J. Safra Sarasin

The Strategic Minerals Conundrum

How to Achieve the Transition to a Low-Carbon Economy

Sustainability Series
March 2024

Sustainable Swiss Private Banking since 1841

Dr Daniel Wild
Chief Sustainability Officer
Daniel.Wild@jsafrasarasin.com

Martina Wengle
Stewardship Specialist
Martina.Wengle@jsafrasarasin.com

Slawa Rein
Sustainability Specialist
Slawa.Rein@jsafrasarasin.com

Elena Berton
Investment Writer
Elena.Berton@jsafrasarasin.com

Contents

Introduction

Planet Earth is experiencing significant changes in climate patterns. A successful green transition has a crucial role to play in mitigating change or adapting to new climate conditions. This transition is intricately tied to a substantial demand for metals required to produce batteries, electric vehicles, and various high-tech applications for a decarbonised world.

Increased demand could create an unprecedented opportunity for the minerals and metals sector. But to achieve this transition without significant social or environmental side-effects, the industry must address significant environmental, social and governance (ESG) challenges. Mining and mineral processing generate substantial waste and greenhouse gas emissions, use large quantities of water and potentially toxic chemicals. They are also linked to many human rights abuses, such as health and safety incidents, as well as poor employment rights, including forced and child labour.

The key issue is clear. Can the mining sector, which is essential for the energy transition, scale up production fast enough to meet demand, while at the same time overhauling its supply chains to meet stricter ESG criteria?

The industry must eliminate poor practices and effectively implement robust standards to minimise the risk of significant negative social and environmental impacts. It is up to all stakeholders, especially investors, to help it adopt best practices, such as improvements on material ESG metrics, drive change and build a responsible mining sector for the future.

Investing in the energy transition is crucial due to the ever-increasing demand for metals. However, investors should be aware of the challenges linked to metal extraction and act responsibly. A prudent investment process in the area of minerals and mining would therefore involve a three-pronged approach: 1) selecting companies with best practice operations, 2) engaging with companies to address remaining shortcomings, 3) investing in solution providers along the whole value chain.

Exhibit 1 - J. Safra Sarasin's investment approach to the mining value chain

Select leading companies	Engage with companies to improve practices	Invest in solution providers
Invest in mining companies that follow best practices for social and environmental standards.	Improve practices and address company-specific shortcomings by addressing material topics along the value chain.	Invest in companies along the value chain that focus on resource-efficiency and circular economy products, such as recycling.

Source: Bank J. Safra Sarasin, 2024

The mining industry is playing a crucial role in developing greener economies that align with the transition path towards net zero outlined in the Paris Agreement. Responsible exploration and mining of strategic metals and minerals, supported by the investment community, will be essential in achieving this objective.

Key Points

- **Demand for clean energy is set to quadruple by 2040, creating further opportunities for strategic metals. But it will also present significant ESG challenges, as metal extraction has a significant environmental and social impact. Mineral mining generates waste and greenhouse gas emissions, uses large amounts of water and potentially toxic chemicals. It is also linked to many human rights issues.**

- **Several metals needed for the energy transition are concentrated in a few countries. This means that mineral-rich countries will gain importance on the global stage, shifting the power dynamic in their favour. Competition for the scarce resources could also intensify geopolitical rivalries.**

- **A more circular economy could help meet part of the fourfold growth in demand for strategic minerals as the green transition gathers speed. The International Energy Agency (IEA) estimates that recycling alone could account for 10% of the supply of minerals such as copper, lithium and nickel by 2040.**

- **Investors have several tools at their disposal to take advantage of the surge in demand for raw materials, such as investments in commodity futures or the currencies and sovereign bonds of resource-rich countries. Holding the equity of companies that have adopted best practices is another option that allows investors to apply good stewardship practices and address ESG weaknesses.**

- **As a sustainable investor, J. Safra Sarasin Sustainable Asset Management takes a multi-layered approach. It supports and engages with companies in the mining value chain that have adopted best practices and that are catalysing the transition to a low-carbon economy.**

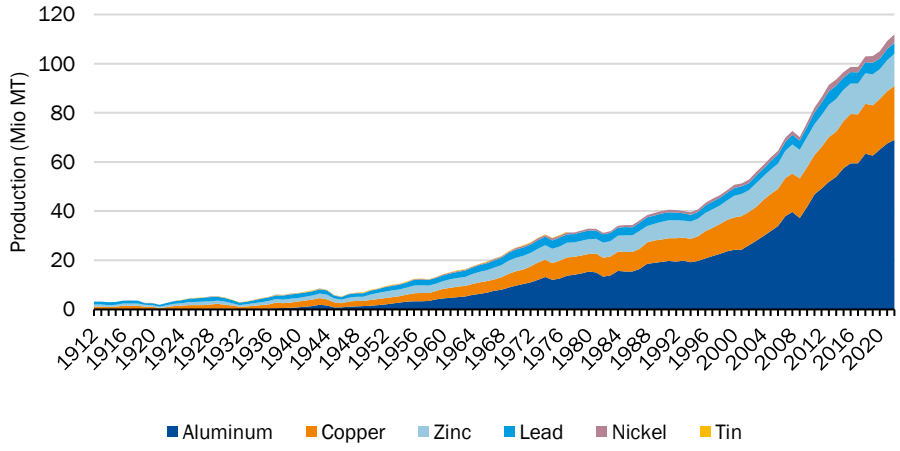
The rise of metals in the green transition

Over the last century, worldwide metal production has increased significantly. This trend is set to continue due to global efforts to reduce carbon emissions. Stricter regulations implemented now and in the future are expected to further push the demand for metals.

Metals are resources, elements and alloys that have high electrical and thermal conductivity, malleability, ductility, and light reflectivity. These properties make them essential in many industries, from aerospace and defence to automotive and medical device manufacturing. Metals are also key components for green energy technologies. The most abundant varieties in the Earth's crust are aluminium, iron, magnesium, titanium and manganese. Most metals are found in ores, such as bauxite (aluminium ore) and hematite (iron ore). These ores must undergo mechanical and chemical extraction before they can be refined and made ready for use.

