TRENDS
MINERALS

Yes, in my backyard! Under Pressure, International Competition for Strategic Minerals Required for the Energy Transition Intensifies

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While global economic growth sets off again at full tilt, the disorganisation of logistics chains and the high demand for low-carbon technologies have led to a spike in the prices of metals that are strategic to the energy transition, to the point of generating shortages of essential electronic components and jeopardising production in some industrial sectors. To achieve the climate objectives of the Paris Agreement, guarantee their geopolitical independence and secure their material supplies, States and businesses are sharpening their elbows to create integrated industrial sectors, from mining to battery production.

DATA OVERVIEW

The electrification of end-uses is in excess of the supply of strategic metals

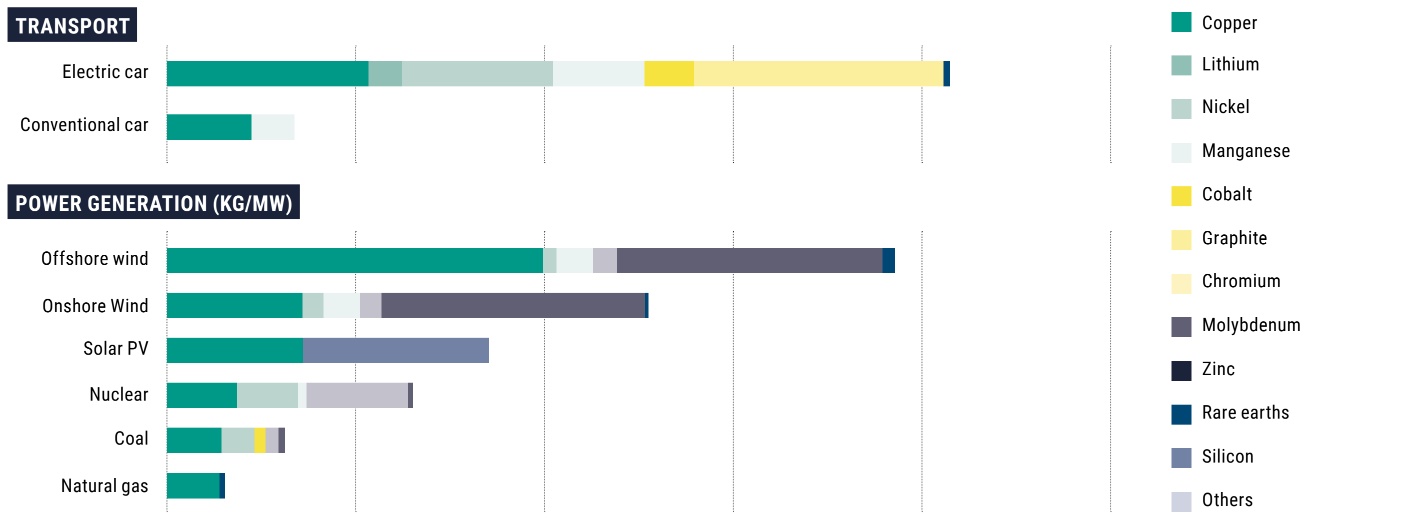
"We are moving from the era of oil into one of metals". With these words, Christel Bories, CEO of the French mining company Eramet, reminded us that the economic and social transformations necessary to achieve the objectives of the Paris Agreement are primarily materials-based and will require large amounts of raw materials.[1]

The International Energy Agency (IEA) makes no mistake about this. In May 2021, it published a special report entitled "The Role of Critical Minerals in Clean Energy Transitions", stressing that most of the technologies necessary for the low-carbon transition require much greater quantities of metals than their carbon-intensive alternatives (**fig. 1**): six times more for an electric car than for a conventional car, for example, and nine times more for wind power than for a gas-fired power plant with equal energy production levels. Since 2010, in line with the increased share of renewables in the electricity mix, the metal-intensity for each new unit of electrical power generation capacity has increased by 50%. A scenario where the world achieves carbon neutrality in 2050 would require a six-fold increase in metal production by 2040.[2] In 2020, the World Bank was already talking about the need to increase the production of metals six-fold, in particular, non-ferrous metals such as cobalt, graphite and lithium, to meet the needs of low-carbon technologies in 2050.[3]

