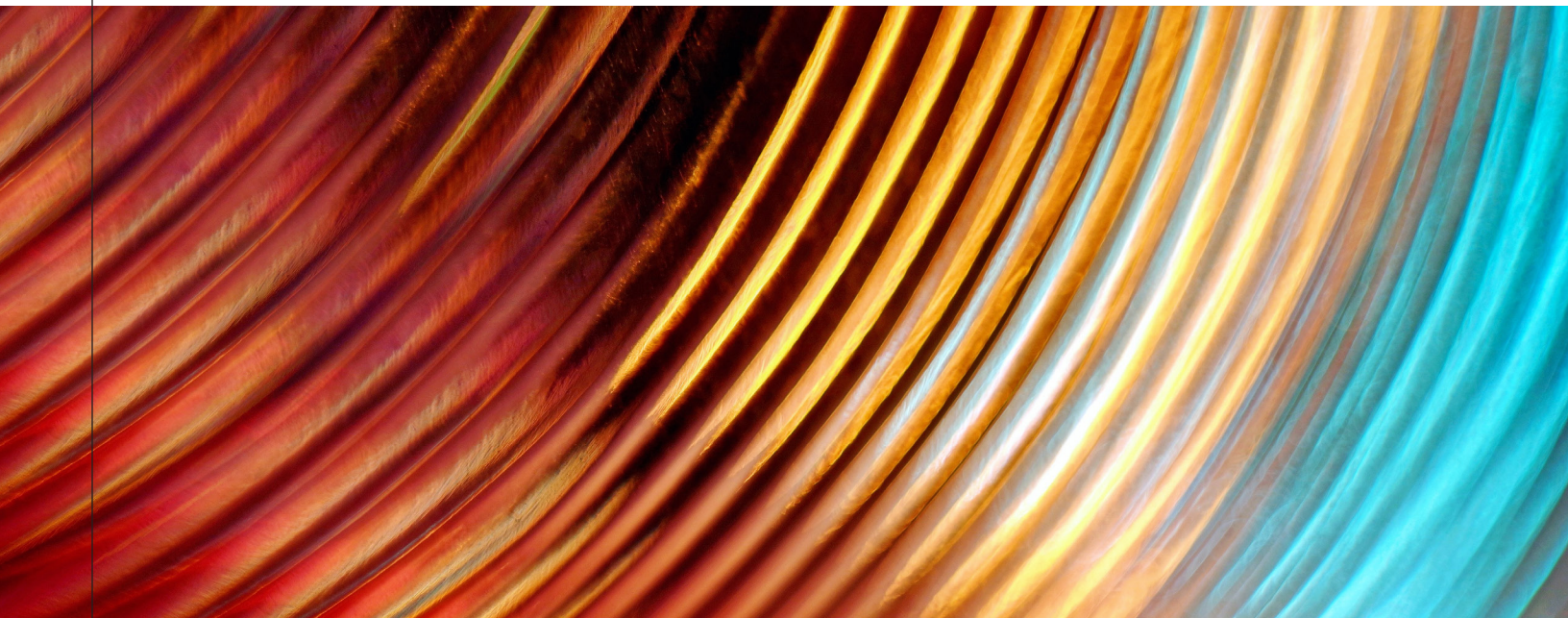


Metals of the Future 2.0: How the Energy Transition Is Transforming the Metals Markets



In the two years since we published [our research](#) on electric vehicles (EVs) and metals, we've seen a dynamic metals market unfold before our eyes. The copper, lithium, and nickel markets are undergoing a rapid transformation, driven by the green energy revolution, which has spurred investments and innovation to meet the growing demand of EVs and renewable energy. In this paper, we explore how supply and demand for some of these “commodities of the future” have been shaped by the transition to a low-carbon future. We also explore governmental responses from emerging markets (EMs) to these shifting dynamics.

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Corporate Credit Analyst
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Demand Dynamics

The energy transition from traditional fossil fuels to renewable resources, as well as the electrification of several global economic sectors, is now evident in the demand for copper, lithium, and nickel. Investments in electric grids worldwide have accelerated in the last couple of years as a result of investments in renewable power systems and the infrastructure needed to support the electrification of transportation and other sectors.

