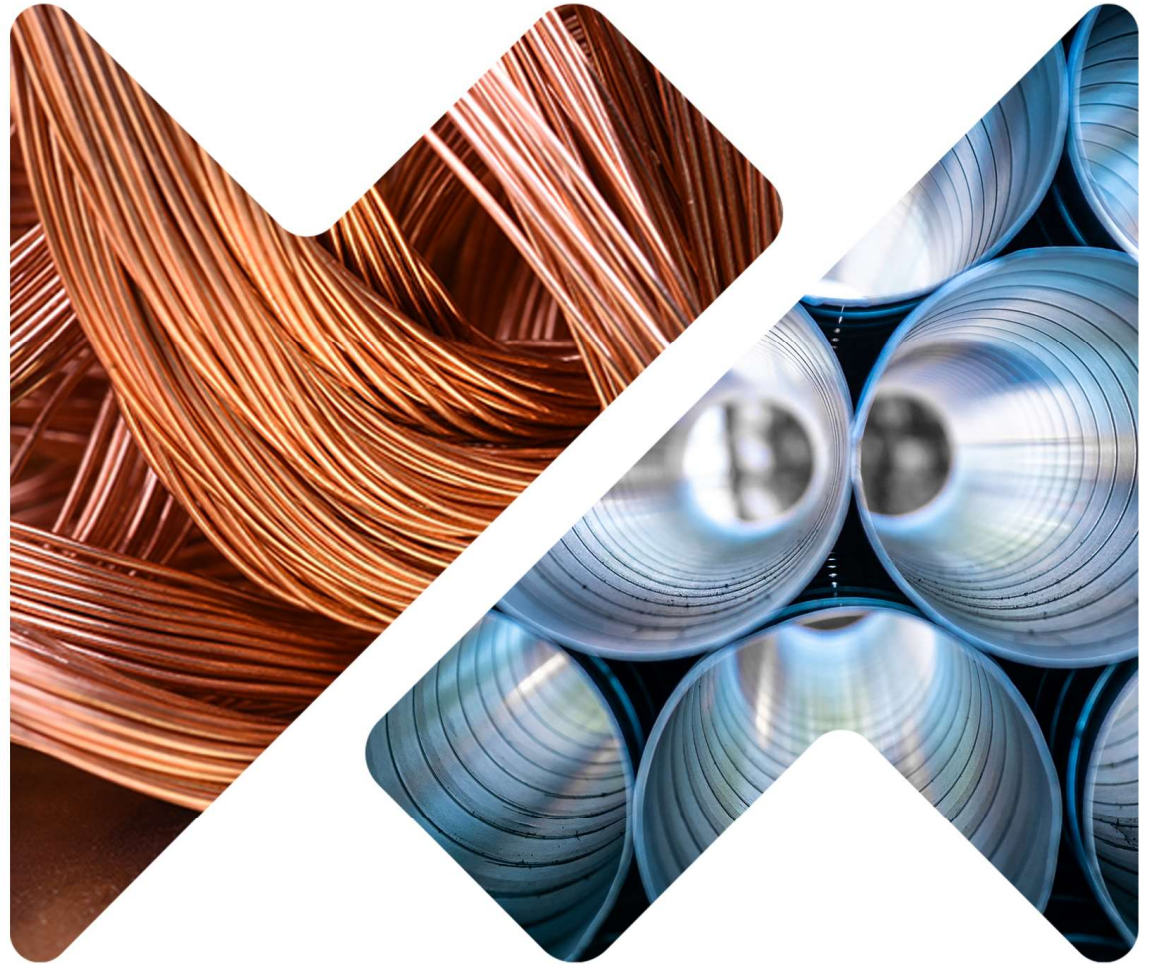


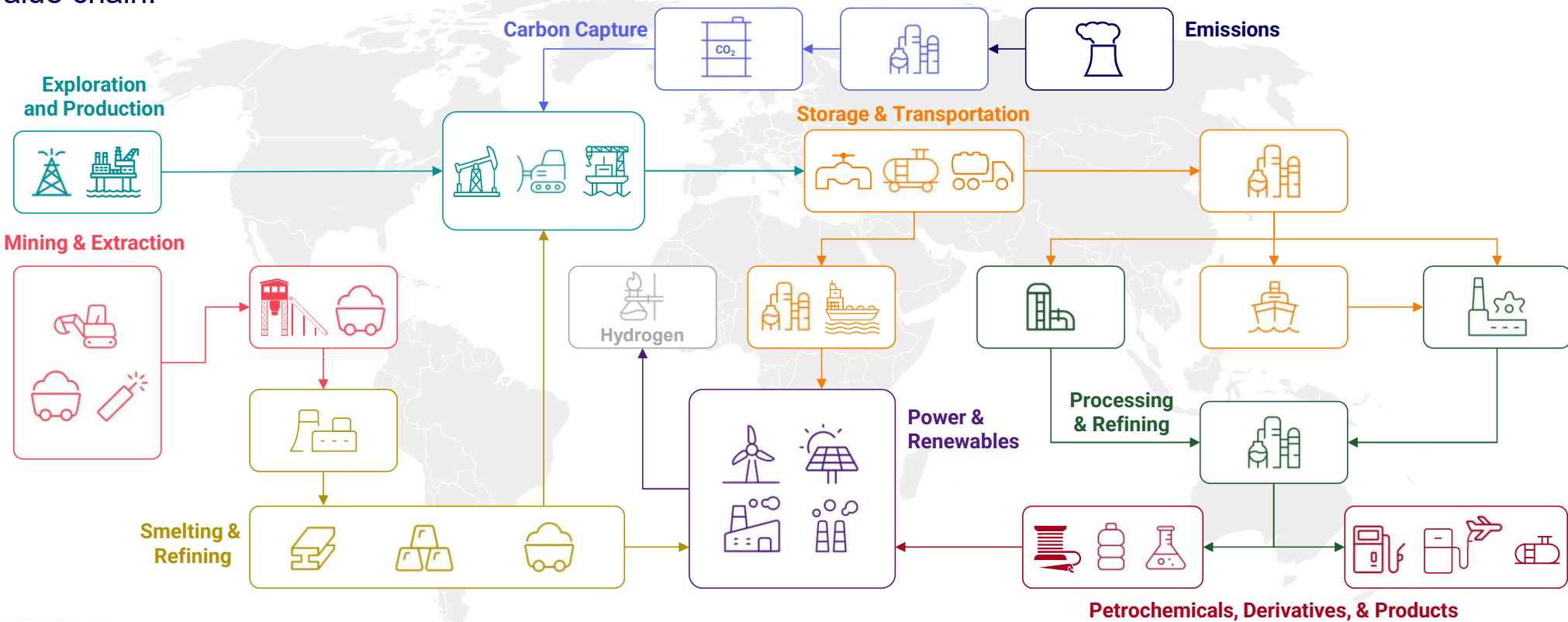
# The five pillars of the energy transition: Where do metals fit in?

Rowena Gunn



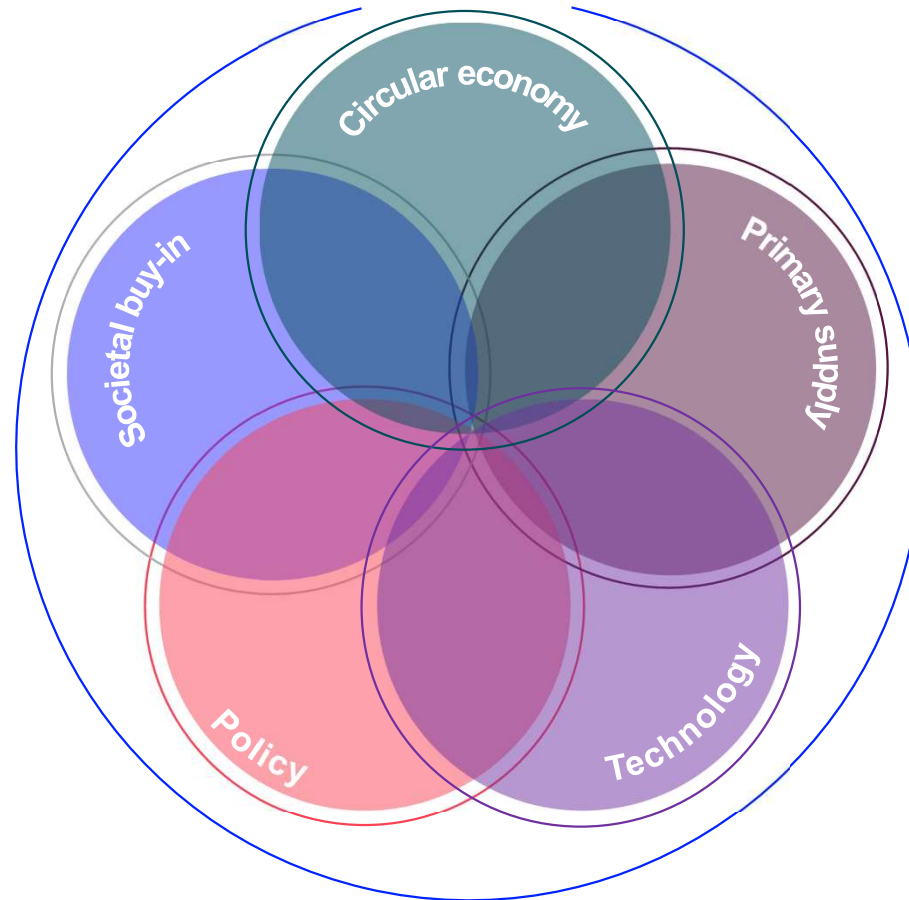
# Wood Mackenzie: your industry is our business

Wood Mackenzie provides market, asset, and corporate data and analysis across the global natural resource value chain.



