MINISTÈRE
DE L'ÉCONOMIE,
DES FINANCES
ET DE LA SOUVERAINETÉ
INDUSTRIELLE ET NUMÉRIQUE
Liberté
Égalité
Fraternité

Trésor-Economics

No. 351 • October 2024

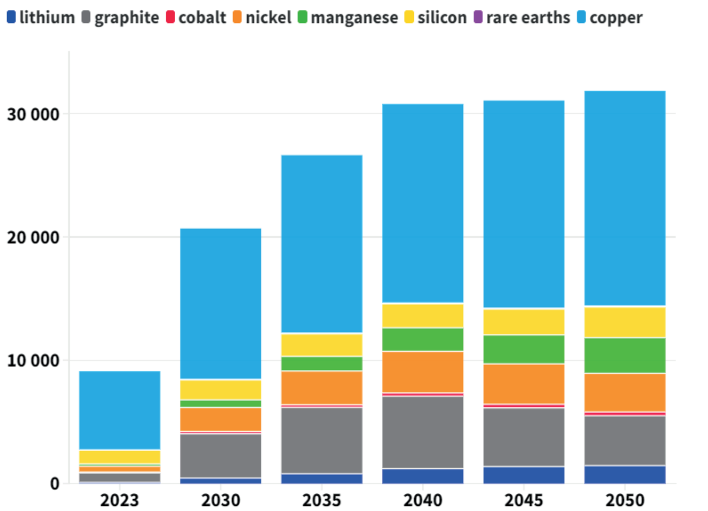
Direction générale du Trésor

Minerals in the Energy Transition

Alban Aubert, Sary Zoghely and Xavier Le Guennec

- The energy transition is expected to involve use of mineral-intensive technologies, with high demand for certain so-called "critical" or "strategic" minerals such as lithium, graphite, nickel, manganese, silicon, rare-earth elements and copper.
- In the short term, the global supply of critical minerals appears to be sufficient to meet the new uses related to the energy transition. Lithium and nickel prices have been falling since early 2023 against the backdrop of a sharp uptick in Chinese production and slowdown in global demand. Production nevertheless remains highly geographically concentrated, with a handful of countries holding a monopoly over the extraction of key critical minerals, and China now dominating refining and processing for the majority of these minerals.
- Global demand could more than triple between now and 2050 in order to meet international and domestic environmental targets (see Chart below), with this spike in demand far exceeding current production levels for lithium, graphite and cobalt. Although many mineral-producing countries are eager to capitalise on their resources, the possibility of shortages cannot be ruled out – not least because the current low-price environment is weighing on the anticipated profitability of investments and new production sites, potentially leading to projects being postponed.
- Many governments have responded to these risks, and to mounting geopolitical tensions, by introducing policies to secure and diversify supplies of critical minerals. At the same time, recent years have seen a sharp increase in trade barriers affecting these minerals, largely as a result of positioning strategies further down the value chain.

Projected demand for critical minerals between now and 2050 (in thousands of tonnes)



Source: International Energy Agency (IEA), based on a scenario reflecting announced climate targets, produced in May 2024.

1. The use of minerals for the energy transition

1.1 The energy transition is a mineral-intensive process

Energy transition policies, especially the production of electric vehicles and the rollout of renewable-energy infrastructure, are mineral-intensive in nature.[1]

The automotive industry requires critical minerals to produce lithium-ion batteries[2] with higher energy densities and extended battery lives. Lithium is the main component in cathodes – which in some cases also include nickel, manganese and cobalt (known as "Li-NMC" models, currently the most popular battery technology) – while anodes are made of graphite.

In the renewable energy sector, rare-earth elements[3] are needed to manufacture the permanent magnets used in wind turbines, silicon is an essential component of solar panels, and copper is used in renewable power generation systems (and in various parts of electric vehicles) on account of its conductivity.

It is difficult to accurately predict future mineral consumption trends owing to a high degree of technological uncertainty. The projections used here for electric vehicles are based on a scenario in which Li-NMC battery technologies dominate. They do not take into account the potential impact of innovative technologies using other, more affordable or more efficient minerals.[4] Although silicon and rare-earth elements cannot easily be replaced yet, aluminium could be used as a substitute for copper in some applications (such as cables and electrical equipment), even though it has different properties (copper offers better electrical and thermal conductivity, whereas aluminium is lighter).

