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Committees of Congress

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Advanced Lithium-Ion Energy Storage Battery Manufacturing in the United States

SUMMARY

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November 26, 2025

Michael Alan Havlin
Analyst in Industrial Organization and Business

Due to increases in demand for electric vehicles (EVs), renewable energies, and a wide range of consumer goods, the demand for *energy storage batteries* has increased considerably from 2000 through 2024. Energy storage batteries are manufactured devices that accept, store, and discharge electrical energy using chemical reactions within the device and that can be recharged to full capacity multiple times throughout their usable life. Although a wide range of chemistry types for such batteries are available, the lithium-ion battery became the most widely adopted across a wide range of end uses (e.g., EVs, power grid storage, computers, electric bicycles) during the 2010s and 2020s.

Congress has created a broad array of policy frameworks supportive of the domestic battery manufacturing industry. Such policies initially tended to be more focused on supporting downstream consumers of batteries, which in turn generated demand for batteries and indirectly supported the battery manufacturing industry. Over time, this policy framework shifted focus toward the battery manufacturing industry itself with legislation such as the American Recovery and Reinvestment Act of 2009 (ARRA; P.L. 111-5). More recently, the Infrastructure Investment and Jobs Act of 2021 (IIJA; P.L. 117-58) and P.L. 117-169 (the FY2022 reconciliation act) further expanded and specified this policy framework. P.L. 119-21 (the FY2025 reconciliation act) reduces the duration and scope of certain industrial policies affecting the battery industry.

Manufacturers in the People's Republic of China (China) dominate the U.S. and global supply of lithium-ion batteries. China's share of the global battery manufacturing supply chain is approximately 70%-90%. Imports of lithium-ion batteries and battery parts from China to the United States grew at accelerated rates into the 2020s. Manufacturers in China captured market share partly because of historically lower prices compared with global and U.S. competitors. Manufacturers located in China are able to maintain lower prices because of certain industrial practices or policies, which commonly occur there, such as vertical integration, economies of scale, trade protections, subsidies, and currency devaluation. Although lower-priced batteries may benefit battery consumers (e.g., EV manufacturers) in the short term, reliance on imports for these critical components may present supply chain diversification risks and long-term market vulnerabilities.

Investments in some aspects of the domestic battery manufacturing supply chain have occurred, and imbalances within the domestic supply chain may continue. The U.S. manufacturing industry for lithium-ion energy storage batteries has largely matured in some downstream processes, such as battery pack assembly. Domestic investment in further upstream activities, such as battery cell component manufacturing and active material manufacturing, has not kept pace with investment in further downstream processes. If domestic pack and cell assemblers, for example, continue to be reliant on imports for certain components and materials, then the energy independence and supply chain resilience issues may continue to be areas of concern for some Members of Congress.

Congress might consider a range of policy options that may impact the battery manufacturing industry, including (1) overseeing existing programs; (2) further adjusting the EV tax credit; (3) adjusting or eliminating the battery and critical mineral production subsidies; (4) introducing job training programs for advanced battery manufacturing; (5) assessing trade barriers; and (6) augmenting supply chain visibility tools. Some of these options were considered by the 119th Congress when it enacted P.L. 119-21.

If Congress were to consider taking further action related to the battery manufacturing industry, certain potential trade-offs or themes might emerge, including (1) tension between battery consumers (e.g., EVs, grid power, computers) and battery manufacturers; (2) conflict with trade agreements and trading partners; (3) market distortions when the government takes action in a market economy; (4) integration or disintegration between domestic supply chain participants; (5) impacts on federal expenditures; and (6) creation of market uncertainty.

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Introduction

Congress has long shown interest in the U.S. energy sector, the U.S. manufacturing sector, and U.S. supply chains through hearings, reports, and legislation. An increasingly essential component of these sectors is *energy storage batteries*. Energy storage batteries are manufactured devices that accept, store, and discharge electrical energy using chemical reactions within the device and that can be recharged multiple times throughout their usable life. They are used in conjunction with a wide range of energy, transportation, consumer, and manufacturing goods and services. *Advanced lithium-ion energy storage batteries* are an increasingly common battery type used across the U.S. economy.[1] A range of goods, services, and infrastructures in which Congress has expressed an interest have critical functionalities that currently use advanced lithium-ion energy storage batteries at a variety of scales; examples include electric vehicles (EVs), the power grid, data centers, robots, drones, and computers.[2]

Congress has incrementally created a broad policy framework that might affect the battery manufacturing industry. Coinciding with the incremental establishment of this legislative framework, a lithium-ion energy storage battery manufacturing industry emerged in the United States during the 2010s and into the 2020s. The most recently enacted components of this framework include the Infrastructure Investment and Jobs Act of 2021 (IIJA; P.L. 117-58), P.L. 117-169 (the FY2022 reconciliation act), and P.L. 119-21 (the FY2025 reconciliation act).

This report (1) analyzes historical trends in the energy storage battery manufacturing industry; (2) analyzes current and projected investment trends within the domestic value chain for lithium-ion energy storage battery manufacturing; and (3) discusses some policy options available to Congress should Congress seek to take further action.

Historical Trends

The domestic lithium-ion energy storage battery manufacturing industry has grown since 2000.[3] To varying degrees, this growth is broadly associated with vehicle electrification, renewable energy adoption, manufacturing innovations, and policy frameworks built around the energy, transportation, and manufacturing industries. From approximately 2000 to 2009, domestic battery

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[1] For a definition of *advanced lithium-ion batteries*, among other terms used in this report, see the **Appendix**.

[2] This report does not address other energy storage tools, such as hydrostatic power and hydrogen, used in some of these sectors.

[3] Yan Zhou et al., *Lithium-Ion Battery Supply Chain for E-Drive Vehicles in the United States: 2010-2020*, Argonne National Laboratory (Argonne), March, 2021, https://publications.anl.gov/anlpubs/2021/04/167369.pdf; Ahmad Pesaran et al., *North American Lithium-Ion Battery Supply Chain Database Development – Phase II*, National Renewable Energy Laboratory, December 5, 2022, https://www.nrel.gov/docs/fy23osti/85610.pdf; Rebecca Bellan, "Automakers Have Battery Anxiety, So They're Taking Control of the Supply," *TechCrunch*, July 23, 2021, https://techcrunch.com/2021/07/23/automakers-have-battery-anxiety-so-theyre-taking-control-of-the-supply/; Bellan, "Tracking the EV Battery Factory Construction Boom Across North America," *TechCrunch*, February 6, 2025, https://techcrunch.com/2025/02/06/tracking-the-ev-battery-factory-construction-boom-across-north-america/; Nate Martinez, "GM Begins Work at Brownstown Lithium Ion Battery Plant; Set for 2010 Opening," *MotorTrend*, August 13, 2009, https://www.motortrend.com/news/gm-begins-work-at-brownstown-lithium-ion-battery-plant-set-for-2010-opening-5015/; PR NewsWire, "LG Chem's Holland Plant Accelerates Battery Production," October 21, 2015, https://www.prnewswire.com/news-releases/lg-chems-holland-plant-accelerates-battery-production-300163934.html; WardsAuto, "LG Chem Details Cell-Making Process at Michigan Plant," November 3, 2015, https://www.wardsauto.com/industry/lg-chem-details-cell-making-process-at-michigan-plant; Georgia Wilson, "Timeline: Tesla's Construction of Gigafactories," *Manufacturing Digital*, May 10, 2021, https://manufacturingdigital.com/digital-factory/timeline-teslas-construction-gigafactories.

manufacturing decreased compared to the prior decade as the U.S. economy exhibited broader deindustrialization patterns.[4] Then, from 2009 to 2020, some battery manufacturing activities increased, generally because of factors such as vehicle electrification, deployment of solar power systems, decreased costs of lithium-ion batteries, and some public policy actions. From 2020 through 2024, the domestic battery manufacturing industry grew at accelerated rates compared to the 2010s. Although such growth has onshored[5] some elements of the battery manufacturing supply chain to the United States, some other elements remain predominantly abroad.

Data for the lithium-ion energy storage battery manufacturing industry are often grouped together with data for other types of batteries, such as lead-acid batteries and primary batteries. This report uses different data sources covering both broad and specific battery industries to generate insights into the advanced lithium-ion energy storage battery manufacturing industry.

Imports and Exports

U.S. import and export data on lithium-ion energy storage batteries suggest that consumption and domestic production of lithium-ion batteries increased. The data also indicate continued competitive pressure from imports.

Imports

U.S. import data on energy storage batteries show an increase in imports of (1) lithium-ion energy storage batteries and (2) parts for energy storage batteries.[6] **Figure 1** shows that total imports of all energy storage batteries increased from 2009 through 2024[7] and that nearly all of this increase was due to increases in imports of lithium-ion energy storage batteries.[8] In 2009, lithium-ion batteries represented 17% of total energy storage battery imports; by 2024, that percentage had increased to 84%.[9] Imports of battery parts also increased during this period (see **Figure 2**), with a similar pattern of accelerated increases into the 2020s. The increase in parts imports was driven by non-lead-acid energy storge battery parts. Under the U.S. Harmonized Tariff Schedule (HTS) classification system, battery parts include battery cells, battery modules, separators, and other unspecified parts.[10] The People's Republic of China (China) is the main source of lithium-ion energy storage battery imports: 69% of finished lithium-ion energy storage battery imports and 33% of imported parts for non-lead-acid energy storage batteries came from China in 2024.[11]

[4] Based on CRS analysis of employment from the Bureau of Labor Statistics (BLS), sales data from the Census Bureau, and gross domestic product from the Bureau of Economic Analysis (BEA).

[5] In this report, *onshoring* refers to a trend of increased domestic production that outpaces increases in imports and results in a larger proportion of domestic consumption being sourced from domestic producers.

[6] As measured by nominal dollar value.

[7] Publicly available data date as far back as 2009.

[8] CRS calculations based on U.S. Import and Export Merchandise trade statistics from the Census Bureau's USA Trade Online data tool.

[9] Ibid.

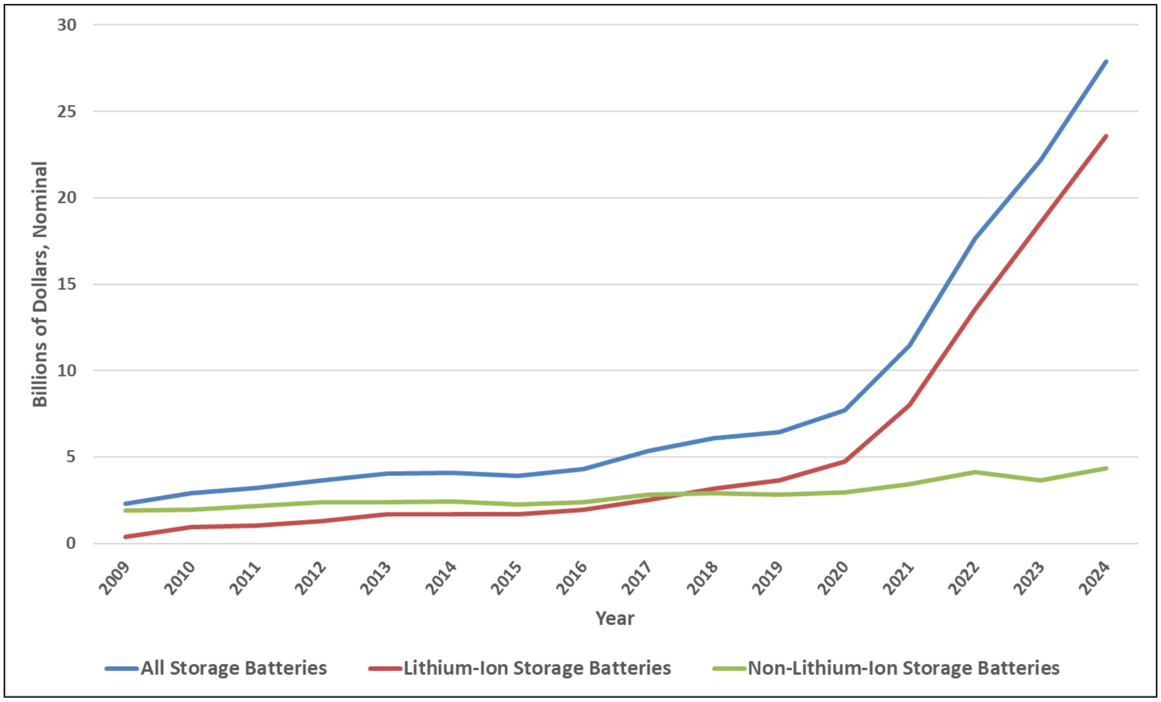
[10] U.S. International Trade Commission (USITC), "Chapter 85: Electrical Machinery and Equipment and Parts Thereof; Sound Recorders and Reproducers, Television Image and Sound Recorders and Reproducers, and Parts and Accessories of Such Articles," in *Harmonized Tariff Schedule (HTS) of the United States (2025), Revision 10* (April 2025), https://hts.usitc.gov/; and David Coffin and Jeff Horowitz, "The Supply Chain for Electric Vehicle Batteries," *USITC Journal of International Commerce and Economics* (December 2018), https://www.usitc.gov/publications/332/journals/the_supply_chain_for_electric_vehicle_batteries_0.pdf.

[11] CRS calculations using U.S. Import and Export Merchandise trade statistics from the Census Bureau's USA Trade Online data tool.

Because of a variety of factors, such as subsidies,[12] trade protections, overcapacity, economies of scale, vertical integration, and currency devaluation, manufacturers in China can produce batteries at lower costs, which has allowed them to capture 70%-90% of the global value chain for lithium-ion batteries.[13]

Figure 1. Imports of Energy Storage Batteries

(nominal dollars)



Source: CRS with U.S. Import and Export Merchandise trade statistics queried by CRS using the U.S. Census Bureau's USA Trade Online data tool.

Notes: Data on imports of lithium-ion batteries are publicly available going back to 2009. From 2009 through 2011, Lithium-Ion Storage Batteries is published under Harmonized Tariff Schedule (HTS) code 8507.80.8010. From 2012 through 2024, Lithium-Ion Storage Batteries is published under HTS code 8507.60. All Storage Batteries is the sum of all six-digit HTS codes from 8507.10 to 8507.80. Non-Lithium Storage Batteries is that sum minus Lithium-Ion Storage Batteries. CRS did not adjust these data for inflation.