## The five pillars of the Energy Transition

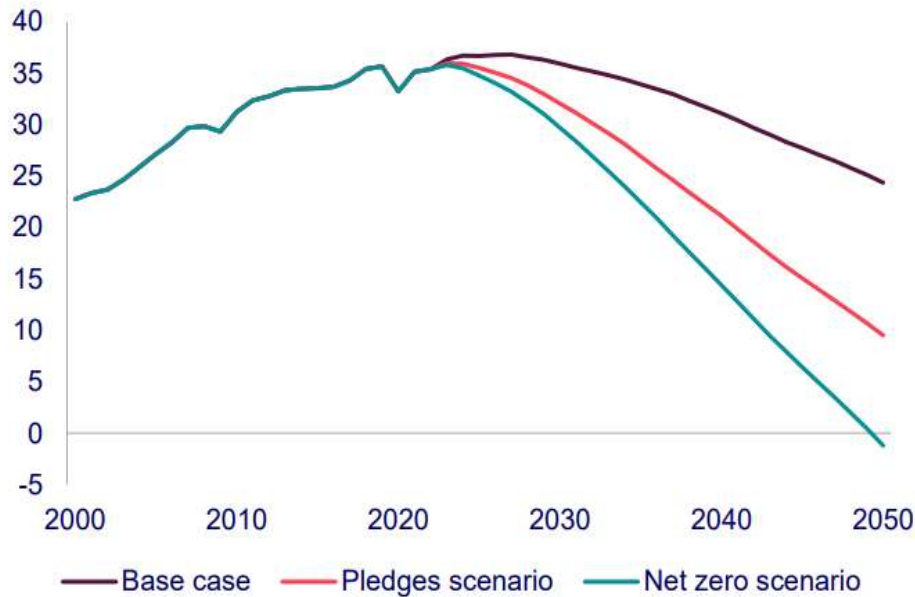
Is net zero probable, possible or .....(you can think it but can't say it !)



# Is achieving net zero even possible? Hope is not a strategy

The world needs to reach net zero before 2050 to meet the most ambitious goals of the Paris Agreement

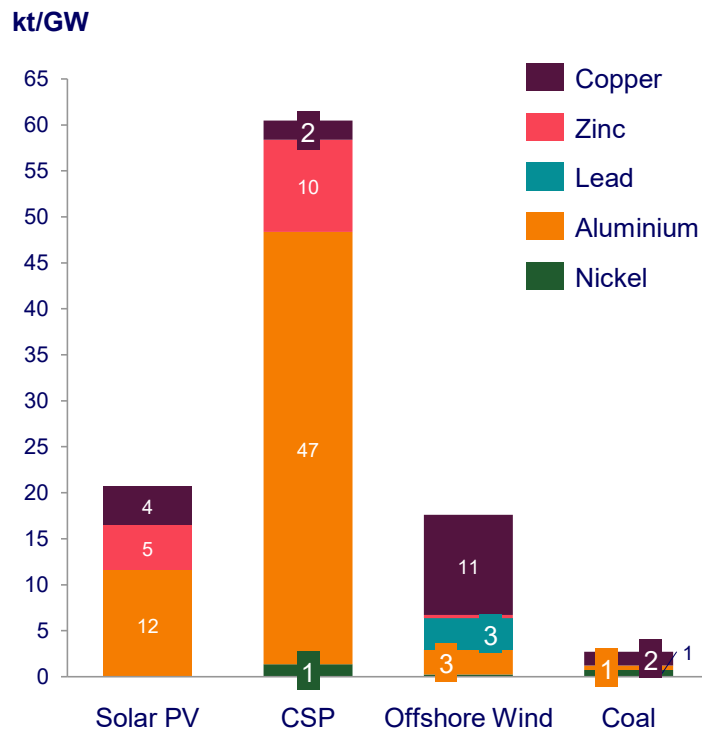
**Global energy-related CO<sub>2</sub> emissions, Bt**



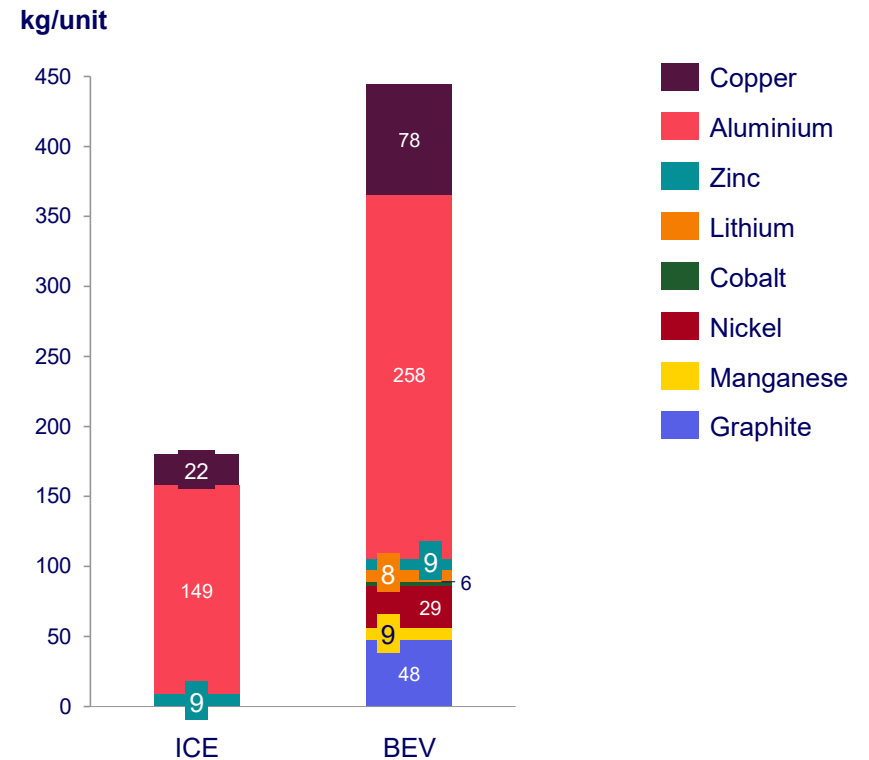
Scenario	Trajectory	Policy	Enablers
<b>Base Case (ETO)</b>	Consistent with 2.5 °C global warming	Evolution of current policies	Steady advancement of current and nascent technologies
<b>Pledges Scenario (AET-2)</b>	Consistent with below 2 °C warming (Global net zero by 2060)	Aligned with NZE pledges announced in the run up to COP28	Incorporates policy response to the current energy crisis, and geopolitical challenges facing global economy
<b>Net zero 2050 scenario (AET-1.5)</b>	Consistent with 1.5 °C warming (Global net zero by 2050)	Aligned with most ambitious goal of Paris Agreement	Early peak energy; rapid hydrogen and carbon removal deployment; consumer shift

Metal intensities for low carbon power and transportation massively increase our exposure to minerals that are strategic and *may* be critical ...

### Base metals used in clean energy technologies



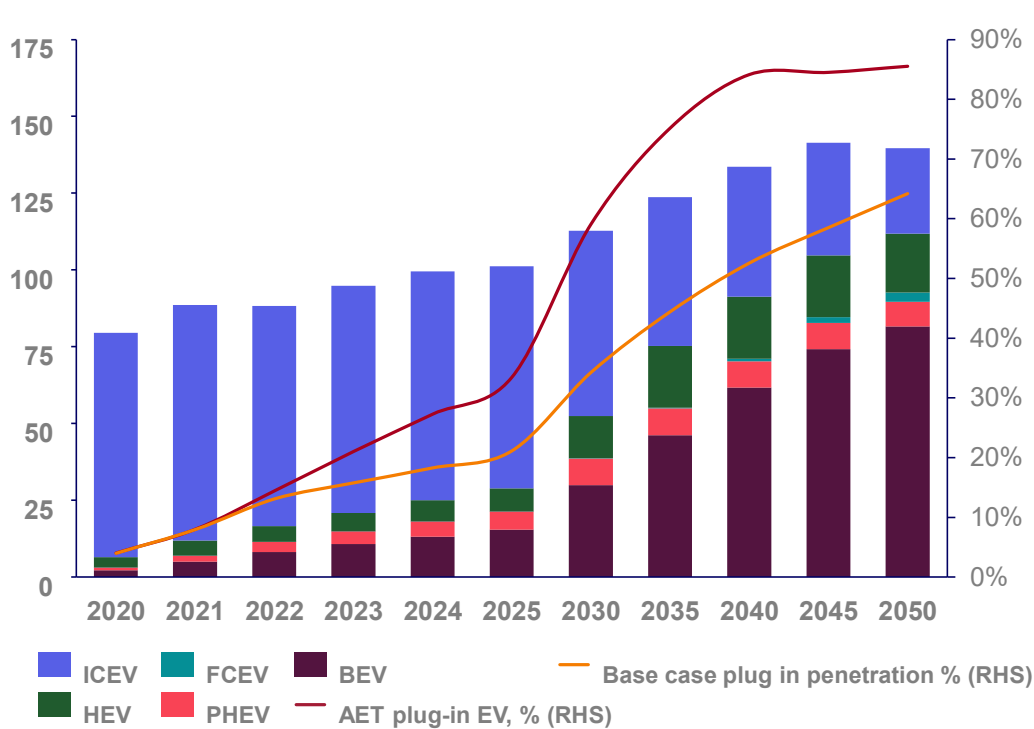
### Metals used in passenger ICEs and BEVs



