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Critical Minerals Security – The race across the Atlantic

Nissan Intelligent Mobility Forum

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Benchmark Minerals Intelligence value chain support

- **James Mills – Principal Consultant xEV**
  - Responsible for value chain integration for EV transition growth
  - Supplier evaluation and contractual negotiation for Volkswagen AG battery procurement for critical materials

PRICE ASSESSMENTS & MARKET DATA	Lithium (8 Carbonate, 6 Hydroxide, 1 Spodumene) Cobalt (Sulphate, Metal, Hydroxide) Natural Graphite (8 Flake, 3 Spherical Graphite) Synthetic Graphite (4 Needle Coke, 2 Pet Coke)	Nickel (2 Sulphate, MHP) Anode and Cathode prices (6 Anode, 7 Cathode) Lithium Ion Battery Cells Gigafactory Assessment Anode & Cathode Market Assessments	WEEKLY / MONTHLY
FORECASTING, CONSULTANCY & ESG	Lithium Cobalt Nickel Natural & Synthetic Graphite Anode and Cathode	Lithium Ion Battery Database Solid State Batteries Recycling ESG Life Cycle Assessments	QUARTERLY
NEWS ANALYSIS, WEBINARS & EVENTS	News & analysis Supply chain commentary Presentation archive	Quarterly Review Magazine Video Archive In-person events in all regions	REGULAR

Lithium-ion battery demand

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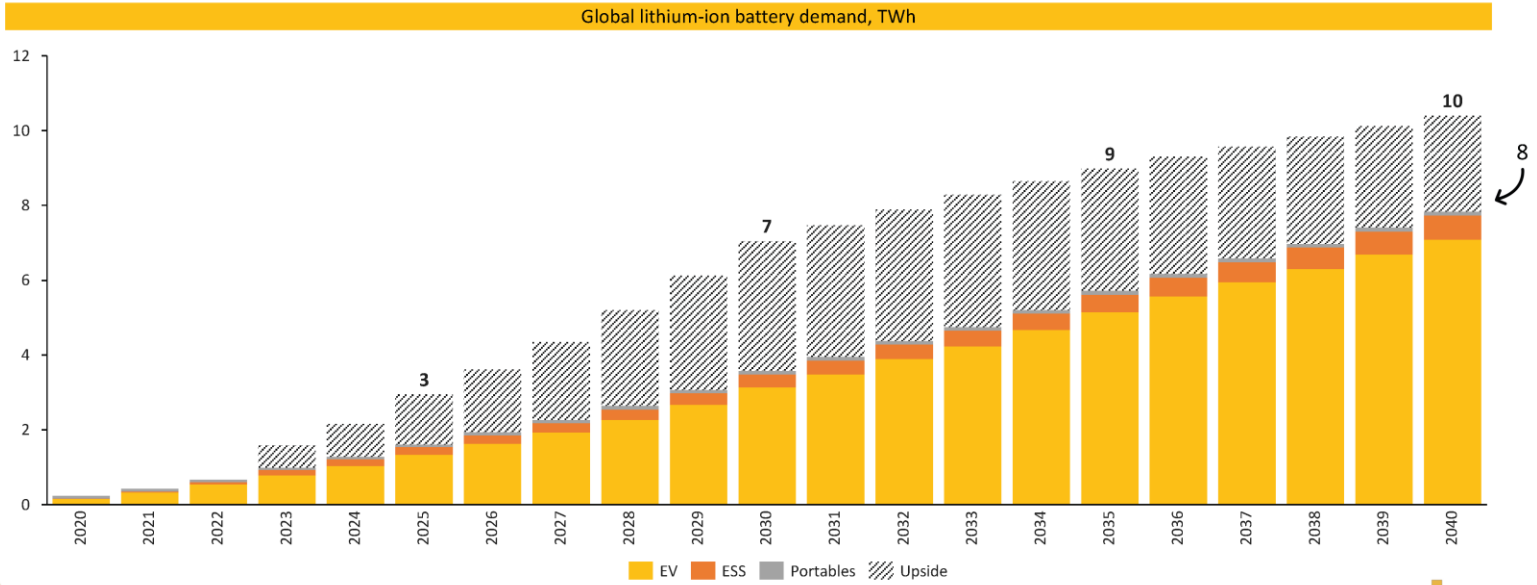
The global battery value chain is entering the Terawatt Era