The last 100 years have seen unprecedented growth in global non-ferrous metal production. While the annual industrial production of non-ferrous metals – i.e. aluminium, copper, lead, nickel, tin and zinc – remained below 10 million tonnes until the 1950s, by 2020 it had soared to 110 million tonnes (see Exhibit 2).[1]

Exhibit 2 - World non-ferrous industrial metal production per annum



Source: United States Geological Survey (USGS), 1912 – 2022

Global decarbonisation efforts are expected to further boost demand. To date, more than 70 countries have set a net zero target, covering about 76% of global emissions.[2] Transition technologies use more metals than conventional solutions and rely more on strategic materials. For example, while conventional vehicles use 20 to 25 kilograms of copper, hybrid and electric vehicles need between 40 and 80 kilograms (see Exhibit 3).[3] Electric vehicle

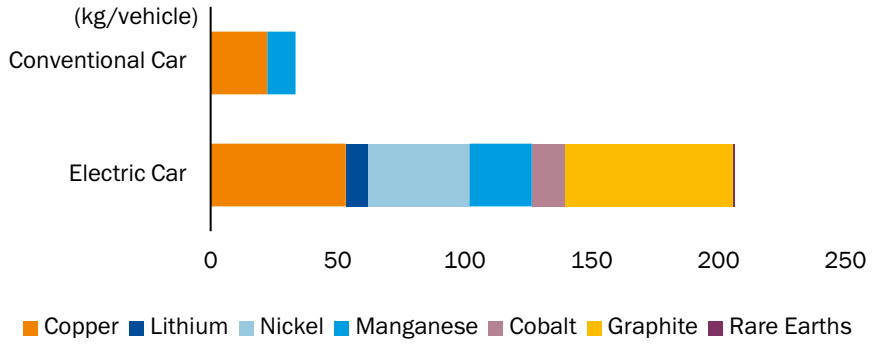
[1] United States Geological Survey (USGS), 1912 – 2022, Historical Statistics for Mineral and Material Commodities in the United States

[2] United Nations, For a livable climate: net-zero commitments must be backed by credible action, 2023

[3] IEA, Minerals used in electric cars compared to conventional cars, May 2021

(EV) production is estimated to account for 50-60% of the demand for energy transition metals, followed by power grids and solar photovoltaics (35-45%).[4]

Exhibit 3 - Minerals used in conventional cars compared to electric cars



Source: IEA, 2021

The International Energy Agency (IEA) estimates that in order to meet the goals of the Paris Agreement ("well below 2°C global temperature rise") mineral demand for clean energy technologies will grow fourfold by 2040. A global net zero scenario by 2050 would require six times more minerals. In fact, the demand for key metals in EVs and battery storage is expected to grow by around 30 times, with lithium seeing the fastest growth, followed by cobalt, nickel and rare earths.[5]

While many metals are critical and/or make a significant contribution to the energy transition, this paper focuses on a selected number of illustrative metals, based on either the quantities and/or specific functionalities required for the energy transition.

Exhibit 4 - Metals and their use in the energy transition

Metal	Characteristic	Use
Copper	Efficiently transmits electricity	Electric wiring, charging infrastructure, power distribution systems
Lithium	Lightest naturally occurring metal	Essential component of lithium-ion batteries
Nickel	Enhances battery performance	Essential component of lithium-ion batteries
Cobalt	High melting point ability to maintain strength at raised temperatures	Essential component of lithium-ion batteries
Rare Earth Elements	Production of high-performance magnets	Used in wind turbines and electric vehicle motors

Sources: Bank J. Safra Sarasin, IEA, 2021 and Science Direct, 2021

Protecting the future supply of strategic minerals

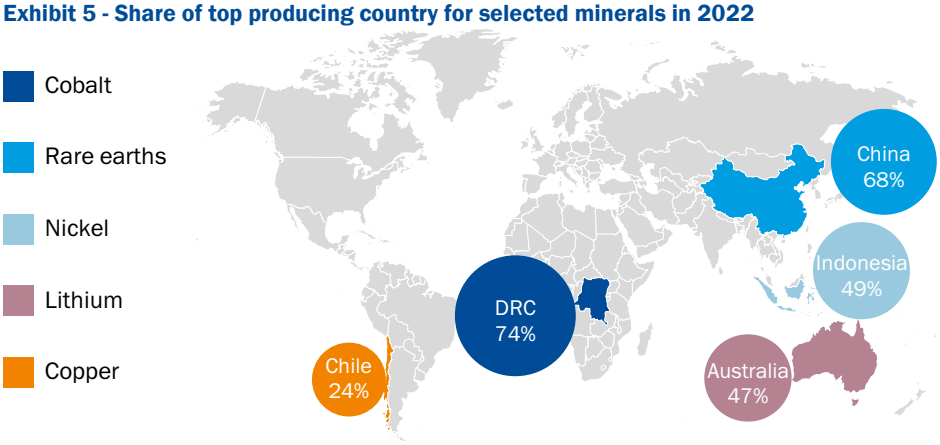
Unlike oil and gas, the resource deposits of many metals needed for the energy transition are highly concentrated in a handful of countries. Chile is the world's top copper producer, contributing roughly a quarter of the world's total copper production in 2022.[6] South Africa and the Democratic Republic of the Congo (DRC) account for some 70% of global platinum and cobalt production respectively, while China accounted for 68% of global rare earths production in 2022 (albeit down from over 80% in the mid 2010).[7] Australia and Chile

[4] Eurometaux, Metals for Clean Energy.
[5] IEA, The Role of Critical Minerals in Clean Energy Transitions, May 2021.
[6] Statista, Kupferproduktion weltweit nach Ländern, 2022
[7] IEA, Ibid.

together account for around 70% of global lithium mining, making them the dominant players in this industry.[8]

The level of concentration is even higher for processing and refining operations. China has gained a strong foothold in these areas across most metals. Its share of refining is around 35% for nickel (the figure becomes higher when including the involvement of Chinese companies in Indonesia), 50-70% for lithium and cobalt, and as high as 90% for rare earth processing, which converts mined output into oxides, metals and magnets.[9] The concentration of resources can lead to major supply problems for critical raw material in case of unexpected disruptions, particularly for markets like Europe, where local production is very limited.