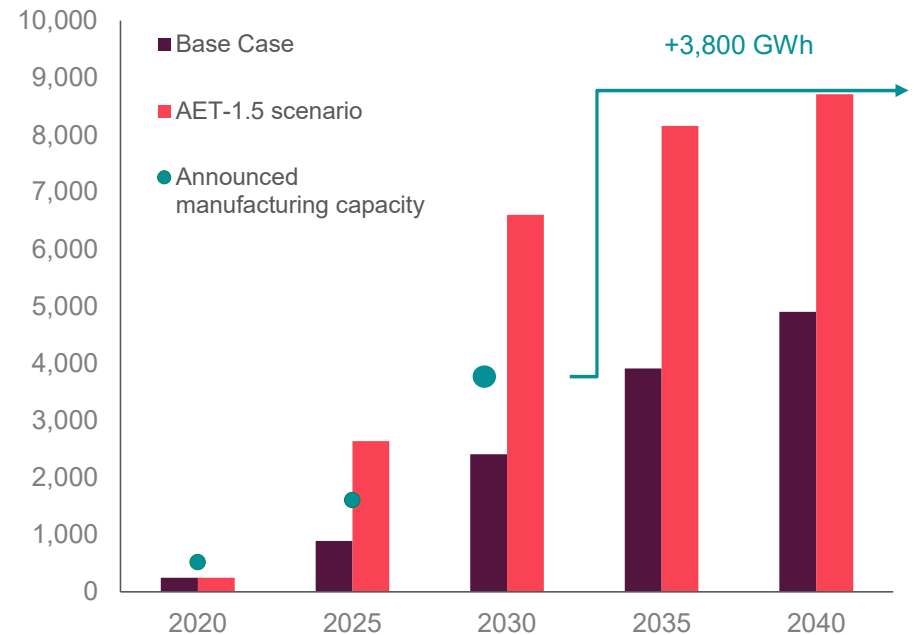
# Plug-in EV penetration reaches 60% by 2030 in a net zero world...

Placing more pressure on metals supply.

### Automotive sales by powertrain, M units



### Lithium-ion battery demand (GWh)

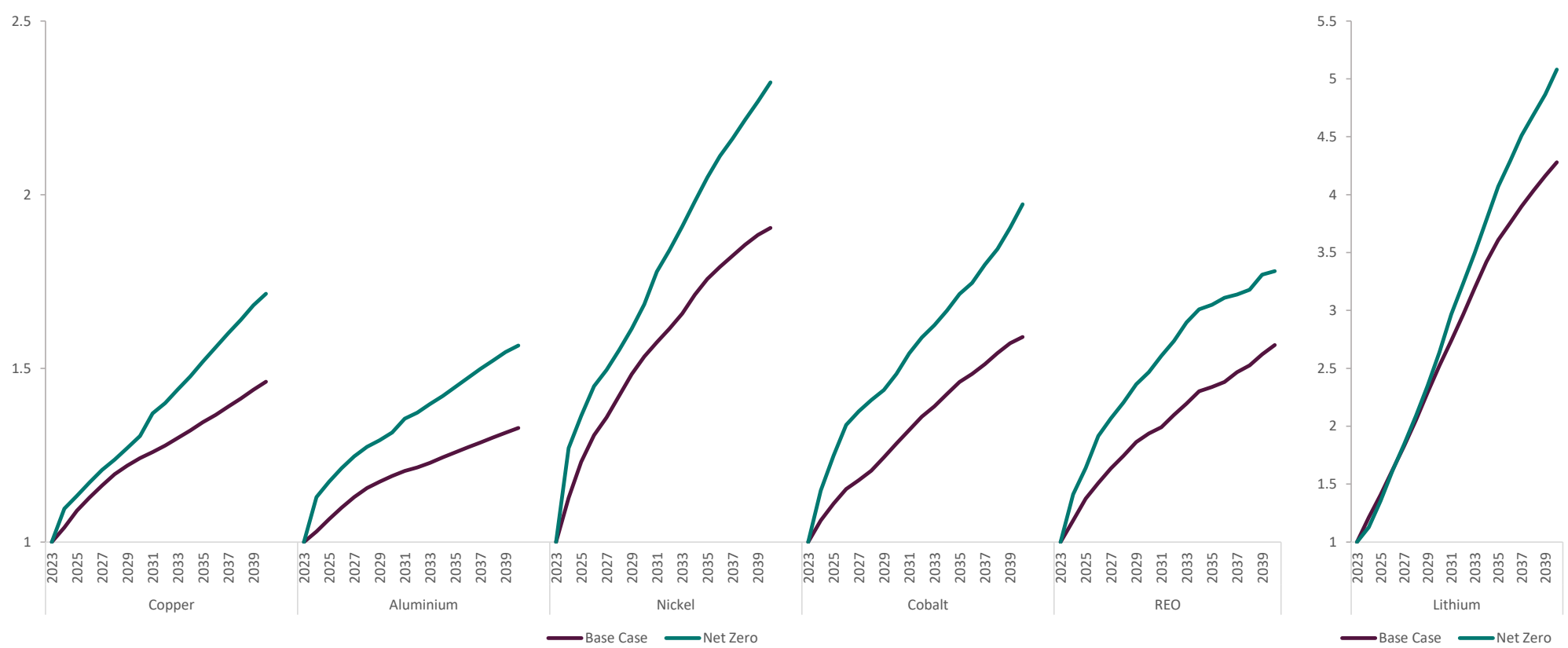


Abbreviations: ICE – internal combustion engine; FCEV – Fuel cell electric vehicle; BEV – Battery electric vehicle; HEV – Hybrid electric vehicle; PHEV – Plug in hybrid electric vehicle

## Additional burden on base metals and BRMs

Even under our base case - 2.5 degree warming scenario - demand increases will put pressure on supply.

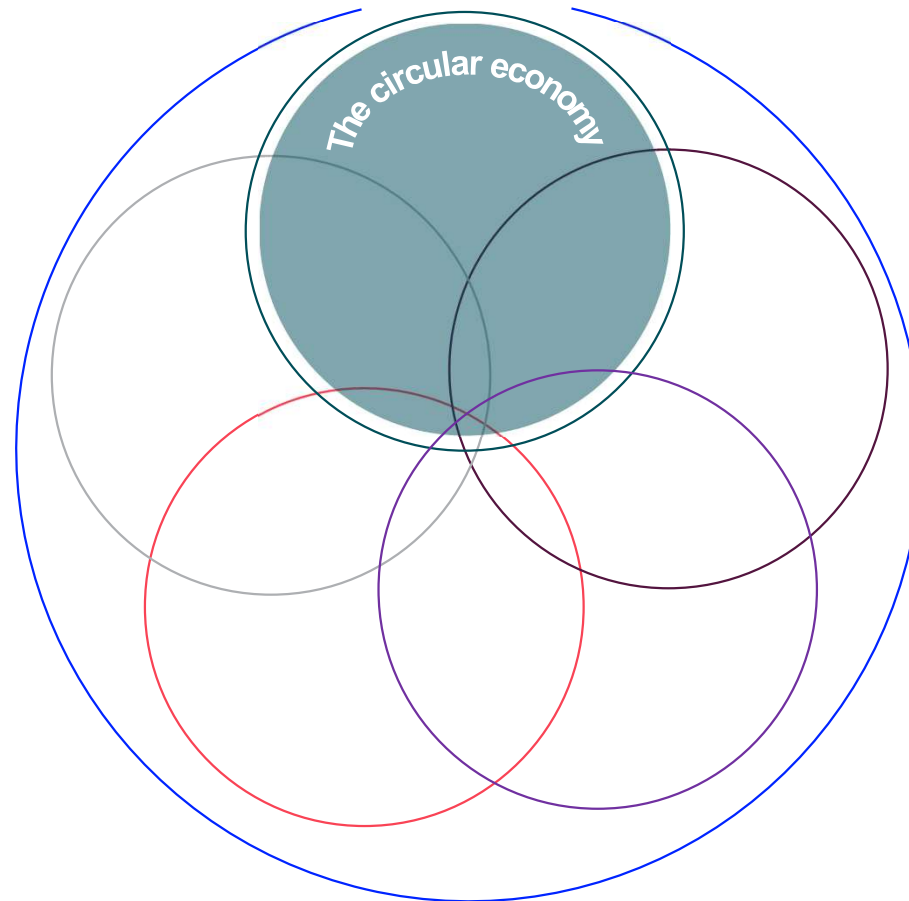
Demand for mined metal: ETO versus net zero – indexed to 2023



# The five Pillars of the Energy Transition: #1 The circular economy

## Enablers:

**Policy**  
**Societal attitude to Waste**  
**Economics**  
**Reduces the need for primary**  
**Lower carbon footprint**  
**Reduced waste**  
**Strategic “home grown” supply**