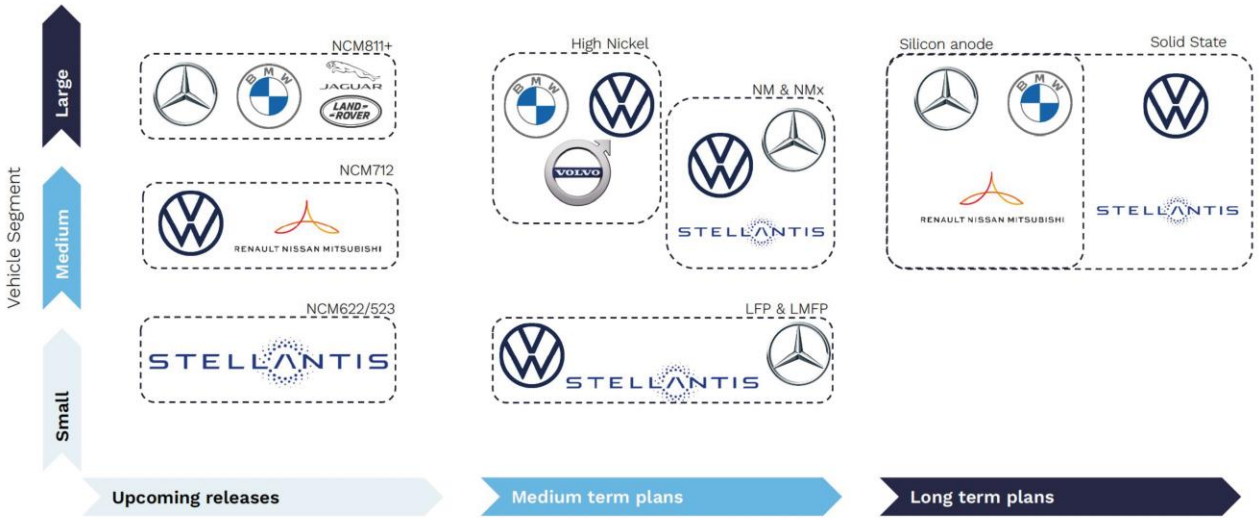
- The role of renewable battery technology in the low-carbon economy is swelling, moving beyond 1 TWh cumulative installed demand during 2023 and climbing to 8 TWh base case by 2040.
- Lithium-ion battery cell demand is driven by sustainable mobility, rising to >90% market share into the next decade.



OEM battery roadmaps drive performance from solid state and cost optimisation from LFP/LMFP

- Global automotives are diversifying the technology portfolio to target broad customer requirements centred around the trade-off between performance and price.
- Fundamental to understand regional demands against the role of multiple technologies and critical minerals dynamics.

OEM chemistry roadmap: Europe



rho motion

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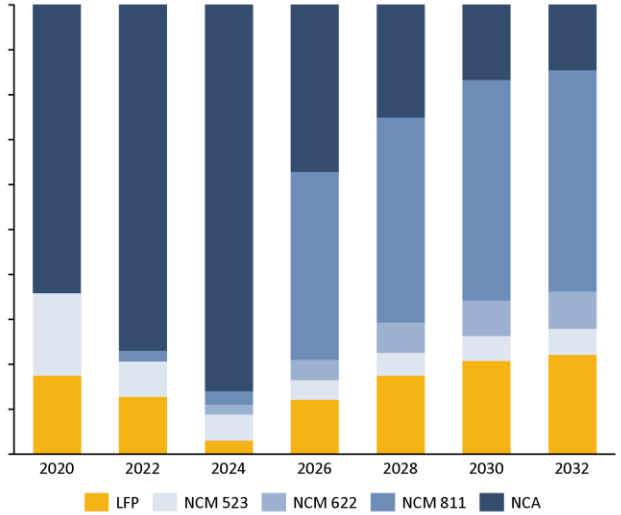
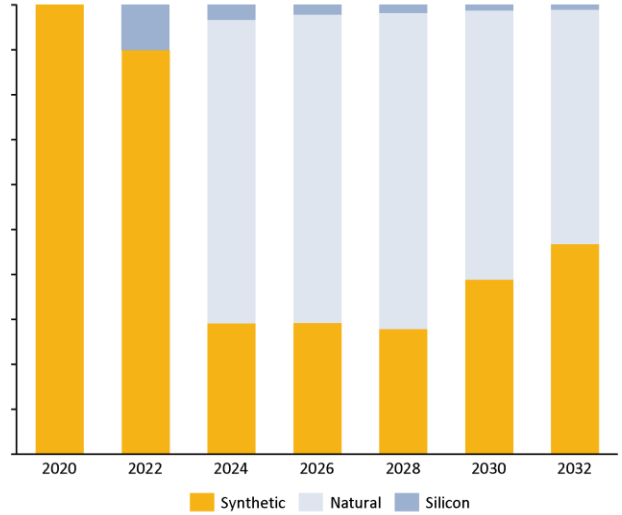
Evolving technology requirements are driving critical minerals demand…

- Cathode and anode roadmaps are yielding rapidly changing requirements for critical minerals.
- The technology mixes need to consider the availability of critical minerals to sustain manufacturing, with legislation pressures e.g., Inflation Reduction Act or EU Critical Minerals Act, driving design and procurement behaviour.