1.2 The energy transition is already absorbing a significant share of most critical minerals

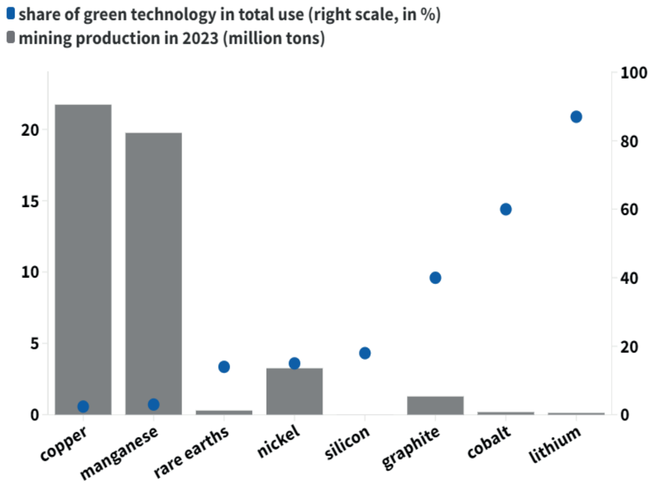
The vast majority of extracted lithium is used to make batteries for electric vehicles (87% of total output,[5] see Chart 1), while the battery production sector uses 40% of all extracted cobalt. In both cases, batteries have overtaken other uses in the past 15 or so years: previously, lithium was mostly used in glass and ceramics, while cobalt was primarily used in superalloys for gas turbines and nuclear reactors, as well as in the defence sector. However, these two minerals are still extracted in much smaller quantities than other major metals (less than 200,000 tonnes per year each in 2023).

Nickel and graphite – with annual production of 4 megatonnes (Mt) and 2 Mt respectively – are employed in a wide range of industrial applications: the former is used in stainless steel, consumer goods and specialised medical and other equipment, while the latter is an important component of brake pads, refractory metals and lubricants. The use of both minerals in battery production has risen sharply, with the sector now absorbing 25% of extracted graphite and 20% of nickel output. Silicon and rare-earth elements are also increasingly used in renewable energy technologies (accounting for between 15% and 20% of output). These minerals are also used in electronic products, production of which is also expected to grow rapidly in the coming years.[6]

Energy transition-related uses, which are a relatively recent phenomenon, absorb only a small share of copper and manganese output (between 2% and 3%). These two minerals are extracted in large quantities (20 Mt per year) to cater to industrial demand: copper for broader purposes (the construction sector and the manufacture of electrical grids and equipment) and manganese for more specific uses (steel alloys).

(1) The IEA estimates, for instance, that a typical electric vehicle requires six times the mineral inputs of an internal-combustion vehicle.
(2) The extent to which a mineral is considered "critical" (or "strategic") depends on producer-specific dependencies and geopolitical threats to supplies.
(3) The term "rare-earth elements" covers 17 metallic elements with similar properties that are especially valuable for energy and digital transition-related systems and technologies. Despite their name, these elements are in fact relatively abundant (although production is currently dominated by China – see Chart 2).
(4) According to EVMarketsReports, lithium iron phosphate (LFP) batteries have achieved significant penetration, with their market share increasing from 6% in 2020 to 30% in 2022. LFP batteries, which are favoured by Chinese manufacturers in particular, are cheaper to produce than Li-NMC versions, while the latter technology offers better overall energy performance.
(5) Information about the use of minerals for energy transition-related purposes comes from the following website: https://www.mineralinfo.fr/fr/securite-des-approvisionnements-pour-leconomie/substances-critiques-strategiques. Data on copper comes from Wood Mackenzie. The baseline years are 2021 for graphite, manganese and copper, 2022 for cobalt and nickel, 2023 for lithium, and 2018 for silicon.
(6) For instance, silicon is a key material for manufacturing semiconductors. According to Technavio, the semiconductor market for is expected to grow by 3.4% per year on average between 2024 and 2028.

Chart 1: Global output of critical minerals and share of output used for energy transition-related purposes, 2023



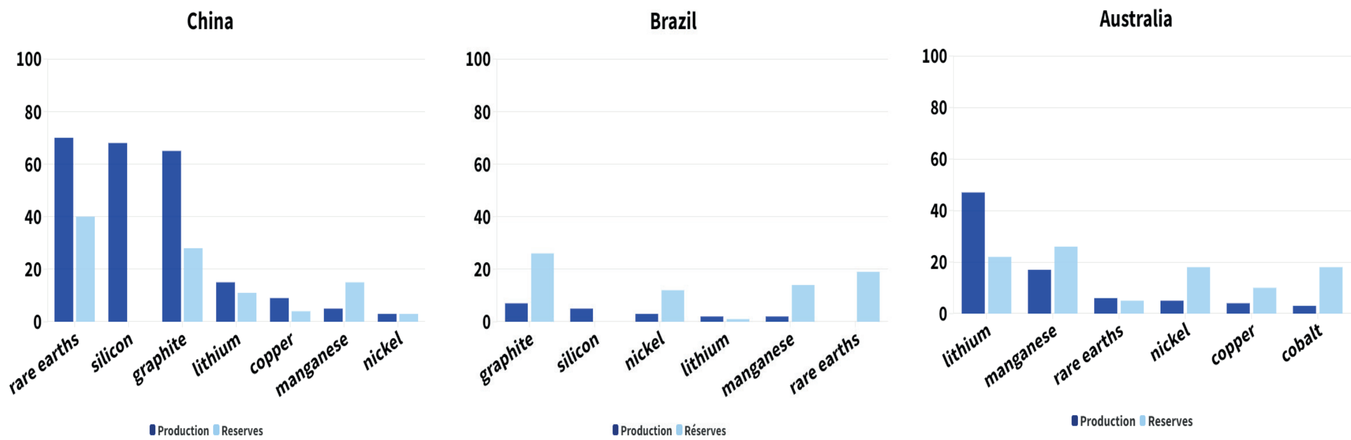
Source: United States Geological Survey (USGS), French Geological Survey (BRGM), DG Trésor calculations.

