

# Assessing Philippines' potential in the global green metals' revolution

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Mining Philippines, September 2023



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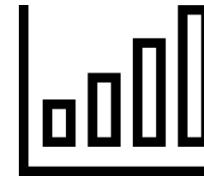
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# Presenters



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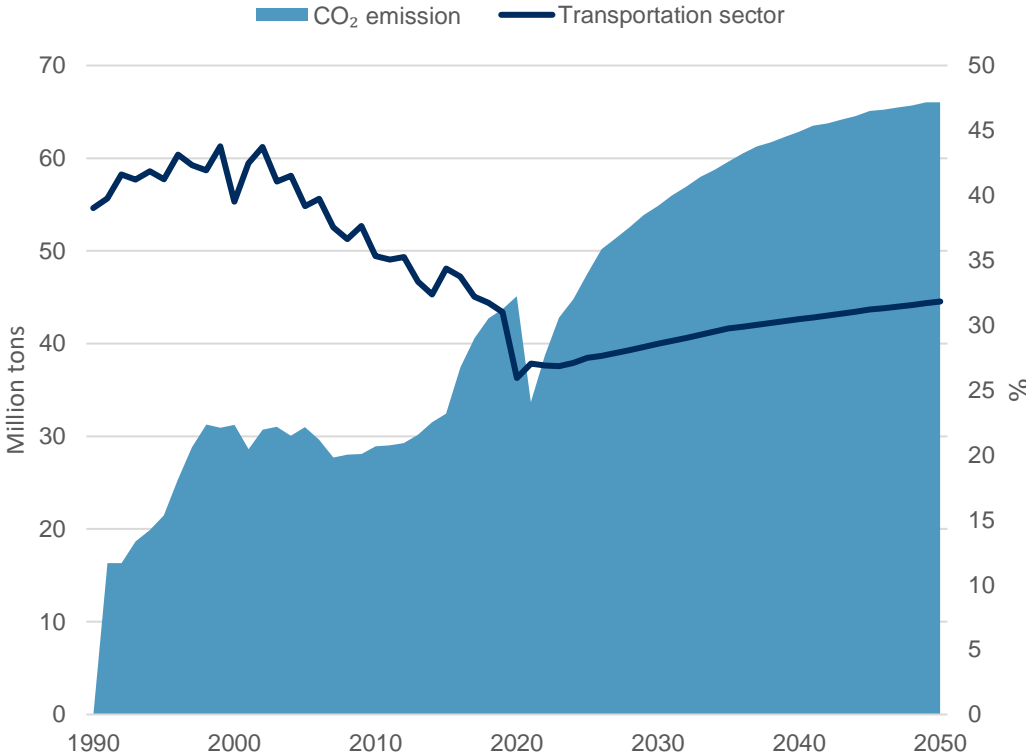
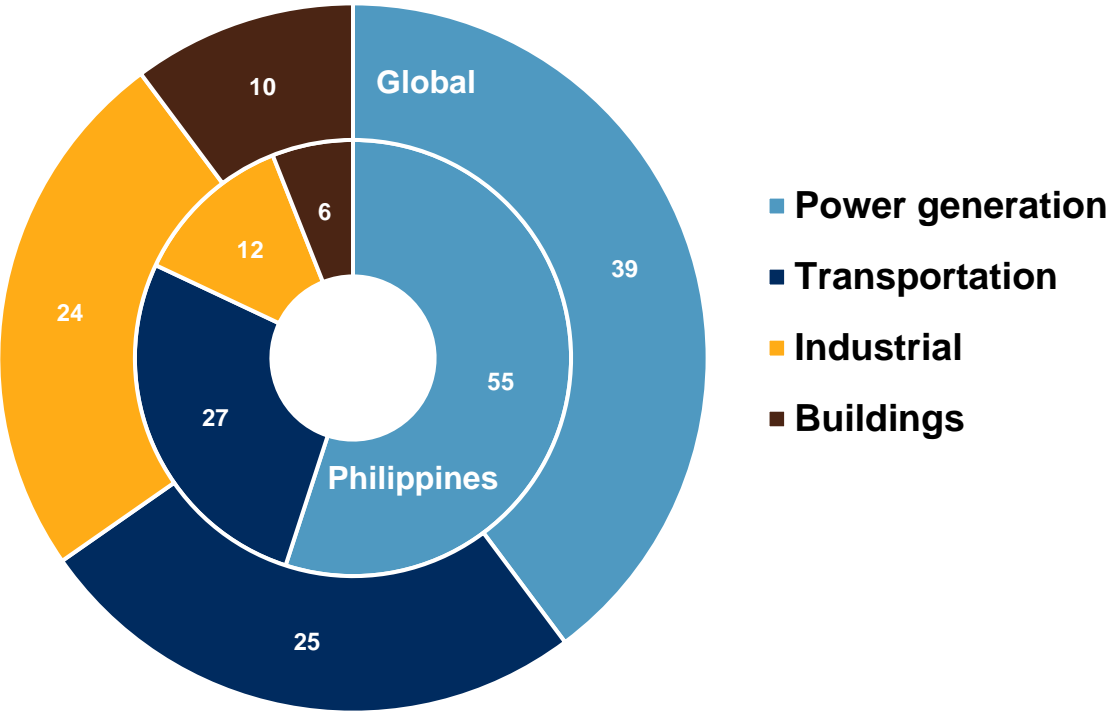
# Assessing Philippines' potential in global green metals revolution

- 1 Electrification of transport and battery technologies**
- 2 Battery metals overview — copper, nickel, lithium**
- 3 Assessment of Philippines' battery metals potential**

# Expected breakdown of CO<sub>2</sub> emissions by direct combustion for 2022

Passenger cars, marine, aviation, transportation account for 25% global emission, more in Philippines

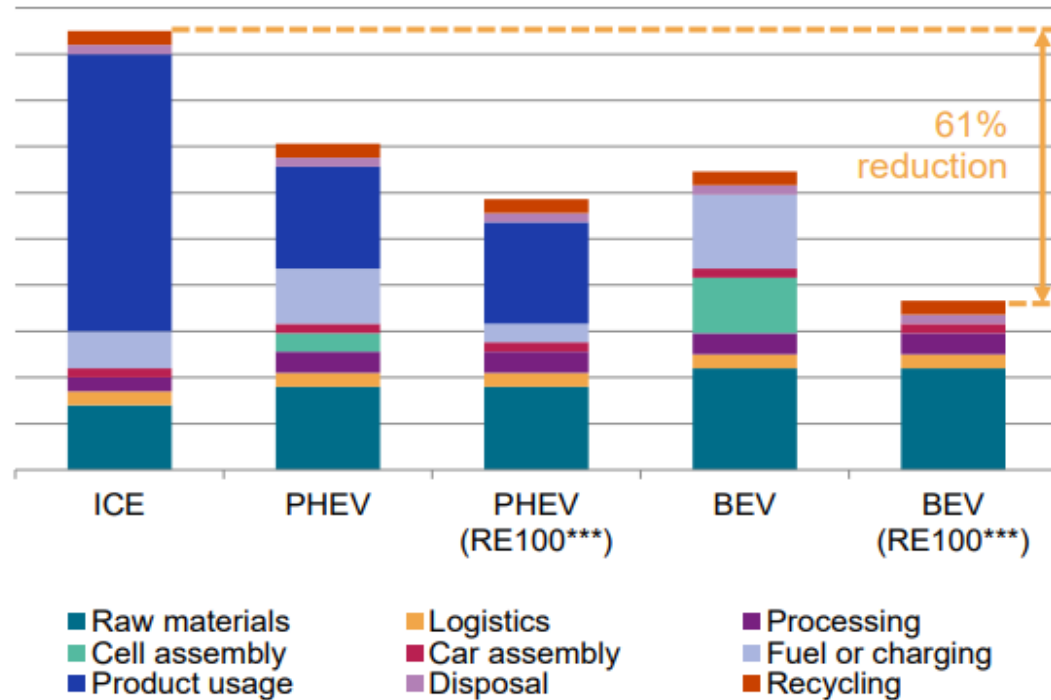
Philippines transportation sector share in total emission expected to rise to 32% in 2050



Data compiled September 2023.  
MMt = million metric tons.  
Source: S&P Global Commodity Insights.

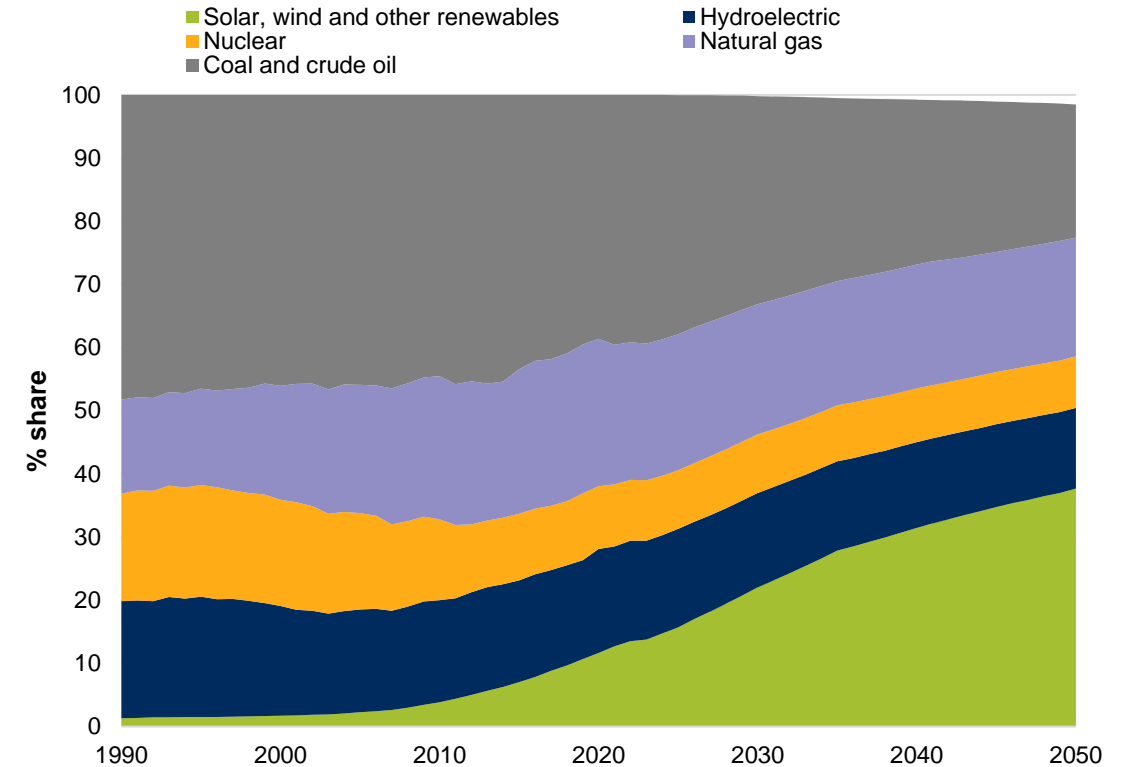
# Battery technology crucial to electrification, shift to renewables

Breakdown of carbon footprint by propulsion type\*\*



Data compiled September 2023.  
 ICE = internal combustion engine; PHEV = plug-in hybrid electric vehicle; BEV = battery-electric vehicle.  
 \*\* Illustrative; \*\*\* Assumption that 100% of renewable energy is used in cell assembly and electric vehicle charging.  
 Source: S&P Global Mobility.

Renewables expected to account one-third of global electric supply in 2042

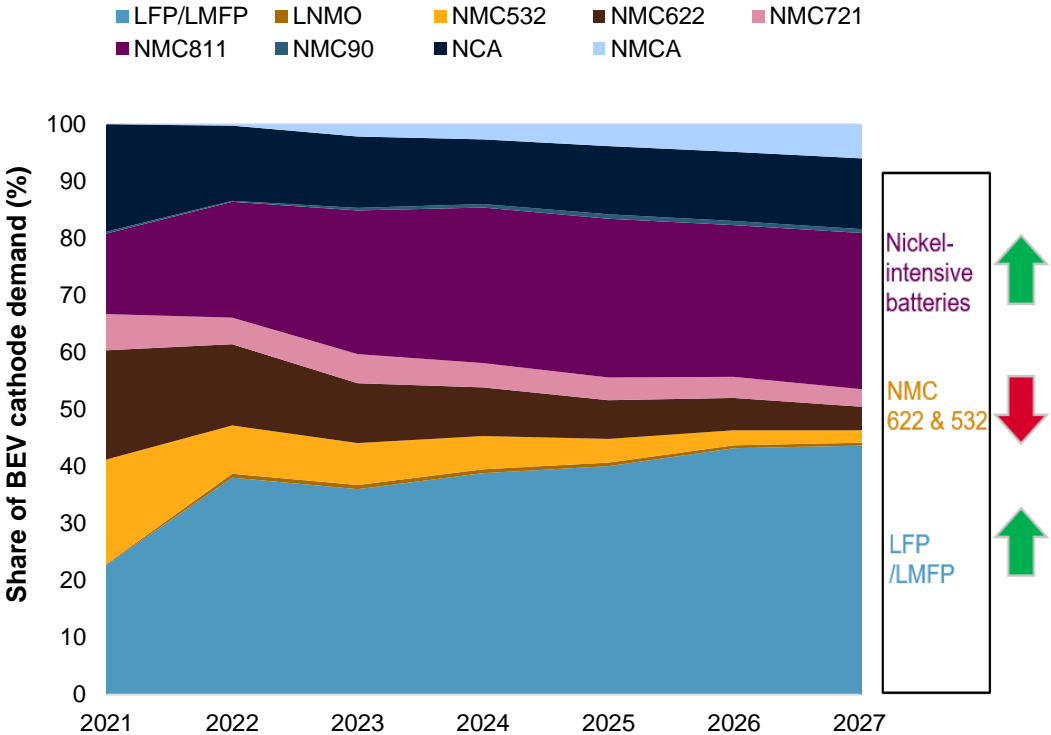


# Various battery technologies available depending on consumer need

LFP technology offers good balance, but Nickel-rich batteries remain top choice for more premium cars