Cathode market share, %



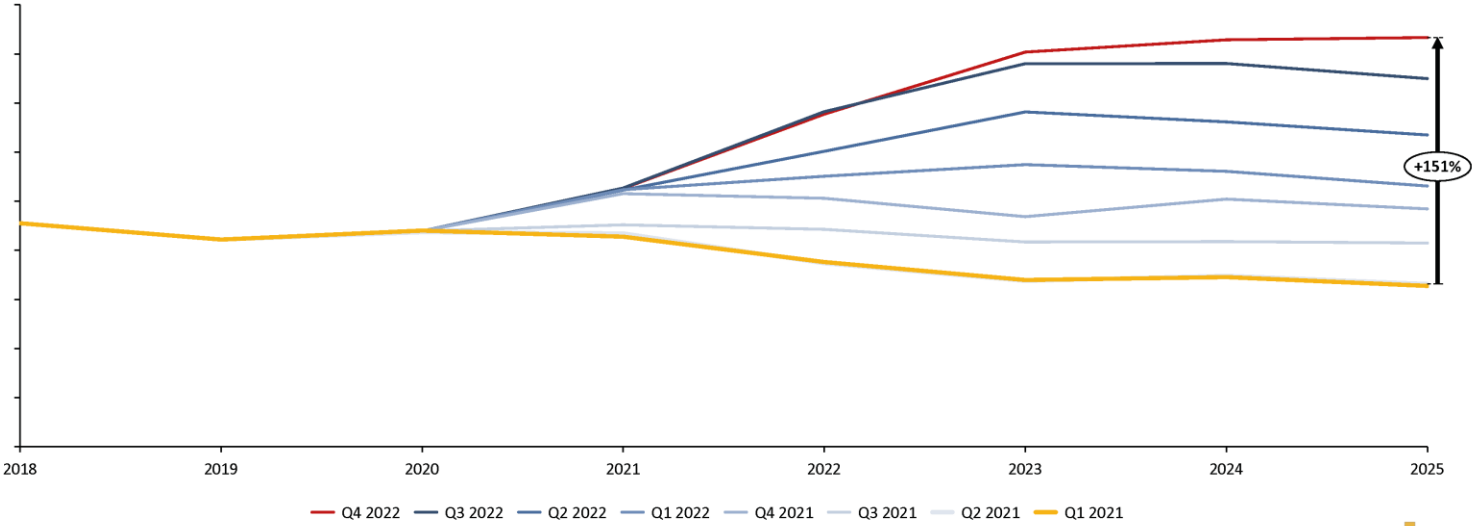
Anode market share, %



…with dynamic markets requiring proactive monitoring

- Unlocking the potential of low-cost Lithium-Iron-Phosphate (LFP) cathode technology generated major interest and demand in expanding applications for stationary storage and EVs.
- Design and procurement teams need reliable, independent forward looking market data to remain competitive.

