



Economic Contribution of the U.S. Lead Battery Industry



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January 2018

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EXECUTIVE SUMMARY

Lead batteries are essential to everyday life, and with a recycling rate of 99 percent, they are the most recycled consumer product in the United States. A new lead battery consists of 80 percent recycled material, and nearly 75 percent of its lead comes from recycling. Lead battery manufacturers and recyclers contribute to the U.S. economy in three ways:

1. When battery manufacturing and recycling companies employ workers and generate business income. These represent **direct impacts**.
2. When battery manufacturing and recycling companies purchase goods and services from recyclers, manufacturers and other suppliers. These represent **supplier impacts**.
3. When workers at battery manufacturing and recycling companies, and workers at supplier companies spend their after-tax income on consumer goods. These represent **worker spending impacts**.

Workers in the lead battery industry hold a variety of occupations, many of which are accessible to those who have only a high school diploma. The industry directly employs 20,550 workers, spends \$1.4 billion annually on payroll and generates \$11.6 billion in output, or business sales. The average, per-worker salary among lead mining and recycling companies is \$83,606; the average, per-worker salary among lead battery manufacturers is \$62,343. These salaries exceed those in several other private industry sectors including the service sector, construction and agriculture.

In addition to the workers the U.S. lead battery industry directly employs, it supports 35,860 supplier jobs in a variety of industries and 38,320 jobs from worker spending, also in a variety of industries, with the service sector benefiting the most.

Together these impacts total nearly 95,000 jobs. Beyond its job impact, the lead battery industry annually supports nearly

- \$6 billion in labor income;
- \$11.2 billion in gross domestic product (GDP);
- \$28.5 billion in output or overall economic impact in 2016; and
- \$2.5 billion in government revenue.

These impacts represent the lead battery's contribution to the U.S. economy.¹

¹ Gross Domestic Product (GDP) represents the total value of goods produced by the U.S. lead battery industry. Output represents total sales made by the U.S. lead battery industry. GDP is smaller than output because it excludes payroll, profits and the cost of supplies. Payroll is a subset of GDP and GDP is a subset of output. Therefore, these figures should not be combined.

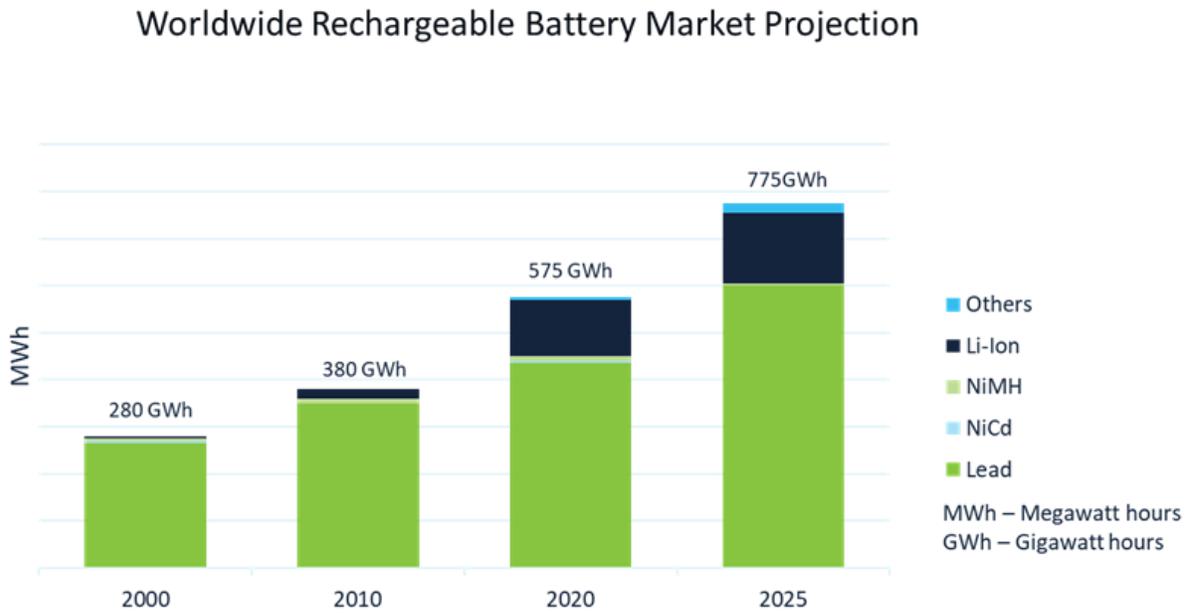
INTRODUCTION

Lead batteries are among the world's safest and most reliable sources of energy. Whether starting a car, storing power from a solar panel or powering a communications tower, lead batteries provide essential energy every moment of each day to millions of people around the globe. Lead batteries are also among the most environmentally sustainable manufactured products, with a recycling rate of 99 percent. The industry, built on 150 years of proven and progressive technology, operates on environmentally sound principles, provides a growing base of meaningful employment and contributes to the economic development of the communities in which its products are made. The lead battery industry is a vital contributor to our global energy needs and to the development of essential energy.

