

Battery Supply Chains

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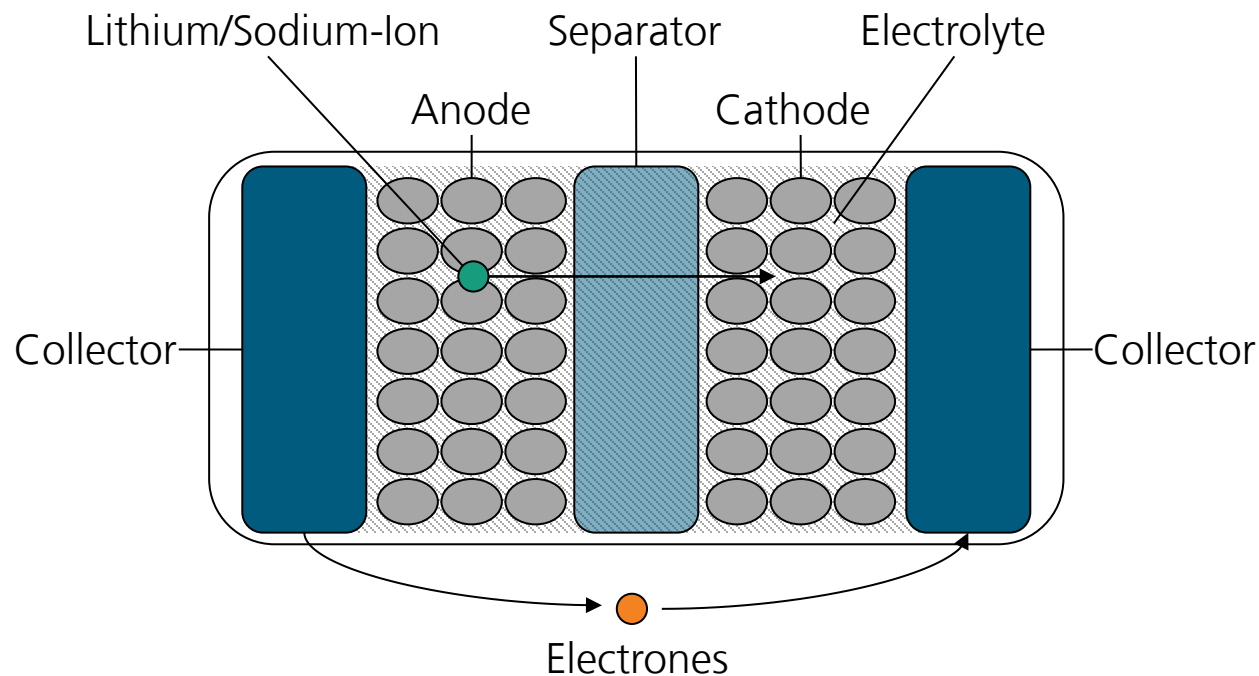
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Components and Different Types of Lithium-/Sodium-Ion Battery Cells

Components of a Lithium-/Sodium-Ion Battery Cell



Different Battery Cell Types

Lithium-Ion Batteries:

- **NMC:** Cathode made up of Lithium, Nickel, Manganese and Cobalt. High volumetric and gravimetric energy density.
- **LFP:** Cathode made up of Lithium, Iron and Phosphate. Compared to NMC, lower gravimetric and volumetric energy density, but higher cycle stability, improved safety and reduced material costs.
- **LMFP:** Cathode made up of Lithium, Manganese, Iron and Phosphate. Increased energy densities compared to LFP.