Record sales of electric vehicles (**see Transport sector**) in 2020, the exponential growth

FIGURE 1

MINERALS USED IN A SELECTION OF CLEAN ENERGY TECHNOLOGIES - *Source: IEA, 2021*



of the capacities of renewable energy production facilities (**see Energy sector**), and also the high demand for consumer goods during lockdowns and during the economic recovery, have increased pressure on the supply of raw materials and semi-finished electronic products. The nickel market, for example, experienced a supply shortfall of 34,900 tonnes during the first four months of the year. Initially falling by 20% in 2020 due to the pandemic, global nickel demand increased by 9.2% in the first six months of 2021, while supply grew by only 5.8%. Japanese company Sumitomo Metal, which produces batteries for Tesla and supplies cathodes to Panasonic, estimates that global nickel demand for batteries will increase by 18% over the year.[4] Australian investment bank Macquarie estimates the lithium deficit to be 2,900 tonnes in 2021, and Credit Suisse expects it to grow to 248,000 tonnes in 2025.[5]

The costs of most strategic metals have therefore been subject to very high inflation since the second half of 2020. Between September 2020 and September 2021, nickel prices jumped 27.7%, lithium carbonate 48.5% and cobalt 51.9%[6] (**fig. 2**). These three materials are the most important components of lithium-ion batteries, currently the most popular and efficient energy storage technology for electric cars. 50 to 70% of the price of these batteries is now determined by the price of the raw materials, as against 40 to 50% five years ago, according to the IEA. In turn, 30 to 40% of the cost of an electric vehicle depends on the battery price. A doubling of lithium or nickel prices could result in a 6% increase in battery costs, which would then have repercussions on all sectors dependent on them and useful for the transition, warns the agency.[2]

Prices of polysilicon, a conductive material essential for solar panels, have also increased by more than 300% between early August and the end of September 2021 ($35/kg), due to the Chinese government's enforced shutdown of refining plants in the middle of the energy crisis in early autumn 2021.[7] Indeed, while China's electricity mix is 73% coal-based, a complex combination of domestic and geopolitical factors led to rationing the plants' production. Price inflation for coal, in the context of a rebound in demand and of emissions mitigation policies, no longer allows coal-fired power stations to produce within the nationally-regulated tariff without incurring economic losses. Several industrial sites were then forced to close in order to rebalance supply and demand.[8]

Thus, in August 2021, in the Yunnan province, silicon producers were only operating at 10% of their usual output. Five Chinese companies, among the world's biggest manufacturers of solar modules (LONGi Green Energy, JinkoSolar, Trina Solar, JA Solar and Risen Energy), then called for solar panel installation projects to be postponed,[9] while investments in solar power continued to grow in the first half of 2021.[10] Inflation and shortages of metals threaten to pull the brakes on the production rate and therefore, on the adoption of low-carbon technologies, while on the contrary, climate objectives call for it to be sped up.

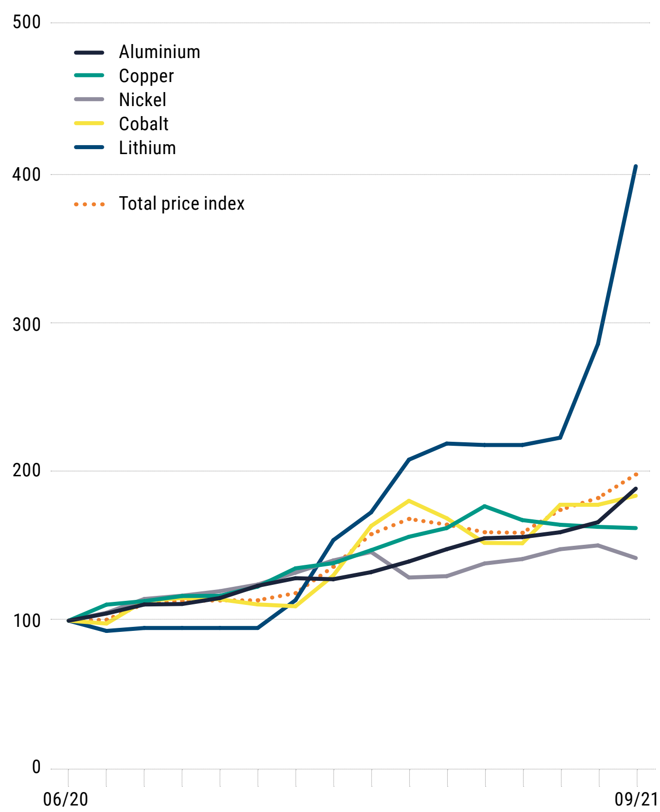
Here and there, political events have occasionally contributed to this price inflation in raw materials: aluminium prices, for example, reached a record level after the coup in Guinea, the second largest bauxite producer in the world.[11] The arrival in power of the Taliban in Afghanistan could also have medium-term repercussions on the global lithium supply (**see Signals**).