	Sodium-ion	LFP (Li-ion)	Nickel-rich NMC/NCA (Li-ion)
Operating temperature	-40 to 80 degrees C	-10 to 60 degrees C	-20 to 60 degrees C
Charging time	80% in 15 mins	5 hours (30 mins with fast charging)	5 hours (30 mins with fast charging)
Life cycle	2,000, 3,000 or 5,000-8,000*	5,000-8,000	3,000+
Volumetric energy density	200-260 Wh/l	350+ Wh/l	500+ Wh/l
Gravimetric Energy density	<160 Wh/kg	150-180 Wh/kg	>200 Wh/kg
Nominal voltage	~3.0V	~3.2V	~3.6V
Key raw materials for cost	Sodium	Lithium	Lithium, nickel

Growing uptake of LFP for its lower cost; nickel-rich cathodes for higher performance

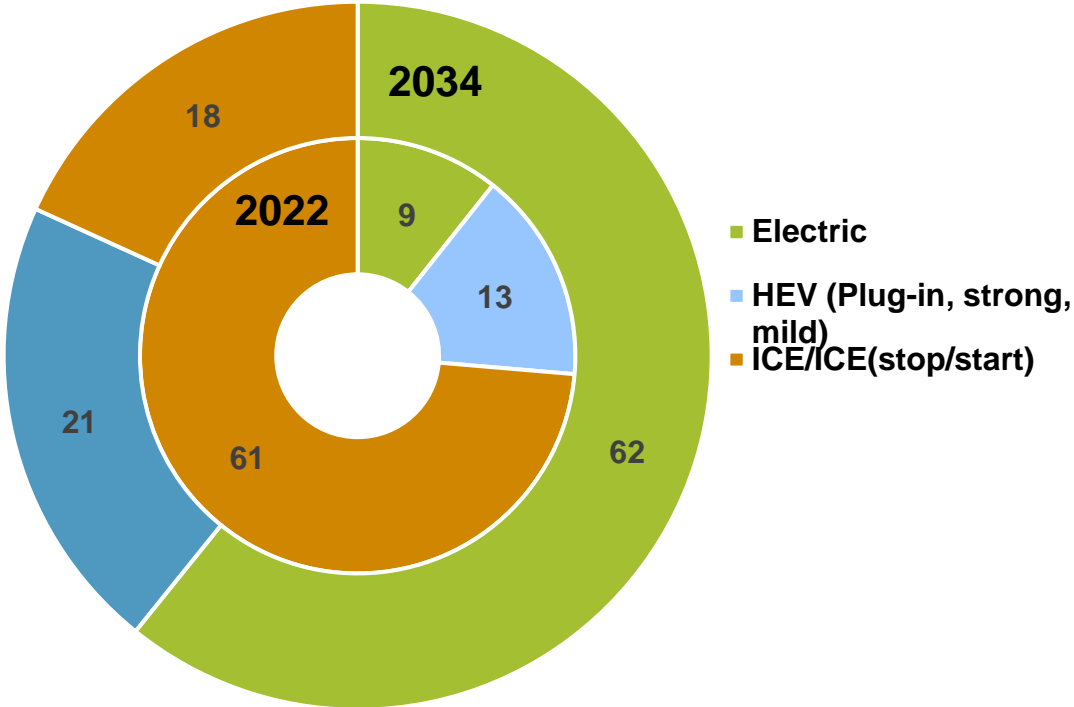
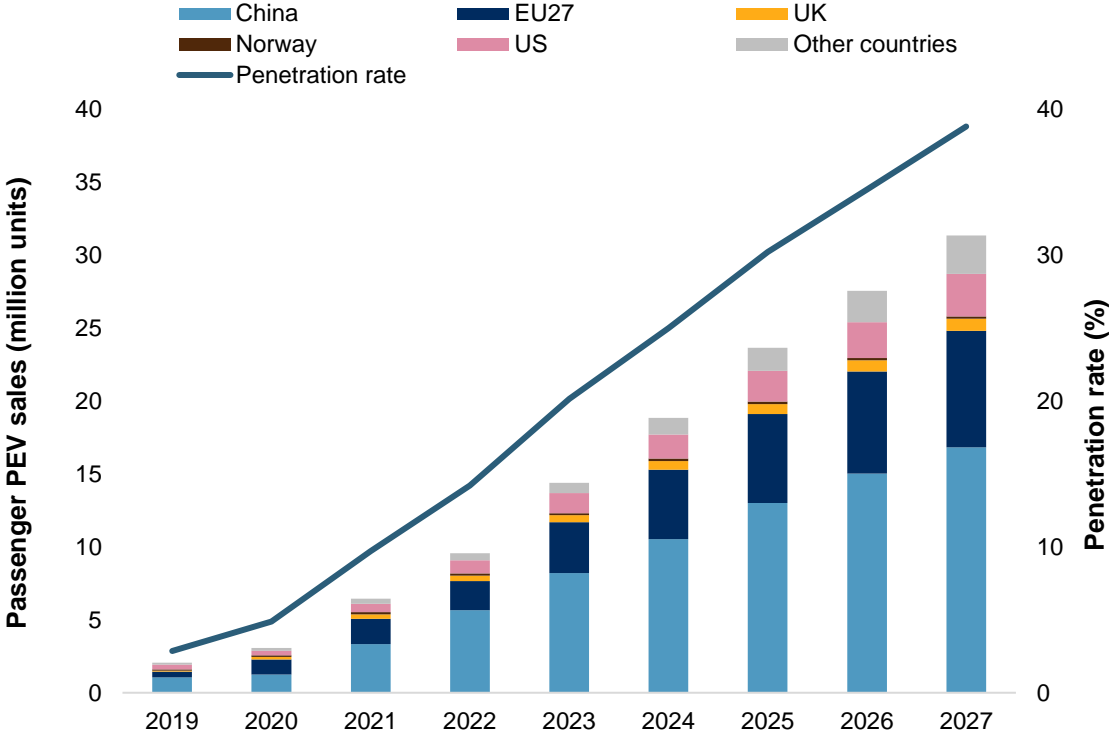


Data compiled July 7, 2023.  
 LFP = lithium ferrous phosphate; LMFP = lithium manganese ferrous phosphate; LNMO = lithium manganese nickel oxide; NMC = lithium-nickel, manganese and cobalt battery; NCA = lithium-nickel, cobalt and aluminum battery; NMCA = nickel manganese cobalt aluminum; Wh/l = watt-hours per liter.  
 Source: S&P Global Commodity Insights.

# Strong passenger PEV sales outlook despite near-term headwinds

PEV sales forecast to grow at 27% CAGR over 2022–27

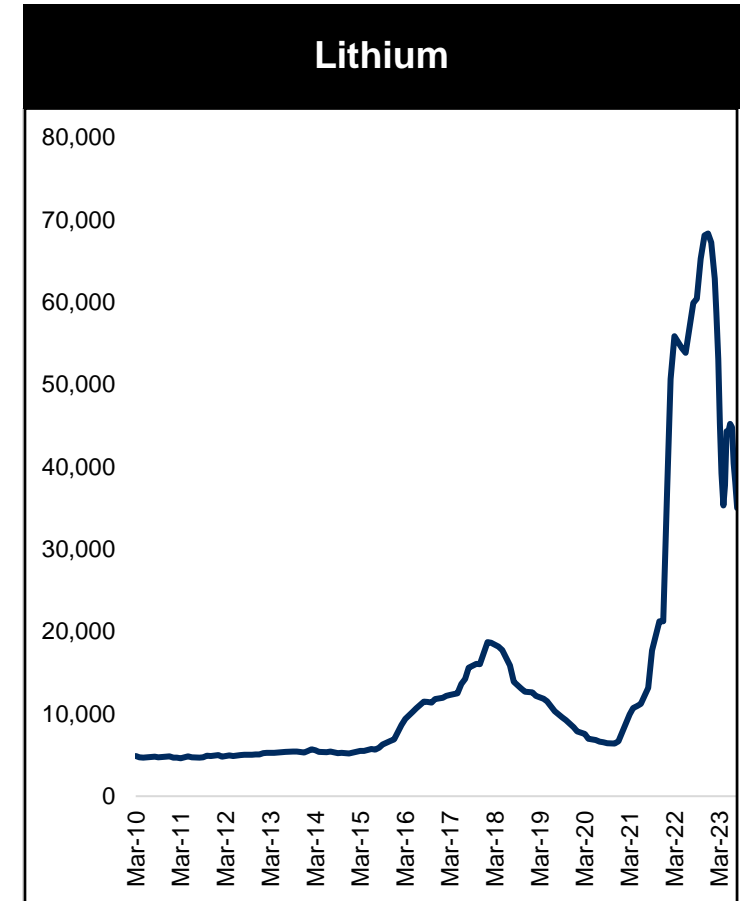
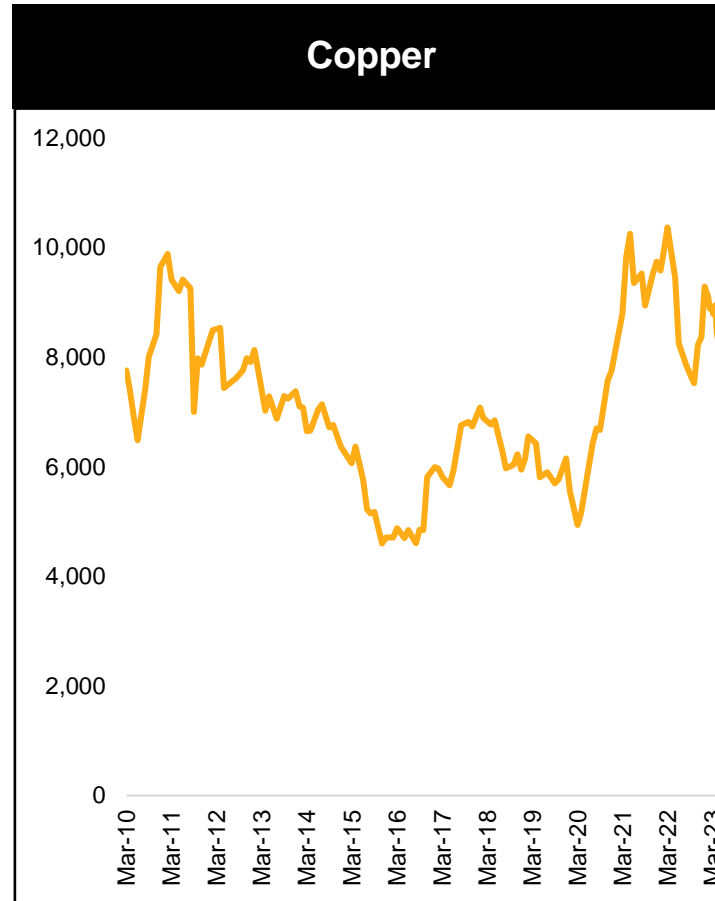
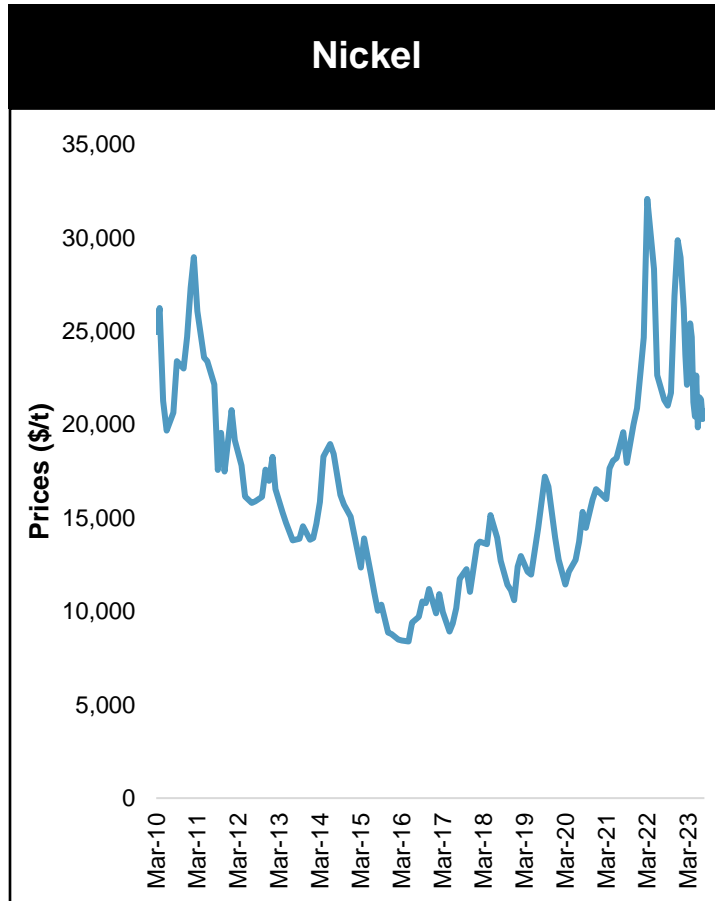
Electric vehicles make 60% of light passenger vehicles production in 2034, up from 10% in 2022



Data compiled April 2023.  
 PEV = plug-in electric vehicle, HEV = hybrid electric vehicle, ICE = internal combustion engines, CAGR = compound annual growth rate.  
 Source: S&P Global Mobility, AutoTechInsight., Light passenger vehicles only (0-6T GVW)



