Energising the Future: Battery Recycling Market Outlook and Opportunities

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Australian Battery Recycling & Manufacturing Summit

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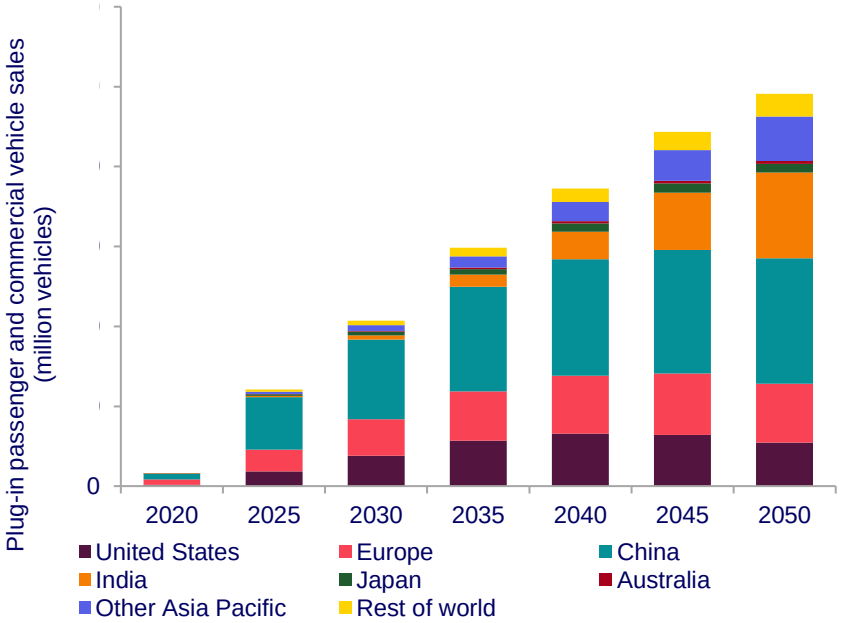
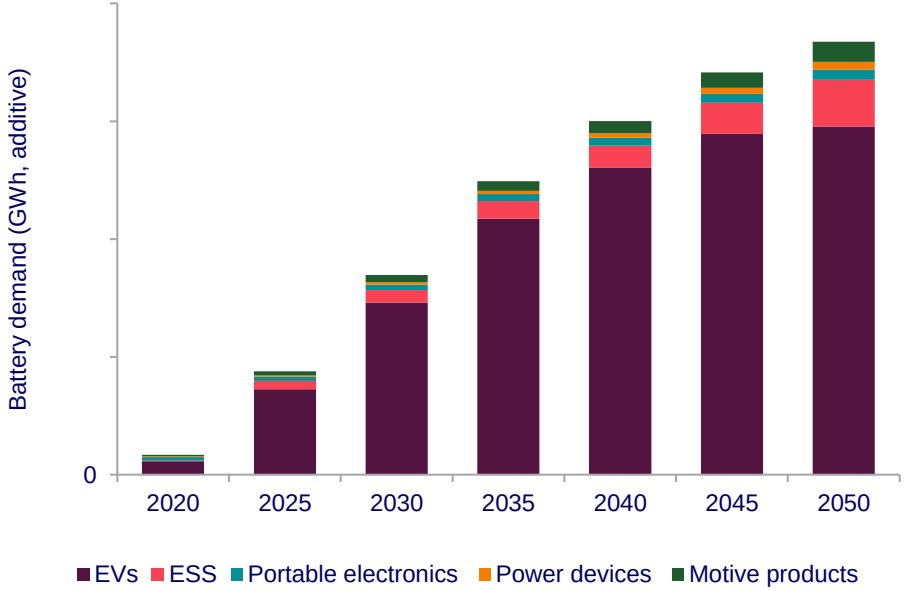
The global battery recycling industry is growing rapidly, presenting further opportunities for supply

Passenger EV adoption is forecast to drive an eightfold increase in Li-ion battery demand from the automotive sector by 2050

Plug-in electric vehicle sales forecast by country



Li-ion battery by end-use segment demand forecast



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Source: Wood Mackenzie Q2 2023

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Governments and OEMs are aligning with decarbonisation strategies, driving EV battery demand growth

