



# From Metal to Electron: A Spotlight on Battery and Rare Earth Metals

Amogh Patil

# Outline

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The Next Revolution

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Energy Transition Metals Overview

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China: The World's Refiner

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Market Instruments

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Regulating Change: Policy Overview

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Supply and Demand Outlooks

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New Horizons

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# The Next Revolution



From Coal  
to Oil



Now Oil  
to  
Electricity



# Three Key Areas



Renewable Electricity

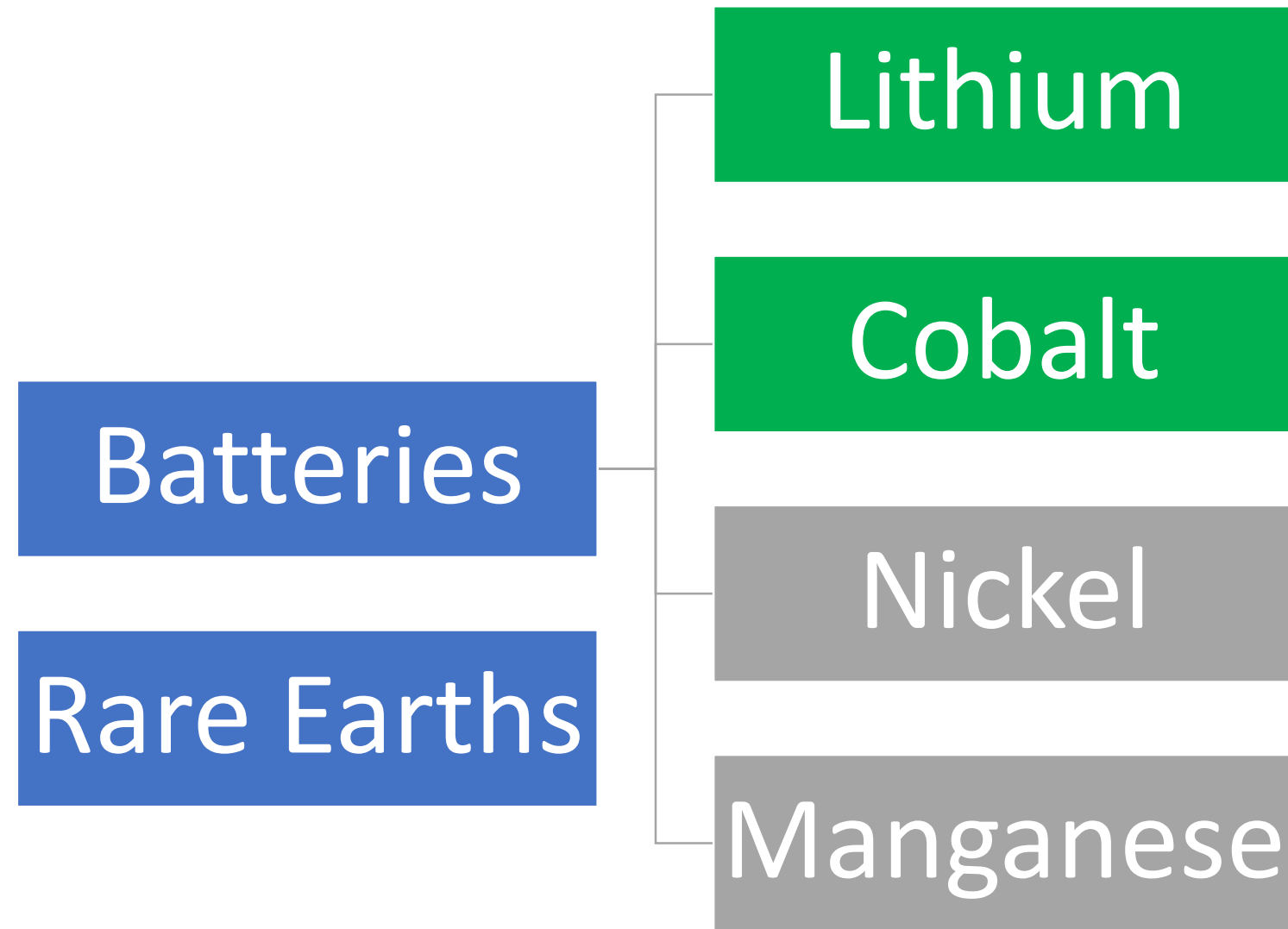


Grid Upgrades



