



Optimizing opportunities: the global landscape of mineral development

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EY

Building a better
working world

Weaker global economic growth, easing inflation and slowing property market in China

Real GDP growth

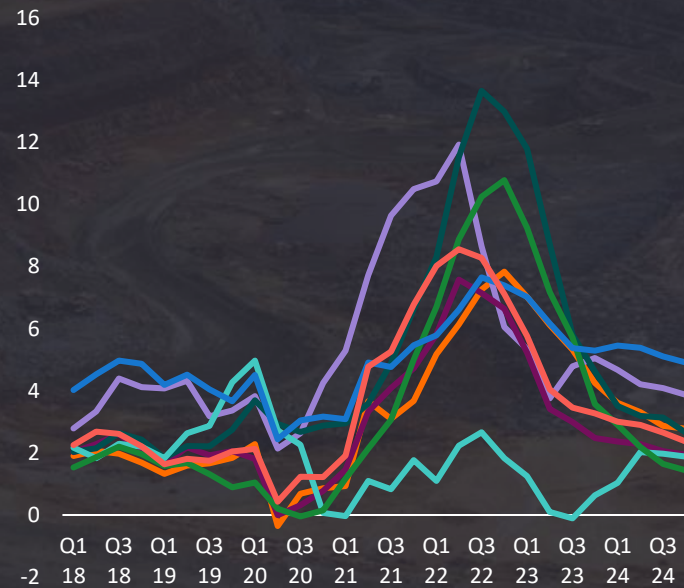
January 2018 to April 2023 (Index 100 = January 2018)



— China
— European Union plus UK
— Latin America
— United States
— World

Consumer price index

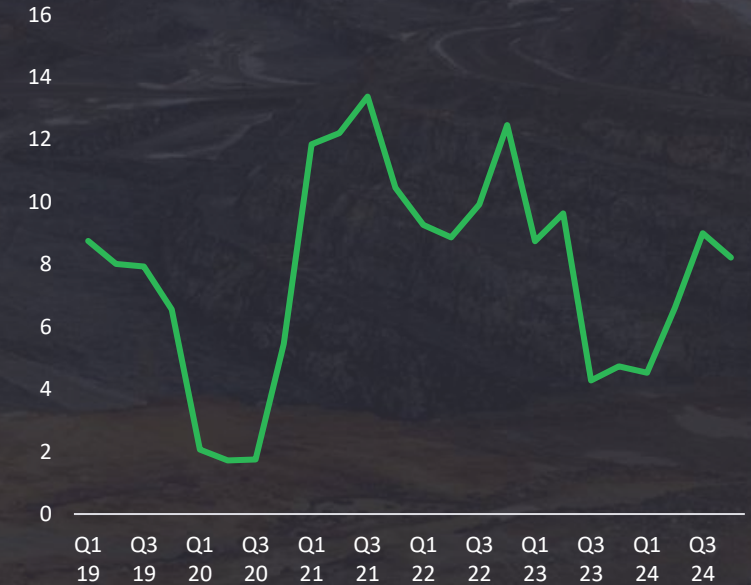
Q1 2018 to Q4 2024f



— Australia
— Brazil
— Canada
— Chile
— China
— European Union plus UK
— South Africa
— United States