Exhibit 5 - Share of top producing country for selected minerals in 2022



Source: IEA, 2022

China's dominance in strategic minerals is partly due to the natural deposits across the country, but also to deliberate planning. The Chinese government launched its Belt and Road Initiative (BRI) in 2013 to develop new trade routes connecting the country with the rest of the world, increasing China's economic leverage. Since the project inception, the related engagements (investments and construction) have crossed the USD 1 trillion mark.

As a result, China has already secured a large proportion of mining resources and even more in processing. Metals and mining engagements are a growth area, increasing by 131% in the first half of 2023 compared to the first half of 2022.[10] Chinese companies are actively acquiring lithium mines across the globe to secure their access to strategic raw materials. Among the 136 lithium-ion battery plants planned worldwide as of 2019, 101 will open in China.[11]

In response, Europe and the US have been undertaking measures to catch up in securing critical strategic resources. An example of this is rare earth elements, where China accounts for around 68% of the production. Europe does not have any mines producing rare earth elements, but it does have areas with suitable geology for rare earth resources. For example, in January 2023, Swedish state-owned mining company LKAB said it had identified more than 1 million tons of rare earth oxides in the Kiruna area in the far north of the country, the largest known such deposit in Europe.[12]

In March 2023, the European Union unveiled the Critical Raw Materials Act (CRMA). The law is designed to guarantee a supply of the minerals that it has deemed crucial for the green

[8] International Renewable Energy Agency (IRENA), Critical Materials For the Energy Transition: Lithium, January 2022
[9] IEA, Ibid.
[10] Green Finance & Development Center, China Belt and Road Initiative Investment Report 2023 H1, July 2023
[11] IRENA, Ibid.
[12] Reuters, Sweden's LKAB finds Europe's biggest deposit of rare earth metals, 13 January 2023

transition as well as end its dependence on China. The CRMA is the result of the situation during the Covid-19 pandemic, when supplies of essential goods dried up, and Russia's invasion of Ukraine and the consequent reduction in natural gas supplies.[13]

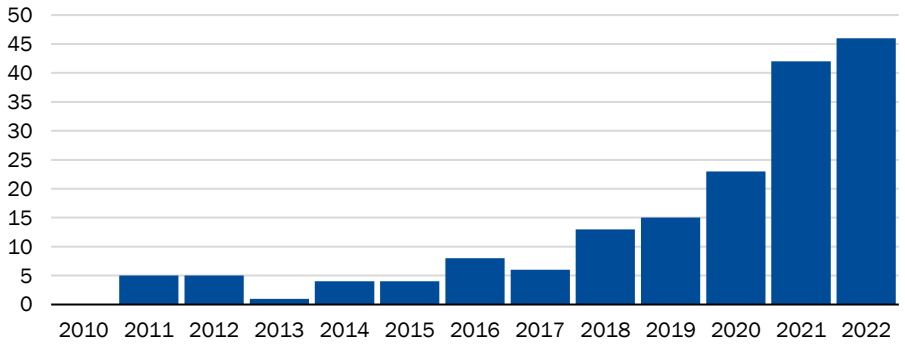
The EU's regulation sets a framework to support the development of domestic capacities and strengthen the circularity of the critical raw material supply chains within member countries.[14] In response, China placed restrictions on exports of gallium, germanium and graphite, which are part of the EU's strategic raw material list, and banned exports of technology for processing rare earths citing national security concerns.[15]

For its part, the US government launched in 2022 massive tax credits with the Inflation Reduction Act (IRA) to incentivise clean energy projects. The primary goal is to reduce greenhouse gas emissions in the US by 40% below 2005 levels by the end of the current decade. A key component of the Act is a commitment to boosting the domestic supply of strategic minerals to provide the materials needed for a vast expansion of EVs, batteries and renewable energy infrastructure.[16]

The US decision to stimulate the green transition through USD 370 billion of incentives contrasts with the EU, which has opted for a regulatory approach to drive decarbonisation.

Nevertheless, many countries have opted for the regulatory route seeking to protect their strategic materials interest. Many countries have enacted policies and passed regulations to secure metals, with over 100 new policies in the last three years alone (see Exhibit 6).[17]

Exhibit 6 - Policies and regulations in relation to critical materials 2010-2022



Source: IEA, 2023

Investors can benefit from the regulatory push and the rising demand for metals. By carefully integrating ESG factors, there is the potential to select leading companies with best practice operations that are likely to benefit from emerging regulations, while avoiding those that will suffer economic consequences due to lack of compliance and disregard for sustainability risks.

Growing demand and limited supply for metals is set to influence geopolitical events in the future. Mineral-rich countries will gain importance on the global stage and shift power dynamics in their favour. Competition for the scarce resources could also intensify geopolitical rivalries. So far, government roadmaps have focused mostly on the supply side and less on reducing demand, for example through promoting a sharing and circular economy.

[13] European Commission, Critical Raw Materials: ensuring secure and sustainable supply chains for EU's green and digital future, 16 March 2023
[14] European Commission, Ibid.
[15] Reuters, China bans exports of rare earths processing tech over national security, 22 December 2023
[16] The White House, Building a Clean Energy Economy, January 2023
[17] IEA, Introducing the Critical Minerals Policy Tracker, November 2022

In fact, an increase in recycling alone could help meet some of the growing demand for strategic minerals once the green transition gains speed. The IEA estimates that recycling could account for 10% of the supply of minerals such as copper, lithium and nickel by 2040. Materials for renewable energy technologies, such as wind turbines, used to be very difficult to recycle. Nowadays, new composites make it possible to reuse most of the materials again.[18] The aim is to increasingly ensure that the product is designed in such a way that it can be recycled as easily and efficiently as possible.[19]

Electrifying mobility as part of the green transition

The electrification of mobility is an important step towards a low-carbon future. The transport sector is currently responsible for around one quarter of the planet's greenhouse gas emissions, while 95% of the global transport energy still comes from fossil fuels.[20] Replacing combustion-engine vehicles with EVs is therefore key to the clean energy transition.

