. This is reflected in the growth in both the supplier and induced contributions calculated in this model.

IMPLAN Methodology[11]

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 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.

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

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.