China fixed asset investment

Q1 2019 to Q4 2024f

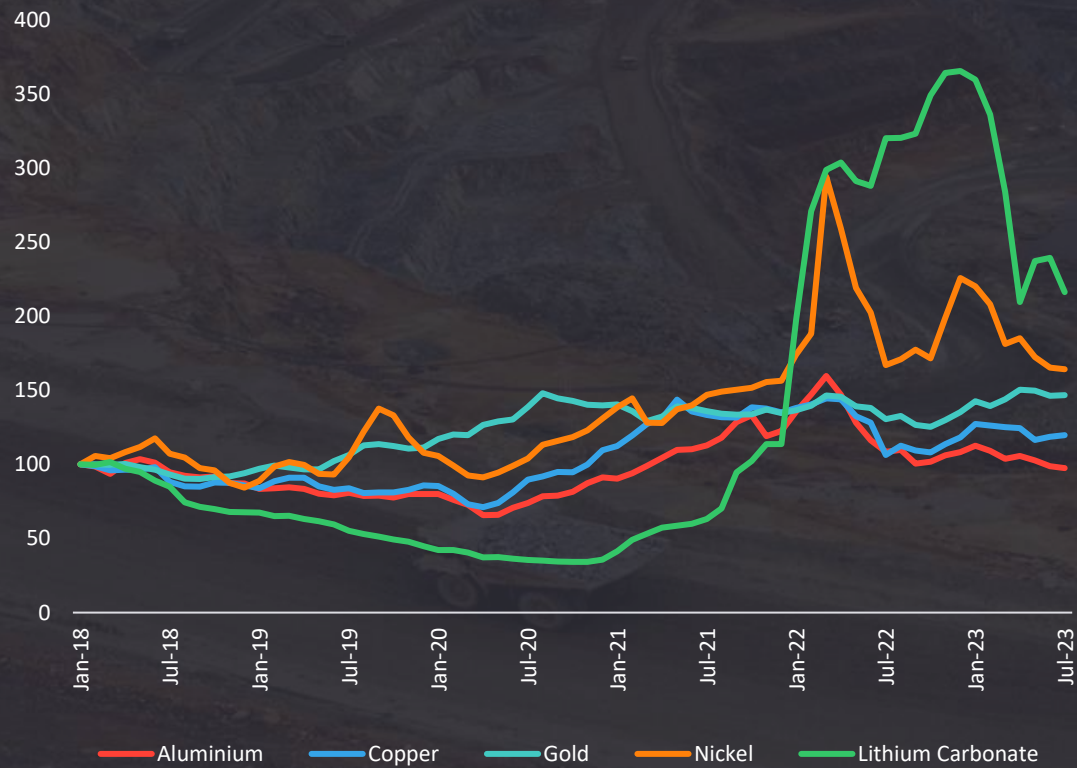


Source: EY Knowledge analysis of Oxford Economics, September 2023

Weaker demand for metals, but inventories remain low

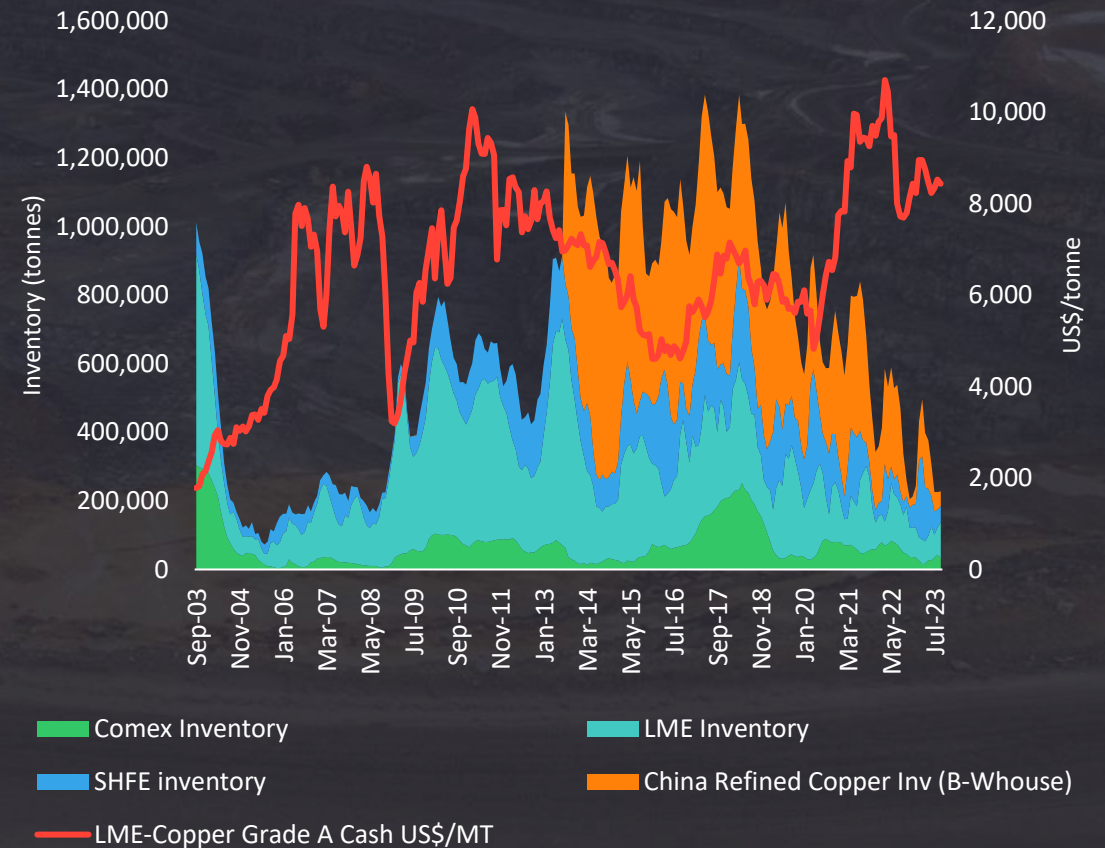
Average monthly prices: lithium, base and precious metals

January 2018–July 2023 (Index 100 = January 2018)



Copper price vs. visible inventories

2003–23



Source: EY Knowledge analysis of Refinitiv Eikon Datastream, September 2023

Increased competition for minerals and metals as the energy transition ramps up and gold remains in demand as a safe haven asset

Renewables and EVs

3 – 6x more copper than conventional power generation and ICE vehicles, respectively

Batteries

EV batteries are expected to account for ~23% of total nickel demand by 2030



Industrial demand

44% of the world is living in rural areas, providing significant scope for industrialization and metals demand

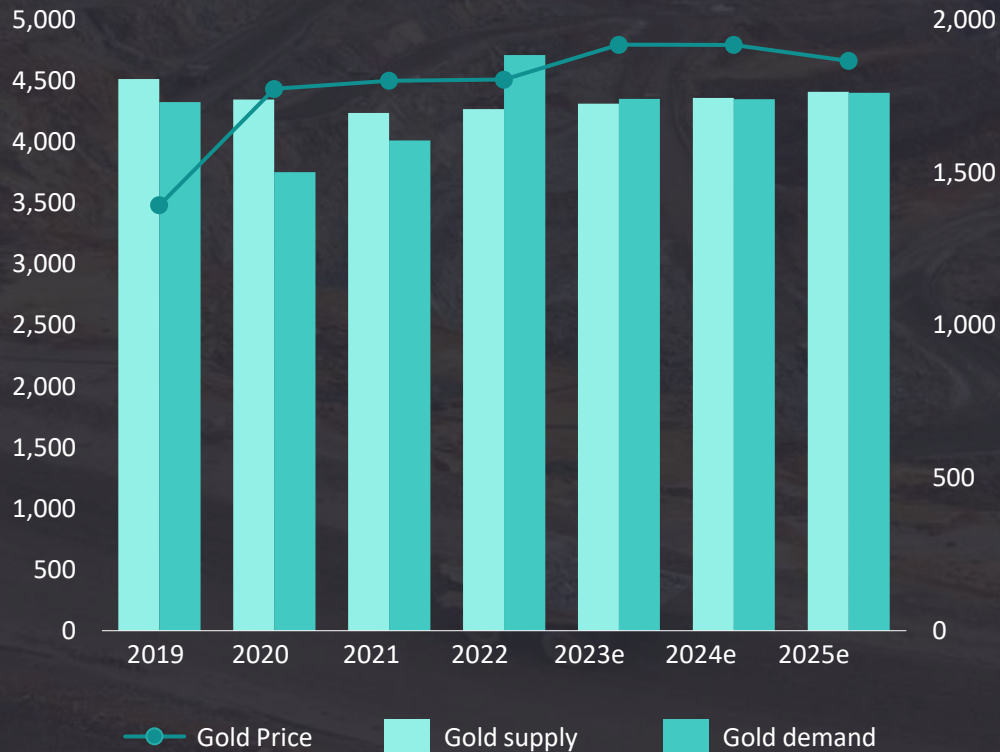
● High usage ● Low usage

Source: EY Knowledge analysis of IEA mineral requirements for clean energy transitions and publicly available sources