1.3 Supplier concentration and investment timeframes are greater causes for concern than mineral reserves

At present, known reserves of critical minerals are still substantial. At the current pace of extraction, identified reserves should be sufficient to meet demand over the long term (equivalent to 36 years for nickel and 150 years for lithium).[7] Moreover, estimates of total remaining reserves of these minerals[8] are regularly revised upwards as ongoing exploration work sheds further light on the technical and economic conditions under which natural resources[9] (primarily lithium and nickel) can be exploited. However, the IEA estimates that it takes almost 16 years for a new mine to come online.[10] This timeframe is a cause for concern, and there is a distinct possibility that mine yields could fall, given that most of those sites with the lowest overheads are already in operation.

Mining, unlike oil and gas extraction, is highly geographically concentrated, with production for some critical minerals restricted to just a handful of countries: the Democratic Republic of Congo (cobalt), Indonesia (nickel), Australia (lithium) and Chile (copper). This concentration reflects the geological distribution of known reserves. However, some countries account for a much lower share of global output than their reserves would suggest, pointing to significant potential (see Chart 2). Examples include Brazil (rare-earth elements), Australia (cobalt), and Argentina, Bolivia and Chile[11] (lithium). Conversely, China's share of global mining output often exceeds that of its reserves (see Box 1).

Chart 2: Share of global mining output and critical mineral reserves – China, Brazil and Australia (%)



Source: USGS.

How to read this chart: The USGS has not assessed the geographical distribution of silicon reserves (silicon is present in abundant quantities in most countries, with enough reserves to meet global demand for several decades).

(7) According to USGS estimates for 2023.
(8) For instance, the USGS estimate for global lithium reserves was revised upwards by 65% between 2019 and 2023. Reserves for nickel, manganese and copper were revised upwards by 46%, 135% and 15% over the same period.
(9) "Natural resources" refer to the estimated volume of minerals present on Earth. "Reserves" correspond to the share of these resources that can be extracted, taking technical and economic factors into account.
(10) This estimate is based on the observed timeframe between discovery and first production; *see The Role of Critical Minerals in Clean Energy Transitions*, IEA, 2022.
(11) The "Lithium Triangle" straddles the border between these three countries.

Once minerals are extracted, they undergo various forms of processing to make them suitable for industrial use. Typically, the minerals are first separated from the extracted ores (mineral processing). These raw materials then undergo further processing (metallurgy) to transform them into finished products (metals, alloys or salts). Battery production generally requires metals with a high degree of purity.[12] At present, most of this refining work is done in China (see Box 1).

Box 1: China's position in global production of critical minerals and metals[a]

China has ramped up its production of green transition-related goods and technologies by employing a three-pronged sourcing strategy:

1. Exploiting domestic resources

China is the world's largest extractor of minerals found primarily within its territory (rare-earth elements, germanium, gallium, etc.). It is also the number-one producer of graphite and silicon because, although these materials are also found in large quantities in other parts of the world, China began extracting them earlier than other countries and on a larger scale.

2. Securing supplies

Between 2005 and 2021, China is estimated to have made close to $125 billion in foreign direct investment (FDI) in the non-ferrous metals sector.[b] The country has also acquired stakes in mining companies and provided loans linked to long-term marketing contracts. These investments cover a wide range of different minerals, including lithium (Australia being the leading recipient of Chinese FDI in this sector), copper and rare-earth elements, even though China is already the world's leading producer of these materials. Chinese mining companies dominate the cobalt sector in the Democratic Republic of Congo,[c] as well as holding a commanding position in nickel extraction in Indonesia and the Philippines.

3. Expanding refining capacity

China holds a dominant position in the refining of almost all critical minerals: more than 40% of global copper output is refined in China, more than 60% of nickel, lithium, cobalt and manganese, and more than 90% of graphite and rare-earth elements. There are a number of reasons for this situation, including the fact that China has looser environmental standards,[d] uses coal to power energy-intensive refining operations (such as for graphite), and has geography on its side (since a large share of the downstream production of battery anodes and cathodes takes place in China, as well as in nearby Japan and South Korea).[e]

a. See Bonnet T., Grekou C., Hache E., Mignon V. (2022), "Métaux stratégiques : la clairvoyance chinoise", *La Lettre du Cepii,* No. 428.
b. According to the American Enterprise Institute.
c. Some 80% of mining exports from the Democratic Republic of Congo go to China. Chinese mining companies control between 70% and 80% of the copper and cobalt market. Under an agreement renegotiated in January 2024, the government of the Democratic Republic of Congo grants mining rights to a consortium of Chinese companies in return for investment in infrastructure (national roads), a share of the profits and the right to market part of the extracted ore.
d. Refining is a highly polluting activity that can generate radioactivity and uses large quantities of water, which then needs to be treated.
e. According to the Fraunhofer Institute for Systems and Innovation Research, in 2022, more than 95% of battery anode production and more than 90% of cathode production was concentrated in China, South Korea and Japan ("Battery starting materials - the Asian dominance in battery components", February 2023).