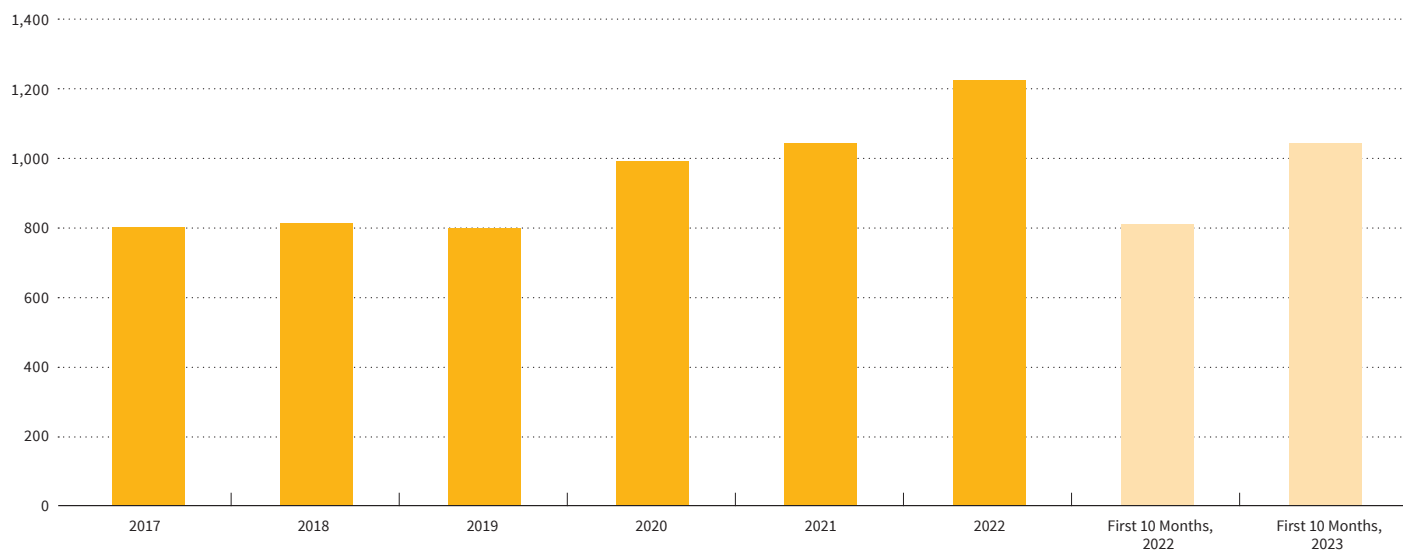
Copper

According to the International Energy Agency (IEA), global investment in electricity grids increased around 8% in 2022. China has led this growth, with investments in grid and infrastructure up 28% year-over-year from January to October 2023. Chinese demand for copper now constitutes 60% of the world total. While demand for all copper uses is higher than historical records, demand for wire, which has multiple uses in the grid and EV infrastructure, has significantly outperformed demand for other copper uses in China.

In Europe, EV sales continue to advance, with EV registrations recording a whopping compound annual growth rate (CAGR) of 55% from 2017 to 2022. Grid and infrastructure investments, coupled with EV adoption, constitute the largest consumers of copper worldwide, strengthening copper demand resilience in the face of current economic challenges.