Electric Vehicles

# Energy Transition Metals Overview



# Lithium



Spodumene Ore

Lithium Hydroxide



Battery Cathodes  
High Nickel Content



Brine Pool

Lithium Carbonate



Battery Cathodes  
Low Nickel Content

# Cobalt



Nickel Ore



Copper Ore

Cobalt Metal

Cobalt Sulfate

Cobalt Hydroxide



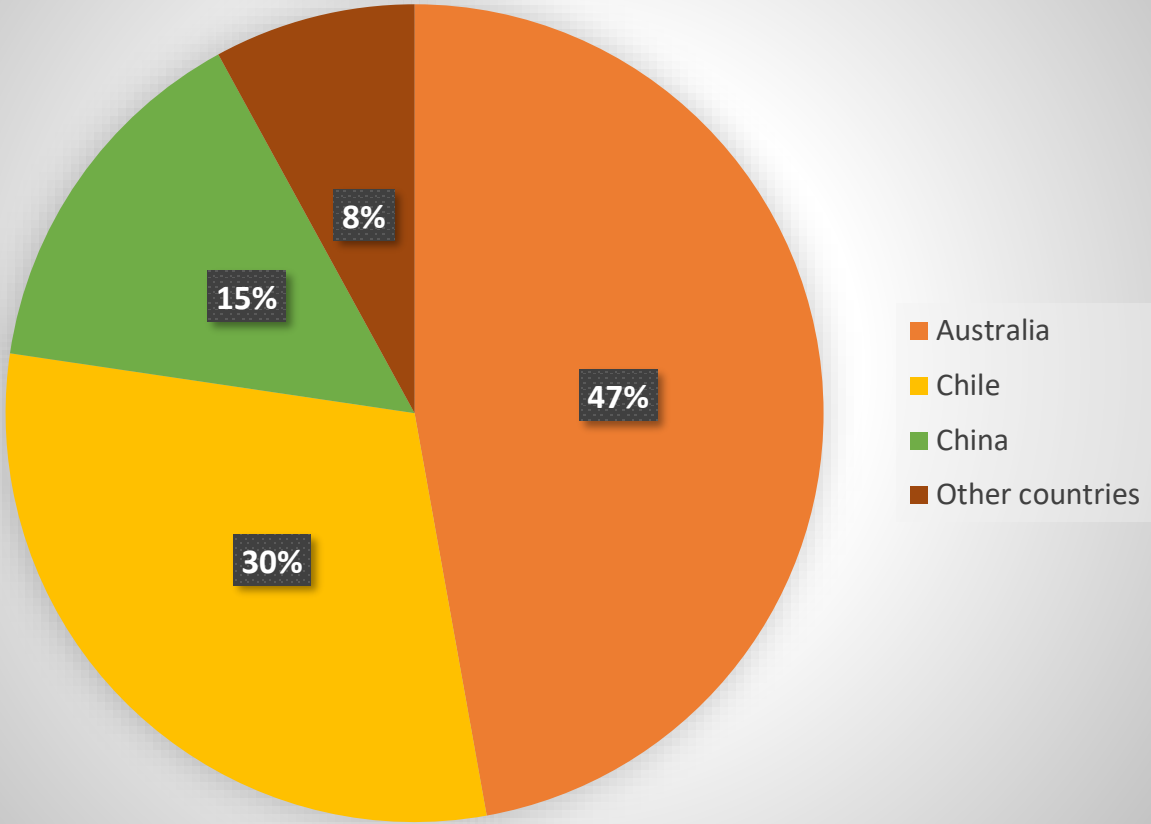
Magnets



Battery Cathodes

# Global Production

### Lithium Production (2022)

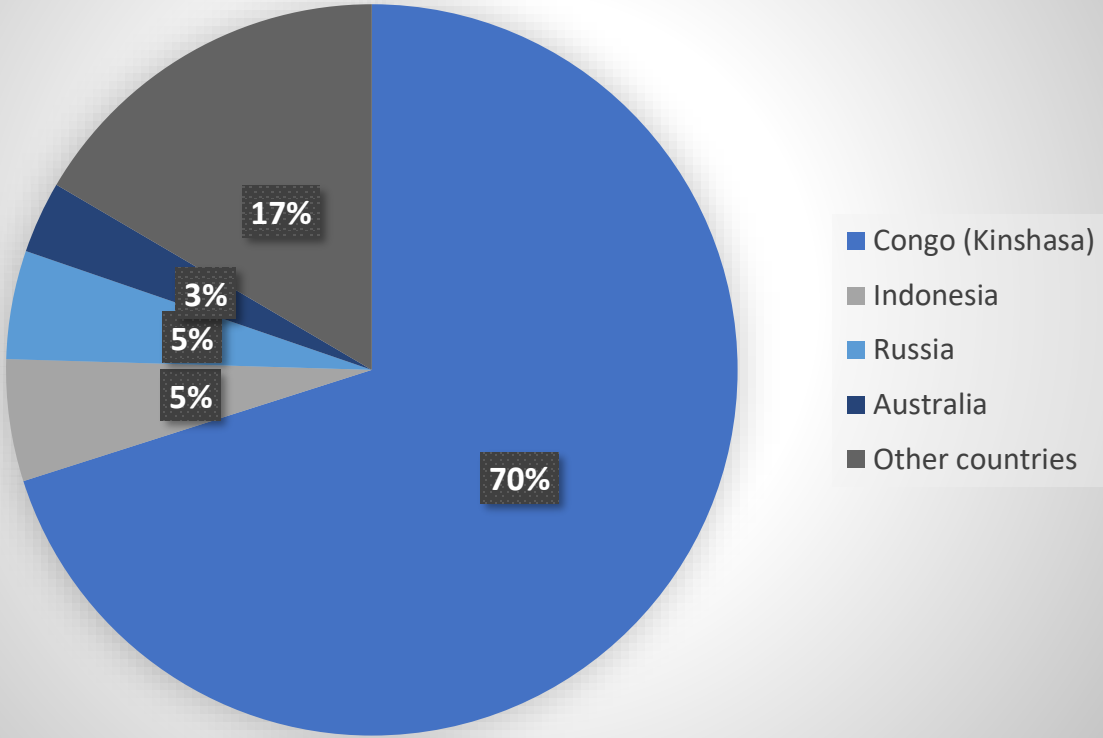


Total: 691,990 MT LCE\*

Source: USGS, USA data withheld in Lithium Production

\*Lithium Carbonate Equivalent

### Cobalt Production (2022)



Total: 185,000 MT



# Rare Earth Elements



Light Rare Earth Elements

Neodymium, Praseodymium



Heavy Rare Earth Elements

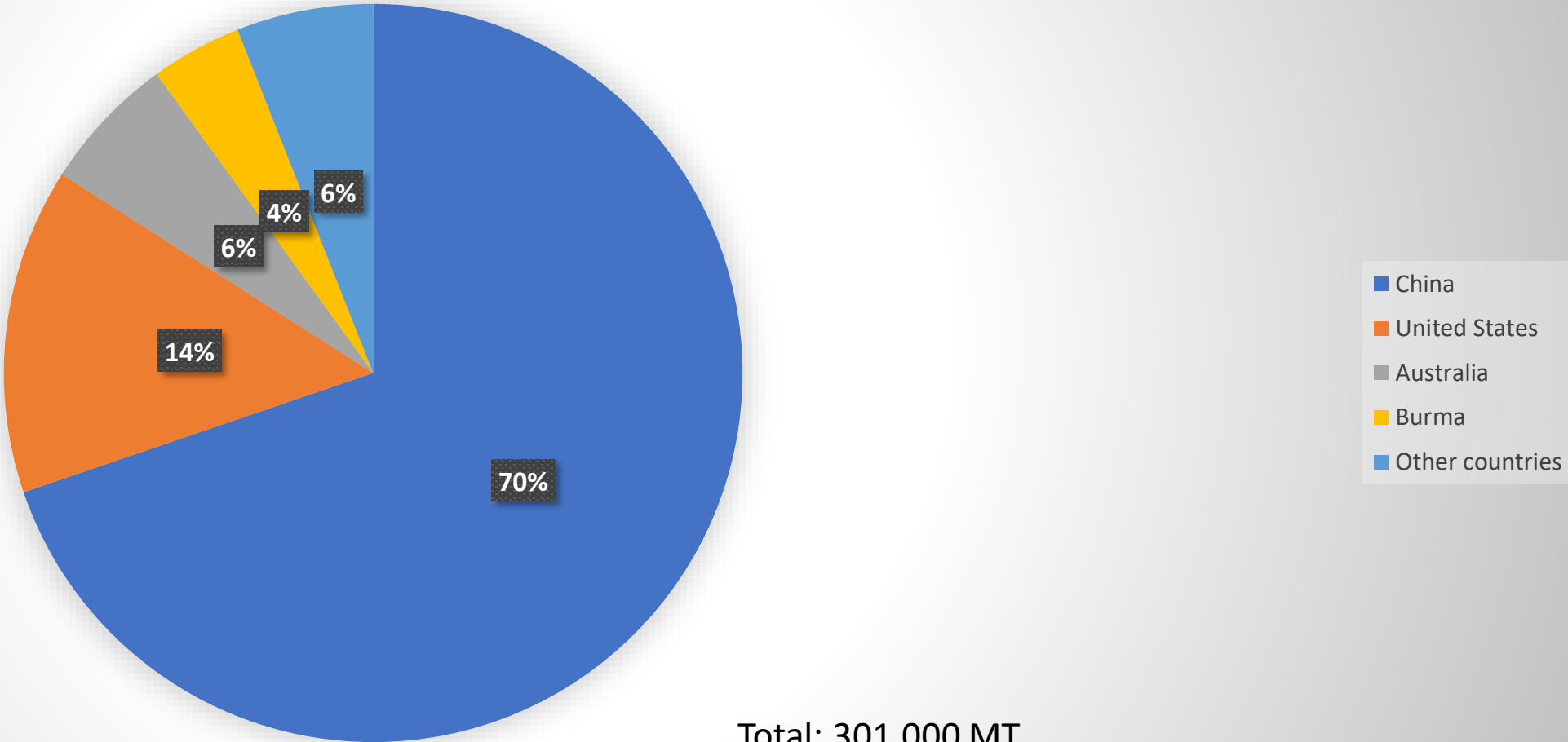
Dysprosium,  
Terbium



Permanent Magnets

# Rare Earth Production

Rare Earths Production (2022)