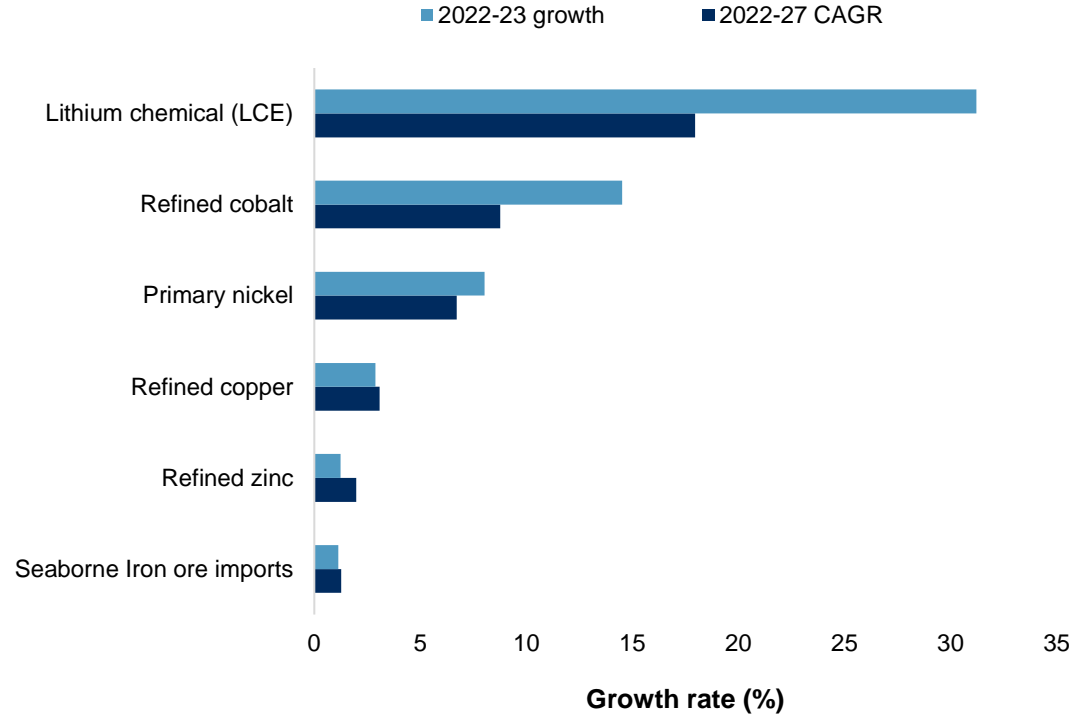
# Battery metals prices remain elevated



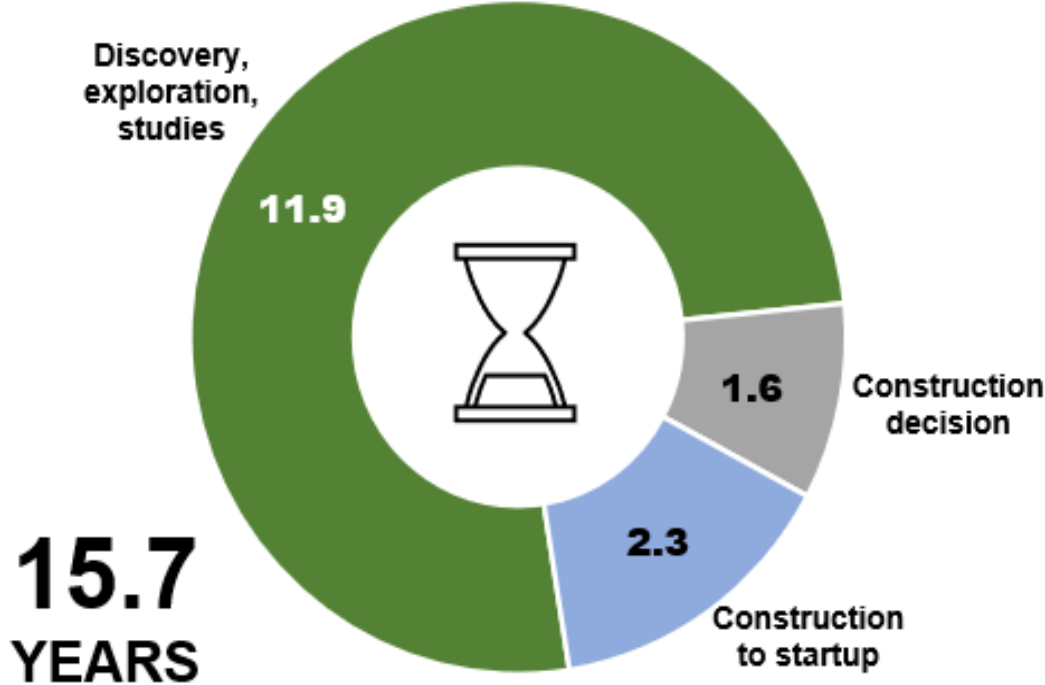
Data compiled September 2023.  
\$/t = dollars per metric ton.  
Source: S&P Global Commodity Insights.

# Demand to easily outpace supply due to inadequate pipeline, longer mine-building time

Battery materials demand growth rates outpace industrial metals



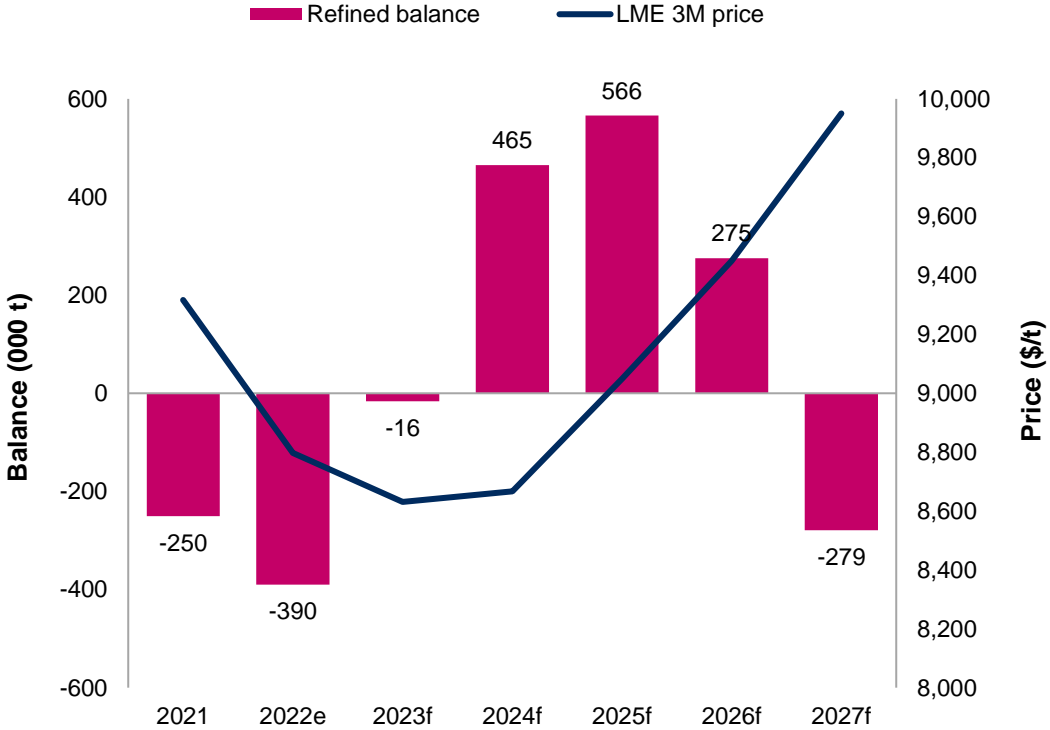
Average lead times of mines\* from discovery to production, 2002–23



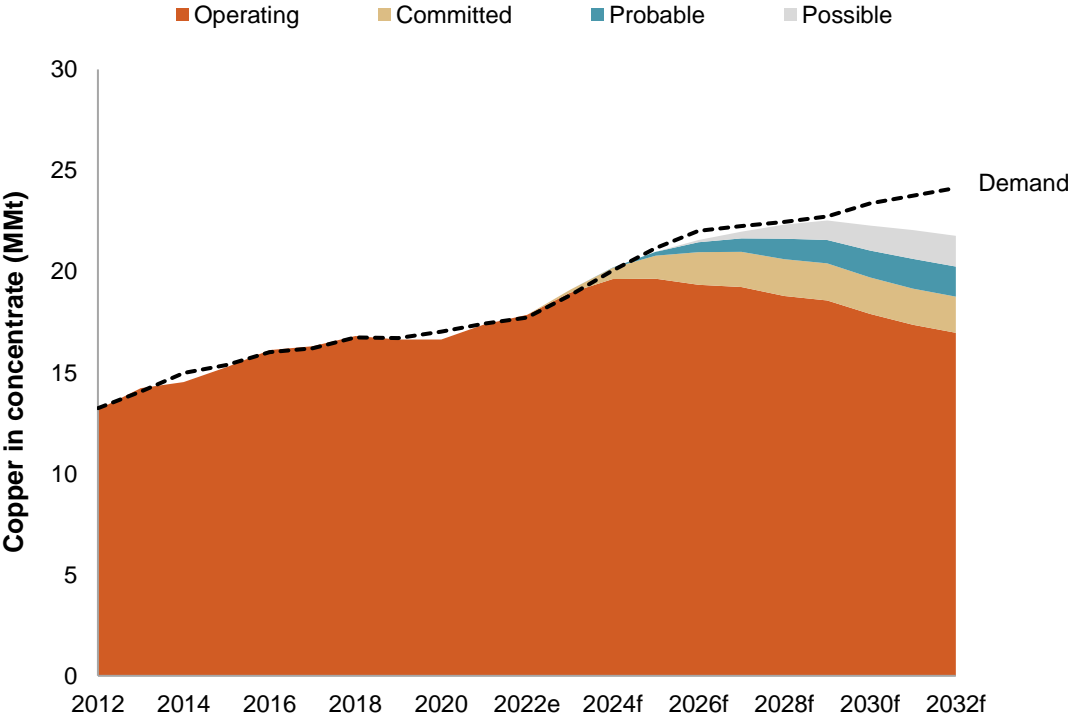
Data compiled September 2023.  
 CAGR = compound annual growth rate; LCE = lithium carbonate equivalent.  
 \* 127 mines in the study, including gold, copper, nickel, silver and zinc mines.  
 Source: S&P Global Commodity Insights.

# Copper supply threatened

Prices to remain elevated despite surplus in the medium term due to longer term threats on supply



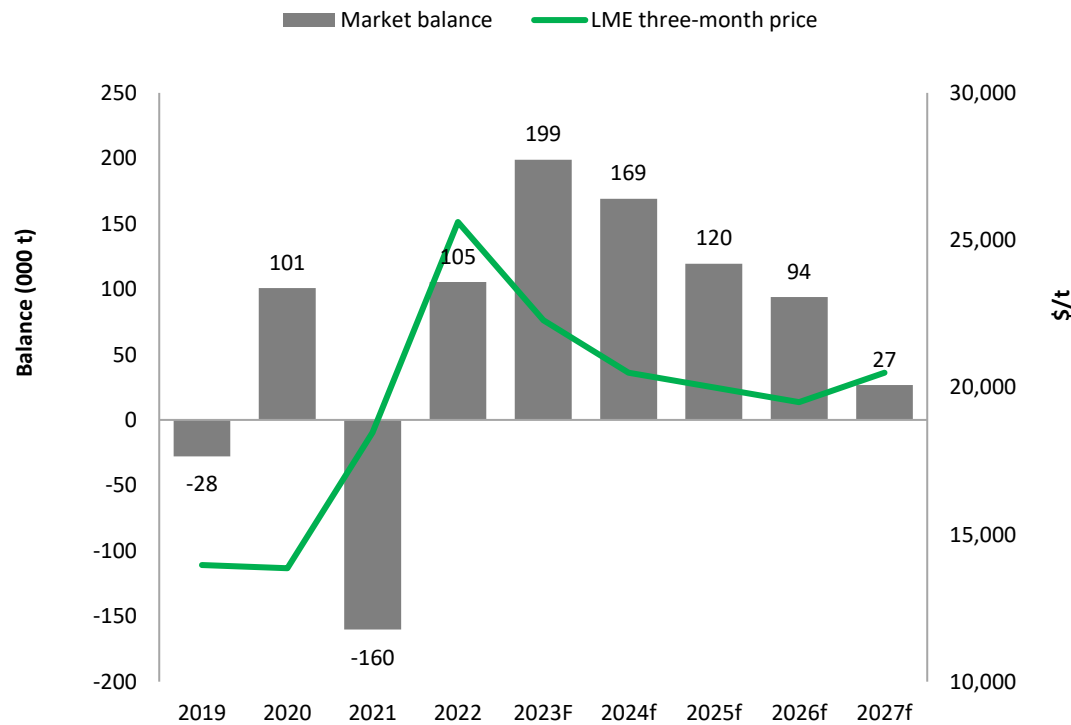
2.2-MMt deficit expected in 2032 and up to 5 MMt in low-supply scenario



