

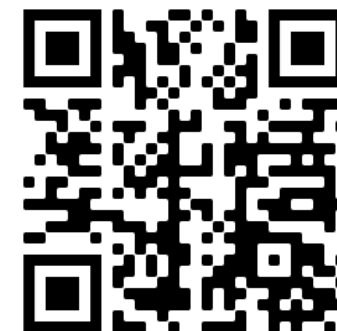


# BATTERY MINERALS IN THE EV ECONOMY

Building the supply chain foundations for the energy transition

Andrew Miller, COO  
Benchmark Mineral Intelligence

NMA Spring Board of Directors Meeting  
Monday 3<sup>rd</sup> April 2023



# Benchmark Mineral Intelligence: Products & Services

## 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

# Financial, industrial and legislative forces are all converging on EVs

FP

ARGUMENT An expert's point of view on a current event.

**The Inflation Reduction Act Is the Start of Reclaiming Critical Mineral Chains**

**The New York Times**

**California E.V. Mandate Finds a Receptive Auto Industry**

**Ford Supply-Chain Leadership Overhaul Reflects EV Ramp Up**

**INDUSTRY**

**yahoo!finance**

**Electra and LG Energy Solution Sign Three-year Cobalt Supply Agreement**

**POLICY**



European  
Commission

**Critical Raw Materials Act: securing the new gas & oil at the heart of our economy | Blog of Commissioner Thierry**



**REUTERS®**

**Volkswagen, Mercedes-Benz team up with Canada in battery materials push**

**The Washington Post**  
*Democracy Dies in Darkness*

ENERGY

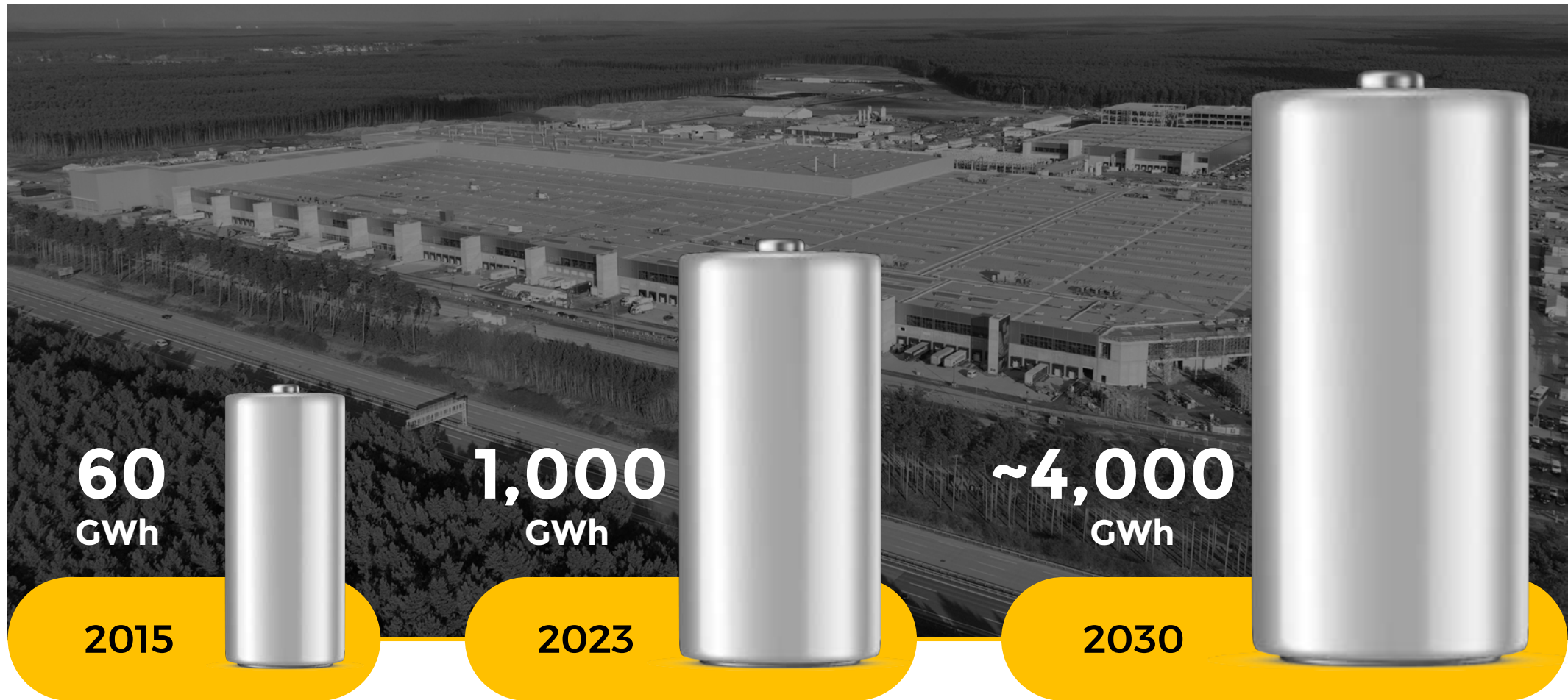
**The Great Lithium Squeeze**

**MARKET FORCES**

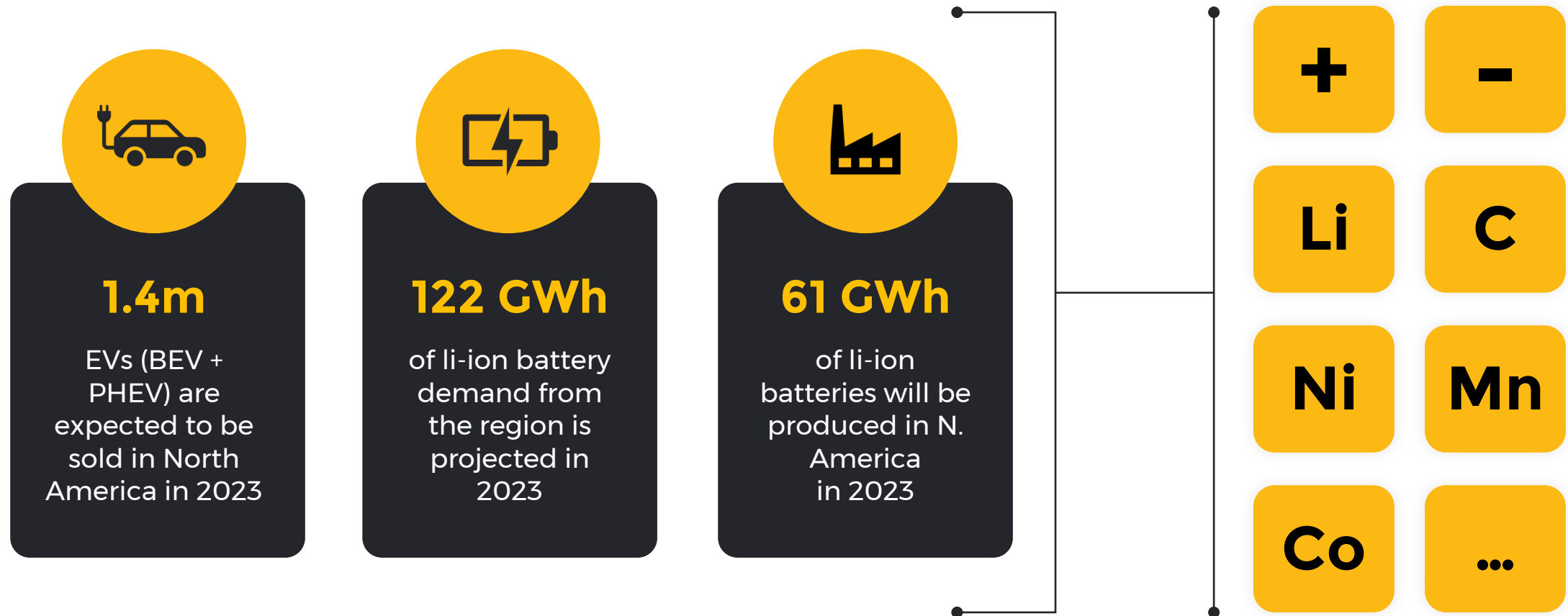
**Bloomberg**

**Lithium Smashes New Record as Supply Struggles to Feed EV Growth**

# Lithium ion batteries are moving from start up to scale up

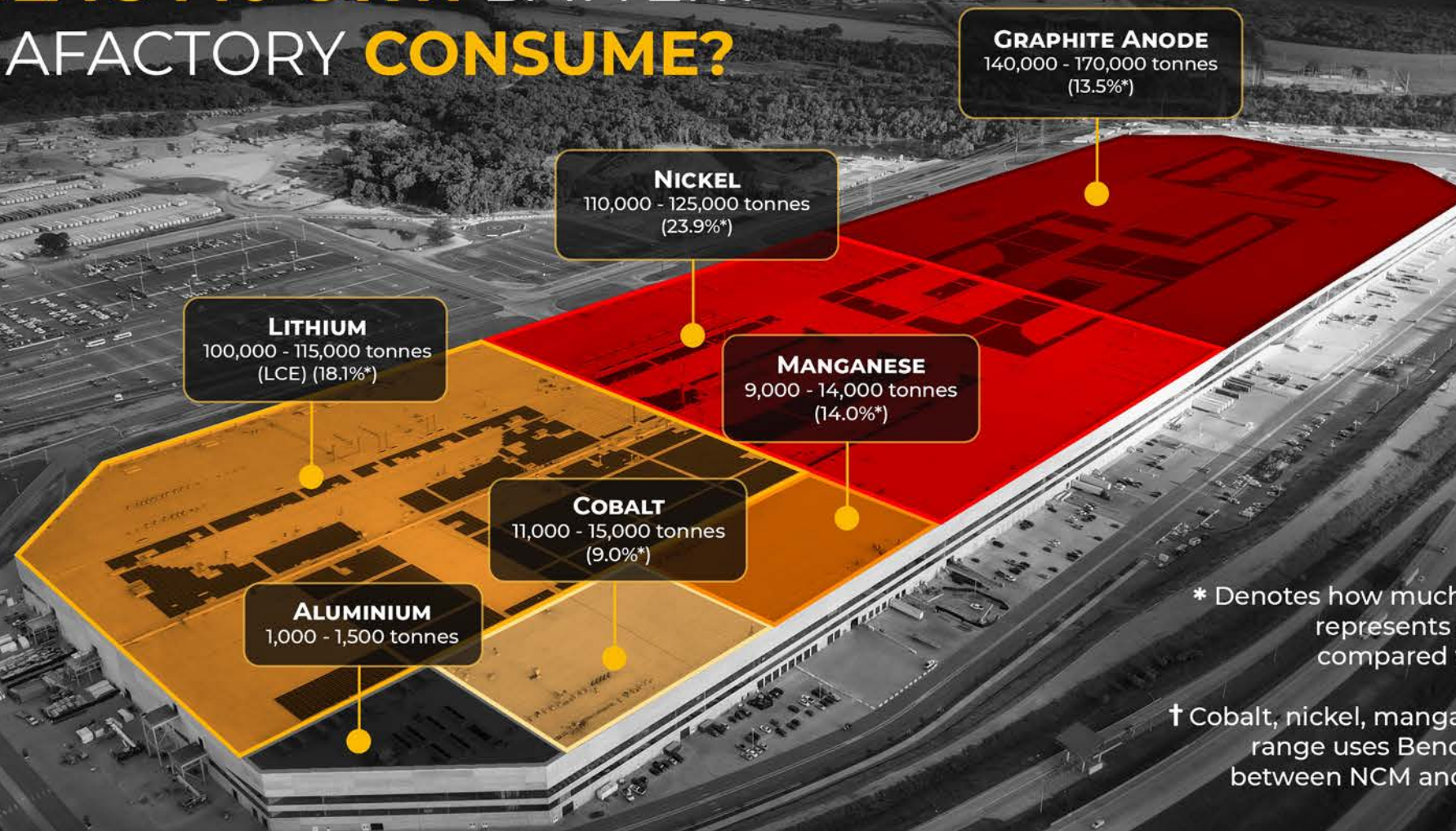


# North America is facing a generational challenge to sustain clean energy ambitions





# HOW MUCH **RAW MATERIAL** WILL **TESLA'S 140 GWH** BATTERY GIGAFACTORY **CONSUME?**

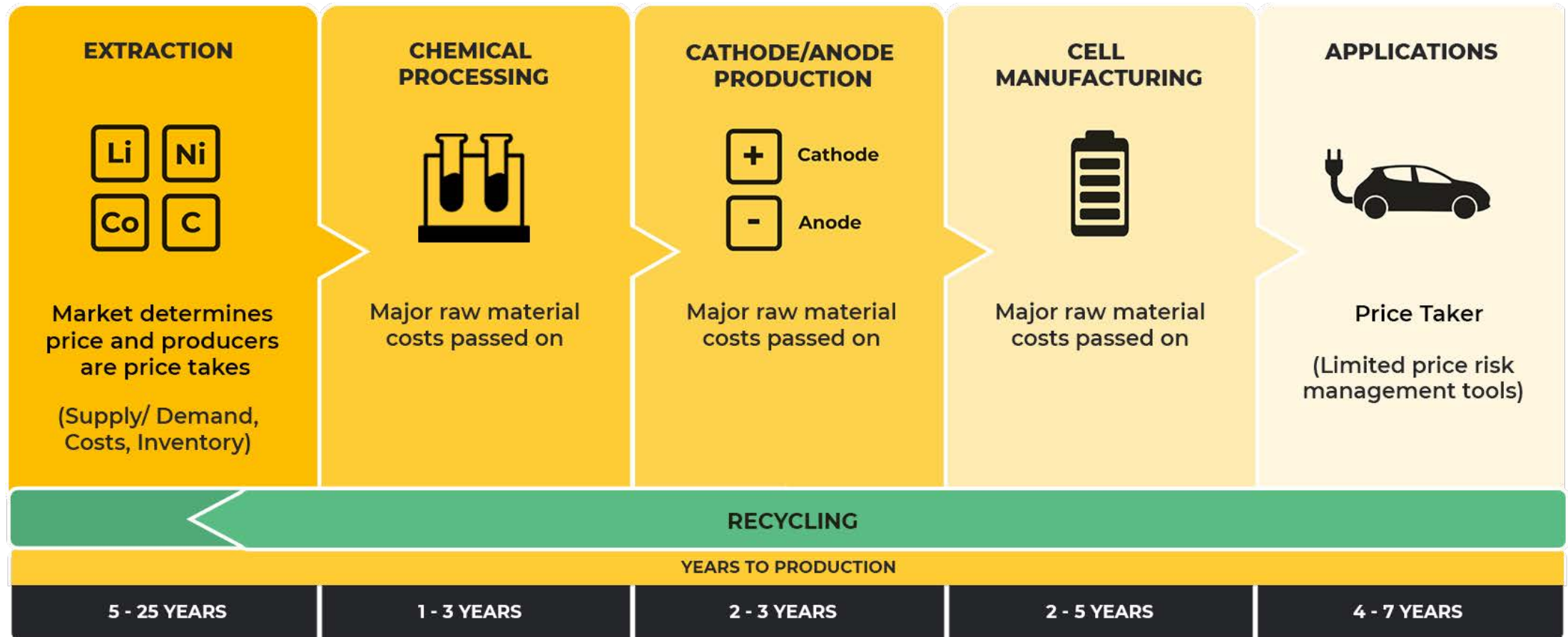


\* Denotes how much of global supply this represents for each raw material compared with 2022 production

† Cobalt, nickel, manganese and aluminium range uses Benchmark assessed split between NCM and NCA chemistries for Tesla end use



# And time is running out - keeping pace with the downstream trajectory will be difficult for less agile upstream markets



# Other strategic considerations only add hurdles to supply chain success



## Location

- Regional supply security of increasing importance to consumers
- Financial incentives to localise from IRA etc

**The Washington Post**  
*Democracy Dies in Darkness*

ENERGY

**The Great Lithium Squeeze**

**FP**

ARGUMENT An expert's point of view on a current event.