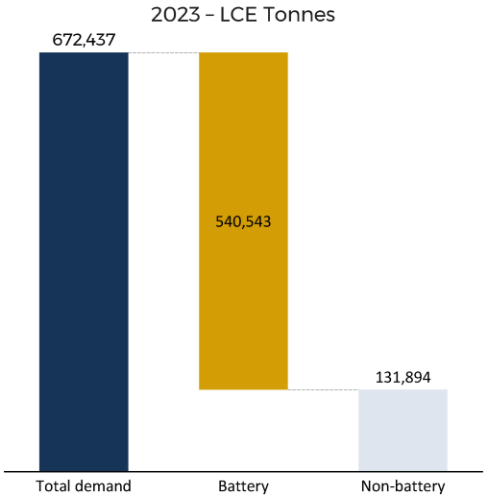
LFP cathode market share forecast, %

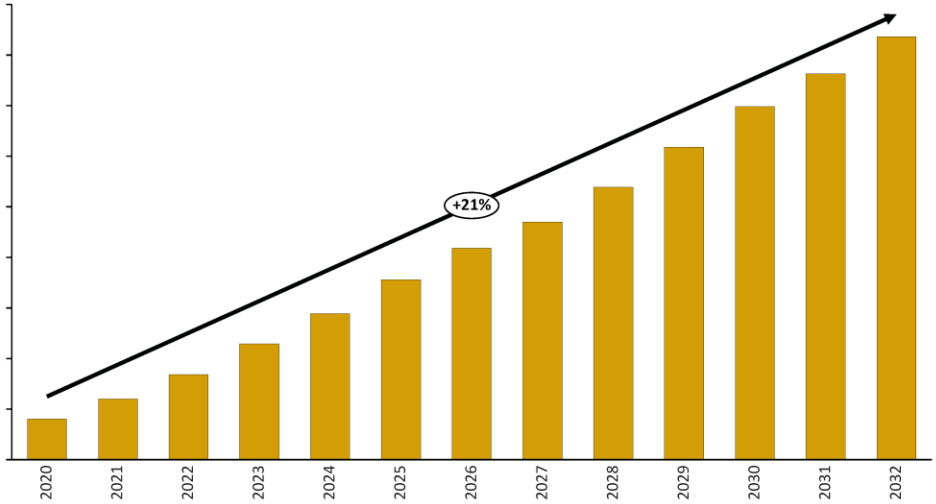


The application of renewable battery technologies are an inflection point in critical mineral demand

- The role of battery technology demand across the critical mineral suite is disrupting traditional industries and placing huge requirements on the rapid evolution and maturity of the scale of supply.
- The lithium industry demand is forecast to grow 16x from 2015 to 2030, challenging the availability of inelastic mining supply.

Lithium chemical demand, base case, LCE tonnes





In 2015 the "other" segment was 60% global demand

Regional gap analysis

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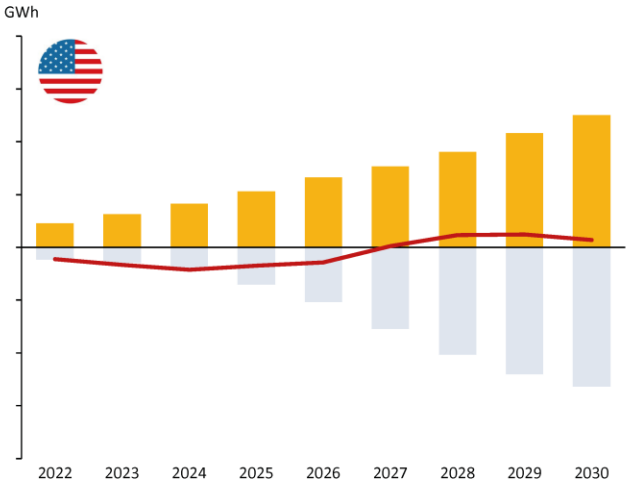
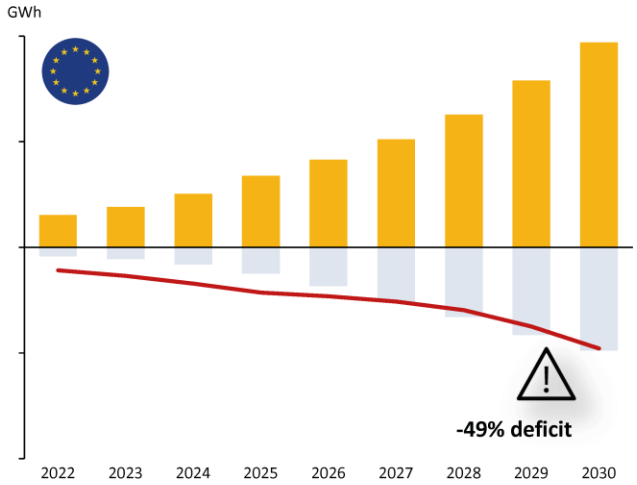
Exploring regional prioritisation of the battery value chain, the U.S. is actively de-risking supply of components and critical minerals

- Success of the 2022 Inflation Reduction Act is evident from the net positive battery cell balance by the end of the decade, encouraging significant capital allocation and strategic partnerships – creating supply chain resilience.
- The European industry remains highly exposed to foreign markets – with China filling the deficit.

Battery cell gap analysis, U.S.



Battery cell gap analysis, E.U.