LEAD BATTERY RECYCLING

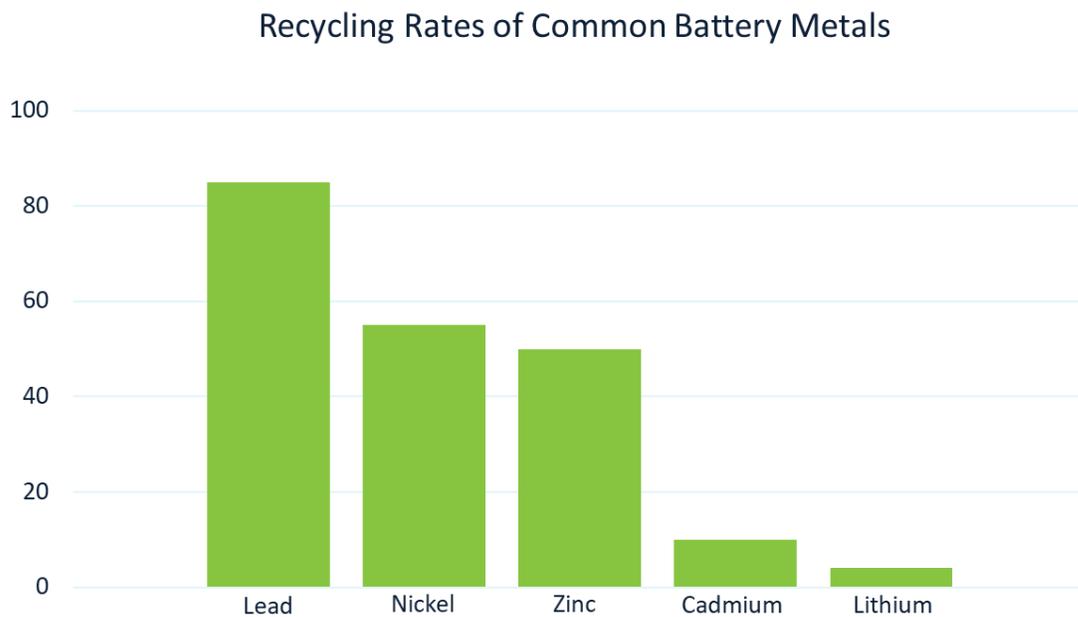
Rechargeable batteries are needed now more than ever to meet the energy demands of the growing U.S. and world populations (Figure 1). Unfortunately, many rechargeable batteries are not recycled profitably (and therefore hardly recycled at all) because the price of recycled materials is higher than the price of virgin materials. The exception is lead batteries. Lead battery manufacturing is the most environmentally sustainable of all battery technologies (Figure 2). In addition, at a rate of 99 percent, lead batteries are the most recycled consumer product in the U.S. (Figure 3).

Figure 1. Rechargeable battery market projections show lead battery production increasing to meet the growing demand.



