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June 25, 2024

# WisdomTree Europe

## Metals of the Future: Commodities Making the Energy Transition Happen

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June 2024

# Metals of the Future: Commodities Making the Energy Transition Happen

**WisdomTree webinar with IBKR**





# Table of Contents

- 1.** Commodity prices in next leg of economic cycle
- 2.** China
- 3.** Metals of the future
- 4.** Metals and Rare Earth Miners
- 5.** Green arms race



**1.**

Commodity prices  
in next leg of  
economic cycle



# The Year of the Dragon is starting to lift commodities



## Asset Class Performance Ranked: 2014-2024

		Year											
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	10 Years	2024 YTD
Performance Ranking	1	Real Estate 15.9%	Cash 0.2%	Commodities 11.8%	Equities 22.4%	Cash 1.7%	Equities 27.7%	Equities 15.9%	Real Estate 27.2%	<b>Commodities</b> 16.1%	Equities 23.8%	<b>Equities</b> 8.6%	Equities 9.5%
	2	Bonds 5.6%	Real Estate 0.1%	Equities 7.5%	Real Estate 11.4%	Bonds -2.4%	Real Estate 23.1%	Bonds 10.3%	<b>Commodities</b> 27.1%	Cash 1.7%	Real Estate 10.9%	<b>Real Estate</b> 4.5%	<b>Commodities</b> 6.8%
	3	Equities 4.9%	Equities -0.9%	Real Estate 5.0%	Bonds 10.3%	Real Estate -4.7%	Bonds 13.6%	Cash 0.5%	Equities 21.8%	Equities -18.1%	Bonds 7.9%	<b>Bonds</b> 1.7%	Cash 1.7%
	4	Cash 0.2%	Bonds -2.8%	Bonds 3.6%	Cash 1.7%	Equities -8.7%	<b>Commodities</b> 7.7%	<b>Commodities</b> -3.1%	Cash 0.1%	Bonds -21.0%	Cash 3.9%	<b>Cash</b> 1.1%	Bonds 3.9%
	5	<b>Commodities</b> -17.0%	<b>Commodities</b> -24.7%	Cash 0.5%	<b>Commodities</b> 0.9%	<b>Commodities</b> -11.2%	Cash 1.7%	Real Estate -8.2%	Bonds -3.5%	Real Estate -24.4%	<b>Commodities</b> -7.9%	<b>Commodities</b> -1.1%	Real Estate -7.9%

Source: WisdomTree, Bloomberg. Data until May 31, 2024; All returns are in USD; ; 10 Yrs returns are annualised from 31 Dec 13 to 31 Dec 23. Data: Equity - MSCI World NR, Bond - Bloomberg Barclays Agg Sovereign TR Unhedged, Real Estate - EPRA/NAREIT Global, Bloomberg Commodity Total Return Index, Cash - US T-Bill 3 Mth. **Historical performance is not an indication of future performance and any investments may go down in value**

# With precious metals now leading the way and industrial metals closely behind



## Commodity Sector Performance Ranked: 2014-2024

		Year											
		2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	10 Years	2024 YTD
Performance Ranking	1	Precious Metals -6.7%	Precious Metals -11.5%	Industrial Metals 19.9%	Industrial Metals 29.4%	Precious Metals -4.6%	Precious Metals 17.0%	Precious Metals 25.6%	Energy 52.1%	Energy 36.2%	Precious Metals 9.6%	<b>Precious Metals</b> 3.9%	Precious Metals 16.0%
	2	Industrial Metals -6.9%	Agriculture -15.6%	Energy 16.3%	Precious Metals 10.9%	Agriculture -10.8%	Energy 11.8%	Agriculture 16.5%	Industrial Metals 30.3%	Agriculture 15.5%	Agriculture -4.4%	<b>Industrial Metals</b> 2.1%	Industrial Metals 15.1%
	3	Agriculture -9.2%	Diversified -24.7%	Diversified 11.4%	Diversified 0.7%	Energy -12.7%	Industrial Metals 7.0%	Industrial Metals 16.3%	Diversified 27.1%	Diversified 13.8%	Industrial Metals -9.1%	<b>Agriculture</b> 0.3%	Diversified 4.4%
	4	Diversified -17.0%	Industrial Metals -26.9%	Precious Metals 9.5%	Energy -4.3%	Diversified -13.0%	Diversified 5.4%	Diversified -3.5%	Agriculture 26.7%	Precious Metals 0.1%	Diversified -12.6%	<b>Diversified</b> -2.5%	Energy 3.8%
	5	Energy -39.3%	Energy -38.9%	Agriculture 2.1%	Agriculture -11.0%	Industrial Metals -19.5%	Agriculture 1.7%	Energy -42.7%	Precious Metals -6.1%	Industrial Metals -2.4%	Energy -21.6%	<b>Energy</b> -9.6%	Agriculture -0.4%

Source: WisdomTree, Bloomberg. Data until May 31, 2024; All returns are in USD; ; 10 Yrs returns are annualised from 31 Dec 13 to 31 Dec 23. Data: proxies for each commodity sector using Bloomberg sub-sector indices TR. Historical performance is not an indication of future performance and any investments may go down in value



# 2. China



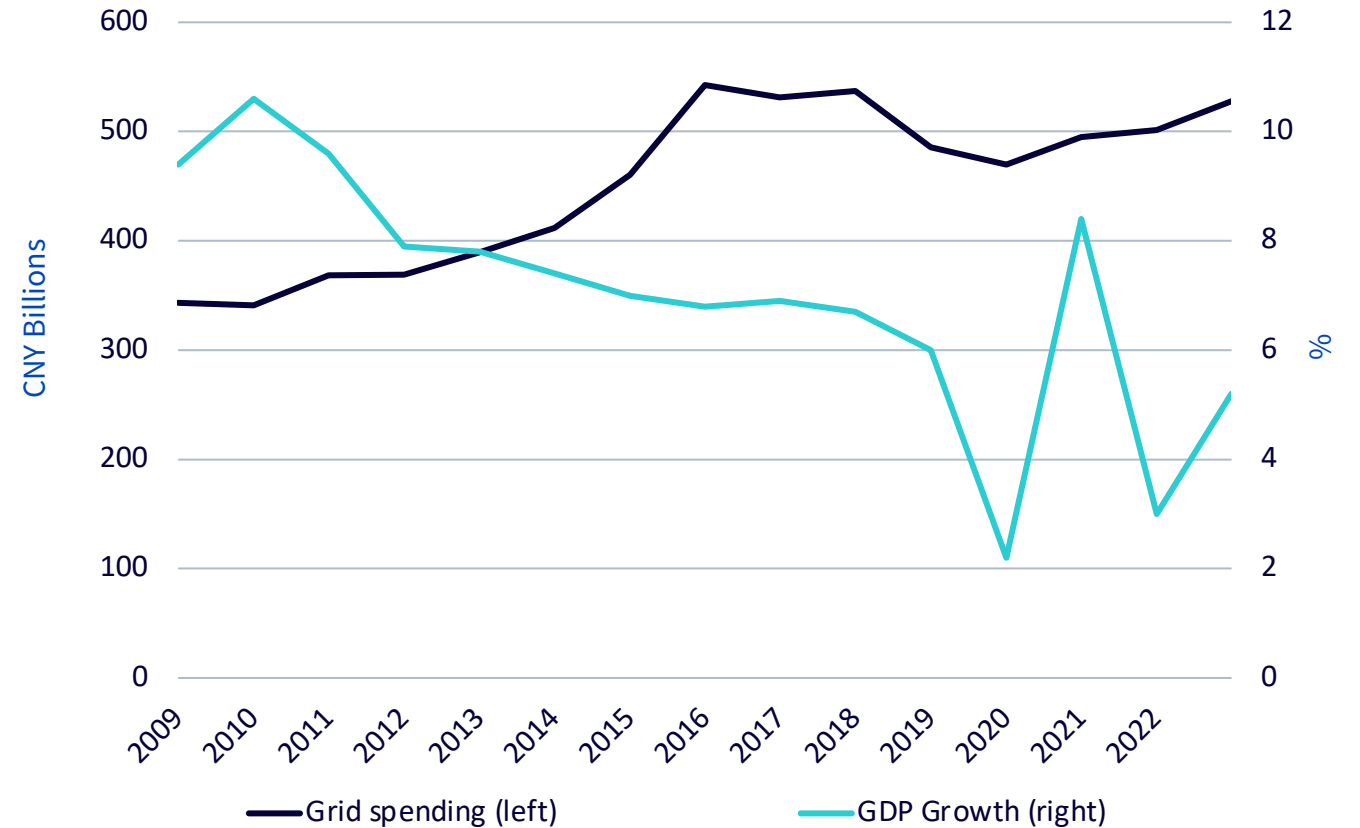


China grid spending  
defies economic  
slowdown



## China is accelerating electrification

### China Grid Infrastructure Spending



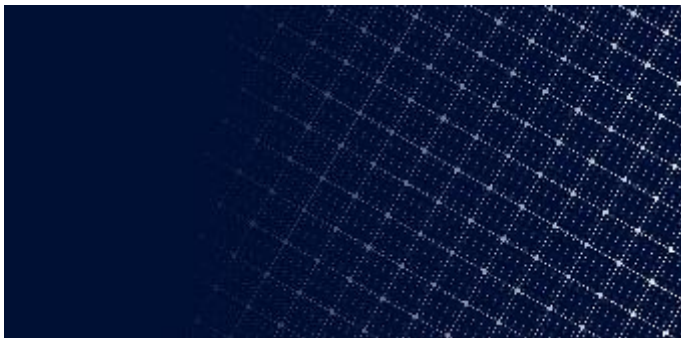
Source: Bloomberg, WisdomTree.

Historical performance is not an indication of future performance and any investments may go down in value.

# Xin san yang: the new three

## Solar cells

- China accounts for more than 80% of the global solar cell exports.
- China accounts for almost 60% of new renewable capacity expected to become operational globally by 2028.
- In 2023, China commissioned as much solar PV as the entire world did in 2022 and is set to accelerate this further.
- China is expected to maintain its 80-95% share of global supply chains in PV



## Lithium-ion batteries

- China accounts for more than 50% of lithium-ion batteries.
- Around 95% of the lithium-iron-phosphate (LFP) batteries for electric light duty vehicles went into vehicles produced in China.
- In 2022, the share of electric cars manufactured in China and sold in the European market increased to 16%, up from about 11% in 2021.