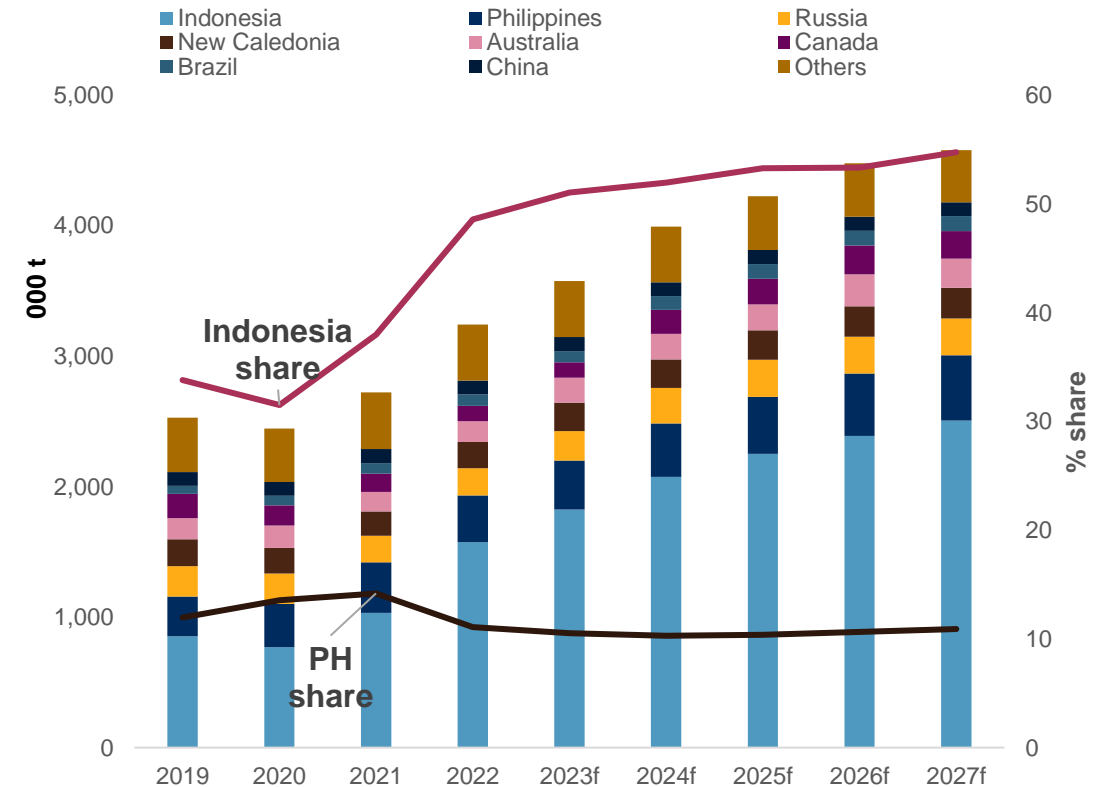
As of Aug. 15, 2023.  
 LME 3M = London Metal Exchange three-month; MMt = million metric tons; \$/t = dollars per metric ton.  
 Source: S&P Global Market Intelligence.

# Nickel demand expected to outpace supply in medium term

Primary nickel will be in surplus until 2027 but will continue to dwindle



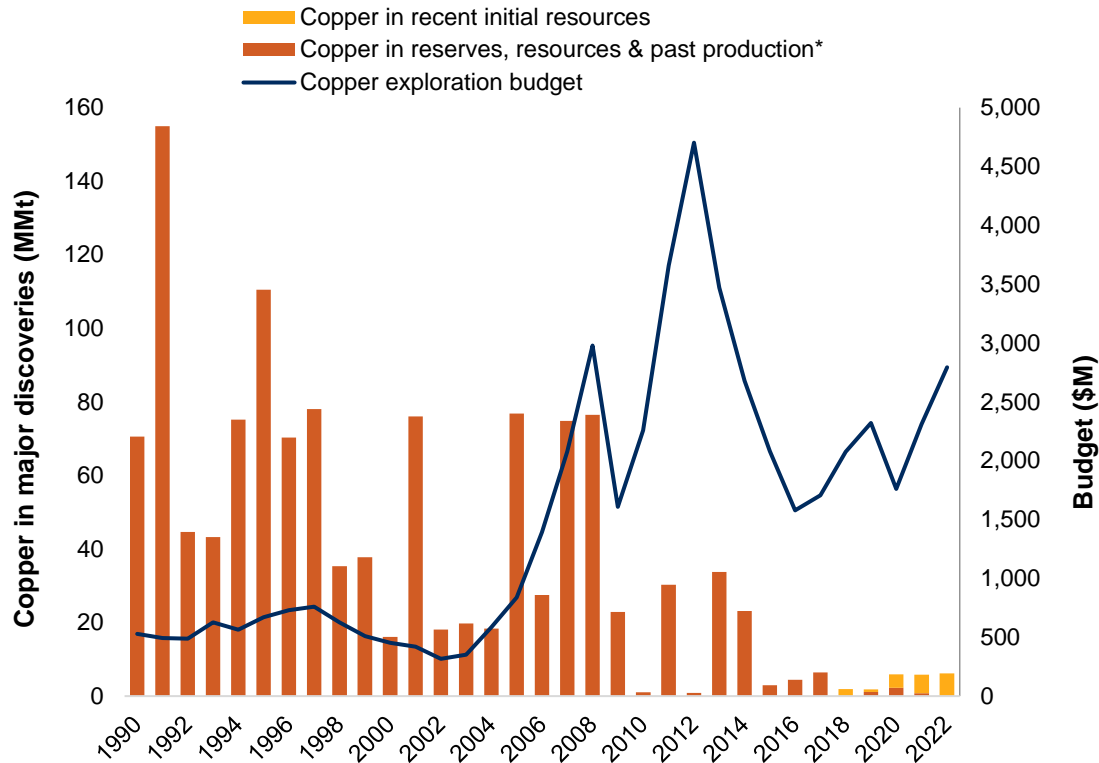
More than half of global mined nickel will come from Indonesia in 2027, PH will grow but not as fast



As of Aug. 17, 2023.  
f = forecast; YOY = year over year.  
Source: S&P Global Market Intelligence.

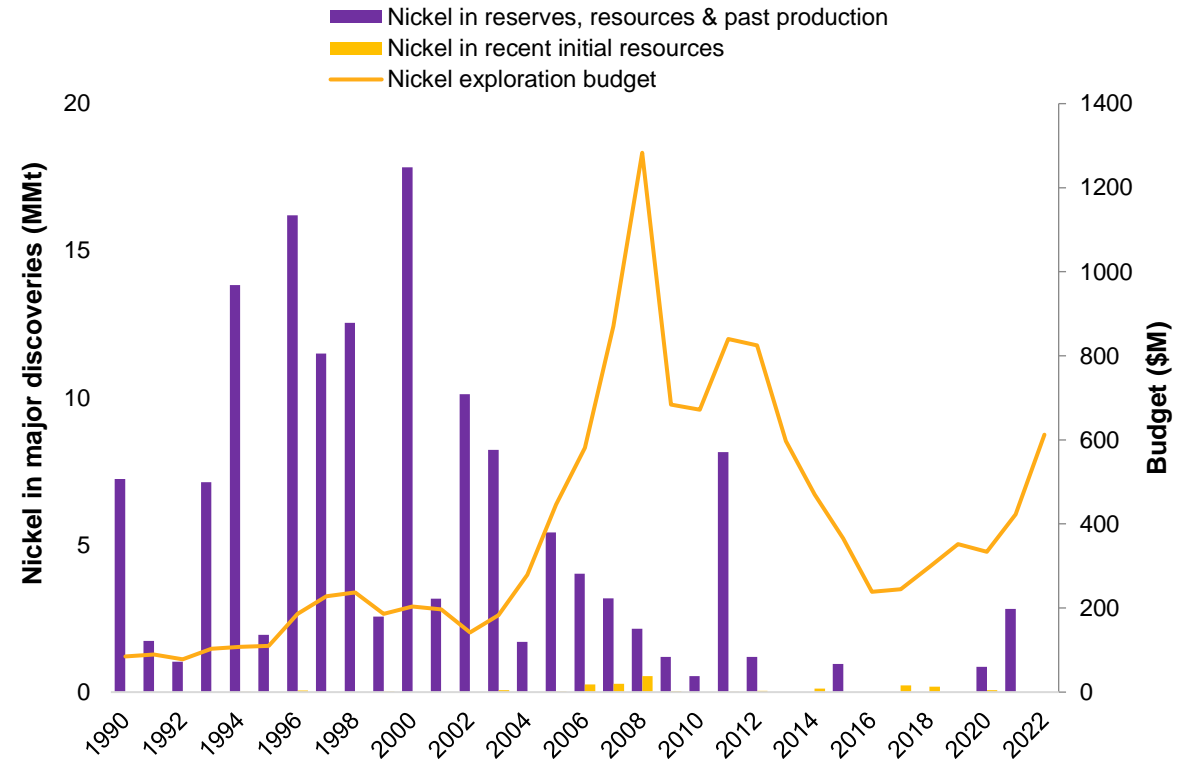
# Copper and nickel discoveries

Copper discoveries still trending down amid increasing budgets, higher prices



As of July 11, 2023.  
MMt = million metric tons.  
Source: S&P Global Market Intelligence.

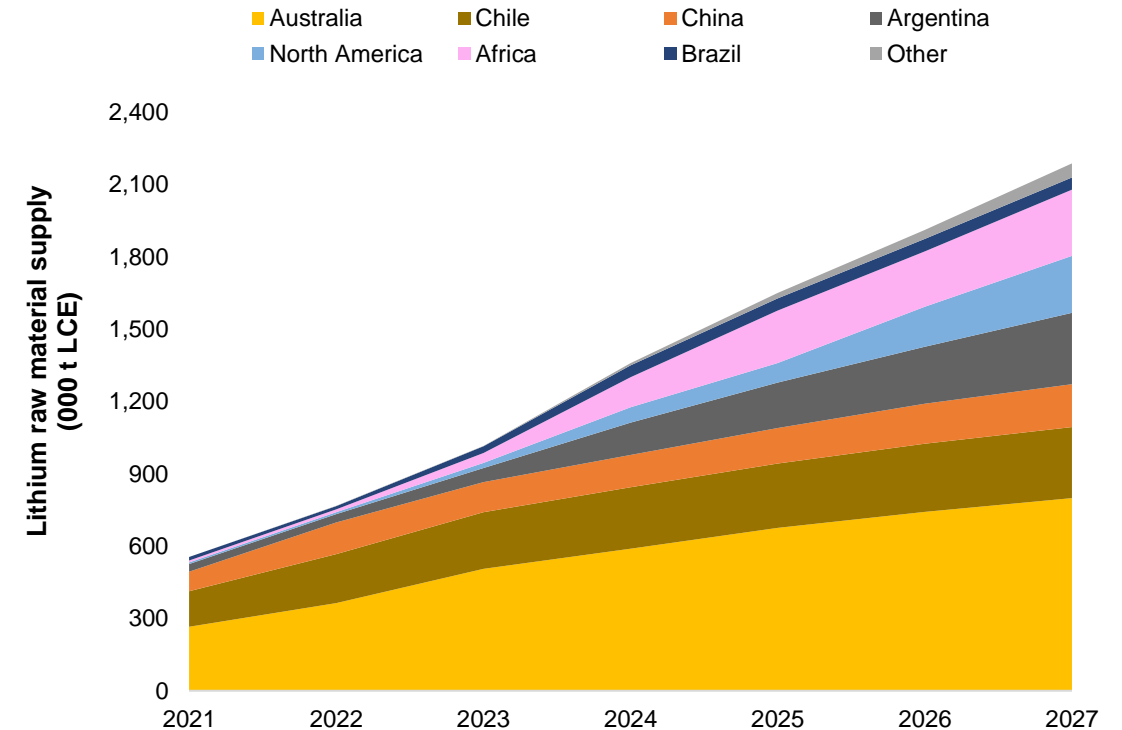
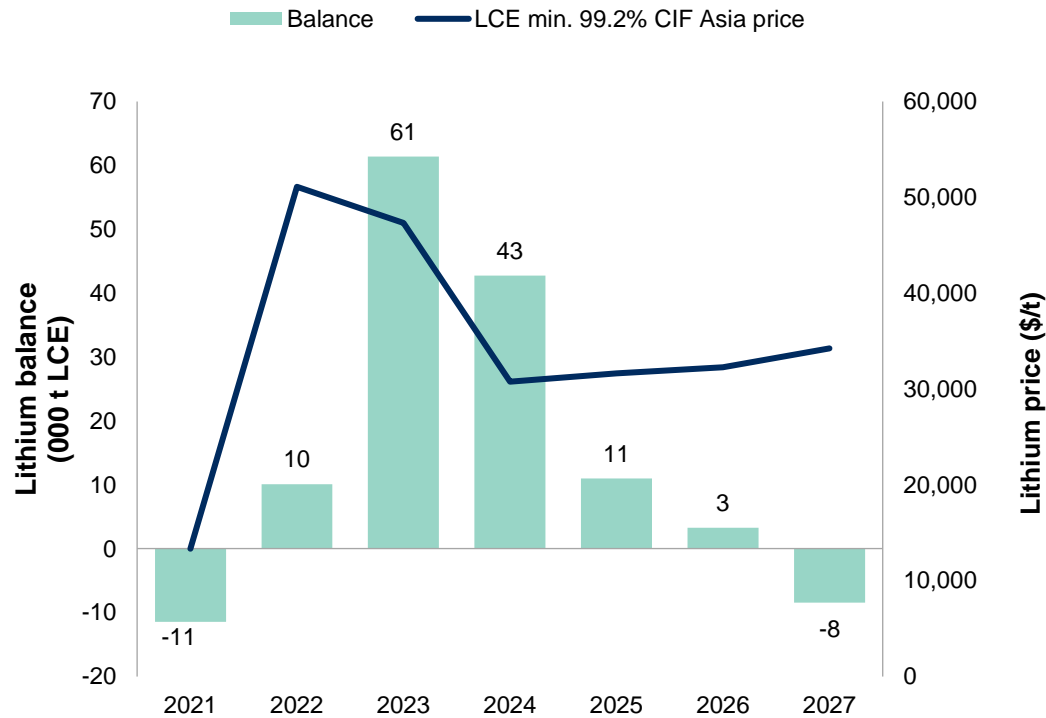
Nickel in recent initial resources remains insignificant as potential additions to major discoveries