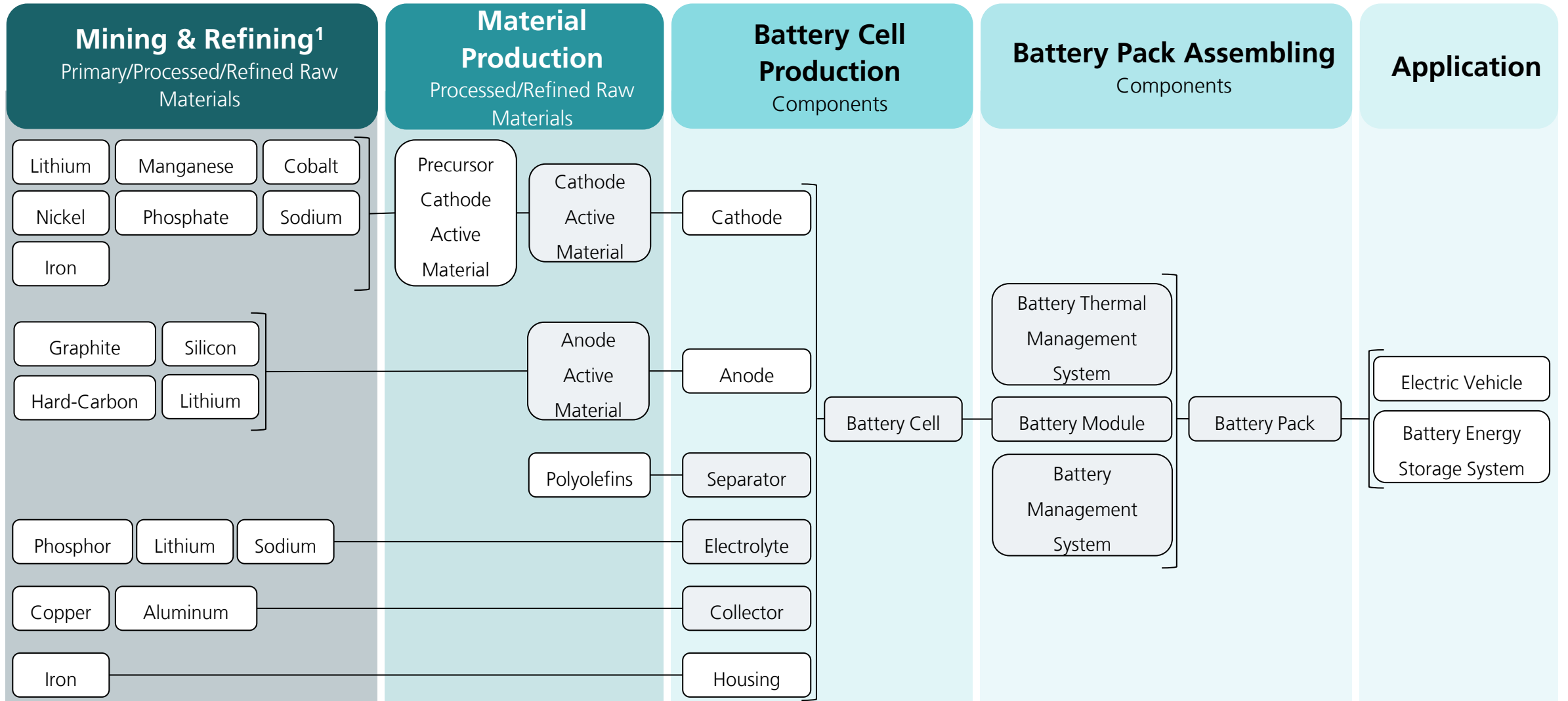
Sodium-Ion Batteries: Cathode material using Sodium instead of Lithium. Lower gravimetric energy density compared to LFP. Compared to Lithium, Sodium has an increased availability.

Battery Supply Chain from Mining to Application

Part of the Net-Zero Industry Act?