The widespread inflation in prices of strategic metals benefits mining companies, with soaring profits for the five largest of them (**tab. 1**), to the point of overtaking those of the five largest oil companies, Bloomberg estimates. 10 years ago, oil companies were still generating profits twice as high as mining companies.[12]

FIGURE 2

CHANGES IN THE PRICES INDEX OF SEVERAL STRATEGIC METALS BETWEEN JUNE 2020 AND SEPTEMBRE 2021

Source: compiled by the author based on data from FMI, 2021



Added to this cyclical increase in demand are the risks posed by the structural configuration of the metals supply market, which marked by a very strong geographical and market concentration of raw material reserves and production capacities for finished and semi-finished products. Although they are abundant in the earth's crust, many of these metals are considered "critical" by governments across many criteria (**see Keys to Understanding**). For example, the Democratic Republic of Congo (DRC) mines 67% of the world's cobalt, China 52% of its rare earth metals[a], and Australia 46.4% of its lithium. The DRC also has 52.2% of the world's cobalt reserves, China, Brazil and Russia 69% of its rare earth reserves, while Chile and Australia hold almost three-quarters of the world's lithium reserves underground.[13] The landscape is even more impressive downstream of the supply chains, since China alone accounts for the vast majority of the refining and processing capacities of all of these metals[b], as well as for a very large share of the production capacities of the finished products necessary for the energy transition (lithium-ion batteries, solar panels, wind turbine nacelles, blades and towers, etc.).[14]

In a context of growing geopolitical tensions between the United States and China, this hyper-concentration of the means of production of critical metals and of their transformation into finished and semi-finished products is a fundamental challenge to the autonomy of regions and businesses wishing to carry on their energy transitions. Over the past decade, awareness of their geostrategic vulnerability has led the world's largest economies to launch new regional industrial programmes aimed at diversifying their supplies, controlling value chains and thus strengthening their resilience to potential shocks, whether economic or political.

KEYS TO UNDERSTANDING

THE CRITICALITY OF METALS, A RELATIVE NOTION

Two factors make up the "criticality" of each metal: the risks threatening its supply (geological availability, its mining and production concentrations, political stability of producer countries, etc.), and the importance of said metal for economies. The variation in the appraisal of these factors leads to different evaluations of the criticality of metals according to the economic area, context and period: the latest list drawn up by the European Union in 2020 qualifies 30 materials as "critical", as against only 14 in 2011, whereas the United States had 35, Japan 34 and China 24. These lists include both geologically rare metals as well as metals that are abundant but subject to extreme pressure because of future demand (copper, bauxite, and "rare earths"...), or the political and environmental contexts of their mining when it is highly geographically concentrated (cobalt in the Democratic Republic of Congo – DRC).

