



CRITICAL METALS: LEARNING FROM OUR MATERIAL FOOTPRINT

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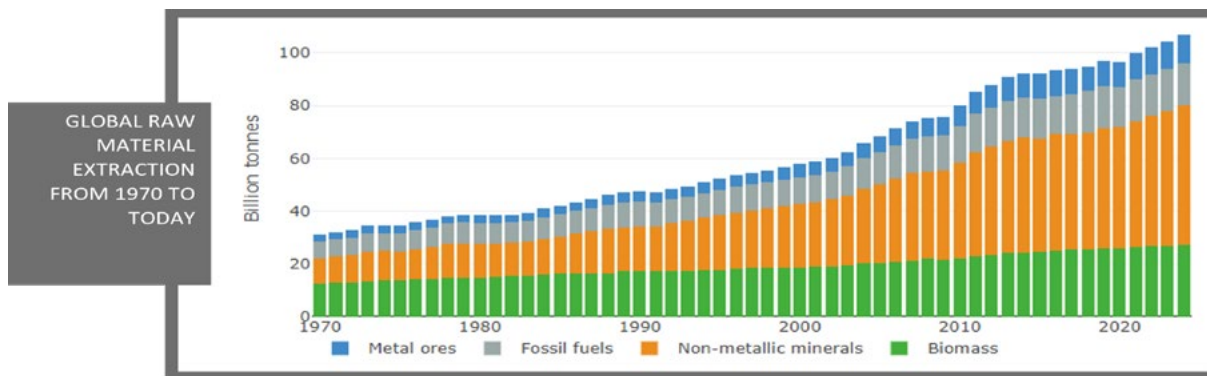


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What material flows are needed to support human life? The concept of ‘material footprint’ attempts to answer this question. And the figures are staggering: our global material footprint has been growing by 235% since 1970¹. In 2023, 104 billion tonnes of abiotic and biotic materials were extracted, representing flows of 12.7 tonnes per capita per year. This is an average of 35 kg per day and per person throughout the world: 17 kg of non-metallic minerals, mainly sand², 5.3 kg of fossil fuels, 3.4 kg of metal ores and 9 kg of biomass. 75% of these resources are non-renewable.



Source: Materialflows.net, 2024

In rich countries such as France, the material footprint is far greater: between 18 and 29 tonnes of materials per person and per year, depending on sources³. In other words, on average, 50 to 80 kg of mineral, metallic, agricultural and energy raw materials – excluding water (or the figure would be much higher) are needed to support the lifestyle of a single person in a rich country⁴. We are unfamiliar with these orders of magnitude as we never actually witness the flows required for the extraction and production of the raw materials used to build our infrastructure, homes, equipment and support our daily consumption. “Out of sight, out of mind” and remote from our understanding of the world, to quote the late anthropologist Bruno Latour who pointed out the widening gap between the “world we live in” and the “world we live from”.

The facts are before us: the economic metabolism that sustains us is cumbersome and rather unknown. While materials supplying metals only account for 10% of mass material flows, they represent 17% of the weight of non-renewable abiotic flows and have a much higher financial value than non-metallic minerals (a kilo of sand is worth a few cents, a kilo of copper several euros, for example). In value terms, metals take the lion’s share! This also applies to energy consumption and to the many environmental impacts generated by the metals industry. The environmental and economic metabolism of metals is particularly heavy, thereby offering a perfect example of the ‘double materiality’ concept that is currently dividing the financial industry.

In this article, through an investment lens, we shall examine how

this unheard of and physically unsustainable reality is already impacting – and will continue to impact - financial markets and investment strategies.

DEMAND ON THE RISE

As efforts are being made to transform our use of energy – with a strong focus on electrification, new types of demand are emerging and expanding. The global impact is all the stronger, as it comes on top of a power-hungry economic and industrial system set to last, and soaring demand for digital capacities.

The many studies conducted so far converge: the digitalisation of our economy and the transformation of our energy and mobility systems are aggravating factors, as they consistently require more infrastructure (servers, data centres, power grids, power generation facilities). Whether driven by generative artificial intelligence or electrification, this acceleration will only strengthen our need for metals. Historical observations have shown that the so-called ‘energy transition’ has, so far, involved superimposing and interlinking different energy sources and intertwining them with more and more materials - both in number and volume⁵. Most of these new needs require large initial investments in materials and energy.

Wind turbines, power grid components, electric vehicle charging stations and a fleet of electric cars? Their greenhouse gas emissions curves will evolve more or less in line with their costs: high at the beginning during the construction stage, then much lower during their lifespan.