NZIA

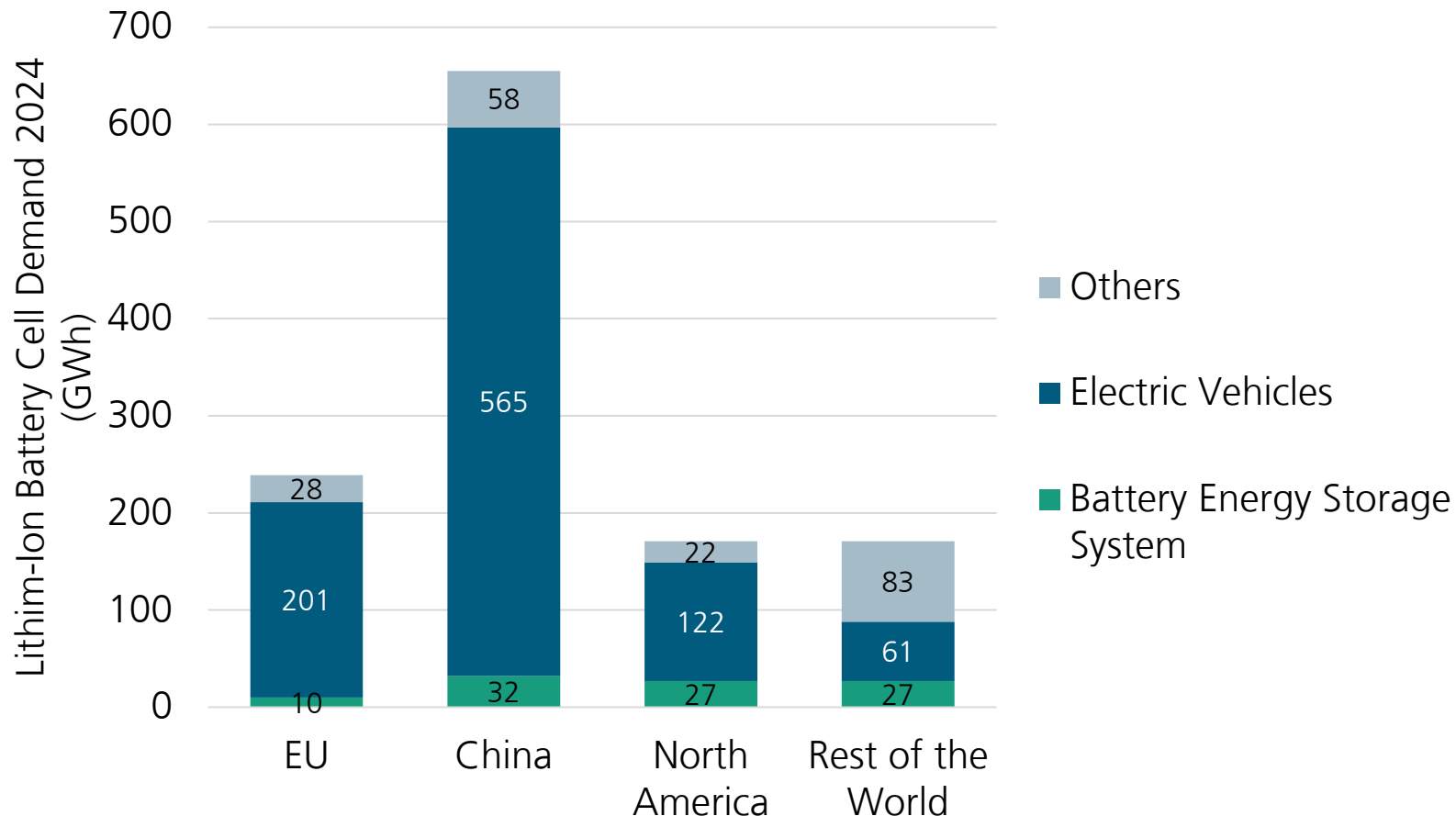
Non-NZIA



¹ Incomplete selection of currently used and future relevant materials shown. Material composition depends on technology type.

77% of Lithium-Ion Battery Cell Demand is used for Electric Vehicles in 2024

Global Demand for Lithium-ion Batteries in 2024 by Region and Application

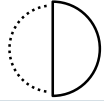
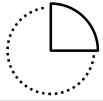

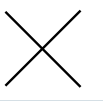
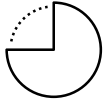
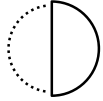
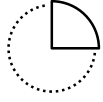
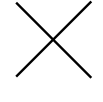


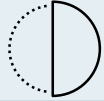



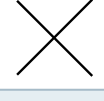
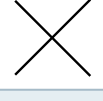








- **Regional distribution:** China dominates world demand with 53%, Europe makes up 19%.
- **Distribution by Application:** Electric vehicles dominate with 77%, followed by others (15%) and battery energy storage systems (8%).

