

# Battery Critical Minerals and Materials 101

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Learn more about our Regional Clean Economies initiative and our series on *Securing the Critical Battery Materials Supply Chain in the Southeast*

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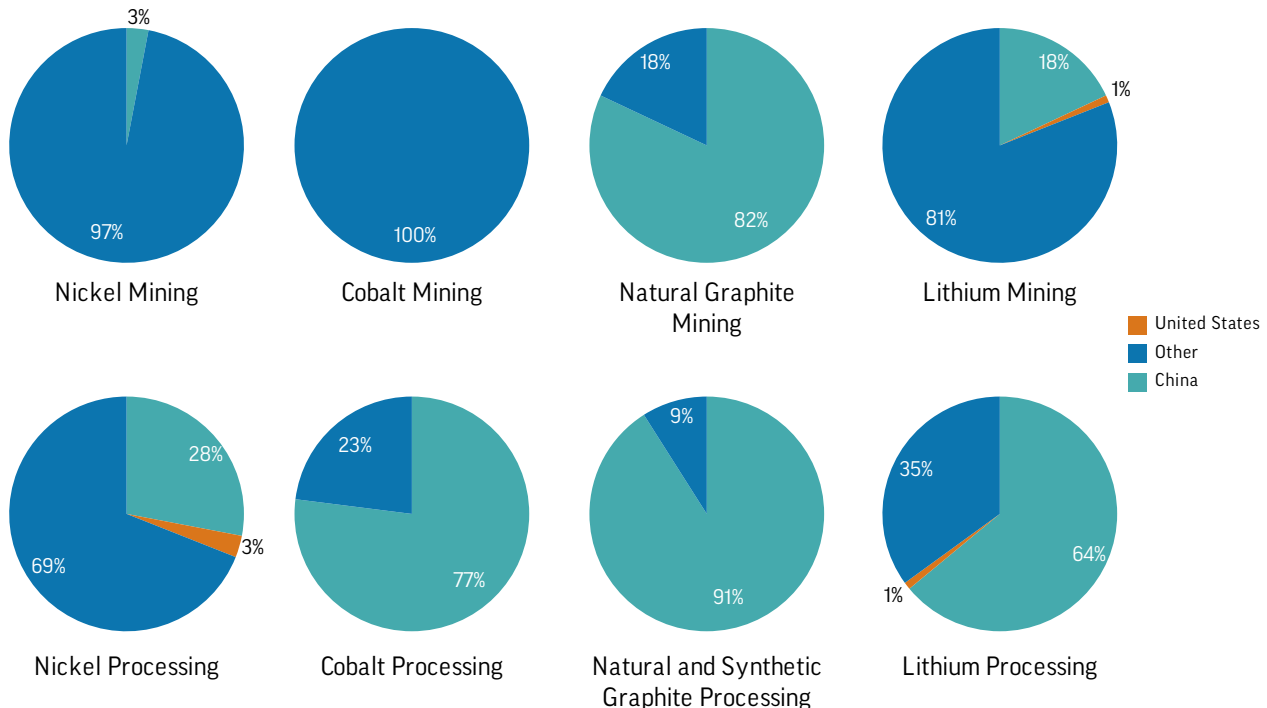
Lithium-ion is the most common type of large format batteries used for stationary storage installations and electric vehicles, although alternative chemistries like sodium-ion and solid-state batteries may be on the horizon. While the exact composition of these batteries may vary depending on their unique chemistries and structures, all require significant inputs of minerals and materials that must be mined, synthesized, and/or refined. Globally, infrastructure to produce many of these materials is concentrated in Asia, often China. This fact sheet defines several of the most common battery critical materials and their global mining and processing resources.

## Where Are The Critical Minerals In A Battery?

**Anode:** The part of the battery with negative charge. The largest mineral component of the anode is graphite, which comprises more than 50 percent of the anode. Graphite can be produced from natural graphite deposits or synthesized from high-carbon inputs but must be extremely high purity to be considered “battery-grade.”

**Cathode:** The part of the battery with positive charge. In a lithium-ion battery, the cathode contains a combination of lithium (usually sourced as lithium carbonate) and other metals. Lithium comprises a comparatively smaller portion by weight than the other cathode materials but is an essential material. Alternative battery chemistries such as sodium-ion may omit lithium from the composition entirely.

FIGURE 1: CRITICAL MINERAL MINING & PROCESSING BY COUNTRY



Source: Alice Wu, *Critical Thinking on Critical Minerals*, (Washington, DC: Federation of American Scientists, 2024), <https://fas.org/publication/critical-thinking-on-critical-minerals>.

## Lithium-ion Chemistries

The most common large-format lithium-ion battery chemistries are Nickel-Manganese-Cobalt (NMC) and Lithium-Iron-Phosphate (LFP).

**NMC batteries** have tended to dominate the market due to their higher energy density. This cathode includes lithium and a 1:1:1 or 8:1:1 ratio of nickel, manganese, and cobalt. Due to cost, safety, and human rights concerns, some companies are shifting away from this chemistry.

**LFP batteries** offer a lower-cost solution reliant on more abundant materials of iron and phosphorous, although it is less energy-dense than NMC batteries. This cathode includes lithium and a 1:1 ratio of iron to phosphorous. Many companies are shifting back to this chemistry.

## Emerging Chemistries

New chemistries including **sodium-ion** are emerging as alternatives to lithium-ion batteries that use more abundant materials and offer greater energy density alongside improved safety.

**Solid-state batteries** are another emerging battery type that may continue to use lithium in anode materials but would reduce reliance on graphite while enhancing battery performance and safety.