EXHIBIT 1

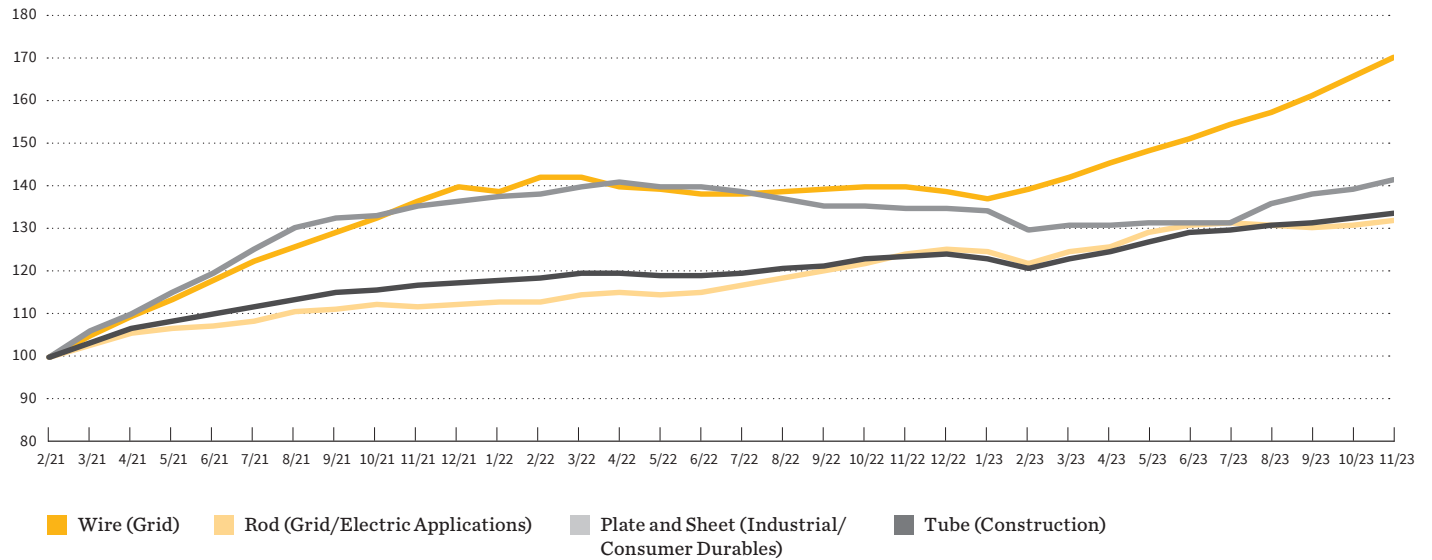
China Electricity Investments, Grid and Infrastructure (in Billion CNY)



Sources: Bloomberg and William Blair, as of October 31, 2023.

EXHIBIT 2

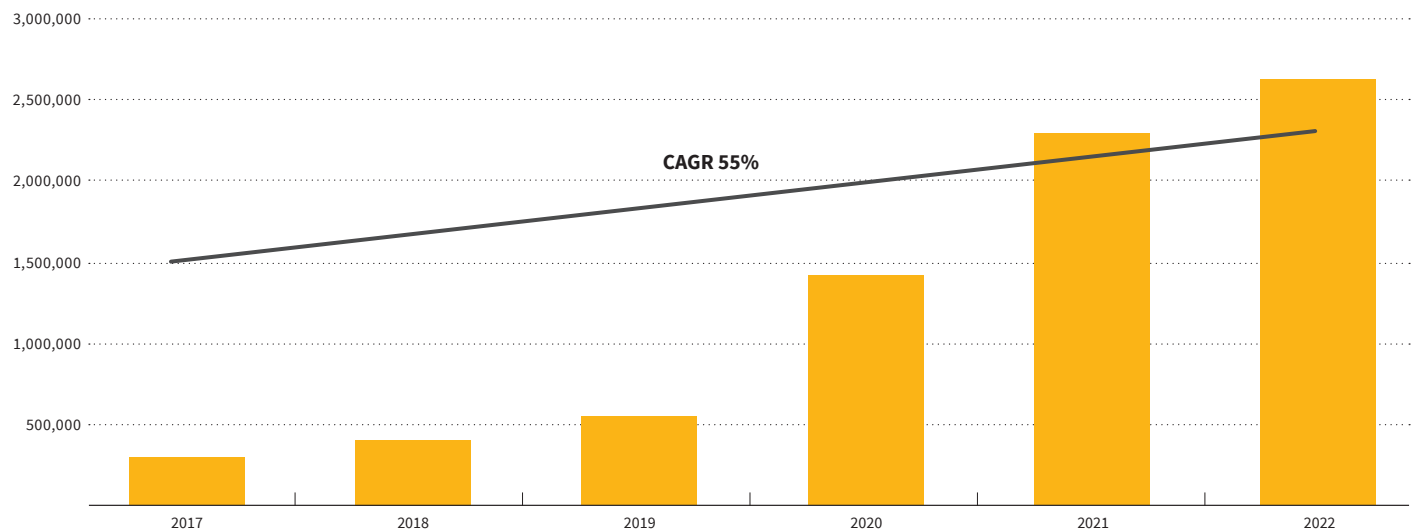
China Copper Demand (Uses)



Sources: Bloomberg and William Blair, as of August 31, 2023. Indexed to 100 in December 2020.