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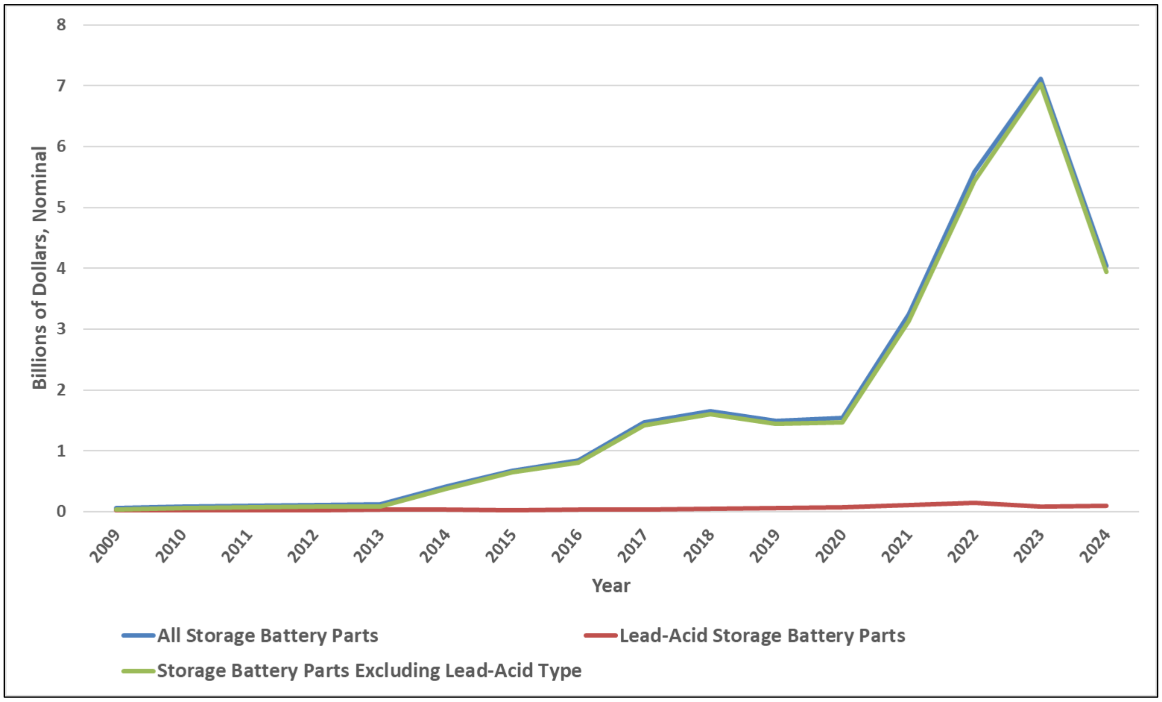
[12] This report defines *subsidy* consistent with the Word Trade Organization (WTO) Agreement on Subsidies and Countervailing Measures, to which the United States is a party. For purposes of this report, subsidy refers to a policy where there is a financial contribution by a government and the recipient benefits. For more information, see WTO, *Agreement on Subsidies and Countervailing Measures*, https://www.wto.org/english/docs_e/legal_e/24-scm.pdf; and International Trade Administration, *Trade Guide: WTO Subsidies Agreement*, https://www.trade.gov/trade-guide-wto-subsidies.

[13] See, for example, Varun Sivaram et al., *Winning the Battery Race: How the United States Can Leapfrog China to Dominate Next-Generation Battery Technologies*, Carnegie Endowment for International Peace, October 21, 2024, https://carnegieendowment.org/research/2024/10/winning-the-battery-race-how-the-united-states-can-leapfrog-china-to-dominate-next-generation-battery-technologies?lang=en.

Figure 2. Imports of Parts for Storage Batteries

(nominal dollars)



Source: CRS with U.S. Import and Export Merchandise trade statistics from the U.S. Census Bureau's USA Trade Online data tool.

Notes: Lead-Acid Storage Battery Parts is published within HTS code 8507.90.4000. Storage Battery Parts Excluding Lead-Acid Type is published within HTS 8507.90.8000. All Storage Battery Parts is the sum of these two series. CRS did not adjust these data for inflation.

Exports

U.S. domestic export data can provide insights into domestic production because, by definition, any domestic goods exported from the United States were grown, produced, manufactured, or changed[14] within the physical boundaries of the United States, including U.S. Foreign Trade Zones.[15] Export data on storage batteries show similar trends as import data (see **Figure 1** and **Figure 2**) over the same time frame: an increase in energy storage battery exports largely driven by lithium-ion batteries (see **Figure 3**) and an increase in exports of storage battery parts largely driven by parts for non-lead-acid batteries (see **Figure 4**). Exports of non-lead-acid battery parts showed a large increase in 2024 almost entirely from exports to Mexico. Exports of non-lead-acid battery parts to Mexico increased from $43 million in 2023 to $1.9 billion in 2024, which constituted 95% of all non-lead-acid battery part exports from the United States in 2024. Mexico's import data do not show increases in battery part imports from the United States, but Mexico's imports of finished lithium-ion batteries from the United States increased from $109 million in 2023 to $1.8 billion in 2024, which might suggest some HTS classification differences between the United States and Mexico, with the increases being recorded as finished batteries in

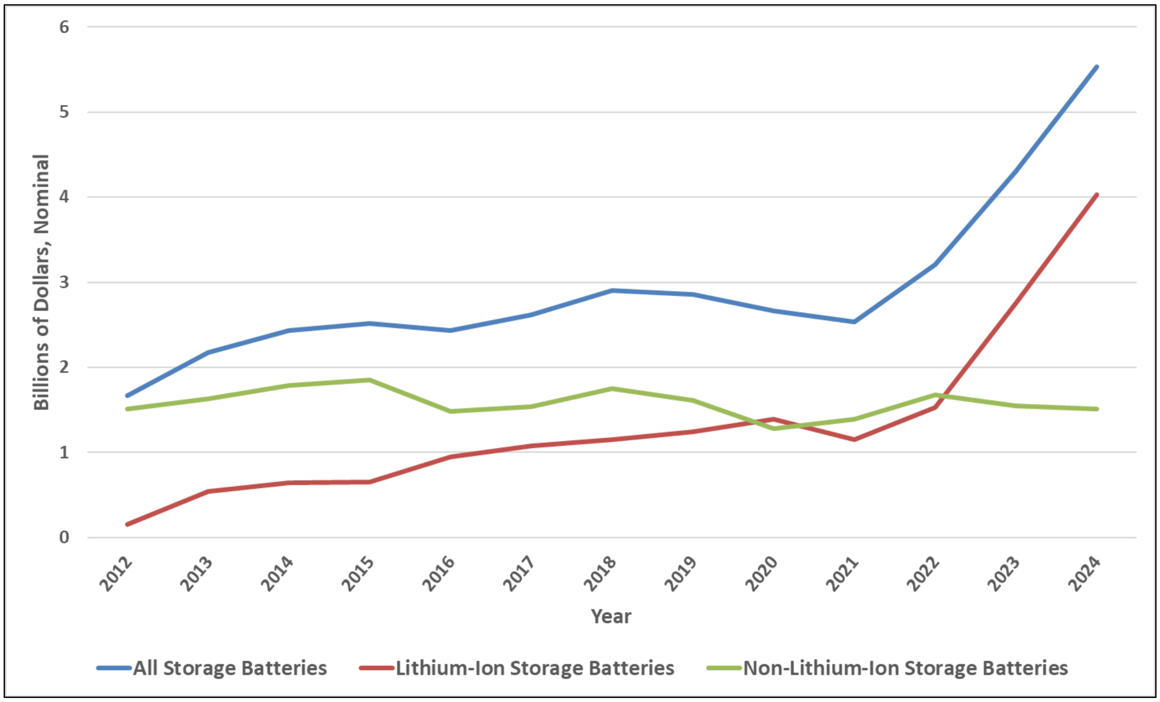
[14] Census Bureau, "Guide to the U.S. International Trade Statistical Program," https://www.census.gov/foreign-trade/guide/sec2.html.

[15] Census Bureau, "Guide to the U.S. International Trade Statistical Program."

Mexico's system.[16] This may further suggest that the parts being exported from the United States to Mexico might be battery cells or battery modules—rather than cell components such as separators.

Figure 3. Domestic Exports of Energy Storage Batteries

(nominal dollars)



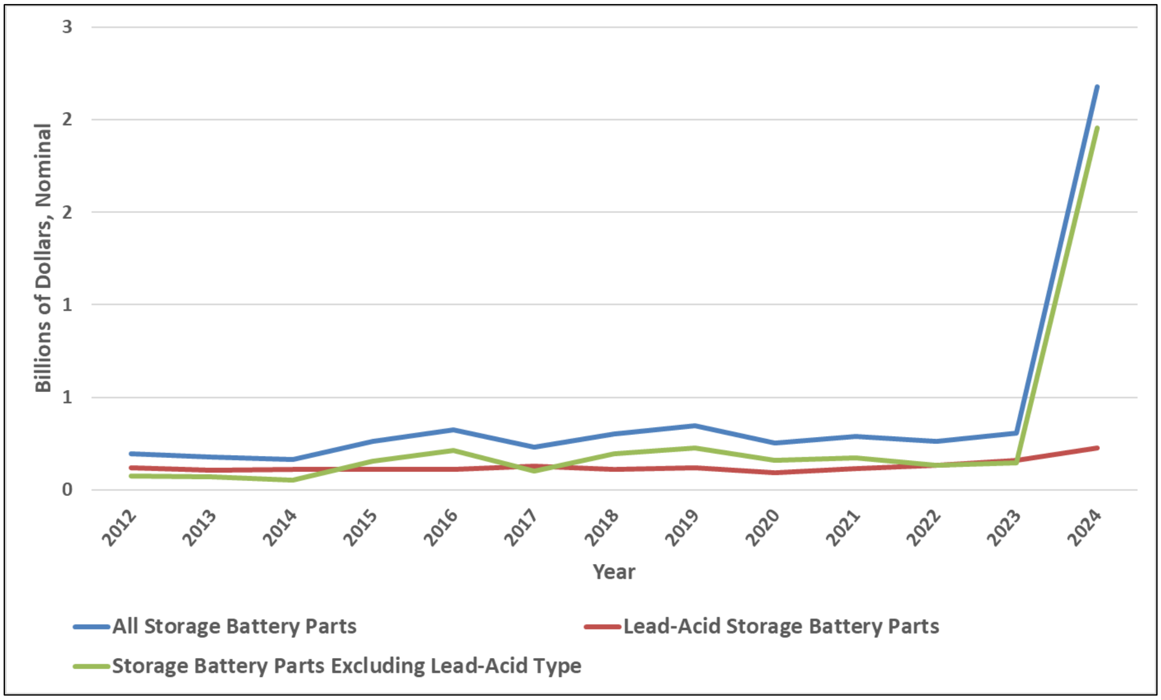
Source: CRS with U.S. Import and Export Merchandise trade statistics from the U.S. Census Bureau's USA Trade Online data tool.

Notes: Export data on lithium-ion batteries are publicly available going back to 2012. Lithium-Ion Storage Batteries is published under Census Schedule B classification code 8507.60. All Storage Batteries is the sum of all six-digit classification codes from 8507.10 to 8507.80. Non-Lithium Storage Batteries is that sum minus Lithium-Ion Storage Batteries. CRS did not adjust these data for inflation.

[16] Trade Data Monitor, "Mexico Imports from United States," accessed October 25, 2024, https://tradedatamonitor.com/.

Figure 4. Domestic Exports of Parts for Energy Storage Batteries

(nominal dollars)



Source: CRS with U.S. Import and Export Merchandise trade statistics queried by CRS using the U.S. Census Bureau's USA Trade Online data tool.

Notes: For consistency with **Figure 3**, 2012 is the starting year. All Storage Battery Parts is published within Census Schedule B classification code 8507.90. Storage Battery Parts Excluding Lead-Acid Type is published under Census Schedule B classification code 8507.90.8000. Lead-Acid Storage Battery Parts is the difference between All Storage Battery Parts and Storage Battery Parts Excluding Lead-Acid Type. CRS did not adjust these data for inflation. Nearly all of the increase in 2024 was due to exports to Mexico.

Global and Domestic Prices

In addition to broad demand increases from downstream consumers of batteries, price decreases may also help explain the increase in imports and exports of lithium-ion energy storage batteries. All things remaining constant, as the price of a commodity decreases, the consumption of that commodity increases. Global prices of lithium-ion energy storage batteries have decreased because of a wide range of factors (e.g., industrial innovations, technological development, economies of scale, overcapacity, and subsidies). Depending on country-specific policies and conditions, some countries tend to have lower production costs and prices than others.[17] Such lower production costs contribute to private-sector decisions about where to locate manufacturing facilities and capacity.[18]

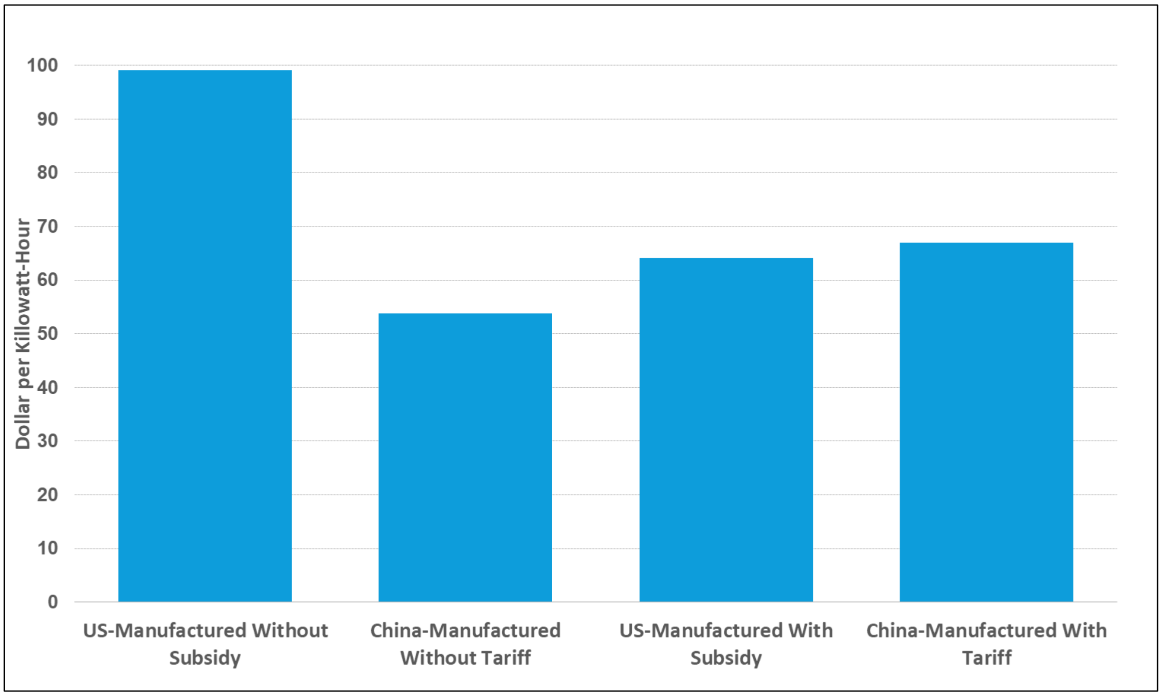
[17] Donald Chung et al., *Automotive Lithium-Ion Cell Manufacturing: Regional Cost Structures and Supply Chain Considerations*, Clean Energy Manufacturing Analysis Center, April 2016, https://www.nrel.gov/docs/fy16osti/66086.pdf; and Bloomberg New Energy Finance, "Long-Term Electric Vehicle Outlook 2024—Data," June, 2024.

[18] Abigail Cooke et al., *Cheap Imports and the Loss of U.S. Manufacturing Jobs*, Census Bureau, Center for Economic Studies, Working Paper 16-05, https://www2.census.gov/ces/wp/2016/CES-WP-16-05.pdf; Susan N. Houseman, *Understanding the Decline of U.S. Manufacturing Employment*, W.E. Upjohn Institute for Employment Research, Working Paper 18-287, June 7, 2018, https://research.upjohn.org/cgi/viewcontent.cgi?article=1305&context= (continued...)

Production costs of domestically manufactured batteries may be higher than some import prices of batteries. Domestic subsidies and tariffs may cumulatively offset the difference.[19] For example, see **Figure 5** for a price comparison of domestically produced batteries and imports of batteries from China. According to BloombergNEF, in 2024, the U.S. market price of some U.S. lithium-ion batteries would have been approximately 90% more than the price of equivalent batteries imported from China but for U.S. subsidies and tariffs. The U.S. production subsidies and tariffs on batteries imported from China might have resulted in market prices for some U.S. batteries being less than those from China.[20]

Figure 5. Lithium-Iron-Phosphate Battery Cell U.S. Market Price Comparison

2024



Source: Figure created by CRS from BloombergNEF, "Long-Term Electric Vehicle Outlook 2024 – Data," June 2024.