# Lithium surplus expected to diminish until turned to deficit in 2027

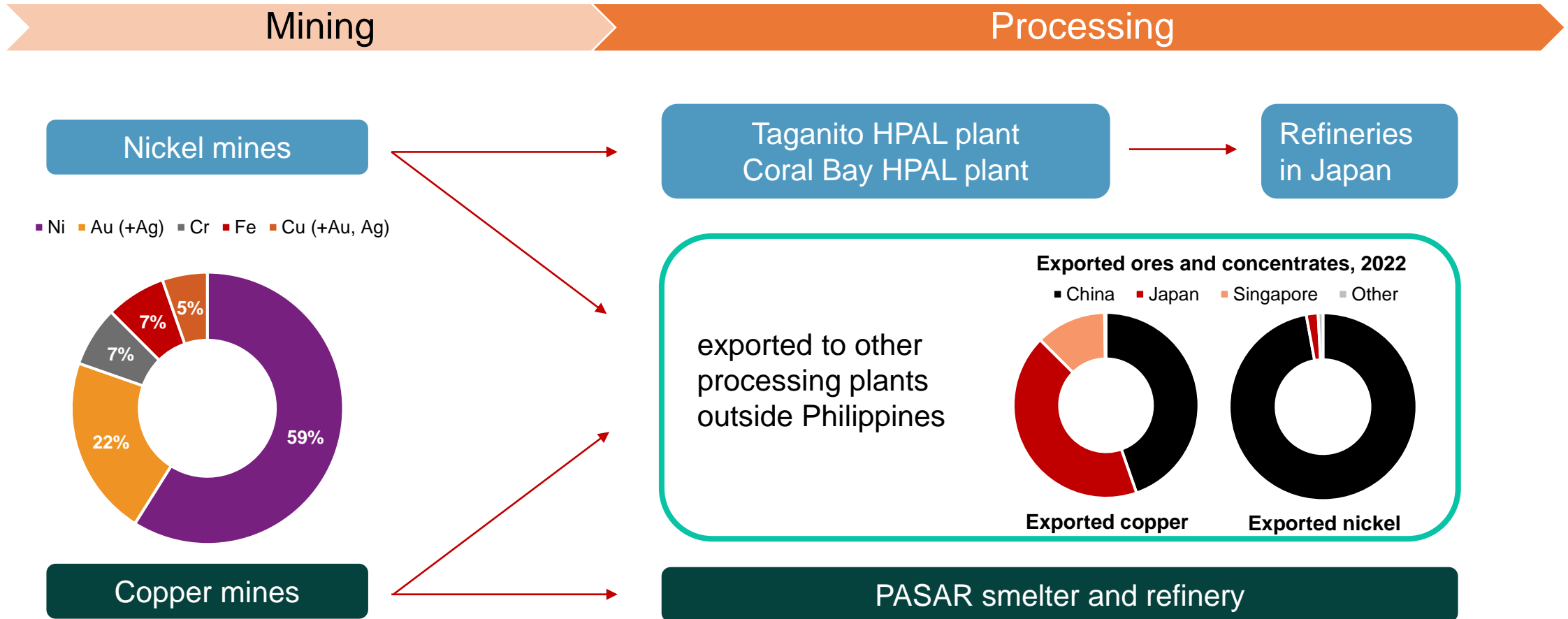
Solid project pipeline sustains lithium market surplus to 2026

Australia expected to remain largest lithium supplier; rapid growth in Africa, North America



As of Aug. 22, 2023.  
 LCE = lithium carbonate equivalent; \$/t = dollars per metric ton.  
 Source: S&P Global Market Intelligence.

# Philippines more involved in upstream industry



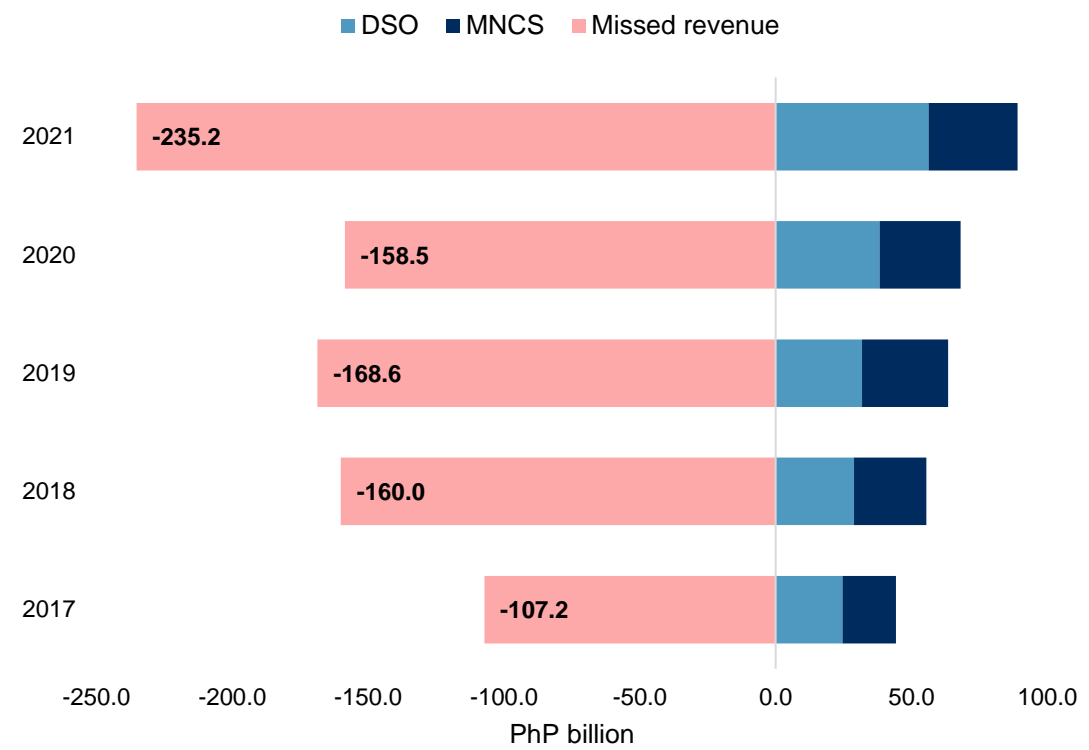
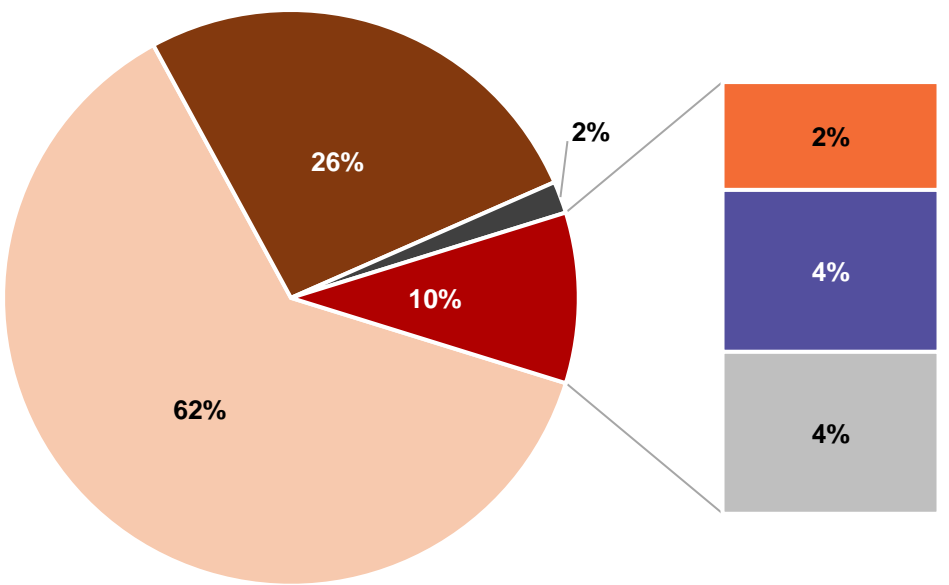
As of Sept. 11, 2023  
 HPAL = high pressure acid leach. PASAR = Philippine Associated Smelting and Refining Corp.  
 Other countries include Malaysia, Indonesia and South Korea.  
 Sources: S&P Global Commodity Insights; Philippines Mines and Geosciences Bureau.

# A few projects currently in development; significant ore value lost due to lack of local processing capacities

Only 14% of current MPSAs are nickel, copper projects under development

Potential additional value of ores lost due to lack of local processing capacity

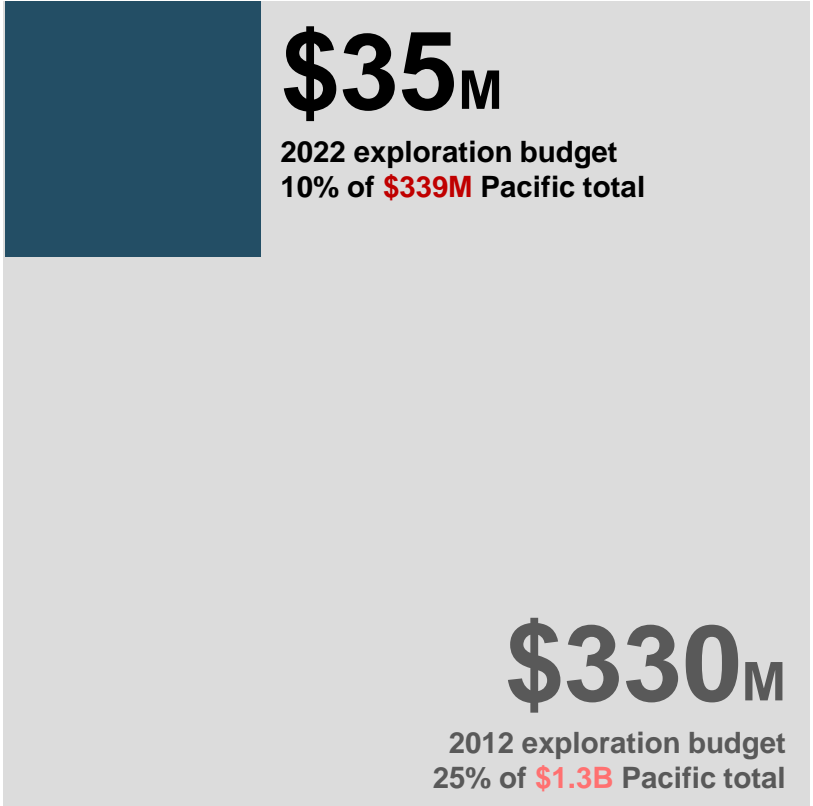
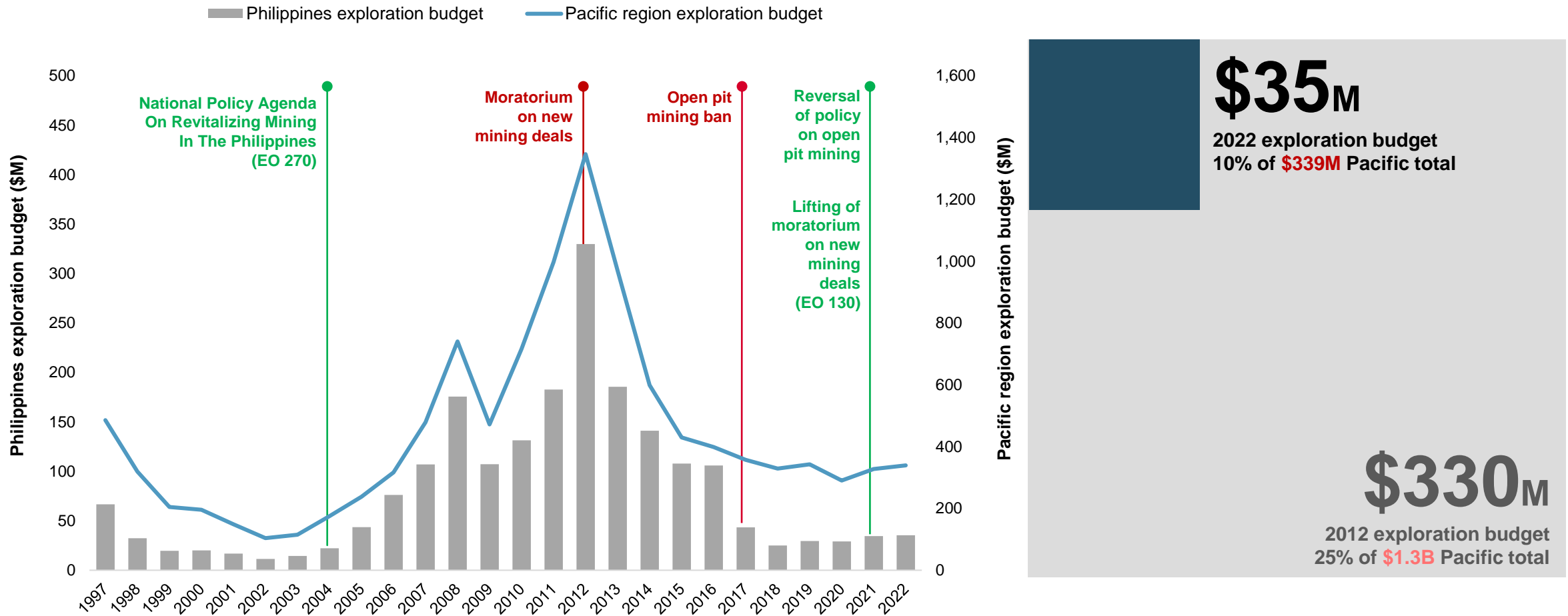
- Exploration
- Commercial operation
- Other\*
- Development w/ copper
- Development w/ nickel
- Development - other^



As of Sept. 11, 2023.  
 \* Includes projects under care and maintenance and inactive operating period. ^ Includes projects for copper, gold, magnetite and silver.  
 MPSA = mineral production sharing agreement; DSO = direct shipping ore; MNCS = mixed nickel-cobalt sulfide. PhP = Philippine peso.  
 Sources: S&P Global Market Intelligence; Philippines Mines and Geosciences Bureau.