Source: Fraunhofer ISI 2024, Meta-Markt-Monitoring, [metamarketmonitoring.de](https://www.metamarketmonitoring.de)

Market Outlooks Expect an Increase of LFP and LMFP Market Shares

Indication for Current and Future Relevance of Different Cathode Active Materials by Application

| Technology Type | Current Relevance | | Future Relevance | | Legend |
|-----------------|---|--|---|---|---|
| | Electric Vehicles | Battery Energy Storage System | Electric Vehicles | Battery Energy Storage System | |
| Nickel-Based |  |  |  |  |  Very high Relevance  High Relevance  Low Relevance  No Relevance  Increasing  Decreasing |
| LFP |  |  |  |  | |
| LMFP |  |  |  |  | |
| SIB |  |  |  |  | |

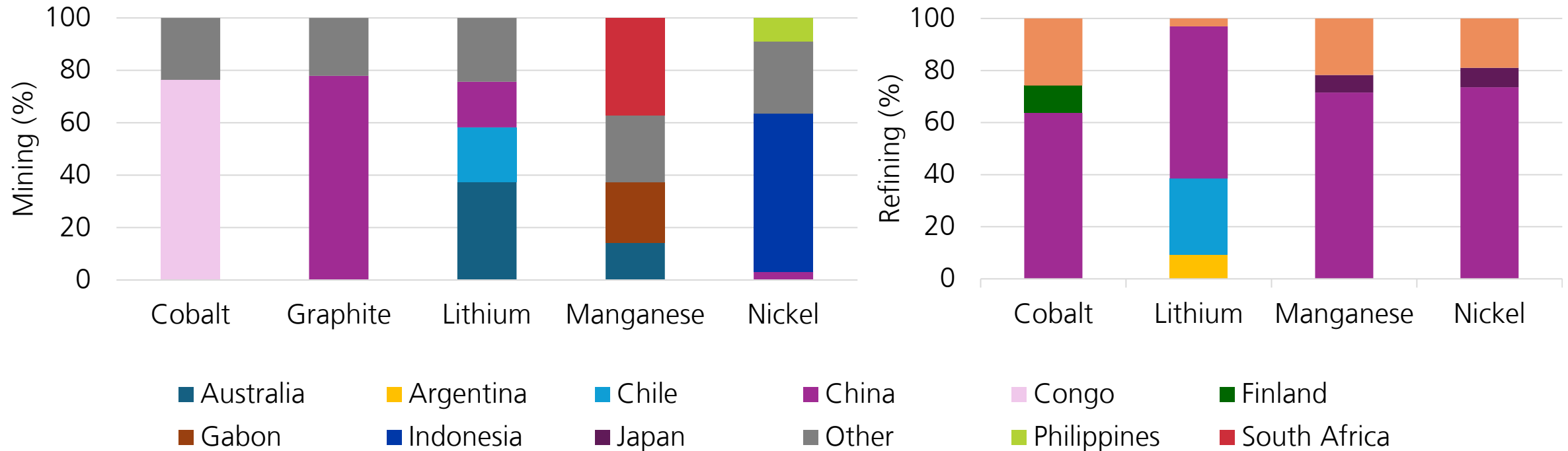
Source: Based on Bobba et al. (2025) <https://dx.doi.org/10.2760/3300656>

Availability of Production and Production-Capacity Data for Battery Components

| Component | Data available? | Regional Resolution |
|-----------------------------------|------------------------|----------------------------|
| Cathode Active Material | Yes | National Level |
| Anode Active Material | Yes | National Level |
| Separator | Yes | National Level |
| Electrolyte | Yes | National Level |
| Collector | No | - |
| Battery Cell | Yes | Organization Level |
| Battery Module | No | - |
| Battery Pack | No | - |
| Battery Management System | No | - |
| Battery Thermal Management System | No | - |