Sources: BRGM, 2018; European Commission, 2020; Interior Department of the United States, 2019; Andersson, P., 2020

THE OBSERVATORY'S LENS

The market concentration in industrial sectors strategic to the low-carbon transition

States in battle order to increase their material sovereignty and reduce their geostrategic dependence

The rare earths crisis at the dawn of the 2010s left a lasting impression. As part of its Rare Earths Industry Development Plan 2009-2015, China had at that time decided to ration its rare earth exports by imposing quotas and taxes on its producers with the aim, it told the World Trade Organisation, of *"protecting its natural resources and ensuring their sustainable economic development"*. China having become the market's price-maker, the prices of certain rare earth elements

a "Rare earths" are a group of 17 metals which are not rare in the strict sense of the word, but whose concentrations in the earth's crust are very low, which makes their extraction energy intensive. They are remarkable for their catalytic, magnetic, electrical, chemical, optical and heat-resistance properties, which make them essential materials for many technologies such as smartphones, LCD screens, energy saving light bulbs, LEDs, lasers, permanent magnets in wind turbines, especially offshore, and also in armaments also.

b From 35% for nickel to 50-70% for lithium and cobalt, and up to 90% for rare earths, according to IEA figures. Source: IEA, 2021

TABLE 1

PROFITS OF THE FIVE LARGEST MINING COMPANIES IN THE FIRST HALF OF 2021 AND IN THE FIRST HALF OF 2020

Source: compiled by the author based on company financial reports

Measured in EBITDA: earnings before interest, taxes, depreciation

RANK	S1 2020	S1 2021	VARIATION	SOURCE 2021
BHP	9,700	23,000		Estimations by Bloomberg[12] in May 2021. Semester-wise data unavailable in the BHP annual report.
RIO TINTO	9,640	21,037	118%	Rio Tinto Interim Results 2021
VALE	6,627	19,706	197%	VALE S.A EBITDA 2006-2021 MacroTrends
GLENCORE	4,833	8,645	79%	2021 Half-Year Report
ANGLO	3,350	12,140	114%	2021 Interim results

had then increased by up to 2,000% by 2011.[15] By doing this, China intended to force foreign industries to set up on its soil in order to benefit from technology transfers and facilitate the domestic sector's upswing towards high value-added activities, revealing in the process, the vulnerability of global supply chains to Chinese supply.[16] For the first time in history, the United States, the European Union and Japan then filed a joint complaint with the WTO's dispute settlement body to protest against the obstruction of free trade. Although the WTO finally forced China to lift its barriers rare earths have never lost their strategic power, as seen when Xi Jinping let a theoretical embargo on rare earth exports to the United States hang in the air right in the middle of the 2019 trade war.[17]

Since then, Japan has greatly reduced its dependence on China for its supply of rare earths. From over 90% in 2010, it now imports no more than 58% of its rare earths from its neighbour. This is the result of a diversification policy brought by the government, mainly through the independent public administration of the Japan Oil, Gas and Metals National Corporation (Jogmec). As far back as 2011, Jogmec rescued Australian mining company Lynas from bankruptcy in exchange for a priority position for Japan in long-term rare earth sales contracts. The agency is also investing in rare earth mining projects abroad, such as in Namibia, through a joint venture with the Canadian Namibia Critical Metals group.[18]

In Europe, the problem is all the more acute as the European Commission is now intending to tackle *"the double challenge of the green and digital transformations"*, while recognising in its communication on the Green Deal that *"[European industry] remains too linear and dependent on a flow of new materials mined, exchanged and transformed into goods, and ultimately disposed of as waste or emissions. Only 12% of the materials used come from recycling.*[19]" However, although tricky from a technical point of view, recycling strategic metals potentially represents a non-negligible resource for economies seeking to diversify their supplies.[20]

This is why the EU has launched a series of initiatives aimed at developing regional and circular industrial sectors in strategic domains to achieve digital and low-carbon sovereignty at all levels of the value chain, from raw material production through to recycling. Thus, in 2017, the European Commission inaugurated the European Battery Alliance aimed at creating a top international level supply chain for the manufacture and recycling of batteries.[21] While the European Union became the leading market for electric vehicles in 2020 (**see Transport sector**), it has very little lithium-ion battery production capacity within its borders. Then, in September 2020, the European Raw Materials Alliance (ERMA), was set up within the framework of the Action Plan on Critical Raw Materials aiming once again to reduce European dependency by creating regional sectors.[22] Led by France, six EU Member States and 17 businesses, the first "Battery Airbus" project obtained European Commission support, which called it an "Important Project of Common European Interest" (IPCEI) in December 2019, authorizing €3.2 billion in State public aid. A second European Battery Innovation program was launched in early 2021 and now involves twelve States and 42 businesses including car manufacturers (Tesla, BMW, Stellantis, etc.), battery manufacturers such as Northvolt, and raw materials and chemicals players, such as Arkema and Solvay. With €2.9 billion in public funds, the project hopes to raise €9 billion in additional private investment.[23]