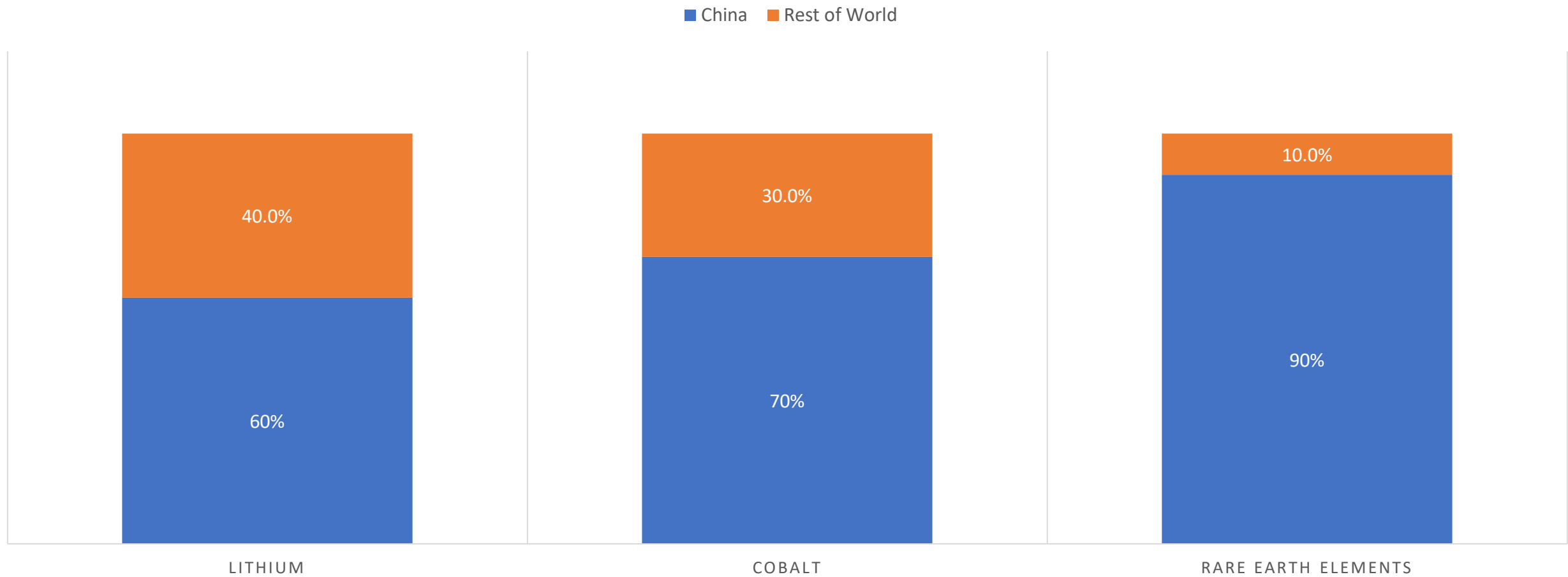
Source: USGS



# The Dragon in the Fog

# China: The World's Refiner

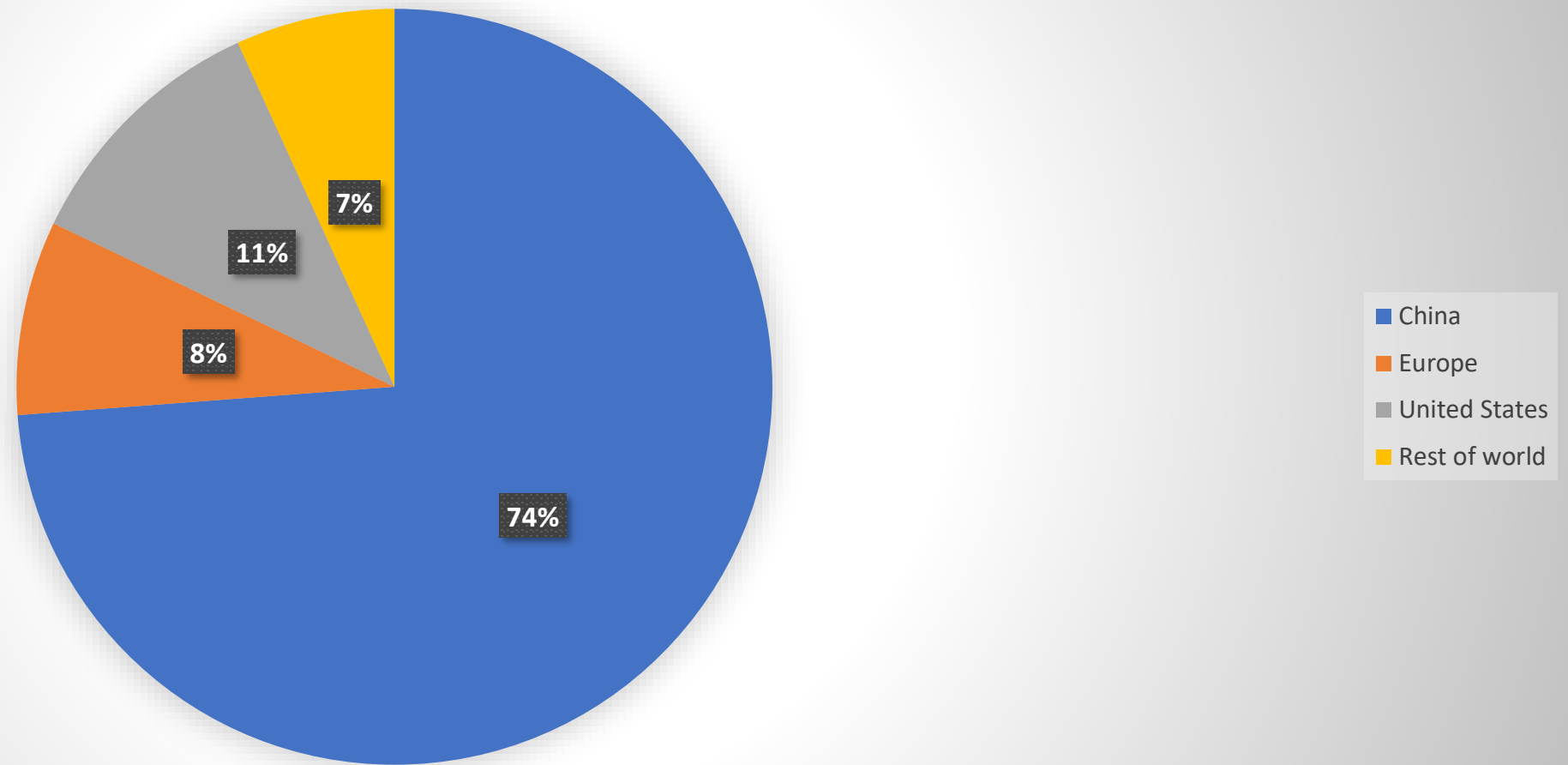
## MINERAL PROCESSING FACILITIES BY OUTPUT



Source: IEA

# China's Revolution

Planned Battery Production Capacity by 2025



