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# Powering the future: Assessment of U.S. light-duty vehicle battery manufacturing jobs by 2032

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## SUMMARY

Localizing the electric vehicle (EV) battery supply chain is a strategy that can strengthen the United States' economic resilience, reduce dependence on foreign supply chains, support job growth, and vest U.S. workers and communities in the transition to zero emissions. Federal regulations, such as the new multi-pollutant standards from the U.S. Environmental Protection Agency (EPA) for light-duty and medium-duty vehicles for model years 2027 and beyond, along with federal incentives and supply chain investments, further support this direction. As EV adoption is expected to accelerate, establishing a robust domestic battery supply chain can help to meet growing demand for EVs while creating high-quality jobs.

Through an extensive literature review and collection of company announcements, this paper estimates a jobs-per-gigawatt-hour (GWh) ratio for the production of battery packs and cell components for light-duty vehicles (LDVs) and for the recycling of batteries, and then scales these estimates by GWh based on various U.S. domestic production scenarios. For the analysis of battery packs, we consider three scenarios. The first scenario is based on estimates of battery demand needed to support growth in the light-duty EV fleet to 69% of new sales by 2032, based on EPA's final Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles. The second and third scenarios are bottom-up assessments of U.S. battery production capacity based on company announcements through September 2024.

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The analysis of battery cell components and recycling follows a similar approach. It first estimates a jobs-per-GWh ratio that is then scaled based on estimates of future production in GWh. The scaling of battery cell component and recycling jobs is based on industry announcements on production capacity of cell components and recycling facilities. This capacity is typically about one quarter of the capacity of the battery pack production scenarios above.

The analysis finds that battery pack production may require about 95 workers or jobs per GWh, and an additional 49 workers per GWh are needed for production of battery cell components and for battery recycling. Jobs in battery pack production encompass cell production, module assembly, and battery pack assembly. For cell components, jobs are broken down as follows: cathode production averages 15 jobs per GWh, anode production 10 jobs, electrolytes 4 jobs, and separators 3 jobs. Battery recycling requires an average of 17 jobs per GWh.

Based on the jobs-per-GWh ratio and production scenarios, **we project that the growing U.S. battery industry will create between 84,000 to 125,000 domestic jobs by 2032**. These jobs are direct jobs created at the facilities. Specifically, battery pack production could generate approximately 73,000 to 114,000 jobs. Battery cell component manufacturing and battery recycling could add an additional 11,000 jobs based on the announced production capacity domestically for these sectors. There is also potential to increase domestic production of cell components and recycling, which could lead to more job creation. These estimates do not account for several other types of jobs, such as construction jobs, indirect roles in the upstream supply chain such as mining, material extraction, and refining, or induced jobs in supporting sectors.

The paper also provides an overview of the various job types and skills needed in the battery sector, and the emerging federal policies supporting jobs growth. It highlights the potential for automotive workers to transition and retrain into battery manufacturing roles, leveraging their transferable skills in mechanical and electrical systems, quality control, and precision assembly. Key federal initiatives, including battery-related investments and the Battery Workforce Challenge Program, can assist in the development of the domestic battery supply chain, as can automakers' support for job transfers from traditional vehicle manufacturing to battery plants.

## BACKGROUND

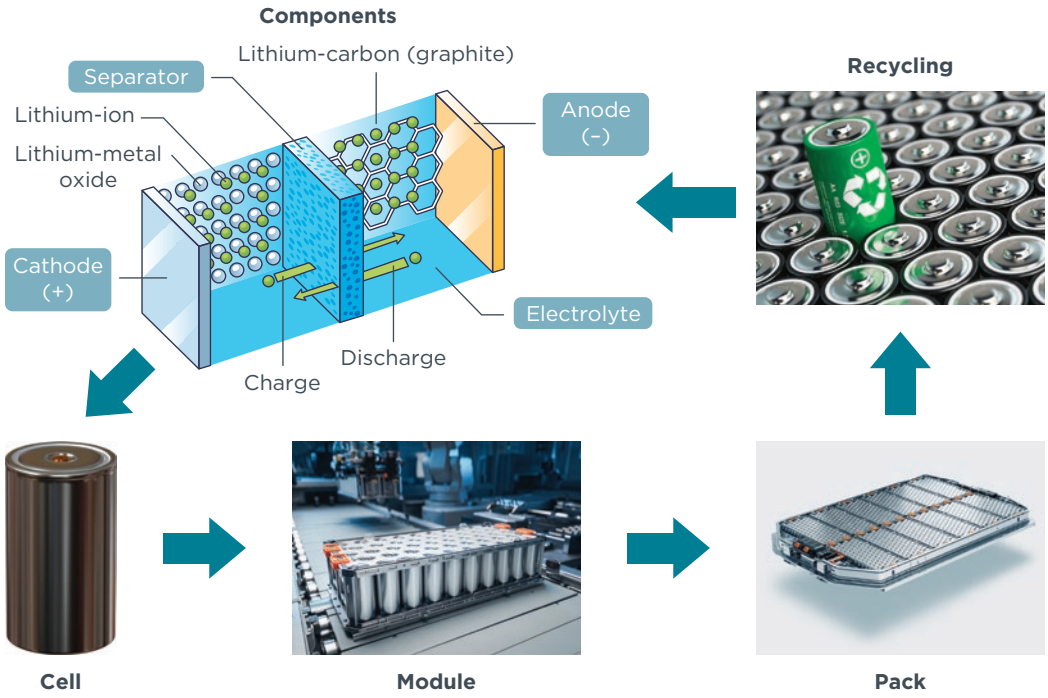
The shift toward EVs is gaining momentum in the United States, with EV sales representing nearly 10% of all new light-duty vehicle in 2024 (EV-Volumes, 2024). This growth is anticipated to accelerate further in response to federal and state regulations and the billions of dollars in incentives and supply chain investments from the Inflation Reduction Act (IRA) of 2022. The EPA finalized the new Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles in April 2024 (U.S. Environmental Protection Agency [U.S. EPA], 2024a). EPA projects that these standards could result in EVs making up 69% of all passenger vehicle sales by 2032, with 56% being battery electric vehicles (BEVs) and 13% plug-in hybrid electric vehicles (PHEVs). In addition, 13 states have adopted California's Advanced Clean Cars II regulations, putting them on the path toward 100% new light-duty zero-emission vehicle (ZEV) sales by 2035 (Bui & Slowik, 2024). Federal tax credits of up to $7,500 are available for the purchase of qualifying EVs, while many states also offer incentives, rebates, and tax exemptions (Internal Revenue Service, 2024; Bui & Slowik, 2024).

The increased demand for batteries to meet the potential EV boom presents an opportunity for the United States to develop and strengthen its domestic battery supply chain. Advanced manufacturing production credits in Section 45X of the IRA aim to incentivize U.S.-based manufacturing facilities, including those producing batteries (Internal Revenue Service, 2023). These incentives include tax credits of $35 per kilowatt-hour (kWh) for domestically produced battery cells, $10/kWh for domestically produced battery modules, and a 10% credit for the cost of producing critical minerals and electrode active materials. Electrode active materials are electrochemical materials used in making cathodes, anodes, and other components of a battery cell.

For a new EV to be eligible for the full $7,500 consumer tax credit under Section 30 of the IRA, the EV must meet requirements regarding the sourcing of battery packs, cell components, and critical minerals. To be eligible for $3,750 in tax credits related to battery pack and cell components, a percentage of the value—60% in 2025 and increasing 10% each year until it reaches 100% in 2029—must be manufactured or assembled in North America. To be eligible for $3,750 in tax credits related to critical minerals, a percentage of the value of the minerals—60% in 2025 and increasing to 80% in 2027 and later years—must be extracted or processed in the United States or a free-trade agreement partner or recycled in North America. Starting in 2025, EVs containing critical minerals that are extracted, processed, or recycled by a company classified by the U.S. government as a Foreign Entity of Concern will not be eligible for the credit (U.S. Department of Treasury Internal Revenue Service, 2024). Therefore, establishing and expanding battery manufacturing facilities within the United States will help meet the growing needs of the EV market, while also stimulating the economy and creating jobs.

Given the importance of the transition to EVs and the resulting job implications, it is essential to understand the key steps in the life cycle of a lithium-ion EV battery. Figure 1 illustrates the battery production processes within the scope of this analysis. Battery cells are metallic cartridges that contain a cathode, anode, and separator bathed in an electrolyte solution. EV battery cells are typically in cylindrical, prismatic (rectangular), or pouch form. Once assembled, these cells are grouped into modules. The number of cells within each module varies depending on the automaker's specifications. These modules are then arranged within a metallic frame equipped with housing to shield the cells from physical impacts. The final stage involves integrating the modules into a battery pack, which includes making electrical connections. A robotic arm typically positions the modules within the pack housing, followed by a technician making manual connections. The pack housing cover is then manually installed, and automated robotic arms fasten screws, likely with a technician verifying these connections. Once a battery reaches its end of life, it can be recycled at designated facilities (Melançon, 2024; Layosa, 2021).

**Figure 1**
**Simplified diagram of the life cycle of a lithium-ion electric vehicle battery**




*Note:* The analysis of cell components in this paper includes those highlighted in the figure: separator, anode, cathode, and electrolyte.



In this paper, we estimate the jobs associated with battery pack production, from cells to modules to packs. We also estimate the additional job potential from the production of cell components—including cathodes, anodes, electrolytes, and separators—as well as battery end-of-life recycling. Jobs related to upstream processes, such as mining, materials processing, and refining, are not included. The paper also provides an overview of the various job types and skills needed in the battery sector, and reviews emerging federal policies supporting jobs growth.

## ANALYSIS OF BATTERY PRODUCTION

This section defines and quantifies three scenarios of future U.S. battery demand and production. The three scenarios are described here and in further detail below:

- The first scenario, *69% EV Sales By 2032*, is based on estimates of light-duty EV market growth from EPA's new multi-pollutant emissions standards. We estimate battery demand associated with this growth in EV sales would increase from about 90 GWh in 2024 to about 770 GWh by 2032.
- A second scenario, *Announcements From LDV-Only Facilities*, is based on industry announcements about investments in facilities that only produce batteries for LDVs. Twenty-nine of the facilities we identified have disclosed information about production capacity, which sums up to about 210 GWh in 2024 and to about 820 GWh by 2032.

» The third scenario, *Additional Battery Announcements*, includes the LDV-only facilities plus industry announcements about investments in facilities that produce batteries for LDVs in addition to other applications. Fifteen of the additional facilities we identified that produce batteries for LDVs and other uses have disclosed information about production capacity. These 15 facilities plus the 29 LDV-only facilities brings the total number of facilities under the Additional Battery Announcements Scenario to 44. The disclosed information about production capacity from the 44 facilities sum up to about 430 GWh in 2024 and to about 1,200 GWh by 2032.

## BATTERY NEEDS TO MEET EPA'S FINAL MULTI-POLLUTANT STANDARDS

For the first scenario, 69% EV Sales By 2032, we assess the demand for batteries needed to supply a growing light-duty EV fleet that reaches a 69% sales share by 2032, including 56% BEVs and 13% PHEVs. The specifications for new EVs are derived from Optimization Model for reducing Emissions of Greenhouse Gases from Automobiles (OMEGA) (U.S. EPA, 2024b). These specifications are based on the agency's "light-duty central case" or Pathway A compliance analysis that supports the 2024 final rulemaking (U.S. EPA, 2024a). The 2024 specifications reflect the industry-average model year 2023 values for the baseline fleet. The 2032 specifications are informed by EPA's analysis of expected industry compliance with the final multi-pollutant standards.

Our analysis projects that vehicle battery size will decrease from an average of 94 kWh in 2024 to about 92 kWh by 2032 for a 300-mile range BEV. Average battery capacities for 40-mile range PHEVs remain around 16 kWh from 2024 to 2032 (U.S. EPA, 2024b). We assume that 70% of EVs sold in the United States use domestically produced batteries in 2024, and this share increases linearly to 100% by 2027, aligning with EPA's analysis (Shen et al., 2024; U.S. EPA, 2024c).

## SUMMARY OF BATTERY PRODUCTION ANNOUNCEMENTS

For the second and third scenarios, Announcements From LDV-Only Facilities and Additional Battery Announcements, we compiled and assessed industry announcements of U.S. battery production. We collected 89 announcements related to 68 battery production facilities that produce cells, modules, or packs—or combinations of these categories, including cells and modules, modules and packs, or cells, modules and packs—for LDVs only or for LDVs and other applications. Some announcements come from the same facility and provide updates following the original announcement, such as downsizing, expansion, or cancellation. Of the 68 facilities, 44 of them disclosed information about their production capacity. These data are compiled from EV Jobs Hub (Blue Green Alliance Foundation & Atlas Public Policy, 2024) and additional sources as of September 2024.

Each announcement provides information on the battery facility, including the parent company, facility location, production categories (cells, modules, or packs, or combinations of these categories), planned operation date, phase of the facility (whether it's a new facility, expansion, or downsizing), investment amount, capacity (in GWh or other units), and number of jobs, among other details. We then cross-checked each announcement with multiple news sources to verify the information and uncover additional details, including whether the batteries are used for purposes other than LDVs, such as for medium- and heavy-duty vehicles (MHDVs) or stationary storage; if the reported jobs pertain specifically to the facility or the surrounding region; and if there are

reported construction and other indirect jobs. Details for the 89 announcements of LDV battery production plants are presented in Table A1 in the appendix.