Notes: Lithium-Iron-Phosphate is a particular type of lithium-ion battery. *Subsidy* refers to the $35 per megawatt 45X tax credit authorized in the Infrastructure Investment and Jobs Act (P.L. 117-58). When BloombergNEF estimated these prices, it used the 25% tariff rate that was effective in 2024.

Domestic Battery Manufacturing Output and Employment

Domestic manufacturing production output and sales are measures and outcomes of economic activity. The Bureau of Economic Analysis (BEA) and the U.S. Census Bureau (Census) publish output and sales data on a wide range of industries, including energy storage battery manufacturing. They do not publish detailed data for advanced lithium-ion energy storage battery

up_workingpapers; Mary Amiti et al., *How Did China's WTO Entry Affect U.S. Prices*?, National Bureau of Economic Research (NBER), Working Paper 13487, June 2017, https://www.nber.org/system/files/working_papers/w23487/w23487.pdf.

[19] For discussion of battery industry subsidies, see "Production Tax Credits."

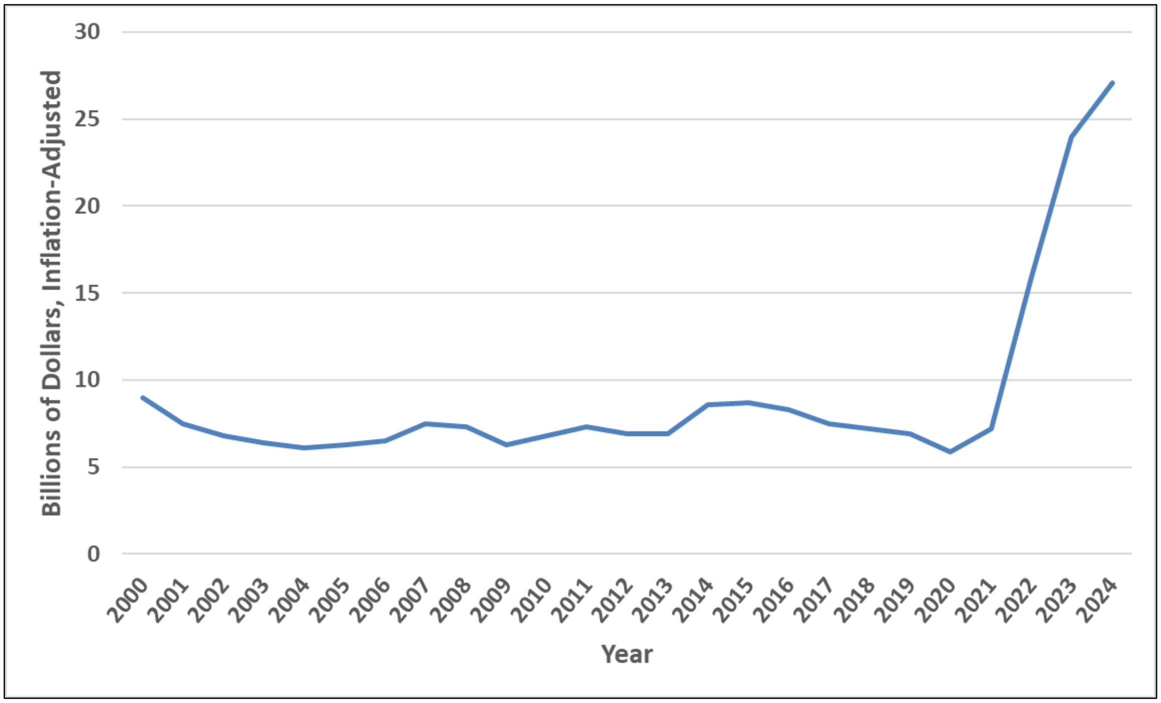
[20] BloombergNEF, "Long-Term Electric Vehicle Outlook 2024—Data."

manufacturing specifically. This section considers sector-wide output and sales data alongside other sources to make inferences about trends in domestic production and sales of lithium-ion energy storage batteries.

Domestic energy storage battery manufacturing output fluctuated from 2000 through 2020, and then grew from 2020 through 2024 (see **Figure 6**).[21] From 2020 to 2024, inflation-adjusted output increased by 359%, which resulted in output reaching the highest level on record since at least 1997.[22] Additionally, the 121% growth rate from 2021 to 2022 was the highest annual growth rate on record since at least 1997.[23] The sector-wide data obscure some underlying industrial shifts that occurred during the 2010s, which are described below.

Figure 6. Gross Output of Energy Storage Battery Manufacturing

(2017 constant dollars)



Source: CRS, using data covering Storage Battery Manufacturing from the dataset "U.Real Gross Output by Industry – Detail Level" from the Bureau of Economic Analysis (BEA) Interactive Data Tables tool for Gross Domestic Product by Industry.

Note: The data are inflation-adjusted by BEA with a base year of 2017.

A compositional shift away from lead-acid[24] energy storage batteries and toward other types of energy storage batteries occurred in the domestic battery manufacturing industry during the 2010s and early 2020s. The shipment value of domestically produced non-lead-acid energy storage batteries increased from $0.7 billion in 2013 to $16.6 billion in 2022, while the shipment value of domestically produced lead-acid energy storage batteries decreased from $5.3 billion in 2013 to

[21] CRS analysis of data covering storage battery manufacturing from the dataset "U.Real Gross Output by Industry – Detail Level" from BEA's Interactive Data Tables tool for Gross Domestic Product by Industry.

[22] Ibid.

[23] Ibid.

[24] Lead-acid batteries and lithium-ion batteries are different types of batteries that can sometimes be used for similar purposes.

$2.2 billion in 2022.[25] These trends show non-lead-acid energy storage batteries' share growing from 11% in 2013 to 88% in 2022.[26] This shift toward domestically produced non-lead-acid batteries coincided with growth in U.S. domestic exports of lithium-ion energy storage batteries during the same time period (illustrated in **Figure 3**). Additionally, a wide range of industry and academic reports identify lithium-ion battery factories starting or expanding production in the United States during the 2010s and early 2020s.[27]

The trends in U.S. shipment value, domestic export value, and import value indicate onshoring in the end-use segments of the battery supply chain during the 2010s and early 2020s. Generally, the shipment value of domestically produced non-lead-acid energy storage batteries increased more than imports of such and exports of such from 2013 to 2022.[28] As a result, the proportion of completed non-lead-acid batteries consumed in the United States that were from domestic manufacturers increased. In 2022, approximately half of finished non-lead-acid energy storage batteries purchased or shipped in the United States in 2022 were from domestic manufacturers.[29] Additionally, in 2022, approximately 90% of U.S. shipments of completed non-lead-acid energy storage batteries from U.S. manufacturers went to entities in the United States.[30]

Employment is a measure and outcome of economic activity. The U.S. Bureau of Labor Statistics (BLS) publishes employment data on a wide range of industries, including the battery manufacturing industry. BLS does not always publish data at all levels of detail. For the battery manufacturing industry, BLS does not publish data specifically on advanced lithium-ion energy storage battery manufacturing. BLS does publish more general data covering the total battery manufacturing industry that might provide insights into the underlying advanced lithium-ion energy storage battery manufacturing industry when considered with other data sources. The

[25] Census Bureau, "Economic Surveys: AM1631VS101 Annual Survey of Manufactures: Value of Products Shipments: Value of Shipments for Product Classes: 2016, 2015, 2014 and 2013," accessed January 21, 2025, https://data.census.gov/table?d= ECNSVY+Annual+Survey+of+Manufactures+Annual+Survey+of+Manufactures+Value&p= 335911:3359111:3359114:3359118; Census Bureau, "Economic Census: EC1700NAPCSPRDINDAll Sectors: Products by Industry for the U.S.: 2017," accessed January 21, 2025, https://data.census.gov/table?g=010XX00US&y= 2017&d=ECN+Core+Statistics+Economic+Census&n=00&napcs= 2030050000:2030075000:2030075003:2030075006:2030100000:2030125000; and Census Bureau, "Economic Census: EC2200NAPCSPRDIND," accessed June 30, 2025, https://data.census.gov/table/ ECNNAPCSPRD2022.EC2200NAPCSPRDIND.

[26] Percent Non-Lead-Acid calculated by CRS as the non-lead-acid value divided by the sum of the non-lead-acid value and lead-acid value.

[27] Martinez, "GM Begins Work at Brownstown Lithium Ion Battery Plant; Set for 2010 Opening"; PR NewsWire, "LG Chem's Holland Plant Accelerates Battery Production"; WardsAuto, "LG Chem Details Cell-Making Process at Michigan Plant"; Wilson, "Timeline: Tesla's Construction of Gigafactories"; Zhou et al., *Lithium-Ion Battery Supply Chain for E-Drive Vehicles in the United States: 2010-2020*; Ron Selak, "100 Million Battery Cells Produced at Lordstown Plant," *The Vindicator*, December 6, 2024, https://www.vindy.com/news/local-news/2024/12/100-million-battery-cells-produced-at-lordstown-plant; Akasol, "Akasol Enters North American Market with New Production Facility," press release, June 26, 2019, https://web.archive.org/web/20220124070529/https://www.akasol.com/en/news-akasol-location-usa; and Jackie Charniga, "EV Battery Company Akasol to Lay Off 188 Metro Detroit Workers," *Detroit Free Press*, February 8, 2025, https://www.freep.com/story/money/cars/2025/02/18/ev-battery-company-akasol-borg-warner-lay-off-188-workers/79080233007/.

[28] Shipment value of domestically produced non-lead-acid energy storage batteries increased by $15.9 billion from 2013 to 2022. Imports of non-lead-acid energy storage batteries increased by $12.8 billion. Exports of non-lead-acid energy storage batteries increased by $0.9 billion. The sum of the increase in imports and exports is 12.5 billion, which is less than the increase in shipment value of domestically produced non-lead-acid batteries.

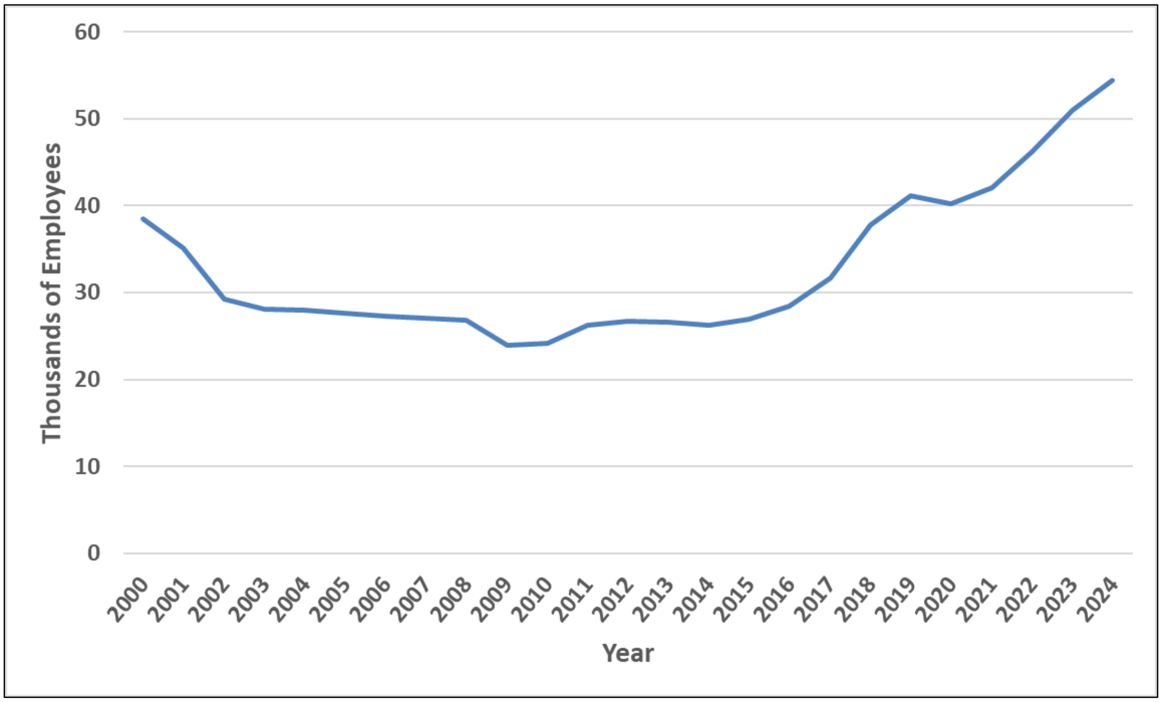
[29] Calculated by CRS as (domestic shipments – exports) ÷ (domestic shipments – exports + imports).

[30] Calculated by CRS as (domestic shipments – exports) ÷ (domestic shipments + exports).

lithium-ion battery manufacturing industry may not compose a majority of storage battery manufacturing employment, but it may compose enough to be a contributor to the overall trend.

Battery manufacturing employment was higher in 2024 than in any previously recorded year since 1972.[31] Battery manufacturing employment grew at successively accelerating rates from 2015 through 2018 and from 2021 through 2023 (see **Figure 7**).[32] Growth continued in 2024, and employment in battery manufacturing reached a new record high of 54,400 employees in 2024, while employment in the entire manufacturing sector decreased.[33]

Figure 7. Battery Manufacturing Employment in the United States



Source: CRS, using Current Employment Statistics Survey (National) data covering North American Industry Classification System (NAICS) code 33591 from the Bureau of Labor Statistics' One Screen Data Tool.

Note: Accelerated decreases in 2001, 2002, 2009, and 2020 occurred during economic recessions.

The confluence of these trends in employment, output, sales, prices, imports, and exports indicates the growth of the lithium-ion energy storage battery manufacturing industry in the United States in recent years. This growth appears to have largely occurred within the more final-stage assembly activities rather than in materials and components manufacturing.

Domestic Supply Chain Investments

This section examines data trends for planned investment increases in manufacturing facilities for advanced lithium-ion batteries and their components across the domestic supply chain and different manufacturing processes. The manufacturing process and supply chain for advanced

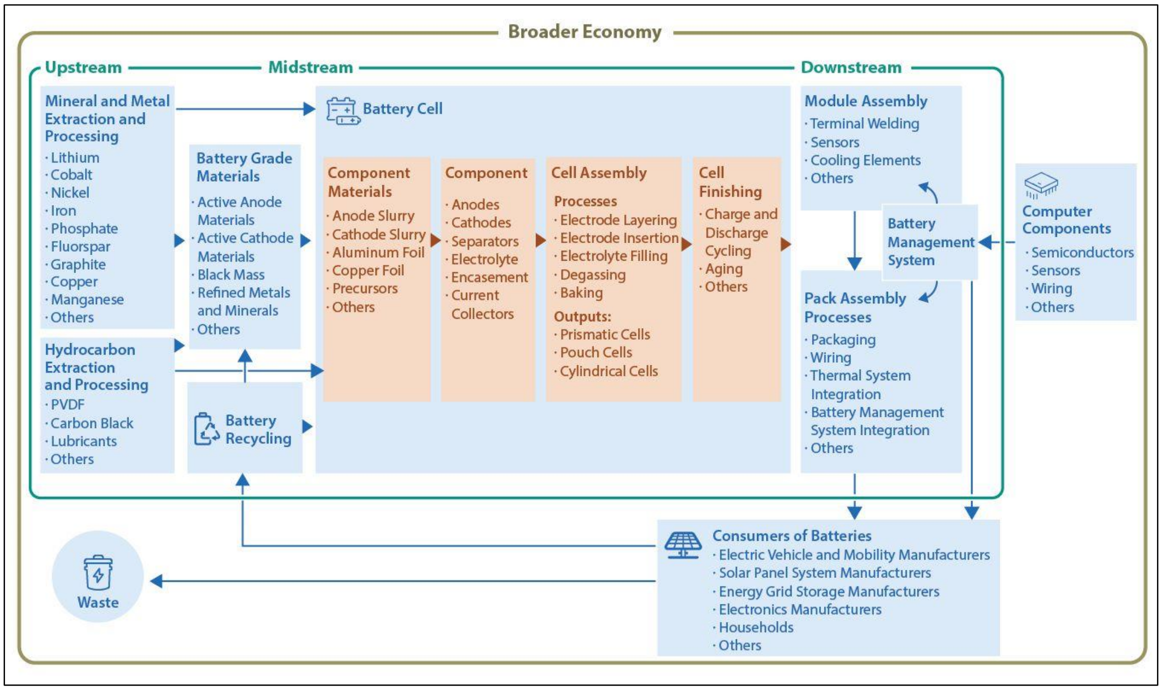
[31] CRS analysis of data from Current Employment Statistics Survey (National) covering North American Industry Classification System (NAICS) code 33591 from BLS's One Screen Data Tool.