# How are these metals traded?



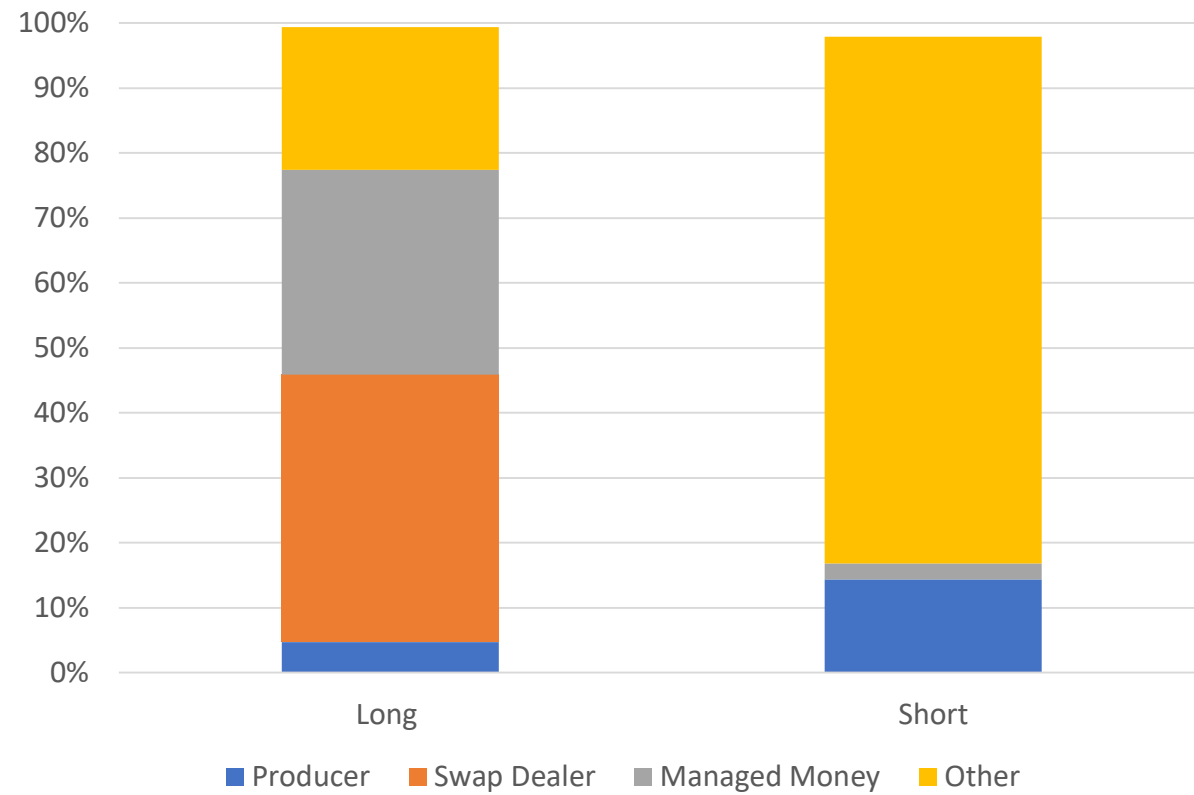
PRICE ASSESSMENTS  
FASTMARKETS, PLATTS



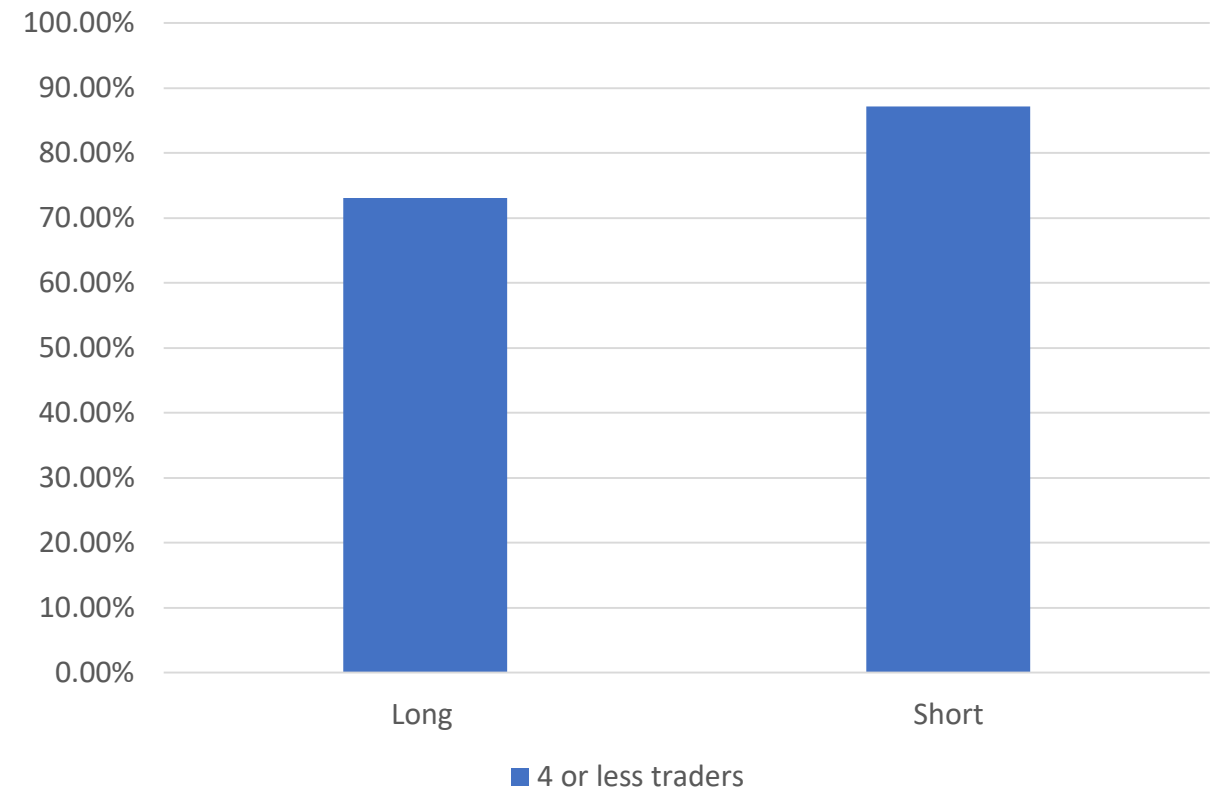
FUTURES  
CME, LME, SGX