Gold supply and demand: retail players increased investment in bars and coins as a hedge against inflation

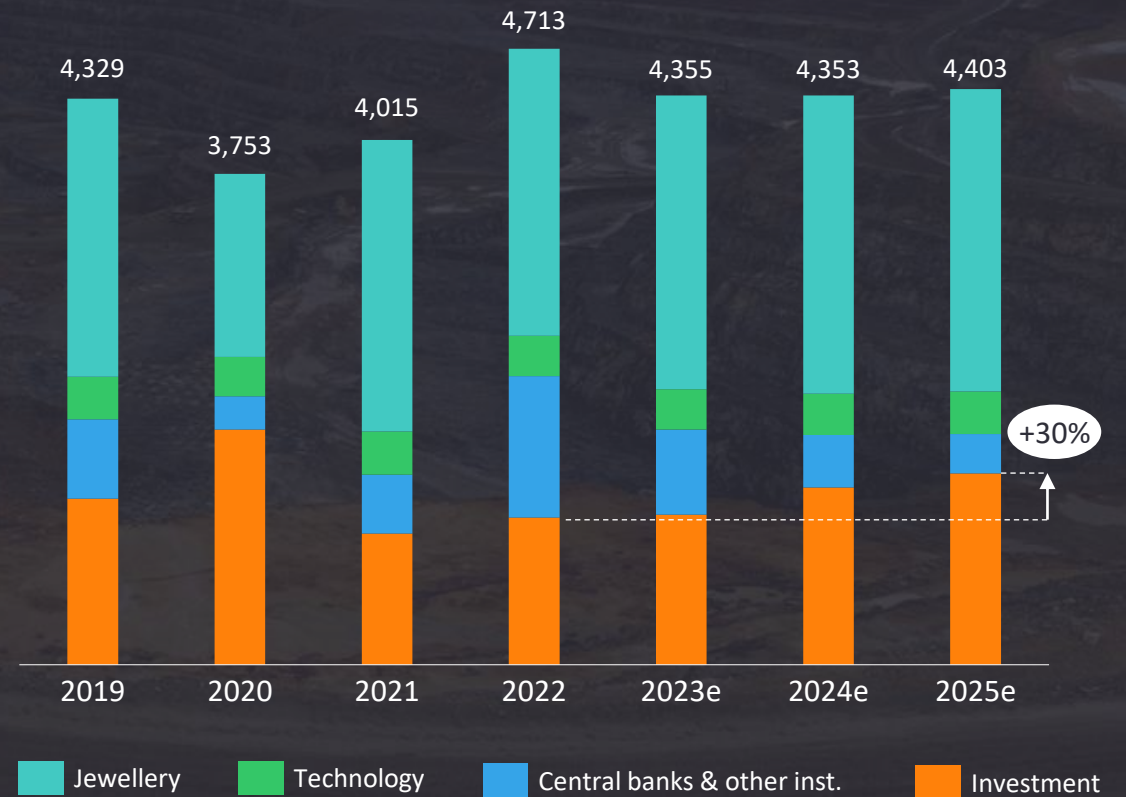
Gold demand, supply and price forecast*

2019–25e



Gold demand by type

2019–25e



Note: * Forecasts are based on consensus estimates

Source: EY Knowledge analysis of World Gold Council, Morgan Stanley, HSBC and S&P Capital IQ Pro

Copper demand is expected to more than double by 2050

Global copper supply-demand balance, 2022–50e (million tonnes)

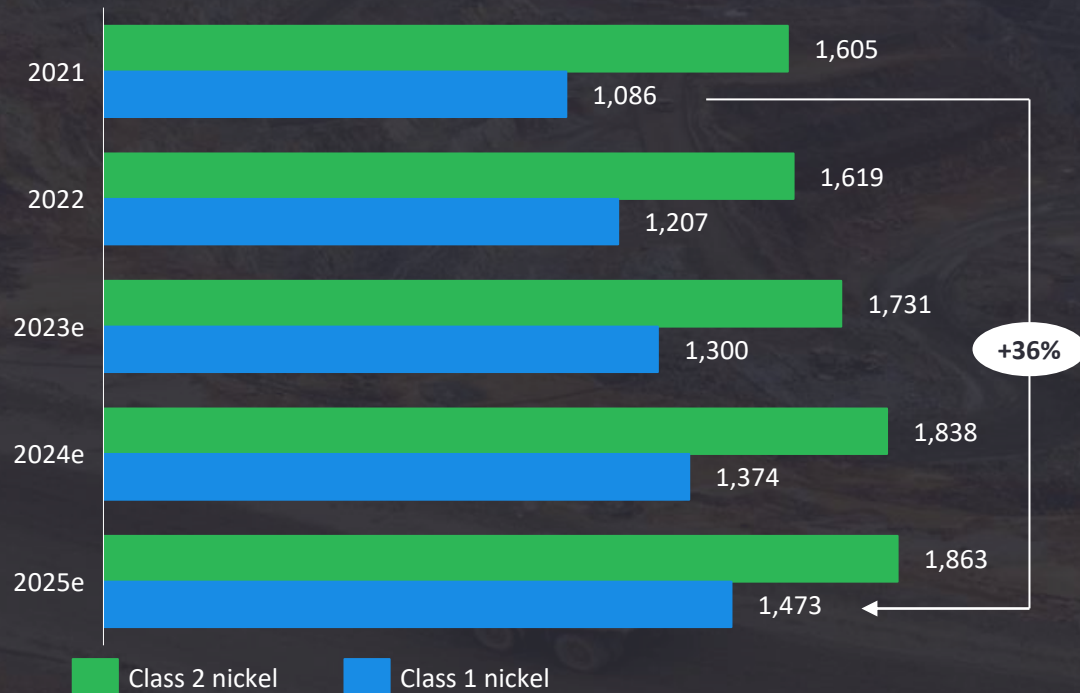


Source: EY Knowledge analysis of data from S&P Global, a range of broker forecasts, RFC Ambrian