Several assumptions were made to help standardize the data and prepare for the analysis:

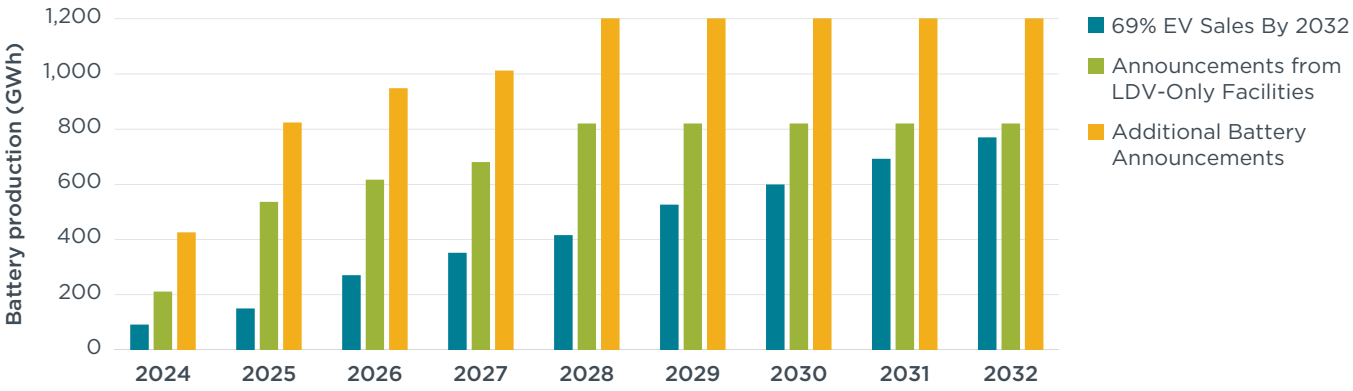
- Battery pack manufacturing in GWh in each scenario is based on the total production capacity in GWh from facilities that specify capacity or provide battery or vehicle output figures, which can be converted to GWh. As a result, not all collected announcements are included in the total GWh.
- If an announcement gives information about production capacity only in terms of how many batteries or EVs the facility could power, we assume that each EV referenced in the announcement has a 100-kWh pack. This assumption is based on the typical average pack size in new U.S. BEVs in the 2022–2024 timeframe (Shen et al., 2024). It is also consistent with the announcements for several battery production facilities (Kentucky Office of the Governor, 2022; Hyundai Media Center, 2023).
- When a company states that it "assembles cells to packs" and does not indicate it purchases cells from another party, we assume that the company produces cells, modules, and packs. If the company reports purchasing cells from another party to make packs, we assume that modules and packs are assembled at the company's facility.
- When investments or jobs are part of a joint venture, we evenly split the investment in dollars, capacity in GWh, and number of jobs between the companies participating in the joint venture.
- If an announcement does not include a start date for production, it is assumed to begin in 2028.
- We assume the total production capacity remains constant for the 2028–2032 period, as none of the identified announcements disclosed information on planned production beyond 2028.

The announcements of battery production capacity are categorized into two scenarios. We first assess the Announcements From LDV-Only Facilities Scenario, which is based on facilities that produce batteries for LDVs only. Twenty-nine of the 44 LDV-only facilities we identified have disclosed information about production capacity. We then assess facilities that produce batteries for LDVs *in addition to* batteries for other applications. Fifteen of the 24 additional facilities we identified have disclosed information about production capacity. The Additional Battery Announcements Scenario includes the 29 facilities from the LDV-Only Facilities Scenario plus the 15 facilities that produce batteries for LDVs and for other applications, for a total of 44 facilities. Battery facilities that do not produce batteries for LDVs are not included in our analysis.

Figure 2 shows our assessment of annual battery pack production in gigawatt-hours (GWh) from 2024 through 2032. For the 69% EV Sales By 2032 Scenario, we estimate this level of EV growth corresponds to an increase in battery production from about 90 GWh in 2024 to 770 GWh by 2032. For the Announcements From LDV-Only Facilities Scenario, we estimate an increase in production from about 210 GWh in 2024 to about 820 GWh by 2028. For the Additional Battery Announcements Scenario, we estimate an increase in production from about 430 GWh in 2024 to about 1,200 GWh in 2028.

**Figure 2**

**Projected U.S. battery pack demand and production for the three scenarios**




*Note:* The 69% EV Sales By 2032 Scenario is based on estimates of EV market growth from the EPA multi-pollutant emissions standards. The Announcements From LDV-Only Facilities Scenario is based on company announcements of LDV battery production capacity. The Additional Battery Announcements Scenario is based on the LDV-only facilities plus announcements of battery production capacity at facilities that produce batteries for LDVs and for other applications within the same facility.

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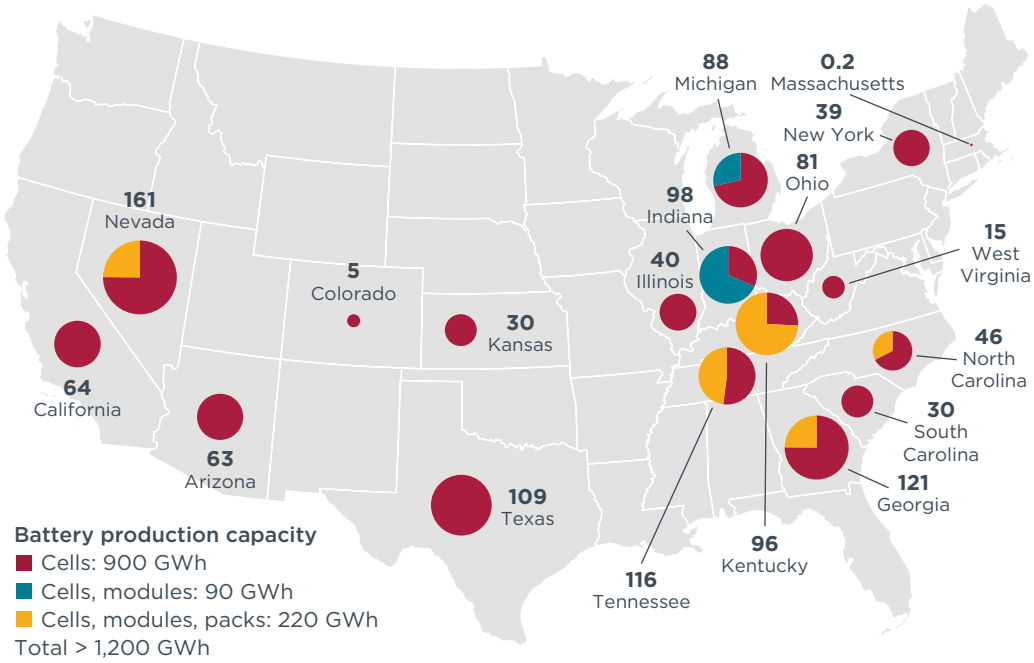
The numbers in Figure 2 are comparable with other studies. Argonne National Laboratory estimates that the announced capacity of battery production for the United States will be roughly 1,200 GWh by about 2028 (Gohlke et al., 2024). According to Benchmark Mineral Intelligence data collected as of second quarter of 2024, the total announced capacity of facilities in the United States will reach 1,295 GWh by 2030 (Benchmark Mineral Intelligence, 2024). Bloomberg also found that the total announcements of lithium-ion battery production capacity for North America comes to roughly 800 GWh by 2025 (McKerracher, 2024).

According to company announcements, battery production is rapidly increasing across the United States. Figure 3 shows the announced battery production capacity in GWh at the state level for the 44 facilities that disclosed information about production capacity under the Additional Battery Announcements Scenario. Announcements are categorized by the type of production: cells only, cells and modules, or cells, modules, and packs. Most of the announced capacity is for the production of battery cells, which adds up to about 900 GWh and accounts for 75% of the total capacity shown. Announced capacity of facilities that produce both cells and modules is more than 90 GWh, representing about 7% of the total. Facilities that produce cells, modules, and packs have an announced capacity of about 220 GWh, representing about 18% of the total.

**Figure 3**

**Announced battery production capacity in gigawatt-hours (GWh) by state in 2028**

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As shown, production is heavily concentrated in parts of the Midwest and Southeast that have traditionally been hubs for conventional vehicle manufacturing (Bui et al., 2021), suggesting there is relative proximity between several U.S. auto and battery manufacturing facilities. Additionally, there are some other relatively high-capacity production sites in Western states and in Texas.

Several additional points provide context to the figure. Joint ventures between major cell manufacturers—including LG Chem, Panasonic, Samsung SDI, and SK Innovation—and major EV battery pack manufacturers (typically automakers) sum up to 160 GWh annually. Other battery production categories such as modules, modules and packs, or packs manufacturing alone can contribute another 210 GWh of capacity, with most of the capacity (88%) in these production categories coming from pack manufacturing. These categories are not shown in the figure to avoid potential double counting. The sources of the cells used for these processes are uncertain; they may originate from domestic cell production or from overseas.

## ANALYSIS OF U.S. BATTERY PRODUCTION JOBS

As domestic battery production increases, so does the creation of battery production jobs. In this section, we describe the types of battery-related jobs and estimate the potential jobs creation based on the above scenarios. We first estimate jobs related to battery pack production, defined here as the manufacturing of battery cells and modules and their assembly into battery packs. We then estimate the additional jobs related to the production of battery cell components (cathodes, anodes, electrolytes, and separators) and battery recycling.

## OVERVIEW OF JOB TYPES

The battery industry workforce necessitates a diverse range of talents. The U.S. Bureau of Labor Statistics (BLS) projects that jobs under the North American Industry Classification System (NAICS) code 3359, which includes the production of EV batteries and chargers, will grow 17% from 2021 to 2031, making it one of the fastest growing manufacturing industries (U.S. BLS, 2023a). Close to 70% of EV battery-related jobs may not require a bachelor's degree but rather training provided by associate and technical degrees at community colleges or through apprenticeships and on-the-job training (Horrigan, 2024).

Some of the jobs required for different stages of the battery production process are summarized below.

- Battery technology research and development: Potential jobs in this category include chemical, mechanical, and electrical engineers as well as data analysts who are responsible for developing and improving new battery designs. Chemists are involved in discovering new chemicals for battery use, while material scientists research the properties, composition, and production of materials used in EV manufacturing and recycling. These jobs usually require a college degree or higher and earn a U.S. median annual salary of $87,000 (Invest WindsorEssex, 2021; U.S. BLS, 2024a).
- Battery cell, module, and pack production: Facilities need electrical, electronic, and electromechanical specialists who assemble battery cells, modules, and packs using automation equipment or manual tools (Vasilauskas et al., 2024). These jobs usually require a high school diploma or equivalent. Median salaries for these jobs range from approximately $39,000 to $50,000 annually in 2023 (U.S. BLS, 2024a). Other essential production roles include chemical, material, and process engineers who design, optimize, test, and ensure the quality of products; supply chain or logistics managers who oversee the procurement of materials and manage the transportation of raw materials and finished batteries; environmental engineers who ensure compliance with environmental regulations and sustainability practices; and robotic technicians who maintain and program robots used in the assembly process (Invest WindsorEssex, 2021; Niri et al., 2024; Northvolt, n.d; Saha et al., 2024; Vasilauskas et al., 2024).[1]
- Battery cell component facilities: These jobs, which involve making the cathodes, anodes and other parts that go into battery cells, are comparable to those at a battery production facility. Component facilities employees can include assembly specialists, chemical and material scientists and engineers, production and process engineers, supply chain managers, and people filling many more roles.
- Battery recycling facilities: Jobs in recycling can include, but are not limited to, chemical and materials recovery engineers, dismantling technicians, recycling process engineers, safety specialists, and research scientists focused on innovative recycling techniques (Invest WindsorEssex, 2021; Niri et al., 2024; Northvolt, n.d.; Saha et al., 2024; Vasilauskas et al., 2024).

## ASSESSMENT OF BATTERY PACK PRODUCTION JOBS

This section assesses the job creation potential from U.S. battery pack production, defined here as the manufacturing of battery cells and modules and their assembly into battery packs.

1 Job descriptions and salary ranges were also gathered in September 2024 from hiring platform Indeed.com.

A wide range of company announcements and literature studies provide insight into the relationship between battery production and labor needs. The descriptions and estimates of labor needs vary by announcement, with some highlighting the jobs to be created using phrases such as "good jobs," "high-paying, quality jobs," "new high-tech jobs," "skilled jobs," and others. These jobs are often described as "on-site," "at the facility," "in the county," or "across the local community." Other studies refer to labor needs more generally, using terms like "workers" or "labor hours."

To understand the potential job creation driven by the growth of battery production, this analysis quantifies the jobs-per-GWh ratio, which then can be scaled according to the total domestic capacity. To help determine this ratio, we select facilities that only produce batteries for electric LDVs, show capacity in GWh or in numbers of batteries or vehicles that can be converted to GWh, and have clear press releases or statements about the number of direct jobs at the physical facility. Table 1 shows the main details of these selected facilities, including company, location, whether it is a joint venture, planned production year, total investment, battery production category, capacity in GWh or converted into GWh, and the estimated number of jobs. More details on these plants are shown in Table A1 in the appendix.

**Table 1**

**Company announcements used to determine jobs-to-GWh ratio for battery production**

| Company | City | State | Joint venture | Planned production | Investment | Battery production category | Capacity (GWh or converted into GWh) | Jobs |
|---|---|---|---|---|---|---|---|---|
| **Hyundai Motor Group** | Ellabell | Georgia | Yes | 2025 | $2.15 billion | Cells, modules, packs | 15 | 1,500 |
| **LG Energy Solution** | Ellabell | Georgia | Yes | 2025 | $2.15 billion | Cells, modules, packs | 15 | 1,500 |
| **Ford Motor Company** | Glendale | Kentucky | Yes | 2025 | $2.9 billion | Cells, modules, packs | 43 | 2,500 |
| **SK Group** | Glendale | Kentucky | Yes | 2025 | $2.9 billion | Cells, modules, packs | 43 | 2,500 |
| **BMW AG** | Greer | South Carolina | No | 2015 | $10 million | Modules, packs | 2 | 120 |
| **LG Corporation** | Holland | Michigan | No | 2025 | $4.7 billion | Cells, modules | 20 | 1,200 |
| **Samsung SDI Co., Ltd** | Kokomo | Indiana | Yes | 2025 | $1.55 billion | Cells, modules | 17 | 700 |
| **Stellantis** | Kokomo | Indiana | Yes | 2025 | $1.55 billion | Cells, modules | 17 | 700 |
| **Samsung SDI Co., Ltd** | Kokomo | Indiana | Yes | 2027 | $1.6 billion | Cells, modules | 17 | 700 |
| **Stellantis** | Kokomo | Indiana | Yes | 2027 | $1.6 billion | Cells, modules | 17 | 700 |
| **Mercedes-Benz Group** | West Blocton | Alabama | No | 2022 | $1.0 billion | Packs | 26 | 600 |
| **Hyundai Motor Group** | Montgomery | Alabama | No | 2024 | $205 million | Modules | 20 | 400 |
| **General Motors** | New Carlisle | Indiana | Yes | 2027 | $1.5 billion | Cells | 15 | 850 |
| **Samsung SDI Co., Ltd** | New Carlisle | Indiana | Yes | 2027 | $1.5 billion | Cells | 15 | 850 |
| **American Battery Factory** | Tucson | Arizona | No | 2025 | $1.2 billion | Cells | 15 | 1,000 |
| **LG Energy Solutions** | Spring Hill | Tennessee | Yes | 2024 | $1.15 billion | Cells | 25 | 850 |
| **General Motors** | Spring Hill | Tennessee | Yes | 2024 | $1.15 billion | Cells | 25 | 850 |
| **General Motors** | Warren | Ohio | Yes | 2024 | $1.3 billion | Cells | 22 | 1,092 |
| **LG Corporation** | Warren | Ohio | Yes | 2024 | $1.3 billion | Cells | 22 | 1,092 |
| **General Motors** | Lansing | Michigan | Yes | 2022 | $1.15 billion | Cells | 20.5 | 850 |
| **LG Corporation** | Lansing | Michigan | Yes | 2022 | $1.15 billion | Cells | 20.5 | 850 |
| **Amprius Technologies** | Brighton | Colorado | No | 2025 | $190 million | Cells | 5 | 332 |

*Note:* When a joint venture is involved, the data on investments in dollars, capacity in GWh, and the number of jobs are equally split in the table among the participating companies. More details on assumptions are in the text above and in the appendix.