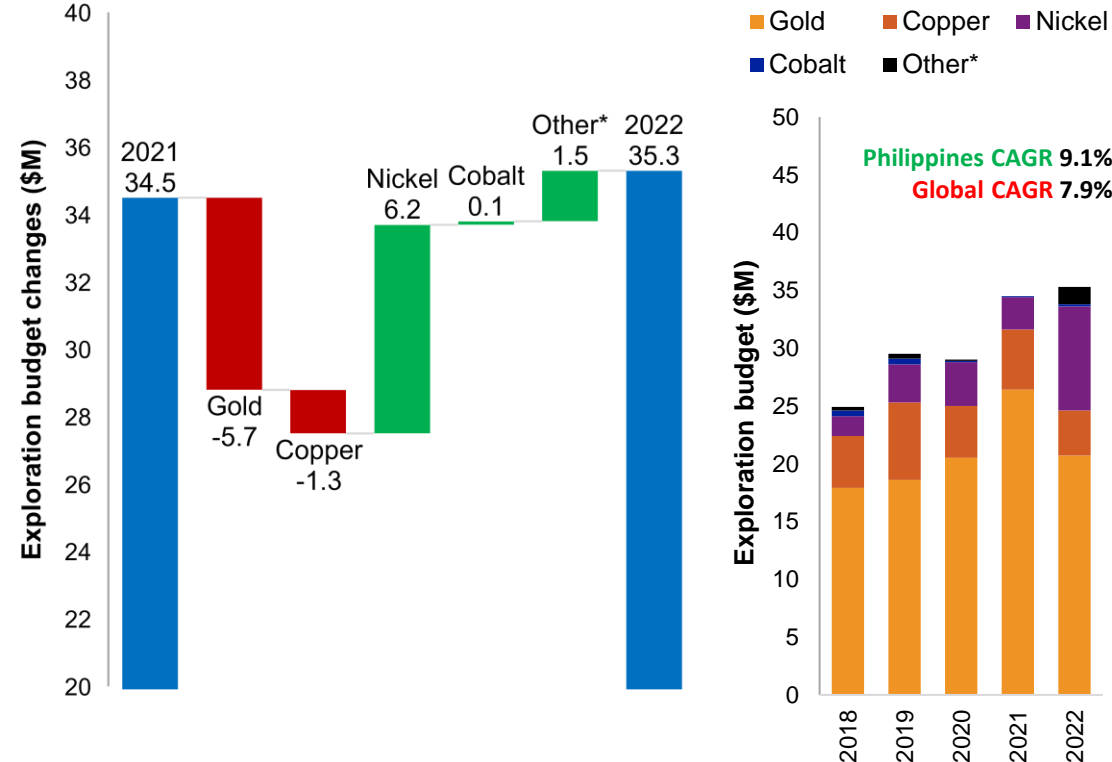
# Philippines exploration budgets dwindle in recent decade



As of Aug. 11, 2023.  
 Source: S&P Global Market Intelligence.

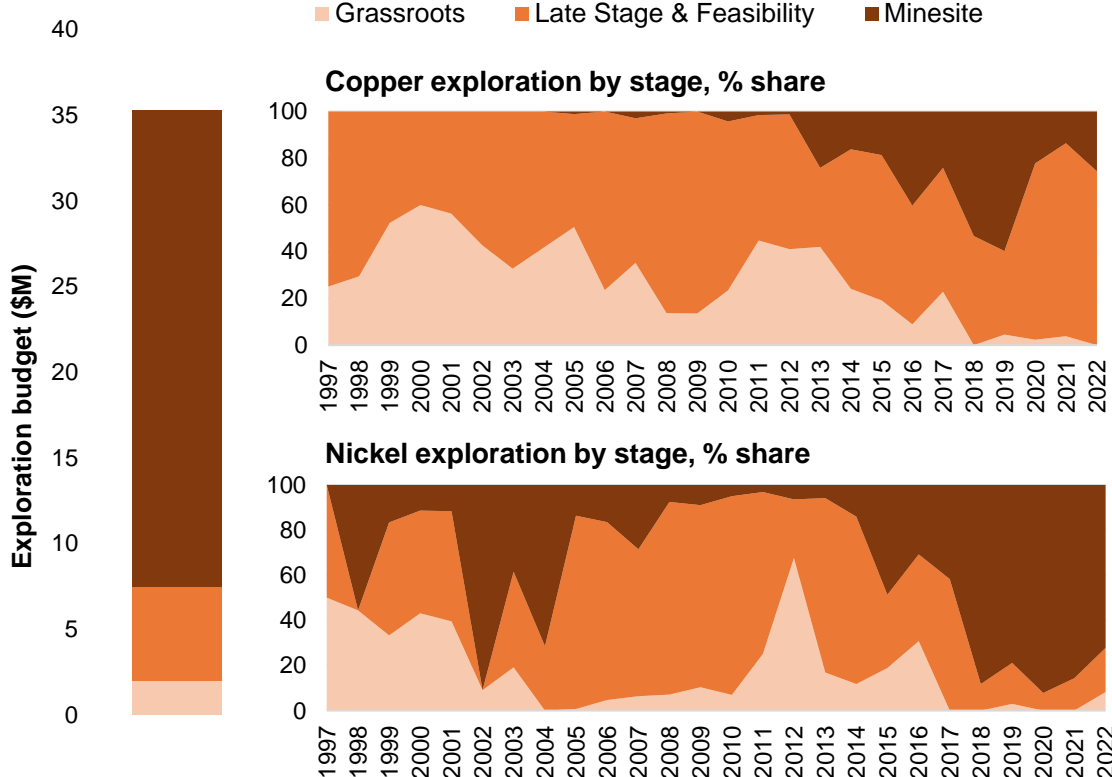
# More intensive exploration for green metals in 2022; majority of allocations still directed to minesite activities

Local exploration remains gold-focused; nickel exploration lifted 2022 total



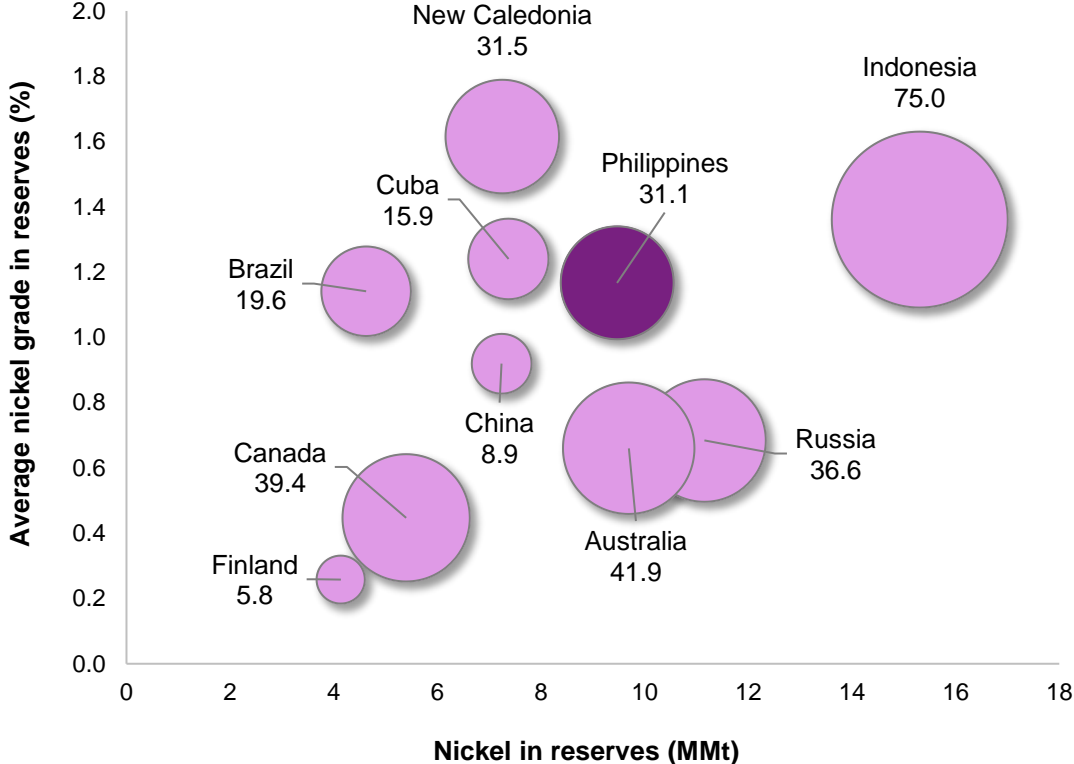
As of Aug. 11, 2023.  
 CAGR = compound annual growth rate.  
 \* Other includes silver, molybdenum, platinum, zinc-lead and other minor commodities.  
 Source: S&P Global Market Intelligence.