EV batteries are expected to account for ~23% of total nickel demand by 2030

Nickel Class 1 vs Class 2 demand

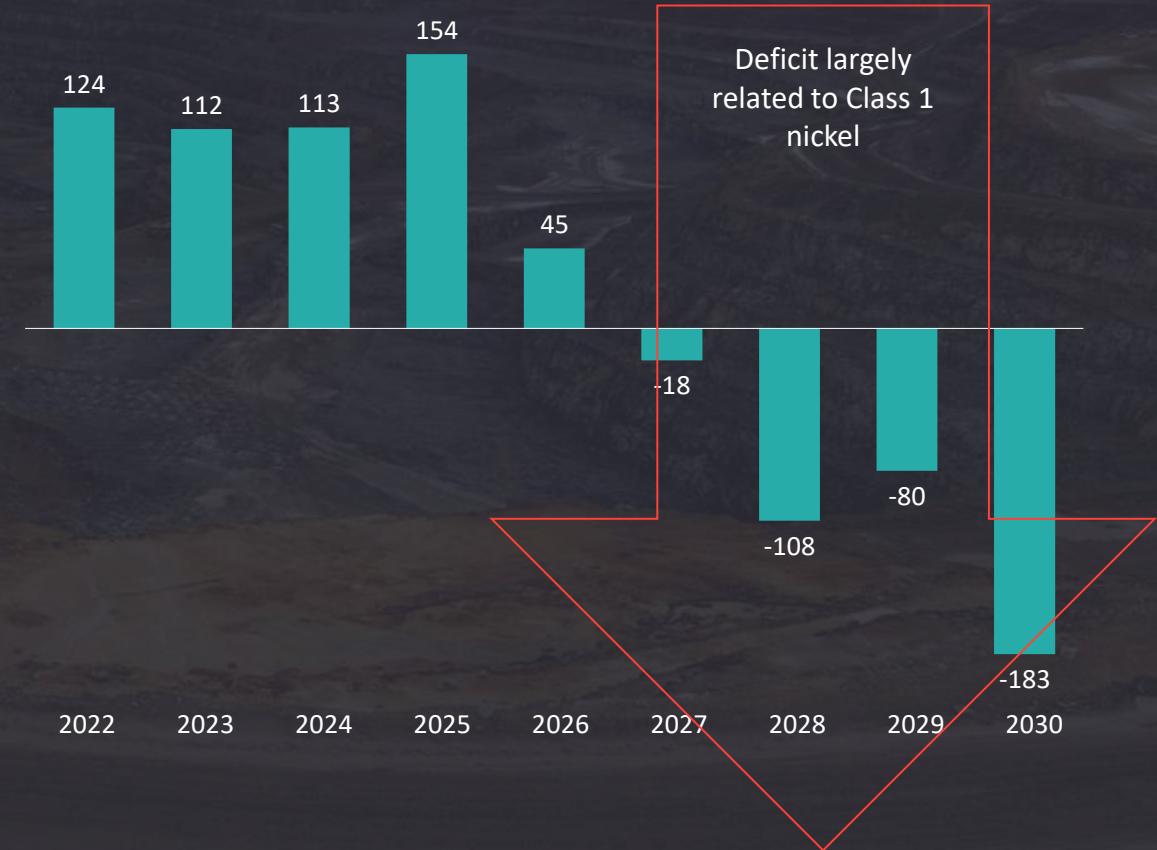
(kt), 2021–2025e



Higher growth expected in the demand for Class I/high-grade nickel due to increased usage in EV batteries

Nickel market balance

(kt), 2022–2030

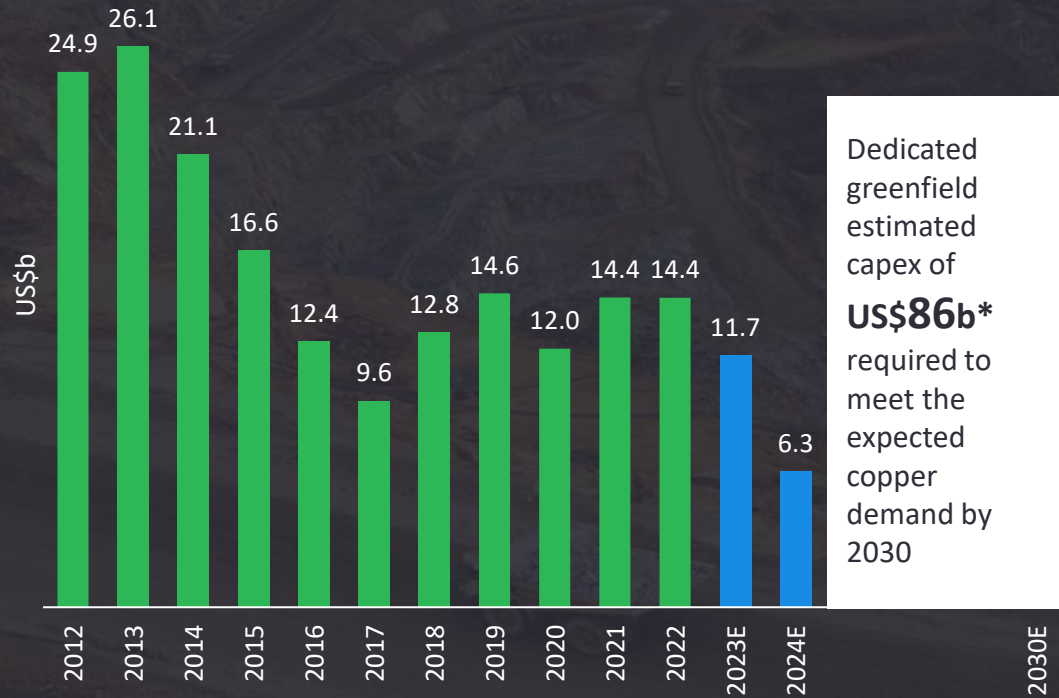


Note: Class 1 is the high-grade nickel predominately used in battery production, while Class 2 is the low-grade nickel used in stainless steel production estimates