## Electric vehicles

- In 2022 China accounted for more than 60% of the global electric sales.
- More than half of the electric cars on roads worldwide are now in China and the country has already exceeded its 2025 target for new energy vehicle sales.
- In 2022, 35% of exported electric cars came from China, compared with 25% in 2021.
- Made in China 2025 stipulates that 80% of the EVs and plug-in hybrids sold in China are home-grown brands

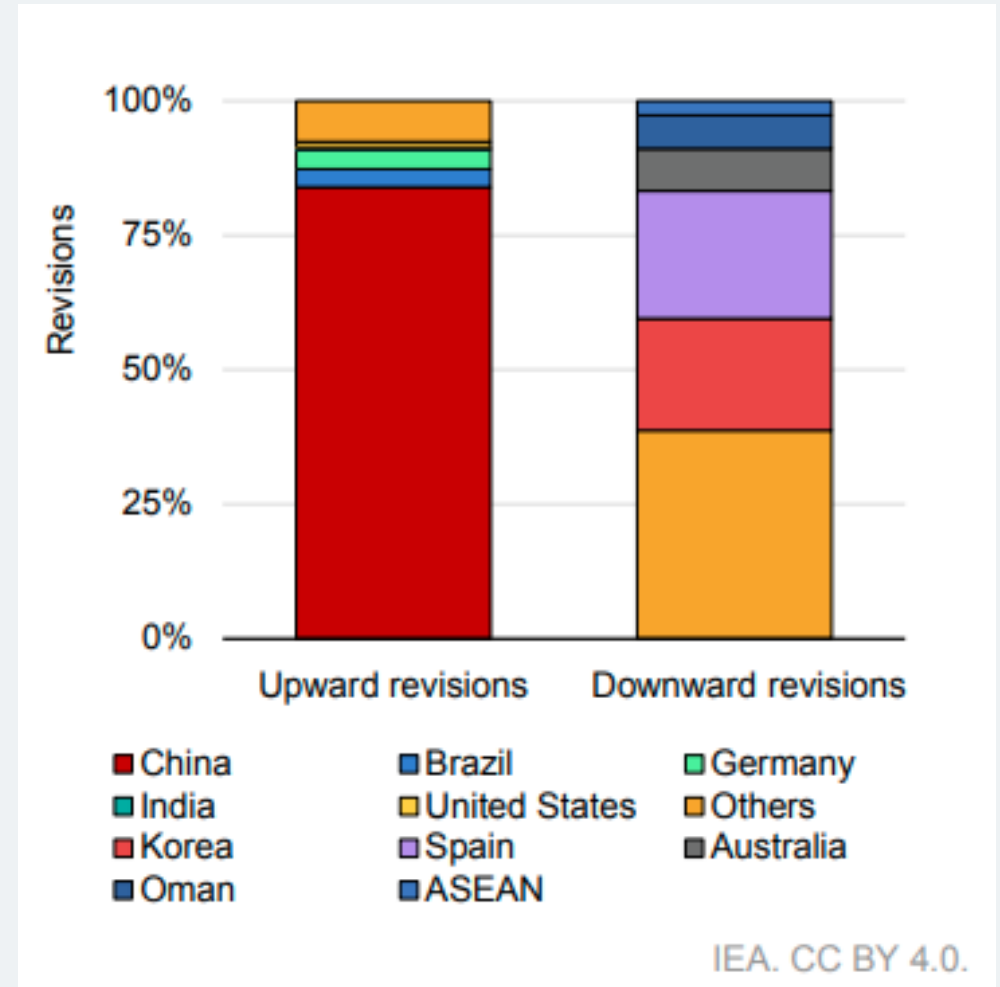
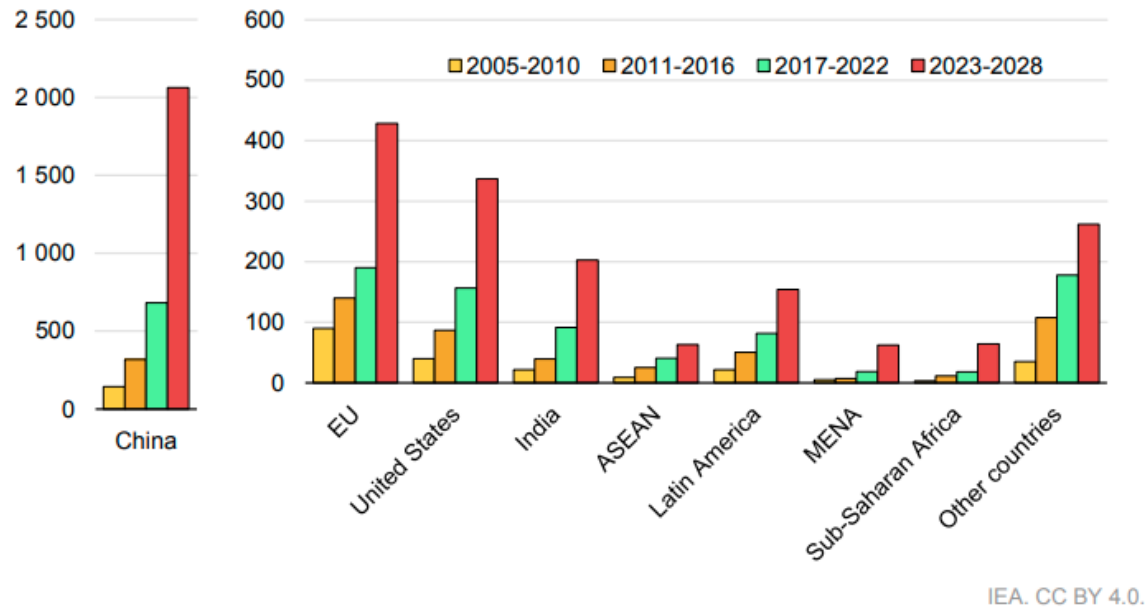


Sources: China General Administration of Customs, International Energy Agency Renewables 2023 and Global EV Outlook 2023.  
Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

# China's dominance in renewables

## Renewable electricity capacity growth by country/region, main case

+ Renewable electricity capacity forecast revisions by country, 2023-2027

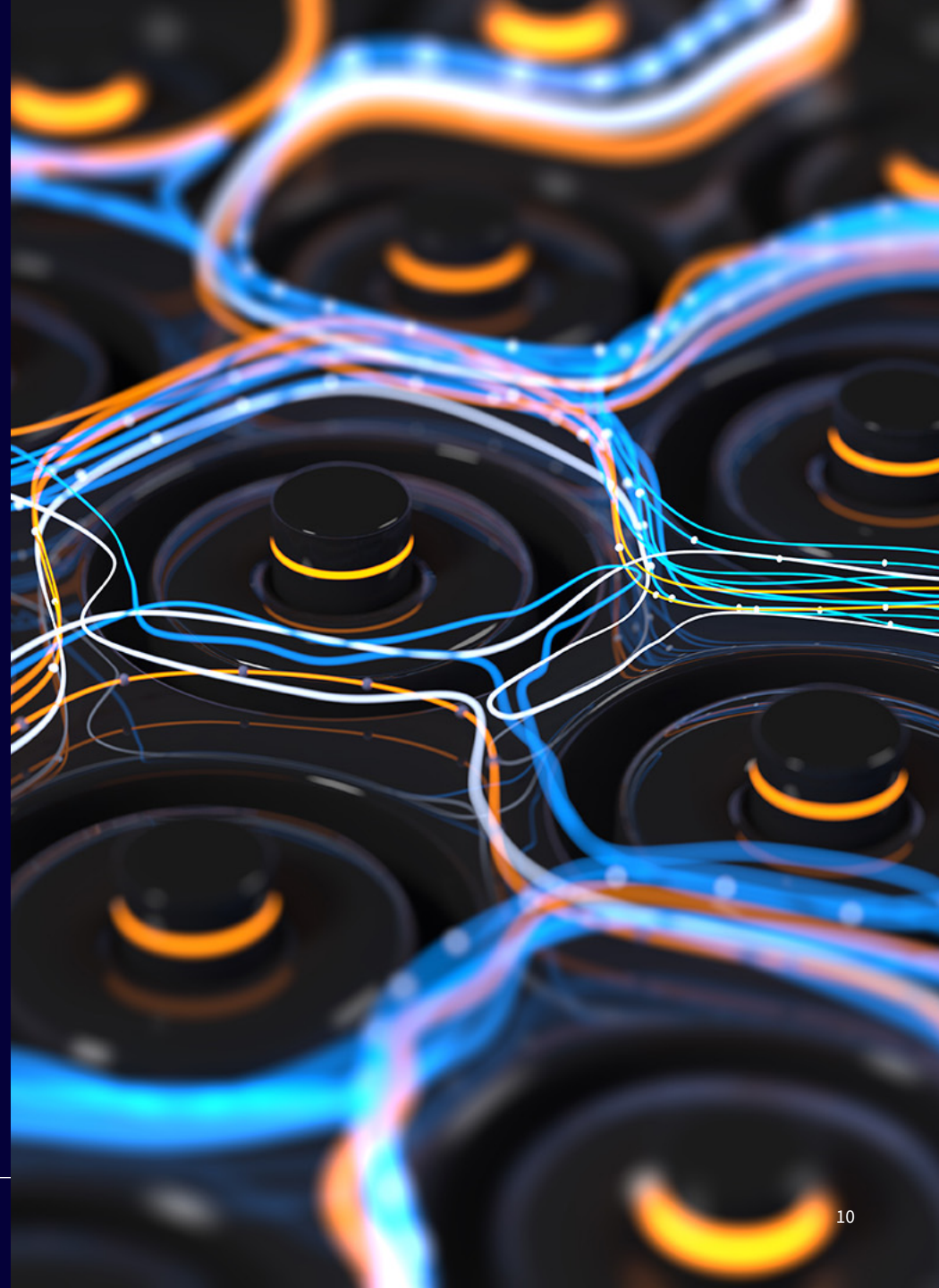


Sources: International Energy Agency Renewables 2023.  
 Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties



# 3.

## Metals of the future



# Moving to an energy system compatible with new zero emissions will require a large increase in renewable technologies



## Technology shift by 2050

### Growth by 2050 relative to 2022:

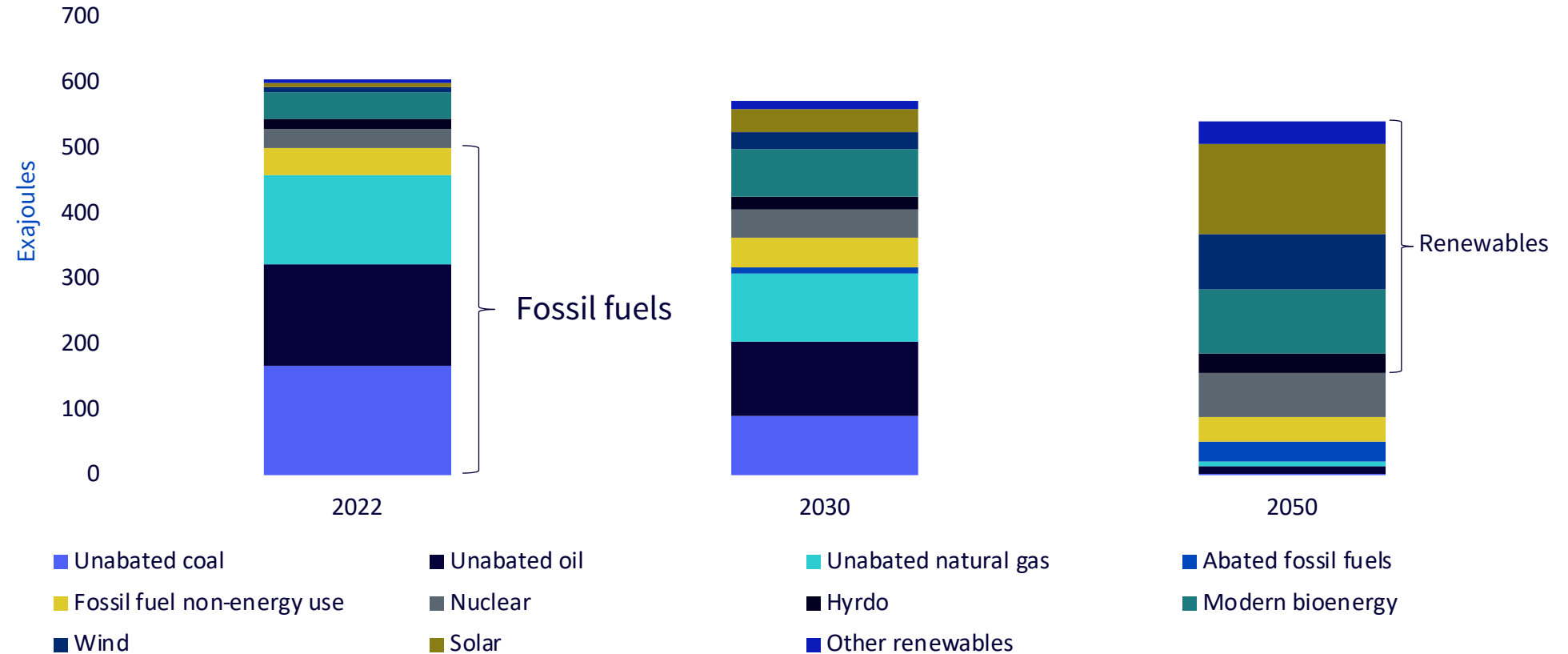
- + Solar: 21x
- + Wind: 11x
- + Bioenergy: 2x
- + Hydro: 2x
- + Nuclear: 2x

### Decline by 2050 relative to 2022

- + Coal (unabated): 99%
- + Oil (unabated): 93%
- + Natural gas (unabated): 95%

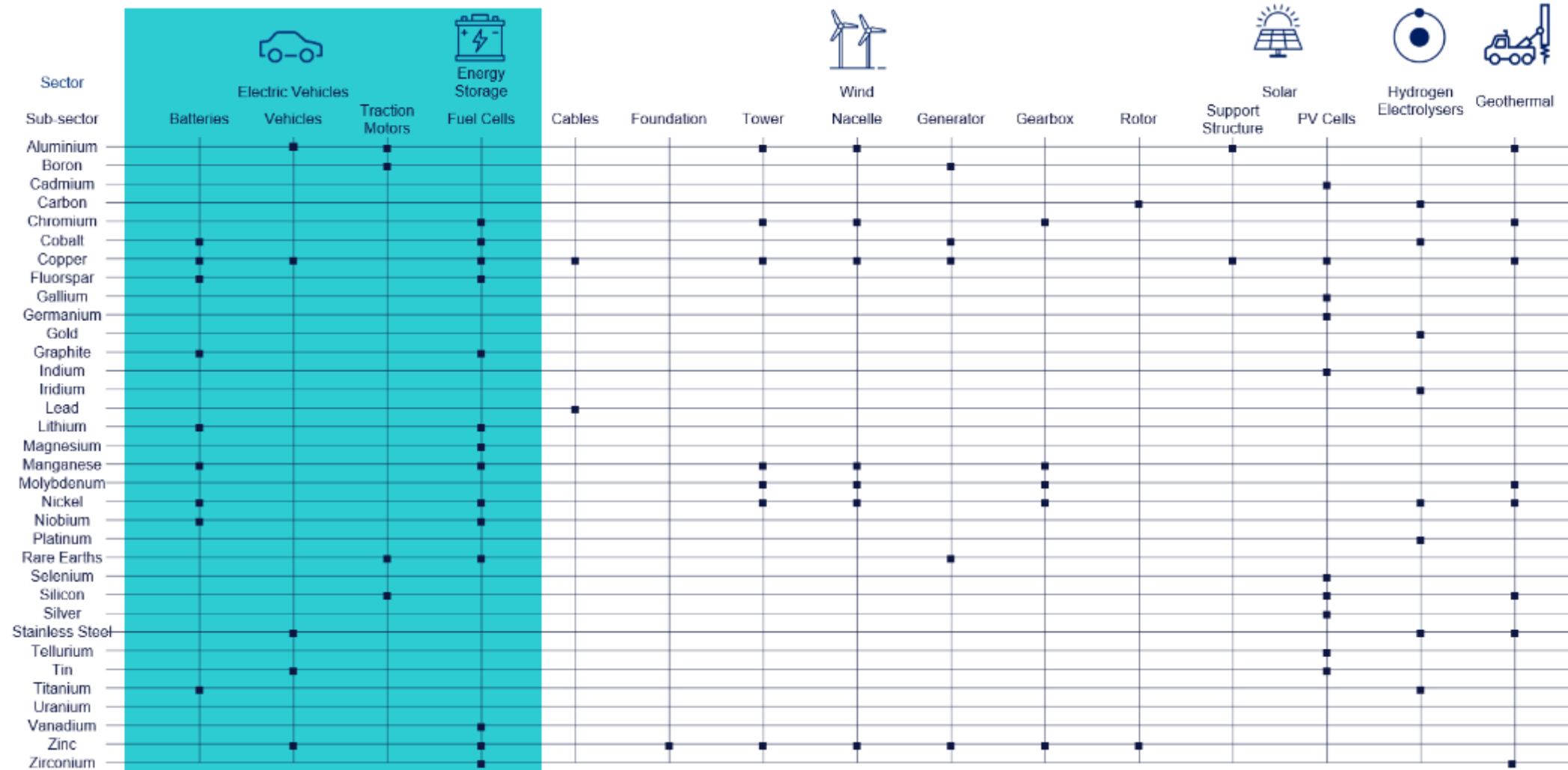
Non-energy use fossil fuels to remain broadly the same

## Pathway to Net Zero



Source: International Energy Agency Net Zero Roadmap 2023. Abated means to use a carbon capture utilisation and storage system (CCUS); unabated means to combust without a CCUS. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties.

# The transition will be metals-intensive



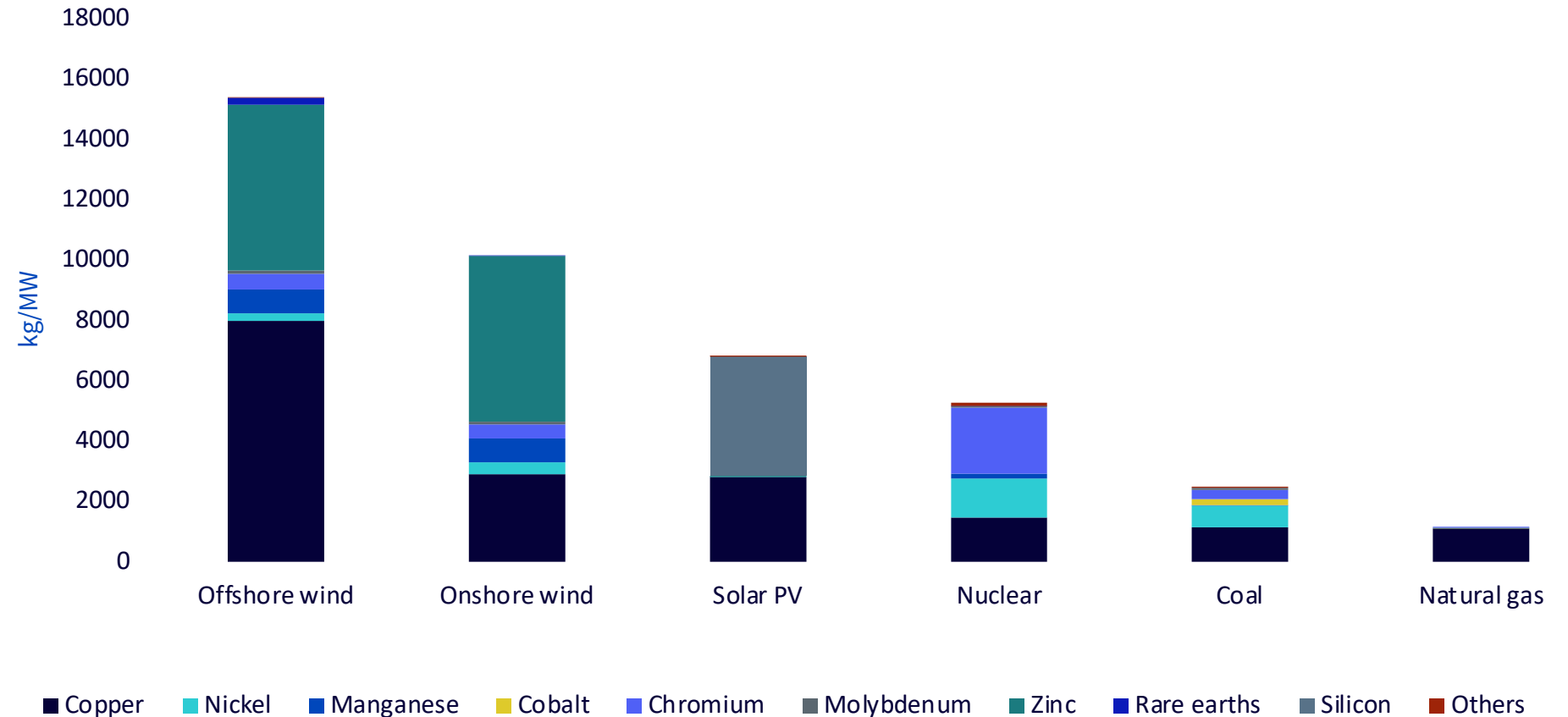
# The transition to renewables will be a metal-intensive journey