The example of a medium-sized car illustrates the significant difference between electric and internal combustion engine vehicles in terms of their impact on the climate. When comparing the two types of vehicles, taking into account the carbon emissions of the entire value chain (including battery production) an electric vehicle is better for the climate after already 60,000 kilometres.[21] This has a major effect over the total service life of the vehicle, which is 200,000 kilometres. This calculation takes into account Switzerland's energy mix, i.e. the various energy sources used in the country. An EV performs equally well or slightly better than a combustion vehicle even with an energy mix consisting only of fossil fuels.[22]

But while EVs are more climate friendly than conventional vehicles, the production of the lithium-ion batteries used to power them is a significant source of embedded emissions. This means that the production of batteries can generate as many emissions as producing all the other materials used to make an EV.[23] Consequently, the optimisation of mining and processing in the context of battery production is critical.

There is no denying that extracting and processing the materials needed for energy transformation will generate emissions. However, the energy transition is poised to have an overall positive impact on the planet, as seen in the ramp up of electric mobility and the gradual phasing out of carbon-heavy internal combustion engines.

[18] Orsted AS, Can wind turbines be recycled?

[19] Handbook of Recycling, From Recycling to Eco-design, 9 May 2014

[20] United Nations, Climate Change Fact Sheet, Sustainable Transport Conference, 14-16 October 2021

[21] Source: Based on data collected by TCS and PSI. The CO2 emissions per KM for EVs are based on the Swiss Energy Mix

[22] Sustainability By Numbers, Electric cars are better for the climate than petrol or diesel, 26 January 2023

[23] McKinsey, The race to decarbonize electric-vehicle batteries, 23 February 2023

An ESG perspective on mining

The transition to a decarbonised economy will make increased reliance on mining inevitable. At the same time, it is undeniable that mining takes a toll on the environment and society. The main ESG issues in the mining sector, such as waste, water, emissions and human rights, deserve a closer look.

Waste

Mine waste results from the extraction and processing of metals and minerals. It includes materials such as topsoil, which is removed to gain access to mineral resources, and tailings left once the mineral is extracted.[24] The main reason for the large amount of waste is the low concentration of metals in the soil or rock. For example, gold is currently mined from ores that contain 0.5 grams of gold per tonne. This means that even a small amount of gold ore (approximate monetary value as of December 6, 2023: USD 32.5) generates a tonne of waste.[25, 26] To make things worse, the average grade of copper ore mined has declined from 0.9% (one tonne of ore containing 9 kilograms of copper) per year in 2005 to 0.7% in 2019.[27] The decline is due to the depletion of higher-grade resources.

The mechanical and chemical processes used to extract minerals from the ore produce a liquid slurry made of mineral particles and residual water, known as tailings. Tailings are often stored in heaps or in large ponds surrounded by a dam. Their management is typically complex, since they contain reprocessing chemicals as well as elevated levels of metals. Storage facilities can collapse, with catastrophic consequences and lasting impacts on human health, the economy and the environment.[28]

Water

Mining is highly water intensive and poses serious contamination risks to water supplies. The various processing stages (ore separation, drilling cooling, processing machinery and dust suppression) require large quantities of water. It takes around 90 cubic metres of water – enough to fill 550 domestic bathtubs – to produce one tonne of copper.[29]

Over 50% of lithium and copper mines are located in water-scarce areas, especially in Chile and Peru.[30] It takes two million litres to produce one tonne of lithium.[31] This is due to the production process where lithium-rich brine is pumped into large evaporation pools. Over several months, the brine slowly evaporates until the lithium concentration in the water increases and reaches a level of 6%. The concentrated brine is then further processed in chemical plants.[32]

Mining poses significant contamination risks from acid mine drainage, wastewater discharge and the disposal of tailings.[33] Lithium brine has been linked to groundwater depletion and desertification in arid areas, as well as freshwater pollution due to the failure to

[24] European Commission, Mining Waste
[25] Geotechnical Practice for Waste Disposal, Mine Waste Disposal, 1993
[26] Finanzen.ch, Gold price
[27] IEA, Average copper ore grade in Chile by production route, 2005-2019, 3 May 2021
[28] European Commission, Ibid.
[29] Arthur D. Little, Water Supply for Mining Industry: The Chile case, March 2023
[30] IEA, The Role of Critical Minerals in Clean Energy Transitions, March 2022
[31] IEA, Reducing the impact of extractive industries on groundwater resources, 22 March 2022
[32] Tom Hegen, The Lithium Series 1
[33] IEA, Ibid.

control toxic chemicals during the processing phase.[34] The impact of mining on water resources can also turn mines into stranded assets. One example is the Pascua-Lama gold and copper mine in the Huasco River Basin, on the border between Chile and Argentina. Production was put on hold in 2013 over environmental concerns, with the Chilean authorities ordering the definitive closure of the project. The Huasco River Basin is also home to 70,000 small-scale farmers who rely on water for irrigation, who had viewed the massive open-pit mine, one of the largest in the world, as a threat to the local waterways.[35]

Greenhouse gas emissions

Overall, the metals and mining sector is responsible for 10% of global greenhouse gas emissions – of which 7% is from steel production, 2% from aluminium production, and the reminder from other metals. The carbon footprint of metal production is mostly driven by the energy requirements and the associated energy mix.[36] The majority of steel, around 71% worldwide, is made via primary production methods using blast furnaces and basic oxygen furnaces, which are four times more polluting than the electric arc furnaces used elsewhere.[37] These emissions will increase in step with the growing demand for energy-transition resources.