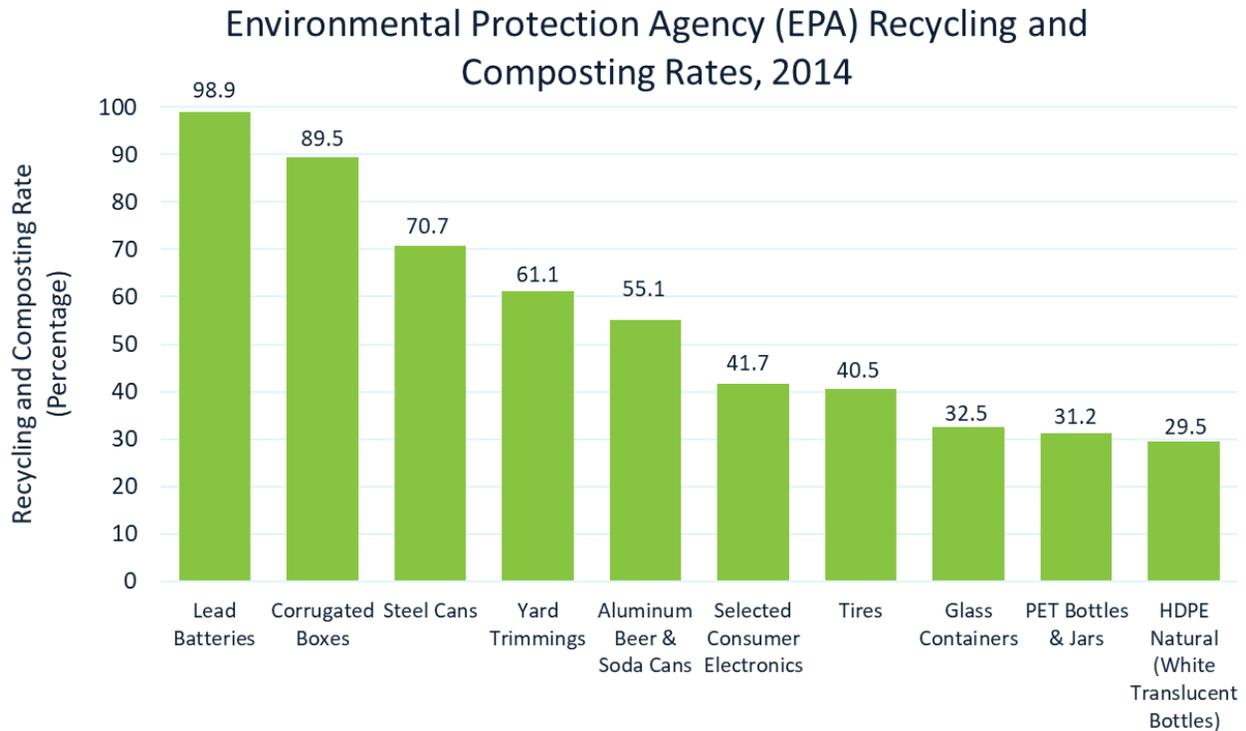
Source: *The Rechargeable Battery Market and Main Trends 2014-2025*, Avicenne Energy, March 2015.

Figure 2. With the highest recycling rate, lead is the most environmentally sustainable battery metal.



Source: United Nations Environmental Programme, 2011.

Figure 3. The Environmental Protection Agency (EPA) ranks lead batteries as the most recycled consumer product in the United States.



Source: "Environmental Impact and Life Cycle Assessment of Lead Battery and Architectural Sheet Production," *The International Journal of Life Cycle Assessment*, 2016.

ABOUT BATTERY COUNCIL INTERNATIONAL

Battery Council International (BCI) is a non-profit organization established by battery manufacturers and recyclers to inform and educate stakeholders on the need for continued investment in sustainable battery technologies to store energy. BCI is committed to advancing lead battery innovation to support the integral role lead batteries play in powering our everyday lives. Learn more at www.batterycouncil.org.