## Renewable technologies are more metal-intensive than traditional sources of energy

- + The electrification of our energy use will require more transmission and distribution cabling
- + Copper demand in particular will benefit for higher demand for wiring



## Minerals in clean energy technologies vs. traditional power generation sources



Source: International Energy Agency The Role of Critical Minerals in Clean Energy Transitions, 2021  
 Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

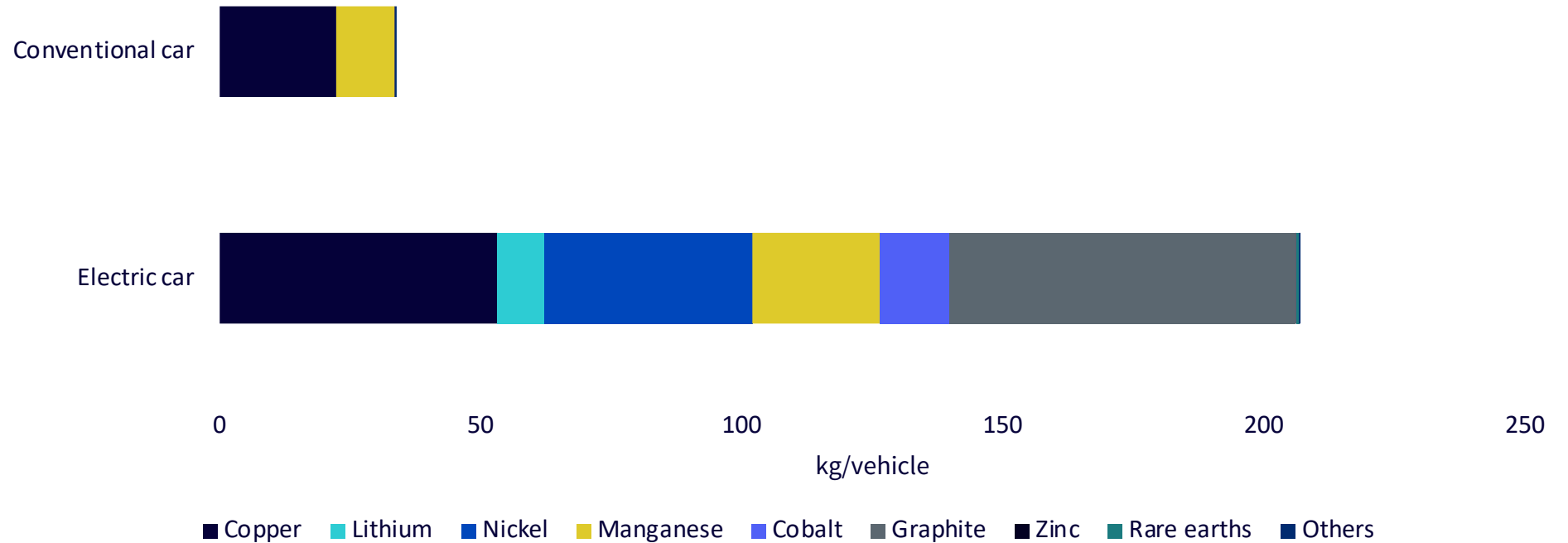
# The transition to electric vehicles will also be metal-intensive

## Electric vehicles (EV) are more metal intensive than conventional cars

+ Even though technologies within the EV space are constantly shifting, it's clear that they require more copper and lithium than conventional cars



### Metals in Cars



Source: International Energy Agency The Role of Critical Minerals in Clean Energy Transitions, 2021  
Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

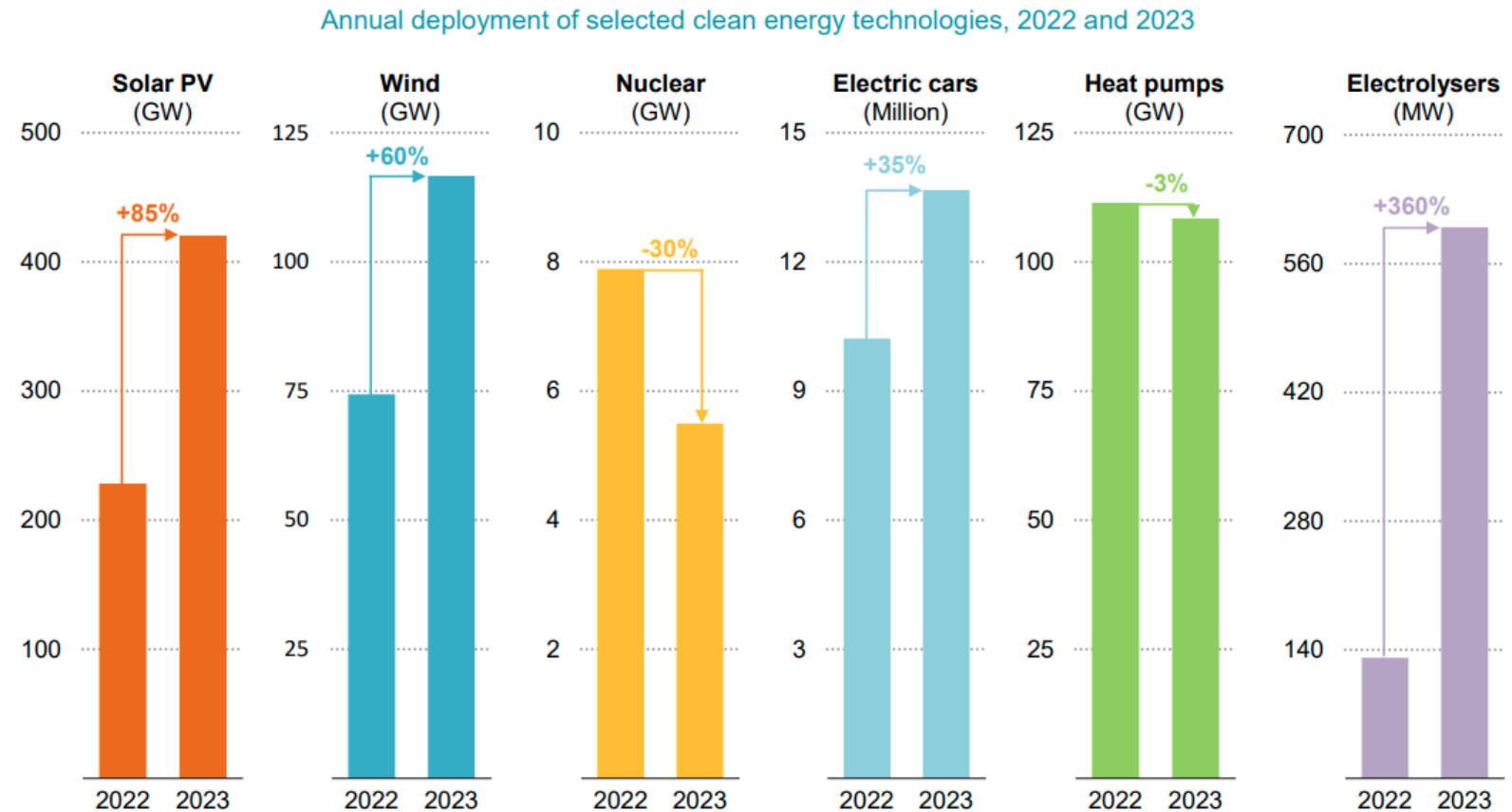


# Is the energy transition running out of steam?

## As clean energy deployment climbed new heights for some key technologies

### Not when looking at these numbers

- + The growth numbers are strong
- + They still beating expectations, but maybe by a smaller margin than in previous years
- + For all the hype that nuclear attracted, deployment fell in 2023
- + Wind and solar are still powering the bulk of the transition



IEA 2024. CC BY 4.0.

Note: "Annual deployment" refers to sales or capacity additions. GW = gigawatt; MW = megawatt; Mn = million.