Fit for 55 – 55% emissions reduction by 2030

100% zero-emission vehicles by 2035

40% EV penetration by 2030

Continuation of new energy vehicle subsidies to 2027

50% EV penetration by 2030

67% EV penetration by 2032 under EPA standards

US$7,500 tax credit under the Inflation Reduction Act until 2032

100% battery EV fleet

80% EV sales in Europe and 50% in North America and China, by 2030

100% BEV sales in Europe and 50% in USA by 2030

1 million EV sales in North America and China by 2025

Zero emissions for all vehicles sold in Europe by 2035

Produce only EVs by 2030

Produce 3.5 million EVs by 2030

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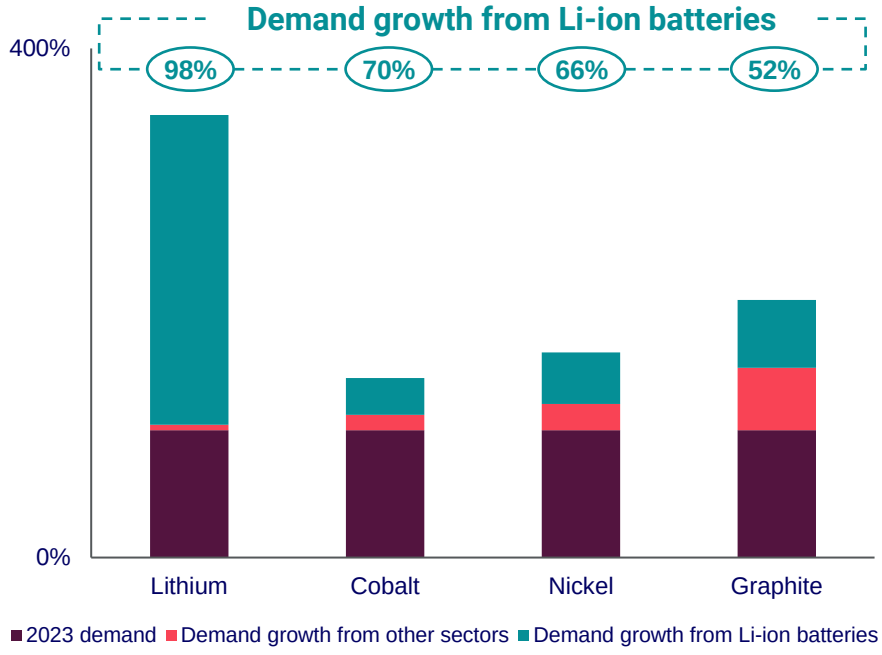
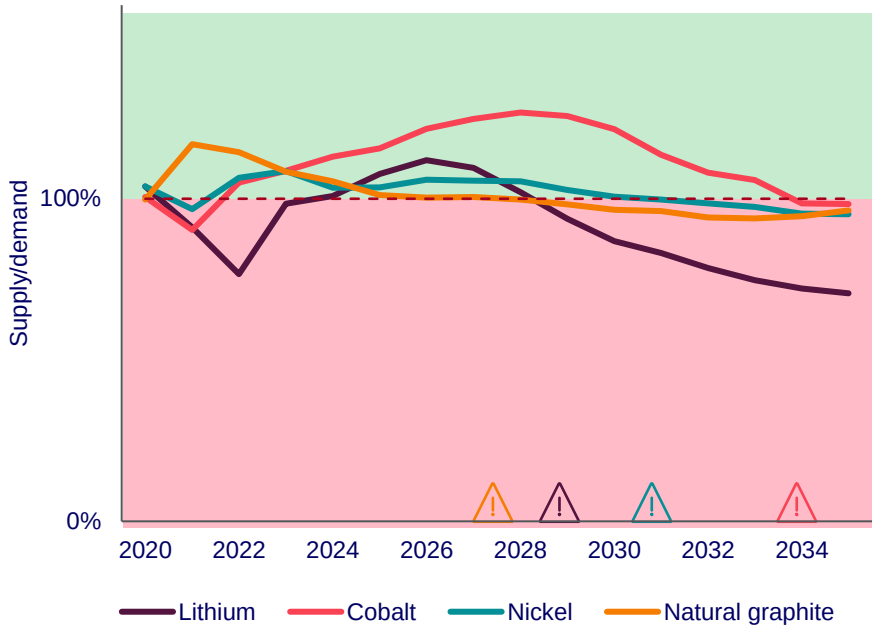
Additional battery sector demand is expected to drive long-term deficits in markets for lithium, cobalt, nickel and graphite demand