**The Inflation Reduction Act Is the Start of Reclaiming Critical Mineral Chains**



## Sustainability

- EV producers green credentials increasingly tied to supply chain
- Brand/reputational risks



Exclusive: Facing green pressure, Indonesia halts deep-sea mining disposal

**The Guardian**

**Dark matter and lithium water**



## Product specs

- The right type of chemical (delivered in the optimal form) is essential
- VIU will differ across technologies

**Automotive World** est. 1992

**BMW Group Sustainability through Innovation 2022**



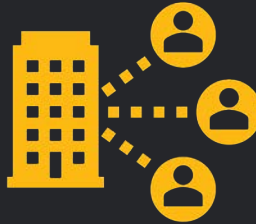
# Project development timelines are getting longer as we build the wider ecosystem for EV-scale extraction



**Machinery**



**Infrastructure**

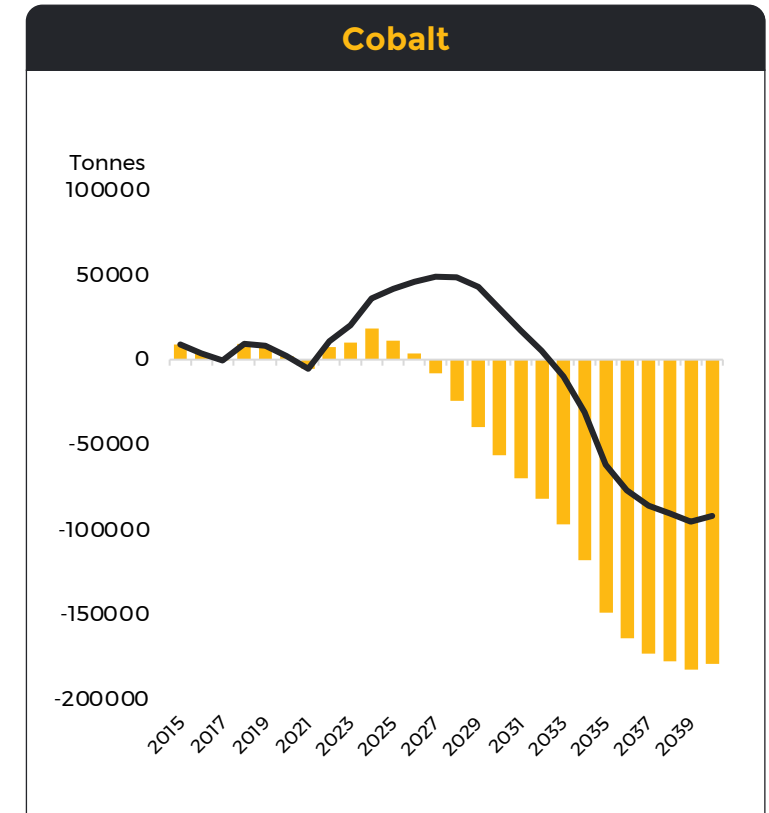
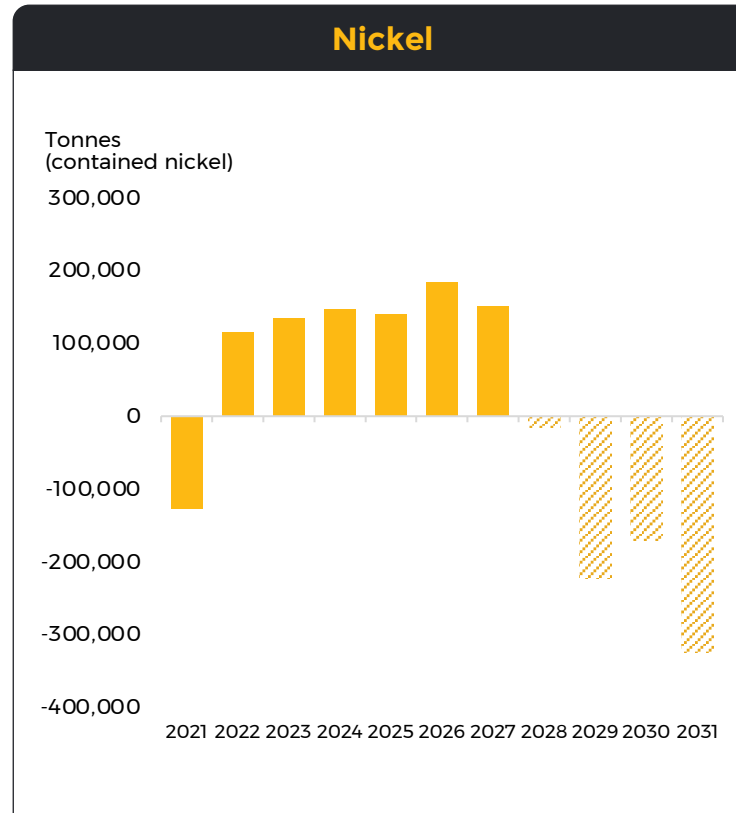
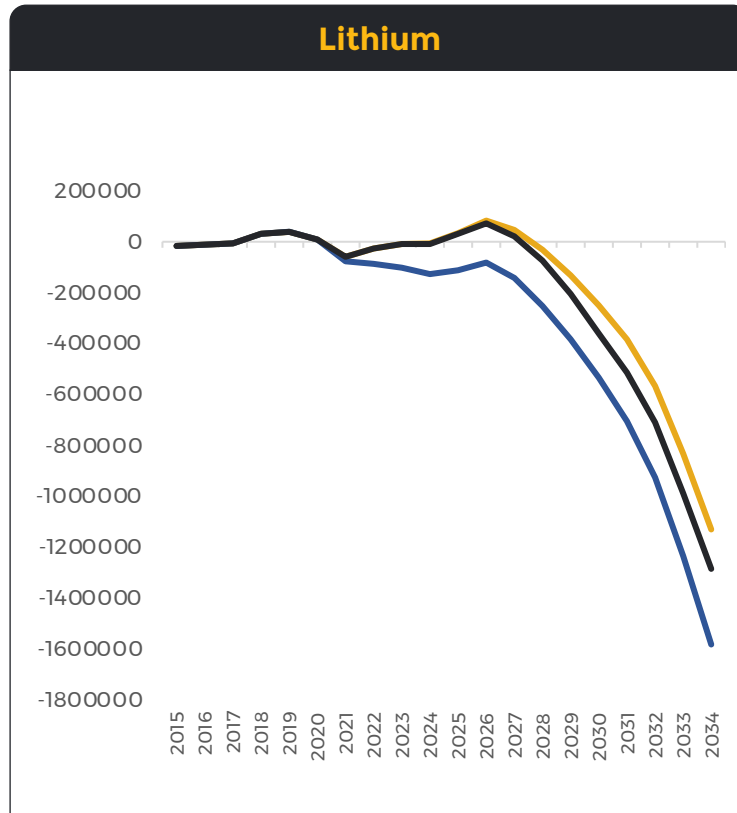


**Workforce**

“

We are already seeing intensifying shortages in equipment, infrastructure, refining materials and skilled labour. This is having an inflationary impact on project economics....