[32] Ibid.

[33] Ibid.

lithium-ion energy storage batteries can be complex and is sometimes spread vertically across multiple entities.[34] The entire process, from raw material extraction through completion of an end-use battery pack, may involve multiple international entities. **Figure 8** shows a conceptual schematic of this supply chain to visualize, interpret, and clarify the battery industry investments, relationships, and potential imbalances discussed in this section.

Figure 8. Lithium-Ion Battery Supply Chain



Source: CRS.

Notes: The labeling of upstream, midstream, and downstream segments is a common technique in industrial policy and supply chain analysis. It is designed to help policymakers and analysts process information and understand the relationships between supply chain participants. A wide range of sources classify activities into the segments as illustrated here. PVDF = polyvinylidene fluoride.

Segmentation of the battery manufacturing supply chain and its activities can be a tool to help policymakers understand how investments up and down the supply chain may relate to each other. As illustrated in **Figure 8**, the battery manufacturing supply chain has three main segments: (1) upstream, (2) midstream, and (3) downstream. Each segment has its own industrial processes, relationships, and material flows. The upstream segment includes activities such as raw material extraction and industrial supplies production. Midstream activities entail taking upstream

[34] Sarah Scott and Robert Ireland, *Lithium-Ion Battery Materials for Electric Vehicles and Their Global Value Chains*, USITC, Working Paper ID-068, June 2020, https://www.usitc.gov/publications/332/working_papers/gvc_overview_scott_ireland_508_final_061120.pdf; Coffin and Horowitz, "The Supply Chain for Electric Vehicle Batteries"; Department of Energy (DOE), *2021-2024 Four-Year Review of Supply Chains for the Advanced Batteries Sector*, December 2024, https://www.energy.gov/sites/default/files/2024-12/20212024-Four%20Year%20Review%20of%20Supply%20Chains%20for%20the%20Advanced%20Batteries%20Sector.pdf; Jon Bokrantz et al., "Unravelling Supply Chain Complexity in Maintenance Operations of Battery Production," *Production Planning & Control*, vol. 1, no. 22 (October 2024), https://doi.org/10.1080/09537287.2024.2414334; Johann-Philip Abramowski et al., "Building Blocks for an Automated Quality Assurance Concept in High Throughput Battery Cell Manufacturing," *Procedia CIRP*, vol. 120 (2023), https://doi.org/10.1016/j.procir.2023.09.097; and Jacob Wessel et al., "Traceability in Battery Cell Production," *Energy Technology*, vol. 11, no. 5 (May 2023), https://onlinelibrary.wiley.com/doi/epdf/10.1002/ente.202200911.

products as inputs, processing them into discrete battery cell components,[35] and then assembling those components into battery cells. Participants in the downstream segment assemble battery cells into battery modules and packs that have suitable characteristics for each end use, such as EVs, grid storage, and electronics.

Generally, a completed advanced lithium-ion battery contains components and elements typically produced by different supply chain participants. A completed end-use advanced lithium-ion energy storage battery is a battery pack containing battery modules and a battery management system.[36] A battery module contains battery cells and elements of the battery management system. A battery cell contains an anode, a cathode, an electrolyte, and a separator. Anodes and cathodes are made of certain active materials and current collector foil, among other materials. These parts are complex, often contain plastics and rubbers, and are made from raw materials such as lithium, cobalt, iron, phosphate, fluorspar, graphite, copper, and aluminum.

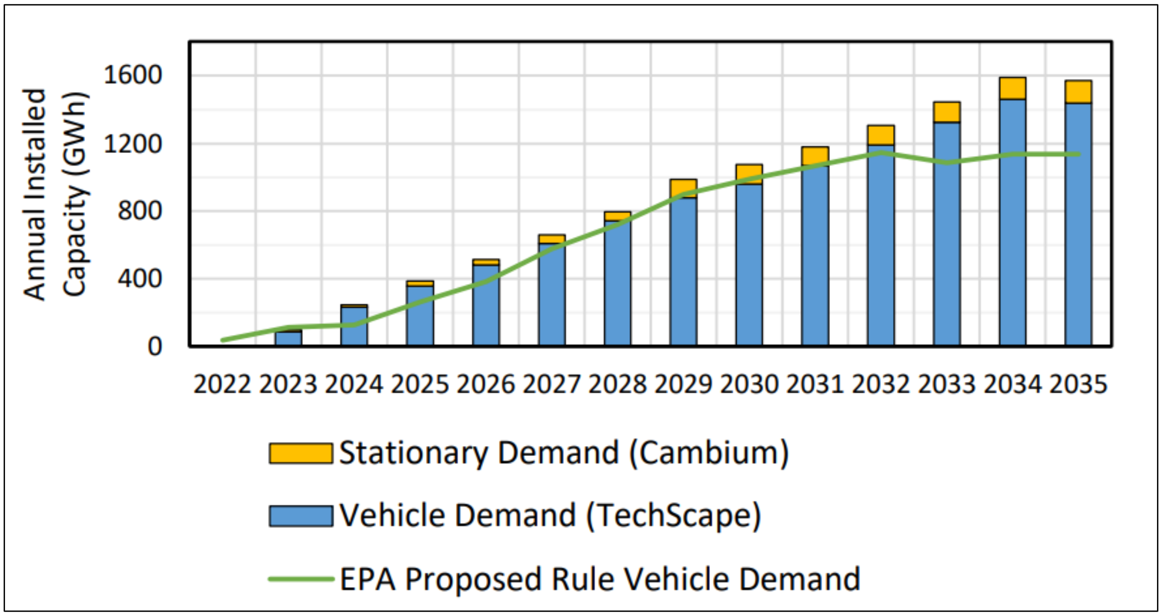
Over the last decade, there has been slow and iterative growth of the battery manufacturing supply chain. Although some elements of the domestic supply chain grew, data trends for production and investments in different manufacturing facility types indicate that this was not uniformly so across the supply chain. Generally, during the 2010s and early 2020s, growth in the domestic battery manufacturing industry tended to occur more in the downstream final-stage assembly activities, such as battery pack, battery module, and EV assembly, with such assemblers partially relying on imports for battery cell components and battery cells. While some increases in battery cell manufacturing capacity in the United States occurred during the 2010s, such increases generally tended to be smaller than capacity increases in pack and module assembly. Trends in recent investment announcements indicate that manufacturers may be in the process of onshoring the battery cell assembly activities; however, there may also be continued imbalances in the components that cell assemblers require.

A number of sources indicate that such investment increases in cell assembly might be sufficient to meet projected total demand for batteries in sold products (see **Figure 9** for one example), but the planned investment increases in some cell component and active material manufacturing activities might be insufficient to meet the needs of cell assemblers.

[35] For definitions of *battery cell* and *battery cell components*, among other terms used in this report, see the **Appendix**.

[36] For definitions of *battery pack* and *battery management system*, among other terms used in this report, see the **Appendix**.

Figure 9. U.S. Lithium-Ion Projected Battery Demand



Source: David Gohlke et al., *Quantification of Commercially Planned Battery Component Supply in North America Through 2035*, Argonne National Laboratory (Argonne), March 2024, https://publications.anl.gov/anlpubs/2024/03/187735.pdf. CRS retrieved the chart from Gohlke et al., who had combined data from Argonne's TechScape dataset, the Cambium dataset of the National Renewable Energy Laboratory, and EPA rule documents from 2023 related to emissions standards for light-, medium-, and heavy-duty vehicles to generate this figure. According to Gohlke et al.'s analysis and charting, these projections show increased usage from different consumers of batteries from 2022 to 2035. For more information on methods and data used to generate this figure, see Gohlke et al., *Quantification of Commercially Planned Battery Component Supply in North America Through 2035*, pp. 9 and 10.

Cell Assembly Planned Capacity Increases with Demand

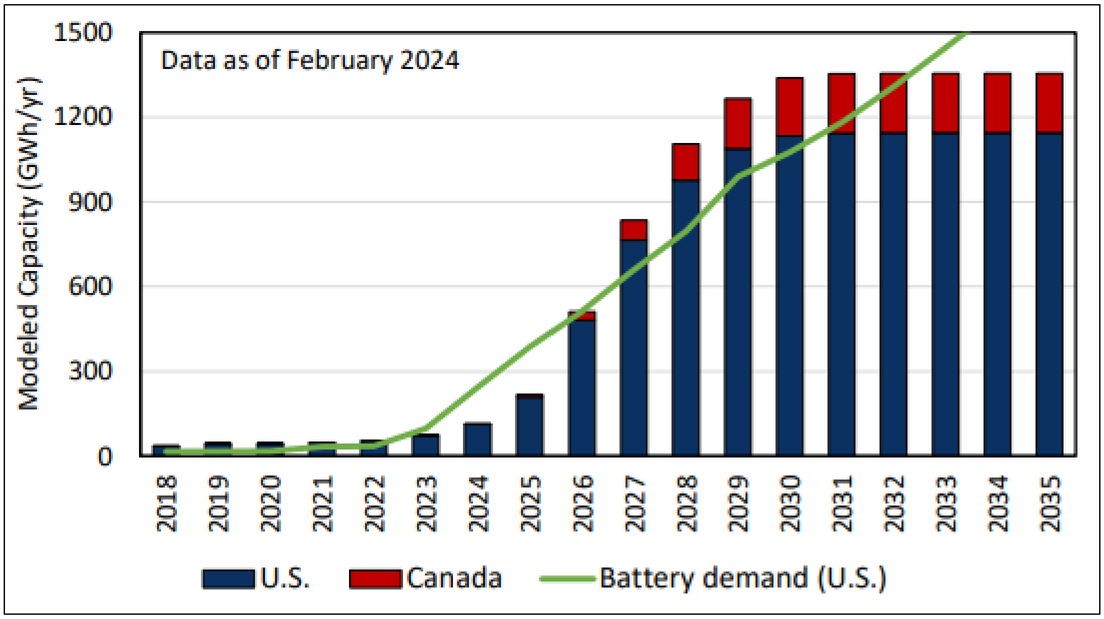
A wide range of sources project that investments in cell assembly facilities are increasing to meet projected demand from consumers of batteries. According to data compiled and modeled by Argonne National Laboratory (Argonne) on investment announcements made by manufacturers, U.S. production capacity of battery cells is projected to grow from 2018 through 2035 to meet the projected growth in domestic battery demand (see **Figure 10**).[37] The Environmental Defense Fund projects that announced future capacity for final battery manufacturing is high enough to meet demand from EV manufacturers.[38] Some of these assembly facilities may be owned and operated by automotive companies, some may be joint ventures with automotive companies, and some may be unrelated to automotive companies.[39]

[37] Gohlke et al., *Quantification of Commercially Planned Battery Component Supply in North America Through 2035*.

[38] EDF, *U.S. Electric Vehicle Battery Manufacturing on Track to Meet Demand*, December 2023, https://www.edf.org/sites/default/files/2023-12/EDF%20Analysis%20on%20US%20Battery%20Capacity%2012.13.23%20final%20v3.pdf.

[39] Gohlke et al., *Quantification of Commercially Planned Battery Component Supply in North America Through 2035*.

Figure 10. Projected Lithium-Ion Cell Production Capacity



Sources: Gohlke et al., *Quantification of Commercially Planned Battery Component Supply*; and Tsisilile A. Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry*, Argonne, February 2024, https://publications.anl.gov/anlpubs/2024/03/187907.pdf.

Notes: CRS retrieved this figure from Gohlke et al. The bars represent projected capacity, and the line represents projected demand. When projecting production capacity contained in this chart, Gohlke et al. used announcements made by private companies and included adjustments for qualitative evaluations of how concrete the plans are. Gohlke et al. retrieved projected demand estimates from Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry*, which models market data and policy conditions to estimate projected demand.

Component Planned Capacity Increases Less Than Cell Capacity

Although the domestic increase in cell assembly capacity is projected by researchers to meet future demand, this is projected not to be the case for the components required by cell assemblers. According to a range of sources, planned investment in domestic facilities for cell component and battery grade materials appears to lag behind projected cell assembly capacity. According to data compiled and modeled by Argonne, certain component types may not have sufficient capacity to meet the projected expansion in cell assembly capacity. A 2024 McKinsey & Company report also projects that North American capacity for components will be less than the demand for those components.[40] A 2024 Carnegie Endowment report also found that facility capacity for cell components is relatively underrepresented in the United States compared with facility capacity for battery cells.[41] The components and materials with future capacity projected to be less than future cell capacity and demand include (1) anode and cathode materials (electrode materials), (2) current collector foil, and (3) separators; all key components of advanced lithium-ion batteries. In

[40] Jakob Fleischmann, *The Battery Cell Component Opportunity in Europe and North America*, McKinsey & Company, Battery Accelerator Team and Automotive & Assembly Practice, April 18, 2024, https://www.mckinsey.com/industries/automotive-and-assembly/our-insights/the-battery-cell-component-opportunity-in-europe-and-north-america#/.

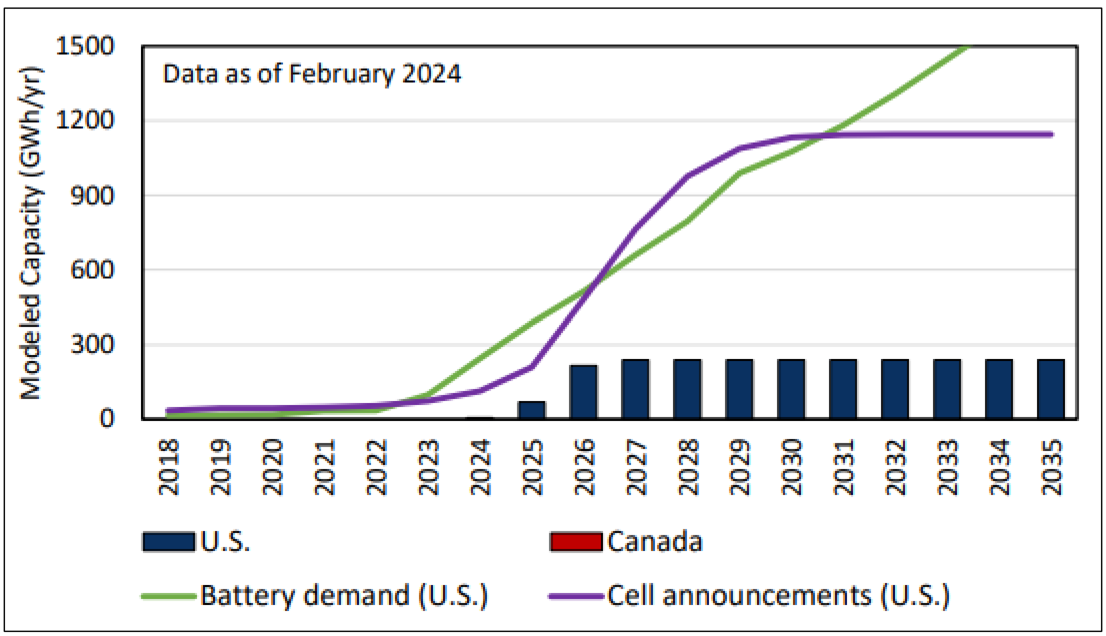
[41] Varun Sivaram et al., *Winning the Battery Race: How the United States Can Leapfrog China to Dominate Next-Generation Battery Technologies*, Carnegie Endowment for International Peace, October 2024, https://carnegie-production-assets.s3.amazonaws.com/static/files/Sivaram%20Gordon%20-%20Battery%20Race-2024.pdf.

particular, current collector foil manufacturing (see **Figure 11** and **Figure 12**) and separator manufacturing (see **Figure 13**) may be areas where planned domestic investment particularly appears to lag behind demand.