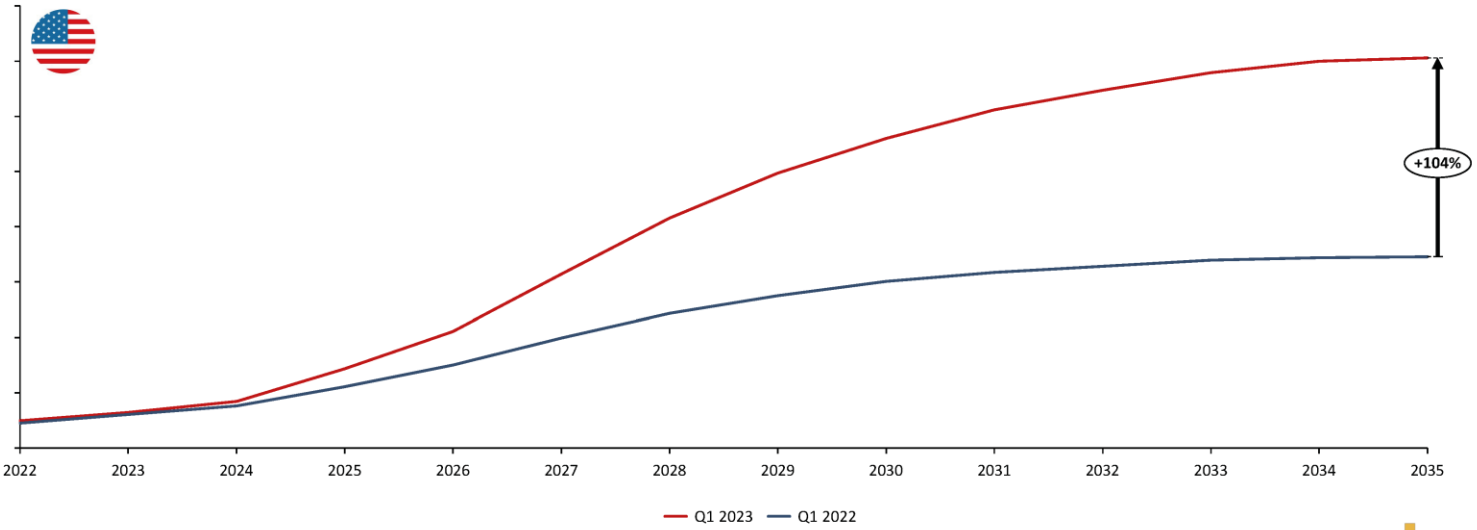


Demand Supply Balance

Boosted by downstream stimulation, North American region witnessed extraordinary battery cell growth post IRA

- Announced post-IRA investments totalled in excess of US$52bn between August 2022 and March 2023.
- 1/2 of that total is allocated towards additional battery manufacturing, and approximately 20% for battery components and EV manufacturing combined.

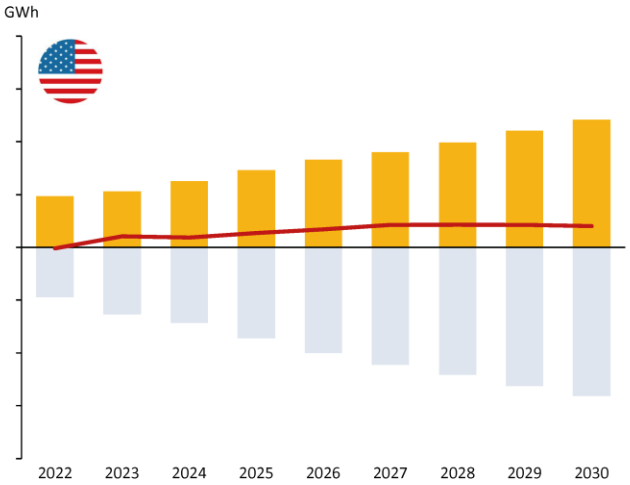
Battery cell supply growth – U.S., GWh



Stepping down to critical minerals, diverse strategies across the ocean could limit the true scale of the battery industry

- Section 30d of the Inflation Reduction Act offers substantial tax credits for the prioritisation of U.S. domestic or trade partner capacity development and supply security, yielding a maximum $7,500/EV.
- European CRMA targets regional extraction, processing and refining, and recycling objectives, but limited non-binding application.

Lithium Chemical gap analysis, U.S.



