Atlantic Council
GLOBAL ENERGY CENTER

ALTERNATIVE BATTERY CHEMISTRIES AND DIVERSIFYING CLEAN ENERGY SUPPLY CHAINS

THE PROBLEM

As the energy transition accelerates, so do requirements for energy storage to support electrification and, increasingly, renewable grids. The IEA estimates that the world will need 266 GW of energy storage by 2030, for which lithium-ion batteries will play a key role. However, global supply chains for key lithium-ion battery minerals are forecast to fall short of this demand. Supporting the market entry of alternative battery chemistries to diversify battery metal supply chains can help meet growing energy storage needs.

PROJECTED MINERAL SUPPLY SHORTAGE	LITHIUM	GRAPHITE	COBALT	NICKEL
	SHORTAGE OF **0.22 MILLION TONS** BY **2030**	SHORTAGE OF UP TO **80,000 TONS** IN **2022**	DEMAND TO REACH **280% OF 2016** REFINING CAPACITY BY **2030**	SHORTAGE OF **0.2 MILLION TONS** BY **2024**

ASSESSING SELECT ALTERNATIVE BATTERY CHEMISTRIES

New chemistries promise to relieve overburdened battery supply chains. In addition, several of these chemistries have the energy density and stability to improve upon the lithium-ion format for certain use cases. Alternative battery chemistries can advance a ‘big tent’ approach to energy storage deployment to enable the energy transition.

1 ALTERNATIVE LI-ION CHEMISTRIES

Reduced cobalt intensity, increased nickel content (LG NMC 811, GM Ultium)
Production is less geographically concentrated, poses less ESG risk, and requires lower upfront capital expenditure than traditional lithium-ion. Can be used for high-range and heavy-duty EVs.

Lithium Iron Phosphate (LFP)
Consists of abundant cathode materials, without cobalt or nickel, resulting in lower costs. Can be used in low-to-moderate range EVs and high-performance grid storage.

2 LIQUID METAL

Uses highly abundant calcium, while its antimony requirements can be onshored. Projected to achieve cost-competitiveness with lithium-ion by 2030, and can be used in grid and distributed storage.

3 SODIUM-ION

Uses widely available carbon and sodium, and projections for ‘at-volume’ pack price are approaching $50/kWh. Can be used in stationary storage and budget EVs in mixed format with Li-ion.

4 SODIUM-SULFUR

Uses abundant sulfide ore, waste sulfur, and sodium deposits, and costs are projected to fall from $500/kWh to $125/kWh by 2030. Can be applied to stationary storage.

5 ZINC-ION

The United States, Australia, India, and Peru account for half of global zinc production. Zinc-ion can be used in grid, distributed, and home storage.

THE BATTERY TRILEMMA: SUPPLY SECURITY, PERFORMANCE, AND COST

The Atlantic Council Global Energy Center devised a set of scored values meant to represent the characteristics of each battery chemistry in terms of its supply security, cost-effectiveness, and performance. The values assigned to each battery are positive and are meant to be interpreted relative to each other.

SUPPLY SECURITY

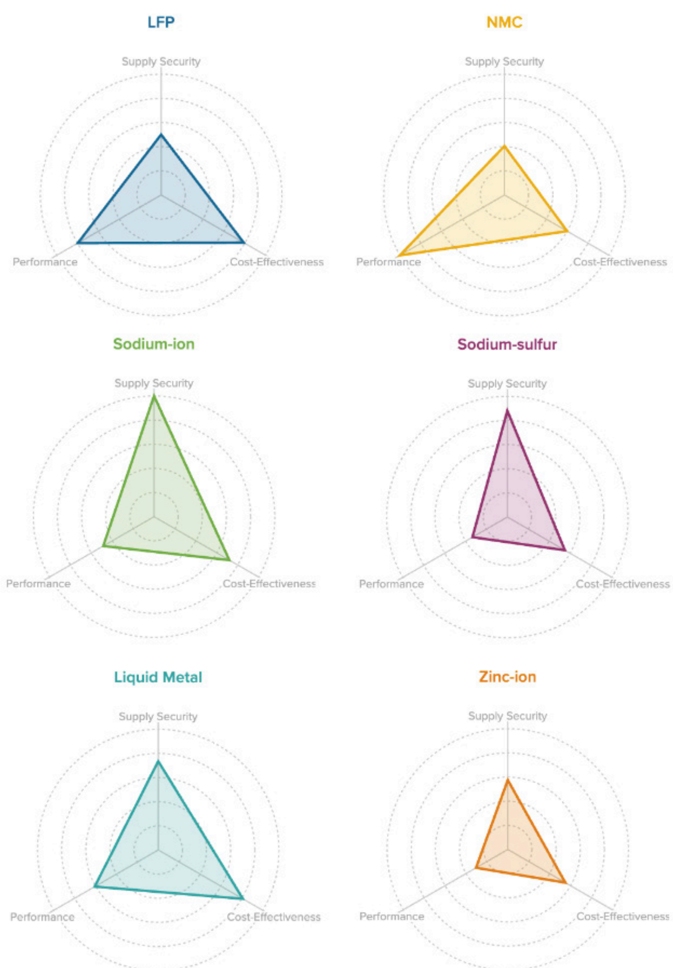
The degree to which each battery's supply chain has been assessed to be secure, in reference to current resource availability, future production projections and geopolitical trends.

COST-EFFECTIVENESS

The relative affordability for each battery chemistry in terms of battery pack cost per kilowatt-hour.

PERFORMANCE

Performance among battery chemistries, assigned via gravimetric energy density values for consistency and its centrality for determining power or cycle duration.



For a more detailed description of the methodology used to create the graphic, see the full report.

Sources: US Geological Survey, BloombergNEF, Institute of Electrical and Electronics Engineers, American Chemical Society, CleanTechnica, PRNewsWire, National Center for Biotechnology Information, MDPI

RECOMMENDATIONS

To close the gap between the current state of deployment for alternative battery chemistries and their potential on an accelerated timescale, policymakers have a few options:

1

Provide capital to fuel innovation.

2

Shift the policymaking focus from lithium-ion mineral inputs to include a diversity of batteries and inputs.

3

Incentivize battery input diversification through a structured tax credit.

4

Forge international partnerships and create a common market for alternative battery technologies.

5

De-risk resource development to widen diversified mineral availability (e.g. antimony, zinc).

6

Alleviate regulatory uncertainty in the implementation of the IRA regarding non-lithium-ion batteries.