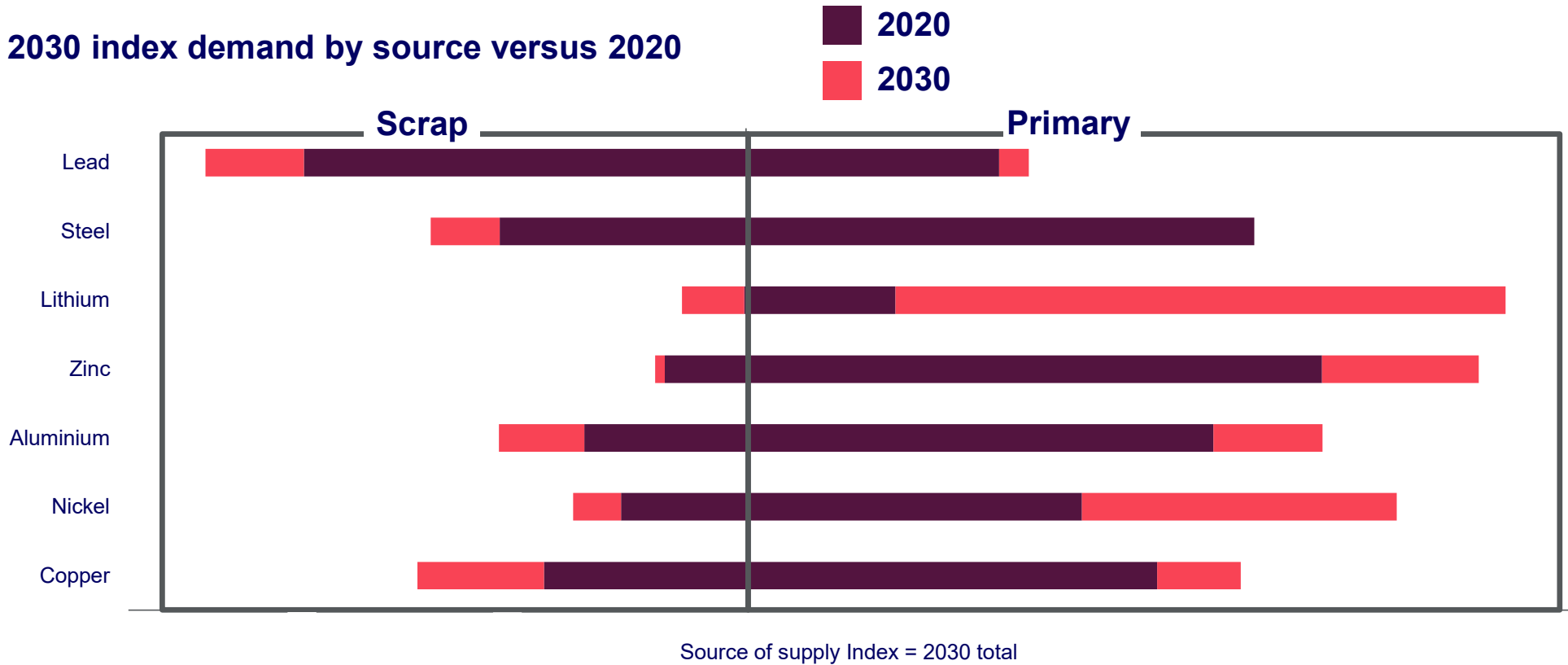
## Impediments:

**Inefficient collection**  
**Degradation/contamination**  
**Technical first use # second use**  
**Costs**  
**Policy**  
**Society**



## How important is scrap as a source of supply?

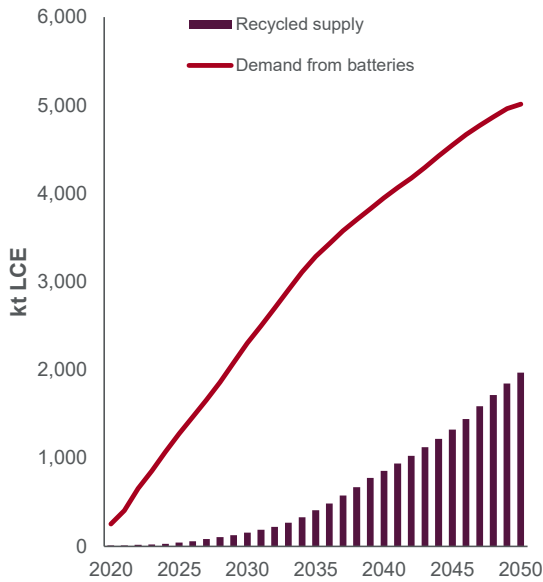
Lead, steel, lithium, aluminium, and copper all see scrap share outpacing primary



# End of life feedstock doesn't impact commodity markets until the 2030s

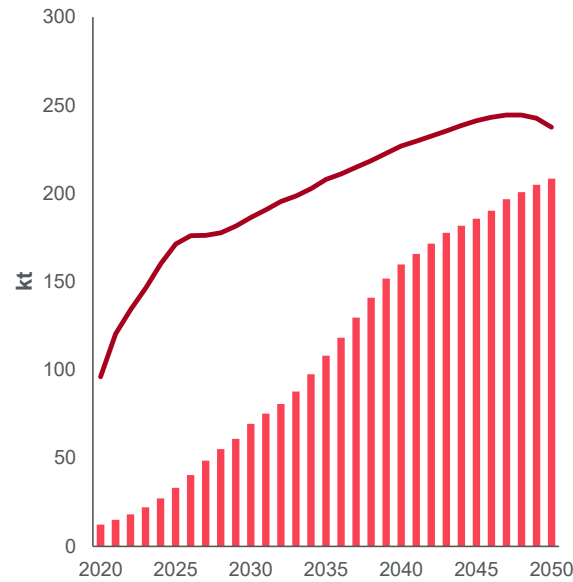
Recycled batteries will NOT materially change the need for primary investment this cycle or next

## Lithium



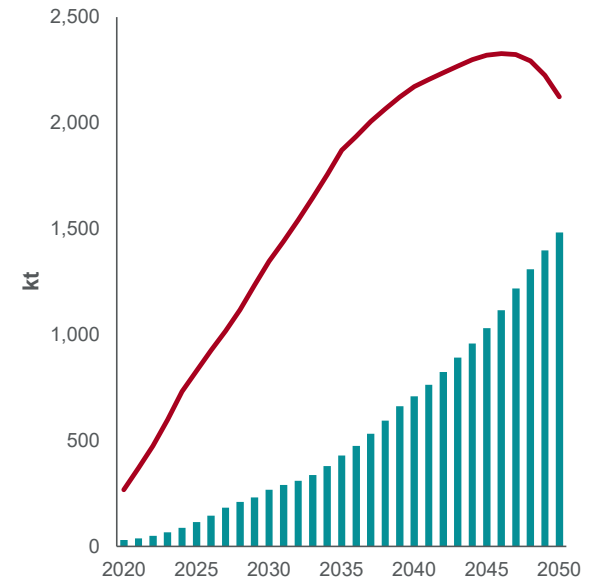
7%      22%      39%

## Cobalt



37%      70%      88%

## Nickel

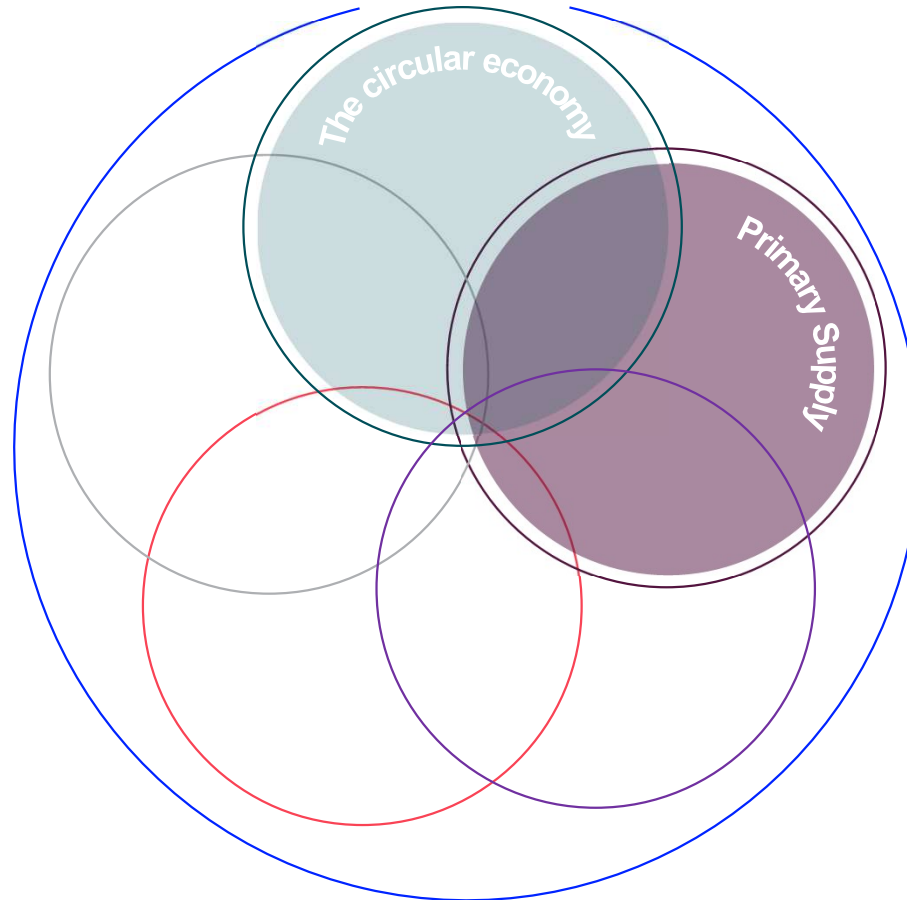


20%      33%      70%

# The five Pillars of the Energy Transition: #2 Primary Supply

## Enablers:

- Demand growth assured
- More primary supply necessary due to grade decline and depletions
- Lack of scrap material means primary supply is the only solution
- Many uses can only utilise primary metal



## Impediments:

- Shareholder reluctance
- Focus on decarbonisation spend
- Project returns
- Wrong price signals
- Risk appetite
- Lack of advanced projects
- Policy
- Society

# Potential shortages develop unless \$200bn is invested in supply by 2030

Does supply rise or demand fall to balance the market ?

