2022 Economic Impact of the Aluminum Industry

Methodology and Documentation

Prepared for

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March 2022

The Economic Impact of the Aluminum Industry: 2022

Executive Summary

The *2022 Economic Impact of the Aluminum Industry* estimates the economic contributions made by the aluminum industry to the U.S. economy in 2022. 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 Data Axle.

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; and 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 **$176.32 billion in total economic output** or roughly 0.73 percent of GDP.[1] Aluminum manufacturers and wholesalers directly employ 164,402 Americans in 2022. These workers earn over $13.55 billion in wages and benefits. When supplier and induced impacts are taken into account, the aluminum industry is responsible for 634,419 jobs in the United States and $47.10 billion in wages; as well as $14.97 billion in direct federal, state and local taxes; not including state and local sales taxes imposed on aluminum products.

[1] Based on 2021 GDP of $24.0 trillion. See: U.S. Bureau of Economic Analysis, Gross Domestic Product [GDP], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/GDP, March 17, 2022.

Summary Results

The *2022 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; and metals service centers and wholesalers. The industry contributes about $176.32 billion in total to the U.S. Economy, or 0.73 percent of GDP and impacts firms in 523 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, 1,344 firms comprise the manufacturing sector of the aluminum industry, and these firms employ over 139,487 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 24,915 jobs at metals service centers and wholesalers.

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 225,236 supplier jobs. These firms generate about $57.39 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,[5] 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 244,781 jobs and $45.66 billion in economic impact, for a multiplier of 0.62.

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

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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 1,344 count.

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

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

and their employees provide $14.97 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)	164,402	225,236	244,781	634,419
Wages	$13,547,560,600	$18,379,530,800	$15,171,734,500	$47,098,825,900
Economic Impact	$73,278,990,100	$57,385,183,000	$45,658,460,400	$176,322,633,500
Taxes				$14,966,864,600

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. Supplier (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.

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 Data Axle, 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.[6] 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).[7]

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 Data Axle as of January 2022; and from industry data provided by AA. Data Axle 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 Data Axle data are adjusted on a continual basis, staff from John Dunham & Associates scanned the data for discrepancies. Member provided data is given first priority in assigning jobs to a facility, followed by Data Axle 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 estimated by applying the percentage of wholesale sales attributable to aluminum products to the wholesale jobs: In such a way, if ten percent of wholesale sales for a certain type of wholesaler are due to the storage and distribution of aluminum products, we assume ten percent of jobs are likewise dependent on aluminum. This is done to Data Axle jobs data at the zip code level, and is then aggregated into the states and congressional districts.

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

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6 The model uses 2018 input/output accounts.

7 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.

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, Data Axle 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 Data Axle in order to allocate jobs – and the resulting economic activity – by physical address or when that is not available, zip code. For zip codes entirely contained in a single congressional district, jobs are allocated based on the percentage of total sector jobs in each zip code. For zip codes 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 Data Axle data.

Data and Modeling Considerations When Comparing 2022 with Earlier Studies

The models developed by JDA for the Aluminum Association in 2013, 2016 and 2018 are based on the same methodology and generally similar data as that constructed for 2022. 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 2018 and 2013, JDA had access to detailed locational data on metals service centers. These data were not available in 2016, 2020 and 2022, therefore, the locations of metals service centers were modeled based on data from Data Axle 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 2020, several locations were identified that had been included in the 2018 study, which should not have been. This includes primary facilities, such as Alcoa plants in Wenatchee/Malaga, WA and Point Comfort, TX. Additionally, some facilities were identified that are better classified as suppliers to the industry, such as FMC Lithium and Chemetall.

3. JDA has accumulated much more detailed information on foundries over the past couple years. Specifically, a number of relatively large "captive" foundries have been included beginning with the 2020 study. In years prior, these locations were often overlooked, as they often are identified in databases under their manufacturing category (i.e., auto manufacturing, auto parts manufacturing, etc).

4. 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, the 2018 model used 2016 data, the 2020 model used 2018 IMPLAN, and the

2022 model uses 2020 IMPLAN (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.

5. In addition to these modeling changes, JDA switched data providers from Dun & Bradstreet to Infogroup/Data Axle. While there are good and bad attributes to both of these data sets, and we firmly believe that the Data Axle 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.

6. The 2022 model uses the brand new 2020 IMPLAN model. The taxes in the 2020 model are significantly impacted by support and transfer payments in response to the COVID impact of 2020. Generally, this means the ratio of taxes to jobs and output are significantly lower than the prior few models.[8]

Table 2 – Aluminum Industry Employment by Sector: 2013-2022 Models

	2013 (revised)	2016 (revised)	2018 (revised)	2020	2022	Trend 2020-2022	Trend 2013 - 2022
Primary	12,787	4,879	3,131	4,829	4,367	-9.57%	-65.85%
Secondary	9,428	9,507	9,412	8,691	9,329	7.34%	-1.05%
Sheet+Extrusions	61,806	62,327	63,757	62,883	63,895	1.61%	3.38%
Foundry*	45,234	50,867	51,364	50,551	49,706	-1.67%	9.89%
Forging	10,328	10,462	10,888	10,464	9,362	-10.53%	-9.35%
Coating	2,814	3,132	2,838	2,664	2,828	6.16%	0.50%
MSC	23,142	24,631	26,563	26,146	24,915	-4.71%	7.66%
Total Direct	165,539	165,804	167,953	166,228	164,402	-1.10%	-0.69%

* 2013-2016 revisd estimates include addition of 8,750 jobs, representing the foundries missed in prior studies (largely captive).

The 2022 Aluminum Association model reflects the best data and modeling techniques available now and should provide a very accurate measure of the economic footprint 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 Methodology[9]

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.

8 For the 2022 tax impact, the overall level of taxes on production and imports (TOPI) are derived from the 2020 IMPLAN model. However, TOPI is then split into individual tax categories using breaks consistent with the 2018 IMPLAN model, due to some distortionary effects resulting from COVID transfers.

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

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.

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 546 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 546 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.