¹Global data from <https://www.materialflows.net/global-trends-of-material-use/> and *Écologie 360* n°3, p141-142, “Double vertigo” article, 2023. ²6.25 tonnes per year per capita, PNUE, Sand and Sustainability Report 2022. ³High income countries <https://unstats.un.org/sdgs/report/2019/goal-12/> and France, cf. <https://www.statistiques.developpement-durable.gouv.fr/sites/default/files/2018-10/lps177-matieres-v2.pdf> ⁴based on the average water footprint per capita in France :1,875 m3 per year, https://fr.wikipedia.org/wiki/Empreinte_eau, or 65 to 104 times higher! ⁵Cf. “Sans transition”, by Jean-Baptiste Fressoz, Seuil, 2024

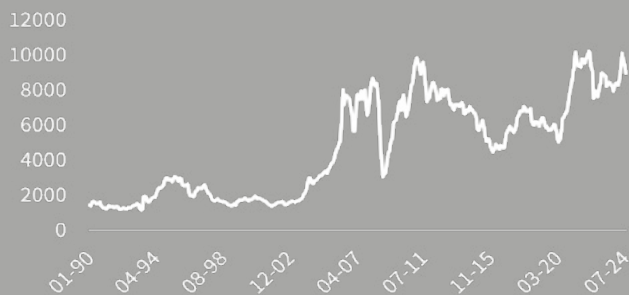


FACING THE CHALLENGE OF PHYSICALLY CONSTRAINED SUPPLY

Within raw materials, metals have specific physical and economic characteristics:

- They are much more costly than mineral materials (sand, gypsum, kaolin...)
- Unlike farming, forestry, animal-based or bio-sourced raw materials, they are not renewable
- They are not substitutable, as each metal is a chemical element with its own specific properties. Gold cannot be replaced with steel, or germanium with scandium.
- The extraction and refining processes are increasingly costly – both environmentally and financially – as the best sites (ie. the most concentrated) have already been mined.
- Mines are complex infrastructures, involving heavy works in often remote locations. The timeframe between exploration and actual production is very long: 15 to 20 years for nickel and copper, for example. Foundries and metal refineries involve heavy infrastructure that can only begin to ‘deliver’ after many years. So naturally, supply does not appear as if by magic to satisfy demand. Demand adapts to supply, and the market contributes to the process through price fluctuations. The graph below shows the sharp variations in the price of copper over the past 20 years – between USD 3 and 10 per kg after hovering around USD 2 per kg for several decades.
- Finally, the social acceptance of the negative externalities caused by this infrastructure is receding throughout the world, including in China. The social and environmental dumping that has been the norm for so long will not last forever! Tensions on the water supply for lithium mines in Chile illustrate the intricate environmental and social issues raised by these projects.

*Price of Grade A copper since 1990 in USD / tonne (London Metal Exchange)



The perfect recipe for inflation is in motion and average prices (...) are set to rise durably



This points to a further paradox: future decarbonisation based on these technological solutions will require increasing our material footprint and producing much more greenhouse gas emissions than we already emit today.

Mankind will therefore extract and refine more metals; and these are mechanically more difficult to mine in all respects (greater land footprint, energy, waste and pollution). The perfect recipe for inflation is in motion and average prices (notwithstanding short-term market fluctuations, which are also driven by economic factors including the cyclical nature of Chinese demand) are set to rise durably. But this where the generalities end!

No two metals are identical, and they can be combined into multiple alloys to address increasingly wide-ranging applications. Technophile clichés such as “thanks to technological progress, extraction and refining techniques will improve” or “productivity gains will lower the costs” fail to offer any historical or technical evidence, as the processes used have barely changed over the past decades. Such hopes will be dampened and, in any case, couldn’t have produced positive effects in the near-term.

WHAT ABOUT RECYCLING?

Others are placing their hopes in the growth of recycling as an effective solution for addressing the challenges caused by the material footprint and mismatched supply/demand. But facts are stubborn: recycling is hampered by the growing complexity of increasingly sophisticated equipment and products, as illustrated by the 3,000 types of aluminium alloys in existence today, or the latest generation smartphones which contain over 70 different chemical elements.

In actual fact, the circular economy is developing at a very slow pace: the Circularity Gap Report initiative, which regularly measures the circularity of our global economy, has reported a new figure of 7.2% for 2023, down from 9.1% in 2018. This means that while flows of recycled materials, referred to as secondary raw materials, rise in absolute terms, they are lower in relative terms compared to the total material flow (primary and secondary). In other words, the linear economy has grown faster than the circular economy over the past 5 years⁶.



CRITICALITY RANKING

The picture we have described is clearly inflationary and will fuel volatility, affecting long-term commodity prices as well as the pricing of mining and metal companies on the stock market. These effects will not be uniform, as the intensity of demand varies depending on the metals and supply does not grow at a steady pace.