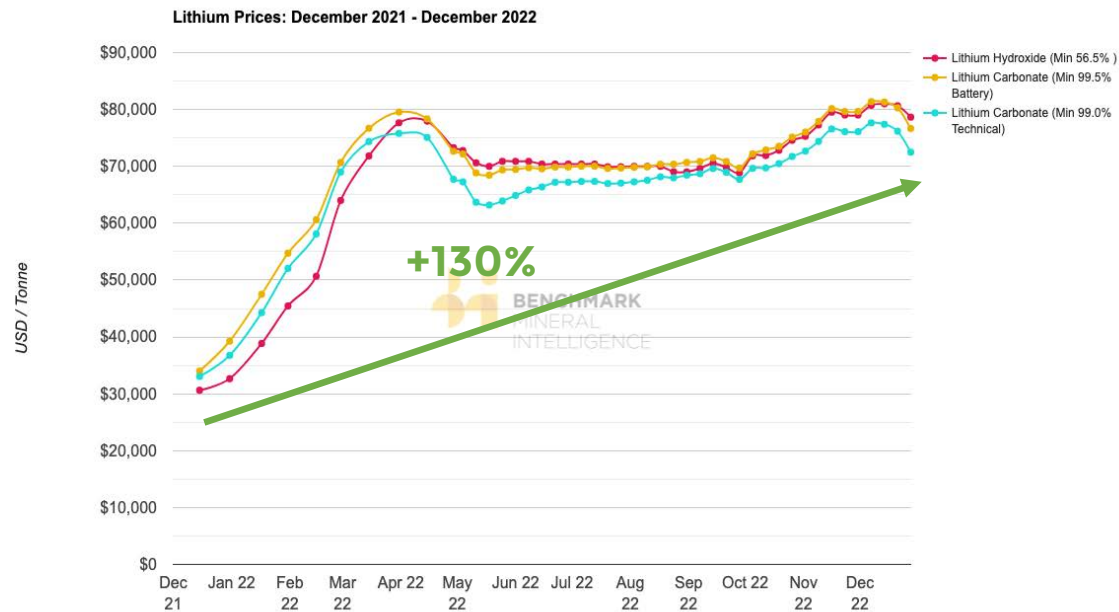
# A battery raw material cliff edge is on the horizon



**Money needs to be deployed today to avoid the challenges of the coming decade**

# As the supply chain scrambles to keep pace, the threat of price volatility escalates

## Benchmark EXW China lithium



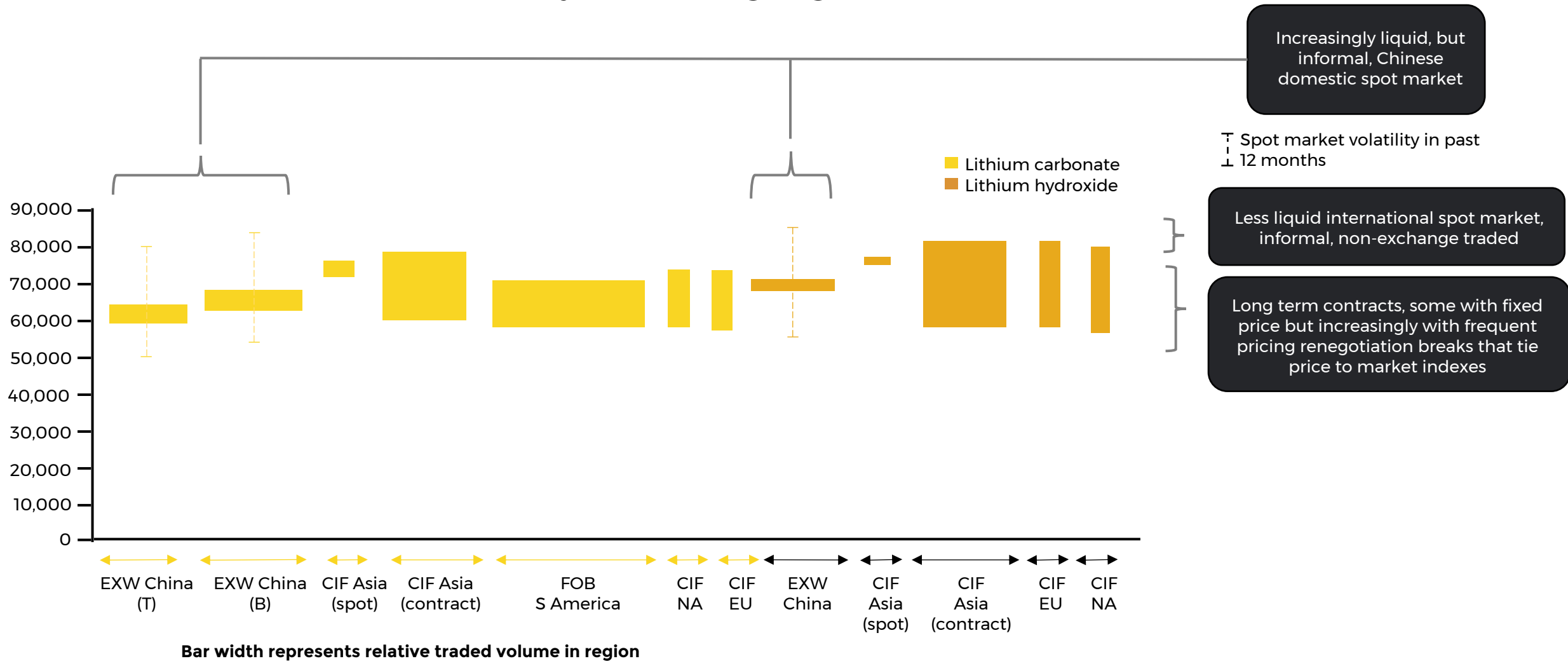
Source: Benchmark Lithium Price Assessments