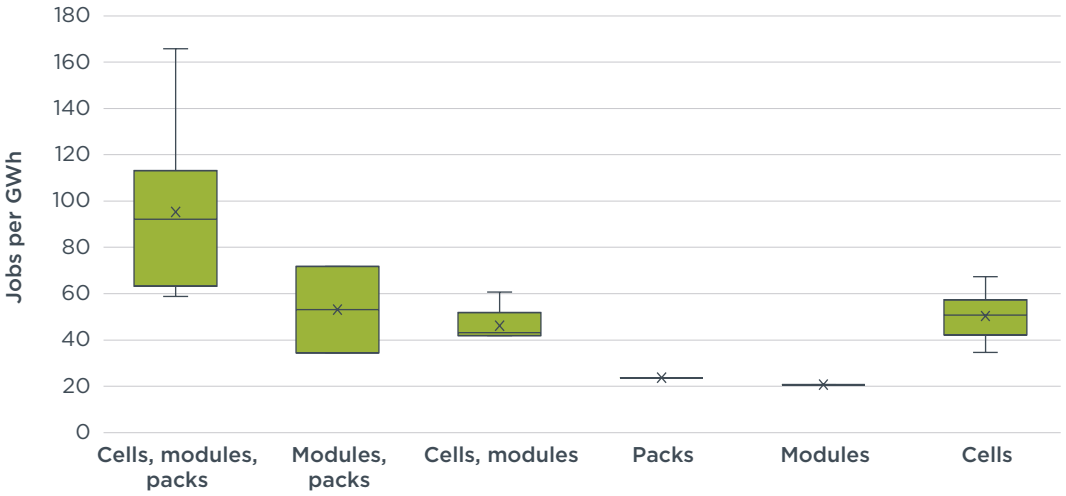
In addition to the announcements, we also use several studies to help quantify the labor demand for component manufacturing. Argonne National Laboratory models a nickel manganese cobalt (NMC) NMC622-G cell plant that produces 60-kWh batteries with a capacity of 100,000 PHEV battery packs per year, or 6 GWh, which requires a total of 980,400 labor hours (Nelson et al., 2019). The study assumes the plant has approximately 300 production days per year and 8-hour shifts for each worker. This translates to approximately 68 workers per GWh. Cotterman et al. (2024) draws on insights on the production process from manufacturing experts to show that the labor needed to manufacture a 60-kWh battery pack—from manufacturing the cells to assembling the pack—ranges from 14 to 24 hours. Using a 300-day plant operation, this equates to roughly 100 to 165 workers per GWh.

FEV Consulting (2023) finds that manufacturing a 100-kWh battery pack requires approximately 11 hours or 13.5 hours, depending on whether a bottom-up or top-down cost estimation approach is used. This translates to 64 workers per GWh using the bottom-up approach or 83 workers per GWh using the top-down approach. It is important to note that this analysis does not specify whether the jobs are full time. To obtain additional data points for manufacturing only the modules and packs, we subtracted the labor requirement for cell production in the FEV Consulting analysis from the total labor requirement for producing the entire battery pack. The FEV Consulting analysis assumes in the top-down approach that manufacturing the battery cells for a 100-kWh battery pack takes 8 hours. Thus, the modules and packs would take 5.5 hours.

Figure 4 summarizes the range of data used to project the labor demand in jobs-per-GWh ratio. The figure shows a range of the ratios and the average, marked as X, across the six categories for the battery production category combinations included in Table 1 above.

**Figure 4**

**Jobs-per-GWh ratio to manufacture battery cells and modules and assemble them into packs**



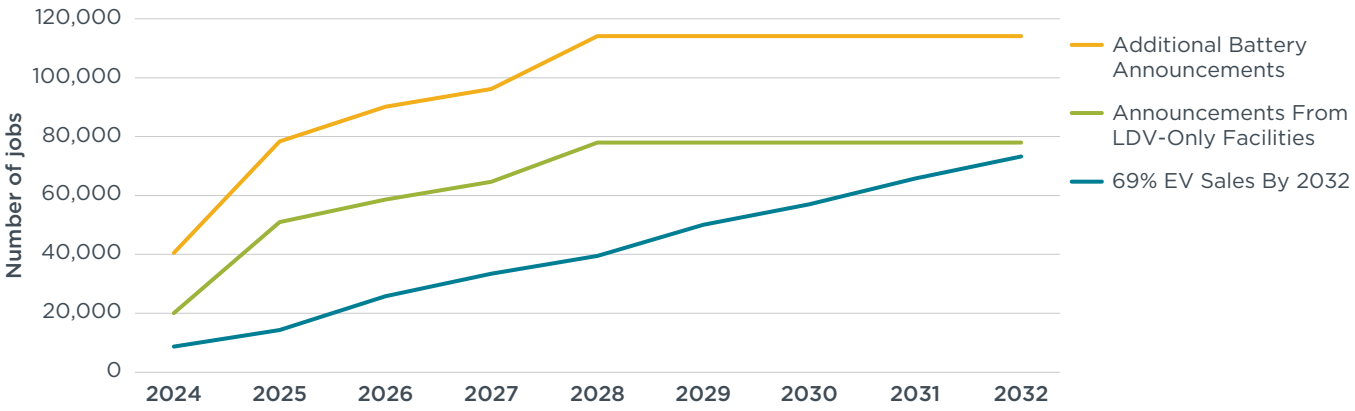

*Note:* The horizontal line within each bar indicates the median value from multiple studies while x represents the average. Half of all values fell between the top of the bar (75th percentile) and bottom of the bar (25th percentile). The vertical lines above and below each bar represent maximum and minimum values.

For an integrated facility producing the entire battery pack—cells, modules, and packs—the average is 95 jobs per GWh. For facilities producing modules and packs, the average is 52 jobs per GWh. For producing both cells and modules, the average is around 45 jobs per GWh. For packs production alone the average is 22 jobs, and for modules alone the average is 20 jobs. The average for cells production alone is 50 jobs per GWh, which is slightly higher than the estimate for both cells and modules.

The jobs-per-GWh findings for battery production using different combinations of cells, modules, and packs are similar to the 95 jobs per GWh for integrated facilities that produce the entire battery pack. Jobs at facilities producing modules and packs, added to the jobs at facilities producing cells, results in 102 jobs per GWh. Producing cells, modules, and packs at three separate facilities results in 92 jobs per GWh.

We multiply the average of 95 jobs-per-GWh findings from Figure 4 by the battery pack needs and production estimates from the three scenarios in Figure 2 to estimate the total number of jobs from U.S. battery pack production from 2024 through 2032. The results are shown in Figure 5. As shown, battery production jobs from the 69% EV Sales By 2032 Scenario increase from about 9,000 in 2024 to about 73,000 by 2032, which is a compounded annual growth rate (CAGR) of about 31%. For the Announcements From LDV-Only Facilities Scenario, the number of jobs grows from about 20,000 in 2024 to about 78,000 by 2032, a CAGR of about 40%. For the Additional Battery Announcements Scenario, the number of jobs grows from about 40,000 in 2024 to about 114,000 in 2032, a CAGR of about 30%.

**Figure 5**
**Projected U.S. battery pack manufacturing jobs for the three scenarios**




*Note:* The 69% EV Sales By 2032 Scenario is based on estimates of EV market growth from the EPA multi-pollutant emissions standards. The Announcements From LDV-Only Facilities Scenario is based on company announcements of LDV battery production capacity. The Additional Battery Announcements Scenario is based on the LDV-only facilities plus announcements of battery production capacity at facilities that produce batteries for LDVs in addition to other applications within the same facility.

## ADDITIONAL JOBS FROM BATTERY CELL COMPONENT PRODUCTION AND BATTERY RECYCLING

This section assesses the potential additional jobs from the manufacturing of battery cell components and battery recycling. We identified 61 announcements related to cell component production from 54 facilities, but the announcements included production capacity for only 29 of these facilities. We also identified 34 announcements from 34 facilities that recycle EV batteries; 11 of these facilities disclosed recycling capacity. We detail capacity and other information about cell component production facilities in Table A1 and battery recycling facilities in Table A2 in the appendix.

Our analysis of cell components includes the production of cathodes, anodes, electrolytes, and separators. These production facilities typically measure capacity in metric tons or EV equivalents. To convert metric tons to GWh, we use the weight breakdown of battery cell components from Argonne National Laboratory's Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET) Model (Wang et al., 2022). GREET provides the weight shares of the cathode, anode, and electrolyte per lithium-ion battery. Generally, cathodes account for 25% to 30% of the weight, depending on whether the material used is nickel manganese cobalt (NMC) or lithium-iron phosphate (LFP). Graphite anodes constitute around 15% of the weight and electrolytes constitute close to 7%. As above, we apply an average battery capacity per vehicle of 100 kWh and estimate the weight of the cell components in each battery. Because separators are not a component covered in GREET, we use announcements that provide a battery or vehicle equivalent (convertible to GWh) based on a 100 kWh-per-vehicle assumption to determine the jobs-per-GWh ratio for this component. When a facility has more than one cell component production category, the data on investments in dollars, capacity in GWh, and the number of jobs are equally split among the components.

As with the battery pack production assumptions, we assume that if an announcement lacks a specified production start date, production begins in 2028. We also assume that total production capacity remains consistent from 2028 through 2032, as none of the cell component facility announcements provided details on planned production beyond 2028.

Although the U.S. battery recycling industry is in the early stage, it is quickly gaining momentum. As mentioned above, nine of the 34 facilities disclosed EV battery recycling capacity in GWh or in EV-equivalent. We refer to this total GWh value as the known EV battery recycling capacity. This differs from facilities that report recycling capacity in metric tons per year and mention EV recycling capability, but the EV-specific capacity remains unknown. Consequently, these facilities are not included in the calculation of the jobs-per-GWh factor. This also means that our estimates of recycling capacity and associated jobs are likely an underestimate.

Table 2 summarizes the information about the cell component production and battery recycling facilities that are used to project the jobs-per-GWh ratio. We used information from five cathode facilities, four anode facilities, four electrolyte facilities, two separator facilities, and nine recycling facilities. The announcements for cell component production and battery recycling do not provide details about how much of the capacity will go toward light-duty vehicle batteries or for other applications.