Demand for battery raw materials in 2035



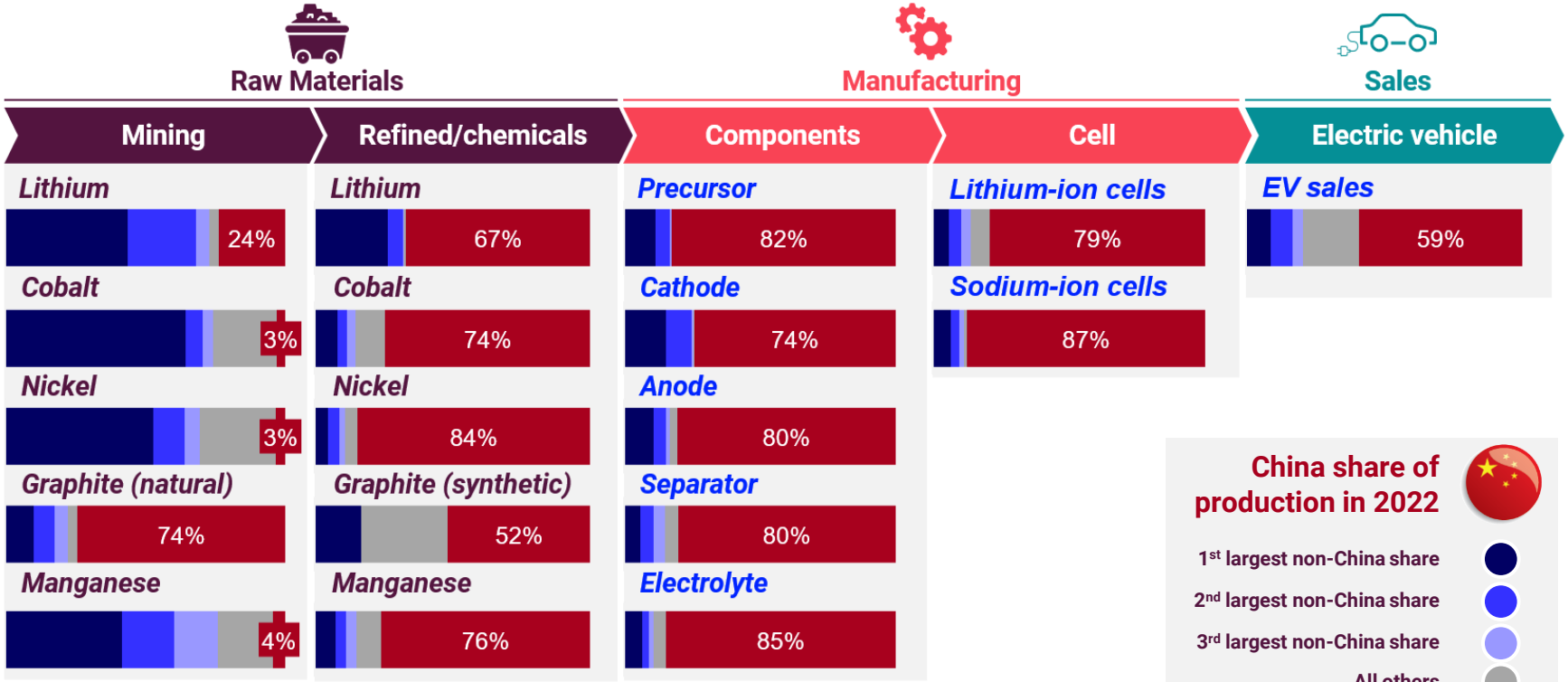
Battery raw material balances (base case)



Source: Wood Mackenzie Q2 2023

Source: Wood Mackenzie Q2 2023

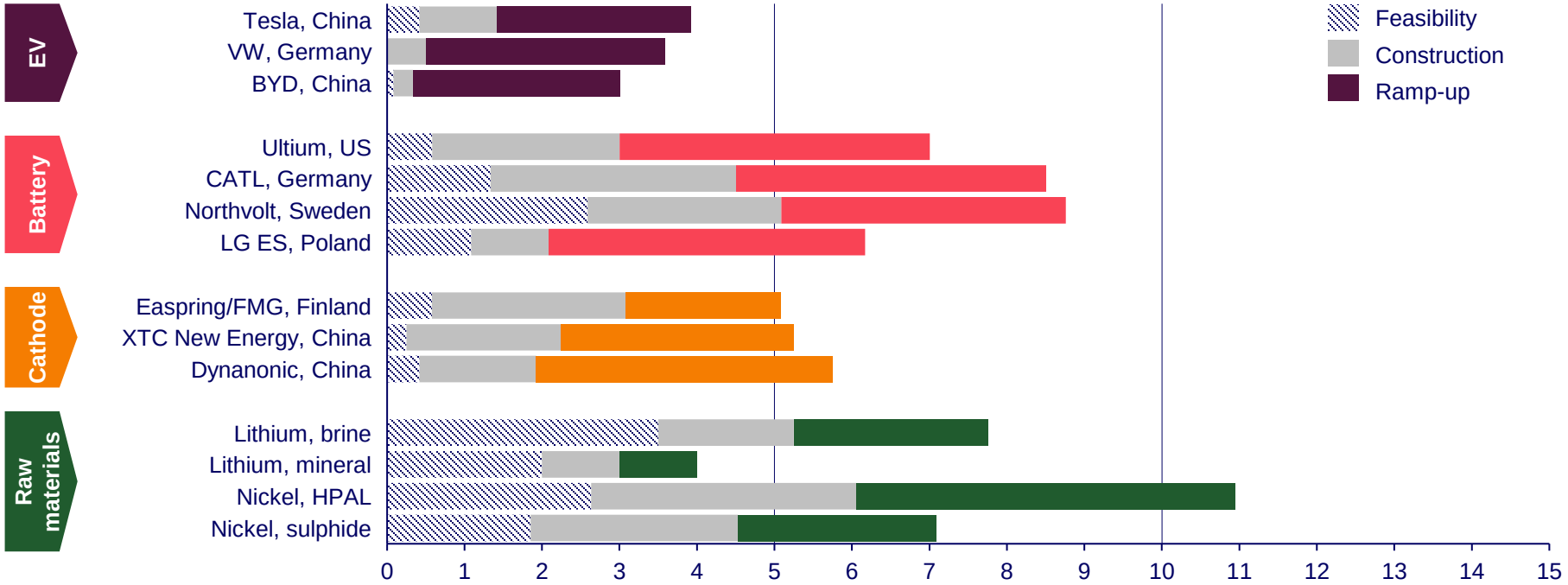
Realisation of overreliance on China has kickstarted a drive to localise a battery supply chain in the West