Mining and Refining of Raw Materials

Global distribution of Mining and Refining for Cobalt, Graphite, Lithium, Manganese and Nickel



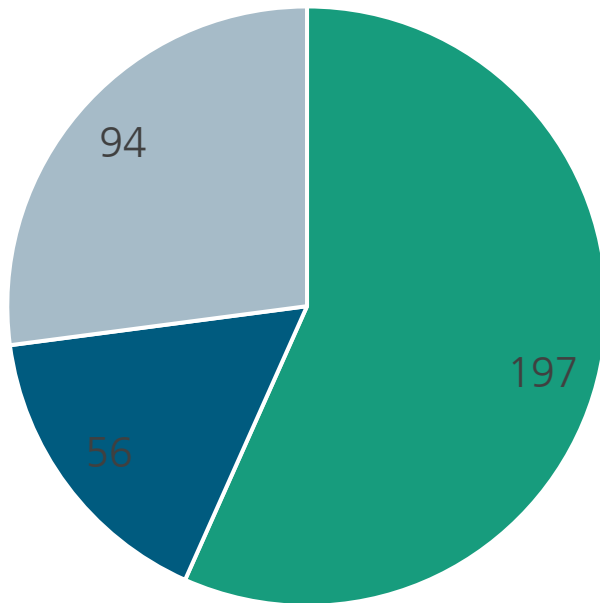
- The **mining** of relevant raw materials is concentrated on few nations, especially Congo for Cobalt, China for Graphite, Australia for Lithium and Indonesia for Nickel.
- Majority of **refining** of these raw materials takes place in China with >50% for Cobalt, Lithium, Manganese and Nickel.

Production of Cathode and Anode Active Materials

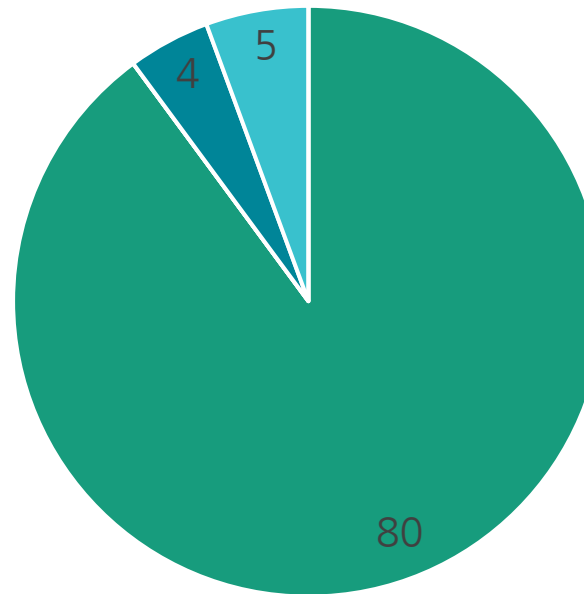
Cathode Active Materials (Mt)

Anode Active Materials (%)

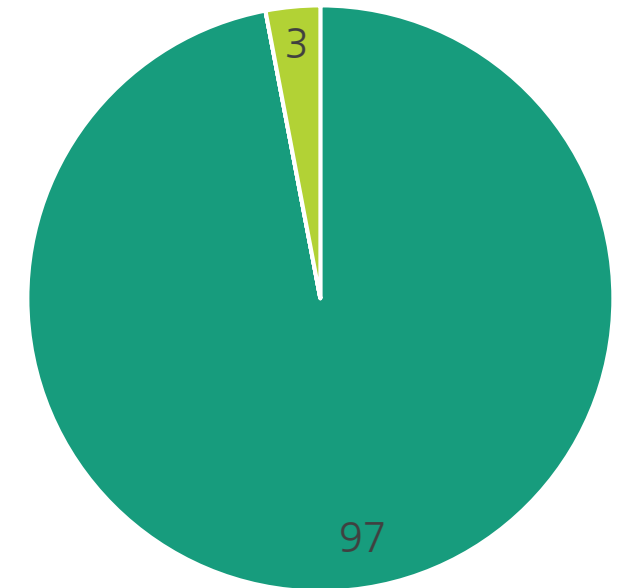
Nickel-Manganese-Cobalt (NMC)