As investors, our role is to pick some of the eggs in the basket. We attempt to identify the metals, alloys and metallic components that will be most impacted by the growing metabolism of our globalised economy.

⁶The Circularity Gap Report 2024. ⁷Interesting summary of sources in “La guerre des métaux rares, la face cachée de la transition énergétique et numérique” by Guillaume Pitron, Les Liens qui Libèrent, Poche, new improved edition in 2023. You may also read Ecologie 360 n°7, Autumn 2024, pages 46-47, “Métaux et Terres Rares, les nouveaux ors verts” and the list of strategic and critical raw materials in Regulation (EU) 2024/1252 of 11 April 2024. *Source: Insee. Data as of 20.09.2024



The terms and definitions for strategic, transition or critical metals vary depending on the country, institution or expert using them. No need to look for an official listing of these metals in tight supply: it doesn't exist.

However, studies, lists and opinions can be found in abundance⁷. By cross-analysing these documents with the "Criticality Assessment results" of the BRGM, CRU & McKinsey, we have drawn up a list of the 11 most critical elements most exposed to factors causing imbalances, in our view:

- 6 ultra-critical elements: Zinc (Zn), Nickel (Ni), Copper (Cu), Tin (Sn), and two rare earth elements - Praseodymium (Pr) and Neodymium (Nd);
- 5 highly critical elements: Graphite (C, name of carbon which is not a metal), Silicon (Si, a metalloid), Lithium (Li), Tungsten (W) and another rare earth, Dysprosium (Dy).

This selection can be widened to include 20 other chemical elements that are merely critical. Those fascinated by Mendeleev's⁸ periodic table of the elements will no doubt appreciate the following list of metals plus 3 metalloids (in italics): Platinum (Pt), Lead (Pb), Bismuth (Bi), Iridium (Ir), Tantalum (Ta), Tellurium (Te), Antimony (Sb), Silver (Ag), Palladium (Pd), Rhodium (Rh), Ruthenium (Ru), Germanium (Ge), Cobalt (Co), Vanadium (V), Titanium (Ti), Scandium (Sc), Magnesium (Mg), Beryllium (Be), Aluminium (Al) and a non-metal element, Selenium (Se)!

HOW CAN INVESTORS PLAY THE THEME?

The expected mismatch between supply and demand will tend to increase volatility and prices, generally in incremental stages (during negative shocks on the supply side, in particular). Mining companies and metal refining activities will be critical to maintaining a robust economy, notably to enable electrification, digitalisation, and the long road to a lower-carbon energy mix. Furthermore, the metals sector concentrates substantial environmental, social, human rights and governance issues that have the potential to generate major risks.

These combined factors have created an attractive and concentrated pool of opportunities for stock pickers amid a risk-on and volatile

environment: in short, one can expect 'high risk/high return'. Selectivity is therefore a must: this is a theme where stock selection based on extra-financial criteria – ESG (Environmental, Social and Governance) – truly makes sense, as it forms the bedrock of our risk analyses.

Indeed, this offers a perfect example of 'double materiality' (another way of saying 'what matters'), both on financial grounds and the impact in the real world, notably for the environment and society.

At first, using the terms ESG and extraction & refining companies in the same sentence may seem surprising. And rightly so, as these are businesses that generate the highest amounts of direct pollution and 75% of industrial mines are concentrated in only 13 countries: Russia, China, Australia, the US, Indonesia, Brazil, Canada, Chile, South Africa, Peru, Guyana, Argentina and India. That said, everything that comes out of mines and the heavy metal industry is later found in the objects we handle and the infrastructure we use daily.

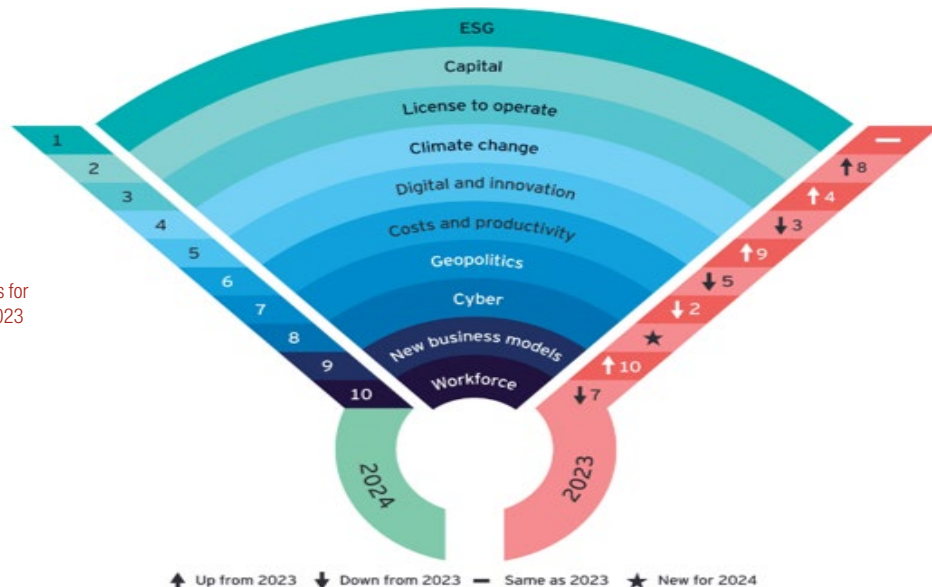
Similarly, a large share of what ends up on our plates would disappear without the mechanisation and extensive use of chemicals upon which our intensive agro-industrial models are founded.