**Table 2**

**Announcements used to the determine jobs-per-GWh ratio for production of cell components and battery recycling**

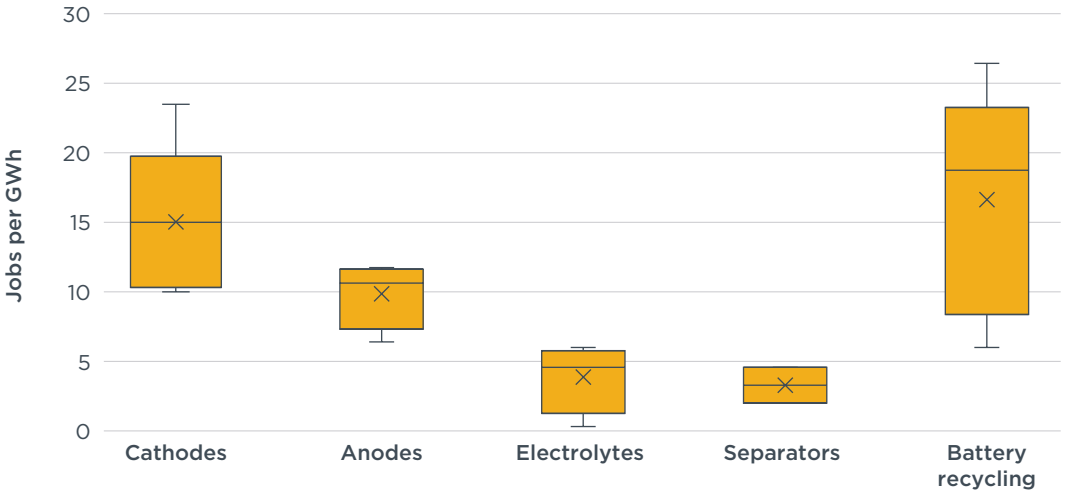
| Company | City | State | Planned production | Investment | Cell component category | Capacity (GWh or converted into GWh) | Jobs |
|---|---|---|---|---|---|---|---|
| **LG Chem** | Clarksville | Tennessee | 2026 | $1.6 billion | Cathode | 40 | 425 |
| **BASF** | Elyria | Ohio | 2012 | $50 million | Cathode | 1.7 | 25 |
| **Guoxuan Hightech** | Big Rapids | Michigan | 2025 | $1.7 billion | Cathode | 75 | 1,763 |
| **Ascend Elements** | Hopkinsville | Kentucky | 2023 | $1 billion | Cathode | 25 | 400 |
| **Israel Corporation** | St. Louis | Missouri | | | Cathode | 15 | 150 |
| **Anovion Technologies** | Colquitt | Georgia | 2025 | $800 million | Anode | 40 | 400 |
| **Graphite One Inc.** | Niles | Ohio | | $435 million | Anode | 25 | 160 |
| **Guoxuan Hightech** | Big Rapids | Michigan | 2025 | $590 million | Anode | 50 | 588 |
| **Sila** | Chicago | Illinois | 2026 | $400 million | Anode | 10 | 225 |
| **Dongwha Electrolytes** | Clarksville | Tennessee | 2024 | | Electrolyte | 225 | 68 |
| **Enchem Co., Ltd.** | Commerce | Georgia | 2022 | $61 million | Electrolyte | 50 | 300 |
| **Mitsubishi Chemical Group** | Memphis | Tennessee | 2023 | | Electrolyte | 85 | 350 |
| **SoulBrain Holdings Co.** | Northville | Michigan | 2010 | | Electrolyte | 12.5 | 63 |
| **ENTEK** | Terre Haute | Indiana | 2027 | $1.44 billion | Separator | 140 | 640 |
| **Celgard/Asahi Kasei** | Charlotte | North Carolina | 2012 | $49 million | Separator | 100 | 200 |
| **Li-Cycle** | Rochester | New York | 2020 | $375 million | Battery recycling | 20.3 | 270 |
| **Li-Cycle** | Tuscaloosa | Alabama | 2022 | | Battery recycling | 2 | 45 |
| **Ascend Elements** | Covington | Georgia | 2022 | $43 million | Battery recycling | 7 | 185 |
| **Ascend Elements and SK ecoplant** | Hopkinsville | Kentucky | 2025 | $60 million | Battery recycling | 5.6 | 60 |
| **Cirba Solutions** | Lancaster | Ohio | 2024 | $400 million | Battery recycling | 25 | 150 |
| **Cirba Solutions** | Columbia | South Carolina | 2024 | $200 million | Battery recycling | 50 | 300 |
| **Cirba Solutions** | Eloy | Arizona | | $200 million | Battery recycling | 5 | 110 |
| **Clarios Circular Solutions** | Florence | South Carolina | | $150 million | Battery recycling | 20 | 375 |
| **Li Industries** | Kettering | Ohio | | | Battery recycling | 5 | 120 |

*Note:* When a facility's production includes more than one cell component category, the data on investments in dollars, capacity in GWh, and the number of jobs are equally split in the table among the components. More details on assumptions are in the text above and in the appendix. For announcements in which the planned production date is not disclosed, represented by blank cells, we assume a production start date of 2028.

Figure 6 summarizes the range of data used to project the labor demand in jobs-per-GWh for the cell components and battery recycling shown in Table 2. For cathodes, the average is 15 jobs per GWh. For anodes, the average is 10 jobs per GWh. The average for electrolytes and separators is four and three jobs per GWh, respectively. The data for battery recycling exhibit a wider range and average around 17 jobs per GWh. In total, cell component manufacturing and battery recycling requires about 49 jobs per GWh.

**Figure 6**

**Jobs-per-GWh ratio for battery cell components and battery recycling**




*Note:* The horizontal line within each bar indicates the median value from multiple studies while x represents the average. Half of all values fell between the top of the bar (75th percentile) and bottom of the bar (25th percentile). The vertical lines above and below each bar represent maximum and minimum values.

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Production of battery cell components and battery recycling could generate significant employment opportunities. Based on the announcements compiled in Table A1 in the appendix, announced cathode production capacity is around 200 GWh by 2032. This represents about 24% of the total GWh that would be required to build all the battery packs in the Announcements From LDV-Only Facilities Scenario. This means that about a quarter of the jobs producing cathodes could be in the United States if companies deliver on their announcements. The announcements in Table A1 also put the capacity of graphite anodes in 2032 at approximately 150 GWh, separators at 240 GWh, and electrolytes at 900 GWh. For EV battery recycling, the industry announcements sum up to 160 GWh; more details are shown in Table A2 in the appendix. These announced capacities are multiplied by the jobs-per-GWh ratio from Figure 6 to estimate the total number of jobs. The exception is electrolytes, which exceed the capacity of battery pack production announcements, and therefore is reduced to not exceed pack production capacity from Figure 2.

Figure 7 combines findings of battery cell component and battery recycling jobs with the earlier analysis of battery pack jobs. It summarizes the estimated jobs from the U.S. production of battery packs (cells, modules, packs), cell components (cathodes, anodes, electrolytes, and separators) and end-of-life recycling. The number of jobs from battery pack production is from the Announcements From LDV-Only Facilities Scenario shown in Figure 5. The number of jobs from battery cell component production and battery recycling is based on the jobs-per-GWh ratio from Figure 6 multiplied by the industry announcements about production of components and recycling described above. The figure shows that the number of jobs could increase from about 24,000 in 2024 to close to 89,000 in 2032, an 18% CAGR. Battery pack production contributes about 88% of these jobs, followed by cell components production at about 10% of jobs, and recycling at about 2% of jobs.

**Figure 7**

**Projected U.S. battery pack manufacturing, cell component production, and battery recycling jobs for the Announcements From LDV-Only Facilities Scenario**

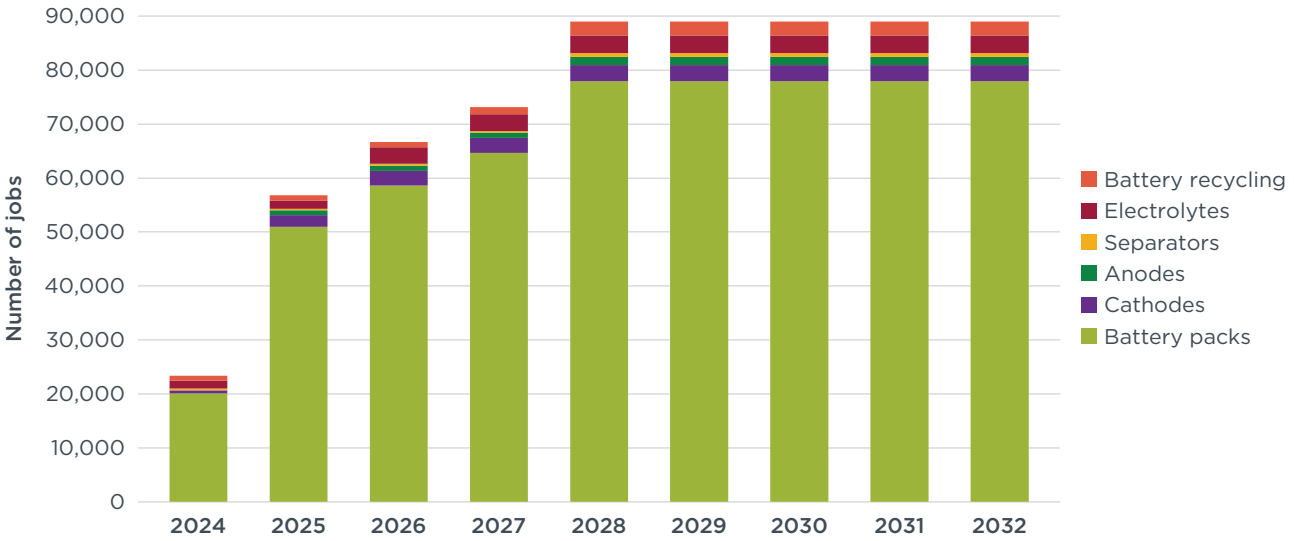


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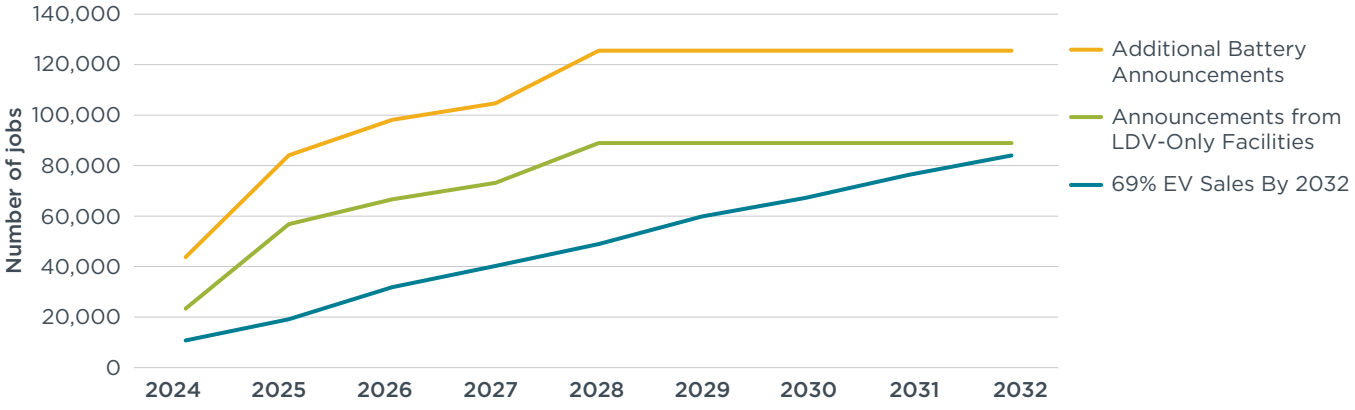
Figure 8 summarizes the potential jobs from U.S. battery pack manufacturing, cell component production, and battery recycling for all three scenarios, using the same methods as in Figure 7. As shown, the 69% EV Sales By 2032 Scenario shows job growth from 11,000 jobs in 2024 to 84,000 jobs in 2032, a 31% CAGR. Battery jobs under the Announcements From LDV-Only Facilities Scenario grow from 23,000 in 2024 to 89,000 by 2032. Under the Additional Battery Announcements Scenario, the number of jobs triples from 44,000 in 2024 to 125,000 in 2032 with a 14% CAGR.

**Figure 8**

**Projected jobs from U.S. battery pack manufacturing, cell component production, and battery recycling**




*Note:* The 69% EV Sales By 2032 Scenario is based on estimates of EV market growth from the EPA multi-pollutant emissions standards. The Announcements From LDV-Only Facilities Scenario is based on company announcements of LDV battery production capacity. The Additional Battery Announcements Scenario is based on the LDV-only facilities plus announcements of battery production capacity at facilities that produce batteries for LDVs in addition to other applications within the same facility.

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With all the jobs created from battery pack manufacturing, cell component production, and battery recycling, the battery sector has the potential to be a good source of domestic jobs. In 2023, the United States had approximately 168 million employed individuals (U.S. BLS, 2024b). Assuming a projected annual growth rate of 0.4% from 2023 to 2033 would result in an additional 6 million new jobs by 2032 (U.S. BLS, 2024b). Our analysis indicates that about 1.5%–2.1% or more of this growth could come from EV battery pack manufacturing, cell component production, and recycling.

Increased domestic production of battery cell component and recycling could contribute even more to job growth. For example, as of September 2024, announced production capacity for cathodes meets 26% of the 770 GWh of battery pack demand in 2032 in the 69% EV Sales By 2032 Scenario. Increasing cathode production to match this scenario's battery demand could bring an additional 8,500 jobs. Similarly, anode, separators, and battery recycling could bring an additional 17,000 jobs if production matches this demand scenario. As noted previously, total numbers of GWh capacity and jobs in EV cell component production and battery recycling are not fully captured due to the lack of data on production capacity, so job numbers could be higher than those shown in the figure.

Additionally, several other job categories related to EV batteries that are not captured in this study—such as temporary construction jobs; jobs in other parts of the upstream supply chain such as material processing, battery enclosure, and electrical component production; as well as induced jobs from supporting sectors—are impacted by the increased economic activity or investment. For example, Gigafactory Nevada reported that about 17,000 construction jobs were created building the facility (Tesla, 2022). The KOREPlex battery manufacturing plant in Buckeye, Arizona, which began construction in 2024, will create an estimated 10,000 direct and indirect jobs, along with 3,400 construction jobs (KORE Power, 2021). There are also jobs related to the significant increase in U.S. processing capacity for critical minerals, such as lithium and graphite, tied to the grants, loans, and incentives provided in the IRA (Northey, 2024).

## COMPARISON WITH OTHER STUDIES

Several other studies also evaluate the jobs potential using a different approach, by calculating workers per million dollars in expenditures or investments. The regulatory impact analysis of the EPA's multi-pollutant standards referenced two U.S. Census Bureau surveys (U.S. EPA, 2024c). The 2017 Economic Survey estimated there were 3.2 workers per million dollars in expenditures for businesses identified under the North American Industry Classification System (NAICS) code 33591 (U.S. Census Bureau, 2017). The 2022 Annual Survey of Manufacturers estimated there were 2.4 workers per million dollars in expenditures under the same code (U.S. Census Bureau, 2022). NAICS code 33591 encompasses establishments primarily engaged in manufacturing primary (non-rechargeable) and storage batteries; these include, for example, dry cell (such as AAA and AA) batteries, watch batteries, transistor radio batteries, lead acid storage batteries, rechargeable nickel-cadmium batteries, and lithium batteries. The 2022 Employment Requirement Matrix provided by the U.S. Bureau of Labor Statistics (2023b) showed 3.8 workers per million dollars in expenditure for both NAICS code 33591 and 335999, the latter of which includes all other miscellaneous electrical equipment and component manufacturing.

Soni (2020) suggested a 0.82 full-time equivalent worker per million-dollar investment in a high battery cost scenario, and 0.46 in low battery cost scenario. The International Energy Agency (2020) provided an estimate of five to 11.4 workers

per million-dollar investment to cover direct and indirect jobs. Another study found that employment related to announced U.S. EV battery, components, and recycling capacity totals 107,000 jobs (Environmental Defense Fund & WSP, 2024). The U.S. Department of Energy (U.S. DOE) estimates there will be more than 90,000 potential new jobs in the battery manufacturing and supply chain (U.S. Department of Energy [U.S. DOE], 2024a).