2. Strong growth in demand for minerals in the medium term is expected to prop up prices

2.1 Critical mineral prices are highly volatile

Some metals and minerals – nickel, manganese, cobalt, lithium, copper, silicon, and certain rare-earth elements (neodymium and praseodymium) – are traded overnight and through three-month futures contracts on open, centralised markets such as the London Metal Exchange and the Shanghai Futures Exchange.

(12) Refined nickel, for example, is often divided into Class 1 nickel (which contains at least 99.8% nickel and is used in the production of Li-NMC batteries) and Class 2 nickel (which is commonly used for metal alloys).

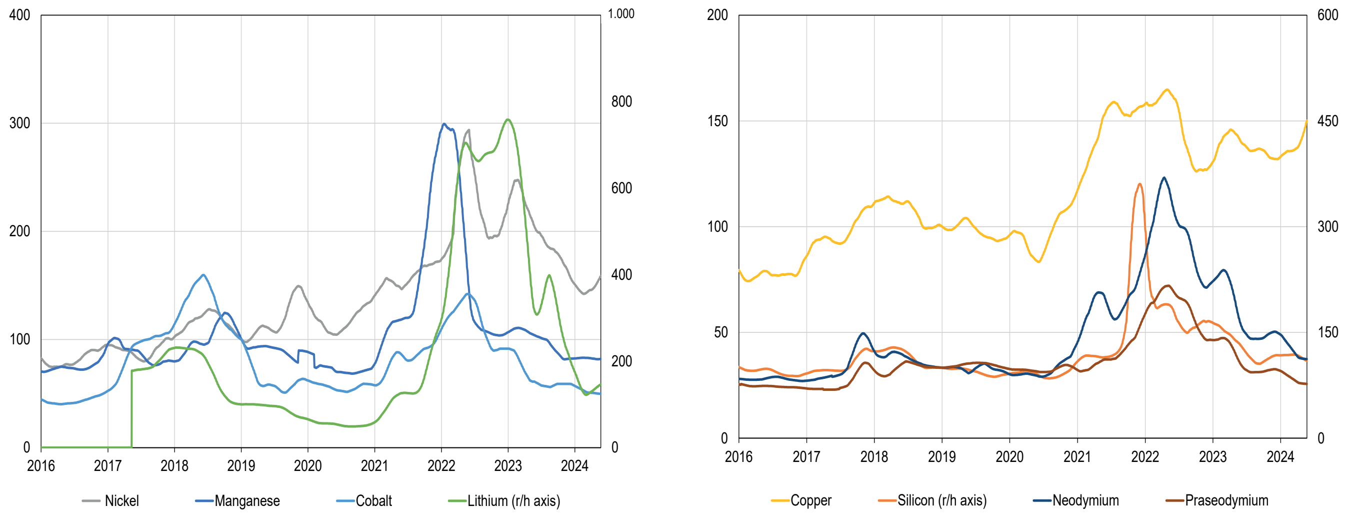
Prices for other metals are set directly through off-market contracts of varying terms between producers (or intermediary sellers) and users (or intermediary buyers). These contractual prices are generally not made public.

Critical mineral prices rise and fall in line with shifts in the balance between supply and demand. Demand is linked in particular to expected future growth in the production of electric vehicles, wind turbines and solar panels, as well as to increased investment in hydrogen fuel cells, superconducting coils and other energy storage systems. On the supply side, the main factors driving price trends are fluctuations in production, mine openings and closures, discoveries of new deposits, and stockpiling and stock drawdown practices along the value chain. At a time of mounting geopolitical tensions, fears of conflict or the imposition of sanctions on producer countries could apply upward pressure on prices.

Recent mineral price trends can be divided into three separate phases (see Chart 3). The first phase – one of relative stability – lasted from 2017 to mid-2021. In the second phase, between the second half of 2021 and 2022, prices increased as global demand spiked with the post-pandemic recovery and the subsequent easing of China's zero-COVID policy. At the same time, supply largely flat-lined before falling in the wake of the Russian invasion of Ukraine. According to the IEA,[13] global demand for lithium tripled between 2017 and 2022, while demand for nickel and cobalt increased by 40% and 70% respectively over the same period. The average annual copper price jumped by more than 40% between 2020 and 2022, average prices for cobalt and manganese were up by almost 100%, and the average price of neodymium – one of the main rare-earth elements used to make wind turbines – ended the period close to 170% higher. In the third phase, starting in 2023, prices for these minerals fell under the combined effect of sluggish global growth and a slowdown in sales of electric vehicles spurred by a reduction in subsidies in Europe and a partial shift in Chinese domestic demand towards combustion-engine vehicles. Prices also fell on the back of a sharp rise in nickel production in Indonesia and stock drawdown practices along the battery value chain. After two years of sharp rises attributable to cyclical factors (see above), this market correction saw a steep dip in prices for minerals used in battery production – especially lithium, nickel, cobalt and manganese. Copper prices, meanwhile, remained stable in 2023.