EXHIBIT 3

EV Registration in Europe



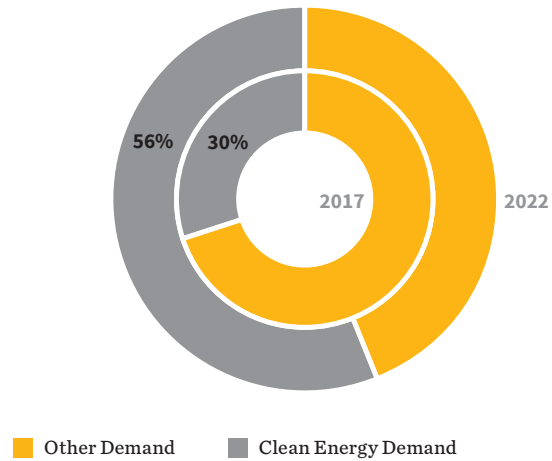
Sources: International Energy Agency (IEA) and William Blair, as of 2022.

Lithium

Among all commodities of the future, lithium has probably undergone the greatest transformation. The electrification of transportation has driven a colossal shift in the demand composition for lithium, which had a CAGR of 23% from 2017 to 2022. EV batteries are the biggest contributor to this dynamic, now representing more than 50% of total demand for lithium (up from about 30% in 2017). Other uses of lithium include consumer electronics (which use lithium-ion batteries), glass making, ceramics, and pharmaceuticals.

EXHIBIT 4

Lithium's Share of Clean Energy Demand



Sources: International Energy Agency (IEA), GlobalData, and William Blair, as of 2022.

“Among all commodities of the future, lithium has probably undergone the greatest transformation.”

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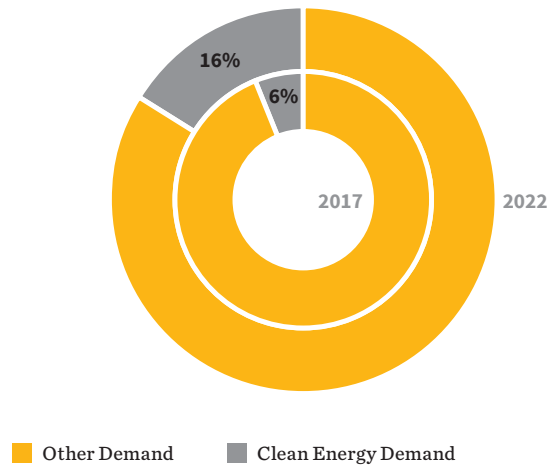
Demand Dynamics (continued)

Nickel

Nickel demand has been accelerating in the last three years. It grew 11% in 2022 and is expected to grow another 14% in 2023. For context, demand growth for most industrial metals is comparable to global annual gross domestic product (GDP) growth, which has been much lower than the double-digit growth experienced in nickel. This growth is a result of nickel being used as a component of EV batteries. The composition of nickel demand has been changing too. Clean energy now constitutes 16% of total demand, up from just 6% in 2017.