Source: International Energy Agency, Clean Energy Market Monitor, March 2024

Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

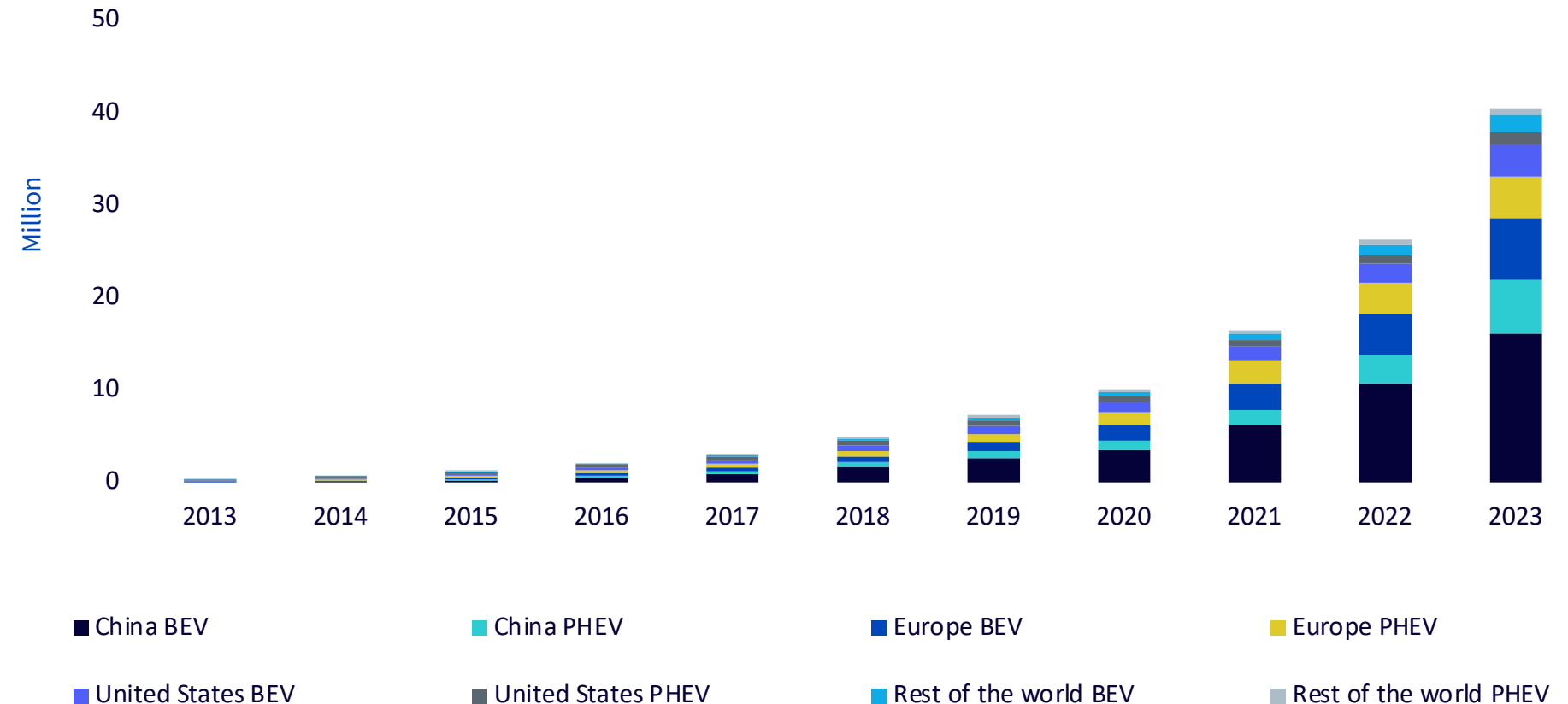
# Electric vehicles are still growing strong



## More than 40 million EVs on the road

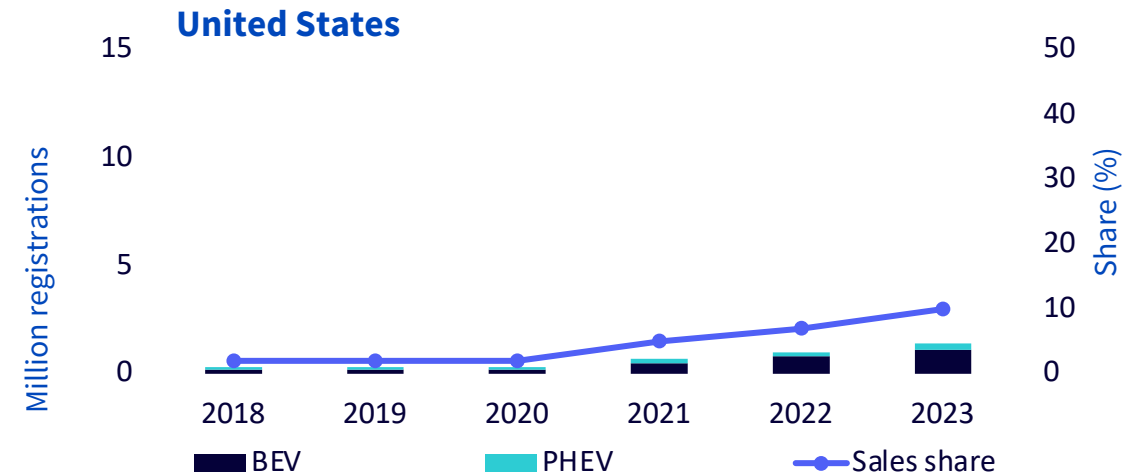
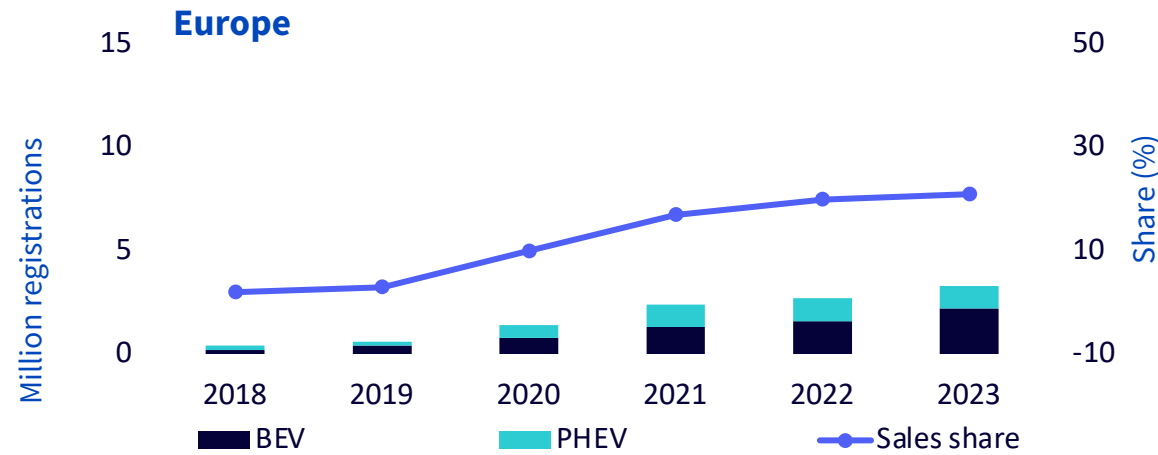
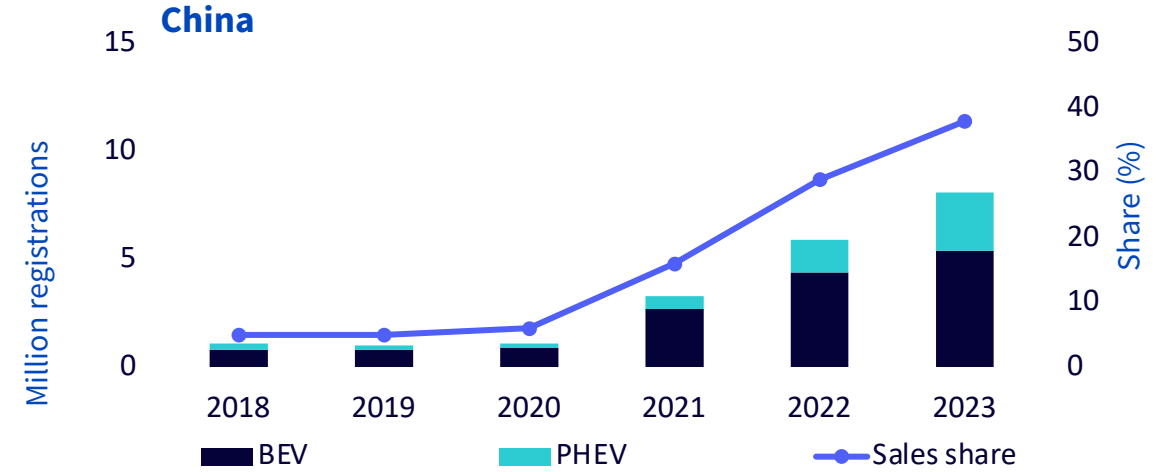
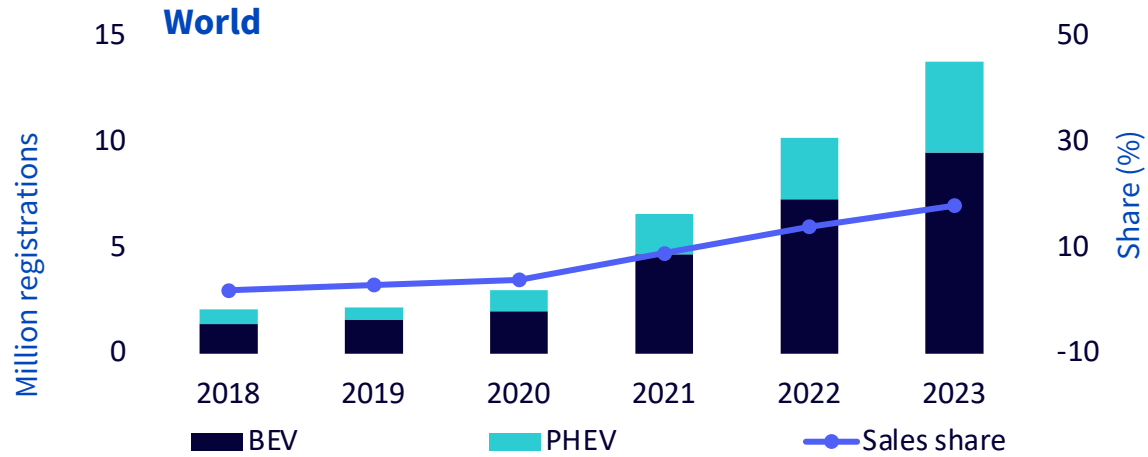
- + EV sales in 2023 were 3.5 million higher than in 2022, a 35% year-on-year increase.
- + Nearly one in five cars sold in 2023 was electric.
- + Electric car sales remained strong in Q1 2024, with 25% y-o-y growth to reach 3 million. That is similar to Q1 2023 y-o-y growth rate.
- + EV sales in Q1 2024 were more than total EV sales in 2020.