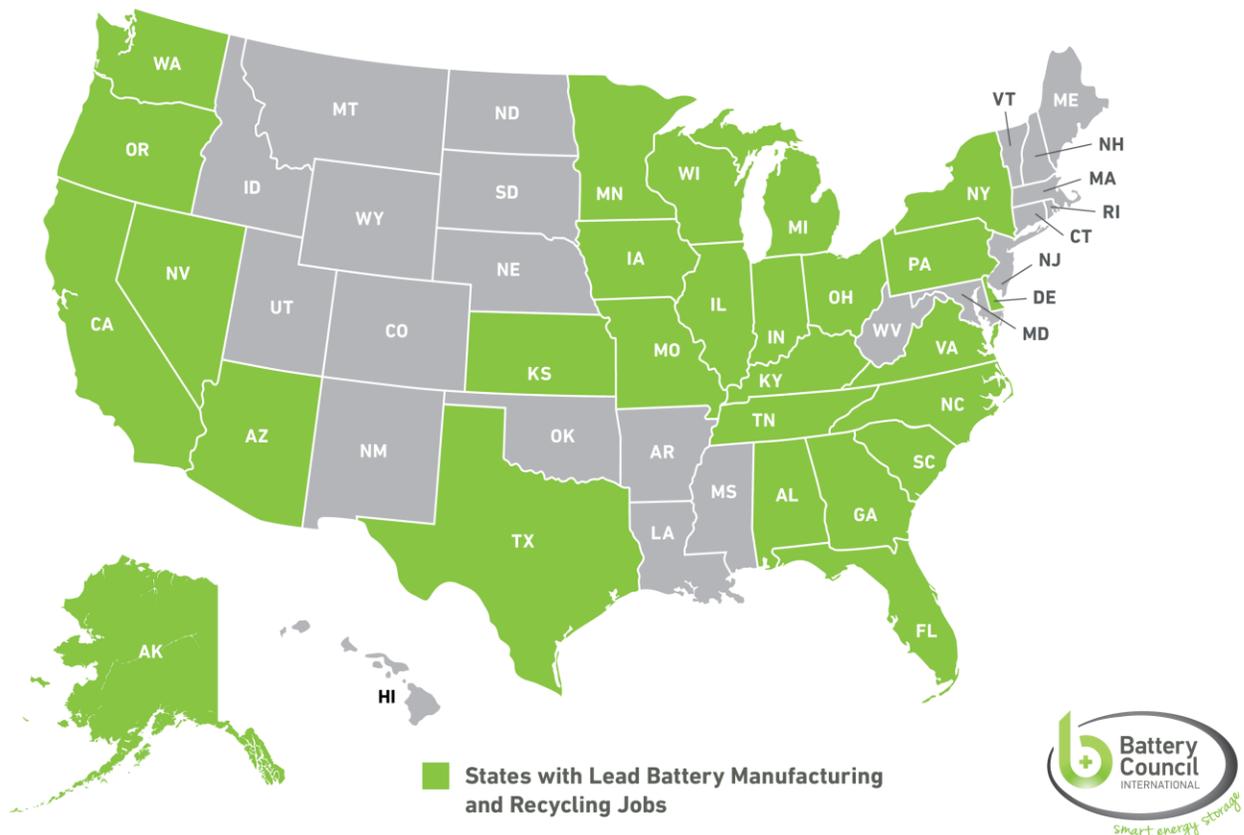
PURPOSE AND METHOD OF STUDY

This study measures the national economic contribution of the U.S. lead battery industry in calendar year 2016. The analysis was conducted using an economic impact model called IMPLAN. A survey was used to collect data including annual employment and payroll

information from 18 BCI member companies located throughout the U.S. (Figure 4).² Survey results were added across states to yield national-level activity that was put into the IMPLAN model. Impact results are presented in terms of jobs, labor income, GDP, output and tax revenue, all of which are explained below. The industry’s economic contribution represents the gross impact of the industry on the U.S. economy in 2016.

Figure 4. BCI member manufacturers and recyclers in the United States employ workers in over half of the country.

Lead Battery Industry Creates **Jobs in 30 States**



Source: Battery Council International, 2017.