Source: Wood Mackenzie Q2 2023

Recycling can supplement traditional supply of raw materials and components, given this is the bottleneck to supply ramp-up

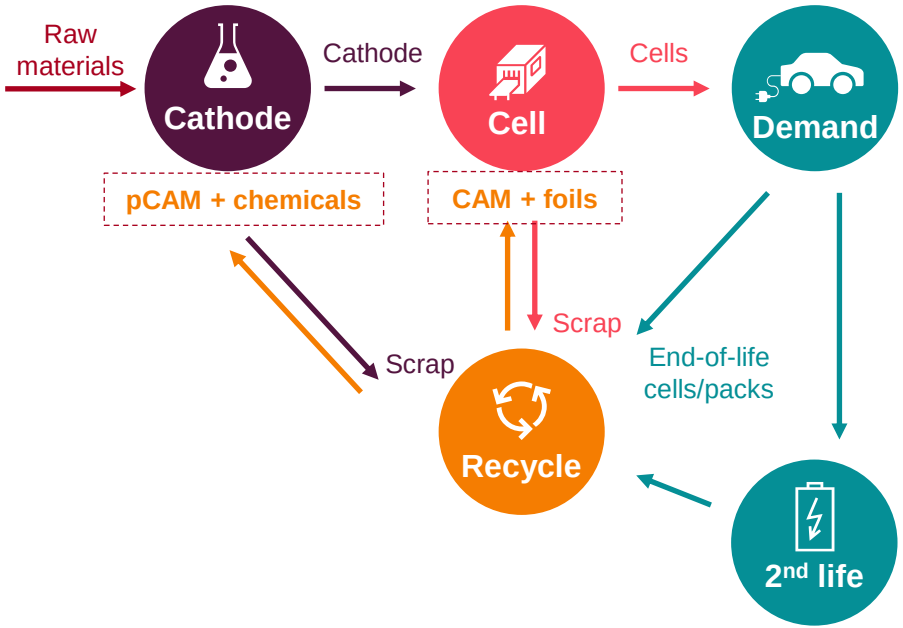
Project lead times



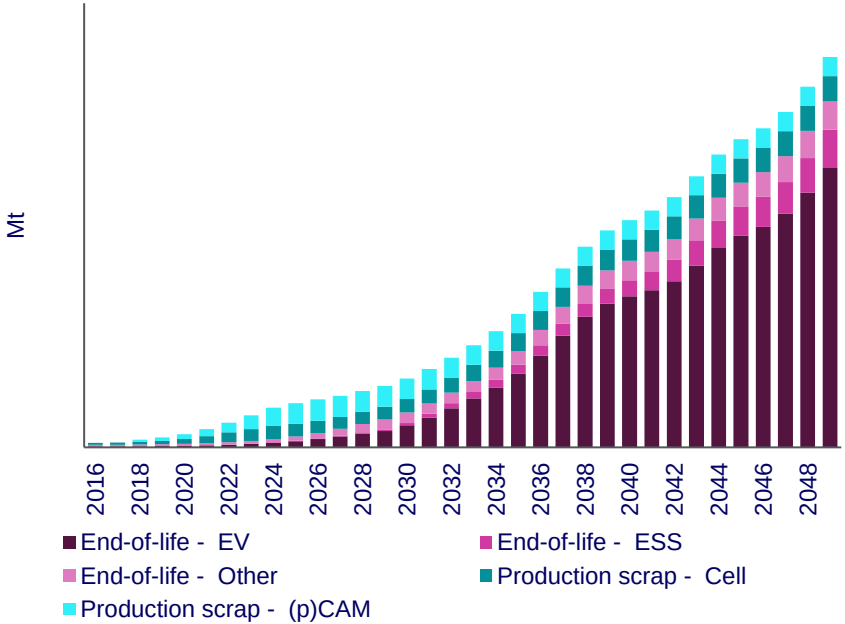
Source: Wood Mackenzie Q2 2023

Surging battery production will provide near-term feedstock through scrap, while end-of-life feedstock will come later