## Benchmark NiSO<sub>4</sub> (Min 22%)



Source: Benchmark Nickel Price Assessments

# The lack of a single market price makes supply chain optimization incredibly challenging



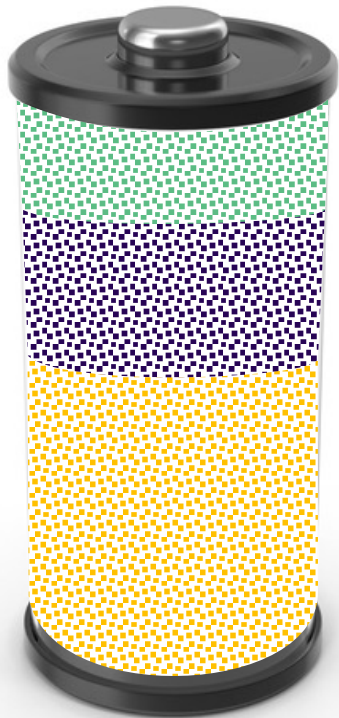


# Batteries are the platform technology for electrification



# Raw materials are now firmly at the heart of EV economics

70% = BOM



## Anode

- Natural spherical Graphite
- Synthetic Graphite
- Foils
- Silicon
- Binders

## Other

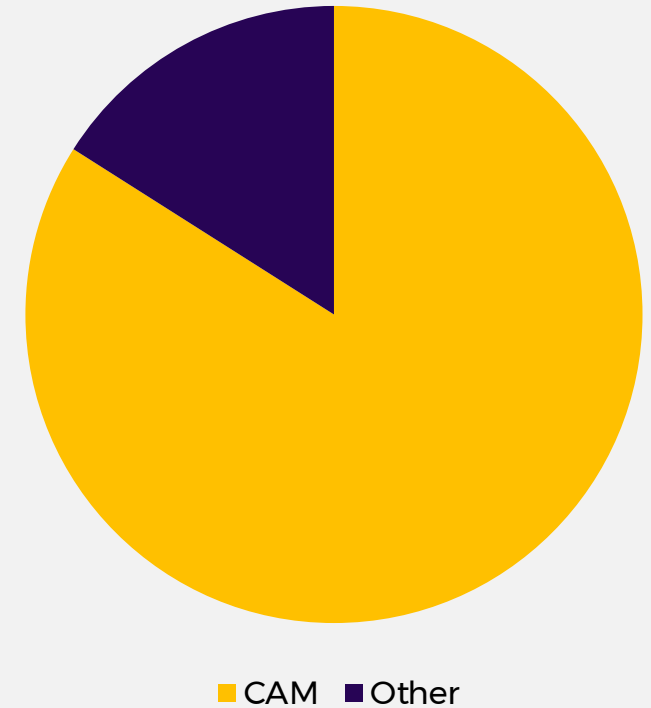
- Separator
- Electrolyte

## Cathode

- Lithium
- Nickel
- Aluminium
- Cobalt
- Manganese
- Iron phosphate










Source: Benchmark Battery Cost Model

## Cathode Cost Breakdown



# This will force further OEM involvement upstream...

Current supplier
  Future supplier
  Undisclosed/None

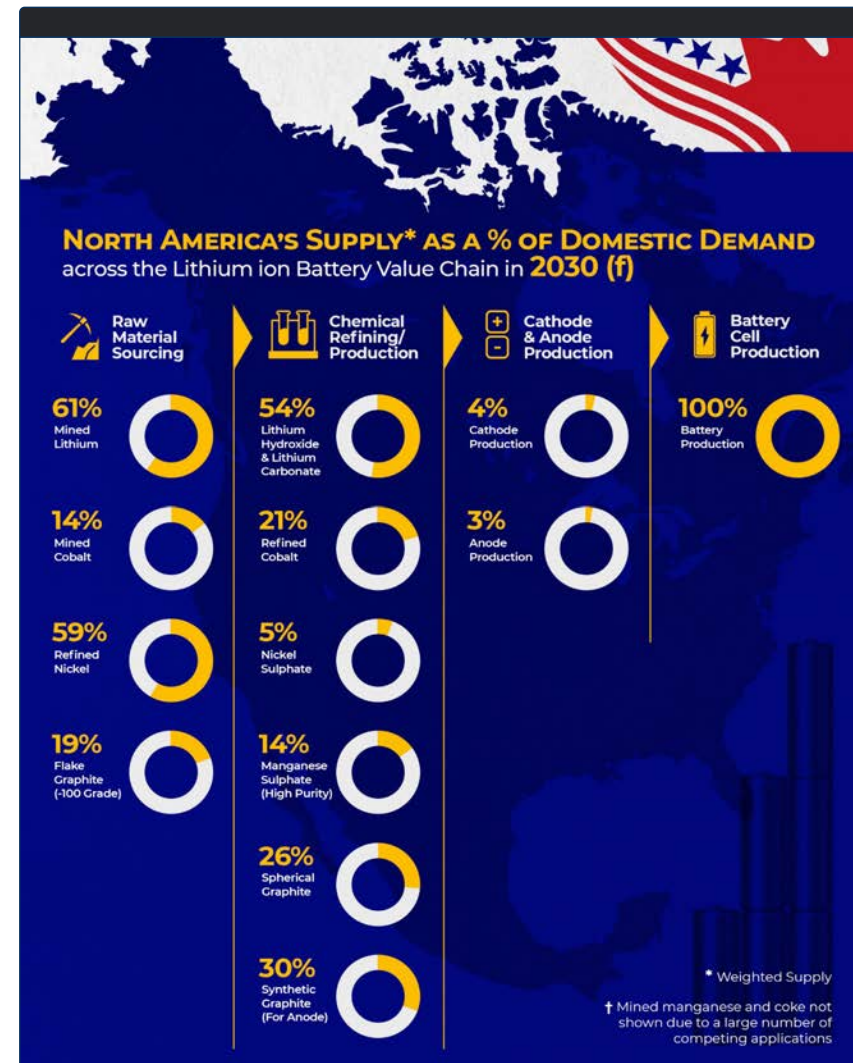
OEM	Mining resources			Battery Materials				Batteries
	Lithium	Nickel	Cobalt	Cathode	Anode	Electrolyte	Separators	