EXHIBIT 5

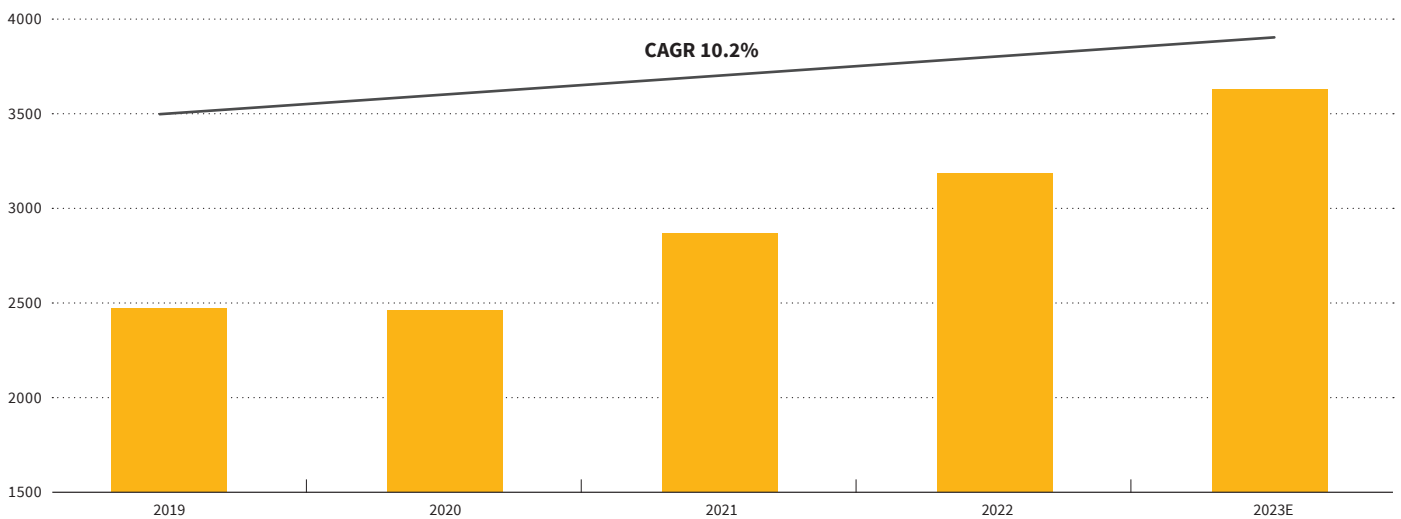
Nickel's Share of Clean Energy Demand



Sources: International Energy Agency (IEA), GlobalData, and William Blair, as of 2022.

EXHIBIT 6

Global Nickel Demand (In Thousand Tonnes)



Sources: Statista and William Blair, as of 2022 (2023 is estimated).

Supply Dynamics

The supply response to the very pronounced demand shifts observed in these metals has been remarkable. Automakers, equipment manufacturers, and battery cell makers all want to get involved in the value chain of these critical metals. As we illustrated in our previous paper, demand for these metals is expected to accelerate even further, raising questions about scarcity and the ability of supply to meet demand.

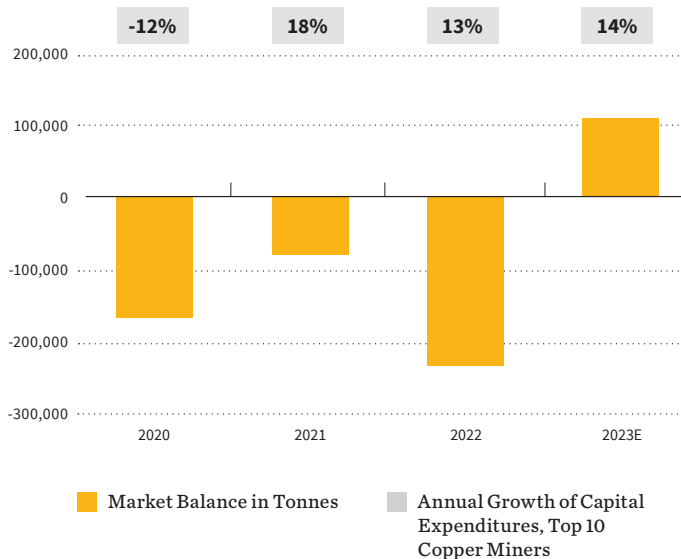
Copper

While copper miners recognize copper's importance for green technologies, production is challenging. Copper miners have faced increased regulatory scrutiny, aging assets, declining grades (the concentration of copper in the ore being mined), and changing weather patterns, including pronounced droughts in Chile and flooding in Zambia. Global copper supply has grown only in the low-single-digit levels over the past three years, with new projects in Peru and the Democratic Republic of Congo mostly offsetting lower production in the world's largest copper producing country, Chile. This has resulted in market deficits over the past three years. In 2023, a surplus is expected due to lackluster demand from developed markets.

Despite these dynamics, copper miners are ramping up investments to fulfil the high anticipated demand. Capital expenditures in the 10 largest miners, which represent about 44% of global production, increased 13% in 2022 and are expected to grow another 14% in 2023.

EXHIBIT 7

Copper Market Balance and Investments



Sources: International Wrought Copper Council, Nornickel, Bloomberg, and William Blair, as of 2022 (2023 is estimated).