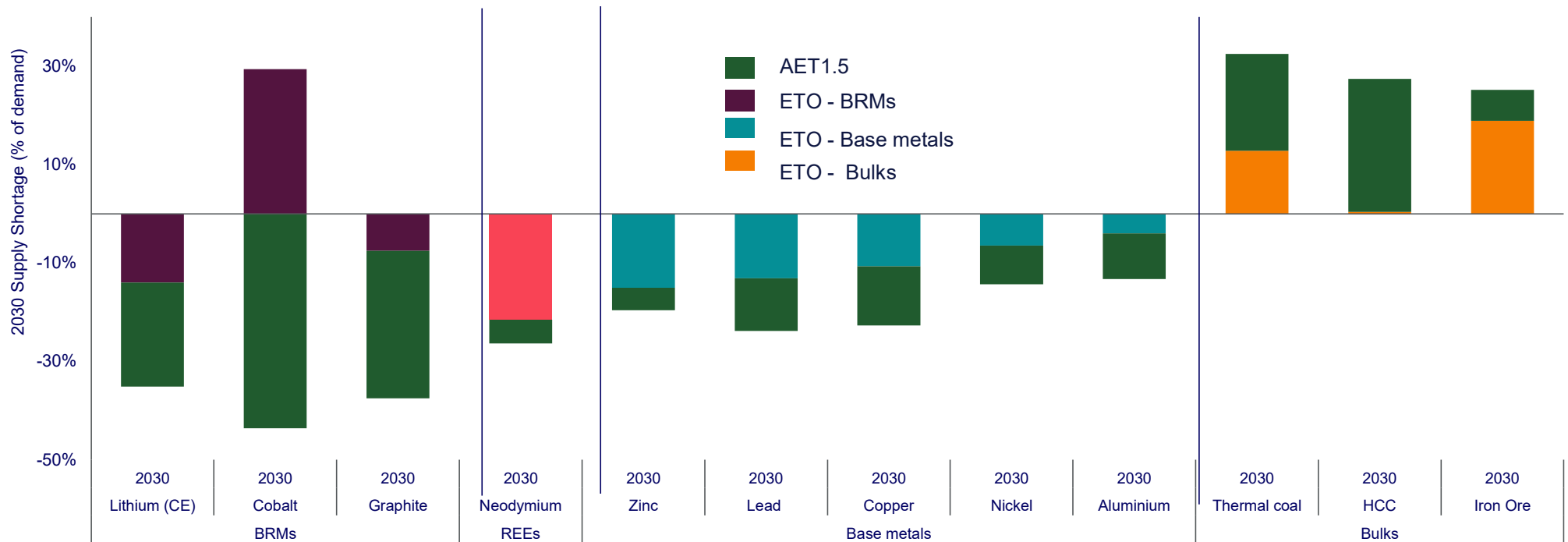
Committed primary supply versus demand in 2030 – 2.3°C Base Case (difference shown as % of demand)



## An AET 1.5 °C trajectory places extraordinary pressure on metals supply

A massive challenge for the metals industry to develop projects due to: lead times, investor dividends and ESG compliance.

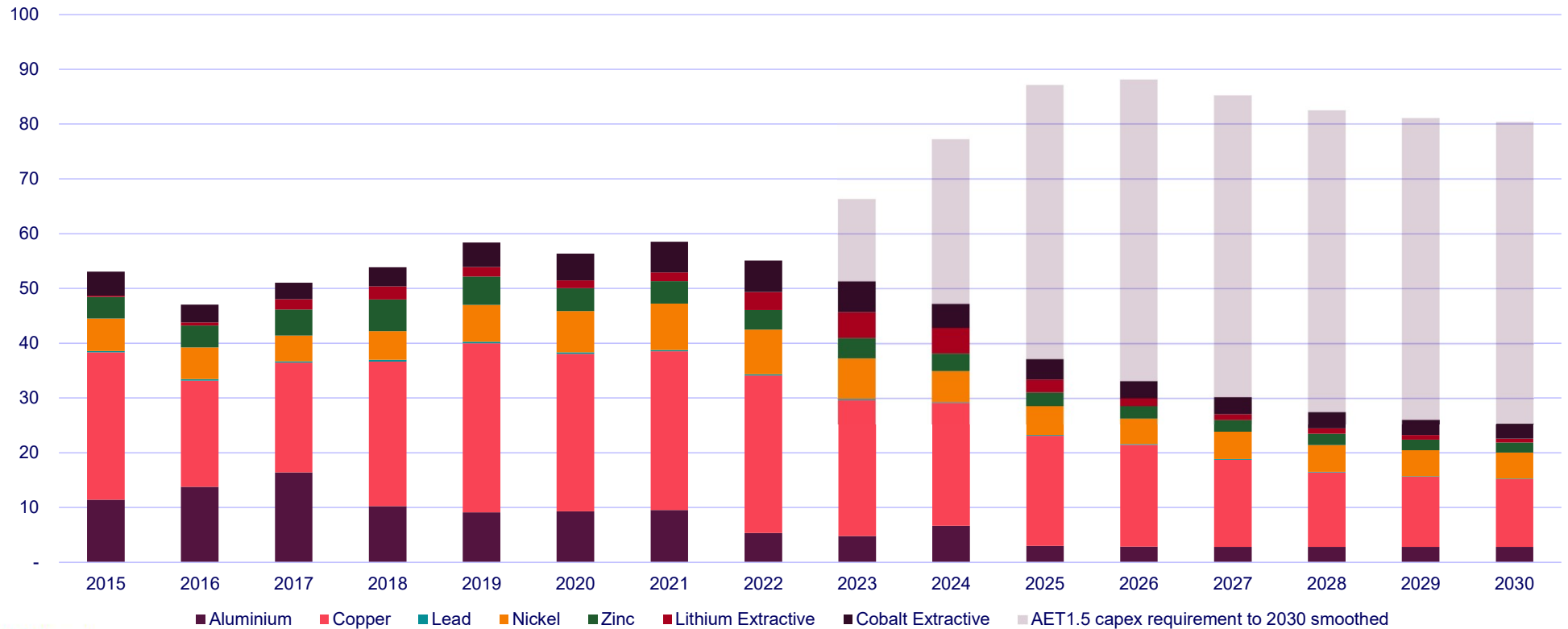
**Committed supply versus demand in 2030 – ETO & AET1.5 scenario (difference shown as % of demand)**



## Is the net zero banking alliance helping the industry grow?

Free cashflow being used for shareholder distribution and decarbonisation. If metals are truly “critical” the focus needs to shift from IRR/NPV to delivery requiring government intervention and new sources of capital.