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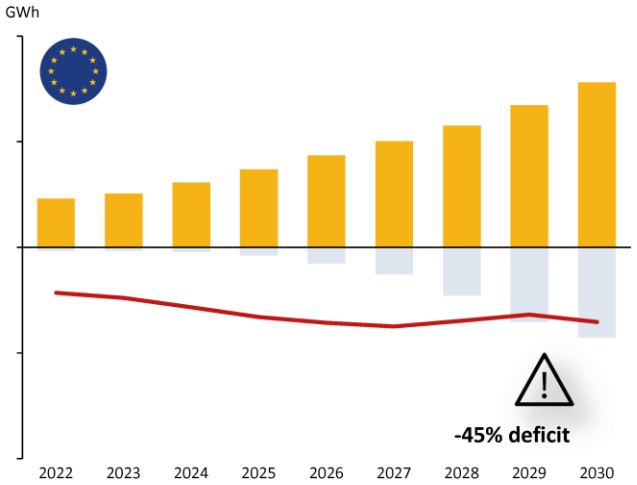
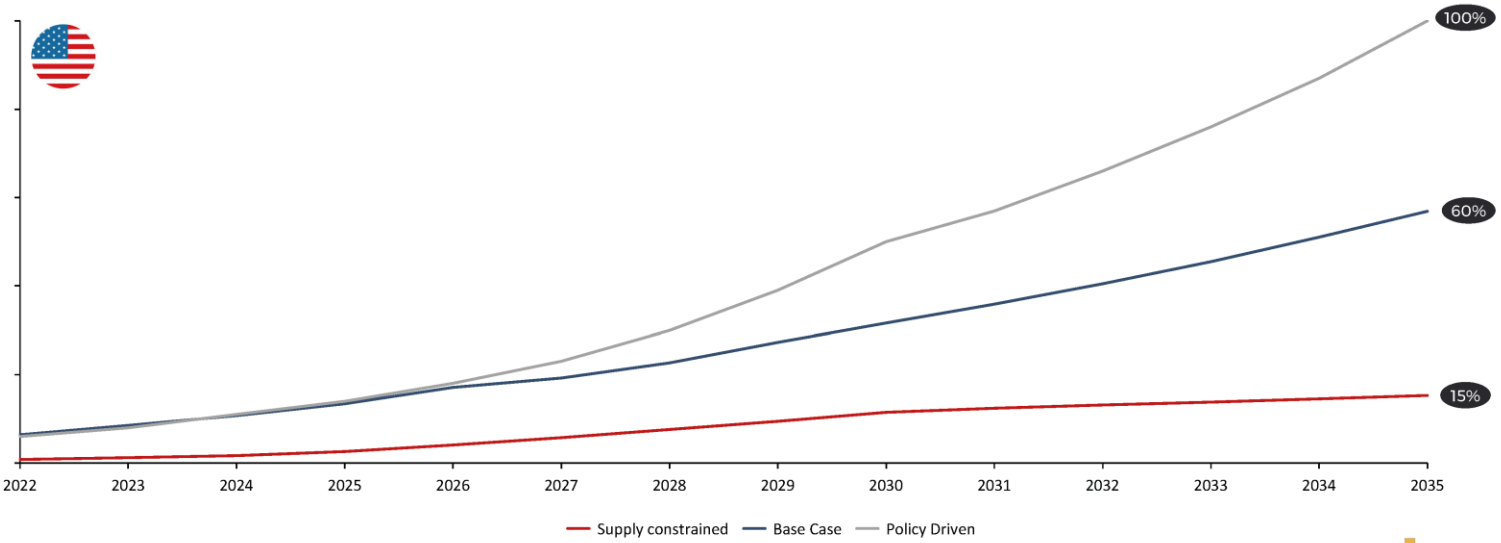


Demand Supply Balance

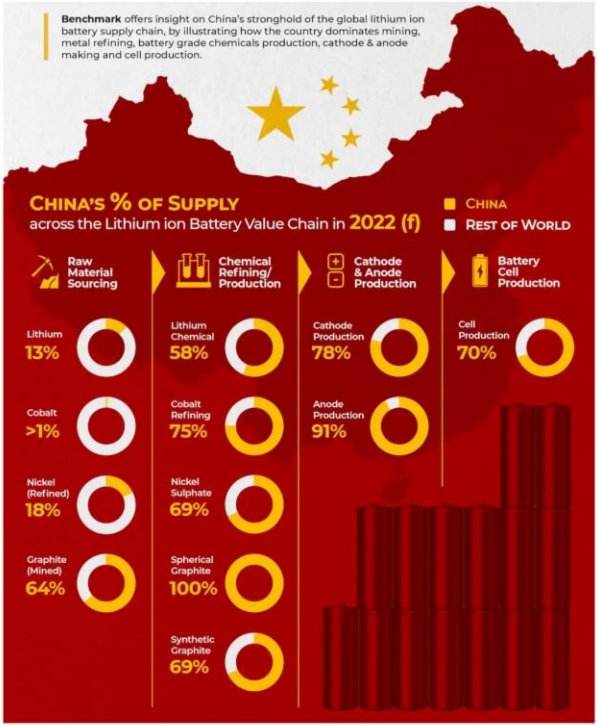
Despite a growing understanding about supply continuity risks, the U.S. market EV objectives fail without critical minerals

- U.S. policy driven EV penetration scenario explores 50% light mobility by 2030 and 100% by 2035.
- Despite mature value chain activity and downstream incentives, the availability of critical minerals will limit the practical reality.
- The U.S. market support is more advanced than Europe, presenting a major regional risk across the Atlantic.