Source: EY Knowledge analysis of USGS, Reuters, IEA report — Energy Technology Perspective and other publicly available sources

Investment in copper and nickel mining needs to increase significantly by 2030

Copper industry expansion capex, 2012–30E



Required and anticipated investment for nickel mining, to meet demand 2022–30, under the IEA NZE Scenario¹



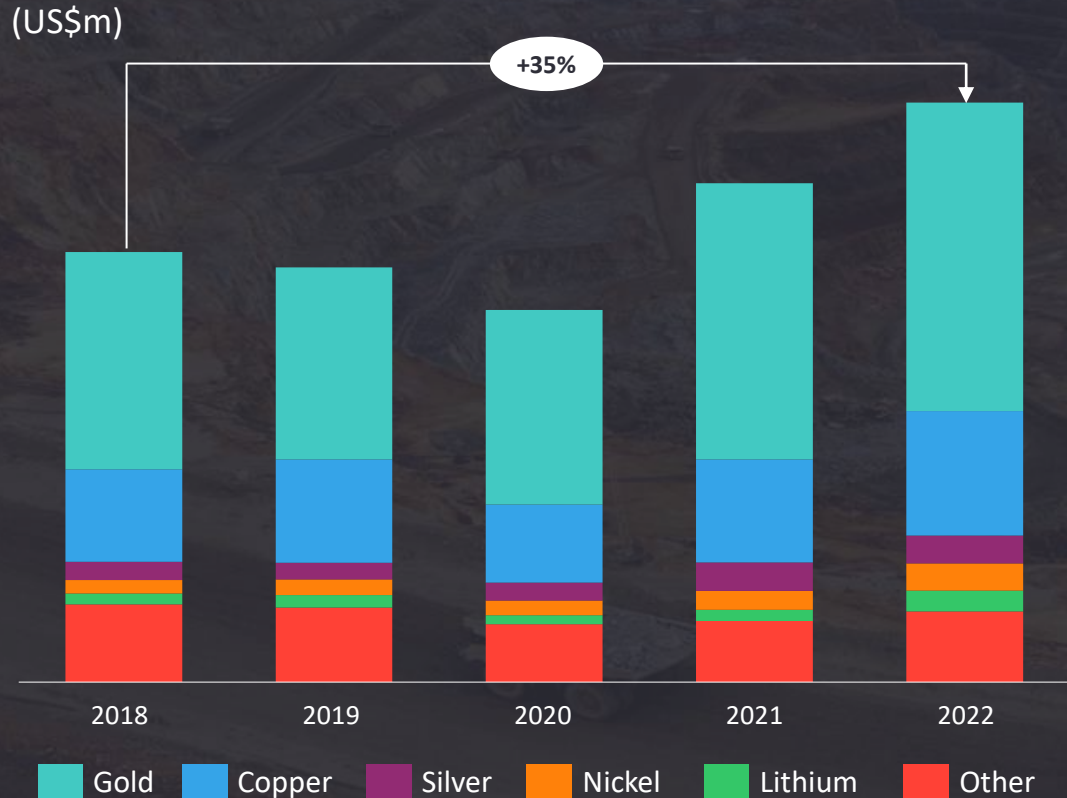
The anticipated investment in the nickel sector is insufficient to meet projected demand for 2030

¹ Considering an average greenfield investment of US\$20,000 needed per ton of copper and existing mines provide same output from 2024–30 and based on current capital intensity estimates

Source: EY Knowledge analysis of data from JP Morgan, S&P Global and IEA

Accelerated investment into exploration and greenfield projects

Exploration spending by commodity, 2018–22



Initial capital cost announcements for greenfield projects more than US\$1b for top five commodities



Source: EY Knowledge analysis of S&P Global Market Intelligence

Supply growth will not just be impacted by demand and capital but location of reserves, access to water and green energy, as well as a range of geopolitical implications

Canada

Reserves

- PGMs: 310t
- Uranium: 564t
- Gold: 2,200t

% renewable energy: 12.5%

US

Investment into critical minerals to secure low-risk domestic supply

Reserves

- Nickel: 0.34mt
- Lithium: 0.75mt

% renewable energy: 3.8%

South America

Increased investment into lithium and copper due to strong reserve profile but access to water will be an increasing issue

Reserves

- Copper: 277mt (Chile/Peru)
- Nickel: 16mt (Brazil)
- Lithium: 11.4mt (Chile/Argentina)
- Iron ore (Fe content): 15mt (Brazil)
- Rare earths: 21mt (Brazil)

% renewable energy: 11.3%

Europe

Focus on developing low-carbon solutions, e.g., green steel and closed loop production for energy transition

% renewables share: 6.9%

Russia

War in Ukraine will change trade flows and divert demand elsewhere
increased trade between Russia and China

Reserves

- Cobalt: 0.25mt
- Nickel: 7.5mt
- PGM: 4,500t

% renewable energy: 2.2%

China

Will face increased competition as companies seek to shore up domestic supply chains

Reserves

- Graphite: 73mt
- Rare earths: 44mt
- Lithium: 1.5mt

% renewable energy: 6.1%

Indonesia and the Philippines

Increased demand for nickel will prompt investment into cleaner nickel production, e.g., HPAL