## Global electric car stock, 2013-2023



Source: International Energy Agency, Electric Vehicle Outlook 2024, April 2024. BEV = battery electric vehicles; PHEV = plug-in hybrid electric vehicles  
 Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

Close to 20% of global cars sales were EVs in 2023  
 Close to 40% of Chinese cars sales are EVs in 2023



Source: International Energy Agency, Electric Vehicle Outlook 2024, April 2024. BEV = battery electric vehicles; PHEV = plug-in hybrid electric vehicles  
 Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

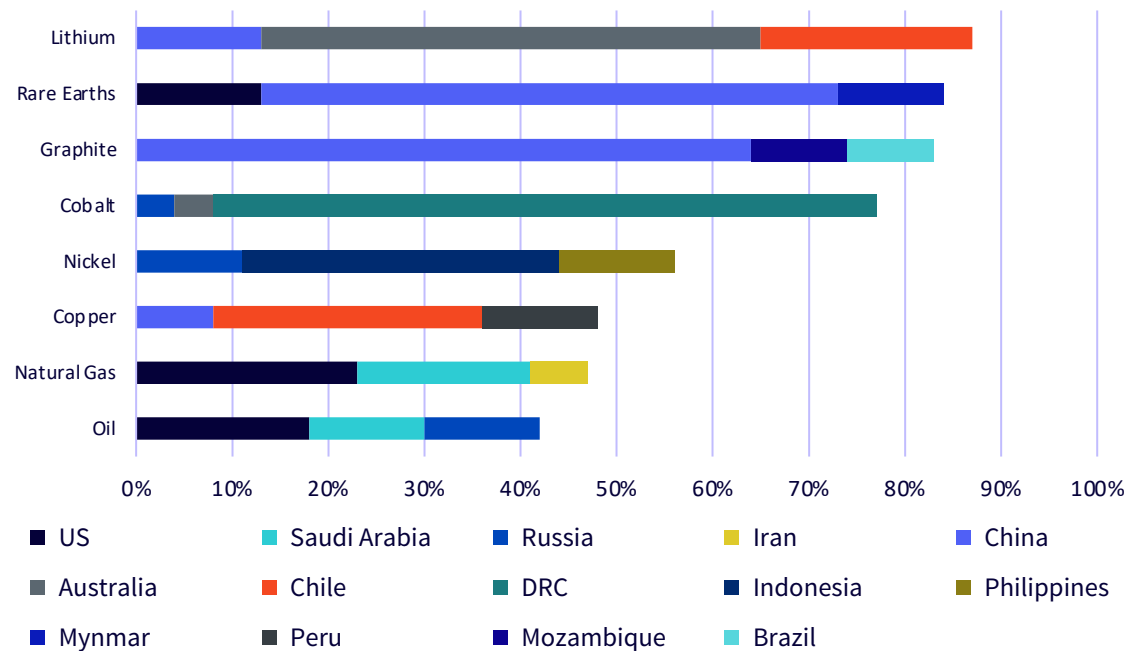
# Sourcing critical raw materials will remain a challenge for the energy transition



## Extraction resources are geographically concentrated

Weaning away from hydrocarbon resources is a challenge because metal mining is even more geographically concentrated than oil and gas

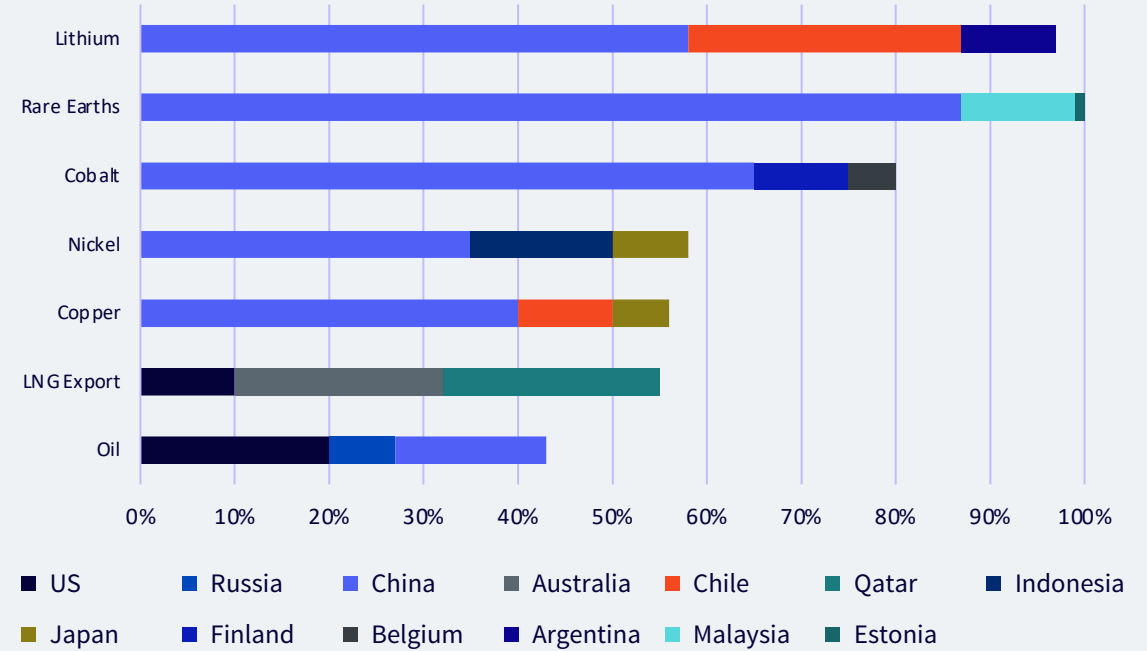
### Top 3 Extraction Countries, Market Share



## Processing resources are even more geographically concentrated, with China dominating

China dominates in every metal processing value chain

### Top 3 Processing Countries, Market Share



Source: International Energy Agency, WisdomTree, 2021. LNG = liquefied natural gas; US = United States; DRC = Democratic Republic of Congo. Historical performance is not an indication of future performance and any investments may go down in value.



# Spotlight on individual metals

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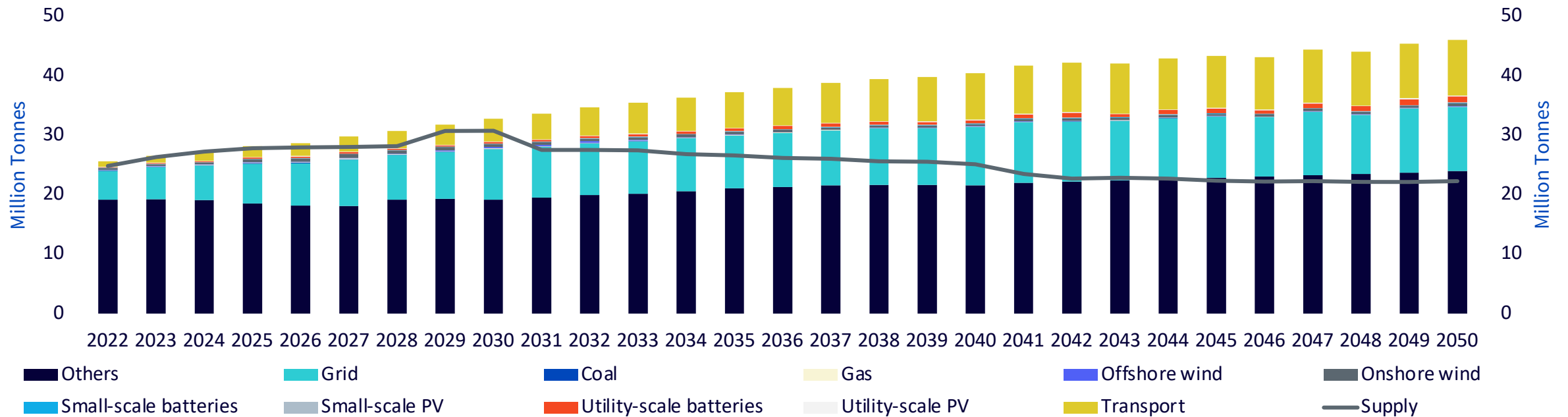
# Copper



## The Metal of Electrification

- + Copper is already in a supply deficit
- + Growing demand from grid upgrades and transportation, will increase the deficit further

### Copper demand and supply



Source: Bloomberg New Energy Finance, Transition Metals Outlook 2023, using a base case scenario. Does not include supply from recycling. Forecasts are not an indicator of future performance and any investments are subject to risks and uncertainties

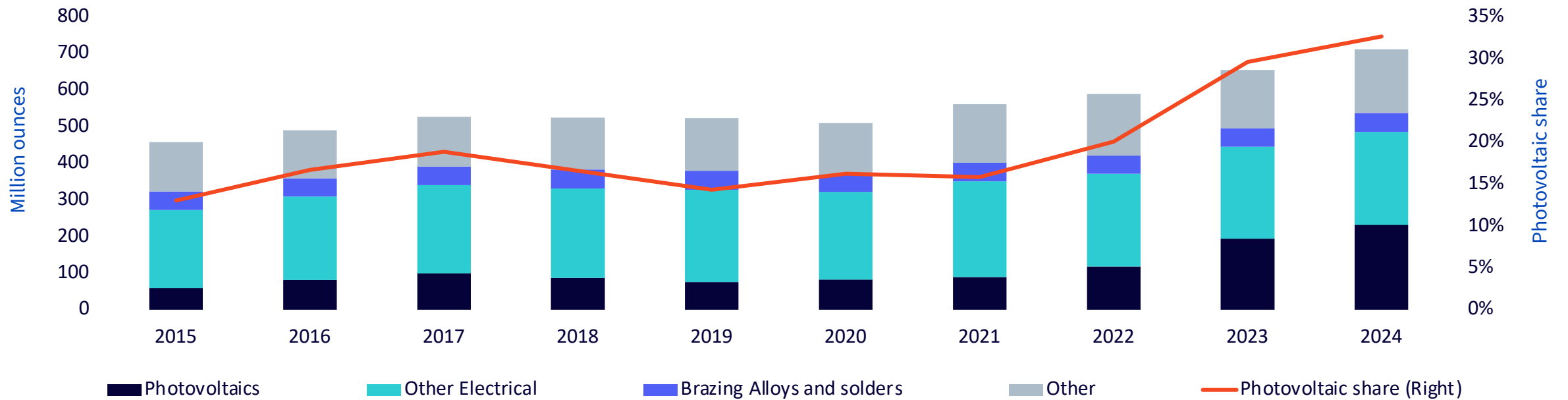
# Silver



## Propelled by photovoltaics (PV)

- + Photovoltaic installations rose 85% in 2023 (IEA, Clean Energy Market Monitor, March 2024), exceeding anyone's forecast at the beginning of 2023, with new capacity additions forecast to reach another record high in 2024.
- + Demand from 5G and automotive electronics all substantially increased