Finally, a world without metals would spell the end of tech and digitalisation. Just as fossil fuels became the lifeblood of our modern world, supplying 80% of our primary energy, materials - and metals in particular - are its backbone. Excluding metals would involve banning virtually all economic activities or sectors from our investments.

As such, fingerpointing at all companies operating in the upstream metals industry is akin to knowingly ignoring the sunken part of the iceberg - ie. the rest of the economy, which is entirely dependent on these players.

As the extent of our material footprint and its systemic nature are known facts, analysing its impacts using an expert ESG approach is truly meaningful: such an approach can clearly discriminate between countries where human rights, social and environmental standards are radically different.

This point is also made in a study conducted by Ernst & Young⁹ revealing that ESG has become the top consideration for mining and metal players in 2024.



Top 10 Business risks and opportunities for mining and metals according to E&Y, 2023

⁸Name of the Russian chemist and father of the current periodic table in which all elements are arranged according to their atomic weight https://fr.wikipedia.org/wiki/Tableau_p%C3%A9riodique_des_%C3%A9l%C3%A9ments ⁹Survey conducted by EY Canada, October 2023, https://www.ey.com/en_ca/mining-metals/risks-opportunities



WE ARE IRON MEN AND WOMEN

Much can be learnt from this analysis. It enables us to better measure the extent of our material footprint and its deep and intricate links with the entire economy, the skeleton of which is essentially made up of metals. Though unaware, many of us humans have now become “Iron Women” and “Iron Men” incapable of living without their daily dose of metal.

As managers of financial assets, this analysis strengthens our conviction that we should continue to steer clear of two popular, though misguided trends. The first is the renewed focus on ‘single materiality’ ie. Exclusively considering a company’s financial performance.

The second negative trend is the temptation to adopt simplistic ESG investment approaches calling for the outright exclusion of the mining and metal producing industries. Indeed, this heterogeneous sector offers a field for investigation, where analysing environmental and social impacts is particularly ‘material’ (ie. important) and legitimate. **This tendency – the easy road – is probably the most pernicious trend, as taking the more complex but rewarding path requires diligence, energy and resources.**

For ESG assessments to be credible and useful, the analysis process must cover the impacts for all stakeholders. On the environmental front, biodiversity, pollution, water and greenhouse gasses should be considered. Analysts should also examine the end-uses of metals, as these also have impacts, and the percentage of secondary raw materials used upstream.

A difficult task, but not unfeasible! If proof were needed, this information typically features in the input data for the Net Environmental Contribution (NEC) we calculate.

Finally, the assessment should cover potential changes to the company’s business model owing to its strategy and investments (decarbonisation, impact reduction, rehabilitation/regeneration of facilities, recycling capacities, changing product mix/end-clients...).

Similarly, on the valuation front, a deep understanding of the company’s business model is essential and goes hand-in-hand with the granular understanding of its social, societal and environmental impacts. In this case, the golden rule – “never invest in something you don’t understand” – requires in-depth knowledge, detailed analysis, meetings with company managers and experts, and even on-site visits.

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As an investment theme, critical materials – which are mainly metals – can rightly be deemed attractive, and even essential. But generalisations, pre-conceptions and half-truths are of no help to investors, savers or simple observers keen to know more about what is at stake. Every single metal is different and unique. Some are more critical than others; the mismatches between supply and demand do not show up evenly across market segments; and the human and environmental costs differ greatly between industry players and site locations. The keys are curiosity, investigation, discipline, nuance and surprises: an ideal playing field for truly responsible investors, portfolio managers and analysts.



Sycomore is part of the Generali Investments platform and offers industry-leading sustainable investments. They are pioneering ESG investors and have actively shaped its development in Europe. The firm focuses on human capital as the main lever to generate high conviction investment ideas, and their responsible investment approach is grounded in unique proprietary ESG research methodology.

- Founded: 2001
- AUM: €7.4bn*



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For more information: www.generali-investments.com