Human rights

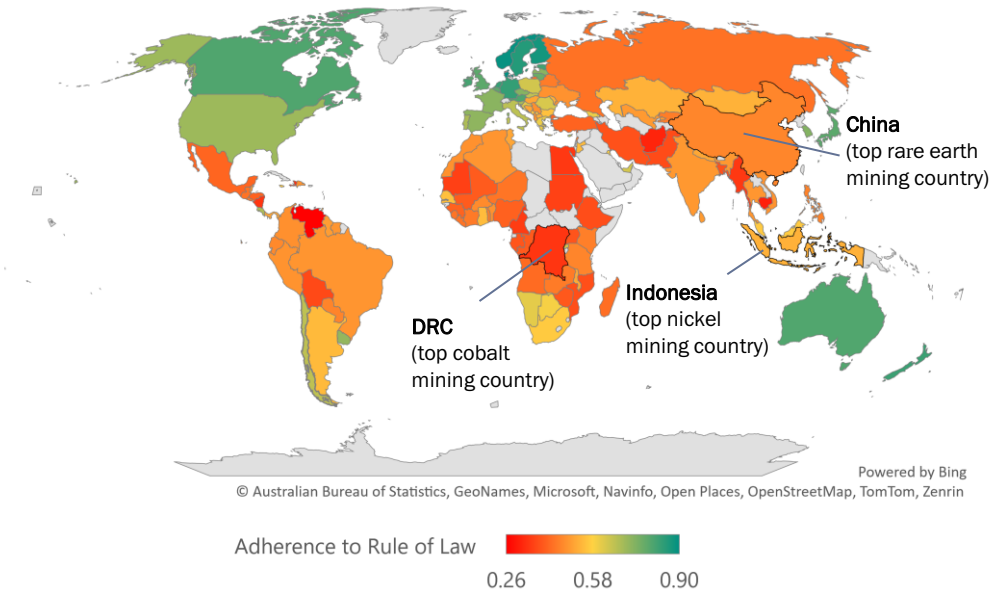
Mining projects often have harmful consequences for local communities – such as pollution, access to water, land rights issues – as well as high a number of health and safety incidents, poor employment rights including forced and child labour. While human rights are a significant issue for all mining businesses, only 22% of companies had a publicly available commitment to respect human rights in 2023. In addition, between 2018 and September 2023, the Business and Human Rights Resource Centre tracked 940 controversies in the mining sector.[38]

With the introduction of several new human rights due diligence laws, companies are now required to systematically address human rights risks. Countries such as Australia, France, the UK, the Netherlands, Germany, Switzerland as well as the EU have already implemented laws related to business and human rights or are in the process of adopting them.[39]

However, the regulatory environment in many producing countries remains weak. China, the Democratic Republic of the Congo and Indonesia are the top producing countries for rare earths, cobalt and nickel respectively, but operations in these locations face greater challenges in ensuring the protection of worker's rights due to lower scores according to the World Justice Project (see Exhibit 8).

[34] ISS Insights, Critical Minerals: ESG Risks and Implications, June 2023
[35] CDP, High and Dry: How Water Issues Are Stranding Assets, 2022
[36] Eurometaux, Ibid.
[37] Roland Berger, It's time for steelmakers to reduce emissions, 21 November 2022
[38] World Benchmarking Alliance, 2023 Corporate Human Rights Benchmark, 20 November 2023
[39] Focusright, Regulatory Developments, October 2023

Exhibit 8 - Country rating on adherence to rule of law by the World Justice Project (WJP)



Source: World Justice Project

Artisanal- and small-scale mining (ASM), which accounts for 15% of the global mining production is often associated with human rights concerns, particularly in relation to workers' rights and child labour.[40] Artisanal miners are not employed by a mining company, typically working with rudimentary tools and inadequate safety precautions. ASM is widespread in the DRC, where ASM accounts for 15-30% of the extracted cobalt.[41] According to Reuters, there are around 150,000-200,000 artisanal miners in the country producing 15,000-30,000 tonnes of cobalt.[42] The Intergovernmental Forum on Mining, Minerals Metals and Sustainable Development estimates that over 40 million people were engaged in ASM compared to seven million in large-scale mining in 2017.[43]

The growing demand for strategic minerals will intensify pressure on ASM and, consequently, environmental and social issues.[44] Although several initiatives have tried to formalise ASM, there are no established best practices yet in place. For example, in 2022, non-governmental organisation Global Witness evaluated the International Tin Supply Chain Initiative (ITSCI), one of the main established schemes. However, the assessment found that ITSCI permitted the laundering of minerals in DRC. Through interviews with officials, traders, miners and others, the investigation confirmed that minerals came from unvalidated mines in neighbouring territories, including militia-occupied mines known for child labour.

[40] ISS ESG, Critical Minerals, 2023
[41] World Economic Forum, Making Mining Safe and Fair, September 2020
[42] Reuters, Cobalt, Congo and a mass artisanal mining experiment, 13 May 2021
[43] The International Institute for Sustainable Development (IISD), 2017 IGF Annual Report, 2018
[44] Eurometaux, Ibid.

Making a difference with investments

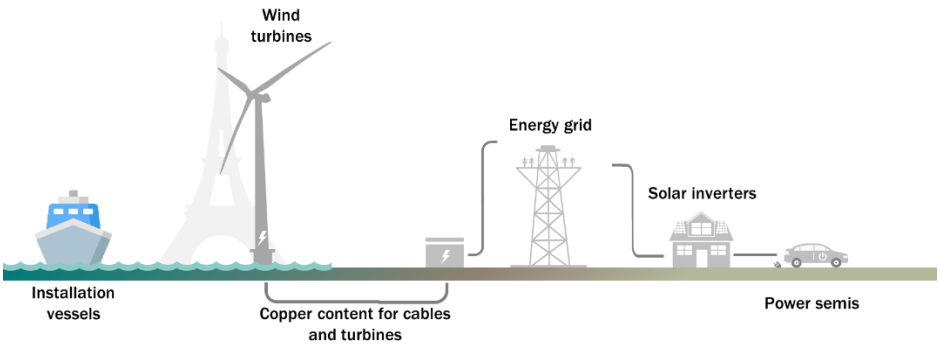
Investors have a number of tools at their disposal to take advantage of the surge in demand for the raw materials needed for the green transition: commodity futures, sovereign bonds or investments exposed to corporate bonds or equities. However, the first two options in isolation make it difficult to address sustainability concerns.