Battery material and recycling flows



Recycling feedstock forecast

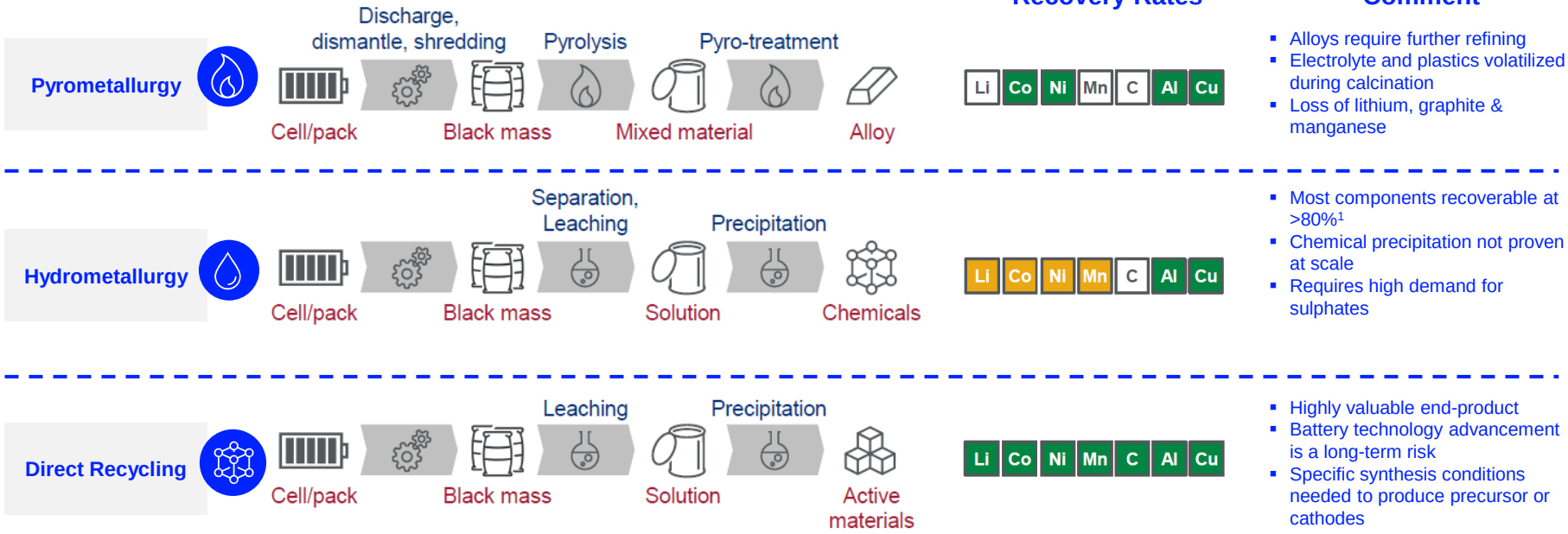


Source: Wood Mackenzie

Source: Wood Mackenzie Q2 2023

Three main Li-ion battery recycling methods – pyrometallurgy is well developed but hydrometallurgy has surged on high lithium prices

Overview of Three Li-ion Battery Recycling Processes



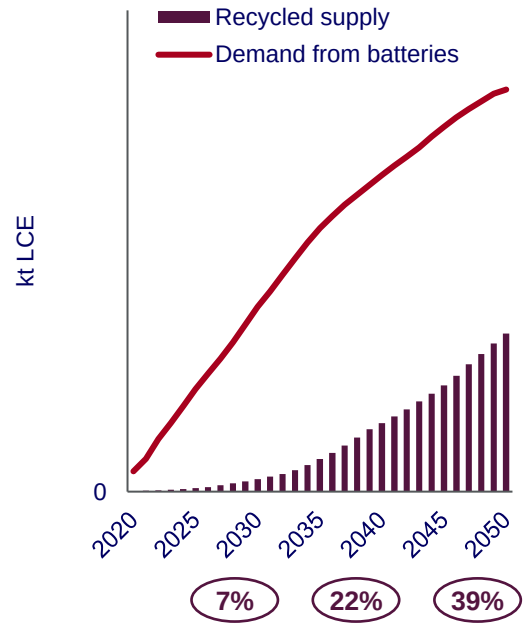
Source: Wood Mackenzie

1. Depending on technology

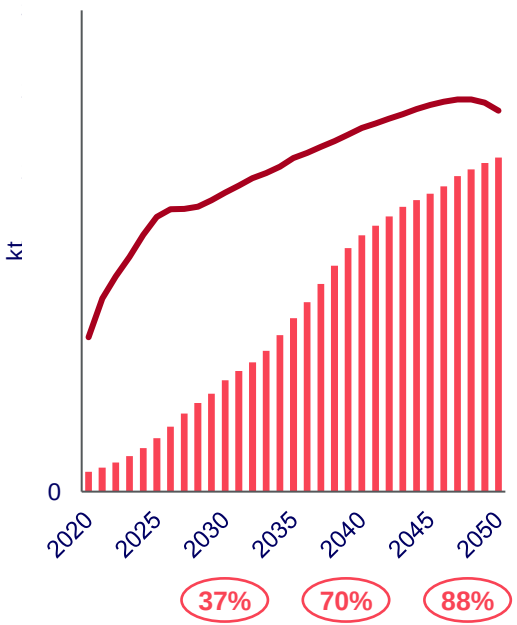
From 2030 recycling is expected to represent a large share of BRM supply to the battery sector, particularly for cobalt and nickel