Table 3 summarizes the collection of studies on the relationship between investments and workers. It shows workers per million dollars of expenditure or investment where applicable and the types of jobs in the scope of each study. Investments in battery pack production under the Announcements From LDV-Only Facilities Scenario, plus cell component manufacturing facilities, total approximately $96 billion as of September 2024. For the final column, we multiply the workers per million dollars of expenditure by 96,000—the number of millions in $96 billion—for the five studies with workers-per-investment ratios.

**Table 3**
**Comparison of jobs estimate with other studies**

| Study | Workers per million dollars of expenditure/ investment | Job types | Job estimates based on battery pack facilities under the Announcements From LDV-Only Facilities Scenario plus cell component manufacturing |
|---|---|---|---|
| **Economic Survey (2017)** | 3.2 | Battery manufacturing (NAICS code 33591) | 309,000 |
| **Annual Survey of Manufacturers (2022)** | 2.4 | Battery manufacturing (NAICS code 33591) | 232,000 |
| **Employment Requirement Matrix (2022)** | 3.8 | Battery manufacturing (NAICS code 33591) and miscellaneous electrical components (NAICS code 335999) | 367,000 |
| **International Energy Agency (2020)** | 5–11.4 | Direct and indirect jobs for battery cell manufacturing | 275,000–627,000 |
| **Soni (2020)** | 0.46 or 0.82 (based on whether battery cost is 25% or 45% of EV cost) | Full-time equivalent direct, indirect, and induced jobs in battery manufacturing for electric vehicles using 2018 investments and IMPLAN model | 44,000–79,000 |
| **Environmental Defense Fund & WSP (2024)** | — | EV batteries, components, and recycling | 107,000 |
| **U.S. Department of Energy (2024a)** | — | Battery manufacturing and supply chain (three categories: cells; packs; minerals, materials, and components) | > 90,000 |

These job estimates cover a wide range of batteries and job types. For example, NAICS code 33591 encompasses companies that primarily engage in the production of primary (non-rechargeable) and storage batteries. The workers-per-investment ratios could be covering a variety of battery types in addition to LDV batteries, as mentioned above, and it is unclear of the extent of battery cell component production that is included in this code. It likely also includes other upstream cell component production, MHDV vehicle batteries, and other upstream material extraction and processing that mainly serve the battery supply chain. The International Energy Agency (2020) study covers a range of jobs from direct and indirect jobs for battery cell manufacturing. The

Environmental Defense Fund & WSP (2024) study includes MHDV vehicles, and the EV components considered in the analysis are not fully specified. As a result, our estimate of jobs at facilities that produce LDV batteries (89,000 jobs) may represent the lower end of job projections compared to these studies. Soni (2020) uses investment data from 2018, reflecting the early stages of the EV market, when significant investments were still needed to bring EVs to mass adoption. This may explain why this projection is lower compared to our analysis. Meanwhile, the U.S. DOE (2024a) collection shows the closest job estimation to our study.

## DEVELOPING AN EV BATTERY WORKFORCE

Recent efforts to support the growth and development of a workforce for EV battery production include workforce training programs, targeted investments, public-private partnerships, and policy support.

The transition from traditional automotive manufacturing to EV battery production involves a shift in skills and job functions. However, many of the skills acquired by automotive workers to build traditional internal combustion engine vehicles (ICEVs) may also provide the foundational knowledge and skill sets needed for battery manufacturing; this crossover could help preserve jobs and maintain stable employment in the automotive manufacturing sector overall (Saha et al., 2024; Cotterman et al., 2022). For example, both EV and ICEV manufacturing require a strong foundation in mechanical and electrical systems. Automotive workers who are accustomed to working on ICEVs can potentially apply their knowledge of complex mechanical systems to the assembly and maintenance of EV batteries. Similarly, expertise in quality control and precision assembly, which is critical in automotive production, is also essential in ensuring the high standards needed for battery production.

Workers familiar with automated assembly lines and robotics in traditional automotive manufacturing could potentially transition to similar roles in EV battery production, if adequate retraining programs are available. The use of robotics and automation is prevalent in both fields, and the ability to program, maintain, and operate these systems is a valuable skill set that remains relevant. Additionally, safety protocols and standards are crucial in both environments, and workers trained in maintaining safety in automotive plants can apply these practices to battery production facilities (Saha et al., 2024; Cotterman et al., 2022).

While the extent of skill transferability from traditional ICEV automotive manufacturing to the emerging EV battery industry remains somewhat unclear, training programs could help to bridge skill gaps. In March 2024 the U.S. DOE and U.S. Department of Labor released the Battery Workforce Initiative's National Guideline Standards for registered apprenticeships in battery machine operating (U.S. DOE, 2024b). This effort aims to foster partnerships between battery manufacturers, community colleges, and unions by developing training curricula and requirements for battery manufacturing operations. The Battery Workforce Challenge Program, established in September 2024 and led by the U.S. DOE, is intended to help build the next generation of engineers, technicians, and workers for the growing battery industry. The program consists of developing a collegiate competition, building regional workforce training hubs, creating an accessible and equitable platform for training and job opportunities, and providing education to middle through high school students on careers in EV and battery manufacturing (U.S. DOE, 2024c).

A just transition in the battery and EV manufacturing sector can be encouraged by comprehensive support from federal and local governments, in partnership with automakers and other key industry stakeholders. The Biden administration has announced several efforts to support EV battery development. Approximately $5 billion in investment from the Battery Materials Processing and Battery Manufacturing and Recycling Program has been targeted, as of September 2024, to support the development of new, retrofitted, retooled, or expanded domestic facilities for battery material processing, component manufacturing, advanced battery production, and recycling (U.S. DOE, 2023). Thirty-nine projects across the United States have been selected for these investments (U.S. DOE, 2024d). These efforts focus on supporting communities with a history of a skilled automotive workforce and align with the Justice 40 Initiative goal that 40% of the overall benefits of federal investment will flow to underserved and burdened communities. Criteria for project funding include ensuring the jobs created will pay good wages and are provided with the free and fair opportunity to join, form, and support a union (U.S. DOE, 2024c).

In addition, $2 billion in funding for Domestic Manufacturing Conversion Grants and up to $10 billion in loans for automotive manufacturing conversion projects can work hand in hand to spur the conversion of established facilities to support the manufacturing of LDVs and MHDV electric vehicles, along with EV component production and assembly. Preference for the grants is given to projects that commit to high-paying jobs, uphold collective bargaining agreements, and prioritize the transition of automotive manufacturing communities (U.S. DOE, 2023; U.S. DOE, 2024c).

Ensuring that battery jobs are of high quality, with competitive wages and benefits to attract and retain skilled workers, can help to build a stable and experienced workforce. All selectees for grants under the Battery Materials Processing and the Battery Manufacturing and Recycling programs have developed Community Benefits Plans that highlight companies' commitments to battery manufacturing career pathways for community members. Some plans specifically mention recruiting workers from traditionally marginalized communities and from industries, such as steel, that have had closures and layoffs (U.S. DOE, 2024d). In addition, joint ventures between automakers and battery companies for battery cell production, as highlighted in Table 1, are a central focus of contract negotiations for the United Auto Workers (UAW), underscoring the need for high-quality and well-paid jobs at these battery production plants (Saha et al., 2024).

Battery manufacturing is an emerging industry that faces unique challenges and opportunities when it comes to workforce benefits and labor relations. In May 2024, UAW President Shawn Fain visited Ultium Cells Lordstown—General Motors' joint venture with LG Energy Solutions in Warren, Ohio. Workers at the plant started at $16.50 an hour, with a 7-year progression to $20. This contrasts with the $31 an hour long-term production workers earned at a nearby former GM assembly plant that was shut down in 2019. As of June 17, 2024, UAW and GM reached a tentative agreement on raising the starting wage to $26.91 an hour, increasing to $35 an hour after one year on the job ("GM's Ultium Cells workers," 2024). A recent study provides an insight into the positive impact of the agreement on creating good jobs and retaining workers who otherwise would need to move away from the area to find employment (Atlas Public Policy, 2024). In addition, in October 2023, GM agreed to address worker displacement by enabling any GM powertrain and parts workers in at-risk positions to move into EV-related roles while receiving the same wage and benefit levels they had at their current facility (Chen, 2023).

# CONCLUSIONS

This paper details the various stages of the EV battery production process, from the creation of battery cells and the assembly of modules and battery packs to battery recycling. It estimates a jobs-per-gigawatt-hour (GWh) ratio that is scaled according to various U.S. domestic production scenarios. The following conclusions emerged from the analysis:

**The EV transition will increase demand for batteries, but U.S. capacity to produce batteries might grow even faster.** We project EPA's new multi-pollutant standards for light-duty and medium-duty vehicles for model years 2027 and beyond will boost demand for LDV batteries from about 90 GWh in 2024 to 770 GWh by 2032. Industry announcements indicate the capacity to produce LDV batteries may grow from 210 GWh in 2024 to about 820 GWh by 2032. Announcements about facilities producing batteries for other types of vehicles and for uses beyond transportation—in addition to LDV batteries—increases the total battery production capacity from 430 GWh in 2024 to about 1,200 GWh in 2032.

**Battery pack production could require around 95 workers per GWh, while battery cell component production and recycling could employ another 49 workers per GWh.** Battery pack production jobs include producing and assembling cells, modules, and packs. Producing battery cell components includes manufacturing cathodes at 15 jobs per GWh, anodes at 10 jobs per GWh, electrolytes at 4 jobs per GWh, and separators at 3 jobs per GWh. Battery recycling averages about 17 jobs per GWh.

**The growing demand for EV batteries could create about 84,000 to 125,000 jobs by 2032, with even greater potential through increased domestic upstream and downstream processes.** The production for battery packs has the potential to create roughly 73,000 to 114,000 jobs. Additionally, production of cell components such as cathodes, anodes, electrolytes, and separators, along with battery recycling based on the announced production capacity, could contribute around 11,000 jobs in the United States. Increased domestic production of battery cell components and recycling to match battery pack demand could contribute even more to the workforce. More jobs would be created in categories not captured in the study, such as construction jobs, upstream supply chain jobs—including mining, material extraction, and refining—and induced jobs from supporting sectors.

**Federal and automaker support could help attract and retain skilled workers for battery production.** Federal initiatives—such as the Biden administration's $5 billion investment in battery development, $2 billion in conversion grants for manufacturing facilities, and $10 billion in facility-conversion loans—can support the creation of high-quality, well-paid jobs, particularly in communities with a strong history of automotive production. Additionally, programs like the Battery Workforce Initiative and Battery Workforce Challenge Program, which foster collaboration among key battery supply chain stakeholders, can support essential training programs for this growing sector. Automakers' support for job transfers and wage retention between battery and fossil-fuel vehicle manufacturing facilities will further underscore the commitment to retain skilled workers.

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# APPENDIX

The tables below provide more information on the announcements of battery pack, battery cell component production, and battery recycling facilities used in this analysis. Several assumptions were made to help standardize the data collected from the company announcements and prepare for the analysis:

- Battery pack manufacturing, cell component manufacturing, and battery recycling in GWh in each scenario is based on the total production capacity in GWh from facilities that specify their production capacity or provide battery or vehicle output figures, which can be converted to GWh. As a result, not all collected announcements are included in the total GWh.
- If an announcement gives information about production capacity only in terms of how many batteries or EVs the facility could power, we assume that each EV referenced in the announcement has a 100-kWh pack.
- When a company states that it "assembles cells to packs" and does not indicate it purchases cells from another party, we assume that the company produces cells, modules, and packs. If the company reports purchasing cells from another party to make packs, we assume that modules and packs are assembled at the company's facility.
- When a facility's production includes more than one cell component category, the data on investments in dollars, capacity in GWh, and the number of jobs are equally split in the table among the components.
- When investments or jobs are part of a joint venture, we evenly split the investment in dollars, capacity in GWh, and number of jobs between the companies participating in the joint venture.
- If an announcement does not include a start date for production, it is assumed to begin in 2028.
- We assume production capacity remains constant for the 2028–2032 period as none of the identified announcements disclosed information on planned production beyond 2028.