Cell Component Supply Chain and Policy Uncertainty

Uncertainty regarding supply, demand, and public policy may be contributing factors to the potential underinvestment in electrode materials, current collector foil, and separators. Argonne suggests that potential domestic manufacturers of cell components and active materials may be waiting for more upstream and downstream investments to materialize before they commit to investments themselves; these midstream manufacturers may need a market for both suppliers and customers to further materialize before they can manifest investments themselves. Additionally, certain aspects of the IIJA and rulemaking process may have introduced ambiguity regarding some cell component manufacturer's eligibility for certain production tax credits. For example, some current collector manufacturers and separator manufacturers may have been unsure whether they would receive certain tax credits pursuant to the FY2022 reconciliation act (P.L. 117-169) because cathode foils are not explicitly listed in the statute as other components were.[42] The Internal Revenue Service (IRS) later clarified that cathode foils and separators are eligible for credits pursuant to the FY2022 reconciliation act.[43]

Figure 11. Aluminum Current Collector Foil Planned Capacity



Sources: Gohlke et al., *Quantification of Commercially Planned Battery Component Supply*; and Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry.*

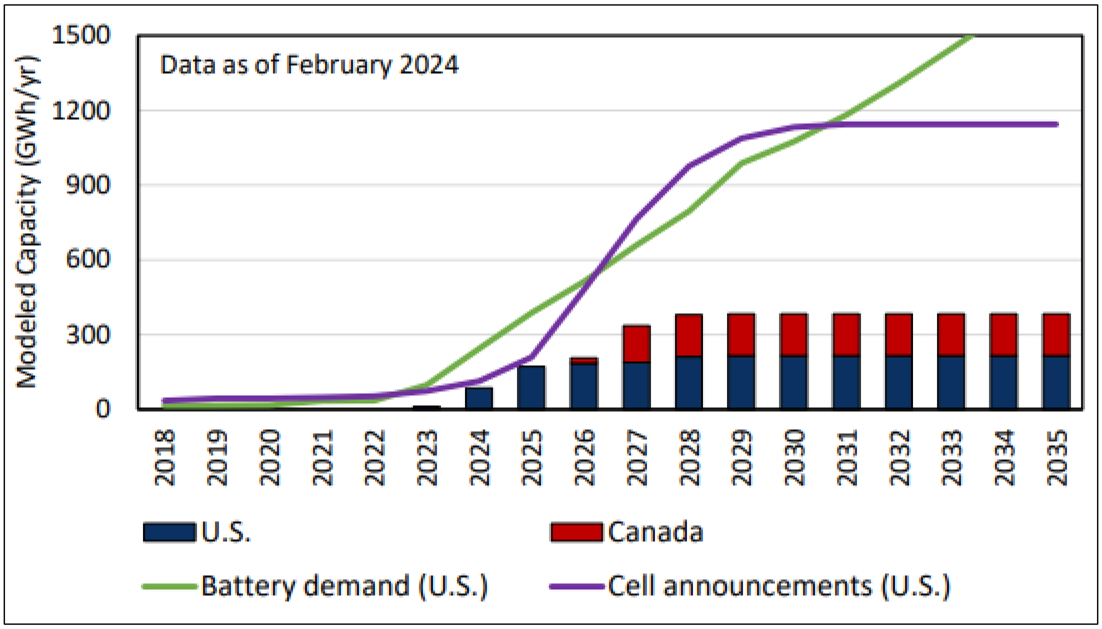
Notes: CRS retrieved this figure from Gohlke et al. The bars represent projected capacity, the green line represents projected battery demand (see **Figure 10**), and the purple line represents projected cell

[42] Ibid.

[43] Internal Revenue Service (IRS), "Section 45X Advanced Manufacturing Production Credit," 88 *Federal Register* 86844, December, 15, 2023, https://www.federalregister.gov/documents/2023/12/15/2023-27498/section-45x-advanced-manufacturing-production-credit; and IRS, "Advanced Manufacturing Production Credit," 89 *Federal Register* 85798, October 28, 2024, https://www.federalregister.gov/documents/2024/10/28/2024-24840/advanced-manufacturing-production-credit.

announcements (see **Figure 10**). When projecting current collector production capacity, Gohlke et al. used announcements made by private companies and included adjustments for qualitative evaluations of how concrete the plans are. Gohlke et al. retrieved projected demand estimates from Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry*, which models market data and policy conditions to estimate projected demand.

Figure 12. Copper Current Collector Foil Planned Capacity



Sources: Gohlke et al., *Quantification of Commercially Planned Battery Component Supply*; and Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry.*

Notes: CRS retrieved this figure from Gohlke et al. The bars represent projected capacity, the green line represents projected battery demand (see **Figure 10**), and the purple line represents projected cell announcements (see **Figure 10**). When projecting current collector production capacity, Gohlke et al. used announcements made by private companies and included adjustments for qualitative evaluations of how concrete the plans are. Gohlke et al. retrieved projected demand estimates from Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry*, which models market data and policy conditions to estimate projected demand.

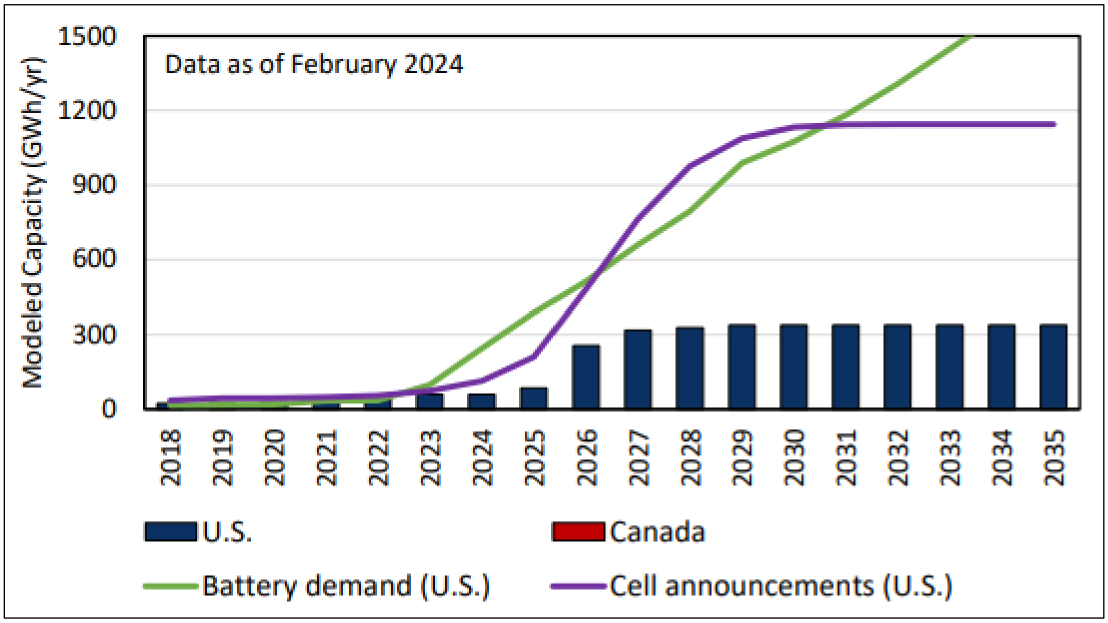
Public comments in the *Federal Register* related to separators are illustrative of how statutory construction and the rulemaking process can impact market and policy uncertainty for market participants.[44] For example, ENTEK Lithium Separators, a U.S. separator manufacturer, stated that "separators were not explicitly included in the definition of qualifying battery components" in the FY2022 reconciliation act and that inclusion of separators in the IRS rulemaking would reduce "ambiguity" and provide "clarity" for the entire supply chain.[45] The IRS included separators in the final rulemaking, which was published two years after enactment of the FY2022

[44] IRS, "Advanced Manufacturing Production Credit," 89 *Federal Register* 85798; ENTEK Lithium Separators LLC (ENTEK), "ENTEK Notice 2022-47 Comment Letter," February 2, 2023, https://www.regulations.gov/comment/IRS-2022-0021-0264; and IRS, Notice 2022-47, https://www.regulations.gov/document/IRS-2022-0021-0001/comment?filter=separator.

[45] ENTEK, "Comments on IRS REG-107423-23," February 13, 2024, https://www.regulations.gov/comment/IRS-2023-0063-0103.

reconciliation act.[46] As suggested by Argonne and market participants, such time and ambiguity could have contributed to underinvestment.

Figure 13. Separator Planned Capacity



Sources: Gohlke et al., *Quantification of Commercially Planned Battery Component Supply*; and Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry*.

Notes: CRS retrieved this figure from Gohlke et al. The bars represent projected capacity, the green line represents projected battery demand (see **Figure 10**), and the purple line represents projected cell announcements (see **Figure 10**). When projecting current collector production capacity, Gohlke et al. used announcements made by private companies and included adjustments for qualitative evaluations of how concrete the plans are. Gohlke et al. retrieved projected demand estimates from Barlock et al., *Securing Critical Materials for the U.S. Electric Vehicle Industry*, which models market data and policy conditions to estimate projected demand.

The data aggregation and modeling performed by Argonne and others indicate that the IIJA and FY2022 reconciliation act may be having an impact on investment announcements in some subsegments of the industry, such as cell assembly and electrode material manufacturing, but the investment impact on some other activities, such as separator and foil manufacturing, may be more limited.[47] More battery manufacturing facilities are operating, under construction, or planned in the United States than before the FY2022 reconciliation act and the IIJA were passed, but a wide range of preexisting trends (e.g., vehicle electrification, solar industry growth, other federal policies) and policies may have also contributed to this increase.[48]

Uncertainty Can Affect Investments

Data trends discussed in this report are based on companies' stated plans, which are subject to change and fundamental uncertainty. Private-sector investment plans generally are made with certain assumptions or expectations about current and future market and policy conditions. Fundamental uncertainty about such conditions, and changes to the perceptions of conditions, generally are factors that can affect business investment

[46] IRS, "Section 45X Advanced Manufacturing Production Credit," 88 *Federal Register* 86844; and IRS, "Advanced Manufacturing Production Credit," 89 *Federal Register* 85798.

[47] Gohlke et al., *Quantification of Commercially Planned Battery Component Supply in North America Through 2035*.

[48] Ibid.

commitments. For example, if a private entity in the supply chain perceives uncertainty regarding its eligibility or the continued existence of a particular funding program, this uncertainty might be reflected in its investment plans. Furthermore, if expectations around policy or market conditions change, planned investments could change. Company announcements on prospective investments may not materialize into actual investments if participants' perceptions and evaluations of current and future policy and market conditions change.

In 2025, several battery manufacturing companies announced investment cancellations or closures of existing facilities.[49] Examples of cancellations include

- Kore Power's $1.3 billion planned investment in Arizona,[50]
- Freyr Battery's $2.6 billion planned investment in Georgia,[51] and
- Amprius Technologies planned investment in Colorado.[52]

Some of the companies cited market dynamics, such as falling battery prices,[53] as well as policy conditions as contributing to their cancellations.[54]

Policy Options for Congress

This section discusses past congressional actions related to battery manufacturing and discusses some policy options for Congress to consider.

Congress has enacted legislation that may have affected the development of a battery supply chain based in North America and other countries with which the United States has or has historically had a free trade agreement. Such legislation includes elements contained within broad statutes such as the Energy Policy Act of 2005 (EPAct; P.L. 109-58); Energy Independence and Security Act of 2007 (EISA; P.L. 110-140); Emergency Economic Stabilization Act of 2008 (EESA; P.L. 110-343); American Recovery and Reinvestment Act of 2009 (ARRA; P.L. 111-5); the IIJA; the FY2022 reconciliation act (P.L. 117-169); and the FY2025 reconciliation act (P.L. 119-21).

While some advanced lithium-ion battery manufacturing activities, such as pack and module assembly, increased in the United States coinciding with the enactment of these laws,[55] other U.S.-based activities might not have grown, potentially resulting in U.S. manufacturers'

[49] Kate Magill, "Clean Energy Manufacturers Cancel Projects as Trump-era Policies Take Hold," *ConstructionDive*, April 25, 2025, https://www.constructiondive.com/news/inflation-reduction-act-canceled-projects-q1-2025-kore-freyr/746353/; National Association of Manufacturers News Room, "EV, Battery Plants Being Canceled," *National Association of Manufacturers*, April 10, 2025, https://nam.org/ev-battery-plants-being-canceled-33746/; Saijel Kishan, "Ghost Factories Are a Warning Sign for Green Manufacturing's Future," *Bloomberg*, July 5, 2025, https://www.bloomberg.com/news/features/2025-07-05/ghost-factories-are-a-warning-sign-for-green-manufacturing-s-future.

[50] Nathan Owens, "Kore Power Nixes Plans for 1.25B Battery Plant in Arizona," *ManufacturingDive*, February 6, 2025, https://www.manufacturingdive.com/news/kore-power-nixes-plans-for-1-25-billion-battery-cell-plant-buckeye-arizona/739430/.

[51] Jeff Amy, "Battery Firm Abandons Plan for a $2.6 Billion Plant in Georgia," *AP News*, February 7, 2025, https://apnews.com/article/georgia-freyr-electric-battery-plant-newnan-5b718f627462bb1d5cc3bf4d835ae879.

[52] Olivia Young, "Lithium-Ion Battery Manufacturer Puts Controversial Colorado Plant on Hold," *CBS News*, July 4, 2025, https://www.cbsnews.com/colorado/news/lithium-ion-battery-manufacturer-controversial-colorado-plant-hold/.

[53] Laura Camper and Clay Neely, "Freyer Battery Abondons Proposed $2.6 Billion Georgia Factory," *Times Herald*, February 6, 2025, https://www.times-herald.com/news/freyr-battery-abandons-proposed-2-6-billion-georgia-factory/article_bd1d4dd0-e49f-11ef-94be-1f58670d5df4.html.

[54] Amprius Technologies, "Letter to Shareholders Q1 2025," https://d1io3yog0oux5.cloudfront.net/_15d603107655b0c3011d6824064af26b/amprius/db/2337/25775/letter_to_shareholders/Amprius+Technologies+Q1+2025+Letter+to+Shareholders.pdf.

[55] See "Domestic Battery Manufacturing Output and Employment."

continued reliance on imports for battery cells, battery cell components, and battery grade materials. Reliance on imported components and materials may result in certain congressional concerns related to supply chain resiliency continuing to go unaddressed in the industry.

Congress may continue to engage in oversight activities to assess the effect of implemented legislation. Congress also may engage in legislative activities that could affect the industry. Such options might be broadly broken into four categories: (1) options that affect product demand, (2) options that address product supply, (3) options that affect trade and promote domestic manufacturing, and (4) options that increase reporting on and visibility into the effect of policy.