Secondary supply of raw materials from recycled batteries

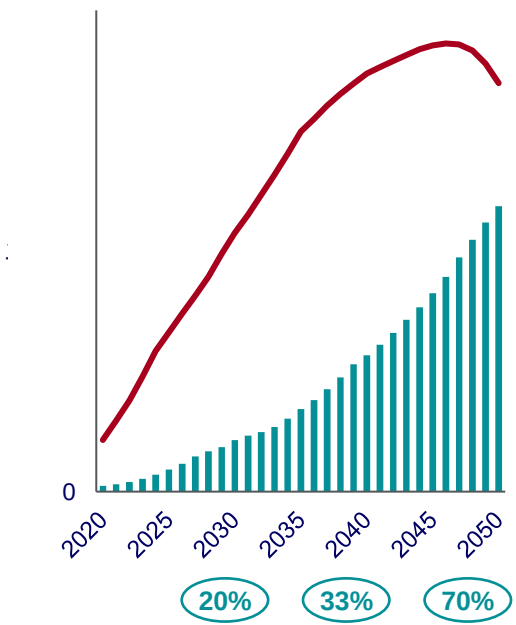
Lithium



Cobalt



Nickel



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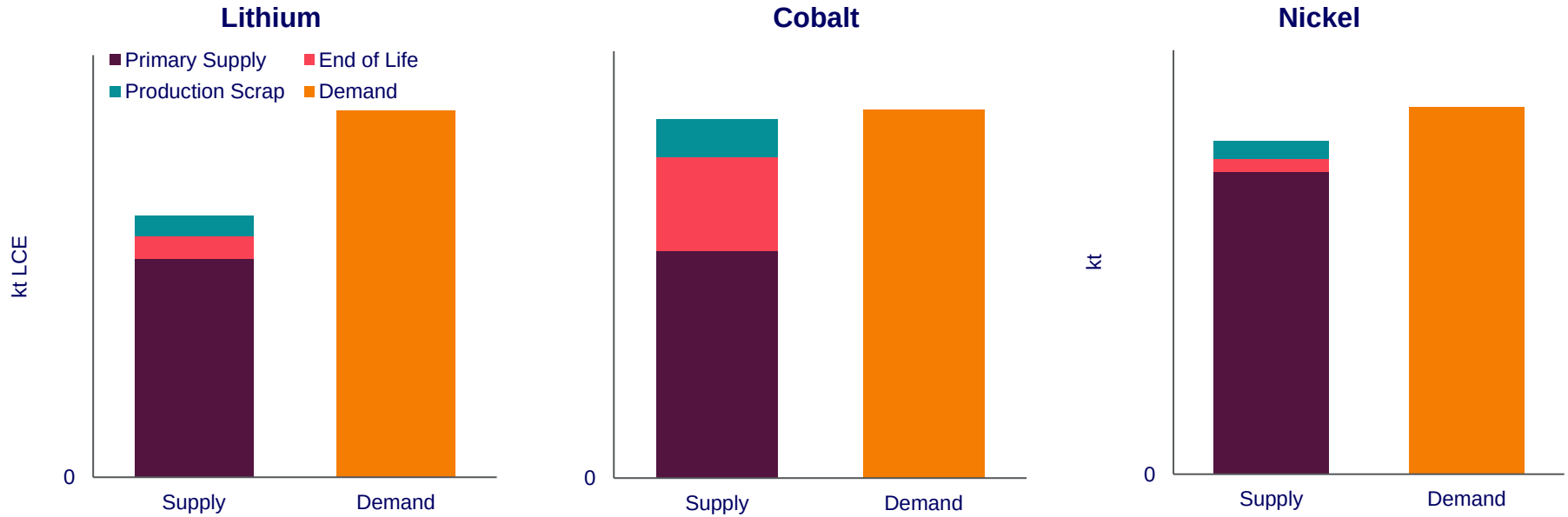
Source: Wood Mackenzie Q2 2023

Even with high forecast recycling rates, BRM supply is expected to fall short of overall demand

Supply and demand for key battery metals in 2035



Deficit in 2035:
29% of demand

Deficit in 2035:
2% of demand

Deficit in 2035:
9% of demand

Source: Wood Mackenzie

Source: Wood Mackenzie Q2 2023

Demand for recycled material expected to grow strongly due to policy, traceability, ESG and carbon reduction trends

Recycled Content Regulations

- EU minimum recycled content requirements from 2030: 85% lead, 16% cobalt, 6% lithium and nickel.
- BRMs recycled in North America eligible for the US IRA EV tax credit.
- In China OEMs are responsible for recycling batteries they sell

Carbon footprint reduction

- EU carbon footprint label on batteries from 2025 and carbon footprint limit from 2027
- Recycling lowers carbon footprint
- Focus on nickel lithium and graphite