In early 2024, the prices of some minerals began to climb again under the effect of supply constraints. Sanctions imposed by the United States and the United Kingdom on Russian exports of copper, nickel and aluminium had a particularly marked effect, with copper and nickel prices increasing by 20% and 18% respectively between December 2023 and May 2024.

Chart 3: Prices of critical minerals,[a] three-month moving average



Source: Refinitiv.

How to read this chart: A moving (or rolling) average reflects the average of a series of data points over a given period of time (in this case, three months). Using this metric eliminates the least significant fluctuations.

a. Rare-earth elements are represented by neodymium and praseodymium, the two minerals in this group most commonly used in the production of permanent magnets.

(13) IEA (2023), "Critical Minerals Market Review 2023".

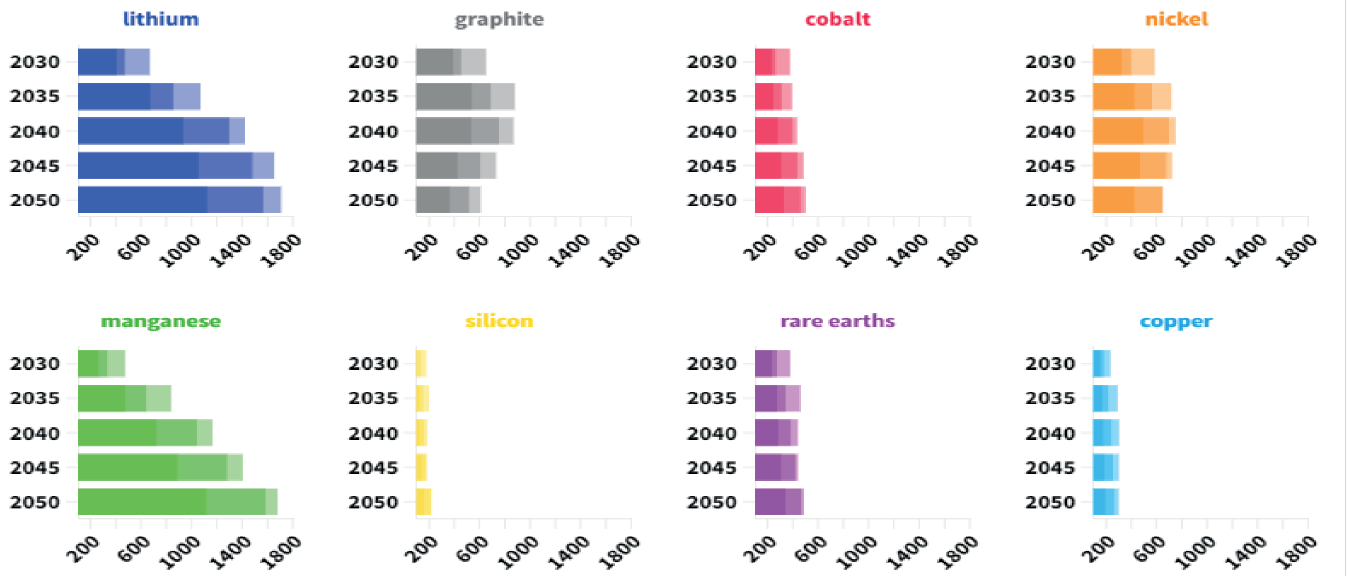
Many critical minerals experience high price volatility because production is often limited and markets are relatively shallow, with trading tending to take place under multi-year contracts rather than on the markets.[14] For instance, the price of silicon fluctuated wildly in late 2021 as China – the world's leading producer of this material – introduced energy-saving measures in a number of regions. This move affected production, causing the price of silicon to rise fourfold between July and October 2021 before halving again by the end of the year. In some cases, prices for these minerals can also follow cyclical patterns, with depressed prices contributing to a fall in production, which in turn eventually pushes prices upwards. Complex effects linked to yield expectations also come into play. In 2023, for instance, falling mineral prices raised fears of reduced investment in production capacity, which in turn could affect the pace of the energy transition and the expected profitability of existing extractive sites.

In the long term, however, uncertainty as to the ability of supply to keep pace with demand (see below) is expected to keep prices high.