The FY2025 reconciliation act (P.L. 119-21) contains provisions affecting the battery manufacturing industry. The changes contained in P.L. 119-21 could, in some cases, affect demand for batteries and the cost of certain upstream inputs; the provisions in P.L. 119-21 affecting the battery industry tend to do so by rescinding, striking, or amending language in the FY2022 reconciliation act.

Continued Oversight

Congress could continue oversight to determine the effect of previous legislative actions on the battery manufacturing industry. Congress might monitor the ways that the executive branch continues to implement the IIJA, FY2022 reconciliation act (P.L. 117-169), FY2025 reconciliation act (P.L. 119-20), and other statutes and whether these priorities align with those of Congress. Congress might assess whether the existing efforts, such as the production tax credits implemented pursuant to the FY2022 reconciliation act and FY2025 reconciliation act, are achieving desired aims. Congress might also assess the sufficiency of the grants and loans authorized by the IIJA, both in effect and availability of funding. Stakeholder groups may have conflicting views, with continued oversight seen as reflecting policy stability or reflecting a shift in congressional focus. The extent to which these programs impact the budget and government expenditures may be a particular area of congressional interest.

Product Demand

Congress might address aspects of the lithium-ion battery manufacturing industry by affecting end-user demand for batteries. End-user demand for batteries is driven by battery consumers, such as EV manufacturers, renewable energy system manufacturers, and households. Congress could consider augmenting certain existing policies and programs related to demand for battery manufacturing, such as (1) EV purchaser tax credits, (2) energy tax credits, (3) domestic preference statutes, and (4) EV research and development programs.

Numerous statutes enacted from 1978 through 2025 may have affected demand for advanced batteries, with some recent statutory changes occurring in the 117th and 119th Congresses. Certain provisions in the FY2022 reconciliation act (P.L. 117-169), for example, were regarded as tending to increase demand for advanced batteries by expanding, augmenting, or extending programs authorized under previously enacted statutes such as EPAct, EESA, and ARRA. The FY2025 reconciliation act (P.L. 119-21) contains a range of provisions that could affect consumption of products that contain or use advanced batteries; those provisions tend to reduce the scope and duration of certain provisions of the reconciliation act.[56] The potential impact of the FY2025 reconciliation act on the battery industry will partially depend on how reliant EV and renewable energy consumption is on the consumption subsidies enacted in prior Congresses. On the one

[56] Such provisions include §70502, which sets to expire EV tax credits and §§70513 and 70512, which set to expire some energy tax credits.

hand, if consumption of EVs, renewable energies, and other products that contain batteries is resilient to the removal of consumption subsidies, then the effects on battery demand may be limited. On the other hand, if consumption of products that contain or use batteries is more sensitive to these subsidy removals, then the battery industry could experience a larger change in consumer demand that may affect sales.

EV Tax Credits

Modifying EV tax credits might affect the battery manufacturing industry because EV manufacturers are one of the leading end-use purchasers of advanced batteries.[57] EV purchaser tax credits ended as of October 1, 2025, under P.L. 119-21.[58] Prior to the enactment of P.L. 119-21, tax credits for EVs had most recently been modified by the FY2022 reconciliation act (P.L. 117-169). Pursuant to Section 13401 of the FY2022 reconciliation act, individuals purchasing new EVs were eligible to receive tax credits provided that the EV and the battery contained within it meet certain sourcing requirements, such as being assembled in North America with battery-active materials from the United States or certain other qualifying countries.

Congress has incrementally revised EV purchaser tax credits since the establishment of the first EV tax credit in 2008. Section 13401 of the FY2022 reconciliation act, enacted in 2022, eliminated a previously established cap on the number of vehicles sold by a manufacturer that can qualify and created some sourcing and assembly requirements for EVs and their batteries. Specifically, the FY2022 reconciliation act requires that (1) qualifying EVs be assembled in North America; (2) certain percentages of a qualifying EV battery's component parts be manufactured or assembled in North America; (3) certain percentages of the EV battery's mineral inputs be sourced from the United States, be sourced from a country that has a free trade agreement with the United States, or be recycled in North America; and (4) none of the EV battery's component parts or critical minerals come from a foreign entity of concern.[59] The FY2022 reconciliation act did not require that EVs or their batteries be manufactured in the United States to qualify for the tax credits.[60]

The FY2022 reconciliation act did not include domestic sourcing requirements in tax code Section 45W, which allowed businesses purchasing EVs to receive tax credits between $7,500 and $40,000 per vehicle.[61] In some cases, vehicle dealerships appear to have received the Section 45W credit for foreign-made EVs and passed the benefits of the credit to consumer lessees in the form of reduced down payments.[62] This circumstance would allow consumers to benefit from the EV tax credits when leasing foreign-made EVs, potentially undercutting domestic battery supply

[57] International Energy Agency (IEA), *Batteries and Secure Energy Transitions*, 2024, https://www.iea.org/reports/batteries-and-secure-energy-transitions/executive-summary.

[58] Electric vehicles acquired after September 30, 2025, would no longer be eligible for tax credits under 26 U.S.C. §25E, 26 U.S.C. §30D, or 26 U.S.C. §45W.

[59] P.L. 117-169; and CRS In Focus IF12603, *The Tax Credit Exception for Leased Electric Vehicles*, by Nicholas E. Buffie.

[60] The United States is not the only location that can satisfy the requirements. For more information, see Chad P. Bown, *Industrial Policy for Electric Vehicle Supply Chains and the US-EU Fight over the Inflation Reduction Act*, Peterson Institute for International Economics, May 2023, https://www.piie.com/sites/default/files/2023-05/wp23-1.pdf; and Lee Harris, "Union Leader: Stellantis Will Send Electric-Vehicle Jobs to Mexico," *American Prospect*, December 14, 2022, https://prospect.org/labor/stellantis-will-send-electric-vehicle-jobs-to-mexico/.

[61] CRS In Focus IF12600, *Clean Vehicle Tax Credits*, by Donald J. Marples and Nicholas E. Buffie; and CRS In Focus IF12603, *The Tax Credit Exception for Leased Electric Vehicles*, by Nicholas E. Buffie.

[62] CRS In Focus IF12603, *The Tax Credit Exception for Leased Electric Vehicles*, by Nicholas E. Buffie.

chains in the process.[63] Research from the National Bureau of Economic Research (NBER) found that this particular policy had "negative domestic benefits" for the U.S. economy.[64]

The FY2022 reconciliation act EV tax credit expansion contributed to increased demand for EVs,[65] and the content restrictions might have shifted demand for EVs toward North American vehicle manufacturers, but it is unclear to what extent this extended to the U.S. battery manufacturing industry. Some research has found that the share of EVs with U.S.-assembled batteries decreased after enactment of the FY2022 reconciliation act and the IIJA.[66] This research attributes the decrease to the lack of existing U.S. production capacity for batteries relative to the increased demand for batteries. That same research found that announced investment in such battery manufacturing capacity was increasing.[67]

Under P.L. 119-21, enacted in July 2025, the EV tax credits were eliminated effective October 1, 2025. Historically, there has been a positive relationship between the EV tax credits and consumption of EVs,[68] and EV manufacturers are among the largest consumers of batteries.[69] Eliminating these tax credits might reduce demand for EVs, which in turn could reduce demand for batteries. If demand for EVs were to decrease, battery manufacturers might decrease investments, cancel prospective investments, or lower production in the U.S. battery industry in response. The extent to which this could occur may partially depend on how reliant demand for EVs is on the EV tax credits, the degree to which domestic battery industry is able to identify alternative markets beyond EVs, and whether or not existing manufacturing capacity already meets this new level of demand.

The elimination of EV tax credits might increase government tax revenues because consumers purchasing EVs would no longer be eligible for the credit. In addition, decreased use of EVs might contribute toward increased use of gas-powered vehicles, which might result in higher federal gas tax revenues.[70] According to estimates from the Joint Committee on Taxation (JCT), repeal of the three EV tax credits would reduce federal deficits by $190 billion over the FY2026-FY2034 time frame.[71]

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[63] Ibid.

[64] Hunt Allcott et al., *The Effects of "Buy American": Electric Vehicles and the Inflation Reduction Act*, NBER, December 2024, http://www.nber.org/papers/w33032.

[65] Allcott et al., *The Effects of "Buy American"*; and James Stekelberg and Thomas Vance, "The Effect of Transferable Tax Benefits on Consumer Intent to Purchase an Electric Vehicle," *Energy Policy*, vol. 186, article 113936 (March 2024), https://doi.org/10.1016/j.enpol.2023.113936.

[66] David Coffin and Jeff Walling, "Electrifying the Global BEV Landscape: Top Suppliers and Consumers of BEVs and BEV Batteries," *USITC Journal of International Commerce and Economics* (June 2024), https://www.usitc.gov/publications/332/journals/jice_electrifying_the_global_bev_landscape.pdf.

[67] Ibid.

[68] Allcott et al., *The Effects of "Buy American"*; and Stekelberg et al., "The Effect of Transferable Tax Benefits on Consumer Intent to Purchase an Electric Vehicle."

[69] IEA, *Batteries and Secure Energy Transitions*, 2024, https://www.iea.org/reports/batteries-and-secure-energy-transitions/executive-summary.

[70] CRS In Focus IF13064, *Electric Vehicle Taxes and the Federal Highway Trust Fund*, by Nicholas E. Buffie, Anthony A. Cilluffo, and Ali E. Lohman; and CRS Report R48472, *The Highway Trust Fund's Highway Account*, by Ali E. Lohman.

[71] P.L. 119-21 terminates the credit for vehicles acquired after September 30, 2025 (the last day of FY2025). In the JCT cost estimate for P.L. 119-21, tax credit termination is projected to raise $7.430 billion (from repeal of the used clean vehicle credit), $77.829 billion (from repeal of the clean vehicle credit), and $104.516 billion (from repeal of the credit for qualified commercial clean vehicles). The termination of the alternative fuel vehicle refueling property credit, which predominantly subsidizes the installation of electric vehicle charging equipment, is projected to raise $1.963 (continued...)

Congress has incrementally and iteratively modified the scope, duration, and qualifications of these EV tax credits since they were first introduced in 2008. P.L. 119-21 accelerates the phaseout of the credits, with previous statutes (e.g., ARRA and FY2022 reconciliation act) tending to extend the timeline of phaseouts. Congress may conduct oversight to evaluate the impacts of the elimination. If the impacts are consistent with congressional priorities, Congress may continue its oversight activities. Alternatively, if the impacts are not consistent with congressional priorities, Congress might consider establishing more narrowly scoped or modified tax credits with stricter content requirements. For example, it could enact United States-only assembly and mineral sourcing requirements rather than the general North American or trade-partner requirements established under the FY2022 reconciliation act.

Energy Tax Credits

Congress has iteratively and incrementally introduced, repealed or sunset, and reintroduced energy tax credits numerous times since they were first introduced in 1978. In 2022, the FY2022 reconciliation act (P.L. 117-169) was enacted and became the most recent law to expand and extend the scope and duration of such credits. The FY2022 reconciliation act included phaseouts or construction deadlines for the different credits with an array of different ending years ranging from 2025 through 2034. The FY2025 reconciliation act (P.L. 119-21) set the availability of some of these tax credits to expire at a faster pace than in the FY2022 reconciliation act (P.L. 117-169). Pursuant to P.L. 117-169, P.L. 119-21, and other previous legislation, entities that invest in or produce electricity from renewable or zero-emission energy sources may be eligible for tax credits under Internal Revenue Code (IRC) Sections 45, 45Y, 48, and 48E.[72] The FY2022 reconciliation act also established tax credits for investments in battery storage systems in IRC Sections 48 and 48E.[73]

P.L. 119-21 sets some of these tax credits to expire by the end of calendar year 2027. Specifically, Sections 70513 and 70512 of P.L. 119-21 eliminate the 48E and 45Y tax credits for wind and solar facilities placed in service after calendar year 2027. For other technologies (e.g., nuclear, geothermal, hydropower), the credit is set to phase out over a longer time frame than wind and solar credits.[74]

Modifying energy tax credits might affect the battery manufacturing industry because batteries often are used in conjunction with renewable energies, such as solar power and wind power systems.[75] A body of research suggests that the previous versions of these tax credits (the IRC Section 48 and 45 tax credits) increased demand for renewable energy.[76] This in turn may have

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billion over the same period. See U.S. Congress, JCT, *Estimated Revenue Effects Relative to the Present Law Baseline of the Tax Provisions in "Title VII – Finance" of The Substitute Legislation as Passed by the Senate to Provide for Reconciliation of the Fiscal Year 2025 Budget*, JCX-35-25, 119th Cong., 1st sess., July 1, 2025, p. 5 (hereinafter JCT, *Estimated Revenue Effects Relative to the Present Law Baseline of the Tax Provisions in "Title VII – Finance"*).

[72] For more information, congressional clients may contact Nick Buffie; and CRS Report R48358, *Domestic Content Requirements for Electricity Tax Credits in the Inflation Reduction Act (IRA)*, by Nicholas E. Buffie.

[73] 26 U.S.C. §48 and 26 U.S.C. §48E.

[74] CRS Report R48358, *Domestic Content Requirements for Electricity Tax Credits in the Inflation Reduction Act (IRA)*, by Nicholas E. Buffie.

[75] For more information, congressional clients may contact Nick Buffie; and see IEA, *Batteries and Secure Energy Transitions*, 2024; CRS Report R48358, *Domestic Content Requirements for Electricity Tax Credits in the Inflation Reduction Act (IRA)*, by Nicholas E. Buffie; and CRS Insight IN12003, *Inflation Reduction Act of 2022: Incentives for Clean Transportation*, by Melissa N. Diaz.

[76] Trieu Mai et al., *Impacts of Federal Tax Credit Extensions on Renewable Deployment and Power Sector Emissions*, National Renewable Energy Laboratory, February 2016, https://docs.nrel.gov/docs/fy16osti/65571.pdf; Luis Mundaca (continued...)

increased demand for inputs such as energy storage batteries. Some of the same research mentions that the uncertainty caused by iterative congressional reconsideration of the credits has generated economic volatility in the renewable energy industry.[77] Some argue that reducing the availability of these credits under a shortened timeline, as enacted by P.L. 119-21, may limit or reduce some demand for batteries and contribute toward volatility in the sector. Eliminating the tax credits also could increase government tax revenues. The JCT projects that the phaseout of the tax credits in IRC Sections 48E and 45Y would reduce federal deficits by $191 billion over the FY2026-FY2034 time frame.[78]

The energy tax credit changes contained in P.L. 119-21 are among many iterative changes to these credits that Congress has enacted since 1978. Congress may monitor the impacts of the changed tax credits and evaluate whether the outcomes are consistent with its priorities. Congress may also conduct oversight to evaluate the impacts of the changes to the energy tax credits. If the impacts are consistent with congressional priorities, Congress may continue its oversight activities. Alternatively, if the impacts are not consistent with congressional priorities, Congress might choose to further accelerate their elimination or modify them. If Congress wishes to reextend the tax credits, an option it could consider is establishing strict U.S. content requirements that might limit the scope of the credits. Similar to the recently terminated EV tax credits, Congress could consider limiting the scope of the energy tax credits by adding U.S. or North American content requirements for batteries used in such energy systems.