Source Traceability

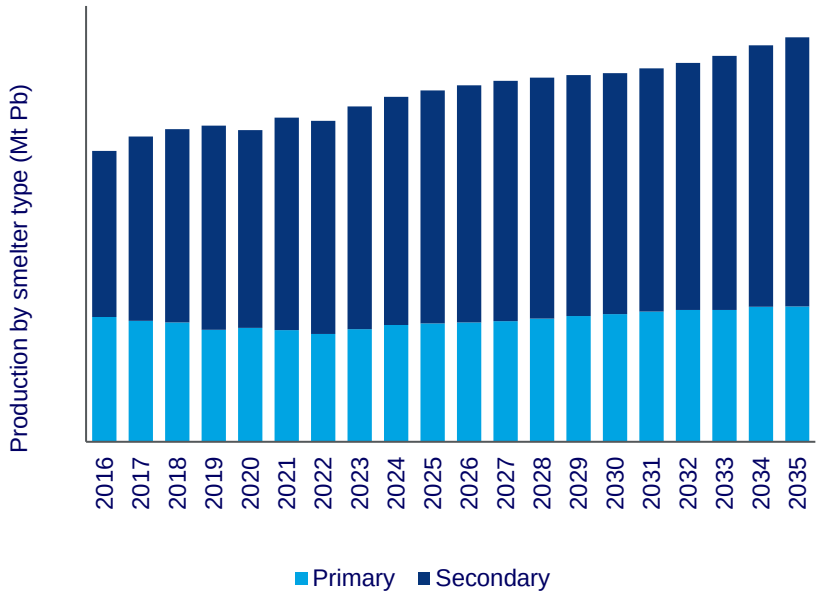
- EU battery digital passports from 2027, BRM sources must be ethically verified
- Sourcing verification methods expected
- Local recycling eases proof of provenance

ESG Factors

- Focus on cobalt recycling due to artisanal mining
- Recycled nickel to combat deforestation
- Recycled lithium to reduce water consumption

Lead-acid batteries (LABs) are the most recycled consumer product globally, current LABs use 80% recycled lead

Lead supply by smelter type

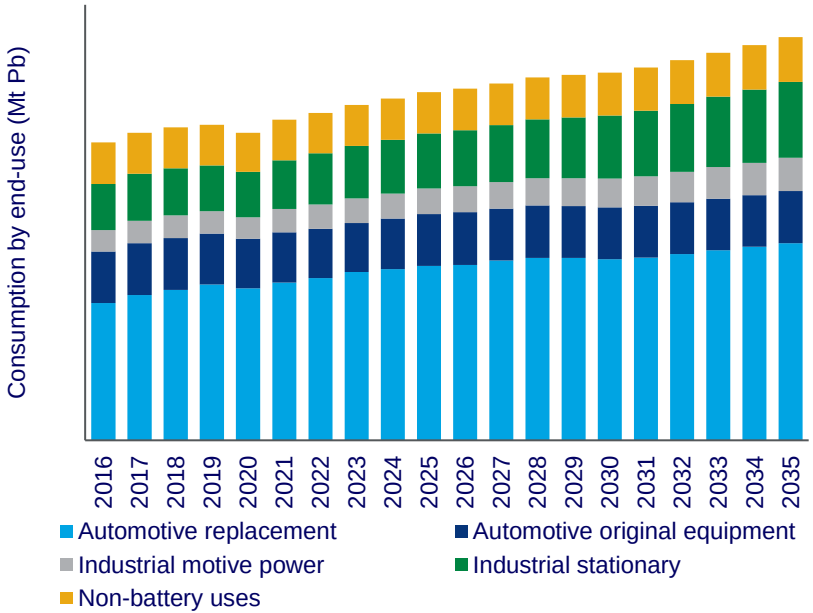


- Trade restrictions for EOL LABs have fostered localised recycling industries
- In Australia secondary lead smelting occurs in every state except WA (though not all from batteries)
- Low lead values in the 90s resulted in cases of poor management of EOL LABs
    - However the recycling industry is now technologically advanced, efficient and clean, a leader in circular economy manufacturing
- Primary and secondary lead is used interchangeably for most applications
    - Yet to see market differentiation between recycled and primary lead products
    - However traceability certification and recycled product premiums could occur in the future

Source: Wood Mackenzie Q2 2023

88% of lead is currently used in batteries, BRM shortages are expected to drive continued demand for LABs for use in EVs

Lead demand by end-use



- Supply shortages and high BRM input prices for Li-ion batteries mean that LABs will continue to be in demand
  - The existing ICE vehicle fleet will continue to require replacement LABs
  - EVs currently use LABs for low-voltage energy requirements such as running the vehicle's computer and radio – requiring ~50% of the lead used in an ICE vehicle
  - LABs have a place in the growing ESS market, given their proven technology and lower cost for weight-agnostic applications
- Mature EOL LAB collection networks are being leveraged for Li-ion battery acquisition
  - LAB recyclers are already moving into Li-ion battery recycling

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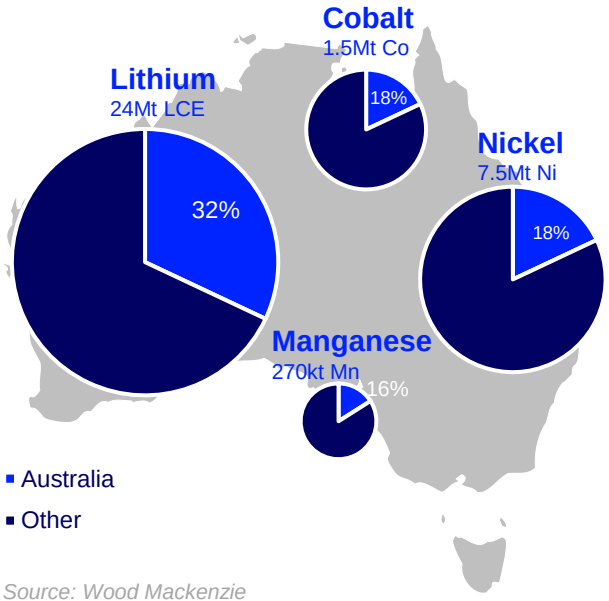
Source: Wood Mackenzie Q2 2023