The obvious way to participate in the trend for minerals is via commodity futures – derivative investment vehicles used to buy specific amounts of a commodity at a specified price and date in the future. The London Metal Exchange (LME) is the most prominent exchange for commodities and offers a platform to trade in key strategic resources such as copper, lithium, nickel, cobalt, zinc and molybdenum.

In addition, investors can benefit from rising materials demand by investing in currencies and sovereign bonds of resource-rich countries. However, the relationship between a country's economic growth and its currency and bond markets is indirect, meaning other factors may cloud the link between the financial returns from these assets, resource prices and export activity.

Finally, it is possible to participate in the energy transition by investing in equities or bonds issued by companies in highly exposed areas, for example businesses in the electrification value chain. These include not only metal mining and processing (upstream) companies, but also suppliers to the mining industry (i.e. engineering and mining services and equipment) as well as waste recycling.

Exhibit 9 - Investing along the electrification value chain



Source: Bank J. Safra Sarasin Ltd, 2023. The simplified value chain is shown for illustrative purposes only and does not constitute an offer, solicitation or recommendation to buy, hold or sell investments and does not consider the circumstances of any individual investor.

Select leading companies in the green transition

For sustainability-oriented investors, it is essential to focus on long-term value creation. This means investing in companies that are best placed to manage the risks and opportunities associated with sustainability. As outlined in the previous sections, waste pollution, greenhouse gas emissions, water use and human rights are significant ESG issues associated with the mining sector.

When investing in the mining value chain, investors should ensure that companies have a relevant sustainability governance in place. Business should outline how ESG issues are addressed and how the implementation and oversight is ensured at the level of the board of directors and senior management level. Mining companies should ensure that they have relevant policies in place such as an environmental policy and a human rights policy. Companies should also disclose data, set targets and communicate achievements. Investors can prioritise companies that excel in these areas, as they will be better equipped to meet regulatory requirements when challenges arise.

J. Safra Sarasin Sustainable Asset Management aims to reduce ESG and climate-related risks not only at the single security level but also at the portfolio level. The bank invests in companies with strong ESG practices, based on its understanding of long-term transformational trends and a proprietary, award-winning assessment methodology. All ratings are conducted by in-house sustainability analysts with specific sector expertise. The sustainability rating incorporates two dimensions, which are combined in the J. Safra Sarasin Sustainability Matrix®: sector rating and company rating. The sector rating is a comparative assessment of industries based upon their environmental and social impacts. The company rating is a comparative assessment of businesses in a specific sector based upon their performance in managing their ESG risks and opportunities.

Engage with companies to improve practices

In many cases, it may not be enough to select leading companies in the mining value chain. One powerful tool available to investors is targeted engagement on company-specific weaknesses. Experience shows that engagement is the most reliable mechanism for investors seeking positive impact.[45] Investors can engage with companies on ESG issues, set concrete targets and track progress. Investors can encourage companies to adopt more best practices. When engaging with businesses, it is important to focus on the most material issues, such as those that have the greatest impact on the planet and society.

Investors should consider ESG engagement along the entire supply chain, making supply chain due diligence a key topic for all “downstream” companies. Electric car manufacturers and other companies are increasingly focusing on responsible sourcing and supply chain due diligence. For example, the problematic value chain in cobalt sourcing has led BMW to source cobalt from Morocco and Australia instead of the DRC for its electric vehicles from 2020 to ensure the metal is sourced responsibly.[46]

For an even stronger impact, investors can join forces to address ESG issues collectively. One example is the Advance initiative by Principles for Responsible Investment (PRI). In 2022, PRI launched the largest investor-led human rights initiative to date. In its first engagement cycle, focusing on 25 metals and mining companies and 15 renewable energy companies, the Advance initiative has brought investors together in collaborative engagement streams to use their influence with companies and other decision-makers to drive positive change. The initiative aims to improve human rights through investor stewardship in the metals, mining and renewables sectors. It was endorsed by 220 investors with USD 30 trillion in assets under management. The goal of the initiative is to address human rights and social issues in the metals, mining and renewables sectors.

Strategic metals are one of the focus areas of the engagement programme at J. Safra Sarasin Sustainable Asset Management. The firm conducts one-on-one engagements with companies in the metals value chain as well as in collaboration with other investors. J. Safra Sarasin Sustainable Asset Management was selected as one of the 120 investors to join the high-profile Advance initiative as a participating investor.

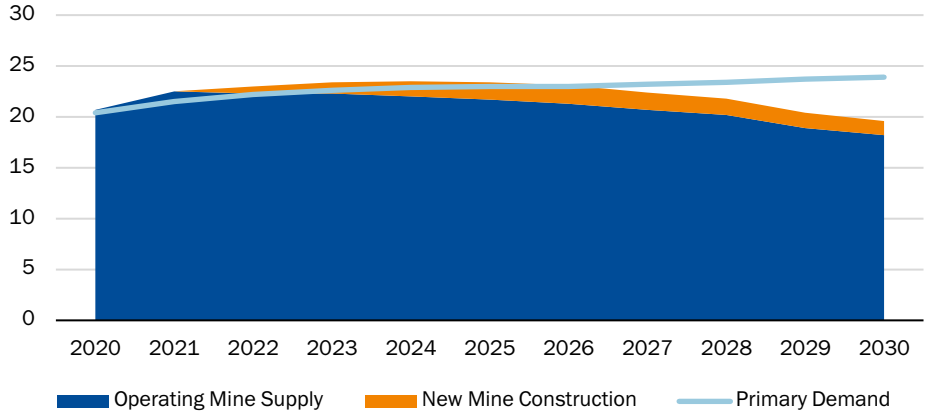
[45] Center for Sustainable Finance and Private Wealth, Investor Impact – How Can Investors Change the World?, 2023

[46] World Economic Forum, Ibid.