## Table A1

### Announcements of battery pack and battery cell component production for light-duty electric vehicles

| Company | Facility name | City | State | Phase | Joint venture | Planned operation | Investment | Cell component | Other applications | Capacity (other units) | Capacity (GWh) | Jobs | Description of jobs | Construction jobs | Other jobs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Sila** | Moses Lake Facility | Moses Lake | WA | Original | | 2026 | $400 million | Anode | | | 10 | 225 | Workers | | | 1, 2 |
| **Anovion Technologies** | Bainbridge Plant | Colquitt | GA | Original | | 2025 | $800 million | Anode | | 40,000 tons/ year | 40 | 400 | High-paying, quality jobs | | | 1, 2 |
| **Guoxuan High Tech Co.** | Big Rapids Battery Factory | Big Rapids | MI | Original | | 2025 | $590 million | Anode | Others | 50,000 tons/ year | 50 | 587 | | | | 1, 2 |
| **Graphite One Inc.** | Advanced Graphite Anode Facility | Niles | OH | Original | | | $435 million | Anode | | 25,000 tons/ year | 25 | 160 | | | | 1 |
| **Group 14** | BAM-2 Factory | Moses Lake | WA | Original + update | | 2024 | $714 million | Anode | | 2,000 tons per year of SCC55 | | 200 | Manufacturing, engineering and other operational functions | 400 | | 1, 2 |
| **Graphite One Inc.** | Graphite extraction facility | | AK | Original | | | | Anode | | | | 130 | High-wage jobs | | | 1, 2 |
| **Group 14** | BAM Factory | Woodinville | WA | Original | | 2021 | | Anode | | 120 tons | | | | | | 1 |
| **Amprius Technologies, Inc** | Amprius Lab | Fremont | CA | Original | | 2023 | | Anode | | Silicon nanowire anode | | | | | | 1 |
| **Soelect** | Greensboro Manufacturing Facility | Greensboro | NC | Original | | 2023 | | Anode | | | | | | | | 1 |
| **NanoGraf** | Anode Facility | Chicago | IL | Original | | 2024 | | Anode | | 1,000 tons | | | | | | 1 |
| **SKI US** | Birla Carbon Facility | Orangeburg | SC | Original | | | $150 million | Anode | Storage | 25,000 tons | 25 | | | | | 1 |
| **Israel Corporation** | LFP Cathode Powder Factory | St. Louis | MO | Original | | | $400 million | Cathode | | 30,000 tonnes LFP cathode material | 15 | 150 | High-paying union and professional positions in our hometown | 850 | | 1, 2 |
| **LG Chem** | Clarksville Cathode Manufacturing Plant | Clarksville | TN | Original + downsize | | 2026 | $1.6 billion | Cathode | | 60,000 tonnes - 600,000 electric vehicles | 40 | 425 | Good jobs | | | 1, 2 |
| **Ascend Elements** | Apex 1 | Hopskinville | KY | Original | | 2023 | $1.0 billion | Cathode | | Precursor (pCAM) and battery-ready cathode active materials (CAM) for 250,000 vehicles | 25 | 400 | A variety of roles – from engineers and chemists to warehouse associates and manufacturing operators | | | 1 |
| **BASF** | Elyria Lithium-ion Battery Material Plant | Elyria | OH | Original | | 2012 | $50 million | Cathode | | 2,500 metric tons per year of NMC cathode materials | 1.67 | 25 | | | | 1, 2 |
| **Guoxuan High Tech Co.** | Big Rapids Battery Factory | Big Rapids | MI | Original | | 2025 | $1.77 billion | Cathode | Others | 150,000 tons of cathode material a year | 75 | 1,763 | | | | 1, 2 |
| **LOTTE Group** | Hardin County Facility | Cecilia | KY | Original | | 2025 | $238.7 million | Cathode | | 36,000 tons of cathode foil a year | 30.24 | 122 | Full-time jobs | | | 1 |
| **6K Inc.** | PlusCAM Plant | Jackson | TN | Original | | 2024 | $250 million | Cathode | | 13,000 TPA | 10.92 | 260 | | | | 1, 2 |
| **TexPower EV Technologies Inc.** | Houston Facility | Houston | TX | Original | | 2023 | | Cathode | | 3 tons per year | | | | | | 1 |
| **Ascend Elements** | Novi Pilot Plant | Novi | MI | Expansion 1 | | 2022 | | Cathode | | | | | | | | 1 |
| **Tesla Motors, Inc.** | Gigafactory 5 | Austin | TX | Expansion 1 | | | $260 million | Cathode | | | | | | | | 1, 2 |
| **LiCAP** | Sacramento Facility | Sacramento | CA | Original | | | $2.93 million | Cathode, anode | Storage | | 0.25 | | | | | 1 |
| **LG Energy Solutions** | Ultium Cells Spring Hill | Spring Hill | TN | Original + expansion | Yes | 2024 | $1.15 billion | Cells | | | 25 | 850 | New high-tech jobs at the facility | | | 1, 2 |
| **General Motors Company** | Ultium Cells Spring Hill | Spring Hill | TN | Original + expansion | Yes | 2024 | $1.15 billion | Cells | | | 25 | 850 | New high-tech jobs at the facility | | | 1, 2 |
| **General Motors Company** | Ultium Cells Warren | Warren | OH | Original + update | Yes | 2022 | $1.15 billion | Cells | | | 22 | 1092 | New high-tech jobs at the facility | | | 1, 2, 3 |
| **LG Corporation** | Ultium Cells Warren | Warren | OH | Original + update | Yes | 2022 | $1.15 billion | Cells | | | 22 | 1092 | New high-tech jobs at the facility | | | 1, 2, 3 |
| **General Motors Company** | Ultium Cells Lansing | Lansing | MI | Original | Yes | 2024 | $1.3 billion | Cells | | | 20.5 | 850 | New high-tech jobs at the facility | | | 1 |
| **LG Corporation** | Ultium Cells Lansing | Lansing | MI | Original | Yes | 2024 | $1.3 billion | Cells | | | 20.5 | 850 | New high-tech jobs at the facility | | | 1 |
| **General Motors Company** | New Carlisle Battery Plant | New Carlisle | IN | Original | Yes | 2026 | $1.5 billion | Cells | | | 15 | 850 | | | | 1, 2 |

| Company | Facility name | City | State | Phase | Joint venture | Planned operation | Investment | Cell component | Other applications | Capacity (other units) | Capacity (GWh) | Jobs | Description of jobs | Construction jobs | Other jobs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Samsung SDI Co., Ltd** | New Carlisle Battery Plant | New Carlisle | IN | Original | Yes | 2026 | $1.5 billion | Cells | | | 15 | 850 | | | | 1, 2 |
| **Amprius Technologies, Inc** | Brighton Facility | Brighton | CO | Original | | 2025 | $190 million | Cells | | | 5 | 332 | Management, engineering, business support personnel, technicians, operators, and maintenance positions | | | 1, 2 |
| **American Battery Factory** | Tucson Battery Cell Gigafactory | Tucson | AZ | Original | | 2025 | $1.2 billion | Cells | | | 15 | 1000 | Scaling up to 1,000 cumulative jobs, including operations, production, scientific and research and development, automation and robotics, executive and other headquarter positions | | | 1, 2 |
| **Sparkz** | Gigafactory | Bridgeport | WV | Original | | | | Cells | Battery materials | | 15 | 350 | | | | 1, 2, 3 |
| **Tesla Motors, Inc.** | Gigafactory 5 | Austin | TX | Original | | 2022 | $10 billion | Cells | LDV | 80 MWh of 4680 battery cells per week | 4.16 | 20,000 | For both battery and EV production | | | 1, 2, 3 |
| **Tesla Motors, Inc.** | Gigafactory 5 | Austin | TX | Expansion 1 | | | $368 million | Cells | | | 105 | | | | | 1, 2 |
| **Envision AESC Group** | Florence Gigafactory | Florence | SC | Original | | 2026 | $810 million | Cells | | | 30 | 1,170 | Skilled jobs in the region | | | 1, 2, 3 |
| **Envision AESC Group** | Florence Gigafactory | Florence | SC | Expansion 1 | | 2026 | $810 million | Cells | | | | 450 | | | | 1 |
| **Envision AESC Group** | Florence Gigafactory | Florence | SC | Expansion 2 | | 2027 | $1.5 billion | Cells | | | | 1,080 | Across local community | | | 1 |
| **EC Power** | EC Power | State College | PA | Original | | | | Cells | | | 0.001 | 12 | | | | 1 |
| **Honda Motor Company, Ltd** | Fayette County EV Battery Plant | Jeffersonville | OH | Original | Yes | 2025 | $2.2 billion | Cells | | | 20 | 1,100 | Jobs in Fayette County, Ohio | | | 1, 2, 3 |
| **LG Corporation** | Fayette County EV Battery Plant | Jeffersonville | OH | Original | Yes | 2025 | $2.2 billion | Cells | | | 20 | 1,100 | Jobs in Fayette County, Ohio | | | 1, 2, 3 |
| **Electrovaya Inc** | US Gigafactory | Jamestown | NY | Original | | 2025 | $48 million | Cells | Storage | | 1 | 250 | | | | 1, 2, 3 |
| **Magnis Energy Technologies** | Huron Campus Gigafactory | Endicott | NY | Original + expansion | | 2022 | | Cells | Storage, HDV, marine etc | | 38 | 2,500 | | | | 1, 2 |
| **Nanotech Energy** | Nanotech Energy Reno Campus | Reno | NV | Original | | 2024 | $94.9 million | Cells | Storage, EMI, electrodes, nanowires | | 15 | 1,000 | To the region over 5 years | | | 1 |
| **Tesla Motors, Inc.** | Gigafactory Nevada | Sparks | NV | Expansion 1 | | 2024 | $1.8 billion | Cells | Semi trucks | | 100 | 1,500 | | | | 1 |
| **Nanotech Energy** | Nanotech Energy Reno Campus | | NV | Update | | 2025 | | Cells | Storage, EMI, electrodes, nanowires | | 6 | | | | | 1 |
| **Toyota Motor Corporation** | Toyota Battery Manufacturing North Carolina | Liberty | NC | Original + expansion | | 2025 | $13.9 billion | Cells | | 200,000 vehicles—with the intention to expand to at least six production lines for a combined total of up to 1.2 million vehicles per year." (original) | 30 | 5,100 | New American jobs | | | 1, 2, 3 |
| **Forge Nano** | Forge Battery North Carolina | Morrisville | NC | Original | | 2026 | $165 million | Cells | Military contracts, aerospace | | 1 | 204 | | | | 1, 2 |
| **Dai Nippon Printing** | Linwood Facility | Linwood | NC | Original | | | $233 million | Cells | | | | 352 | New jobs in Davidson County | | | 1 |
| **Ford Motor Company** | BlueOval Battery Park Michigan | Marshall | MI | Original + downsize | | 2026 | $2.2 billion | Cells | | Planned battery capacity has been cut from 35 GWh to 20 GWh. | 20 | 1,700 | Good-paying jobs in Marshall | | An employment multiplier of 4.38 | 1, 2, 3 |
| **Clarios** | Meadowbrooke Battery Manufacturing | Holland | MI | Original | | 2023 | | Cells | Low voltage battery | | 1.6 | 85 | | | | 1, 2, 3 |
| **Factorial Energy** | Methuen Facility | Methuen | MA | Original + downsize | | 2023 | $50 million | Cells | | | 0.2 | 150 | Local jobs | | | 1 |
| **SES AI Corp** | SES AI Corp Woburn | Woburn | MA | Original | | 2022 | | Cells | | | | | | | | 1 |

| Company | Facility name | City | State | Phase | Joint venture | Planned operation | Investment | Cell component | Other applications | Capacity (other units) | Capacity (GWh) | Jobs | Description of jobs | Construction jobs | Other jobs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Envision AESC Group** | Bowling Green Plant | Bowling Green | KY | Original | | 2027 | $2 billion | Cells | | 300,000 vehicles annually by 2027 | 30 | 2,000 | Skilled jobs in the region | | | 1 |
| **Panasonic Corporation** | Sunflower Plant | De Soto | KS | Original | | 2025 | $4 billion | Cells | | | 30 | 4,000 | Jobs in the manufacturing industry—initial estimate at announcement | 3,800 | 26% indirect jobs + 23% induced jobs | 1, 2 |
| **EnPower** | EnPower Battery Manufacturing Plant | Indianapolis | IN | Original | | 2022 | | Cells | Storage, HDV, marine etc | | 1 | | | | | 1 |
| **Guoxuan High Tech Co.** | Gotion Lithium Battery Plant | Manteno | IL | Original | | 2024 | $1.6 billion | Cells | | | 40 | 2,080 | At Gotion-operated plant | | | 1, 2 |
| **FREYR Battery** | Giga America Battery Plant | Newnan | GA | Original | | | $2.6 billion | Cells | Storage | | 34 | 720 | U.S. jobs for highly skilled workers in Coweta County | | | 1, 2 |
| **Hyundai Motor Group** | Bartow County Facility | Cartersville | GA | Original | Yes | 2025 | $2.5 billion | Cells | | | 17.5 | 1,750 | Stakeholders estimate | | | 1, 2, 3 |
| **SK Group** | Bartow County Facility | Cartersville | GA | Original | Yes | 2025 | $2.5 billion | Cells | | | 17.5 | 1,750 | Stakeholders estimate | | | 1, 2, 3 |
| **SK Group** | Commerce Battery Plant | Commerce | GA | Original + expansion | | 2022 | $2.6 billion | Cells | | | 21.5 | 3,000 | | | | 1, 2, 3 |
| **Solid Power, Inc.** | EV Cell Pilot Line | Louisville | CO | Original | | 2022 | | Cells | | 15,000 cells | | | | | | 1 |
| **Statevolt** | Imperial Valley Gigafactory | | CA | Original | | 2025 | | Cells | Storage | 650,000 vehicles annually | 54 | 2,500 | Personnel directly employed | | | 1, 2 |
| **Tesla Motors, Inc.** | Tesla Kato Road Pilot Battery Facility | Fremont | CA | Original | | 2021 | | Cells | | 1,000 vehicles per week | 10 | | | | | 1, 2 |
| **American Lithium Energy** | ALE HQ and Manufacturing Facility | Carlsbad | CA | Original + expansion | | 2024 | $26.2 million | Cells | Military contracts, aerospace | 1,500,000 cells (8,000 originally) | | 150 | | | | 1, 2 |
| **Enevate Corp** | Irvine Spectrum Manufacturing Facility | Irvine | CA | Original | | | | Cells | Others | | | 100 | | | | 1 |
| **QuantumScape Corporation** | QS Campus | San Jose | CA | Original | | 2023 | | Cells | Storage | 100,000 cells | | | | | | 1 |
| **Sparkz** | Livermore Manufacturing Plant | Livermore | CA | Original + expansion | | 2022 | $700 million | Cells | | | | 800 | | | | 1, 2 |
| **Enovix** | Fremont Production Facility | Fremont | CA | Original | | 2021 | $45 million | Cells | Smartphones, internet of things | 8 million units/year | | 560 | | | | 1, 2, 3 |
| **LG Energy Solutions** | Queen Creek Battery Factory | Queen Creek | AZ | Original + expansion | | 2025 | $3.2 billion | Cells | | | 36 | 2,800 | Manufacturer to directly employ approximately 2,800 persons | 13,600 | 1,100 indirect jobs, 1,600 induced jobs | 1, 2, 3 |
| **KORE Power, Inc.** | KOREPlex Facility | Buckeye | AZ | Original + expansion | | 2025 | $1.2 billion | Cells | Storage | | 12 | 1,250 | Full-time jobs | 3,400 | 10,000 direct and indirect jobs, 3,000 permanent jobs in Maricopa County | 1, 2, 3 |
| **Natron** | Clarios Meadowbrook Facility | Meadowbrook | MI | Original | | 2023 | | Cells, cathode, anode | Storage, telecom networks, data centers | | 0.6 | | | | | 1 |
| **Xerion** | Dayton Cell Production Facility | Vandalia | OH | Original | | 2025 | $65 million | Cells, electrodes, cobalt material, battery materials | Military contracts, wearables | 10 million cells annually when fully built out; currently 1 GWh and 1.5 million cells | 7 | 1,200 | | | | 1, 2, 3 |
| **Our Next Energy Inc.** | One Circle | Van Buren Township | MI | Original | | 2027 | $1.6 billion | Cells, module, packs, cathode | | | 20 | 2,112 | | | | 1 |
| **LG Corporation** | Holland Battery Factory | Holland | MI | Original | | 2010 | $454 million | Cells, modules | | | 5 | 400 | | | | 1, 2, 3 |
| **LG Corporation** | Holland Battery Factory | Holland | MI | Expansion 1 + downsize | | 2025 | $4.7 billion | Cells, modules | | | 20 | 1,200 | At current location in Holland | 650 | | 1, 2 |
| **Samsung SDI Co., Ltd** | StarPlus Energy Gigafactory #1 | Kokomo | IN | Original | Yes | 2025 | $1.55 billion | Cells, modules | | | 17 | 700 | | | | 1 |
| **Stellantis** | StarPlus Energy Gigafactory #1 | Kokomo | IN | Original | Yes | 2025 | $1.55 billion | Cells, modules | | | 17 | 700 | | | | 1 |
| **Samsung SDI Co., Ltd** | StarPlus Energy Gigafactory #2 | Kokomo | IN | Original | Yes | 2027 | $1.6 billion | Cells, modules | | | 17 | 700 | | | | 1, 2 |