	Albemarle, Ganfeng, Yahua	Vale BHP Talon metals	Glencore	Sumitomo	BTR, Shanshan, Chinese suppliers Syrah (2024+)	Mitsubishi Chem, Tinci high-Tech	Sumitomo	Panasonic, LGES, CATL
	Ganfeng, Vulcan Energy (2026+)	Huayou cobalt Tsingshan	Huayou cobalt Tsingshan	Umicore (2025)				LGES, CATL, SDI
				Sumitomo				PPES
	Lithium Americas, Controlled Thermal Resources (2024+)	QPM		POSCO (2024+) BASF	POSCO (2024+)			LGES, CATL
								LGES, SDI, CATL
DAIMLER								SK On, AESC, LGES, CATL
	Vulcan Energy (2026+), Controlled Thermal Resources (2024+)	Terrafame (2025+)						CATL
	Ioneer, Compass, Liontown	Vale, Huayou, BHP						SK On, LGES, CATL
	Vulcan Energy (2026+)	Terrafame						LGES, AESC
	Ganfeng, Livent		Glencore, Managem Group					CATL, SDI, AESC

\*This table indicates public announcements and is not an exhaustive list. For full details, please contact [info@benchmarkminerals.com](mailto:info@benchmarkminerals.com)

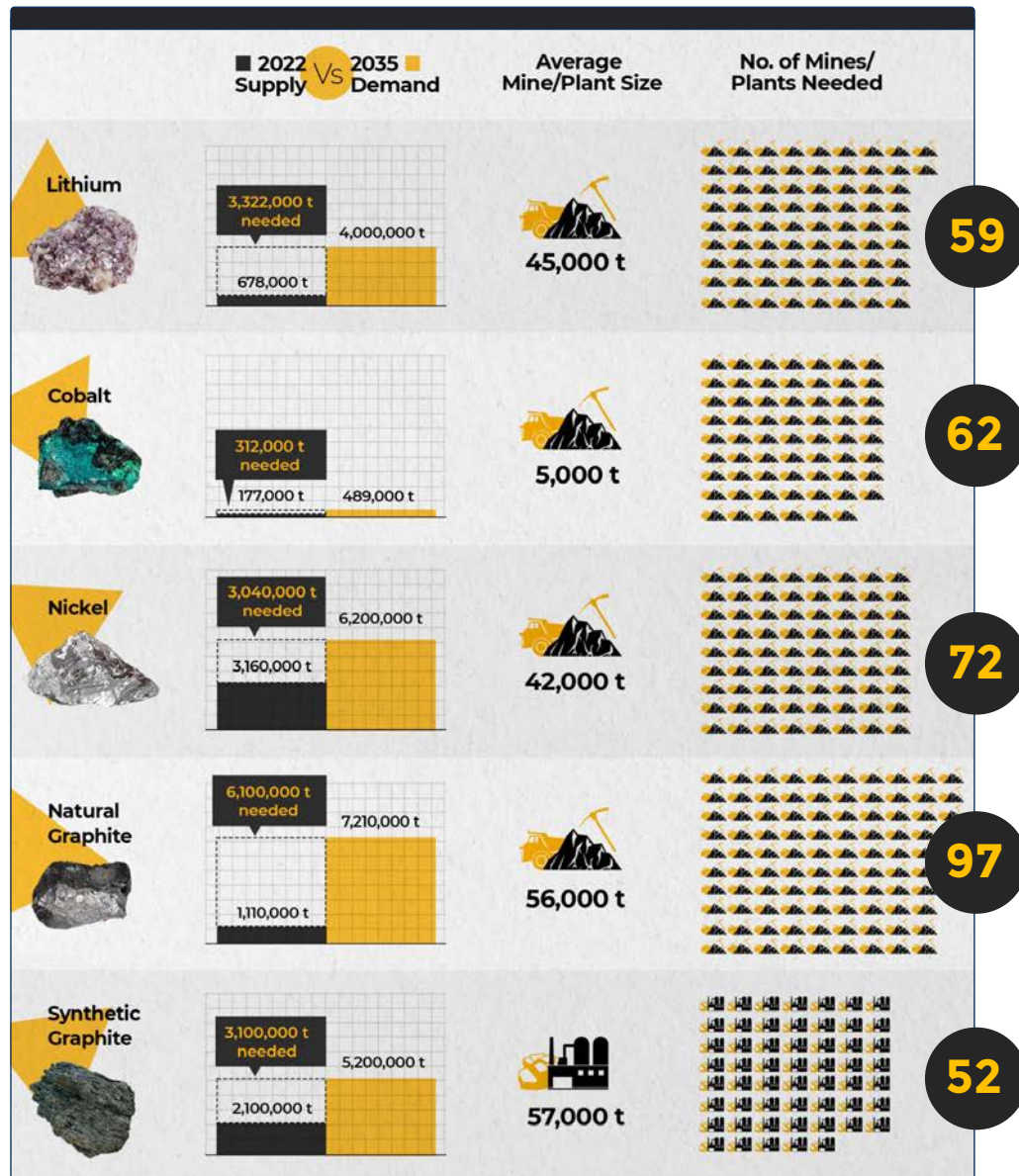
# Can North America meet localised battery demand?