Domestic Preference

Currently, federal agencies, states, municipal governments, schools, and other entities that use federal dollars to acquire goods must comply with "domestic preference statutes" that require a certain amount of U.S. sourcing of goods.[79] Some agency rules pursuant to some of the domestic preference statutes may lack such requirements at the sub-subcomponent or subcomponent level.[80] In some of these cases, such sub-subcomponents or subcomponents may include battery cells used in end products.[81] Additionally, existing domestic preference statutes often have waiver provisions, which have been utilized in some cases to reduce such requirements.[82] Should Congress seek domestic preference requirements and procurement that uses federal dollars to

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and Jessika Luth Richter, "Assessing 'Green Energy Economy' Stimulus Packages: Evidence from the U.S. Programs Targeting Renewable Energy," *Renewable and Sustainable Energy Reviews*, vol. 42 (2015), p. 1174, https://doi.org/10.1016/j.rser.2014.10.060; and Matthew Celsa and George Xydis, "The Inflation Reduction Act versus the 1.5 cent/kWh and 30% Investment Tax Credit Proposal for Wind Power," *SN Business & Economics*, vol. 3, article 68 (2023), https://doi.org/10.1007/s43546-023-00448-x.

[77] Celsa et al., "The Inflation Reduction Act versus the 1.5 cent/kWh and 30% Investment Tax Credit Proposal for Wind Power."

[78] JCT, *Estimated Revenue Effects Relative To The Present Law Baseline Of The Tax Provisions In "Title VII – Finance."*

[79] See, for example, §70923 of P.L. 117-58; CRS Report R46748, *The Buy American Act and Other Federal Procurement Domestic Content Restrictions*, by David H. Carpenter and Brandon J. Murrill; and CRS Insight IN12230, *OMB Issues Final Guidance on "Buy America" Domestic Preference Requirements*. See also CRS In Focus IF13001, *Domestic Preference Statutes: The Berry Amendment and the Kissell Amendment*, by Michael Alan Havlin and Alexandra G. Neenan.

[80] 49 C.F.R. §5323(j); and 2 U.S.C. §184.

[81] CRS In Focus IF10941, *Buy America and the Electric Bus Market*, by Bill Canis and William J. Mallett.

[82] See, for example, an Environmental Protection Agency (EPA) decision to exclude school buses from such a requirement. Joseph Goffman, *Decision Memorandum*, EPA, July 29, 2022, https://www.epa.gov/system/files/documents/2022-08/CSB%20Adj%20Period%20Waiver%20Decision%20Document.pdf; EPA, *Questions and Answers: 2023 Clean School Bus (CSB) Rebate Program*, June 2024, https://www.epa.gov/system/files/documents/2024-06/fy23-csb-rebate-questions-answers-2024-06-20_0.pdf.

incentivize growth of the domestic battery supply chain, it could consider legislation that would direct agencies to issue updated domestic preference rulemakings that require cells, cell components, and battery grade materials to be domestically sourced when procured with federal dollars or contained within a product that is procured with federal dollars. Such domestic content requirement changes might increase demand for domestically manufactured batteries, strengthen integration between domestic supply chain participants, and increase costs of bus procurement, as batteries that meet required specifications may be less available in the United States than other parts of the world.

Product Supply

One way Congress may consider addressing the lithium-ion battery manufacturing industry is through efforts that would lower the cost to produce such batteries in the United States. Broadly, Congress could consider actions that would lower (1) the fixed costs and capital expenses of the industry and (2) the variable costs of the industry.

Fixed Costs and Capital

Fixed costs and capital expenses are longer-term investments and costs, such as expenses on new factories, equipment, and research and development activities. Policies that might affect the fixed costs to produce batteries in the United States include (1) providing direct grants or loans for manufacturing facilities and (2) supporting research and development programs.

Investment Grants

Congress could consider abolishing, further revising, or maintaining certain investment grants for manufacturing facilities. ARRA authorized the Department of Energy (DOE) to award up to $2 billion in grants to "manufacturers of advanced battery systems and vehicle batteries that are produced in the United States, including advanced lithium ion batteries, hybrid electrical systems, component manufacturers, and software designers."[83] The IIJA further expands and specifies the funding, scope, and types of battery manufacturing activities eligible for grants. Section 40207 of the IIJA (42 U.S.C. §18741) authorizes approximately $6 billion in grants to demonstrate projects, construct new facilities, or expand existing facilities that support extracting, processing, manufacturing, or recycling battery minerals, battery materials, battery components, battery cells, and batteries.[84] Division J of the IIJA appropriates approximately $6 billion, to remain available until expended, for purposes described in Section 40207. DOE's Office of Manufacturing and Energy Supply Chains (MESC) oversees the grant program.[85] Such grants authorized by ARRA and the IIJA might support the domestic battery manufacturing industry by directly subsidizing the fixed costs associated with capacity expansion. Congress could consider maintaining the remaining funds, increasing them, or rescinding them.

The results of the IIJA investment grants are unclear, as planning, construction, and development of such facilities have an extended time frame. For example, of the approximate $6 billion to be available until expended, DOE has awarded approximately $2 billion[86] and identified award

[83] Title II of P.L. 111-5.

[84] P.L. 117-58.

[85] DOE, Office of Manufacturing and Energy Supply Chains (MESC), *Manufacturing Capacity*, accessed July 21, 2025, https://www.energy.gov/mesc/manufacturing.

[86] DOE, MESC, "Portfolio," January 10, 2025, https://www.energy.gov/mesc/mesc-portfolio; and DOE, MESC, (continued...)

selectees for an additional $3 billion;[87] however, it may be several years before the funds are expended, construction of these facilities begins, and commercial production begins. Data from Argonne indicate that it takes several years for a battery manufacturing facility to move from announcement, to construction, to actual operation.[88] Argonne suggests that uncertainty regarding availability of buyers and suppliers may contribute to varying levels of investment across the supply chain.[89]

Additionally, changing policy may affect disbursement of funds for projects authorized in Section 40207 of the IIJA and appropriated for in Division J of the act. In January 2025, President Trump issued an executive order and a memorandum that, depending on the details of implementation and potential judicial intervention, may limit awards for battery manufacturers pursuant to the IIJA.[90] Additionally, the FY2026 budget request specifically cites "battery makers" as entities that will receive fewer "taxpayer handouts."[91] The DOE budget justification includes appropriations requests for MESC and did not request the IIJA funds for Section 40207 purposes be rescinded. Some uncertainty regarding these facilities appeared to follow the executive order,[92] with some awardees reportedly expecting to receive funds.[93] Congressional decisionmaking with respect to these IIJA funds may influence concomitant industry investment.

Congress could consider revising these programs to establish a preference for grant applicants who have purchase agreements with other U.S. supply chain participants in order to foster a domestic supply chain. Such a provision might reduce uncertainty across the supply chain, strengthen integration between domestic participants in the supply chain, and contribute to harmonizing the cost structure up and down the domestic supply chain. Additionally, such a provision could contribute toward higher costs for consumers of batteries in the short term if domestic supply chain participants have higher costs than participants located abroad.

Research and Development

Congress has authorized, directed, and funded research and development for battery technology through a range of statutes that primarily provide authorities to DOE. From 1976 with legislation such as the Electric and Hybrid Vehicle Research, Development, and Demonstration Act of 1976

"Battery Materials Processing Grants," accessed July 21, 2025, https://www.energy.gov/mesc/battery-materials-processing-grants.

[87] DOE, MESC, "Bipartisan Infrastructure Law: Battery Materials Processing and Battery Manufacturing Recycling Selections," https://web.archive.org/web/20240921080021/https://www.energy.gov/mesc/bipartisan-infrastructure-law-battery-materials-processing-and-battery-manufacturing-recycling.

[88] Gohlke et al., *Quantification of Commercially Planned Battery Component Supply in North America Through 2035*.

[89] Ibid.

[90] Executive Order 14154 of January 20, 2025, "Unleashing American Energy," 90 *Federal Register* 8353, January 27, 2025, https://www.federalregister.gov/documents/2025/01/29/2025-01956/unleashing-american-energy; White House, "Memorandum to the Heads of Departments and Agencies," presidential memorandum of January 21, 2025, https://www.whitehouse.gov/briefings-statements/2025/01/omb-memo-m-25-11/; Appropriations Committee Democrats, *Background on Unlawful Impoundment in President Trump's Executive Order*, January 29, 2025, https://democrats-appropriations.house.gov/news/fact-sheets/background-unlawful-impoundment-president-trumps-executive-orders; Kate Magill, "Trump Administration Ordered to Resume IIJA, IRA Funding," *ConstructionDive*, April 17, 2025, https://www.constructiondive.com/news/judge-orders-trump-reinstate-iija-ira-funding/745582.

[91] Office of Management and Budget, *Major Discretionary Funding Changes*, May 2, 2025, p. 36, https://www.whitehouse.gov/wp-content/uploads/2025/05/Fiscal-Year-2026-Discretionary-Budget-Request.pdf.

[92] Julie Strupp, "Trump Funding Freeze Leaves IIJA, IRA Projects in Limbo," *UtilityDive*, January 28, 2025, https://www.utilitydive.com/news/trump-funding-freeze-iija-ira-projects/738628/.

[93] "Trump's Second Term is Creating 'a Limbo Moment' for US Battery Recyclers," *Grist*, June 10, 2025, https://grist.org/technology/trump-battery-recycling-lithium-grants-funding-tariffs-ira-tax-credits/.

(P.L. 94-413) and continuing into the 2020s with the IIJA, Congress has authorized, directed, and funded research and development for battery technology through a range of different statutory and budgetary authorities. For example, Section 40208 of the IIJA amended Section 641 of the Energy Independence and Security Act of 2007 (P.L. 110-140) to authorize research on battery recycling. Historically, the National Laboratories of DOE—such as Sandia National Laboratories, the National Renewable Energy Laboratory (NREL), and Argonne National Laboratory—have contributed to federal research on battery technology. Such research and development activities potentially decrease costs for the battery industry because the government is funding development of products, process improvements, alternative materials, and general knowledge that might eventually be commercialized by industry participants. Such research also may contribute toward diversification and resiliency if it results in alternative or additional battery types, such as sodium-ion batteries.[94] This research may not occur sufficiently via the private sector, some could argue, because private sector firms may not prioritize investing in long-term research and development over other uses of capital.[95]

Congress might consider additional legislation affecting research into battery diversification and battery safety. The cost and performance improvements of liquid-electrolyte lithium-ion batteries have contributed toward their widespread adoption; however, over-reliance on one type of battery may present supply chain diversification risks if there were a supply disruption to certain minerals. There may be a gap for the government to fill in supporting research into alternative battery types or technologies with increased potential performance or safety.

Variable Costs

Variable costs are costs that correlate with short-term changes in production levels, such as the costs of raw materials, certain labor types, and utilities. Policies that might affect the variable costs of producing batteries in the United States include (1) tax credits for production of battery cells, modules, components, and minerals (2) and workforce development.

Production Tax Credits

Congress has addressed the costs of production in industry through a variety of methods, including production tax credits. Such tax credits can offset certain production costs. The 117th Congress established a production tax credit applicable to battery cells and battery modules, and the 119th Congress has substantially revised this credit in terms of content and time frame. These actions and their potential effects on the battery manufacturing industry are described below.

Section 13502 of the FY2022 reconciliation act (P.L. 117-169) established tax credits for battery cells and battery modules, which are dollar amounts per megawatt of the cell or the module, and credits for electrode active materials and critical minerals, which are equal to 10% of applicable production costs.[96] The FY2022 reconciliation act also established production tax credits for critical minerals, such as lithium and other minerals used in batteries. The Section 13502 credits

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[94] Tianwei Yu, "The Research and Industrialization Progress and Prospects of Sodium Ion Battery," Journal of Alloys and Compounds, vol. 958, article 170486 (October 2023), https://doi.org/10.1016/j.jallcom.2023.170486.

[95] Eric Budish et al., *Do Firms Underinvest in Long-Term Research? Evidence from Cancer Clinical Trials*, National Bureau of Economic Research, September 2013, http://www.nber.org/papers/w19430; and James R. Brown, "What Promotes R&D? Comparative Evidence from Around the World," *Research Policy*, vol. 46, no. 2 (March 2017), p. 447, https://doi.org/10.1016/j.respol.2016.11.010.

[96] P.L. 117-169; CRS In Focus IF12809, *The Section 45X Advanced Manufacturing Production Credit*, by Nicholas E. Buffie.

are codified in Section 45X of the IRC.[97] Section 13502(b)(3) of the FY2022 reconciliation act included an incremental phaseout of the 45X production tax credits for battery cells, battery modules, and electrode active materials, with those credits scheduled to fully phase out for anything sold after 2032. The Section 13502(b)(3) phaseout schedule did not apply to tax credits for critical minerals.

P.L. 119-21 made changes to the 45X production tax credits. One change is the enactment of a phaseout schedule for the critical minerals tax credits with some exceptions.[98] Pursuant to Section 70514(b)(3)(ii) of P.L. 119-21, tax credits for critical minerals are set to decrease to 75% of normal credit amounts for minerals produced in 2031, 50% for minerals produced in 2032, 25% for minerals produced in 2033, and 0% thereafter.

P.L. 119-21 also modifies IRC Section 45X(d)(4), which states that taxpayers are treated as having sold a credit-eligible component to an unrelated person (e.g., another business) if such component is integrated, incorporated, or assembled into another eligible component that is sold to an unrelated person.[99] This allows eligible components integrated into other eligible components to receive the credit multiple times. P.L. 119-21 modifies IRC Section 45X(d)(4) such that if an eligible "primary component" is integrated, incorporated, or assembled into a "secondary component" produced at the same manufacturing facility and if the secondary component is sold to an unrelated person, then the credit may be allowed for the sale of the secondary component only if at least 65% of the total direct material costs paid or incurred by the taxpayer to produce such secondary component are attributable to primary components mined, produced, or manufactured in the United States. This requirement is to apply to components sold during taxable years beginning after December 31, 2026.

P.L. 119-21 also imposes various *foreign entity* restrictions on the supply chains of firms qualifying for the Section 45X tax credit. Section 70514(c)(1) of P.L. 119-21 amended the 45X tax credit by adding a restriction stating that eligible components "shall not include any property which includes any material assistance from a prohibited foreign entity." Section 70512(c) of P.L. 119-21 defines "material assistance" for battery components based on the percentage of materials, based on cost,[100] that the manufacturer receives from a prohibited foreign entity. *Prohibited foreign entities* include *foreign-influenced entities* and *specified foreign entities* as defined in P.L. 119-21; specified foreign entities include but are not limited to *foreign-controlled entities*. In practice, these definitions encompass individuals, companies, government bodies, and other entities that are closely affiliated with, influenced by, or subject to the jurisdiction of the governments of covered nations, including China, Russia, Iran, and North Korea. In effect, starting in calendar year 2026, battery components are not eligible for the production tax credit if they contain a certain percentage of materials sourced from one or more prohibited foreign entities. The percentage is to be 40% starting in 2026 and to incrementally decrease to 15% in 2030 and subsequent years.[101]

The effect of the changes to these tax credit provisions is yet to be seen. The 45X battery production tax credits might decrease production costs for battery manufacturers because the

[97] P.L. 117-169; and CRS In Focus IF12809, *The Section 45X Advanced Manufacturing Production Credit,* by Nicholas E. Buffie.

[98] This phaseout schedule does not apply to metallurgical coal, which P.L. 119-21 adds to the list of qualifying critical minerals; metallurgical coal is generally used in steelmaking.

[99] Credit-eligible components include solar energy components, wind energy components, certain inverters described in statute, qualifying battery components, and applicable critical minerals. See 26 U.S.C. §45X(c)(1).

[100] See the "material assistance cost ratio" in §70512(c) of P.L. 119-21.