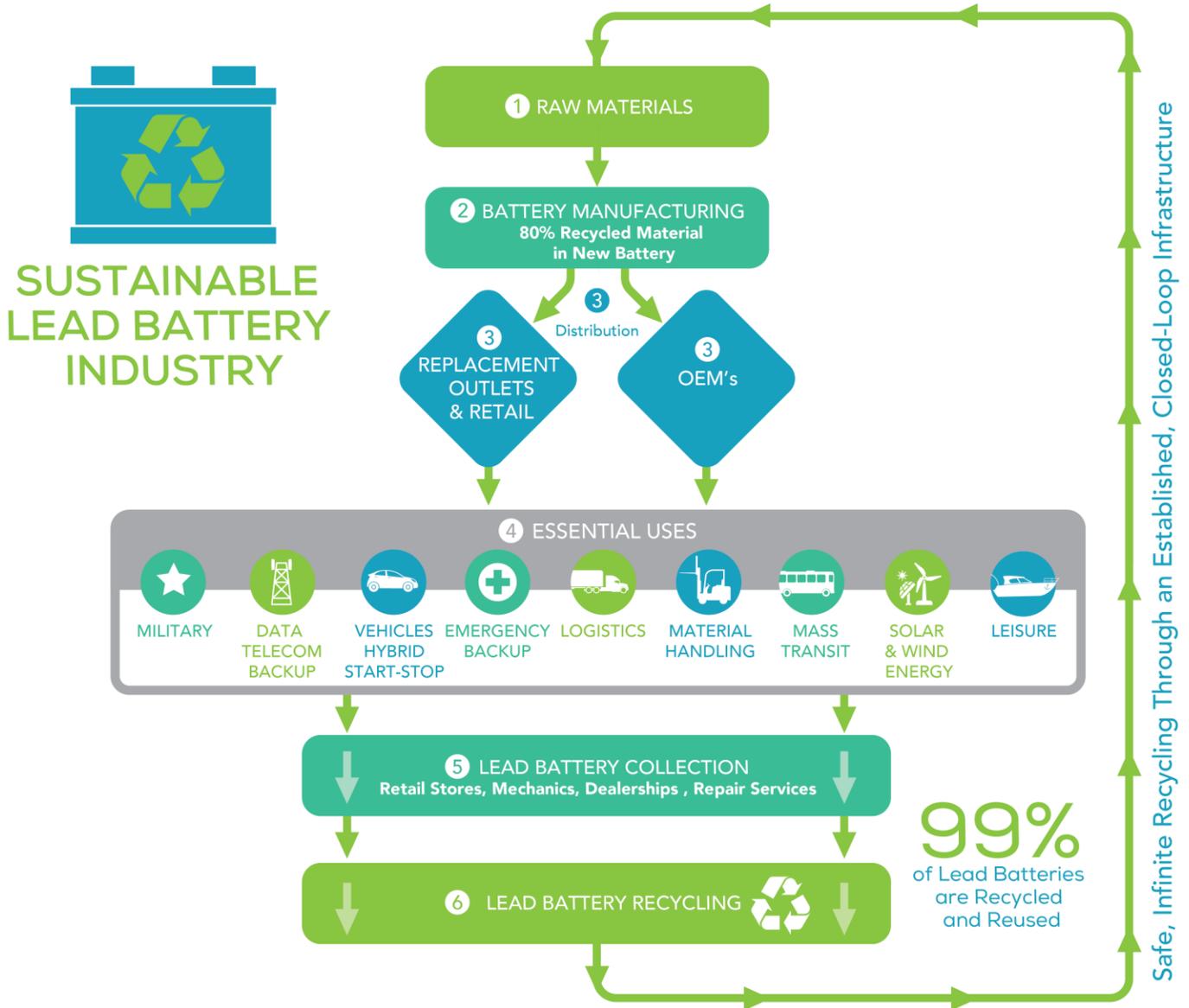
LEAD BATTERY SUPPLY CHAIN

The flowchart in Figure 5 illustrates how lead batteries are recycled and how their components are used to manufacture new batteries. For example, a new lead battery consists of 80 percent

² All individual company data was kept confidential and company identities were not revealed as part of this study.

recycled material, and nearly 75 percent of its lead comes from recycling. Furthermore, 99 percent of lead batteries are collected and recycled. This effective waste-reduction process is sometimes referred to as “cradle-to-cradle” production or a “closed-loop” industry.

Figure 5. An established, nationwide recycling infrastructure makes lead battery manufacturing the most environmentally sustainable of all battery technologies.



Source: Battery Council International, 2017.

ROLE OF LEAD BATTERIES IN THE U.S. ECONOMY

THREE INDUSTRY IMPACT AVENUES

The lead battery industry contributes to the U.S. economy by generating jobs, income, GDP and output (business sales) in three separate ways:

- **Direct impacts:** When battery manufacturing and recycling companies employ workers and generate business income.
- **Supplier impacts:** When battery manufacturing and recycling companies purchase goods and services from recyclers, manufacturers and other suppliers (e.g., equipment, parts, materials, facilities and utilities).
- **Worker spending impacts:** When workers at battery manufacturing and recycling companies and workers at supplier companies spend their after-tax income on consumer goods (e.g., food, housing).

OCCUPATIONAL CATEGORIES

Direct jobs in the lead battery industry are filled by workers in a variety of occupations (Table 1). Production occupations account for more than half of all jobs in the lead battery industry while high-skilled engineers, managers and administrators account for another quarter.

Table 1. Lead battery workers are employed in a variety of occupations.

Share of Lead Battery Workers by Occupation Category

Occupation Category	Percentage of Industry Workers
Production	53.6%
Office and administrative support	9.7%
Architecture and engineering	9.4%
Management	6.6%
Transportation and material moving	5.7%
Installation, maintenance and repair	4.5%
Business and financial operations	4.1%
Sales and related	3.0%
Computer and mathematical	1.9%
Building and grounds cleaning and maintenance	0.4%
Construction and extraction occupations	0.4%
Arts, design, entertainment, sports and media	0.3%
Life, physical and social science	0.2%
Healthcare practitioners and technical	0.1%

Note: Percentages do not sum to 100 due to rounding.

Source: United States Bureau of Labor Statistics, 2014.

Many occupations in the lead battery industry are available to workers who have only a high school diploma:³

- 79 percent of all office and administrative support occupations
- 65.8 percent of all installation, maintenance and repair occupations
- 61.5 percent of all sales and related occupations
- 54.3 percent of all production occupations including assemblers, fabricators and metal and plastic workers
- 41.5 percent of all transportation and material-moving occupations

PAYROLL COMPARISONS

BCI's members represent almost complete coverage of the U.S. lead battery manufacturing, recycling and mining sectors. In 2016, the lead battery industry operated in 30 states,

³ United States Bureau of Labor Statistics, 2014.

generated an estimated \$11.6 billion in output (business sales) and paid nearly \$1.4 billion in payroll to approximately 20,550 employees. The average, per-worker salary among lead mining and recycling companies is \$83,606, higher than in other private industry sectors (Table 2). The average, per-worker salary among lead battery manufactures is \$62,343.