“

North America has a long way to go to displace Chinese supply chain dominance





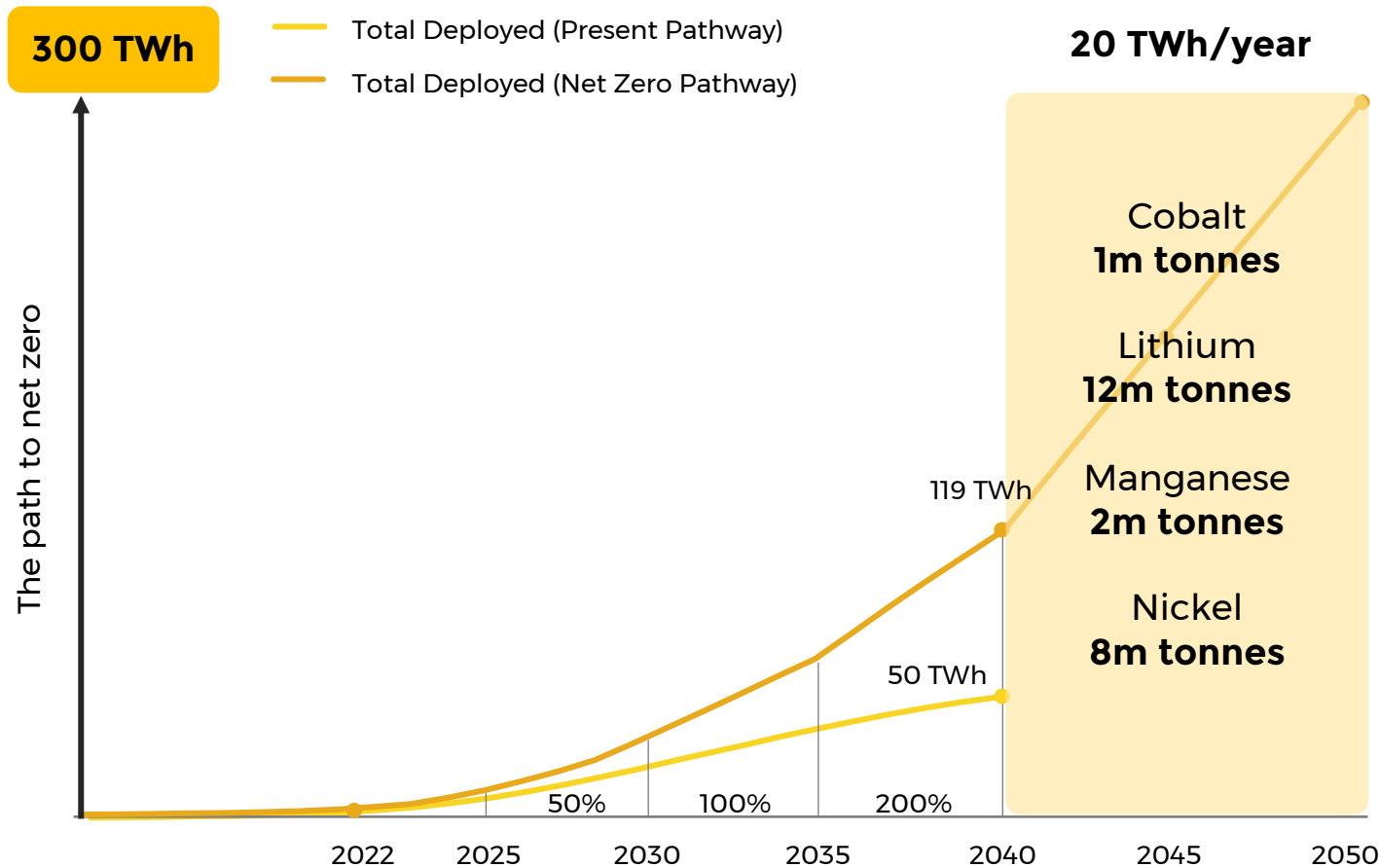


“

**How many new mines will be needed by 2035?\***

\*Without battery recycling

# Longer-term clean energy targets make the scale of the challenge even more daunting



## THE ENERGY TRANSITION IS IN ITS EARLY STAGES

We need to accelerate the entire ecosystem to reach net zero

## FOR ANY QUERIES, CONTACT US :



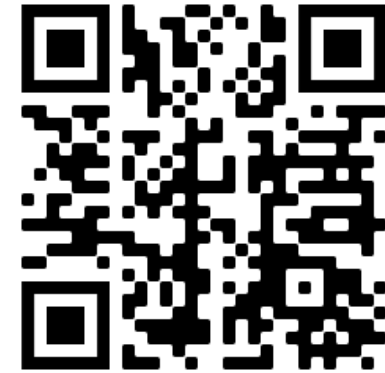
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