2.2 Global demand for critical minerals is expected to rise sharply in the medium term

According to IEA estimates,[15] growth in demand is expected to be particularly buoyant for minerals used in the production of electric vehicles (see Chart 4) – especially lithium,[16] nickel and graphite. Cobalt is the exception to this rule, as it is increasingly being replaced by nickel and, in some cases, manganese. However, demand could well be contained by a decrease in mineral intensity linked to technological progress. This is particularly true for minerals used in the production of solar panels, where significant progress has been made in the past decade or so.[17] Energy transition-related demand will likely remain highest for copper, even though demand growth could be constrained by the possibility of using aluminium as a substitute for some applications. Beyond 2035, uncertainty around the pace of the rollout of green energy, the underlying technologies and changing consumption patterns could lead to a fall in global demand for certain minerals.

Chart 4: Projected increase in energy transition-related demand for minerals by 2050 (base 100 = 2023)



Source: IEA.

How to read this chart: The estimate reflected by darkest portion of each bar corresponds to the IEA's Stated Policies Scenario.

The mid-range estimate corresponds to the Announced Pledges Scenarios.

The estimate reflected by the lightest portion of each bar corresponds to the Net Zero Emissions by 2050 Scenario.

(14) Daily trading on the lithium and cobalt markets represents less than 1% of total annual production of these minerals, versus between 10% and 30% for nickel, copper and zinc.
(15) IEA (2023), op. cit.
(16) Under the IEA's various energy transition scenarios, global demand for lithium could increase by a factor of between 6 and 13 by 2035 compared with 2023 levels.
(17) For instance, solar panels are now half as silicon-intensive as they were around 15 years ago as a result of technological innovation (miniaturisation), which has helped to moderate demand for this metal.

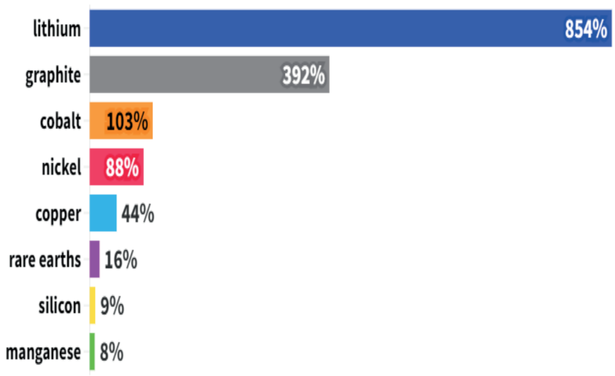
2.3 Uncertainty remains as to the ability of supply to keep pace with demand

Supply shortage risks are limited in the short term. Mining output has accelerated in recent years,[18] especially for copper (following years of stagnation), nickel (driven by production in Indonesia) and lithium (owing to many new extraction projects at *salars*[19] in South America).

Longer-term supply shortage risks are particularly acute for lithium and graphite, which require the largest adjustments in supply to meet projected demand (see Chart 5 and Chart 6 for more detailed demand and supply data for these and other minerals). There is also a risk that copper could be in short supply under the combined effect of a predicted spike in global demand driven by industrial needs in India, China and other emerging economies, a dip in productive investment[20] and an observed decline in productivity at some production sites.

An increase in extraction and refining activities also carries both environmental and social risks. Addressing these risks could push up production costs, given how little progress has so far been made on reducing energy consumption, cutting greenhouse emissions and countering the drying-up of mining sites.

Chart 5: Projected increase in energy transition-related demand for minerals between 2023 and 2040, relative to total production in 2023