Table 2. Payroll-per-worker in the U.S. lead battery industry is higher than in several other private industry sectors.

Payroll-per-Worker in U.S. Lead Battery Industry and Other Industry Sectors (2016 dollars)

Industry Sector	Payroll-per-Worker
Battery Recycling and Lead Mining	\$83,606
Other Manufacturing	\$77,291
Transportation and Utilities	\$70,696
Battery Manufacturing	\$62,343
Other Mining	\$58,748
Services	\$46,131
Trade	\$42,981
Construction	\$38,671
Agriculture	\$15,179

Source: IMPLAN and United States Bureau of Economic Analysis data. IMPLAN is a proprietary source of detailed industry data developed using a combination of government sources. See www.implan.com for more information.

GEOGRAPHIC JOB DISTRIBUTION

Direct jobs in the lead battery industry are distributed among the following regions of the U.S.:

- 37 percent in the Northeast
- 33 percent in the Midwest
- 22 percent in the South
- 9 percent in the West

ECONOMIC IMPACTS AND CONTRIBUTION

The U.S. lead battery industry generated the following job impacts in calendar year 2016:

- **Directly employed approximately 20,550 workers.**
- **Supported an additional 35,860 supplier jobs.** Supplier impacts (indirect impacts) result from companies in the lead battery industry spending money on goods and services.
- **Supported an additional 38,320 jobs from worker spending.** Worker spending impacts (induced impacts) result from workers at lead battery companies and their suppliers spending their wages throughout the economy.

Together these impacts total 94,730 jobs, and in addition to its job impact, the lead battery industry supported nearly:

- \$6 billion in labor income generation
- \$11.2 billion in gross domestic product (GDP)
- \$28.5 billion in output or overall economic impact in 2016

These impacts represent the lead battery’s contribution to the U.S. economy in 2016 (Table 3).⁴

Table 3. The U.S. lead battery industry supports tens of thousands of jobs and generates billions of dollars in economic impact.

Economic Impacts from U.S. Lead Battery Industry in 2016

Impact Type	Jobs	Labor Income	GDP	Output
Battery manufacturing (direct)	16,250	1.013 billion	2.002 billion	7.427 billion
Battery mining and recycling (direct)	4,300	0.360 billion	1.189 billion	4.213 billion
Supplier (indirect)	35,860	2.638 billion	4.602 billion	10.528 billion
Worker spending (induced)	38,320	1.969 billion	3.440 billion	6.309 billion
Total	94,730	5.980 billion	11.233 billion	28.477 billion

Source: IMPLAN analysis conducted by EDR Group.

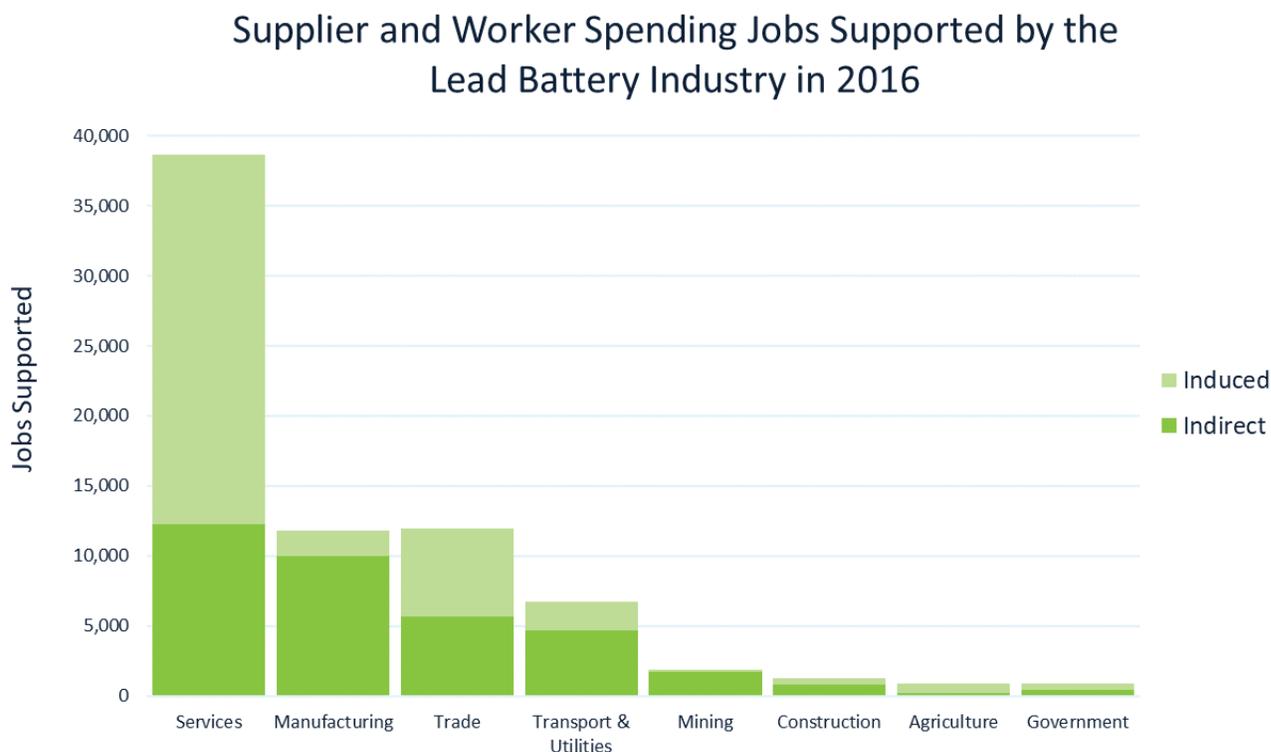
Note: Because lead battery manufacturers use both virgin and recycled lead, some lead mining and recycling companies support manufacturers within the same industry. The rest support other industries. The supplier impact from battery manufacturing reflects this fact by not counting jobs twice, and other impacts resulting from the purchase of virgin and recycled lead content.