Finally, in June 2021, a new Industrial Alliance for Processors and Semiconductor Technologies was set up in order to create an industrial ecosystem in electronic production and unlock new manufacturing capacity for micro and nanotechnologies.[24]

Lines are moving on the other side of the Atlantic too. After taking office as president of the United States, Joe Biden quickly ordered a review of the supply chains of American pharmaceuticals, semiconductors, rare earths and batteries.[25] The audit resulted in the announcement of a 2021-2030 National Plan for Lithium Batteries by the Department of Energy, and other policies aimed at increasing investments and creating jobs in this sector.[26] The White House has also let it be known that it was envisaging the introduction of tariff barriers on the import of permanent neodymium magnets essential for wind turbines, whose production is largely dominated by China.[27] The recent reopening in California of the Mountain Pass mine, which at one time was the biggest rare earths mine in the world, results from this rationale (**see Signals**).

Indonesia has the world's largest nickel reserves (22%), according to the US Geological Survey.[28] Refined nickel sulfate is an essential element in cathode manufacture for household batteries and the lithium-ion batteries used in electric vehicles.[29] As part of its nationalist resource management policy, the government of President Joko Widodo has placed this geological asset at the heart of what economists call a "*policy of industrialisation through import substitutions*", aimed at developing an integrated national economic sector covering the steps from mining to battery production, rather than just exporting the raw materials. Thus, the first thing the government did was to put an end to nickel exports in January 2020.[30] Then in April this year, the Korean LG Energy Solution (LGES), a dominant player in the rechargeable battery market, signed a memorandum of understanding with four Indonesian public companies to form the Indonesian Battery Corporation. The holding brings together the mining companies Antam and MIND ID, the national oil company Pertamina and the electricity company PLN. LGES will invest $9.8 billion in all stages of the value chain, from mining through metal processing and refining to cathode production.[31] In early September, LGES and Hyundai Motor Group inaugurated the construction of the very first lithium-ion battery manufacturing plant for