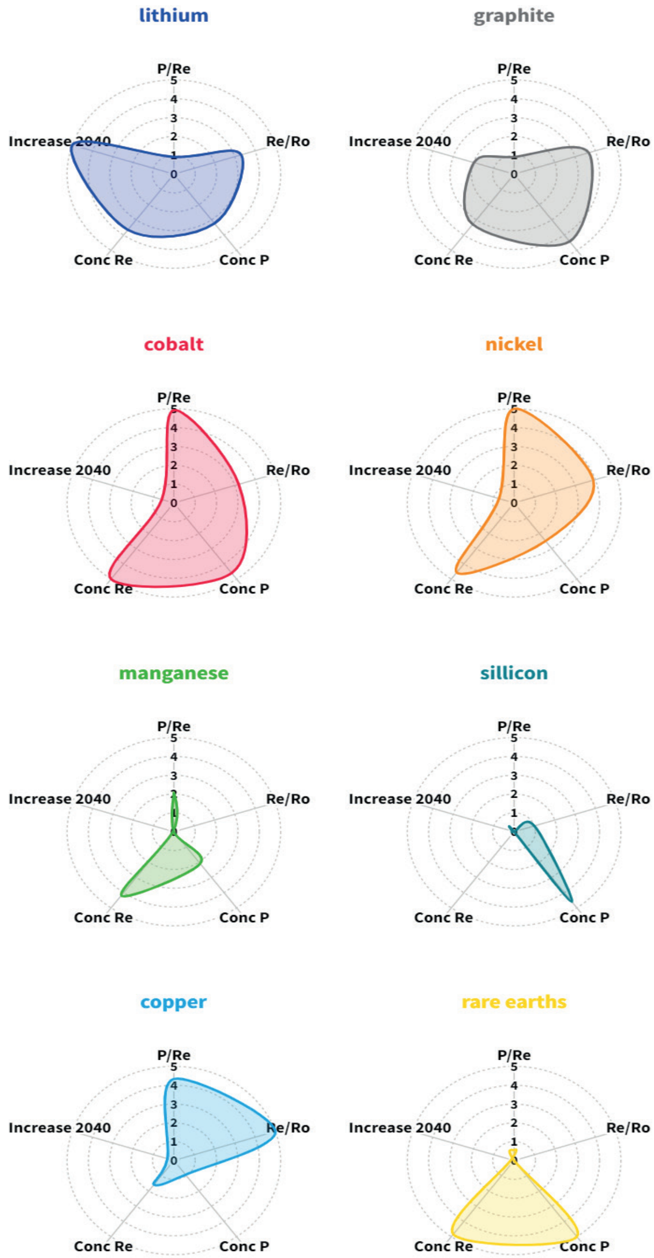


Source: IEA (Announced Pledges Scenario), USGS, DG Trésor calculations.

Recycling could significantly boost the supply of minerals. Circular-economy processes for copper, for instance, are already well-established,[21] leading to significant energy savings.[22] Recycling options for batteries are still limited[23] and are only likely to expand from 2030 onwards – backed by EU regulatory incentives[24] – when first-generation batteries reach the end of their life. The expansion of recycling also depends on improvements in technology, which will reduce costs and improve the quality of recycled products. As things currently stand, recycled graphite is not pure enough to be reused in batteries, the silicon contained in solar panels is hard to recycle for use in new panels, and existing recycling technologies for rare-earth elements are still inefficient.

(18) According to the USGS, mining output for all of these critical minerals rose between 2021 and 2023, with marked increases for lithium (up 58%), graphite (up 35%), cobalt (up 34%) and nickel (up 31%)..
(19) Lithium can be extracted from rocks, with this source representing 60% of total output. However, it can also be obtained from water in salt-encrusted depressions (known as salars in South America). With ongoing advances in pumping and filtration methods, it may be possible to produce "battery-grade" lithium with less environmental harm.
(20) According to Goldman Sachs, investment in copper mines almost halved between 2010 and 2022.
(21) According to Eurostat, more than half of the copper produced in the EU comes from recycled end-of-life materials.
(22) For copper, recycling is more than 80% less energy-intensive than extraction.
(23) Estimates suggest that, globally, around 5% of batteries are currently recycled.
(24) Regulation (EU) 2023/1542 of 12 July 2023 sets a mandatory minimum level of recycled content for batteries in electric vehicles, as well as targets for the recovery of lithium from waste batteries (50% by end-2027 and 80% by end-2031).

Chart 6: Availability of critical minerals for the energy transition



Source: USGS.

How to read this chart: Each criterion is assigned a score ranging from 0 to 5, with a higher value indicating greater risk. These values have been standardised against the highest level across all eight minerals, with a minimum score of 0 for very low risks. The axes are labelled as follows: “P/Re” is the ratio of production to reserves in 2023; “Re/Ro” is the ratio of reserves to resources in 2023; “Conc P” is the geographical concentration of production in 2023; “Conc Re” is the geographical concentration of reserves in 2023; and “Inc 2040” is the ratio of the projected increase in demand between 2023 and 2040 to production in 2023.

3. Some measures introduced to secure supplies could weigh on the markets

3.1 Governments have taken various measures to secure their supply of minerals

With the risk of supply-chain disruption mounting against a backdrop of global supply concentration, many governments have put in place national strategies aimed at reducing their dependence on specific countries or regions (see Box 2 for a discussion of the French and EU strategies). In many cases, these strategies are accompanied by investment programmes focused on three priorities: establishing offtake arrangements with domestic producers or with producers in other countries, increasing national refining capacity, and expanding recycling. In some cases, public policy-makers have sought to encourage manufacturers to improve inventory management practices and run stress tests to assess their vulnerability – measures inspired by the supply pressures experienced in 2021 and 2022, which underscored the importance of better understanding the global mineral value chain.

Box 2: France's strategy for securing supplies of critical and strategic metals

France's strategy is inspired by the January 2022 report by Philippe Varin on securing supplies of mineral raw materials for industry. Led by the Inter-ministerial Delegation for Supplies of Strategic Minerals and Metals (DIAMMS), this strategy focuses on the following aspects:

Better understanding of value and supply chains and their resilience in the short term: The French Monitoring Centre of Mineral Resources for Industrial Sectors (OFREMI),[a] established in late 2022, is a collaborative initiative involving the following government bodies and agencies with expertise in this field: the French Geological Survey Office (BRGM)[b], the French Alternative Energies and Atomic Energy Commission[c] (CEA), IFP Energies nouvelles (IFP-EN), the National Conservatory of Arts and Crafts (CNAM)[d] and the French Institute for International Relations (IFRI). It also invites input and insights from relevant industrial sectors, both upstream and downstream. It monitors markets and value chains for critical minerals and metals, updates criticality factsheets, studies supply and demand trends, and performs resilience tests.