U.S. EV penetration rate scenarios, %



Western consumers need to overcome the entrenched Chinese battery value chain and prioritise new diversified supply



Solving the supply shortage

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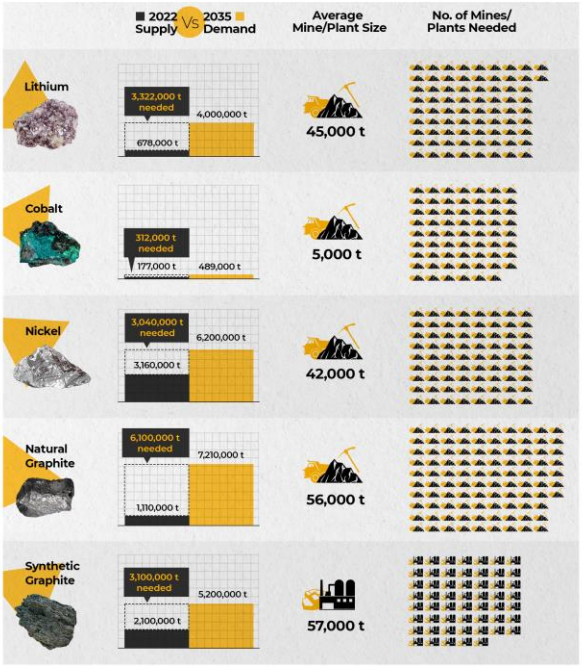
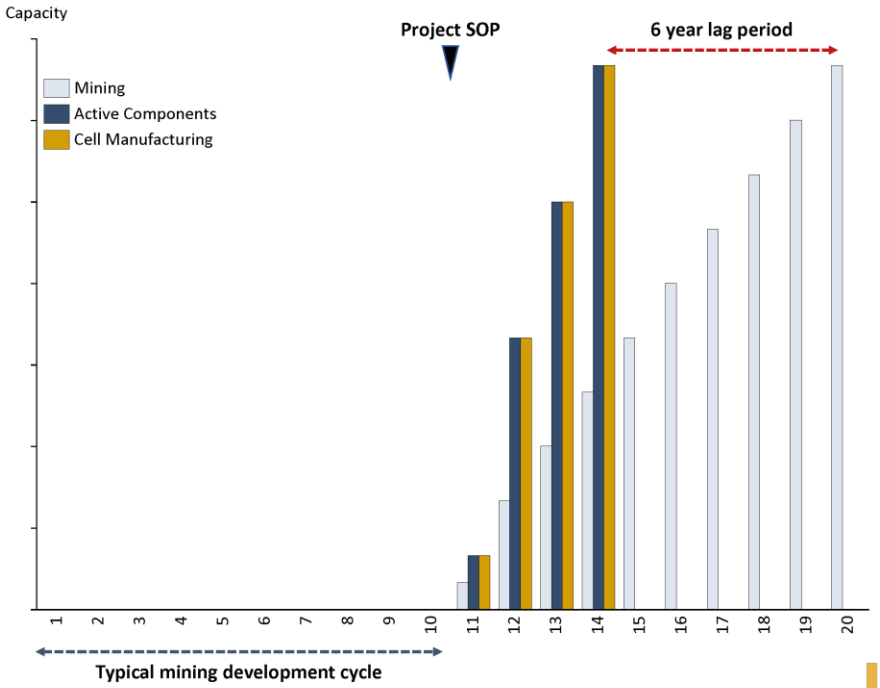
The global supply gap to sustain accelerating battery demand growth requires 336 new mines to be developed by 2035…