Lithium-Iron-Phosphate (LFP)



Graphite

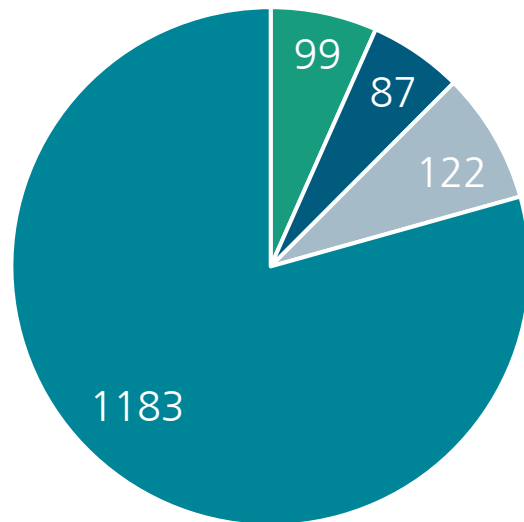


■ China ■ Japan ■ South Korea ■ United States ■ Canada ■ Rest of the World

Global Current and Announced Battery Cell Production

Current Battery Cell Production (GWh)

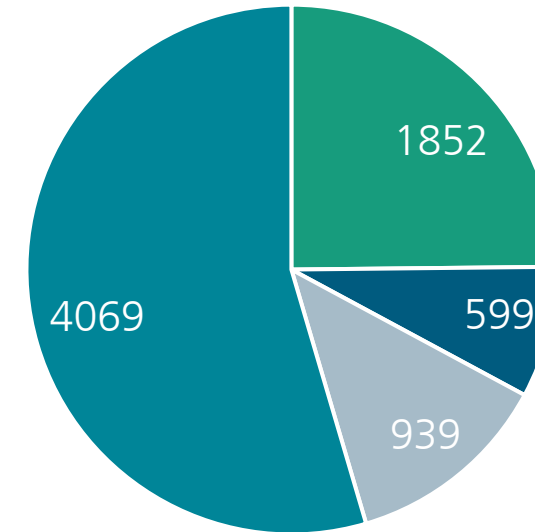
2024, Lithium-Ion Battery Cells only



■ Rest of the World ■ North America ■ Europe ■ China

Announced Battery Cell Production (GWh)

until 2030, not all announcements will be realised

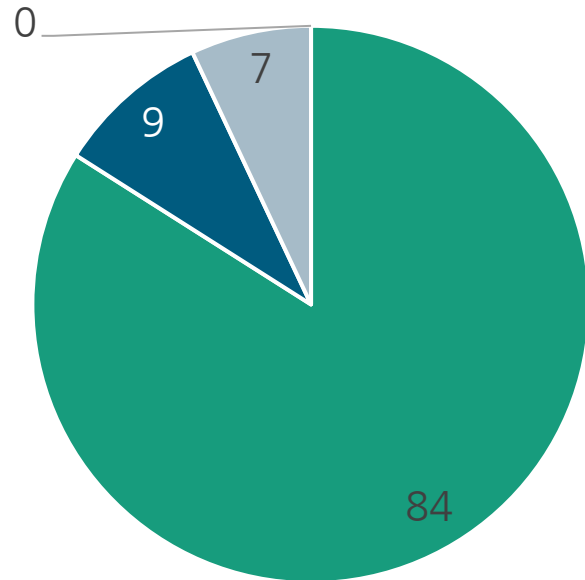


Source: Volta Foundation: Battery Report 2024
<https://volta.foundation/battery-report-2024>