# Market Participants

Open Interest By Category and Position for Cobalt  
10/10/2023

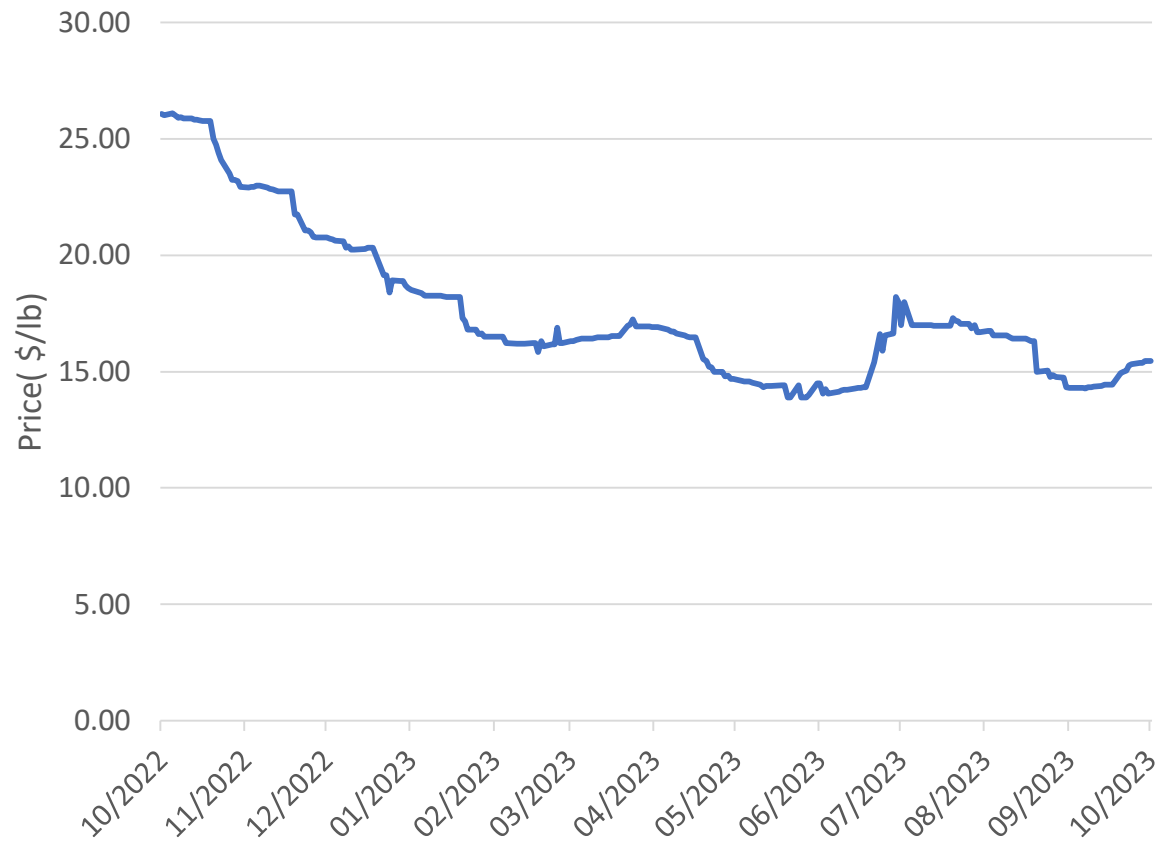


Open Interest Held by 4 or fewer traders for Cobalt Net Position  
10/10/2023

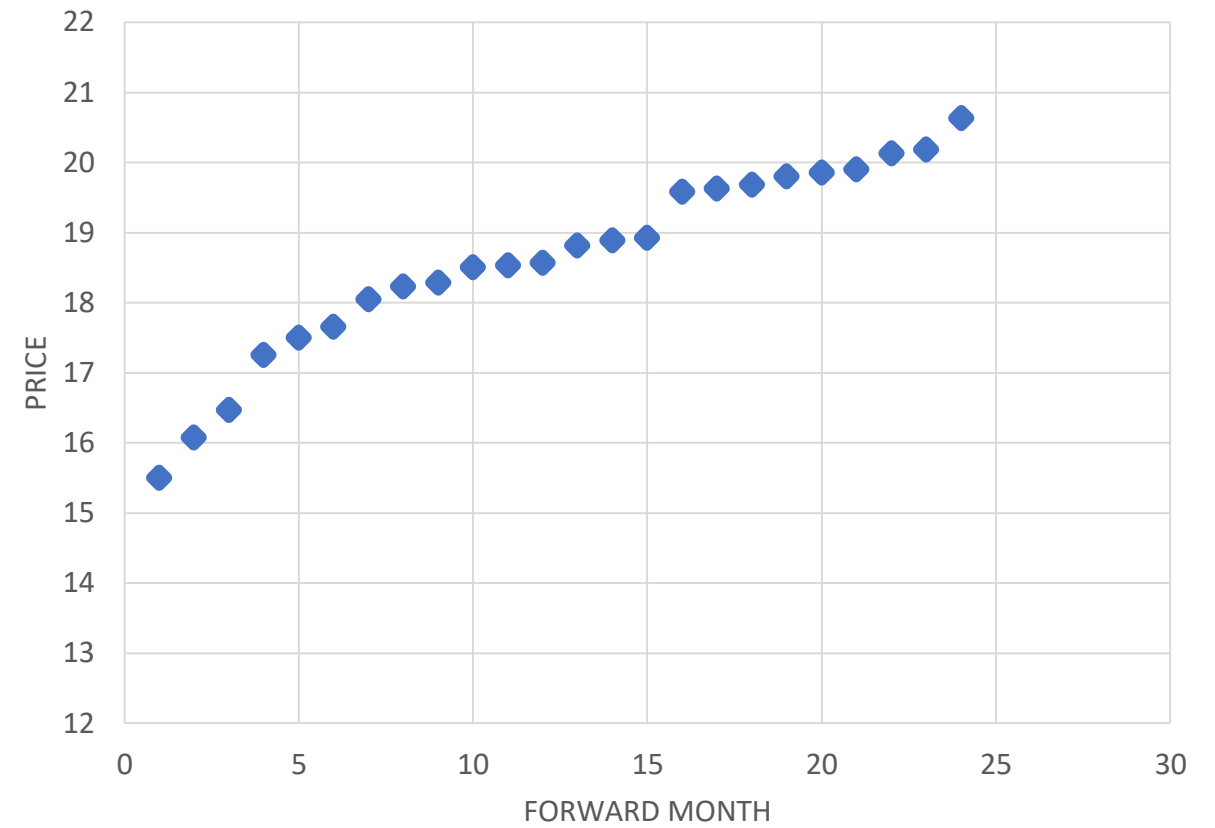