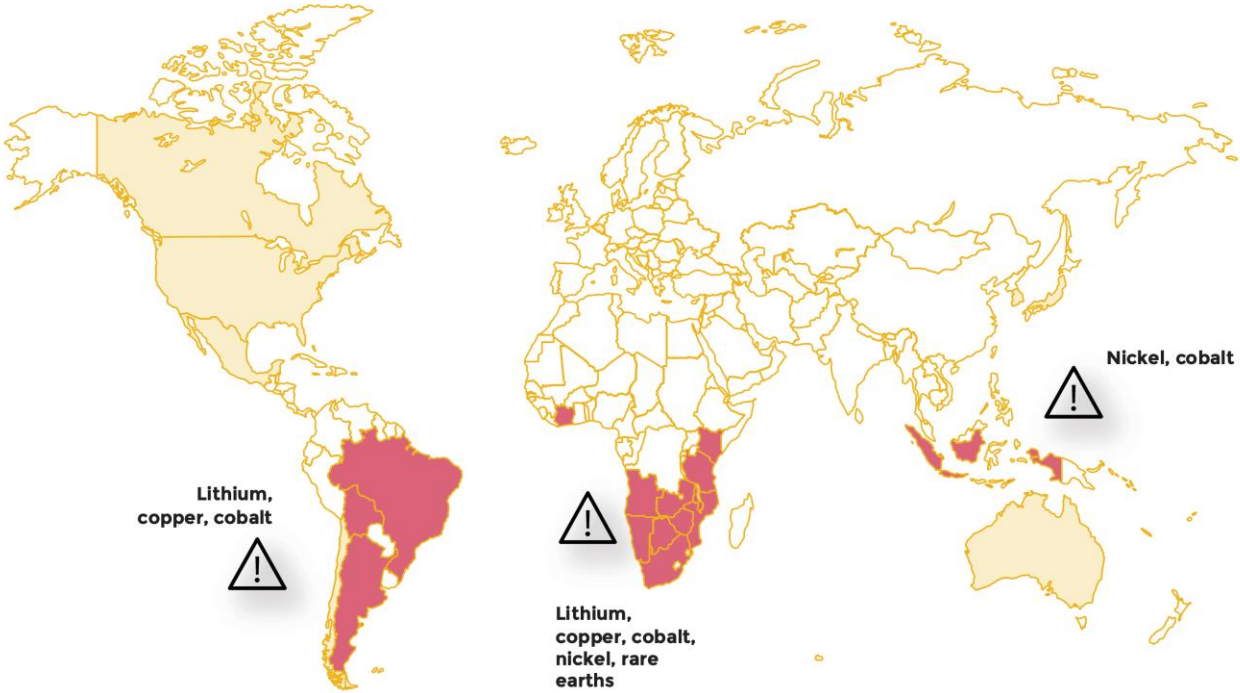


…but lead times on new mining capacity extend 5-15 years

- Strong differential of commercial production roadmap along value chain:
- Cell manufacturing and active components - 2-4 years.
- Mining and refining – 5-15 year development.
- Addition of battery-grade purity, risk of out of specification deliverables is greater.



More direct support targeted to “bridge” to critical minerals



The role and responsibility of the Western OEM

- Western OEMs are increasingly becoming battery producers, with 77% U.S. capacity under automotive JV and 45% European producers.
- Backwards integration and proactive supply chain security offers chances to mitigate price, supply and ESG risks.

Active Market Data

Influence of market drivers increases via contract structures. Mapping price expectations supports financial planning.

Financial Instruments

Price volatility hedging to protect margins e.g., derivatives, futures markets.

Technology Diversification

Diffusion of demand across broader commodity markets e.g., LFP vs. NCM cathodes.

Backwards Integration

Alternative partnership models for supply security to decouple from market dynamics e.g., prepayments, project financing. First mover advantages.

Deglobalisation

Focus on supply chain resilience to improve consistent flow of materials. Emphasis on localised value chains.

Recycling & Closed Loop

Reintroduction of long-term raw materials into the value chain to reduce dependence on primary sourcing.

Benchmark Consulting

Who we are

- Benchmark is a lithium-ion battery supply chain specialist organization.
- Leading international team of experts dedicated to the lithium-ion battery supply chain –including **former Tesla, Volkswagen AG, SQM, Albemarle, BHP Billiton, Glencore and Freeport Cobalt executives**
- Summoned to testify at the **US Senate** in 2017, 2019 & 2020), and briefed the **US White House and Pentagon** on national security implications of battery supply chain geopolitics. Presented to the **G7 Summit** on the Lithium-ion battery supply chain in 2021.
- Leading price reporting agency for battery raw materials, including cobalt sulphate, lithium hydroxide, carbonate, spodumene, flake & spherical graphite, nickel sulphate & MHP.

Where can we support?

- **Research/Consultancy**
- **Market entry studies**
- **Lender's market reports**
- **Procurement strategy definition**
- **Investment Due Diligence**
- **Technical process risk profiling**
- **ESG education** – growing responsibilities and transparency for the supply chain

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