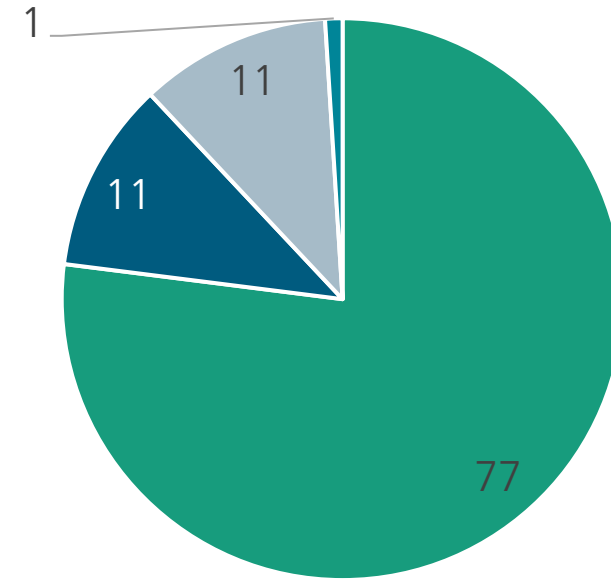
Fraunhofer ISI 2024, Meta-Markt-Monitoring, [metamarketmonitoring.de](https://www.metamarketmonitoring.de)

Market Shares for the Production of Separators and Electrolytes

Separators (%)



Electrolyte Production (%)



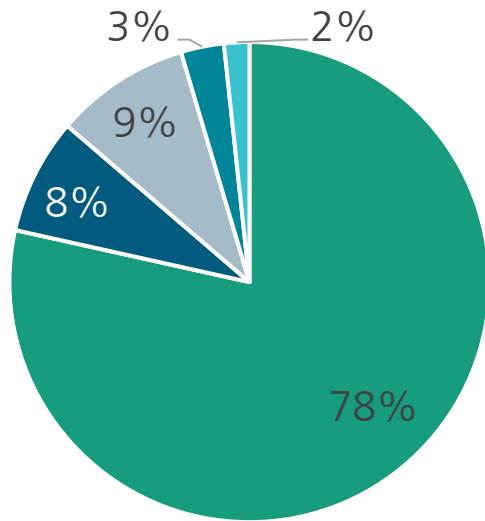
■ China ■ Japan ■ South Korea ■ USA

Source: Fraunhofer ISI 2024, Meta-Markt-Monitoring, [metamarketmonitoring.de](https://www.metamarketmonitoring.de)

Material Costs, Especially for the Cathode Dominate Cell Production Cost

Splits of Cell Production Costs by Category and by Component

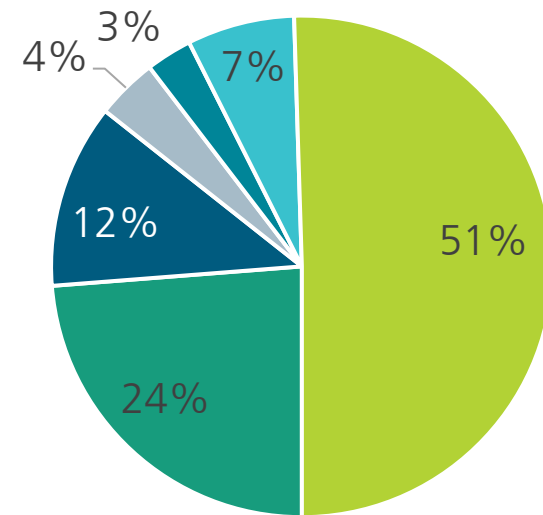
Battery Cell Production Cost by Category



- Material
- Personnel
- Depreciation
- Overhead
- Energy

Source: Lechner et al. (2024) <https://doi.org/10.1038/s44172-024-00306-0>
Bottom-up modelled full cost for a NMC prismatic battery cell used as an indication.

Battery Cell Production Cost by Component



- Manufacturing Overhead
- Anode
- Electrolyte
- Casing
- Separator
- Cathode

Source: Volta Foundation (2024): Battery Report 2024.
<https://volta.foundation/battery-report-2024>

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