Australia

Opportunity to capture more of the energy transition supply chain

Reserves

- Nickel: 21mt
- Lithium: 5.7mt
- Rare earths: 4.1mt

% renewable energy: 4.0%

South Africa

Reserves

- Gold: 5,000t
- Manganese: 640mt

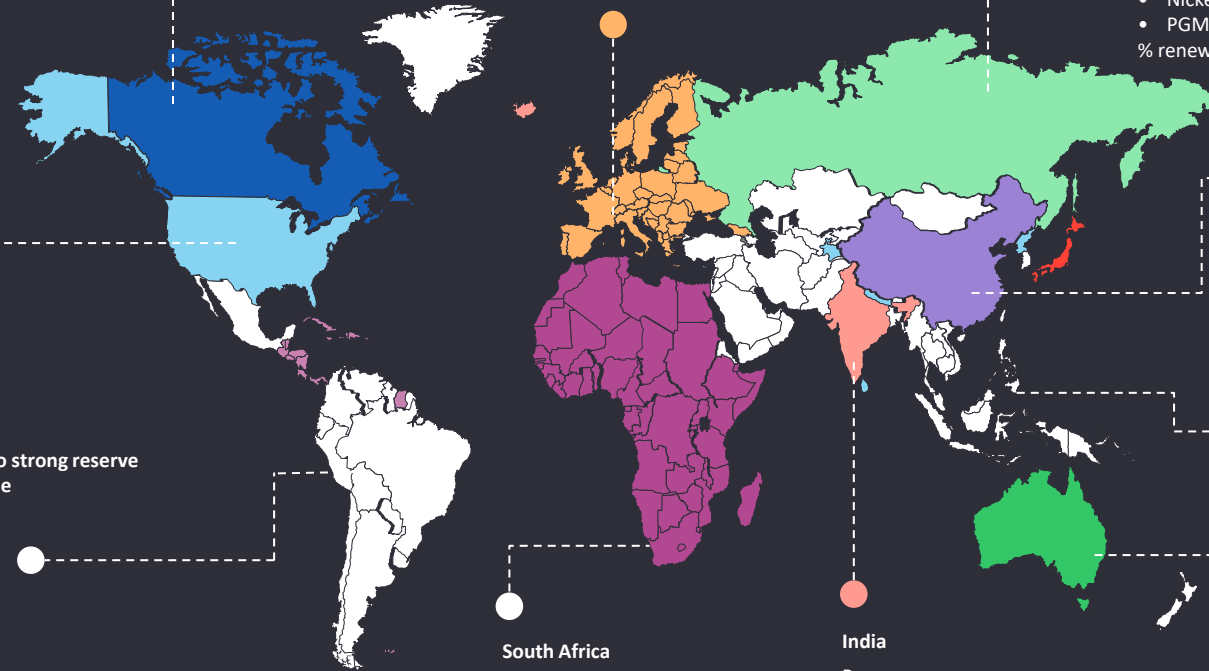
% renewable energy: 2.2%

India

Reserves

- Iron ore: 5,500mt

% renewable energy: 2.8%



Source: IEA, USGS

Note: Renewable energy represents the percentage share of renewables sources to total energy supply within the region. The values for the US, Canada and Australia are for year 2020; values for other regions are for 2019. Also, the value for South America is inclusive of South and Central America.

All factors of ESG are facing scrutiny, and miners need to go beyond policy to gain investor confidence and community acceptance

Nickel: energy intensive

Copper: water

Gold: do we need to mine gold?

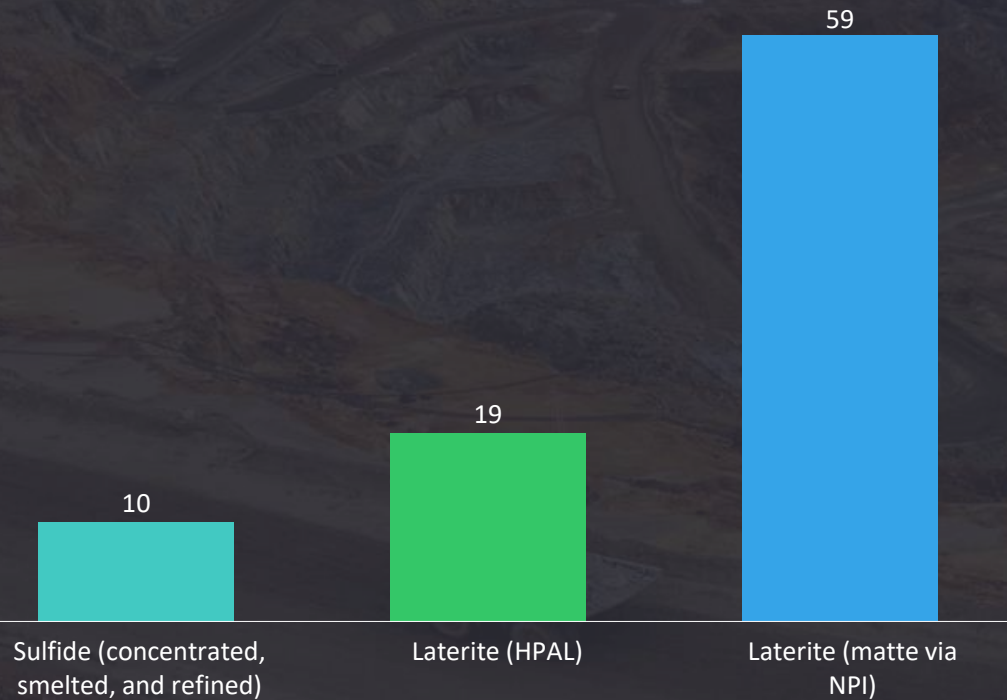
Which are the top ESG issues that the M&M sector will face the most scrutiny from investors?



Energy consumption for mining nickel is expected to rise by 75% by 2030, as mine production is likely to ramp up with the growing demand