“Copper miners have faced increased regulatory scrutiny, aging assets, declining grades and changing weather patterns, including pronounced droughts in Chile and flooding in Zambia.”

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Supply Dynamics (continued)

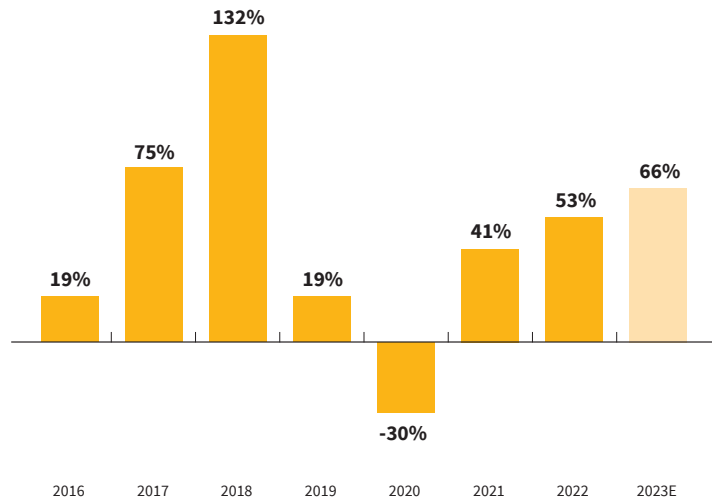
Lithium

The supply of lithium is highly concentrated in a few locations and companies. The two largest lithium operations in the world accounted for 43% of total lithium production in 2022. Still, lithium supply has increased to meet the growing use of rechargeable lithium-ion batteries, which are widely used in consumer electronics, EVs, and energy storage systems. A brief decline of lithium carbonate prices was observed in 2020 as a result of supply-demand dynamics, but prices peaked in 2022. Thus far in 2023, lithium production has surpassed consumption, resulting in an abrupt price correction from all-time highs. Lower EV sales, inventory build-up in the energy storage sector, demand uncertainty in China, and new supply coming online faster than anticipated are key reasons.

An acceleration in demand growth is anticipated for lithium, prompting producers to expand their investments in the sector. Capital expenditures in the five largest lithium producers worldwide, which account for 65% of total production, grew 53% in 2022 and are expected to pick up another 66% this year.

EXHIBIT 8

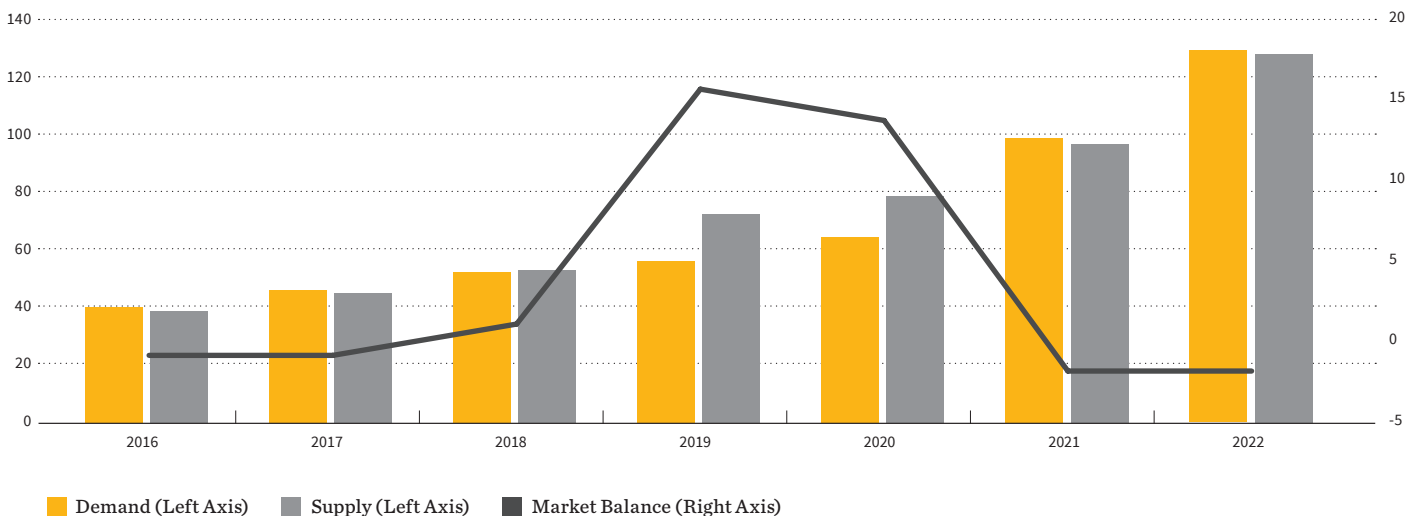
Capex Growth in the Top Five Lithium Producers



Sources: Bloomberg and William Blair, as of 2022 (2023 is estimated).