# Cobalt

## COBALT METAL STANDARD GRADE SPOT PRICES\*



## CME FUTURES COBALT STANDARD GRADE PRICE (10/13/2023)



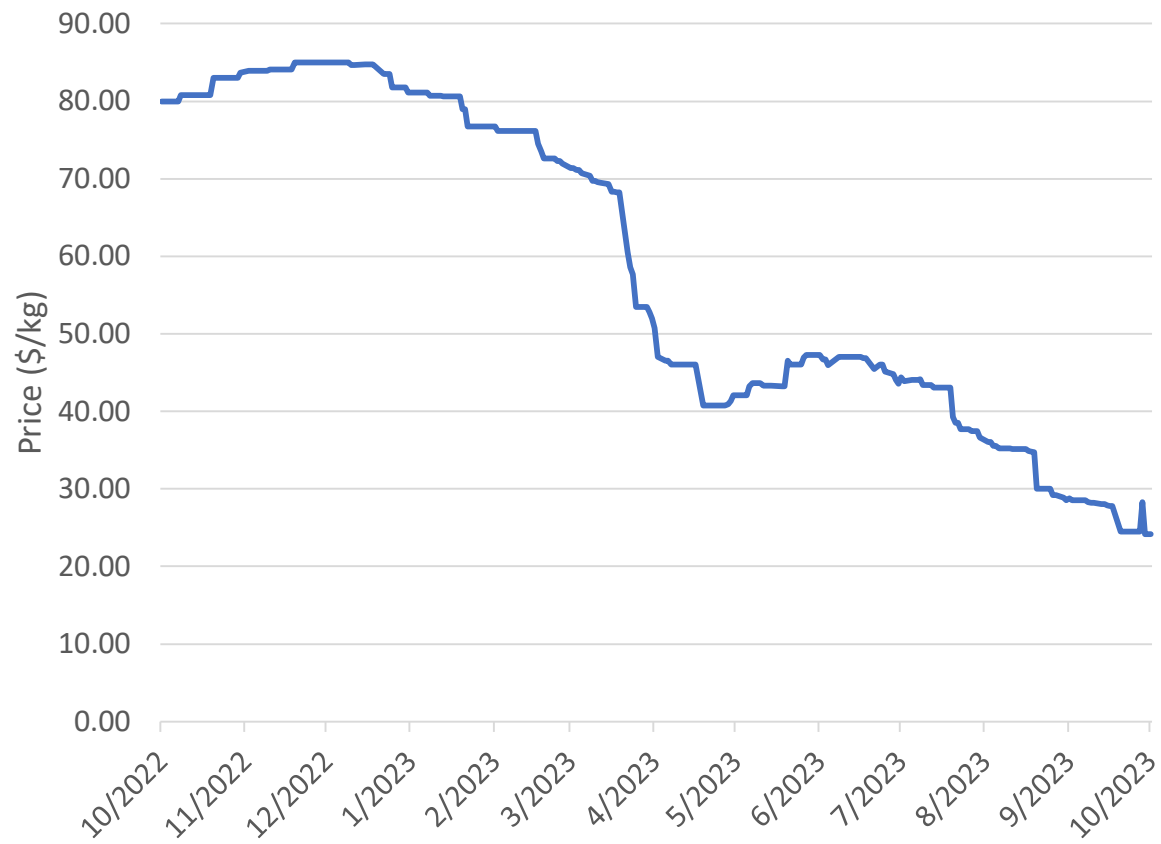
Source: CME

\* Futures Prompt Month Price

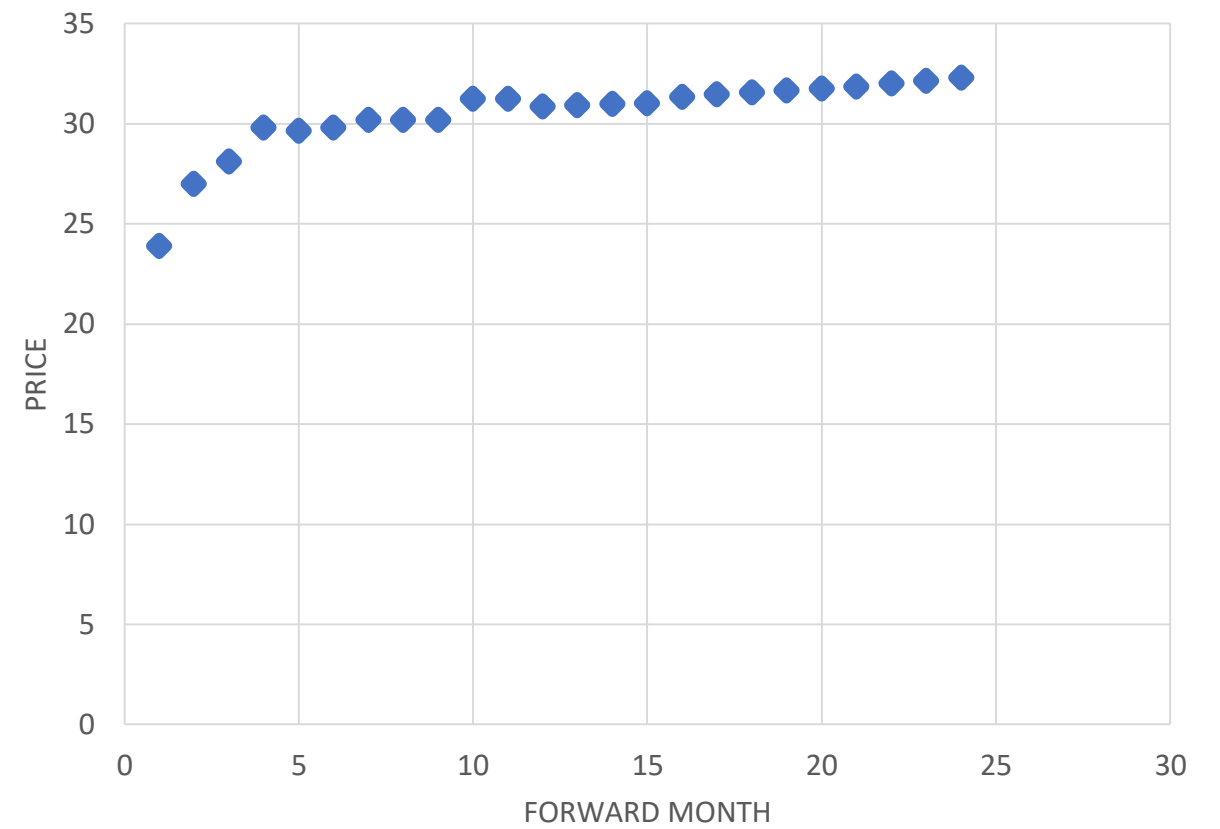


# Lithium

## LITHIUM HYDROXIDE BATTERY GRADE SPOT PRICES\*



## CME FUTURES LITHIUM HYDROXIDE PRICE (10/13/2023)



Source: CME

\* Futures Prompt Month Price

# Exchanges Recognize Demand

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Open Interest for CME Products is rising