Using financial tools: The France 2030 investment plan has earmarked €500 million for a call for proposals for a list of high-priority metals. A separate critical metals value chain investment fund has also been set up, with an initial €500 million contribution from the *Caisse des Dépôts et Consignations* and a target size of €2 billion. On the tax side, processes related to the extraction, processing and recovery of critical raw materials needed for the production of clean technologies are eligible for the Green Industry Investment Tax Credit (C3IV).[e] Meanwhile, the Strategic Projects Guarantee (GPS) covers projects, in France or elsewhere, that serve France's interests through the establishment, on the customer side, of long-term supply contracts.

Leveraging diplomacy: The French Ministry for Europe and Foreign Affairs, working with DIAMMS and DG Trésor, is working to secure France's supply of critical minerals through diplomatic channels. Efforts in this direction include signing letters of intent to promote industrial and technical partnerships with resource-rich countries or with countries wishing to develop projects in the downstream value chain (co-financing of projects, collaboration on R&D, sharing of geology and mining expertise and technologies, and promotion of ESG standards).

a. *Observatoire français des ressources minérales pour les filières industrielles.*
b. *Bureau de recherches géologiques et minières*.
c. *Commissariat à l'énergie atomique et aux énergies alternatives*.
d. *Conservatoire National des Arts et Métiers.*
e. The C3IV was introduced in March 2024 under the Green Industry Act 2023-973 of 23 October 2023. It aims to support projects relating to wind power, solar panels, electric batteries and heat pumps.

At EU level, Regulation (EU) 2024/1252 of 11 April 2024 (known as the Critical Raw Materials or CRM Act) resulted in the following:

- The creation of a list of 34 critical raw materials, including 17 strategic raw materials[f] for which major supply disruptions are expected.
- The setting of four "benchmarks" (non-binding targets) for domestic capacities along the strategic raw material supply chain to be reached by 2030: 10% of the EU's annual needs for extraction, 40% for processing and 25% for recycling, and no more than 65% of the EU's annual needs of each strategic raw material to be sourced from a single non-EU country.
- The introduction of new tools and innovative approaches to build the resilience of EU supply chains, including a fast-tracked appraisal process for projects considered to be "strategic", stress tests to identify potential vulnerabilities among companies that consume strategic raw materials, and the possibility of European Commission certification for mechanisms designed to ensure that critical raw materials are exploited sustainably and responsibly.

f. The European Commission considers the following raw materials to be "strategic": bismuth, boron, cobalt, gallium, germanium, rare-earth elements (heavy and light), lithium, magnesium, manganese, graphite, platinum group metals, copper, silicon, titanium, tungsten and nickel.

3.2 Trade barriers on critical minerals have increased over the past decade

Some producer countries have sought to strengthen their position in the downstream value chain by introducing export restrictions on crude ores,[25] leading to a significant increase in trade barriers on critical minerals over the past 15 years or so.[26] Since these restrictions undermine the mechanisms that balance supply and demand, there is a real risk that they could push up global prices for key energy transition minerals. China, for instance, has announced a number of measures in response to shortage risks and the wider context of its trade war with the United States for high-tech goods. In July 2023, it introduced export controls on gallium and germanium (which are used in advanced electronics and solar panels), extending similar measures to battery-grade graphite in December of the same year. China has also limited exports of antimony since August 2024.

(25) For instance, in the 2010s, the government of Indonesia introduced several measures aimed at gradually banning exports of nickel ores with a view to supporting exports of refined nickel.
(26) According to the OECD, trade restrictions on key energy transition materials increased fivefold between 2009 and 2020.

Publisher:
Ministère de l'Économie,
des Finances
et de la Souveraineté
industrielle et numérique
Direction générale du Trésor
139, rue de Bercy
75575 Paris CEDEX 12

Publication manager:
Dorothée Rouzet
tresor-eco@dgtresor.gouv.fr

English translation:
Centre de traduction
des ministères économique
et financier

Layout:
Mimose Mellia
ISSN 1962-400X
eISSN 2417-9698

Recent Issues in English

September 2024

No.349 World Economic Outlook in Autumn 2024: Monetary Easing and Geopolitical Tensions
Directorate General of the Treasury (DG Trésor) International Forecasting Teams

https://www.tresor.economie.gouv.fr/Articles/tags/Tresor-Eco

Direction générale du Trésor

@DGTresor

To subscribe to *Trésor-Economics*: **bit.ly/Trésor-Economics**

This study was prepared under the authority of the Directorate General of the Treasury (DG Trésor) and does not necessarily reflect the position of the Ministry of Economy, Finance and Industrial and Digital Sovereignity