### Industrial demand for silver



Source: Silver Institute, WisdomTree, April 2024

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# Tin: the forgotten foot soldier of the energy transition

**Tin is called the ‘spice element’ because a little of it is present everywhere in ways that are essential to our quality of life.**



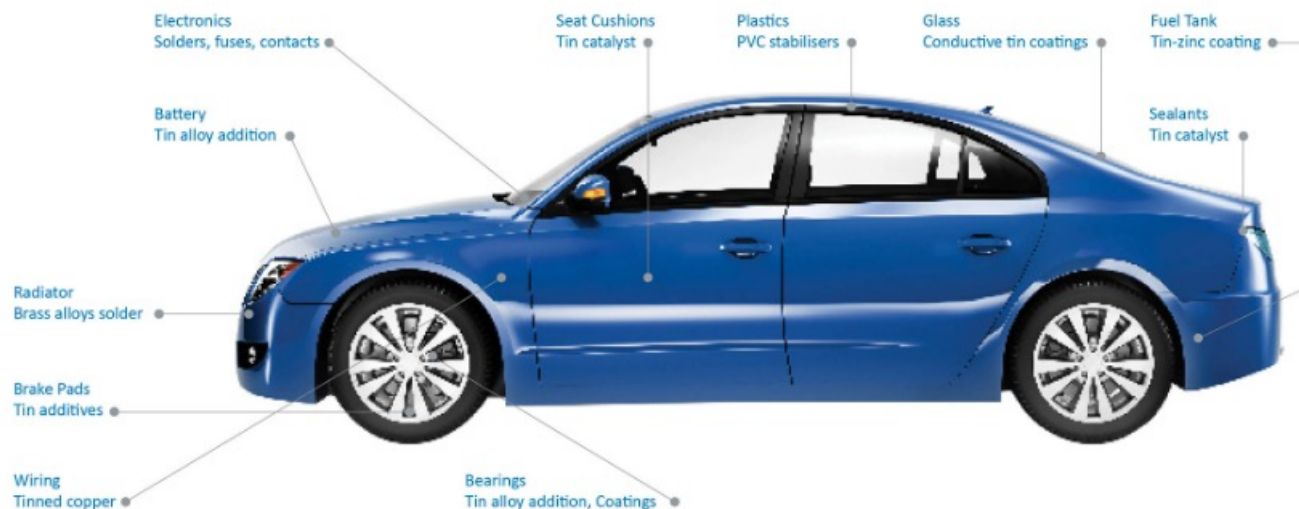
- + Lack of economic alternatives to tin as the metal is relatively cheap and so cost-cutting exercises tend to focus elsewhere

## Upside risks to demand

- + Tin essential for soldering, accounting for more than 50% of the metal’s use and soldering needs are rapidly expanding.
- + Removing lead from solder use, presents upside demand for tin<sup>1</sup>.
- + Not only does tin have a use in lithium-ion batteries, but other competing technologies like potassium-ion, zinc-ion, and sodium-ion rely on tin

## Downside risk to supply

- + Wa State in Myanmar – tin mining has stopped since August 2023
- + Indonesia – export licence delays mean that the majority of tin smelters in Indonesia have not exported any tin in 2024



Source: International Tin Association Ltd 2024, Wood Mackenzie, Reuters. EU Restriction of Hazardous Substances (“RoHS”) directive already limits the lead content in electronic goods to below 1000ppm and requires its elimination in solder by 2030.





# 4.

## Metals and Rare Earth Miners

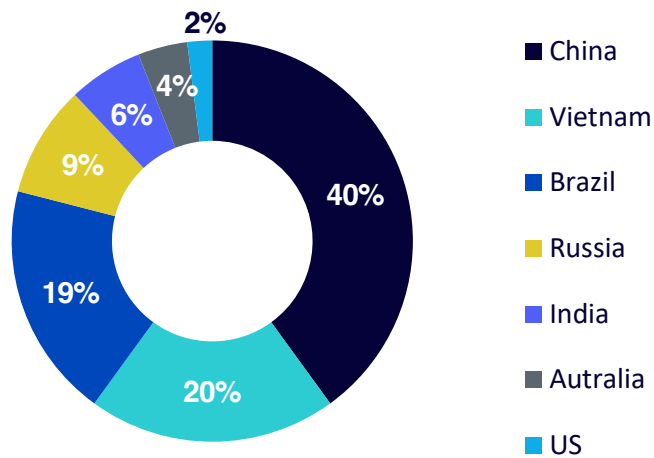


# Global Rare EARTH production

## China's dominance in production

- + From a downstream perspective, China is home to more than 80% of the world's capacity to process rare Earth concentrates or carbonates into materials that manufacturers can use.
- + It would take many years to build enough processing and separation plants to match China's processing capacity of 250kt. China supplied 80% of the rare Earths imported by the US from 2014 to 2017.

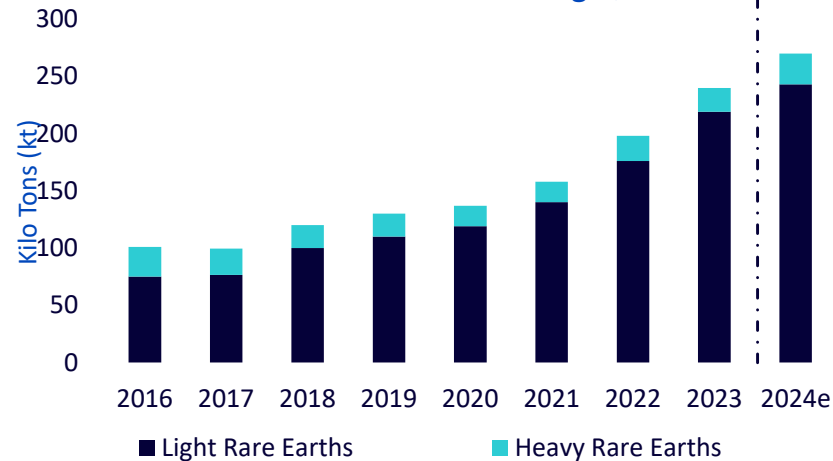
Rare Earth Oxide reserves by country (2023)



## China's rare Earths quota and oligopolies

- + China's rare Earths mining quota more than doubled in the last five years from 105kt of Rare Earths Oxide (REO) in 2017 to 240kt in 2023.
- + The pace of growth is expected to continue at 9% YoY on average over the next 10 years.

China Rare Earths Mining Quota



“The Middle East has oil. China has rare Earth metals”



### Deng Xiaoping

The architect of China's economic reform and development when Deng opened China in 1980s.

Source: US Geological Survey (USGS), BofA Research, WisdomTree as of 12 March 2024  
Forecasts are not an indicator of future performance, and any investments are subject to risks and uncertainties.

# Rare Earths – Vitamins of modern industry

## Key Applications

<b>La</b> 57 Lanthanum	<b>Ce</b> 58 Cerium	<b>Pr</b> 59 Praseodymium	<b>Nd</b> 60 Neodymium	<b>Pm</b> 61 Promethium	<b>Sm</b> 62 Samarium	<b>Eu</b> 63 Europium	<b>Gd</b> 64 Gadolinium	<b>Tb</b> 65 Terbium	<b>Dy</b> 66 Dysprosium	<b>Ho</b> 67 Holmium	<b>Er</b> 68 Erbium	<b>Tm</b> 69 Thulium	<b>Yb</b> 70 Ytterbium	<b>Lu</b> 71 Lutetium	<b>Y</b> 39 Yttrium	<b>Sc</b> 21 Scandium
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+ Rare Earths is a “technology metals” which are almost irreplaceable to the technology in modern world owing to their unique magnetic, phosphorescent, and catalytic properties.



Transportation



Wind Turbines



Industrial



Robotics



Consumer Technology

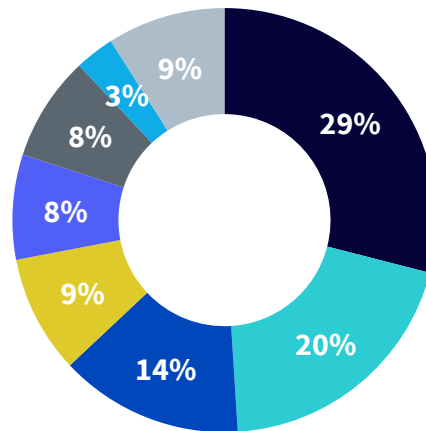


Aerospace

+ Rare Earths are essential to industrial and military technologies.

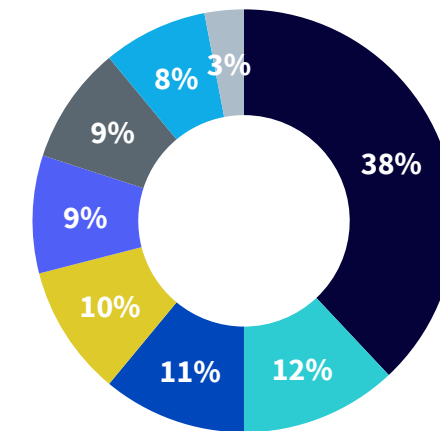
+ The industrial application includes electronics, smartphones, LED lights, Plasma TV, battery technology, electric cars, wind turbines, medical equipment, etc. Military technologies include nuclear power, space, critical defence, etc.