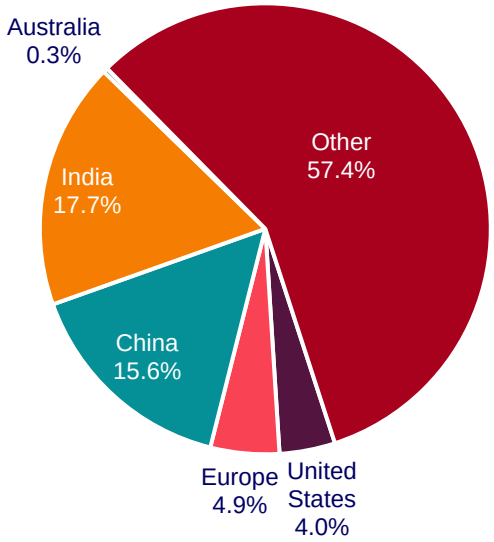
Australia will need to utilise its primary BRM and LAB recycling expertise and innovate to overcome scale challenges

Australian BRM Resources



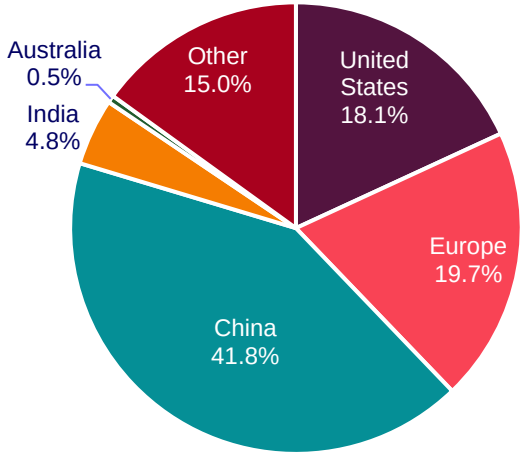
Source: Wood Mackenzie
Note: Lithium and Nickel Reserves 2021, Cobalt and Manganese Reserves 2022

Population 2035



Source: World Bank

EV sales 2035



Source: Wood Mackenzie Q2 2023

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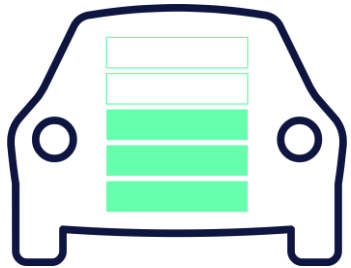
Battery Raw Materials Research Suite

Lithium Research Suite

Market Service
- 2050 forecast horizon
- Near-term outlooks to 2032
- 10+ first-use & end-use segments

Cost Service
- 150 assets costed
- 100+ companies covered
- 10 years forecast horizon
- Industry cost curves & analysis on multiple metrics & structures



Nickel Research Suite

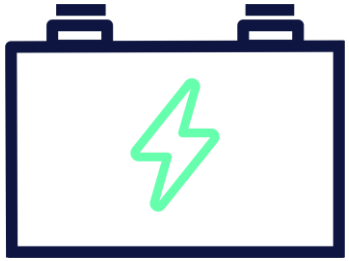
Market Service
- 2050+ forecast horizon
- Nickel sulphate analysis
- Short-term outlooks

Cost Service
- 175 assets costed
- 120 companies covered
- Operating costs from 1992 to 2040
- Quarterly report on 175 projects & operations
- Industry cost curves & analysis on multiple metrics and structures

Cobalt Research Suite

Market Service
- 2050 forecast horizon
- Near-term outlooks to 2032
- 30+ first-use and end-use segments

Cost Service
- 60+assets costed
- 40+ companies covered
- 2040 forecast horizon
- Industry cost curves & analysis on multiple metrics & structures



Graphite Research Suite

Market Service
- 2050 forecast horizon
- Near-term outlooks to 2032
- 10+ market segments
- 40+ countries covered
- Prices for 10+ graphite products including flake concentrates & battery-grades intermediates

Electric Vehicle & Battery Supply Chain Service

The most comprehensive industry analysis of the supply chain for electric vehicles and battery materials, designed to help you:

- Understand future supply trends of existing mines, processing and refining facilities, and future projects.
- Predict battery and metals demand.
- Analyse trade flows and patterns for intermediate and finished products.
- Evaluate new growth opportunities in the battery materials sector.
- Leverage our price forecast for benchmark and ‘battery grade’ metals.

Source: Wood Mackenzie Business

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