[101] The relevant thresholds for battery components are determined based on the year the battery components are sold.

credits reduce tax obligations for battery manufacturers based on how much they sell. The 45X critical mineral production tax credits might reduce costs for battery manufacturers because the credits might decrease market prices of critical minerals that battery manufacturers purchase, such as lithium; this could lower the overall net costs of battery production. The incremental removal of these tax credits could raise battery production costs as the upstream supply of critical minerals qualifies for fewer federal supports. This change could have additional effects on the midstream battery manufacturing segment because it could affect the availability of upstream materials and contribute to market uncertainty. As discussed by Argonne and others, a potential factor explaining underinvestment in battery grade material manufacturing is uncertainty regarding access to upstream materials.

The enacted controls on the materials allowed in order to qualify for the tax credit could increase battery prices. Chinese materials specifically are sometimes cheaper than materials sourced elsewhere. Limiting the supply of materials that manufacturers can acquire if they wish for products to be eligible for the credit may create increased costs. Conversely, such controls may spur investment in alternative supply chains that serve to create greater resiliency and availability. The impact of these controls may also depend on market prices for batteries in the future. Should market prices increase, the cost structure of U.S. producers may become more aligned with relatively higher costs of U.S. upstream suppliers relative to global suppliers. The effects and impacts of the foreign entity changes may ultimately be subsumed by the statutory phaseout of these battery component credits due by the end of 2032, as enacted by the FY2022 reconciliation act.

Should Congress wish to reextend or further modify the production tax credits, it could consider their scope. IRS rulemakings have identified a wide range of supply-related manufacturing costs that qualify for the credits, including the costs of producing certain components that are not explicitly listed in the FY2022 reconciliation act.[102] For example, the IRS final rulemaking includes cathode current collectors within "electrode active materials" despite statute not listing them explicitly and despite literature generally not considering them active materials. Additionally, the rulemaking also considers separators as "electrode active materials," although statute does not list them explicitly, and CRS did not identify any scientific literature that considers them electrodes. This broad interpretation of Section 13502 may alleviate some potential concerns mentioned by Argonne regarding potential underinvestment in current collector and separator manufacturing capacity. Congress might communicate to the IRS whether this inclusion is consistent with its intent in Section 13502.

Congress could broaden or narrow the statutory scope of the production tax credits for battery production. Specifically, Congress could codify that separators and cathode current collectors for use in advanced batteries qualify for the production subsidies in the same way the other explicitly listed components qualify, consistent with the IRS rulemaking. This codification could reduce uncertainty and provide more explicit language for the totality of the midstream segment, which might increase investment in certain areas that might be underinvested in, such as separators and current collectors. Alternatively, if Congress wanted to further limit or reextend a more limited version of the credits, Congress could add language that would clarify to the IRS that its intent was not to include separators and current collectors as qualifying inputs.

[102] CRS In Focus IF12809, *The Section 45X Advanced Manufacturing Production Credit*, by Nicholas E. Buffie; Crux, "Final Guidance Released for 45X Advanced Manufacturing PTCs," October 24, 2024, https://www.cruxclimate.com/insights/45x-final-guidance; and IRS, "Advanced Manufacturing Production Credit," 89 *Federal Register* 85798, October 28, 2024.

A potential impact to specifying separators as eligible for funding is that doing so could favor a certain type of battery. Separators are not required for solid-state batteries, for example, so making separators eligible for such funding could tilt the market away from solid-state battery innovation because non-solid-state batteries would be further subsidized. The inclusion or exclusion of certain components could be seen as technology specific given that not all battery types use all components. Congress might communicate to the IRS whether such inclusions or exclusions are consistent with its intent regarding the components included in Section 45X.

Workforce Development

Congress could consider taking action to address the labor needs of the battery manufacturing industry. The W.E. Upjohn Institute for Employment Research forecasts that 310,000 workers—nearly a 5-fold growth from 2023 levels—will be required by 2030 to support the predicted growth in lithium-ion battery manufacturing.[103] Additionally, the labor needs of each subprocess (e.g., component manufacturing or cell or pack assembly) might vary in quantity and quality, and the labor requirements associated with developing domestic lithium-ion battery manufacturing supply chain may change depending on which portion is growing.[104]

Congress might consider augmenting or creating programs that could expand the labor pool for the lithium-ion battery manufacturing industry. In 2023, the Employment Training Administration (ETA) announced awards of $16 million in new Critical Sectors Job Quality Grants to support training in specified critical sectors.[105] The National Energy Technology Laboratory also has a Battery Workforce Initiative created to "speed up the development of high-quality training" for the battery industry.[106] Congress could use its oversight authority to request updates from ETA and DOE on their proposed training programs.[107] Congress could also consider legislation that would establish training requirements in battery manufacturing projects that receive certain types of federal funding. Such training could decrease manufacturing costs, increase productivity, and decrease uncertainty, which may spur additional investment in battery manufacturing from the private sector. Such training could also limit labor dislocations that might occur as the industry potentially continues to pivot away from lead-acid batteries and toward lithium-ion batteries. Such training may require additional costs to succeed and could have a budgetary impact on private and public organizations.

Trade Protections

Congress could consider increasing, reducing, or maintaining certain trade barriers designed to protect the domestic battery manufacturing supply chain. During the Biden Administration, the

[103] Erik Vasilauskas et al., *Projecting the Demand for Workers in the Production of Lithium-Ion Batteries in the United States*, W.E. Upjohn Institute for Employment Research, May 6, 2024, https://research.upjohn.org/reports/304/.

[104] Vasilauskas et al., *Projecting the Demand for Workers*; Turner Cotterman et al., "The Transition to Electrified Vehicles: Evaluating the Labor Demand of Manufacturing Conventional Versus Battery Electric Vehicle Powertrains," *Energy Policy*, vol. 188 (March 2024), https://doi.org/10.1016/j.enpol.2024.114064; and Anh Bui and Peter Slowik, *Powering the Future: Assessment of U.S. Light-Duty Vehicle Battery Manufacturing Jobs by 2032*, International Council on Clean Transportation, Working Paper 255, January 2025, https://theicct.org/wp-content/uploads/2024/12/ID-255-%E2%80%93-Battery-jobs_working-paper_final.pdf.

[105] U.S. Department of Labor (DOL), *Critical Sectors Job Quality Grants*, 2023, https://www.dol.gov/sites/dolgov/files/general/grants/FY2023CriticalSectorsJobQuality.pdf; and DOL, "Biden-Harris Administration Awards $16M to Improve Job Quality, Expand Access to Good Jobs in Critical Sectors, Including Care, Climate Resilience, Hospitality," September 28, 2023, https://www.dol.gov/newsroom/releases/eta/eta20230928-1.

[106] DOE, National Energy Technology Laboratory, "Battery Workforce Initiative," https://netl.doe.gov/bwi.

[107] DOL, "Employment and Training Administration," https://www.dol.gov/agencies/eta.

executive branch applied tariffs to imported batteries and battery parts originating from China pursuant to broad statutory authorities in Section 301 of the Trade Act of 1974.[108] During the Trump Administrations, the executive branch implemented higher tariffs on a wider range of goods, including batteries.[109]

Economists tend to regard tariffs as inefficient. Tariffs designed to protect nascent industries, where domestic firms are underdeveloped compared with global competitors, can sometimes provide more benefits relative to tariffs on mature industries.[110]

Congress could direct through statute, or request through oversight, increased tariffs for lithium-ion batteries, parts of lithium batteries, and products that contain batteries. While Congress has delegated most tariff setting to the executive branch, it could consider legislation to specify tariffs at the HTS level in statute.[111] Such a policy might pivot demand toward domestic producers of batteries and battery parts rather than imported sources, which could spur additional investments in the domestic battery manufacturing supply chain. In addition, such a policy might increase costs for consumers of batteries, such as EV manufacturers and grid storage companies, particularly in the short run. Additionally, such tariffs could pivot consumers toward products directly unaffected by the tariffs, reducing consumer demand for batteries, and may trigger retaliatory actions by trading partners. Making the tariff increase temporary and focused on nurturing a nascent industry could limit some of these potential impacts.

Visibility

Congress could consider abolishing, revising, or maintaining federal programs that provide visibility into the lithium-ion battery manufacturing industry. High quality and detailed data may help evaluate the effects of congressional action related to the domestic battery manufacturing industry. As previously illustrated in the "Historical Trends" section of this report, visibility into the domestic advanced lithium-ion energy storage battery manufacturing industry is limited; to a lesser degree, visibility into imports and exports of lithium-ion storage batteries is also limited. For example, there is no authoritative and longitudinal federal source on domestic employment and production in the advanced lithium-ion battery manufacturing industry. Additionally, import and export data group certain information together in ways that may limit their utility. The federal agencies that collect and publish data on prices, sales, employment, production, imports, and exports of batteries do so at an aggregation, periodicity, or quality that may not provide sufficient

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[108] White House, "Fact Sheet: President Biden Takes Action to Protect American Workers and Businesses from China's Unfair Trade Practices," press release, May 14, 2024, https://web.archive.org/web/20241231210411/https://www.whitehouse.gov/briefing-room/statements-releases/2024/05/14/fact-sheet-president-biden-takes-action-to-protect-american-workers-and-businesses-from-chinas-unfair-trade-practices/.

[109] White House, "Fact Sheet: President Donald J. Trump Declares National Emergency to Increase Our Competitive Edge, Protect Our Sovereignty, and Strengthen Our National Economic Security," April 2, 2025, https://www.whitehouse.gov/fact-sheets/2025/04/fact-sheet-president-donald-j-trump-declares-national-emergency-to-increase-our-competitive-edge-protect-our-sovereignty-and-strengthen-our-national-and-economic-security/; Office of the United States Trade Representative (USTR), "Notice of Action and Request for Public Comment Concerning Proposed Determination of Action Pursuant to Section 301: China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation," 83 *Federal Register* 28710, June 20, 2018; USTR, "Notice of Action Pursuant to Section 301: China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation," 83 *Federal Register* 40823, August 16, 2018; and USTR, "Notice of Modification of Section 301 Action: China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation," 83 *Federal Register* 47974, September 21, 2018.

[110] Marc J. Melitz, "When and How Should Infant Industries Be Protected," *Journal of International Economics*, vol. 66 (2005), pp. 177-196, https://scholar.harvard.edu/files/melitz/files/infant_jie.pdf.

[111] S. 5564 (118th Congress); H.R. 8982 (117th Congress); S. 1485 (110th Congress).

visibility to monitor the advanced lithium-ion energy storage battery industry. The data that could be evaluated for changes include (1) domestic manufacturing data and (2) import and export data.

Domestic Manufacturing Data

To potentially gain improved visibility into the domestic battery industry, Congress might consider utilizing existing statistical agencies, regulatory agencies, or some combination thereof. The statistical agencies likely most applicable for such purposes include BLS, Census, and the Energy Information Administration (EIA). BLS collects and publishes data on prices, employment, and wages broken out by sector.[112] Census publishes and collects data on sales, establishments, and shipments broken out by sector.[113] EIA collects and publishes information on the energy sector.[114] Congress could use its oversight powers to request that BLS, Census, and EIA be more responsive to the evolving battery manufacturing industry and ensure data are published at a more detailed level. Congress could also, as it has in the past for other topic areas,[115] create mandatory special data collections, such as for the advanced battery industry, for BLS, Census, or EIA to implement; the success of such data collection may depend on the availability of appropriations and the quality of industry reporting. Such changes might add costs to the operations of federal agencies that implement these surveys and increase costs to businesses that must respond to them.

Import and Export Data

Congress may consider options that would affect U.S. trade data collection and publication. The U.S. International Trade Commission (USITC), Customs and Border Protection (CBP), and Census could support improved data collection and publication for imports and exports of advanced lithium-ion energy storage batteries. Collectively, CBP and Census acquire data that cover "virtually all shipments leaving (exports) or entering (imports) the United States,"[116] with some exceptions.[117] Census publishes these data to the public, but the classification detail they use for batteries might be insufficient for full supply chain visibility. The classification system used by CBP—the HTS—is maintained by USITC and may not have the detail necessary for full supply chain visibility. For example, there is no classifying information within the HTS energy storage battery codes on how many battery cells a finished battery contains; such information is necessary to distinguish whether a battery is "advanced" and could help indicate the end use of the battery. Additionally, the classification of parts for non-lead-acid energy storage batteries groups all parts and chemistries together, but there are important distinctions between some of those parts and chemistries. Similarly, the USITC and CBP classifying battery cells as parts to a battery rather than a battery itself or a separate standalone classification obscures certain important information. Furthermore, although the HTS contains classifications for a range of upstream minerals and metals, the current classifications may make systematically identifying battery grade electrode materials difficult.

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[112] BLS, "Overview of BLS Statistics," September 1, 2020, https://www.bls.gov/bls/overview.htm.

[113] Census Bureau, "Topics," October 16, 2024, https://www.census.gov/topics.html.

[114] U.S. Energy Information Administration (EIA), "About EIA," https://www.eia.gov/about/.

[115] For example, see S. 2629 (117th Congress).

[116] Census Bureau, *Guide to International Trade Statistics*, p. 1, https://www.census.gov/foreign-trade/guide/sec1.html.

[117] For description and discussion of coverage, exceptions, and limitations, see 15 C.F.R. Part 30; 19 C.F.R. Part 141; 19 C.F.R. Part 142; 19 C.F.R. Part 143; 19 C.F.R. Part 145; Census Bureau, *Guide to the U.S. International Trade Statistics*; and U.S. Census Bureau, *U.S. Merchandise Trade Statistics: A Quality Profile*, October 3, 2014, p. 6, https://www.census.gov/foreign-trade/aip/quality_profile10032014.pdf.

Congress could consider addressing some of the aforementioned visibility gaps by seeking to modify the HTS. Congress could, through oversight or statute, direct USITC to (1) update its classification system to further classify or distinguish lithium-ion energy storage batteries based on some measure of size by creating new HTS codes that correlate to the quantity of cells or estimated power capacity; (2) create new HTS codes that distinguish the chemistry type of energy storage battery parts; (3) create separate classification HTS codes specifically for energy storage battery parts not elsewhere specified or included; and (4) create certain custom classification categories of interest and direct that data for these categories be furnished by CBP and published by Census at a more detailed level. While chapter 99 of the HTS contains some customized detailed battery and mineral classifications that may be of interest to Congress, many of those classifications have expired, and the data classified under those detailed chapter 99 categories are not publicly published by Census under such detailed classifications. With potential new classifications, U.S. trade data published by Census might provide more visibility into the changing global and domestic value chains for batteries. Such changes might add costs to the operations of federal agencies that implement these programs, such as USITC, CBP, and Census, and increase costs to businesses that must declare accurate information to CBP.

Appendix. Key Terms

Table A-1. Glossary of Key Terms Used in This Product

Term	Definition
Advanced lithium-ion energy storage battery	An energy storage battery containing at least two cells that uses lithium as the principal energy-storing chemical within the battery cell components
Battery	A manufactured device that contains at least one battery cell within a structural encasement and that conveys the energy storage, charging, and discharging properties of the cell(s) it contains
Battery cell	A single manufactured object that can accept, store, and discharge electrical energy using chemical reactions that occur wholly within the object; battery cells are sometimes packaged together into a larger manufactured device called a "battery"
Battery cell components	Constituent elements of a battery cell that work together to directly or indirectly facilitate the cell's storing, charging, and discharging of energy; components of a battery include anodes, cathodes, current collectors, separators, and electrolytes
Battery management system	A thermal and electric monitoring and computer control network that balances and optimizes battery performance and safety
Energy storage battery	A battery that can be charged and discharged multiple times throughout its usable life
Lead	A metal and mineral, which can be found naturally occurring in the Earth's crust
Lead-acid battery	A battery that uses lead as the principal energy-storage chemical within the battery cell components
Lithium	A metal and mineral, which can be found naturally occurring in the Earth's crust

Source: CRS.

Author Information

Michael Alan Havlin
Analyst in Industrial Organization and Business

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