### Rare Earths Application



- Magnets
- Catalysts
- Polishing
- Metallurgy
- Batteries
- Glass
- Ceramics
- Other

### Permanent Magnet Demand in 2019



- Traditional Cars
- Electric Vehicles
- Industrial Products
- Wind Turbines
- Consumer Electronics
- Air Conditioners
- Elevators
- Others

Source: MP Materials, BofA Global Research, WisdomTree as of 29 February 2024

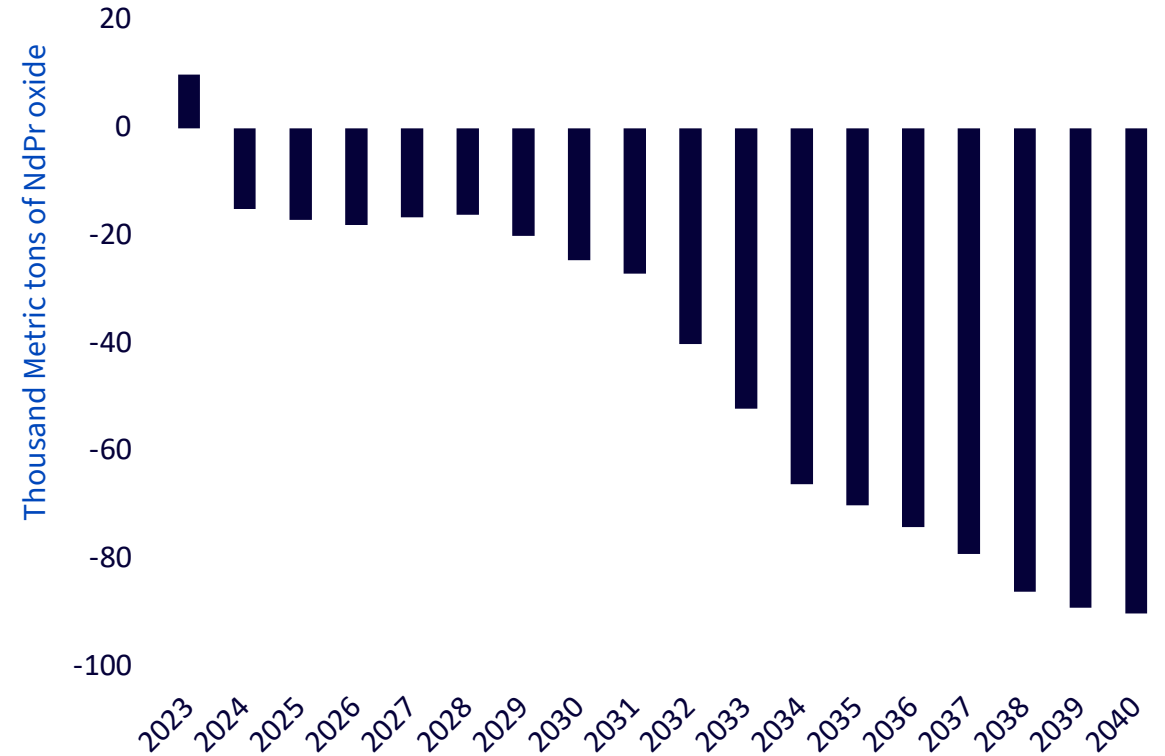
# A precarious supply-demand imbalance looms

## Light Rare Earths (LRE) and Heavy Rare Earths (HRE)

- + From a value and demand perspective, the most important Rare Earths Elements are:
  1. **Light Rare Earths (LRE)** : Neodymium (Nd) and Praseodymium (Pr) known as **NdPr**
  2. **Heavy Rare Earths (HRE)** : Dysprosium (Dy) and Terbium (Tb)
- + **NdPr** is mainly used to produce permanent magnet. While HREs - Dy and Tb normally will add energy efficiency when permanent magnet is performing at high temperature.
- + The US Department of Energy (DOE) continues to rank Dysprosium (Dy) and terbium (Tb) as critical materials.
- + Currently, all HRE separation occurs in China. Australia's Lynas Rare Earths Limited (LYC) ships rare Earths concentrates and carbonate to Malaysia to process and separate. After several years of shipping rare Earths concentrates from the US to China to process into **NdPr**, MP Materials Corp (**MP**) has just completed construction of its own light-Rare Earths Oxide US-based separation facility targeting **NdPr** production and sales from 2024.

Source: Adamas Intelligence, "Rare Earths Magnet Market Outlook to 2040"  
Forecasts are not an indicator of future performance, and any investments are subject to risks and uncertainties.

## Projected Global NdPr Cumulative Balance



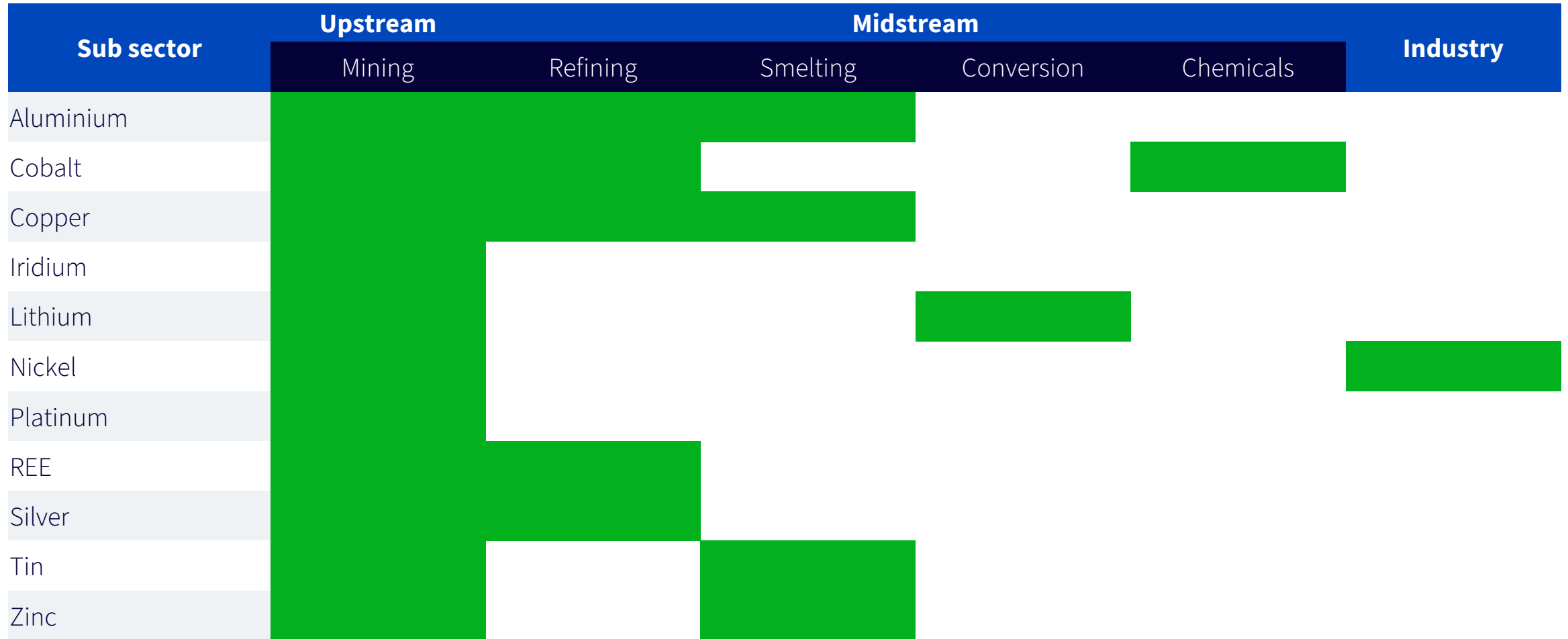
Enabling clean energy technologies to grow at the pace and scale needed to meet global climate targets, will depend on the rate at which critical minerals can be found and mined



Sources of demand for Metals and Rare Earths Elements across the Energy Transition Value Chain										
Commodity	Generation		Storage Transmission/ distribution		Consumption				Net Zero Scenario	
	Wind	Solar photovoltaic	Energy Storage	Power Infrastructure	Electric Vehicles	Electric Motors	Carbon Capture and Storage	Electrification of economy	Supply constrained in 2030	Deficit of supply in 2030
Aluminium	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	30%
Cobalt	Yes		Yes		Yes		Yes	Yes	Yes	45%
Copper	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes	17%
Iridium			Yes			Yes		Yes		
Lithium	Yes				Yes			Yes	Yes	65%
Nickel	Yes	Yes			Yes		Yes	Yes	Yes	46%
Platinum					Yes			Yes	Yes	35%
Silver		Yes			Yes			Yes	Yes	125%
Zinc	Yes	Yes						Yes	No	
Tin					Yes			Yes		
Rare Earths Elements	Yes				Yes	Yes		Yes		

Source: World Bank, The Growing Role of Minerals and Metals for a Low Carbon Future, CRU, Wood Mackenzie, WisdomTree. Forecasts are not an indicator of future performance, and any investments are subject to risks and uncertainties.





# A diversified allocation across the Energy Transition Metals value-chain (ETMVC), tilting towards the highest growth metal categories



Source: Wood Mackenzie. Note: REE = Rare Earths Elements

# Company Examples



	Category (Subsector)	Company revenue exposure
	<b>Lithium</b> (Mining)	<b>97%</b> Lithium mining is in almost all the company's business
	<b>Platinum</b> (Mining)	<b>19% (Platinum)</b> <b>4% (Nickel)</b> <b>3% (Iridium)</b>
	<b>Copper</b> (Mining)	<b>25%</b>
	<b>Application</b> (Transmission & Distribution network owner operators)	<b>3% (Zinc)</b> <b>3% (Silver)</b>

Source: WisdomTree, Wood Mackenzie, 2024. You cannot invest directly in an index. Historical performance is not an indication of future performance and any investments may go down in value.



**5.**

Green arms race





# Green arms race

## Inflation Reduction Act

The 2022 Inflation Reduction Act (IRA) in the USA aims to spur investment in domestic green technology. The majority of the \$394 billion in energy and climate funding in the IRA is in the form of tax credits with strings attached to local sourcing and processing.

## REPowerEU

The European Union launched REPowerEU, an ambitious plan to reduce EU dependence on fossil-fuel imports and accelerate the green transition.

In July 2023, the European Investment Bank (EIB) increased the financing targets by 50% to €45 billion until 2027. This additional financing is expected to mobilise over €150 billion in new green investments, helping Europe cut its carbon emissions to net zero by 2050.

## Critical Raw Material Act

New legislation currently being discussed by the European Union tripartite to onshore more of the supply chain (see next slide)



Sources: Data from The White House (2022) and The European Investment Bank (2023).

## Resource nationalisation

- + Chile (second largest lithium producer, with largest lithium reserves) has threatened to nationalise the industry
- + Chile is also the largest copper producer in the world and has mining royalties to bring its mining taxes to highest level in world

## Knowledge gaps

Significant knowledge gaps are likely to inhibit rapid production of raw material processing and mining capabilities



## Reshoring / onshoring

IRA, CRM Act are examples of efforts to bring more supply chain production close to the consumer market

## Tit-for-tat trade restrictions

China will restrict the exports of gallium and germanium - used in semiconductors and electric vehicles



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# Thank you.

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