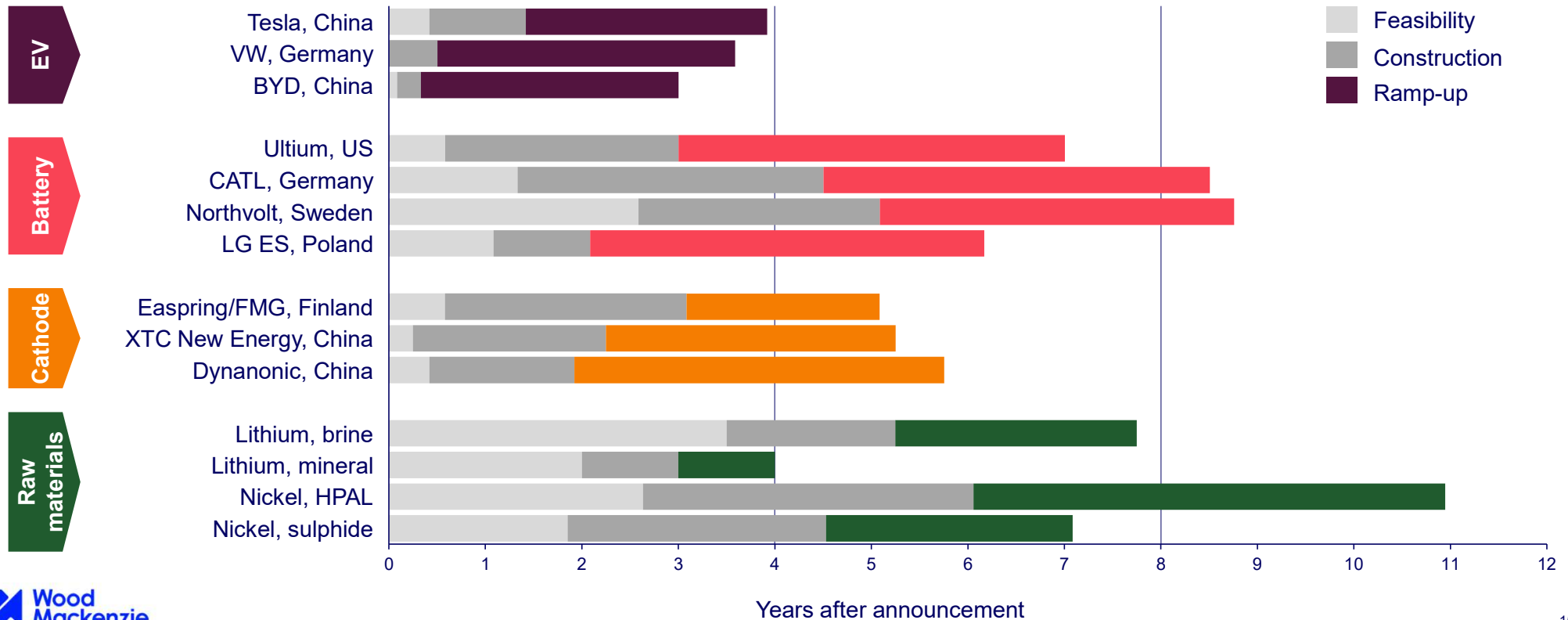
### Global Metals investment Capex (\$Bn)



# The development of mining and refining is *the* rate determining step in the supply chain

Lead times throughout the supply chain are too long for and rapid shifts in production. Battery and cathode factories take several years to build and many more to reach nameplate capacity, while new supply projects have lengthy feasibility times

## Project lead times



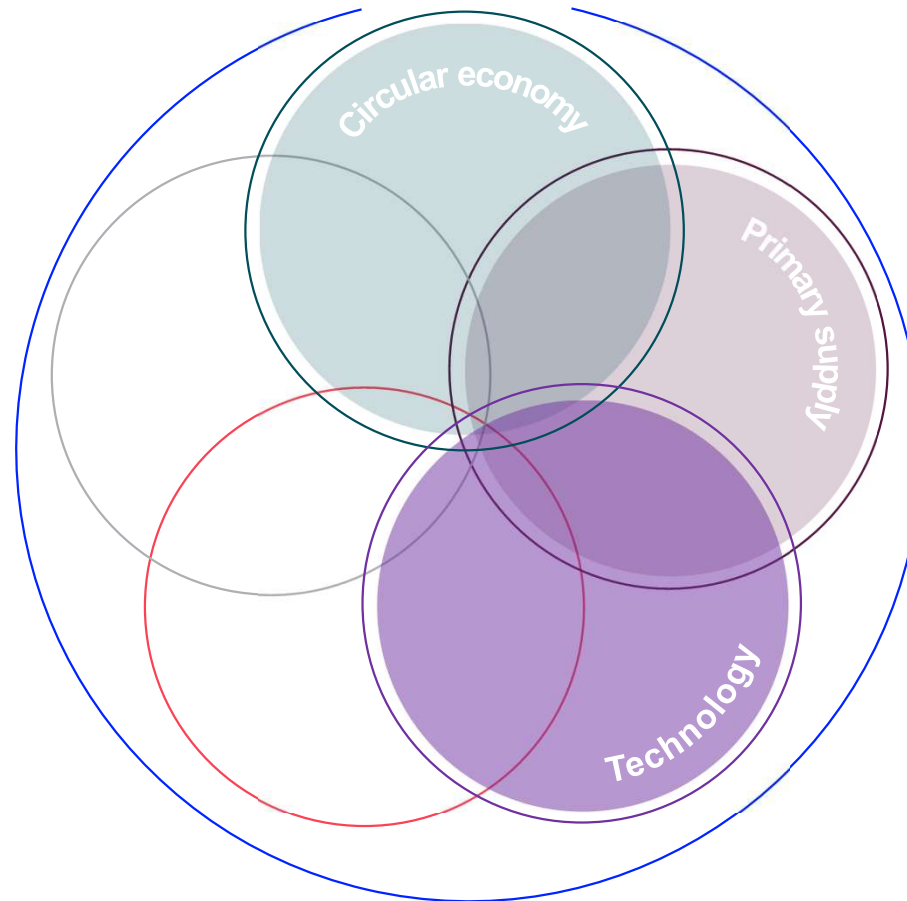
## The five Pillars of the Energy Transition: #3 Technology

### Enablers:

Drive for higher energy density  
Need to reduce reliance on critical commodities and sources of material  
Economic

### Mining technology:

- Improves productivity
- Improves recovery
- Reduces capex
- Reduces opex



### Impediments:

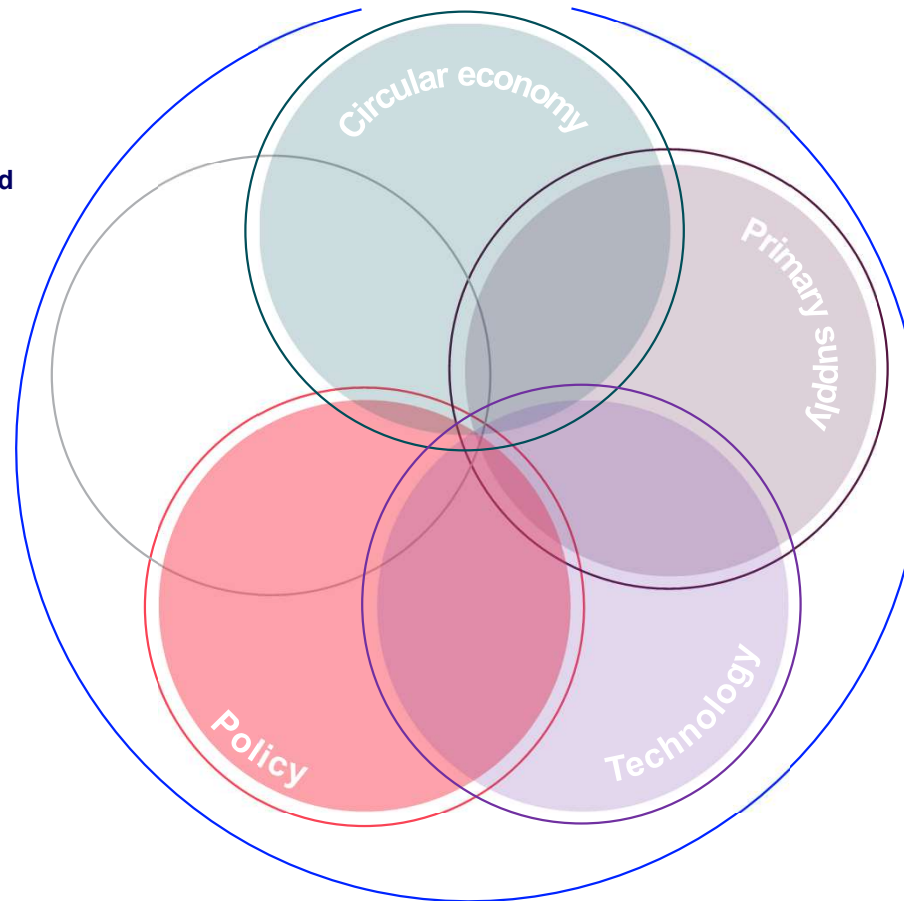
Timescales to commercialize  
Reliance on China  
Knowledge transfer  
Technology transfer  
Capex requirement  
Project returns  
Policy



## The five Pillars of the Energy Transition: #4 Policy

### Enablers:

**COP Framework**  
Some societies want a low carbon world  
driving local policies  
**Autocracies**



### Impediments:

**Political cycles (democracy)**  
**Lack of global alignment**  
**Countries moving at different speeds**  
**Concerns around a “Just” transition**  
**Who pays?**  
**Changing/inconsistent regulatory environment**  
**Royalty/taxation regime**  
**Permitting**  
**Developed World Legacy**  
**Society Pledges # policy**  
**Covid-19 Debts**  
**The economic cycle**  
**Skills shortage**