Advanced exploration dominates for copper, nickel

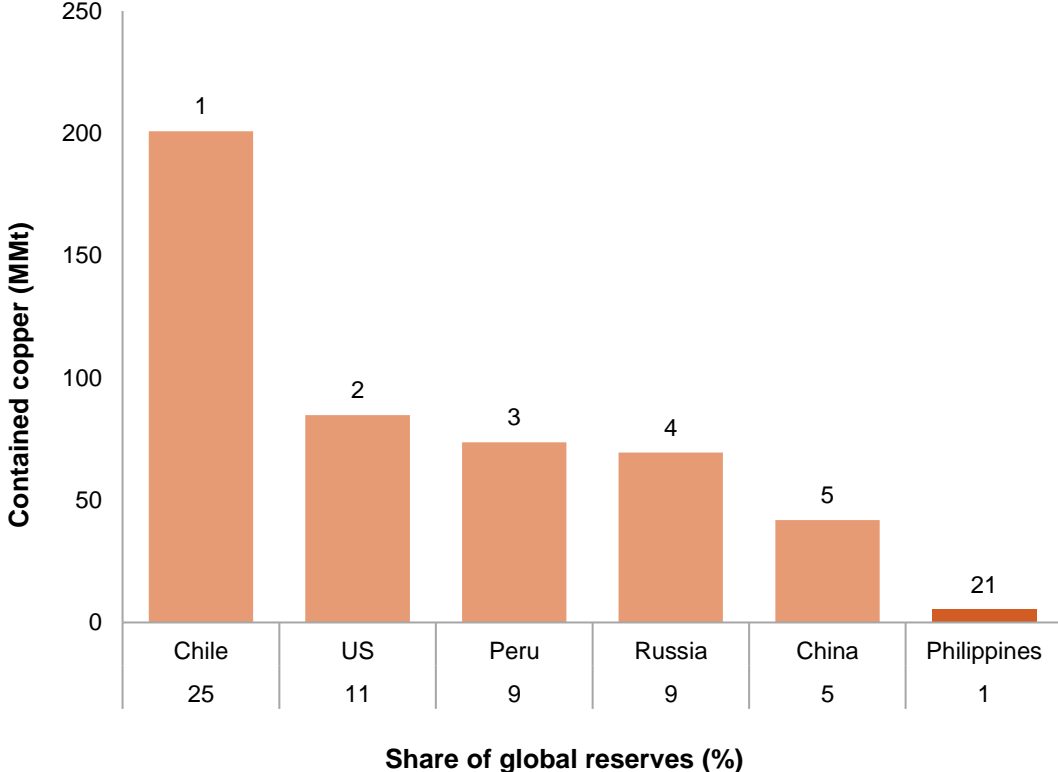


# Philippines nickel reserves competitive; copper reserves lag other countries globally

Philippines hosts 4<sup>th</sup> largest nickel reserves globally



... but lag other countries in copper reserves

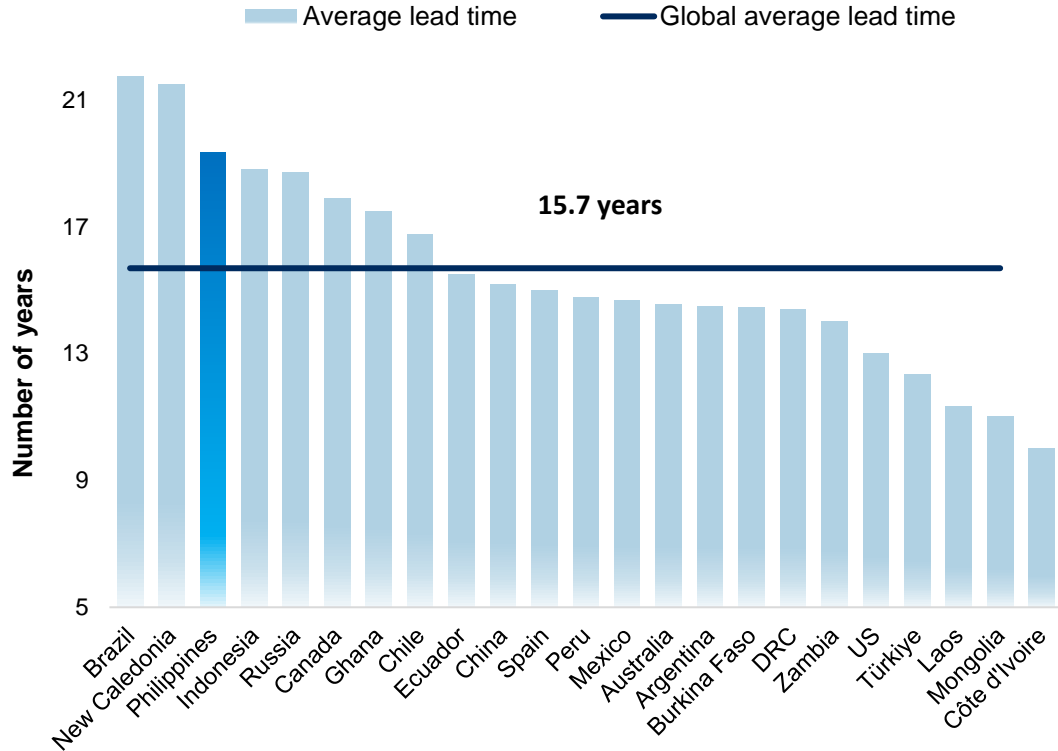
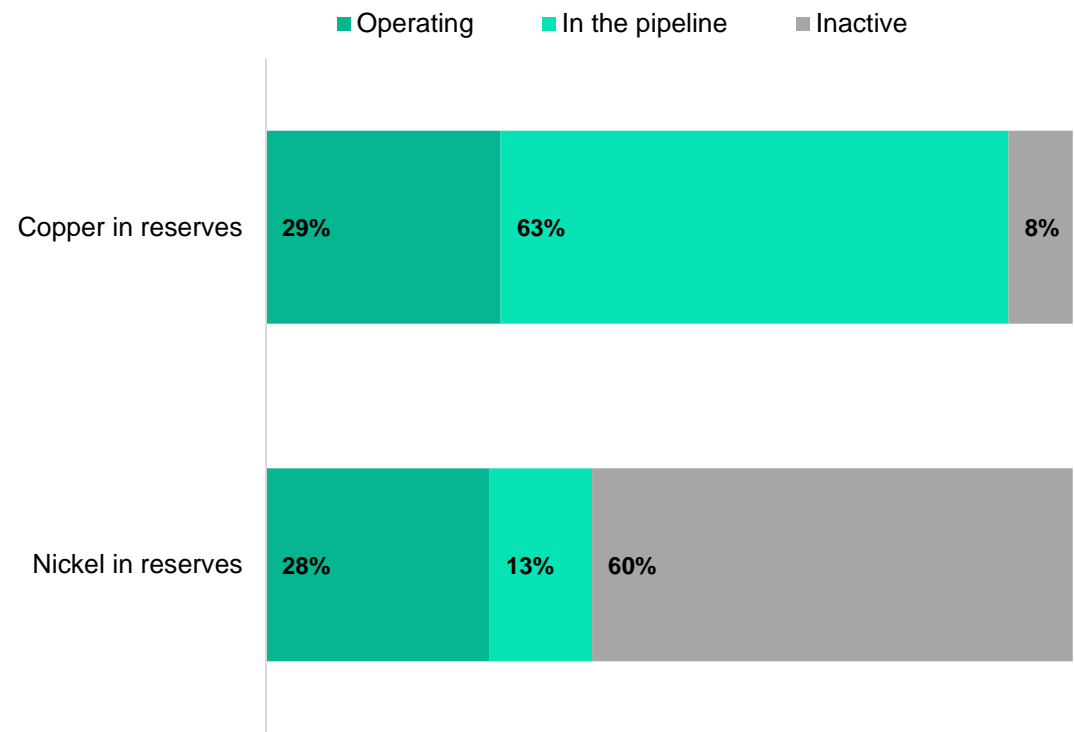


As of Aug. 11, 2023.  
 MMt = million metric tons.  
 Bubble size represents total contained nickel in reserves and resources.  
 Source: S&P Global Market Intelligence

# Philippines holds huge untapped resources, longer lead time to production

Copper, nickel reserves are hosted in underdeveloped deposits

Philippines holds 3<sup>rd</sup> longest average lead time from discovery to production

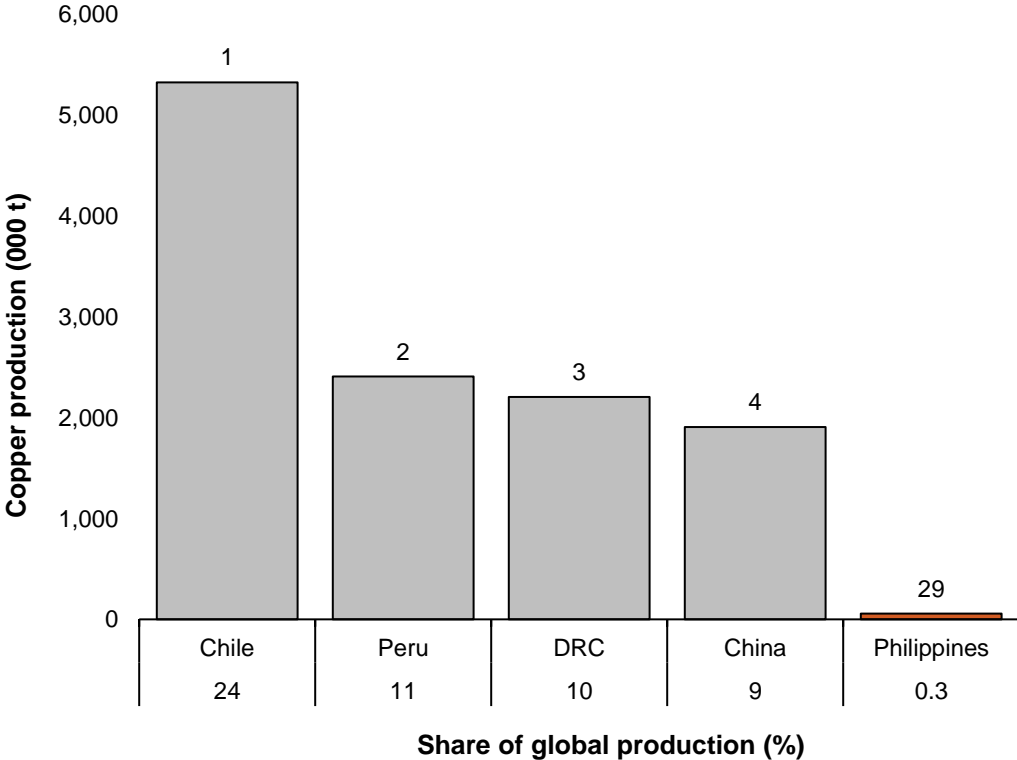
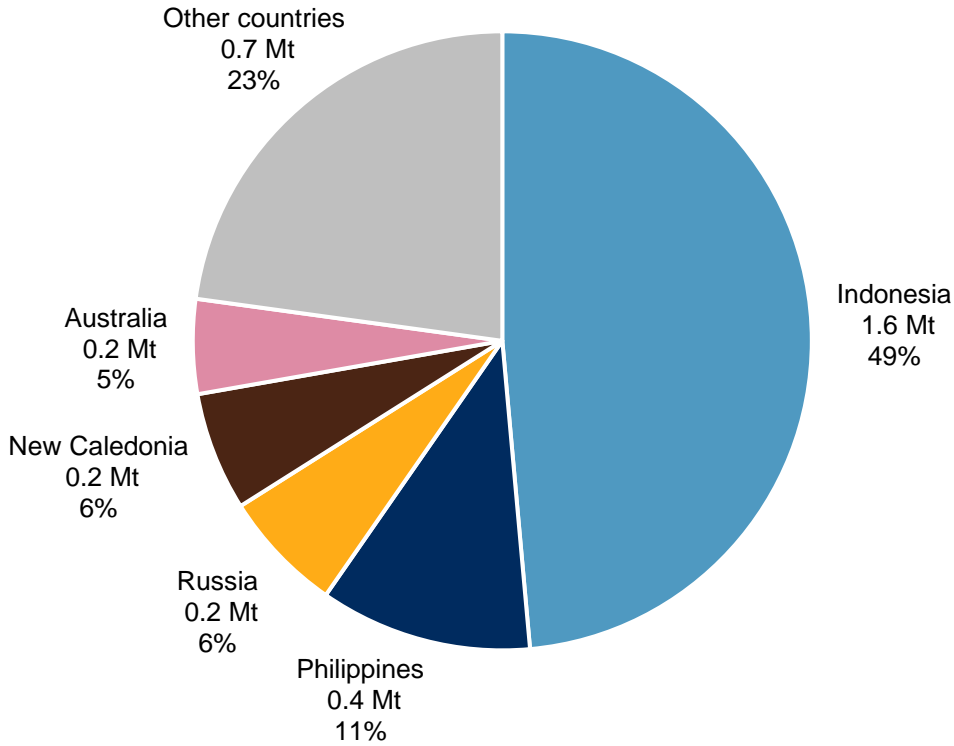


As of Aug. 11, 2023.  
 DRC = Democratic Republic of the Congo.  
 Source: S&P Global Market Intelligence.

# Philippines maintain rank in nickel production, lag other countries in copper production

Nickel production ranks at far 2<sup>nd</sup> spot in 2022 next to Indonesia despite 7% YOY decrease

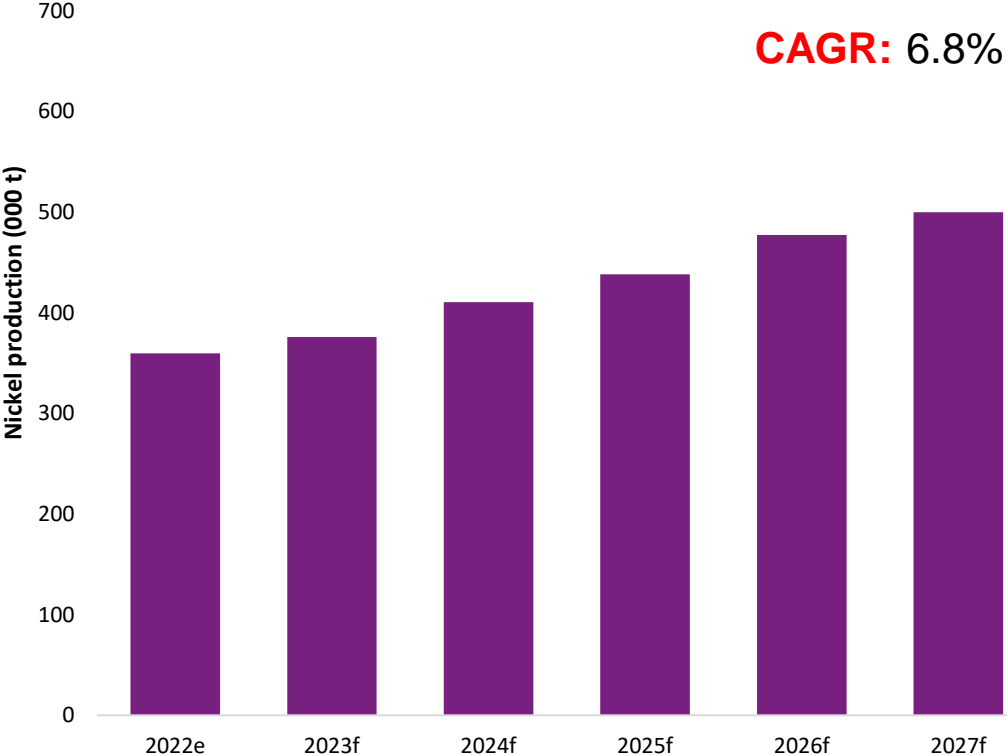
Philippines contributes less than 1% of global mined copper production in 2022



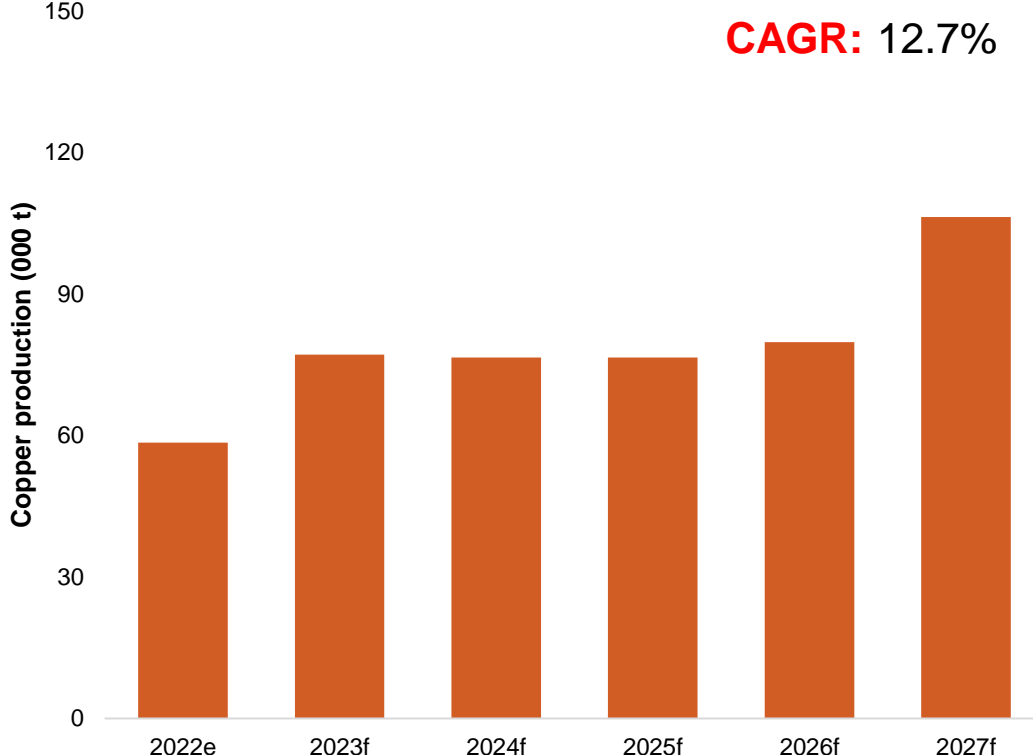
As of Aug. 11, 2023.  
 Numbers above the percentages in the pie chart are the amount of mined nickel produced in million metric tonnes (Mt). YOY = year over year; DRC = Democratic Republic of the Congo.  
 Source: S&P Global Market Intelligence.