| Company | Facility name | City | State | Phase | Joint venture | Planned operation | Investment | Cell component | Other applications | Capacity (other units) | Capacity (GWh) | Jobs | Description of jobs | Construction jobs | Other jobs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Stellantis** | StarPlus Energy Gigafactory #2 | Kokomo | IN | Original | Yes | 2027 | $1.6 billion | Cells, modules | | | 17 | 700 | | | | 1, 2 |
| **Hyundai Motor Group** | EV Battery Cell Manufacturing Joint Venture | Ellabell | GA | Original + expansion | Yes | 2025 | $2.15 billion | Cells, modules, packs | | 300,000 units together with LG | 15 | 1,500 | 3,000 jobs at the plant and 400 additional jobs in Savannah region | | | 1, 2, 3 |
| **LG Energy Solution** | EV Battery Cell Manufacturing Joint Venture | Ellabell | GA | Original + expansion | Yes | 2025 | $2.15 billion | Cells, modules, packs | | | 15 | 1,500 | | | | 1, 2, 3 |
| **Ford Motor Company** | BlueOval SK Kentucky | Glendale | KY | Original | Yes | 2025 | $2.9 billion | Cells, modules, packs | | | 43 | 2,500 | | | | 1, 2 |
| **SK Group** | BlueOval SK Kentucky | Glendale | KY | Original | Yes | 2025 | $2.9 billion | Cells, modules, packs | | | 43 | 2,500 | | | | 1, 2 |
| **Stellantis** | Belvidere Battery Plant | Belvidere | IL | Original | | 2028 | $3.2 billion | Cells, modules, packs | | | | 1,300 | | | | 1 |
| **Envision AESC Group** | Nissan Battery Plant | Smyrna | TN | Original + expansion | | 2012 | $1.7 billion | Cells, modules, packs | | Probably only 3 GWh | 3 | 400 | | | | 1, 2, 3 |
| **Ford Motor Company** | BlueOval SK Tennessee | Stanton | TN | Original | Yes | 2026 | $2.8 billion | Cells, modules, packs | LDV | | 21.5 | 1,500 | | | | 1, 2, 3 |
| **SK Group** | BlueOval SK Tennessee | Stanton | TN | Original | Yes | 2026 | $2.8 billion | Cells, modules, packs | LDV | | 21.5 | 1,500 | | | | 1, 2, 3 |
| **Tesla Motors, Inc.** | Gigafactory Nevada | Sparks | NV | Original + expansion | | 2014 | $6.2 billion | Cells, modules, packs | Storage, electric motors | | 40 | 10,521 | | 17,000 | | 1, 2 |
| **VinGroup** | Chatham County Facility | Durham | NC | Original + update | | 2028 | $2 billion | Cells, modules, packs | LDV, buses, ancillary industry | 150,000 vehicles per year | | 3,500 | | | | 1, 2, 3 |
| **Dongwha Electrolytes** | Dongwha Battery Facility | Clarksville | TN | Original | | 2024 | | Electrolytes | | 90,000 tons | 225 | 68 | Plant on Guthrie Highway will create 68 new jobs that will pay between $55,000 and $150,000 per year | | | 1 |
| **Enchem Co., Ltd.** | US Headquarters and Electrolyte Manufacturing Plant | Commerce | GA | Original | | 2022 | $61.35 million | Electrolytes | | 20,000 tons | 50 | 300 | Enchem Ltd. will build two new manufacturing plants in Jackson County, Georgia, creating more than 300 jobs | | | 1, 2, 3 |
| **Mitsubishi Chemical Group** | Memphis Lithium-ion Battery Material Manufacturing Plant I-III | Memphis | TN | Original | | 2023 | | Electrolytes | | 34,000 tons | 85 | 350 | Workforce number recorded by NREL Battery supply chain database (National Renewable Energy Laboratory, 2024) | | | 1, 2 |
| **SoulBrain Holdings Co.** | Northville Lithium-ion Electrolyte Material Manufacturing Plant | Northville | MI | Original | | 2010 | | Electrolytes | Others | 5,000 tons | 12.5 | 63 | Workforce number recorded by NREL Battery supply chain database (National Renewable Energy Laboratory, 2024) | | | 1, 2 |
| **Capchem Technology** | Lithium-Ion Manufacturing Facility | Ironton | OH | Original | | 2025 | $120 million | Electrolytes | Others | | | 60 | Inside the facility | | | 1, 2 |
| **South 8 Technologies** | South 8 Technologies Facility | San Diego | CA | Original | | 2022 | $12 million | Electrolytes | Others | | | 15 | | | | 1 |
| **SoulBrain Holdings Co.** | Kokomo Operations | Kokomo | IN | Original | | 2025 | $75 million | Electrolytes | Others | | | | | | | 1 |
| **AquaLith** | College Park Facility | College Park | MD | Original | | 2021 | 750,000 | Electrolytes | | | | | | | | 1 |
| **Enchem Co., Ltd.** | Electrolyte Manufacturing Operations | Brownsville | TN | Original | | 2026 | $152.5 million | Electrolytes | | 40,000 tons | 100 | 190 | New jobs in Tier 4, at-risk Haywood County | | | 1, 2 |
| **Duksan Group** | Duksan Electera Shelbyville Plant | Shelbyville | TN | Original | | 2024 | $95 milion | Electrolytes | Others | 60,000 tons | 150 | 101 | Jobs in Bedford County over the next 5 years | | | 1, 2 |
| **Enchem Co., Ltd.** | Kentucky Electrolyte Manufacturing Plant | | KY | Original | | 2026 | | Electrolytes | | 40,000 tons | 100 | | | | | 1 |
| **Enchem Co., Ltd.** | Michigan Electrolyte Manufacturing Plant | | MI | Original | | 2026 | | Electrolytes | | 60,000 tons | 150 | | | | | 1 |

| Company | Facility name | City | State | Phase | Joint venture | Planned operation | Investment | Cell component | Other applications | Capacity (other units) | Capacity (GWh) | Jobs | Description of jobs | Construction jobs | Other jobs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Enchem Co., Ltd.** | Ohio Electrolyte Manufacturing Plant | | OH | Original | | 2026 | | Electrolytes | | 20,000 tons | 50 | | | | | 1 |
| **Ampcera Inc.** | Tucson Facility | Tucson | AZ | Original + expansion | | 2025 | | Electrolytes (SSB) | Others | 10.5 tons | | 11 | | | | 1, 2 |
| **Capchem Technology** | Lithium-Ion Manufacturing Facility | Ascension Parish | LA | Original | | 2028 | $350 million | Electrolytes and solvent | Others | 100,000 tons of electrolyte and 200,000 tons of solvent | 250 | 63 | Direct new jobs | | 474 indirect new jobs | 1 |
| **Advanced Nano Products** | Elizabethtown Facility | Elizabethtown | KY | Original | | 2023 | $49.6 million | Electrolytes input (additives) | | | | 93 | Well-paying jobs | | | 1 |
| **Cabot Corporation** | Pampa Facility | Pampa | TX | Expansion 1 | | 2023 | $90 million | Electrolytes input (additives) | | 15,000 tons | | 75 | | | | 1 |
| **Orion** | La Porte facility | La Porte | TX | Original | | 2025 | $130 million | Electrolytes input (additives) | Others | 12,000 tons | | | | | | 1, 2 |
| **Halocarbon** | North Augusta Manufacturing plant | Beech Island | SC | Original | | In operation | | Electrolytes input (additives) | | | | | | | | 1 |
| **Honeywell International** | Buffalo Research Lab | Buffalo | NY | Original | | 2010 | $81.3 million | Electrolytes input (salt) | | | | 150 | | | | 1, 2 |
| **Orbia** | PVDF production facility | Saint Gabriel | LA | Original | | In operation | $400 million | Electrolytes input (salt) | | 10,000 tons LIPF | 150 | 50 | | | | 1 |
| **Daikin Industries** | Battery Manufacturing Campus | Decatur | AL | Original | | In operation | | Electrolytes input (solvent and additives) | | | | | | | | 1 |
| **Huntsman Petrochemical** | Conroe Plant | Conroe | TX | Original | | In operation | | Electrolytes input (solvent) | Others | 36,287 tons | | | | | | 1 |
| **UBE Corporation** | Waggaman Manufacturing Facility | Westwego | LA | Original | | 2026 | $491 million | Electrolytes input (solvents) | | 100,000 tons DMC and EMC | 30 | 9 | | 300 | | 1, 2 |
| **Solid Power, Inc.** | Electrolyte Manufacturing Operations | Thornton | CO | Original | | 2022 | | Electrolytes solid | | 30 tons | 0.075 | 125 | | | | 1 |
| **Sion Power** | Tucson HQ & Pilot Line | Tucson | AZ | Expansion 1 | | 2026 | $341 million | Learning laboratory/ pilot | | | | 150 | New jobs primarily engineering, skilled technicians, and other manufacturing-related positions | | | 1 |
| **Ford Motor Company** | Ion Park | Romulus | MI | Original | | 2022 | $185 million | Learning laboratory/ pilot | | | | 200 | Engineers | | | 1 |
| **American Battery Solutions, Inc.** | Battery Innovation Center | Lake Orion | MI | Expansion | | 2022 | | Learning laboratory/ pilot | | | | 100 | | | | 1, 2 |
| **Lyten** | Silicon Valley Campus | San Jose | CA | Original | | 2023 | | Learning laboratory/ pilot | | 200,000 cells | | 112 | Workforce number recorded by NREL Battery supply chain database (National Renewable Energy Laboratory, 2024) | | | 1, 2, 3 |
| **Hyundai Motor Group** | Montgomery EV Battery Manufacturing Facility | Montgomery | AL | Original | | 2024 | $205 million | Modules | | 200,000 EV batteries annually | | 400 | EV battery module plant in Montgomery will eventually employ at least 400 people | | | 1 |
| **Hyundai Motor Group** | North Toledo Battery Assembly Facility | Toledo | OH | Original | | 2024 | $13.8 million | Modules | | | | 185 | Manufacturing | | | 1, 2 |
| **Duckyang** | Braselton Manufacturing Facility | Braselton | GA | Original | | | $10 million | Modules | Storage | | | 285 | | | | 1, 2 |
| **Fortescue** | U.S. Advanced Manufacturing Center | Detroit | MI | Original | | 2025 | $35 million | Modules | Storage, off-road, hydrogen, EV chargers, electrolysers | | | 600 | | | | 1, 2 |
| **BMW AG** | Plant Spartanburg | Greer | SC | Original | | 2015 | $10 million | Modules, packs | | 70,000 units | 2 | 120 | | | | 1, 2 |
| **General Motors Company** | Brownstown Battery | Trenton | MI | Original + expansion | | 2009 | $208 million | Modules, packs | | | | 428 | | | | 1, 2 |
| **Toyota Motor Corporation** | Toyota Battery Manufacturing Kentucky | Georgetown | KY | Original | | | $650 million | Modules, packs | | | | | | | | 1 |