# China holds a dominant position in the electric vehicle supply chain



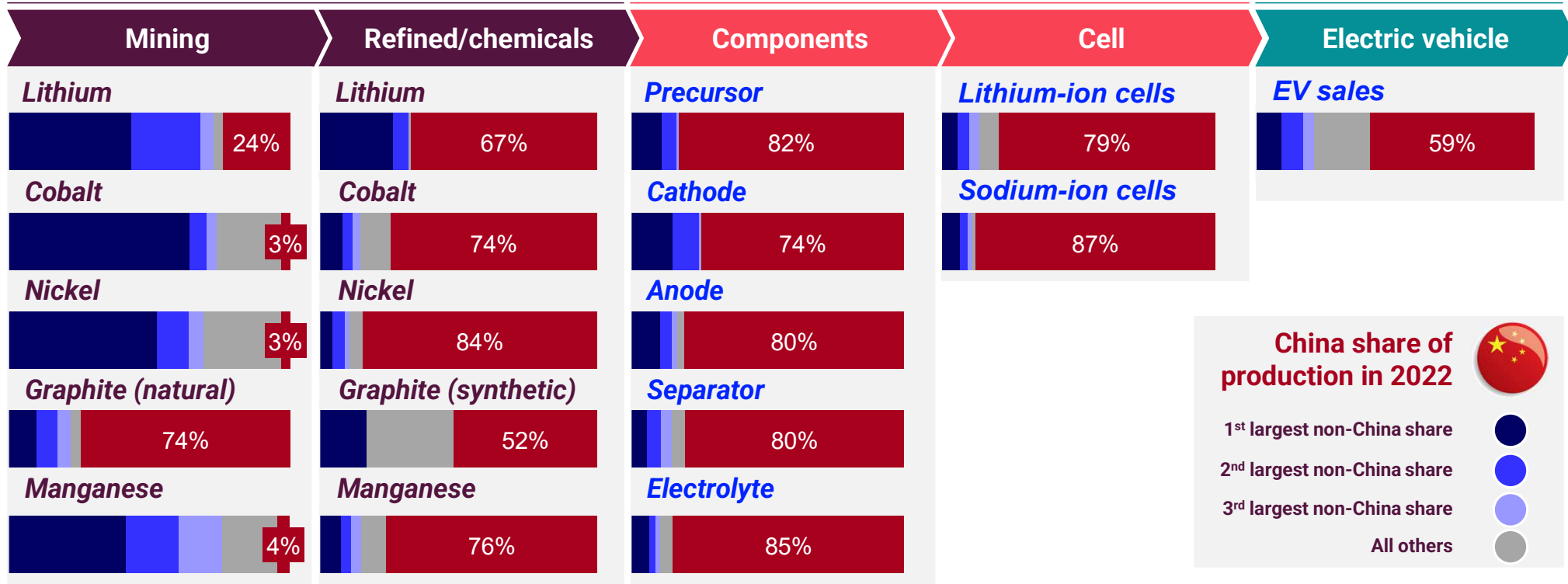
## Raw Materials



## Manufacturing



## Sales



### China share of production in 2022



- 1<sup>st</sup> largest non-China share
- 2<sup>nd</sup> largest non-China share
- 3<sup>rd</sup> largest non-China share
- All others

# Focus on critical and strategic minerals policies and establishing partnerships

This could diversify supply chains but also restrict raw material availability

## Canada: Critical Minerals Strategy 2022

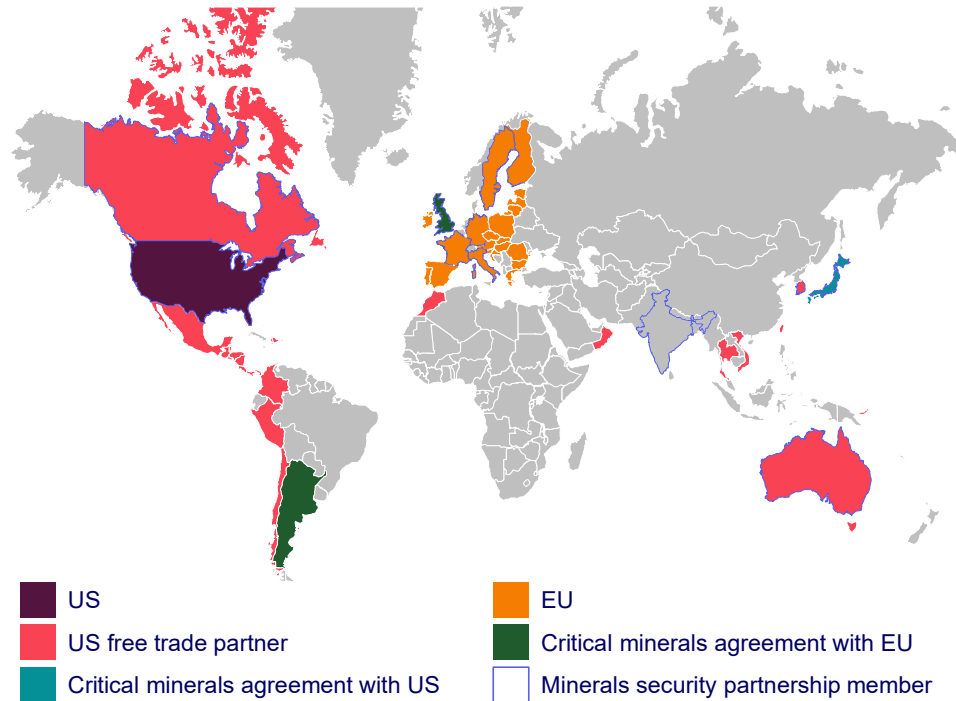
- C\$4bn in funding, C\$1.5bn critical minerals fund
- CMMP sets framework
- Focus on primary supply..

## US: IRA – Inflation Reduction Act 2022

- \$379bn funding for supply security
- Section 30D: Clean Vehicle Credit
- Section 45X: Advanced manufacturing production credit
- 40% emissions reduction by 2030

## EU: Critical Minerals Strategy 2023

- Focus on sustainability & circularity
- Green Deal: Streamlined regulation
- Raw Materials: Content benchmarks
- CBAM 2026, Battery regulation: domestic sourcing, recycled content and carbon footprint



## China

- Fully dominates global production of many critical raw materials at different stages of the value chain.

## Japan & South Korea

- Stockpile strategies for some metals
- Mid & downstream processing investment
- Investment in overseas primary supply.

## Australia: Critical Minerals Strategy 2022

- Focus on expanding mid/downstream processing.
- A\$4bn to promote midstream and critical minerals extraction

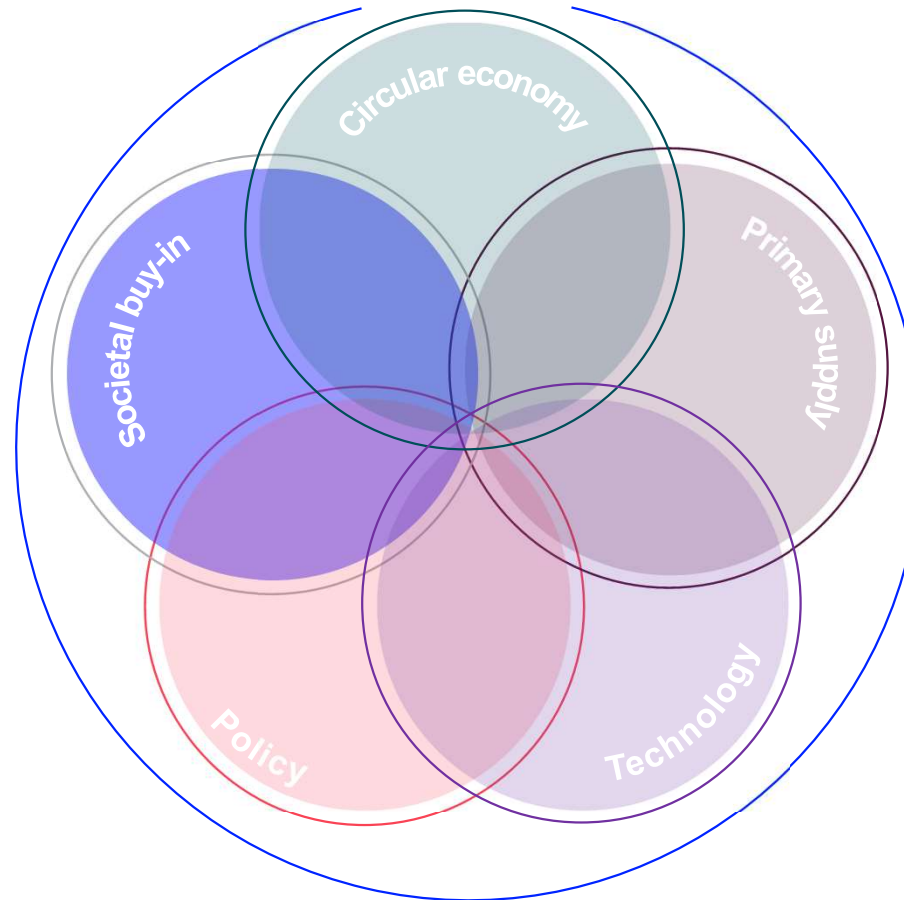
## Minerals Security Partnership

- Collaboration between 13 countries and the EU to catalyse investment in responsible critical mineral supply

## The five Pillars of the Energy Transition: #5 Society

Enablers:

?