Invest in solution providers

In the future, the supply of metals may not be able to meet the demand. According to the IEA, demand will outweigh supply after 2025 even excluding the green energy transition. It is difficult to ramp up supply because supply elasticity is low due to the long lead time required to start a new mining project and the declining quality of resources.[47] The IEA estimates that it takes on average 16.5 years to develop a mining project.

Exhibit 10 – Supply and demand outlook for copper

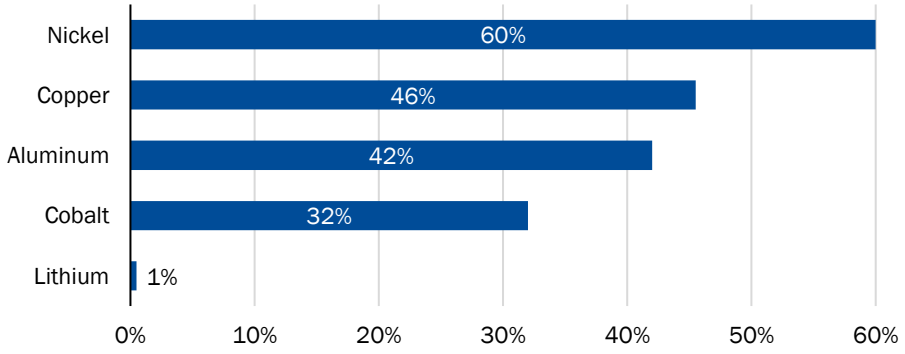


Source: IEA, 2021

As a result, recycling will need to become increasingly important and economically viable.[48] Emerging technologies, such as enhanced metal recovery from waste streams or low-grade ores, may offer the potential for a step change in future supply volumes. This is good news in terms of ESG. Recycling means less extraction of non-renewable resources, while producing the most commonly used metals from recycled material uses 60-97% less energy than producing them from mined material.[49]

The level of recycling is usually measured by two indicators: end-of-life recycling rates and recycled input rates. End-of-life recycling rates refer to the share of material in waste flows that is actually recycled, and recycled input rates assess the share of secondary sources in the total supply of the material.[50] The end-of-life recycling rates vary from metal to metal. While the end of life recycling rate for nickel is relatively high (60%), it is at less than 1% for lithium (see Exhibit 11).

Exhibit 11 - End-of-life recycling rates for selected metals



Source: IEA, 2021

[47] IEA, Committed mine production and primary demand for copper, 2020-2030, May 2021
[48] IEA, Ibid.
[49] OECD, Resource efficiency, the circular economy, sustainable materials management and trade in metals and minerals, 1 Mars 2021
[50] World Bank Group, Minerals for Climate Action, 2020

While in theory metals can be recycled forever, in practice some resources are lost and the energy required to recover them may be disproportionate. Therefore, recycling may not always be technically feasible or economically viable. Recycling can also reduce functionality. For example, the cobalt used in batteries needs to be extremely pure.[51]
The complexity of the end products, often caused by the use of multiple alloys, can make the recycling process more difficult.

Next to recycling companies, innovative solution providers for substitute materials will also gain ground. One example is sodium-based batteries, which could potentially replace lithium-based batteries in EVs.[52] As these batteries use sodium as a key component to store energy, they could offer a great opportunity for European companies to play a major role in energy transition. This is because this innovative battery technology is comparatively less dependent on critical resources. Sodium, one of the key components of salt, is virtually infinitely available.[53]

Reducing material intensity and promoting material substitution through technological innovation can play an important role in alleviating supply constraints, while reducing costs. For example, a 40-50% reduction in the use of silver and silicon in solar cells over the past decade has enabled a spectacular rise in the use of solar panels.

[51] Chemical & Engineering News, Recycling Renewables, 9 April, 2018
[52] Reference Module in Chemistry, Molecular Sciences and Chemical Engineering, Sodium Systems – Low Temperature, Cathode active materials for sodium-ion batteries, 2023
[53] CnEVPost, Byd to build sodium-ion battery production base in Xuzhou, 10 June 2023

Conclusion

Sustainability-minded investors will have to solve the dilemma created by the need for metals and minerals for the energy transition and their ESG challenges. It will be necessary to understand the complexities of the metals value chain and find a more nuanced approach to a sector that may have been avoided for many years due to environmental and social concerns.

Metals are omnipresent in our daily lives as they are part of our buildings, cars, phones and computers, and are the building block of the energy transition. However, it is important to choose the right investments, work with companies to improve their ESG performance and invest in transformative solutions. Handling waste responsibly, ensuring prudent water management and establishing social safeguards are key in transforming the mining sector towards a more sustainable model, as are solution providers such as recycling companies and companies promoting alternative technologies.

As a sustainable investor, J. Safra Sarasin Sustainable Asset Management encourages mining companies to engage in community outreach and to behave responsibly when interacting with their surrounding communities.

While the emissions from the extraction and processing of materials used in the energy transition cannot be denied, the net impact of the energy transition is positive, as seen in the electrification of mobility and reduced reliance on carbon-intensive internal combustion engines. Solving the strategic minerals conundrum means finding the mid-point between the inevitable energy transition and minimising negative effects of mining in a pragmatic approach. For well-informed investors with a deep understanding of the risks and opportunities linked to sustainability, this comes with plenty of opportunities.

Disclaimer

Important legal information

This publication has been prepared by the Sustainability Department of Bank J. Safra Sarasin Ltd, Switzerland, (hereafter "Bank") for information purposes only. It is not the result of financial research conducted by the Bank. Therefore the "Directives on the Independence of Financial Research" of the Swiss Bankers Association do not apply to this publication. Any views, opinions and commentaries in this publication (together the "Views") are the Views of the Sustainability Department and may deviate from those other departments within the Bank. The Bank may make investment decisions or take proprietary positions that are inconsistent with the Views expressed herein. It may also provide advisory or other services to companies mentioned in this publication resulting in a conflict of interest that could affect the Bank's objectivity. While the Bank has taken steps to avoid or disclose, respectively, such conflicts, it cannot make any representation in such regard.

The Views contained in this publication are those of the Sustainability Department as per the date of writing and may be subject to change without notice.