| Company | Facility name | City | State | Phase | Joint venture | Planned operation | Investment | Cell component | Other applications | Capacity (other units) | Capacity (GWh) | Jobs | Description of jobs | Construction jobs | Other jobs | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Nikola** | Nikola Motor Company | Coolidge | AZ | Expansion 1 | | 2023 | | Modules, packs | | | | | | | | 1 |
| **American Battery Solutions, Inc.** | Ovonic Way Plant | Springboro | OH | Original + expansion | | 2023 | | Modules, packs | MHDV | | 4.2 | 338 | | | | 1, 2, 3 |
| **Mercedes-Benz Group AG** | Bibb County Battery Plant | West Blocton | AL | Original | | 2022 | $1 billion | Packs | | Plant produced 260,000 SUVs in 2021; plant may go all electric by 2030 | 26 | 600 | Up to 600 new jobs | | | 1, 2, 3 |
| **BMW AG** | Plant Woodruff | Woodruff | SC | Original | | | $700 million | Packs | | | | 300 | On-site | | | 1, 2 |
| **Samsung SDI Co., Ltd** | Auburn Hills Battery Manufacturing Factory | Auburn Hills | MI | Original + expansion | | 2018 | $133 million | Packs | Storage | | | 829 | Highly skilled positions | | | 1, 2, 3 |
| **Ford Motor Company** | Rawsonville Plant | Ypsilanti | MI | Expansion 2 | | 2022 | $160 million | Packs | | | | 250 | | | | 1 |
| **Honda Motor Company, Ltd** | Marysville Plant | Marysville | OH | Original | | 2025 | | Packs | | | | 300 | Associates | | | 1 |
| **TAB** | Liberty Manufacturing Facility & HQ | Liberty | MO | Original | | 2024 | $15 million | Packs | Storage | | | 50 | | | | 1 |
| **Octillion Power Systems** | Richmond Manufacturing Facility & HQ | Richmond | CA | Original | | In operation | | Packs | Storage | 1,500–2,000 battery packs per day global operation | | | | | | 1, 2 |
| **Hitachi Group** | Mercer County Plant | Harrodsburg | KY | Original | | 2012 | $12 million | Packs | | | | 60 | | | | 1, 2 |
| **Ford Motor Company** | Rawsonville Plant | Ypsilanti | MI | Original | | 2012 | $10 million | Packs | | | | 40 | | | | 1, 2 |
| **Lithion Battery** | Billerica Manufacturing Facility | North Billerica | MA | Original | | In operation | | Packs | | | | | | | | 1 |
| **Cenntro Automotive** | Freehold Facility | Freehold | NJ | Original | | 2023 | | Packs | MDV | | | | | | | 1 |
| **Tesla Motors, Inc.** | Gigafactory 5 | Austin | TX | Expansion 1 | | | | Packs | | | 150 | | | | | 1, 2 |
| **Guoxuan High Tech Co.** | Gotion Lithium Battery Plant | Manteno | IL | Original | | 2024 | $400 million | Packs | | | 10 | 520 | | | | 1 |
| **Hyundai Motor Group** | North Toledo Battery Assembly | Toledo | OH | Expansion | | 2024 | $32 million | Packs | | | | | | | | 1 |
| **ENTEK** | Terre Haute Battery Plant | Terre Haute | IN | Original | | 2027 | $1.44 billion | Separators | | 1.4 million vehicles/1–1.8 billion square meters of separators | | 640 | High wage | | | 1, 2 |
| **Celgard/Asahi Kasei** | Charlotte Manufacturing Facility | Charlotte | NC | Expansion 1 | | 2012 | $49.2 million | Separators | Storage | Additional 1 million batteries/80 million square meters of separators | | 200 | | | 1,000 contractors and suppliers | 1, 2 |
| **MP Assets Corporation** | Virginia Manufacturing Facility | | VA | Original | | | $100 million | Separators | | | | 282 | Permanent | | | 1 |
| **Celgard/Asahi Kasei** | Charlotte Manufacturing Facility | Charlotte | NC | Expansion 2 | | 2026 | | Separators | Storage | | | 100 | Clean energy | | | 1 |
| **Celgard/Asahi Kasei** | Concord Manufacturing Facility | Concord | NC | Original | | 2011 | $100 million | Separators | Storage | | | 289 | | | 131 contractor full-time equivalent jobs as of 12/11/11 | 1, 2, 3 |
| **SEMCORP Advanced Materials Group** | Sidney Manufacturing Facility | Sidney | OH | Original | | 2024 | $916 million | Separators | | | | 1,200 | | | | 1 |
| **Green New Energy Materials** | GNEM Denver facility | Denver | NC | Original | | | $70 million | Separators | | | | 545 | | | | 1 |
| **Orbia** | PVDF production facility | Augusta | GA | Original | Yes | 2026 | $212.5 million | Separators (coating) | Storage, smartphones, laptops, etc. | | | 50 | Manufacturing | 250 | | 1, 2 |
| **Solvay** | PVDF production facility | Augusta | GA | Original | Yes | 2026 | $212.5 million | Separators (coating) | Storage, smartphones, laptops, etc. | | | 50 | Manufacturing | 250 | | 1, 2 |
| **Orbia** | PVDF material processing facility | Saint Gabriel | LA | Original | Yes | 2026 | $212.5 million | Separators (coating) | Storage, smartphones, laptops, etc. | | | | | | | 1 |
| **Solvay** | PVDF material processing facility | Saint Gabriel | LA | Original | Yes | 2026 | $212.5 million | Separators (coating) | Storage, smartphones, laptops, etc. | | | | | | | 1 |

## Table A2

### Announcements of battery recycling facilities for electric vehicles

| Company | City | State | Phase | Planned operation | Investment | Recycling component | Recycling capacity (metric tons per year) | EV equivalent per year | Capacity (GWh or GWh converted from EV equivalent) | Jobs | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Li-Cycle** | Rochester | NY | Original + update | 2020 | $375 million | Recycling (battery) | 90,000 | 203,000 | 20.3 | 270 | 1,2 |
| **Li-Cycle** | Phoenix | AZ | Original | 2022 | | Recycling (battery) | 18,000 | | | | 1,2 |
| **Li-Cycle** | Tuscaloosa | AL | Original | 2022 | | Recycling (battery) | 10,000 | 20,000 | 2 | 45 | 1 |
| **Li-Cycle** | Lordstown | OH | Original | 2023 | | Recycling (battery and battery manufacturing scrap) | | | | 35 | 1 |
| **Omega Harvested Metallurgical** | Winchester | OH | Original | In operation | | Recycling (battery) | | | | | 1 |
| **Cirba Solutions** | Wixom | MI | Original | In operation | | Recycling (battery) | 23,000 | | | | 1 |
| **Cirba Solutions** | Lancaster | OH | Original + update | 2024 | $400 million | Recycling (battery) | | 250,000 | 25 | 150 | 1, 2 |
| **Cirba Solutions** | Columbia | SC | Original + update | 2028 | $200 million | Recycling (battery) | 60,000 | 500,000 | 50 | 300 | 1, 2 |
| **Cirba Solutions** | Eloy | AZ | Original + update | | $200 million | Recycling (battery) | | 50,000 | 5 | 110 | 1 |
| **Clarios Circular Solutions** | Florence | SC | Original | | $150 million | Recycling (battery cathode materials) | 20,000 | 200,000 | 20 | 375 | 1 |
| **Li Industries** | Blacksburg | VA | Original | 2023 | | Recycling (battery) | 55,000 | | | | 1 |
| **Li Industries** | Kettering | OH | Original | | | Recycling (LFP battery and cathode manufacturing) | 10,000 | | 5 | 120 | 1 |
| **Ascend Elements** | Worcester | MA | Original + update | 2019 | | Recycling (battery) | 270 | 630 | 0.63 | | 1 |
| **Ascend Elements** | Covington | GA | Original + update | 2022 | $50 million | Recycling (battery) | 30,000 | 70,000 | 7 | 185 | 1, 2 |
| **Ascend Elements and SK ecoplant** | Hopkinsville | KY | Original | 2025 | $65 million | Recycling (battery) | 24,000 | 56,000 | 5.6 | 60 | 1, 2 |
| **Ascend Elements and Orbia** | Hopkinsville | KY | Original | | $125 million | Recycling (graphite) | | | | | 1 |
| **Ace Green Recycling** | Houston | TX | Original | 2025 | | Recycling (battery) | 20,000 | | | | 1 |
| **Ecobat** | Casa Grande | AZ | Original | 2023 | | Recycling (battery) | 10,000 | | | | 1 |
| **Aqua Metals** | Tahoe-Reno | NV | Original | | | Recycling (battery) | 9,000 (black mass) | 100,000 | 10 | | 1 |
| **Redwood Materials** | | | | | | Recycling (battery) | | | | | |
| **Redwood Materials** | | | | | | Recycling (battery) | | | | | |
| **SungEel HiTech** | Atlanta | GA | Original | 2024 | $37 million | Recycling (battery) | | | | 104 | 1 |
| **American Battery Technology Company** | Fernley | NV | Original | 2023 | | Recycling (battery) | 20,000 | | | 50 | 1 |
| **American Battery Technology Company** | | SC | Original | | | Recycling (battery) | 100,000 | | | 300 | 1 |
| **Green Metal Inc.** | Liberty | NC | Original | 2025 | $19.8 million | Recycling (battery) | | | | 47 | 1, 2 |
| **Collaborative Engineering Services** | Chippewa Falls | WI | Original | 2025 | $15 million | Recycling (battery) | | | | | 1, 2 |
| **Aleon Metals** | Freeport | TX | Original | | | Recycling (battery) | 60,000 | | | | 1 |
| **Jaewon Industrial** | Kokomo | IN | Original | 2024 | $102 million | Recycling (NMP) | 100,000 | | | 100 | 1 |
| **ATC Drivetrain** | Holland | MI | Original | | $10 million | Recycling (battery) | | | | 163 | 1 |
| **Princeton NuEnergy** | Princeton | NJ | | | | Recycling (cathode materials) | 10,000 | 100,000 | 10 | | 1 |
| **Graphite One** | | WA | Original | | | Recycling (graphite, manganese, and others) | | | | | 1 |
| **Agmet** | Oakwoodville | OH | Original | 2021 | | Recycling (metals and industrial byproducts) | | | | | 1 |
| **Blue Whale Materials** | Bartlesville | OK | Original | | $55 million | Recycling (battery) | 50,000 | | | 150 | 1 |
| **ITAP** | Chatsworth | CA | Original | In operation | | Recycling (battery) | | | | | 1 |

## Table A3

### Announcements of battery pack and battery cell component production for medium- and heavy-duty electric vehicles

| Date announced | Company | Facility Name | City | State | Phase | Joint Venture | Planned operation | Investment | Component | Other applications | Capacity | Capacity (GWh) | Jobs | Descriptions of jobs | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/30/20 | Lithion Battery | Lithion Battery | Henderson | NV | Expansion1 | | 2024 | | Cells | Storage, Marine, Medical, Military | | 4.5 | 400 | | 1 |
| 9/16/11 | TotalEnergies | Jacksonville Factory | Jacksonville | FL | Original | | 2011 | | Cells | Storage, Marine, Medical, Military | | 0 | 280 | | 1 |
| 1/18/24 | Cummins | Marshall County Battery Manufacturing Facility | Red Banks | MS | Original | Yes | 2027 | $750 million | Cells | | | 6.3 | 600 | Manufacturing | 1 |
| 1/18/24 | Daimler Truck AG | Marshall County Battery Manufacturing Facility | Red Banks | MS | Original | Yes | 2027 | $750 million | Cells | | | 6.3 | 600 | Manufacturing | 1 |
| 1/18/24 | EVE Energy | Marshall County Battery Manufacturing Facility | Red Banks | MS | Original | Yes | 2027 | $250 million | Cells | | | 2.1 | 200 | Manufacturing | 1 |
| 1/18/24 | Paccar | Marshall County Battery Manufacturing Facility | Red Banks | MS | Original | Yes | 2027 | $750 million | Cells | | | 6.3 | 600 | Manufacturing | 1 |
| 9/20/24 | EnerSys Advanced System | Gigawatt-hour Lithium Ion Cell Facility | Piedmont | SC | Original | | 2028 | $200 million | Cells | MHDV and defense | | 5 | 500 | | 1 |
| 9/20/24 | Forge Battery | | Morrisville | NC | Original | | 2029 | $100 million | Cells | MHDV and defense | | 3 | 280 | | 1 |
| 10/30/20 | Lithion Battery | Lithion Battery | Henderson | NV | Original | | 2021 | | Cells, Modules | Storage, Marine, Medical, Military | | | 100 | | 1, 2, 3 |
| 9/16/11 | TotalEnergies (Saft) | Jacksonville Factory | Jacksonville | FL | Original | | 2011 | $200 million | Cells, Modules | Military hybrid vehicles, aviation, smart grid support, broadband back-up power and energy storage | | | 280 | | 1, 2 |
| 2/10/21 | Microvast | Clarksville Manufacturing Facility | Clarksville | TN | Original | | 2023 | $220 million | Cells, Modules, Packs | Storage | | 2 | 287 | | 1, 2, 3 |
| 4/18/22 | Mullen Technologies | Fullerton Manufacturing Facility | Fullerton | CA | Original + update | | 2024 | $3.5 million | Cells, Modules, Packs | | | | | | 1, 2 |
| 2/1/24 | Volvo | Previous Proterra Factory | Greer | SC | Original | | | $210 million | Cells, Modules, Packs | | | | | | 1 |
| 4/19/23 | BorgWarner | Seneca Battery Plant | Seneca | SC | Expansion1 | | 2024 | $42 million | Modules | | | 3 | 122 | Production, technical support, manufacturing, engineering, maintenance, and supporting function | 1 |
| 11/2/22 | Canoo | EV Battery Module Manufacturing Facility | Pryor | OK | Original | | 2024 | $160 million | Modules | | | 3.2 | 680 | Good-paying manufacturing jobs | 1, 2 |
| 11/9/22 | Sunlight Group | North Carolina Manufacturing Facility | Reidsville | NC | Original | | 2026 | $40 million | Modules, Packs | Storage, marine, off-road, etc. | | 3 | 200 | | 1, 2 |
| 1/13/23 | Nikola Motor Company | Coolidge Multi-Product Factory 4.0 | Eloy | AZ | Original | | 2023 | | Modules, Packs | | | | | | 1 |
| 6/26/19 | BorgWarner | Gigafactory 2 | Hazel Park | MI | Original | | 2021 | $40 million | Modules, Packs | | | 2 | 224 | | 1, 2 |
| 4/19/23 | BorgWarner | Gigafactory 3 | Hazel Park | MI | Original | | 2023 | $10.6 million | Modules, Packs | | | | 62 | | 1 |
| 3/24/15 | Freudenberg | Xalt Energy Battery Park | Midland | MI | Original | | 2015 | $600 million | Modules, Packs | | | | 550 | | 1, 2 |
| 2/2/23 | Freudenberg | Xalt Energy Battery Park | Midland | MI | Expansion1 | | 2024 | | Modules, Packs | | | 19 | | | 1 |
| 6/1/19 | BMZ Group | BMZ | Virginia Beach | VA | Original | | 2017 | $3 million | Packs | Medical equipment, energy storage systems, household appliances and e-bikes. | | | 50 | | 1 |
| 6/11/21 | Xos Trucks | Los Angelese HQ & Manufacturing Facility | Los Angeles | CA | Original | | 2021 | | Packs | Armored cars, forklifts and other heavy work vehicles | 10,000 trucks through 2023 | 2.34 | | | 1 |
| 6/12/23 | Autocar | Birmingham Facility | Birmingham | AL | Original | | 2023 | | Packs | | | | | | 1 |
| 7/11/24 | Cummins | Columbus Facility | Columbus | IN | Original | | | $150 million | Packs, powertrains, other components | Powertrains, other components | | | 250 | | 1 |

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