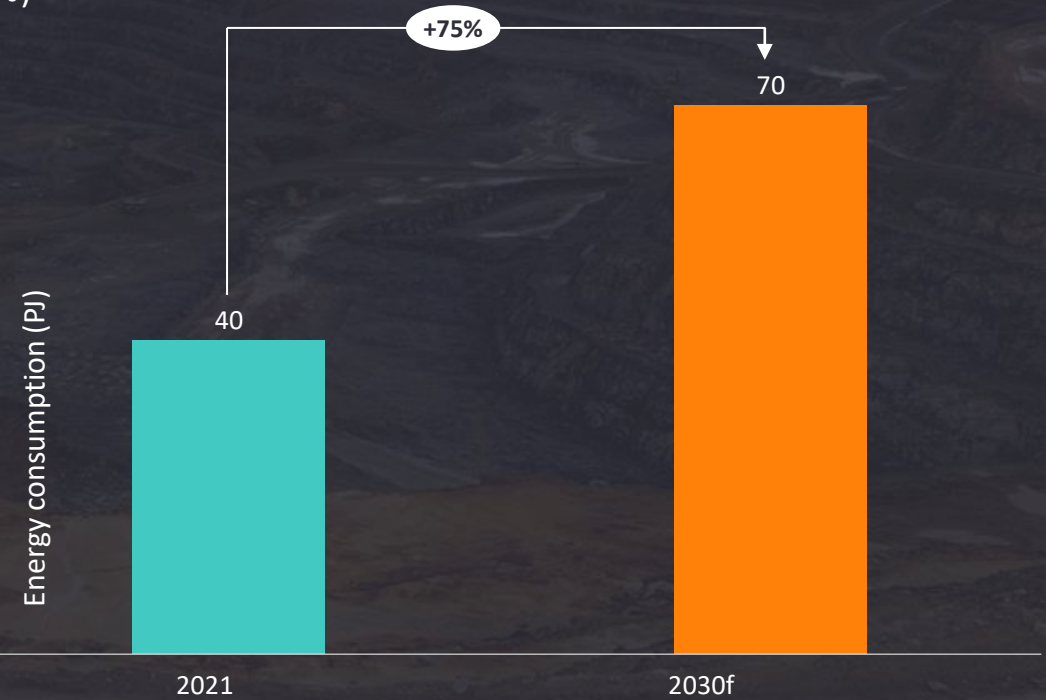
GHG emissions intensity for Class 1 nickel, by resource type and processing route

(tCO₂-eq per tonne of nickel)



Global energy consumption in nickel mining, for meeting NZE¹ scenario demand levels at current carbon intensity

(PJ)



EV manufacturers and other nickel customers are seeking raw materials used in their products to be mined and refined in an environmentally friendly manner, with positive impacts on local communities, and with a limited carbon footprint.

Note: ¹NZE: net-zero emission

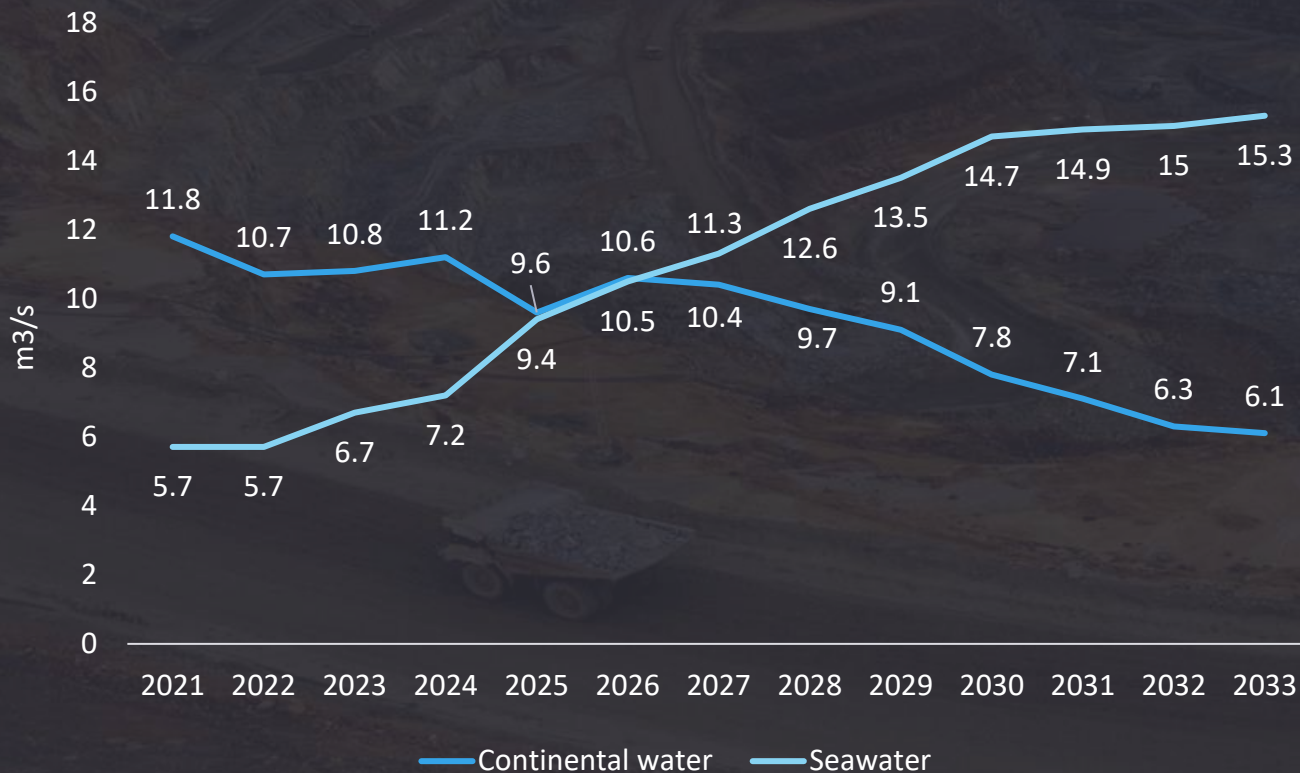
Source: EY Knowledge analysis of IEA — The Role of Critical Minerals in Clean Energy Transitions and Mining Technology

Copper miners are innovating to reduce water consumption in water-scarce areas

Seawater has the potential to represent ~71.5% of the new water sources used in copper mining within the next decade in Chile.

Miners are implementing various measures to address water management challenges.

Water consumption in copper mining



Hydraulic dewatered stacking used by Anglo American eliminates the risk of liquefaction, increases water recovery by 85% and repurposed.

BHP plans to develop **context-based water targets** by 2023 to address the shared water challenges in operating more effectively.