⁴ GDP represents the total value of goods produced by the U.S. lead battery industry. Output represents total sales made by the U.S. lead battery industry. GDP is smaller than output because it excludes payroll, profits and the cost of supplies. Payroll is a subset of GDP and GDP is a subset of output. Therefore, these figures should not be combined.

Indirect and Induced Impacts by Industry

By purchasing goods and services from suppliers and paying wages that workers spend throughout the economy after paying taxes, the lead battery industry supports a variety of industries (Figure 6). More than 38,000 of these supplier and worker spending jobs are in the services industry and approximately 11,800 are in manufacturing. More than 18,000 of the jobs are in the trade, transportation and utilities industries, with the remaining in agriculture, construction, mining and government. The reason such a variety of industries benefit from the lead battery industry is because workers at individual companies and their suppliers spend their wages on food, housing, transportation, recreation and other goods and services.

Figure 6. The U.S. lead battery industry supports jobs in a variety of industry sectors.



Source: IMPLAN analysis conducted by EDR Group.

Tax Revenue Contribution

By paying local, state and federal taxes, the U.S. lead battery industry contributed nearly \$2.5 billion in government revenue in 2016 (Table 4). The industry provided close to \$900 million in revenue to states and localities and approximately \$1.6 billion to the federal government.

Table 4. The U.S. lead battery industry generates billions of dollars in tax revenue.

Tax Revenue Generated by U.S. Lead Battery Industry in 2016

Revenue Type	Revenue
State and local tax revenue	\$0.866 billion
Federal tax revenue	\$1.598 billion
Total	\$2.464 billion

Source: IMPLAN analysis conducted by EDR Group.

CONCLUSION

The U.S. lead battery industry is comprised of battery manufacturing, lead recycling and lead ore mining companies, and is supported by numerous suppliers, retailers and marketing companies. In 2016, the industry directly employed 20,550 workers and had a total payroll of \$1.4 billion. Business sales — which represent the revenue earned by companies in the lead battery industry — totaled \$11.6 billion.

Production by the lead battery industry also generated indirect impacts through transactions with their suppliers and induced impacts through workers at both member companies and suppliers spending their earnings on goods and services. When direct, supplier and worker spending impacts are combined, the industry contributed the following to the national economy in 2016:

- **Nearly 95,000 jobs;**
- **\$6 billion in labor income;**
- **\$11.2 billion in GDP; and**
- **\$28.5 billion in output.**

These impacts are spread across a variety of industries, with services, manufacturing and trade benefiting the most. Finally, by paying local, state and federal taxes, the U.S. lead battery industry contributed nearly \$900 million in state and local tax revenue and \$1.6 billion in federal revenue.

APPENDIX

METHODOLOGY

This analysis was conducted using a 2015 national IMPLAN model; all results are in 2016 dollars. A survey process was used to collect limited, but key annual data from 18 BCI member companies.⁵ Compilation of the survey-derived and supplemental information represents direct impacts. The survey probed annual employment and payroll information. The corresponding direct output (business sales or value of production) was estimated using state-specific output-to-jobs ratios from IMPLAN before summing output across companies within each of the three subsectors comprising the BCI membership. National ratios were used in the few instances where state ratios were not available due to the absence of industry activity in the state-level database. There were also several instances where (direct) payroll was estimated using state-specific (and in two cases national) employee compensation-to-jobs ratios because survey respondents chose not to report annual payroll.