KEYS TO UNDERSTANDING

THE SEMICONDUCTOR SHORTAGE

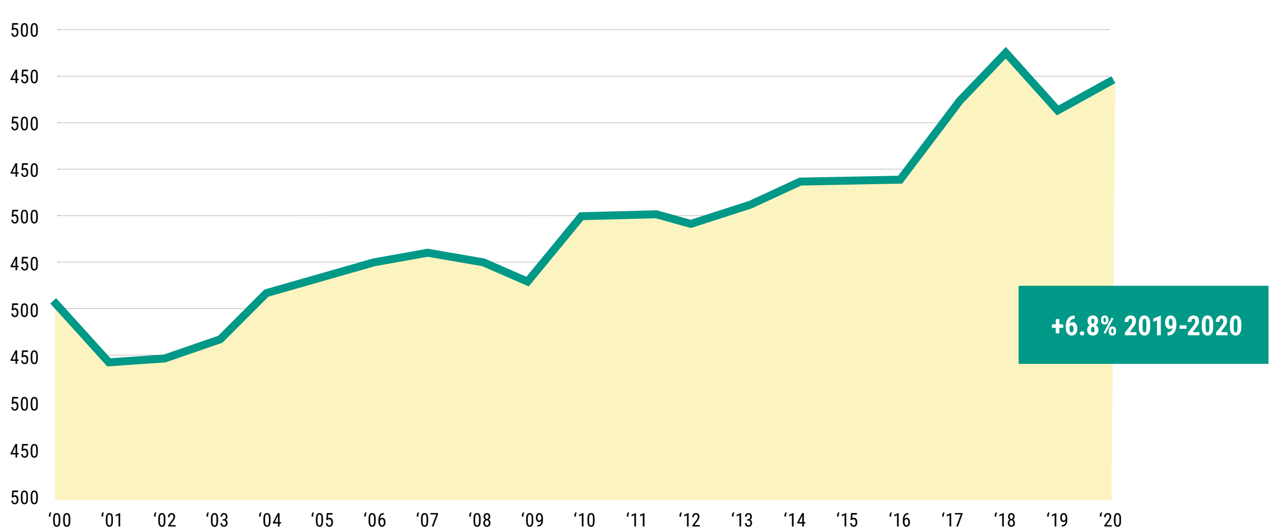
Semiconductors are a group of chemical elements with low conductivity, halfway between that of metals (conductors) and that of insulators. These chemical elements include Silicon (Si), Germanium (Ge), Antimony (Sb) and Gallium (Ga). They are materials crucial in the manufacture of transistors, an essential component of electronic circuits, and their importance for the world economy has grown almost unceasingly over the last twenty years (**fig. 3**). Semiconductors are the 3rd largest US export sector behind aviation and oil, but production capacity for microchips and integrated circuits is concentrated in Asia. The Taiwan Semiconductor Manufacturing Co. (TSMC) occupies nearly 50% of the world market. In early 2020, the deployment of the first 5G networks and the high demand for electronic products of all kinds during the lockdowns (computers, smartphones, gaming consoles...) exceeded semiconductor production capacity. At the same time, several semiconductor production sites had to close during the lockdowns. The main factories, also called fabs, have been quickly forced to invest in opening new production sites. Thus, TSMC has planned to earmark more than $100 bn for opening new factories in the next three years, while Intel is set to spend $20 bn on upgrading its factories this year. The US recovery plan will also earmark $50 bn for this, almost as much as the current value of US semiconductor exports. This semiconductor shortage has brought in its wake a worldwide industrial crisis in the automobile sector, which increasingly uses electronic components. Toyota's production fell 40% in September, while many factories have closed in Europe and the United States. The Boston Consulting Group estimates that nearly 9 million vehicles may not have been manufactured in 2021 because of this crisis.

Source: Market Watch, 17/04/2021 ; Financial Times, 20/08/2021 ; Le Monde, 01/09/2021

FIGURE 3

WORLD SALES OF SEMICONDUCTORS (IN BILLIONS OF DOLLARS)

Source: World Semiconductor Trade Statistics, cited by Semiconductor Industry Association, 2021



electric vehicles in Karawang, near Jakarta.[32]

Companies in search of security of supply

For the time being, therefore, supply chains for metals and semi-finished products remain very highly concentrated in Asia. Several companies producing technology useful for the low-carbon transition have demonstrated their eagerness to secure their supply of strategic metals and semi-finished products, particularly since the main markets for these technologies are tightening up their environmental and climate requirements: for example, the EU envisages that only batteries with a disclosed carbon footprint will be marketed in the common market in 2024.[33]

Faced with growing pressure on demand, the car manufacturer Toyota signed a trade agreement in early October 2021 with BHP to secure nickel sulphate supplies for its Japanese factories. The new factory opened by the mining company in Kwinana, near Perth in Australia, supplies the nickel required by Prime Planet Energy & Solutions, a lithium-ion battery manufacturer joint-owned by Toyota and Panasonic. Alongside this trade deal, the two companies also signed a memorandum of understanding aimed at decarbonising the battery supply chain.[34] Nowadays, it is not uncommon to see trade agreements in this sector accompanied by measures aimed at reducing the upstream environmental impact of the supply chain to the benefit of all the contracting parties seeking to improve their reputation, and to the detriment of Chinese supply chains which are laxer on issues of pollution and human rights.[35]

In June 2021, therefore, Tesla reached an agreement with BHP to secure its nickel supplies in order to reduce its dependence on Chinese suppliers, while improving the environmental performance indicators of its supply chain at the same time. This is the third contract of this kind signed by Elon Musk's firm in eight months following agreements reached on the one hand with the Brazilian company Vale, and on the other hand with the Goro mine in New Caledonia which was recently sold by Vale to the brokerage company Trafigura.[36] On the BHP side, the signing of these agreements is part of a strategy to focus the company's business on minerals strategic to the low-carbon transition since its new CEO, Mike Henry, took office in early 2020.[37] LG Energy Solution is also engaged in a rearguard action, signing a six-year contract with Australian Mines Ltd to secure its access to 71,000 tonnes of nickel and 7,000 tonnes of cobalt.[38]