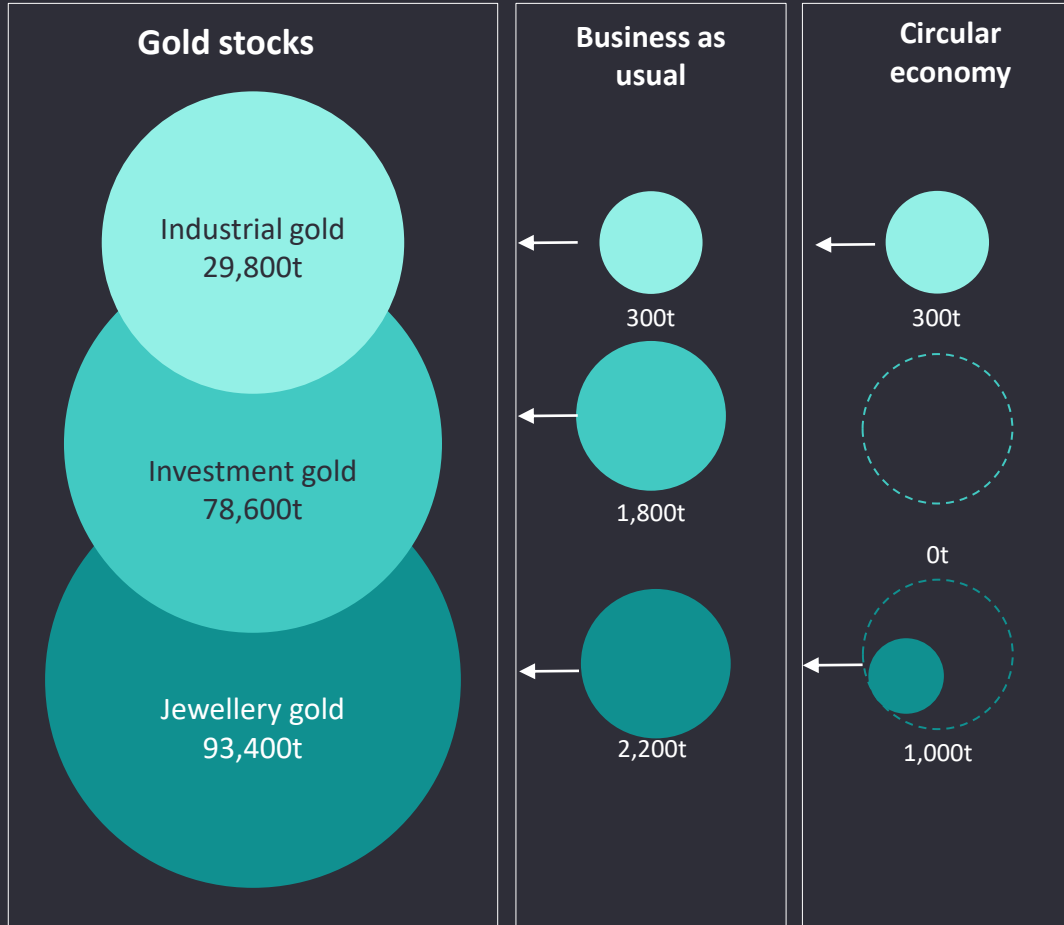
Rio Tinto started a **database platform to increase transparency on its water usage**. Annual use of water is reported and made publicly available.

Codelco signed a **BOOT** (build, own, operate, transfer) contract with Marubeni Corporation to develop the RT Sulfuros desalination plant.

Source: EY Knowledge analysis of the World Copper Conference & Chilean Copper Commission

Increasing a circular economy in the gold industry

Gold stocks and three gold demand scenarios



Source: EY Knowledge analysis

Mining companies are ramping up progress on new business models to maximize value

Shared value model

Circular

Vertical integration

Horizontal market integration

Joint ventures

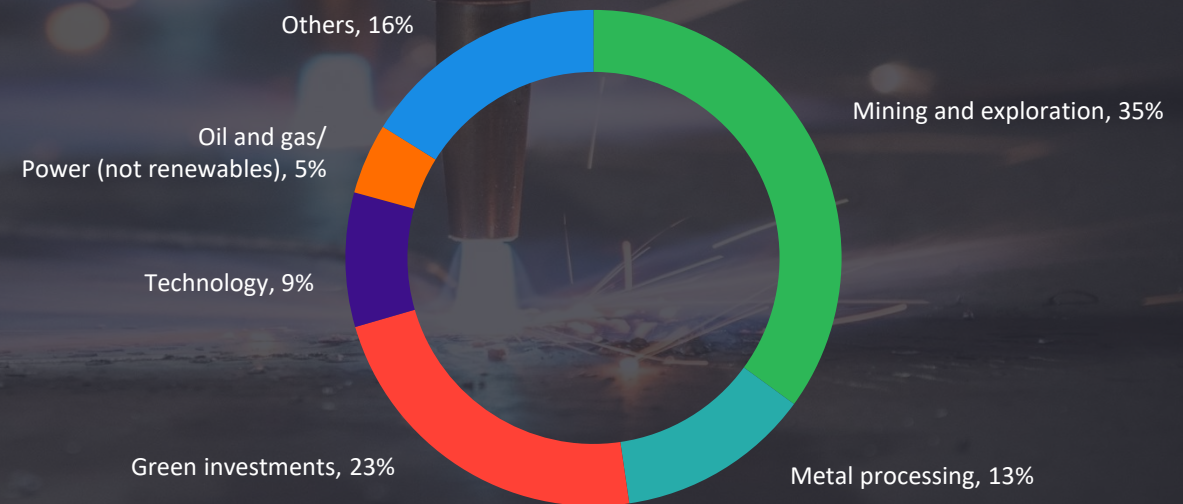
Offtake agreements

The challenge for miners is addressing the need to invest in new business models, while maintaining discipline and returns.

Traditional models may expose miners to more disruption risk

- Miners have an opportunity to redefine their business models to capture optimal value.
- Trading companies are having to increase their focus on customers not just commodities.
- Where does optimal value lie and what does the conglomerate of the future look like?

Analysis of 12 major mining companies' investments 2018–22



Source: EY Knowledge analysis of data from Refinitiv Eikon Datastream and S&P Capital IQ — August 2023

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