EXHIBIT 9

Lithium Demand, Supply, and Market Balances (Thousand Tonnes)



Sources: International Energy Agency (IEA) and William Blair, as of 2022.

Supply Dynamics (continued)

Nickel

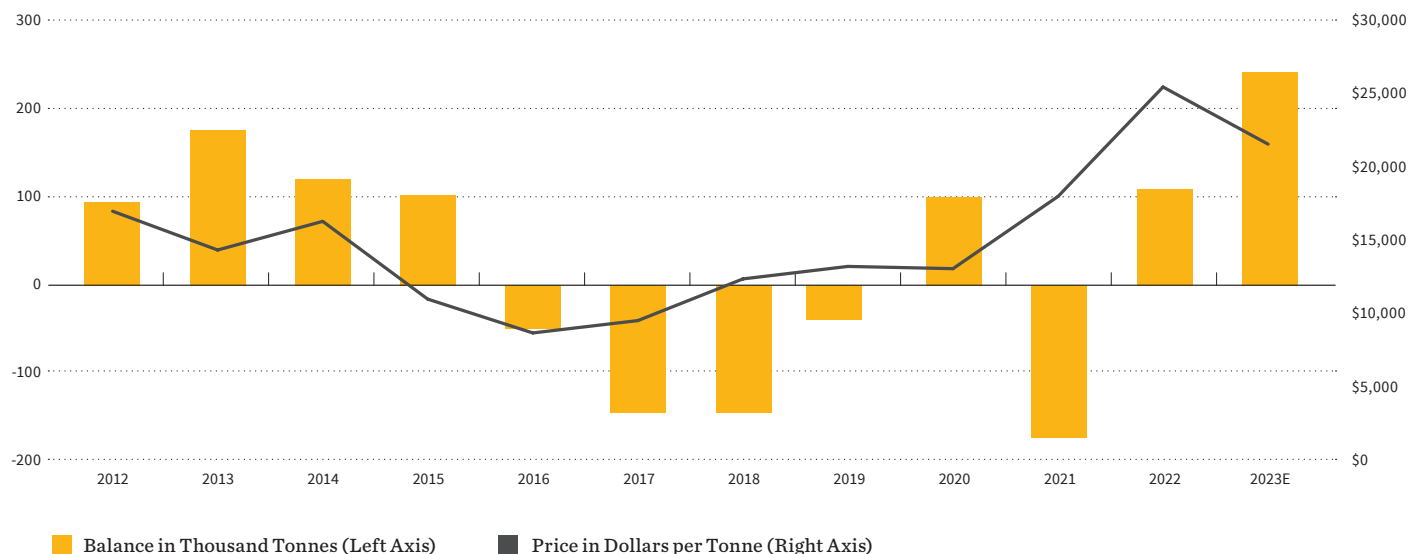
Alongside lithium, nickel has probably seen the largest expansion in production volumes compared to other metals. Since 2019, Indonesia, which accounts for 50% of global nickel ore production, has rapidly developed domestic processing facilities in an attempt to capture more value from the metal and to become a global EV supply-chain hub. According to government estimates, the value of processed nickel products in 2022 was \$30 billion, 10 times higher than it was four years ago. Indonesia increased the number of operating smelters from 15 in 2021 to 43 this year; another 28 smelters are under construction and 24 are in the planning stages.

It's worth highlighting China's contribution to this expansion. The country has made investments of around \$30 billion, and two of the largest nickel industrial hubs (the Morowali Industrial Park and the Weda Bay Industrial Park) are operated by the same Chinese company. This investment stands out as one of the largest under China's Belt and Road Initiative (BRI).