Energy Fuel, a US company specialising in uranium refining, has spearheaded the very first US-European rare earth supply chain, which saw the light of day in 2021. Midway through 2020, Energy Fuel partially converted White Mesa Mill (Utah), the only Uranium refinery in the United States, into a rare earths refining site.[39] In December 2020, Energy Fuel signed a three-year partnership with the American company Chemours to acquire at least 2,500 tonnes/year of monazite, a composite ore containing rare earths, but also uranium, extracted from a mine in the state of Georgia. The monazite is now refined at the White Mesa Mill site to produce rare earth carbonates,[40] the first container of which Energy Fuel shipped to Estonia in June 2021. The Canadian company Neo Performance Materials treats the carbonate there to separate out the elements in its Sillamäe plant,[41] enabling it to diversify its rare earth supply sources for the European market and to ship the uranium back to Energy Fuel.

Upstream of the supply chains, mining companies told to stay in tune with the ecological transition

The mining industry today accounts for 6.2% of the world's energy consumption and 22% of the industrial sector's CO_2 emissions, according to REN21.[42] Like the big oil companies (**see Energy sector**), mining companies are therefore being increasingly urged to present ambitious and demanding climate plans. Environmental and cultural scandals such as the destruction of sacred aboriginal sites by the Australian company Rio Tinto in May 2020 during the extension of an iron mine,[43] and the formation of a toxic lake near the rare earth mines in Baotou (China)[34] have heightened the pressure on mining companies to meet their social and environmental responsibilities. Considering the requirements of the transition and the increasing use of digital devices in everyday life, this sector's energy consumption and emissions are set to increase. So, the big challenge for the mining industry is to present a positive net balance between the pollution and direct emissions generated by its activities and the indirect benefits for society enabled by the deployment of low-carbon technologies.[44]

A growing number of widely different mining companies of all kinds are now keen to increase the exposure of their business portfolios to metals useful in the manufacture of lithium-ion batteries, including nickel. Driven by the acceleration in the sale of lithium-ion battery cars and the demand for metals, competition is also intensifying on the supply side. Furthermore, just like the oil & gas sector with low-carbon energies and services, mergers and acquisitions (M&A) are the preferred vehicle for mining companies when positioning themselves on the nickel market as for other metals.

For example, the South African mining company Sibanye-Stillwater, a gold specialist, has positioned itself to buy the French company Eramet's nickel processing plant in Sandouville in Normandy.[45] The group also bought stakes in two lithium mines, one in Keliber, Finland, and one in Nevada.[46] The Australian company IGO is trying to take over the nickel specialist Western Areas, while Rio Tinto has been participating since 2018 in a joint venture in a nickel mine developed by Talon Metals in the United States as is PolyMet, controlled by Glencore, in Minnesota. In Ontario, Noront Resources is the target of a takeover battle between BHP and Australia's Wyloo Metals. The Canadian province has the benefit of a largely carbon-free electricity mix thanks to hydroelectric power, a substantial advantage in view of the growing environmental and climatic requirements of production chains. In Argentina, which has big lithium reserves, the Chinese battery manufacturer CATL has succeeded in acquiring the Canadian Millenial Lithium Group, which a few days earlier had rejected an offer from its compatriot Ganfeng Lithium.[47]

In 2019, the World Bank, in partnership with the International Finance Corporation (IFC), launched the Climate-Smart Mining (CSM) initiative, a programme aimed at decarbonising and optimising the use of metals necessary for the manufacture of production technology for renewable and low-carbon energy in general. The initiative promotes the integration of renewable energy into mining operations, the decarbonisation of supply chains and the prevention of deforestation, and other practices aimed at improving the sector's social and environmental performance.[48]

In early October 2021, the International Council on Mining and Metals (ICMM), which brings together 28 of the world's biggest mining companies, published an open letter declaring that all of its members were committed to reducing their emissions and to aiming at being "carbon neutral" by 2050.[49] Several of its members had already adopted climate plans with the "carbon neutral" objective several months prior to this.