# Nickel, copper production to increase in medium term

Nickel production to maintain Philippines' ranking globally at 2<sup>nd</sup> spot next to Indonesia



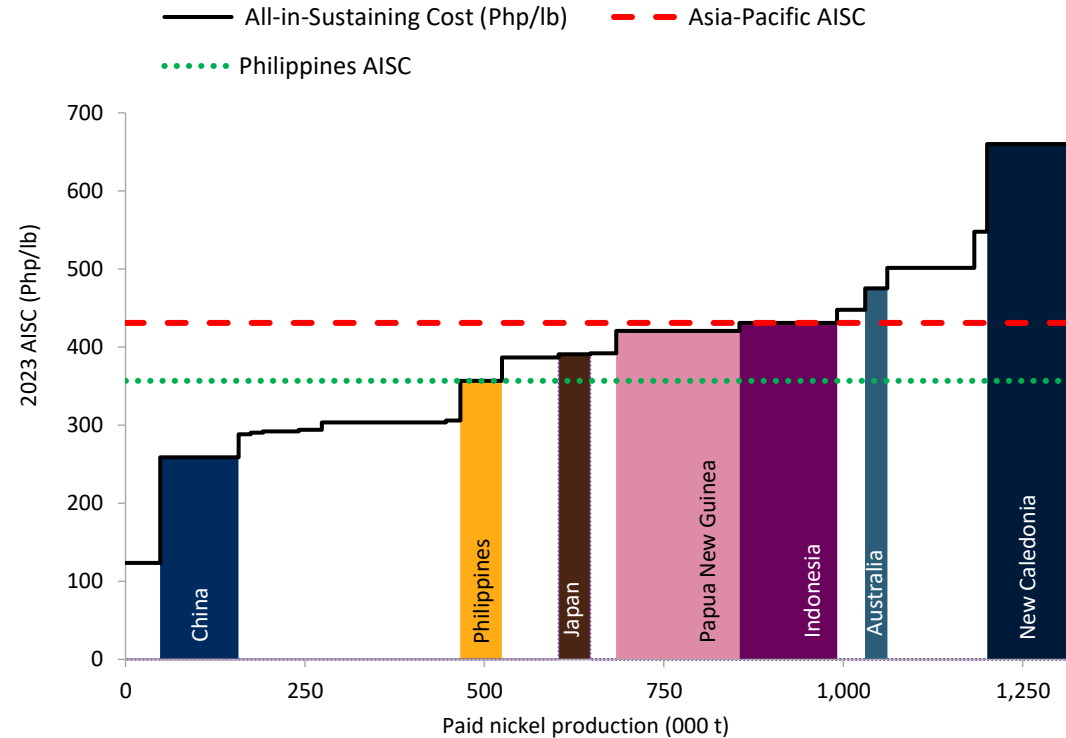
Strong projected growth for copper production with Tampakan mine going online



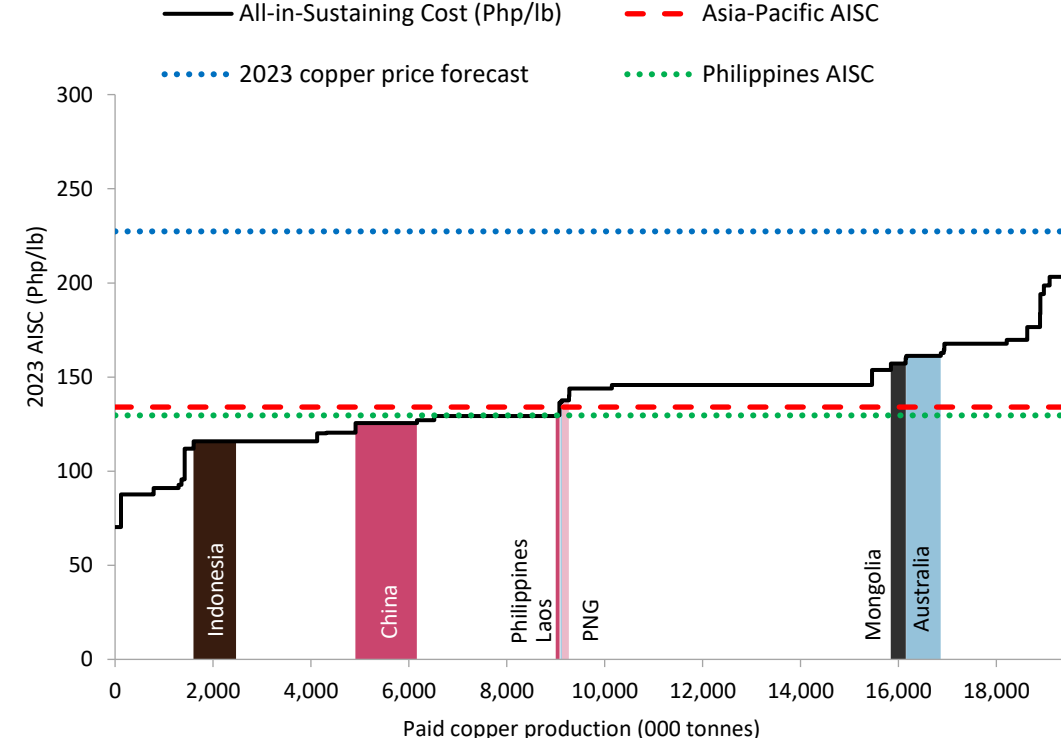
As of Aug. 23, 2023.  
 CAGR = compound annual growth rate.  
 Source: S&P Global Market Intelligence.

# Nickel, copper mines' AISC to trend lower than Asia-Pacific average in 2023

Philippines nickel mines' 2023 AISC remain lower than Asia-Pacific average

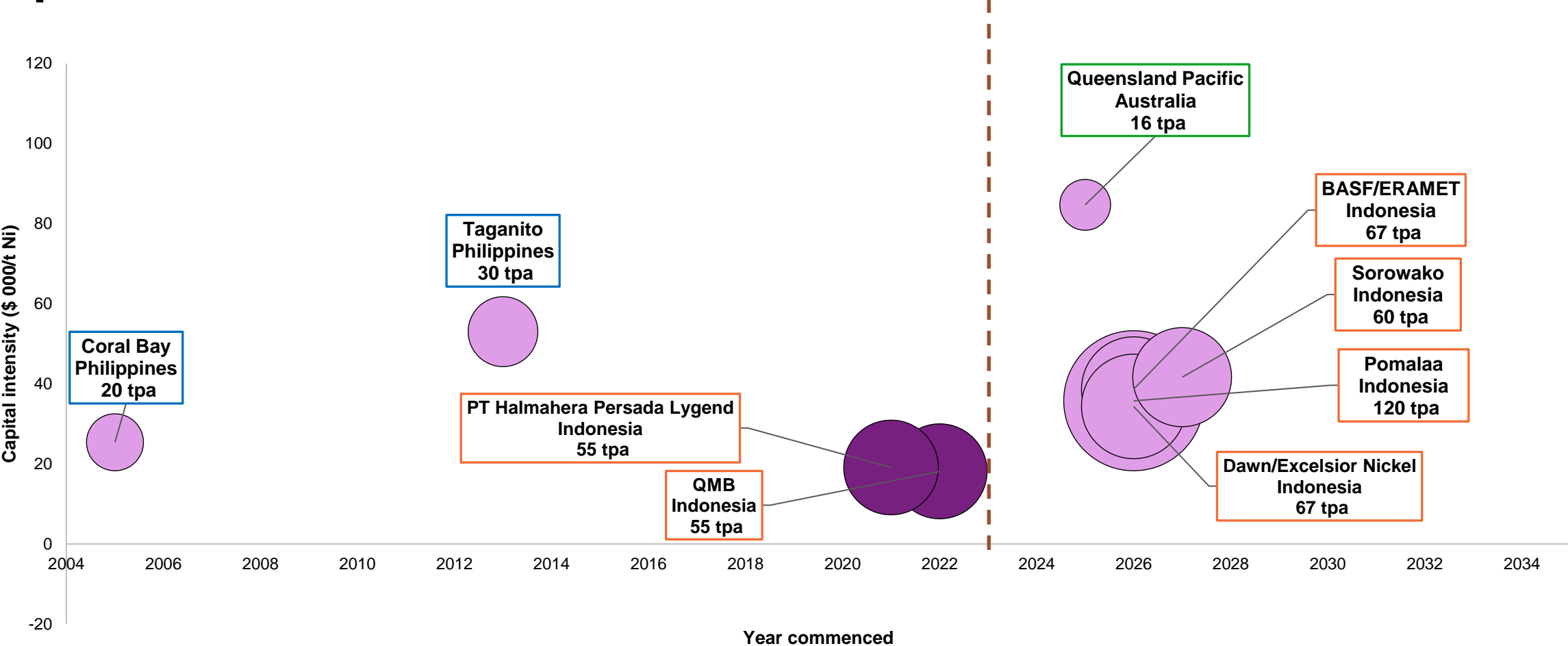


Philippines copper mines' AISC to decline 26% in 2023



As of Aug. 24, 2023.  
AISC = all-in sustaining cost. Costs are presented on a coproduct basis.  
Source: S&P Global Market Intelligence.

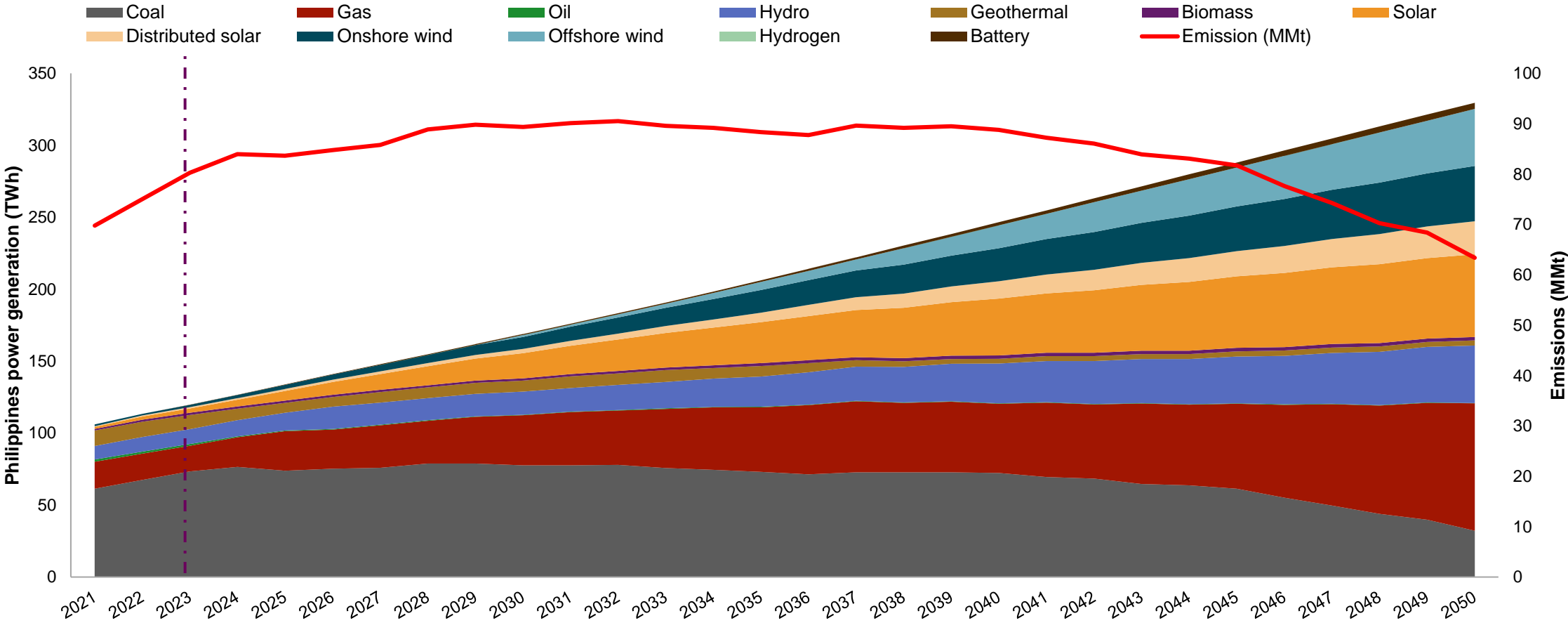
# Recent, future HPAL plants offer lower cost at greater nickel capacities



Data compiled September 2023.  
 Bubble size represents nickel capacity in metric tonnes per annum (tpa).  
 Source: S&P Global Commodity Insights.



# Emissions projected to peak in the medium term; renewables to increase share in energy supply



As of September 2023.  
Source: S&P Global Commodity Insights.

# Conclusion

- 1** Decarbonization in the power generation and transport sectors is crucial to lower emissions.
- 2** Battery technology plays a central role to decarbonize the transport sector and maximize the use of renewable sources of energy.
- 3** The success of electrification depends on meeting demands for battery metals, such as copper, nickel and lithium, that are expected to dip into deficit in the medium term.
- 4** More initiatives from the exploration side to the processing sector are needed to revitalize the Philippines' position in the nickel and copper value chain.
- 5** The mining industry's objectives in expanding the mining and processing involvement of the Philippines must be balanced with the country's decarbonization goals.

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