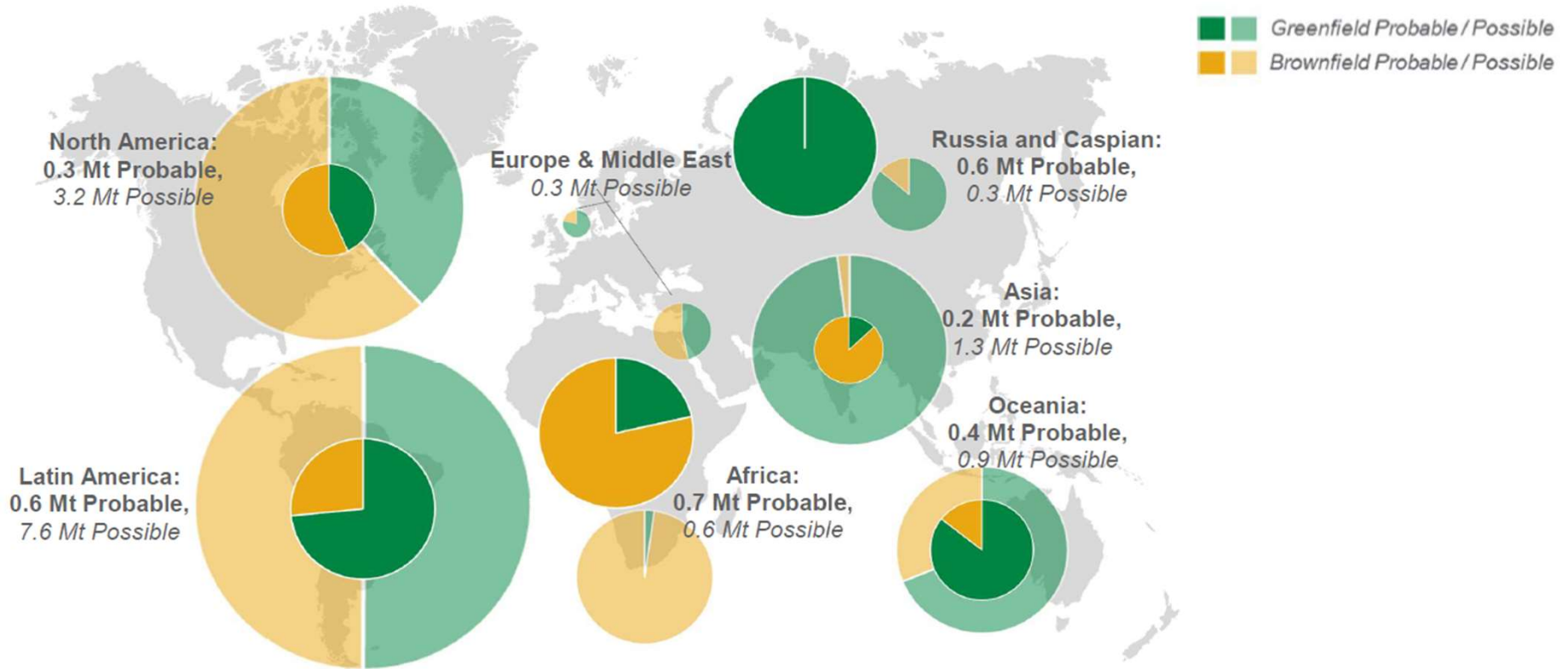


Impediments:

- Mining has a legacy of poor environmental performance**
- Mining is seen as the problem not the solution**
- Lack of understanding driven by NGO's, Social Media and lack of fact checking**
- We don't shout about our successes**
- Lack of industry promotion**
- Rising ESG awareness**
- Society is anti-mining and processing**
- Bananaism**

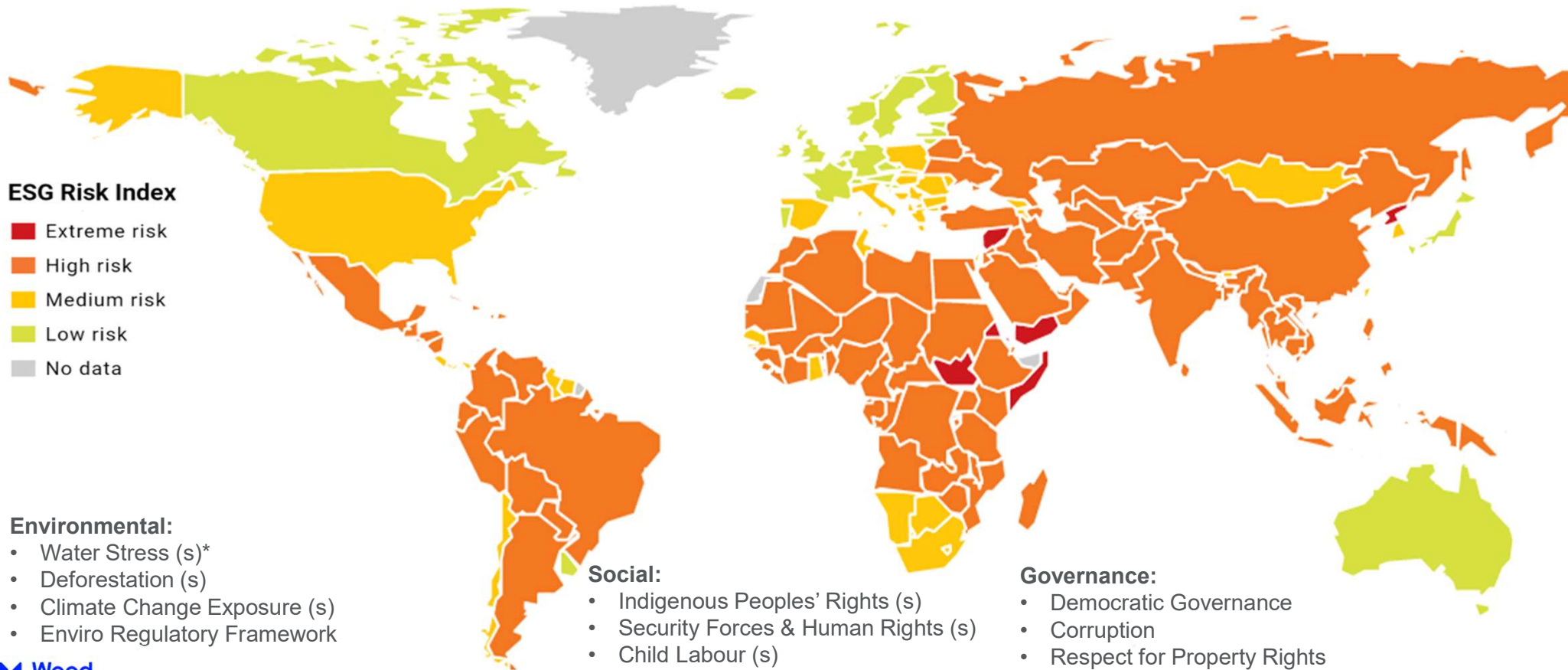
## Copper projects are exposed to socio-political constraints

- 50% of projects located in Latin America where the backdrop is “challenging”



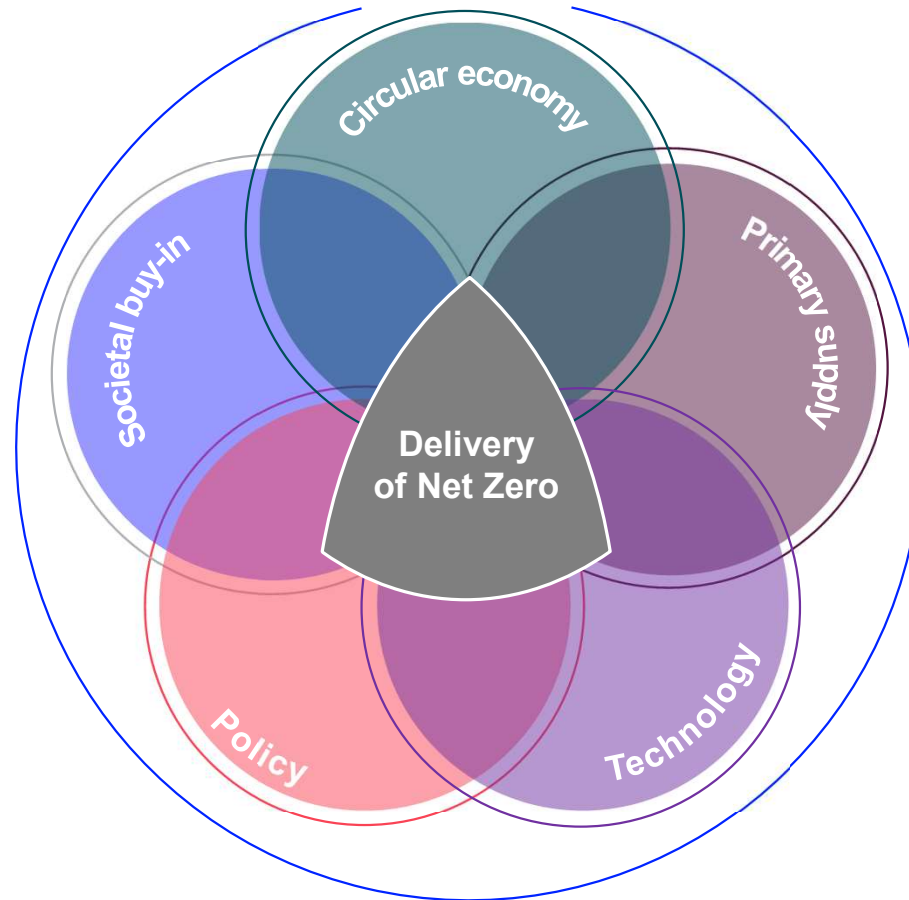
# Society is *preventing* raw materials supply development

We need the supply chain to get more comfortable with risk and society to get on board !



The Energy Transition  
Starts and Ends with  
Metals !

Hope is not a strategy to deliver net zero,  
action is needed



#nometalsnotransition

# Q&A