In February 2021, Rio Tinto's new management unveiled new climate objectives aimed at reducing the carbon intensity of its activities by 30% between 2018 and 2030, lowering its absolute emissions by 15% during the same period, and investing $1 billion in climate-related projects between 2020 and 2024. In terms of strategy Rio Tinto, the second biggest mining company in the world, with emissions estimated at 519 $MtCO_2e$ in 2020, has turned over a new leaf by recognising its responsibility to reduce its Scope 3 emissions – basically, those of its customers. In order to go about this, the Australian group has been racking up research partnerships into breakthrough technology with industry and research actors such as the Chinese group Baowu, world leader for steel, Tsinghua University, the Nippon Steel Corporation and the American aluminium producer Alcoa.[50]

At the end of September 2021, the fate of the Climate Transition Action Plan of BHP, the world's largest mining company, was more uncertain. The Glass Lewis voting advisory agency called on the group's shareholders to vote against this climate plan proposed by management, arguing that its scientific foundations were not clear in the absence of certification from an organisation such as the Science-based Targets Initiative. Furthermore, while Asian steelmakers accounted for 75% of its Scope 3 emissions (402.5 $MtCO_2e$), BHP has kept them out of the "carbon neutral" objective that it has set for its customers for 2050.[51] BHP has, furthermore, committed to reducing its operational emissions compared by 30% by 2030, compared to 2020 levels, and becoming "carbon neutral" by 2050.[52]

Overall, companies in the mining sector seem to have become aware of their strategic role in providing the raw materials necessary for the low-carbon technological transition. Thus, their climate plans are based on three strategic approaches: completely disinvesting from or gradually reducing carbon-intensive energy in their asset portfolios (Anglo will end its thermal coal production in South Africa before 2023,[53] while BHP is envisaging withdrawing from oil and gas); reducing the carbon intensity of their mining activities and of the entire supply chain; and finally, prioritising the exploitation of metal mines intended to supply low-carbon markets and thus contributing to the energy and technology transition downstream of supply chains during the stages of raw materials transformation into finished or semi-finished products.

As an example of this last approach, Rio Tinto and Alcoa formed a joint venture in 2018, Elysis, to develop an aluminium production process free of CO_2 emissions. This involves using "inert anodes" in alumina electrolysis (the Hall-Héroult process) instead of traditional carbon anodes, which enables only oxygen to be released, without having it combine with the carbon from the anode which breaks down to form CO_2.[54] The project is financially backed by Canada and the province of Quebec, each to the tune of CA$60 million. Apple, which is participating in the joint venture, bought a first batch of this aluminium at the end of 2019, specifying neither the products in which it would be used nor the amounts and volumes of the transaction.[55] Elysis intends to market its "zero-carbon" aluminium in 2024.

KEY TAKEAWAYS

In this time of energy transition, the global competition for the raw materials needed for low-carbon technologies is intensifying. The meteoric growth in renewable energy production and the electrification of mobility has highlighted the geostrategic vulnerability of States and supply chains with regard to the concentration of resources, of the production and of the transformation of the metals required for low-carbon technologies (wind turbines, photovoltaic panels, electric cars, etc.). The economic recovery and the high demand for electronic goods have increased pressure on lithium, cobalt, nickel, rare earths and also semiconductors, which have been subject to high price inflation since the second half of 2020. Supply is failing to keep up with demand, and this is already resulting in supply deficits. Consequently, this imbalance could in the medium term jeopardise the transition of sectors whose decarbonisation depends on electrification and on electronics.

In order to strengthen their geostrategic autonomy and provide themselves with the means to achieve the objectives of the Paris Agreement, the European, American, Japanese and Indonesian governments are working to diversify their sources of supply and to shorten value chains by developing regional supply chains for the manufacture of low-carbon technologies. Held to account for their environmental and climate impacts, large mining companies are using mergers and acquisitions to increase the exposure of their business portfolios to the metals required for the energy transition. They are also creating bonds further downstream in the supply chains, where companies producing batteries and low-carbon technologies are seeking to establish long-term contracts for their raw material supplies.

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