This publication is based on publicly available information and data ("the Information") believed to be correct, accurate and complete. The Bank has not verified and is unable to guarantee the accuracy and completeness of the Information contained herein. Possible errors or incompleteness of the Information do not constitute legal grounds (contractual or tacit) for liability, either with regard to direct, indirect or consequential damages. In particular, neither the Bank nor its shareholders and employees shall be liable for the Views contained in this publication. Third party data providers make no warranties or representations of any kind relating to the accuracy, completeness or timeliness of the data provided and shall have no liability for any damages of any kind relating to such data.

This publication does not constitute a request or offer, solicitation or recommendation to buy or sell any financial instruments or accept any services. It should not be considered as a substitute for individual advice and risk disclosure by a qualified financial, legal or tax advisor. You are reminded to read all relevant documentation before making any investment, including risk warnings, and to seek any specialist financial or tax advice that you need. You are not permitted to pass this publication on to others, apart from your professional advisers. If you have received it in error please return or destroy it.

Past performance is no indication of current or future performance. Investments in foreign currencies are subject to exchange rate fluctuations. Exchange rate risk will apply if the investor's reference currency is not the same as the investment currency. Information containing forecasts are intended for information purpose only and are neither projections nor guarantees for future results and could differ significantly for various reasons from actual performance. The Views and opinions contained in this publication, along with the quoted figures, data and forecasts, may be subject to change without notice. There is no obligation on the part of Bank or any other person to update the content of this publication. The Bank does not accept any liability whatsoever for losses arising from the use of the Information (or parts thereof) contained in this publication.

Neither this publication nor any copy thereof may be sent to or taken into the United States or distributed in the United States or to a US person. This information is not directed to any person in any jurisdiction where (by reason of that person's nationality, residence or otherwise) such distribution is prohibited and may only be distributed in countries where its distribution is legally permitted.

This publication constitutes marketing material. If it refers to a financial instrument for which a prospectus and/or a key investor/information document exists, these are available free of charge from Bank J. Safra Sarasin Ltd, Elisabethenstrasse 62, P.O. Box, CH-4002 Basel, Switzerland.

United Kingdom: Where this document is distributed by J. Safra Sarasin Asset Management (Europe) Ltd ("JSSAMEL") to wholesale and institutional businesses, we deal with wholesale and institutional businesses as contacts and not as clients, the protections afforded to clients under the regulatory system do not apply. For further details please refer to the disclosure letter that we have provided to you. Any person other than a wholesale or institutional contact should ignore this presentation. This publication serves for information purposes only and is for the sole use of the recipient. JSSAMEL forms part of the J. Safra Sarasin Group.
A limited company incorporated in Gibraltar with registration number 93596 whose registered offices are 57/63 Line Wall Road, Gibraltar, and registered as an overseas company in England and Wales No. FC029375. Authorised by Financial Conduct Authority registration number 538254. 47 Berkeley Square, London W1J 5AU.

Sustainability Rating Methodology
The environmental, social and governance (ESG) analysis of companies is based on a proprietary assessment methodology developed by the Sustainability Department of the Bank. All ratings are conducted by in-house sustainability analysts. The sustainability rating incorporates two dimensions which are combined in the J. Safra Sarasin Sustainability-Matrix®:
Sector Rating: Comparative assessment of industries based upon their impacts on environment and society.
Company Rating: Comparative assessment of companies within their industry based upon their performance to manage their environmental, social and governance risks and opportunities.
Investment Universe: Only companies with a sufficiently high Company Rating (shaded area) qualify for Bank J. Safra Sarasin sustainability funds.
Key issues
When doing a sustainability rating to individual companies, the analysts in the Sustainability Department assess how well companies manage their main stakeholders' expectations (e.g. employees, suppliers, customers) and how well they manage related general and industry-specific environmental, social and governance risks and opportunities. The company's management quality with respect to ESG risks and opportunities is compared with its industry peers.
Controversial activities (exclusions)
The screening for controversial business activities and practices represent a preliminary step of the Bank's sustainability analysis. The Sustainability Department applies several standard criteria in order to exclude business practices which are in breach of global norms and/or highly controversial business activities (e.g. armaments, tobacco, adult entertainment). The standard set for controversial business activities screening is embedded in all sustainable investment strategies and may lead to the exclusion of companies from the Bank's sustainable investment universe.
Data sources
The Sustainability Department uses a variety of data sources which are publicly available (e.g. company reports, press, internet search) and data/information provided by service providers which are collecting financial, environmental, social, governance and governance reputational risk data on behalf of the Sustainability Department.

MSCI ESG
This report contains certain information (the "Information ") sourced from Bank J. Safra Sarasin Ltd. information providers, including without limitation, MSCI ESG Research LLC and its affiliates (the "ESG Parties ") and may have been used to calculate scores, ratings or other indicators. The Information may only be used for your internal use, may not be reproduced or redisseminated in any form and may not be used as a basis for, or a component of, any financial instruments or products or indices. Although they obtain information from sources they consider reliable, none of the ESG Parties warrants or guarantees the originality, accuracy and/or completeness, of any data herein and expressly disclaim all express or implied warranties, including those of merchantability and fitness for a particular purpose. None of the Information is intended to constitute investment advice or a recommendation

to make (or refrain from making) any kind of investment decision and may not be relied on as such, nor should it be taken as an indication or guarantee of any future performance, analysis, forecast or prediction. None of the ESG Parties shall have any liability for any errors or omissions in connection with any data or Information herein, or any liability for any direct, indirect, special, punitive, consequential or any other damages (including lost profits) even if notified of the possibility of such damages.

Bank J. Safra Sarasin Ltd
Elisabethenstrasse 62
P.O. Box
4002 Basel
Switzerland
T: +41 (0)58 317 44 44
F: +41 (0)58 317 44 00
www.jsafrasarasin.ch

Bank J. Safra Sarasin Ltd
Elisabethenstrasse 62
P.O. Box
CH - 4002 Basel
Tel + 41 (0)58 317 44 44
Fax + 41 (0)58 317 44 00