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Exchanges announce new products

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However, trading volume remains low

# Policy



The main driving force: Policy



Over 200 specific policies



Over \$1.34 Trillion Committed  
Since 2020\*

\*IEA, 2023

# Selected Policies

## **Inflation Reduction Act**

- Over \$350 Billion of tax credits and funding
- 80% of EV materials must be sourced from USA and partners

## **Critical Raw Minerals Act**

- At least 10% of mined materials from the EU
- 40% of processed materials from the EU
- Improved bargaining by centralizing purchases as a unified EU bloc

# Resource Nationalism

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Credits for Local Resources

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DRC Offers to buy back assets

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Chile Nationalizes Lithium

# New Supply



Opening Brine Pools in depleted oil wells



New processes to increase efficiency in ore processing



Mine openings delayed by Covid are back on track



Recycling Plants under Construction

# Direct Lithium Extraction (DLE)

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Faster and more efficient than previous methods

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Chile has mandated it for all new projects

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Long term feasibility under review

# Demand Outlook



High Demand from growing  
EV adoption



Changing Battery Chemistries



Demand Expected to Exceed  
Supply in late 2030s\*



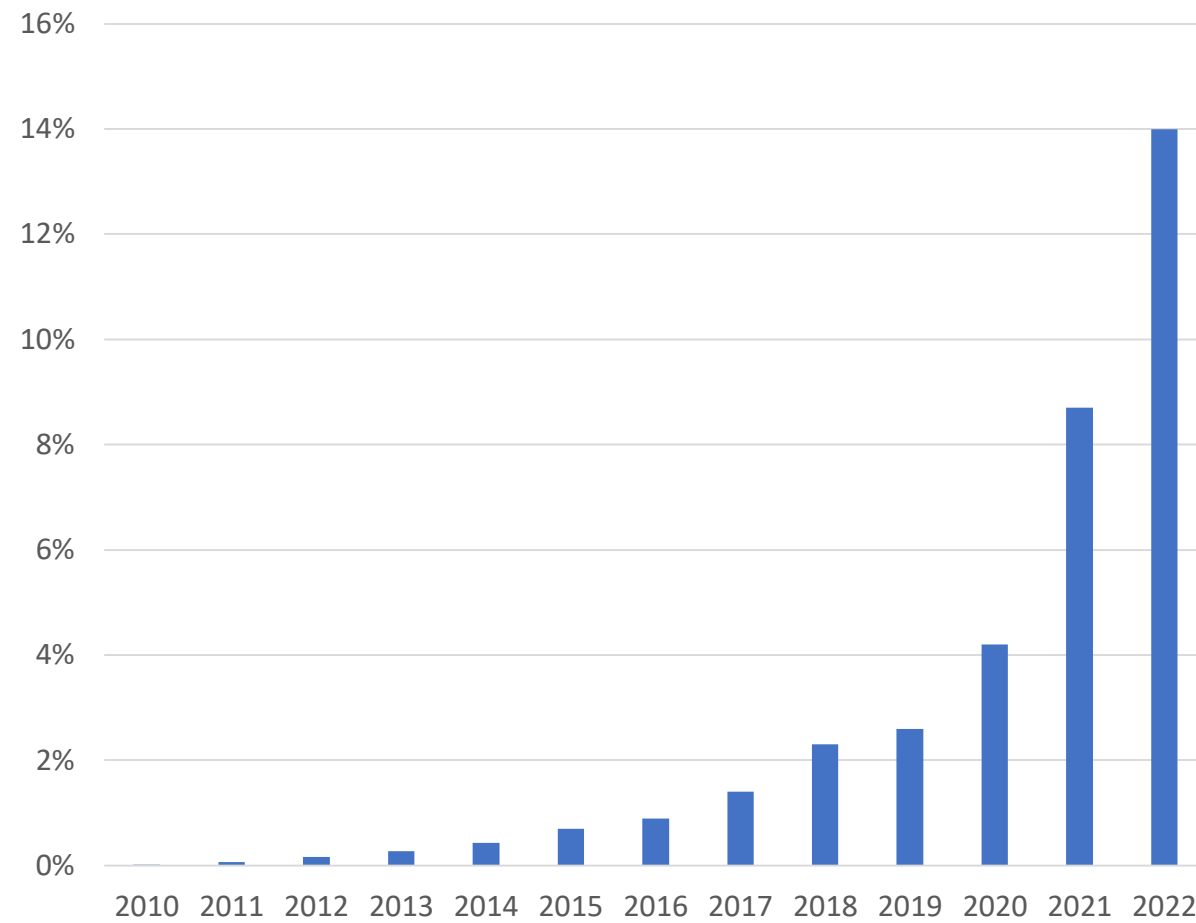
Grid Storage Batteries  
Coming Online

\*IEA, 2023



# Behind the Wheel

EV Sales as Percentage of Total Car Sales



Source: IEA, 2023



# New Horizons

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Presently niche markets with enormous potential for growth

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Industry is in nascent stages with heavy geographical concentration

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This revolution is no longer a matter of possibility but of inevitability

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Shifting from a dependence on oil to an era of transition metals

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