The cleaned survey results were added across states to yield national-level activity for each subsector (manufacturing, recycling and mining and corresponding industry). The national values were input into the U.S. IMPLAN model using the Industry Change activity type. For each subsector, direct sales, employment and payroll values were set, creating custom events in the IMPLAN model. The manufacturing scenario was run first, followed by recycling and mining. To avoid double-counting the impacts from separate IMPLAN runs, direct jobs, payroll and sales from recycling and mining were reduced before running IMPLAN to account for economic activity already captured in the manufacturing IMPLAN run. This adjustment reflects the fact that BCI recyclers and mining companies support BCI manufacturers through their supply chain.

DEFINITION OF TERMS

Input-output models are commonly used to conduct economic impact analysis. There are several input-output models available, including IMPLAN.⁶ Many economists use IMPLAN for economic contribution analyses because the tool measures output and employment impacts, is available on a county-by-county basis and is flexible for the user. IMPLAN has some limitations and qualifications, but it is one of the best tools available to economists for input-output modeling. Understanding the IMPLAN tool, its capabilities and its limitations helps ensure the best results from the model. The U.S. IMPLAN model used for this study estimates economic and tax revenue impacts at a national level. Tax revenue impacts include local, state and federal revenue, estimated using average tax rates for each jurisdiction.

⁵ Some of these companies have multiple establishments, hence the distribution across 30 states.

⁶ See www.implan.com for more information.

One of the most critical aspects of understanding economic impact analysis is the distinction between the local and non-local economy. This is because industry purchases taking place outside the local study region do not benefit the study region itself. Sales made within the local study region, however, grow the economy by bringing dollars into the region. The study region is identified as part of the model-building process. Either the group requesting the study or the analyst defines the study region. For this study, the study region is the entire U.S., meaning that spending by the lead battery industry taking place outside the country represents “leakage” and does not contribute to the growth of the national economy.

Several IMPLAN-specific definitions are essential to properly interpreting the results of an IMPLAN analysis. These definitions are below, with some quoted from the IMPLAN glossary.⁷

Economic Contribution

Economic contribution represents a “gross change in economic activity associated with an industry, event or policy in an existing regional economy.”⁸ This is different from an economic impact, which represents a net change in economic activity.

Jobs

An IMPLAN job equals the annual average of monthly jobs in that industry (this is the same definition used by several government sources). Thus, one job lasting 12 months equals two jobs lasting six months each or three jobs lasting four months each. A job can be full-time or part-time.

Labor Income

Labor income includes all forms of employment income, including employee compensation (wages and benefits) and proprietor income. Proprietor income consists of payments received by self-employed individuals and unincorporated business owners.

Value Added (GDP)

Value added or gross domestic product (GDP) represents the difference between an industry’s total output and the cost of its intermediate inputs (consumption of goods and services purchased from other industries or imported). Value added consists of employee compensation, taxes on production and imports less subsidies and gross operating surplus.

Output

Output represents the value of industry production. In IMPLAN these are annual production estimates for the year of the data set. For manufacturers, output equals sales plus or minus the change in inventory. For service sectors output equals sales. For retail and wholesale, trade output equals the gross margin and not gross sales.

⁷ <https://implanhelp.zendesk.com/hc/en-us/categories/115001507908-Knowledge-Base>

⁸ “Determining Economic Contributions and Impacts: What is the Difference and Why Do We Care?,” *The Journal of Regional Analysis and Policy* 37(2): 1-15, 2007

Direct Impact

Direct impacts represent changes in industry production or expenditures resulting from companies. These initial changes are determined by an analyst to be a result of a specific activity (e.g., sales made by a given company). Applying these initial changes to the multipliers in an IMPLAN model will then display how the region will respond economically to these initial changes.

Indirect Impact (Supplier Impact)

Indirect impacts result from local industries buying goods and services from local supplier industries. As a company increases its production it will require more inputs from local suppliers, in turn increasing the production at those supplier companies. This indirect impact is calculated by applying direct effects to what are called Type I Multipliers.

Induced Impact (Worker Spending Impact)

Induced impacts represent the response of an economy to an initial (direct) change that occurs through re-spending of income. This money is recirculated through household spending patterns causing further local economic activity. A variety of industries benefit from induced impacts because workers at companies experiencing the initial change in production, plus workers at their local supplier companies, spend their wages on food, housing, transportation, recreation and other goods and services.

Total Impact

The total impact is the summation of the direct, indirect and induced impacts.