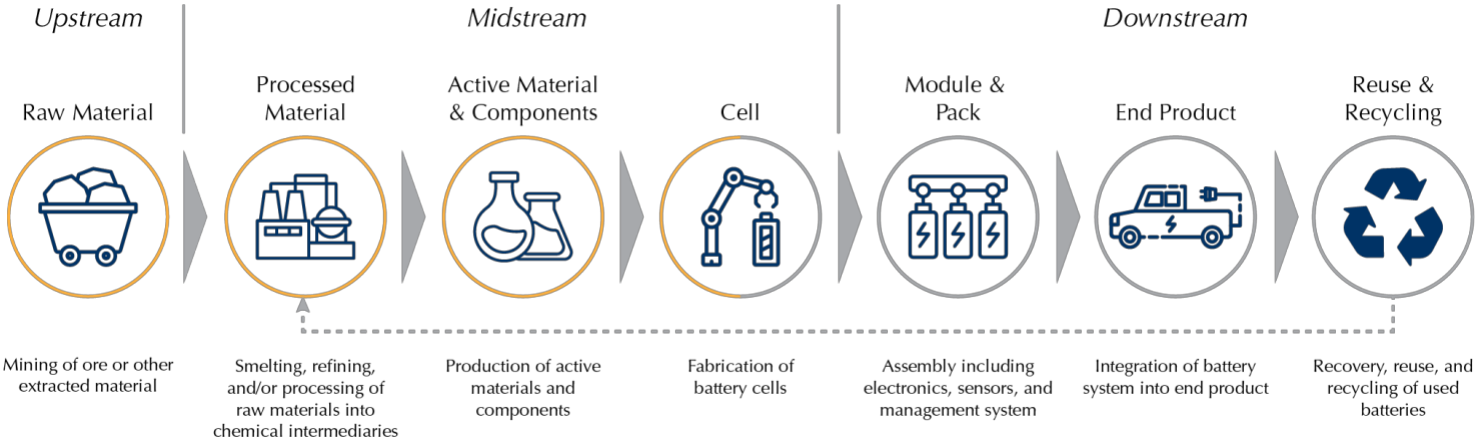
REGIONAL ECONOMIC DEVELOPMENT

# Battery Supply Chain 101

May 2025

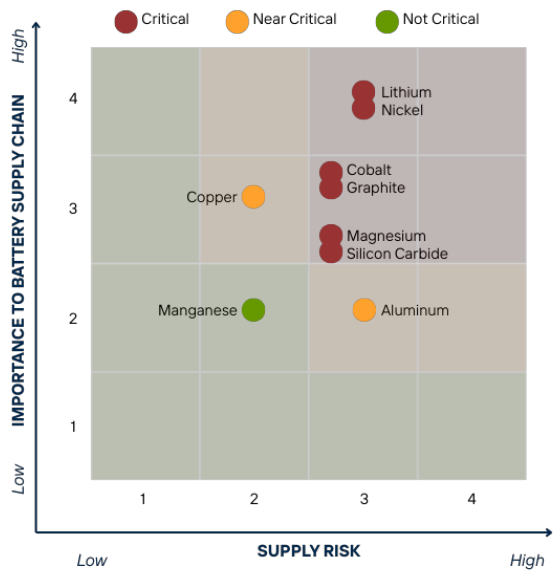
**The battery supply chain is the journey materials take as they are transformed from raw minerals into functioning batteries used in electric vehicles and energy storage systems.**

## SUPPLY CHAIN OVERVIEW




**Mining & Extraction:** Battery production begins with essential raw materials—such as lithium, graphite, nickel, cobalt, and manganese—which are sourced through mining or brine extraction. The quality of materials sourced at this stage directly influences the performance and sustainability of batteries used in electric vehicles and energy storage systems.

- **Hard-Rock Mining:** Metals like lithium, nickel, cobalt, and graphite are mined from solid rock. Ore is extracted from open-pit or underground mines, then crushed and concentrated. For example, lithium is often mined from spodumene rock (such as in North Carolina), while graphite can be extracted from flake deposits (such as in Alabama).
- **Brine Extraction:** Including in parts of Arkansas, lithium-rich saltwater (brine) is pumped to the surface and evaporated in large ponds, allowing lithium salts to be collected.
- **Synthetic Graphite:** Graphite can be manufactured by heating petroleum coke or other carbon-rich materials to extremely high temperatures, forming high-purity graphite used in battery anodes.




*Battery Materials Criticality Index, 2025-2030*
*U.S. Department of Energy, 2023*

**Processing & Refining:** After extraction, raw materials must be refined to achieve the purity needed for battery use. Metals are converted into battery-ready materials, such as lithium carbonate, nickel sulfate, cobalt sulfate, and manganese sulfate. These refined materials form the essential building blocks for battery components.

- **Thermal Conversion:** Materials are heated (calcined or roasted) at high temperatures to facilitate chemical changes, preparing them for further purification. For example, lithium-bearing rock is roasted to enable subsequent chemical extraction of lithium salts.
- **Chemical Treatments:** Materials undergo chemical reactions—such as leaching with acids or bases—to isolate desired elements and remove impurities. This step transforms raw materials into intermediate forms like lithium sulfate.
- **Electrolysis:** Certain metals, such as aluminum and some battery metals, can be purified using electrolysis—a process where electric currents separate pure metal from impurities.

**Battery Components Manufacturing:** Refined materials become specialized battery parts. Cathodes, anodes, separators, and electrolytes are combined and sealed into individual battery cells, which can be cylindrical, rectangular, or a flat pouch. These cells undergo rigorous testing and quality assurance to ensure they can be safely integrated into end-use products.

- **Cathode Production:** Lithium and other metals (nickel, cobalt, manganese, or iron-phosphate) are combined and applied onto aluminum foil to create the cathode, which is where lithium ions travel during discharge to release energy.
- **Anode Production:** Purified graphite, either natural or synthetic, is processed into small particles, sometimes mixed with silicon, and applied onto copper foil to create the anode, which is where lithium ions are stored during charging.
- **Electrolytes & Separators:** Electrolytes are created by dissolving lithium salts into organic solvents. Separators are thin films placed between the anode and cathode to allow lithium ions to move safely.

**Battery Pack Assembly:** Individual battery cells are connected to achieve the desired power and energy levels of the final battery product. These modules are packaged together with other key components to ensure proper function and safety.

- **Battery Management System (BMS):** Electronics monitor and control cell performance, maintain safe operating conditions, and optimize battery life.
- **Thermal Management:** Modules include structural supports and cooling channels in order to function properly. Cooling systems regulate battery temperatures to enhance performance and extend lifespan.

**Final Product Assembly:** Battery packs are installed into final products for stationary and mobile use cases.

- **Electric Vehicles:** Automakers integrate battery packs into electric cars, trucks, and buses. Batteries power electric motors, managed by specialized electronics and software.
- **Energy Storage Systems:** Battery packs store energy from renewable sources like solar or wind, smoothing out energy availability, providing backup power, and stabilizing the electrical grid. Systems range from small household units to large-scale installations for entire communities or utility grids.

**Second Life & Recycling:** At the end of their service life, batteries are managed responsibly through recycling or safe disposal.

- **Recycling:** Used batteries are broken down through chemical or heat processes. Valuable metals (lithium, nickel, cobalt, and graphite) are recovered and recycled into new batteries, reducing the demand for new raw materials.
- **Second-Life Applications:** Batteries that no longer meet stringent vehicle requirements may still be useful for less demanding applications, like stationary storage, backup power, or other energy management purposes.