This vast increase in smelting capacity led Indonesia to become a net importer of nickel ore for the first time in its history in 2023. However, the most significant consequence of this expansion is that total primary nickel production has surged to peak levels leading to market imbalances. The International Nickel Study Group expects this year's surplus to be the largest in the last decade.

EXHIBIT 10

Nickel Market Balance and Price



Sources: International Nickel Study Group, Bloomberg, and William Blair, as of 2022. Balance (left axis) is in thousand tonnes. Price (right axis) is in dollars per tonnes, year-to-date.

EM Resource Nationalism

Countries in which mining for the metals of the future has made up a significant part of GDP have taken an active stance toward the development and commercialization of these resources. Several EM governments recognize the value of these metals to future technologies and aim to capture a larger share of a growing pie. Below we highlight such cases.

Copper

Chile, the top producer of copper, finalized an amendment to its mining tax regime in 2023. The regime, now royalty-based, will increase taxes from 5% to 14% of operating profits to 8% to 26% of operating profits for large producers. The new royalty will also have an ad-valorem component of 1%. While the calculation of taxable income has changed, the new royalty regime promises to increase state revenues from the sector, especially in a high-price environment.

In 2019 Zambia revised its royalty rates from 4% to 6% of operating profits to 5.5% to 10% of operating profits, depending on prices. Copper exports account for as much as 12% of Zambia's GDP, making the resource crucial to its economic development.

In Panama, the mining concession contract for the country's largest copper mine recently sparked unprecedented protests due to its impact on the environment and the distribution of profits between the mine operator and the state. In late November, Panama's supreme court ruled the contract unconstitutional, while the mine, which contributes 3% to 5% to the country's GDP, halted operations due to blockades. Earlier in the same month, Panama's Congress banned new mining concessions and extensions of current concessions. Certainly, this exemplifies a case of resource nationalism, in which a country asserts control over its natural resources.

Lithium

China's push to become the world's top supplier of solar cells, lithium-ion batteries, and EVs, is driving the need for the country to secure a large share of the lithium supply chain. Indeed, China has invested billions to acquire stakes in lithium mines in Latin America and most recently Africa. According to Benchmark Minerals, two-thirds of forecast lithium production will be owned by China in 2030.

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Chile, which is home to the world's largest lithium reserves, announced earlier this year a strategy to nationalize its lithium industry. The strategy would allow the state to lead lithium mining and processing projects through national companies, thereby ensuring a larger revenue share to the state and better environmental conditions. Under the current regime, independent lithium producers are leasing mineral concessions from a governmental organization called Corporación de Fomento de la Producción (CORFO). These leases contributed more than \$5 billion dollars to the Chilean treasury in 2022, about 2% of the country's GDP.

But Chile is not the first country to nationalize its lithium resources. Earlier in 2022, Mexico declared lithium as a strategic mineral, meaning that the exploration, exploitation, and end-use of lithium will be an exclusive right of the state. The country has set up a national lithium company that will seek to establish Mexico as a prominent lithium mining nation.

Nickel

Perhaps another example of resource nationalism has been the ban on exports of nickel ores from Indonesia. Initially implemented in 2014 and reinforced in 2020, the ban sought to develop domestic nickel and EV supply chains. Part of the strategy to develop the domestic market is tax incentives to nickel processing facilities. The government has recently revoked the 10-year tax holiday for low-grade producers to encourage more investment in downstream processes and battery-grade nickel manufacturing.

Investment Implications

We believe the likelihood of enduring demand for metals of the future due to the energy transition bodes well for market prices. For the corporate credit investor, this should translate into robust credit fundamentals, such as margins and cash flows.

Moreover, many metal companies in the EM debt universe have reduced leverage, which could help them withstand metal price volatility.

Maturities are addressed well in advance, while we have noticed an investor preference for debt issued by “future metals” companies in contrast to other metals producers.

As we have highlighted, companies rich in future metals could increasingly benefit from the production and sale of these minerals.

For the countries mentioned above, the metals sector should continue to be a strong driver of GDP and attract foreign direct investment (FDI).

We believe the export value and tax revenue from these metals could increase due to higher production and a resilient price outlook, and over time this should lead to an improvement in sovereign credit fundamentals, which is appealing to the sovereign investor.

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