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Marketing material

Critical minerals at the center of geopolitical tensions

Competition for raw materials vital for the energy transition is intensifying

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IN A NUTSHELL

- Critical minerals and their importance for the energy transition and artificial intelligence are becoming an increasingly important topic in political debates.
- The fact that critical minerals are concentrated in a few countries results in high supply risks that needs to be addressed.
- In the race for digital sovereignty and the expansion of clean technologies, securing reliable, ethical and resilient supply chains is becoming an increasingly strategic priority.

Critical minerals are becoming the focus of political and social debate

Although so-called critical minerals may not yet have really entered the broader social debate, they already play an extremely important role in politics and, above all, in geopolitical disputes. The attempts at rapprochement between the U.S. and China over critical minerals have recently received widespread coverage in the German press.[1] Numerous articles have also examined the high dependence of German companies on these minerals, painting a rather critical picture of future supply.[2]

The elements grouped under the term critical minerals are of fundamental importance for future-oriented technologies such as electric vehicles, wind turbines, and solar cells, and are therefore indispensable for the global transition to sustainable energy production. The concentration of mineral extraction and processing in a small number of countries, as well as long lead times for the development of new mines, pose significant risks to supply chains worldwide. Excessive dependence on high-risk countries such as China for critical minerals also creates significant political and economic risks. Interruptions in supply or shortages cannot be ruled out. An effort to diversify supply chains is intended to remove this risk but diversification cannot be achieved quickly. Nevertheless, a number of governments around the world have recognized the danger and have announced measures to reduce the dependence on just a few sources of critical minerals.

While supply is a source of concern, demand is not. We expect demand for critical minerals to continue to rise sharply as the world urgently seeks to decarbonize.

[1] See "The battle for the new oil," faz.net as of 6/5/25
[2] See "German government sounds alarm: German industry running out of rare earths," faz.net as of 6/5/25

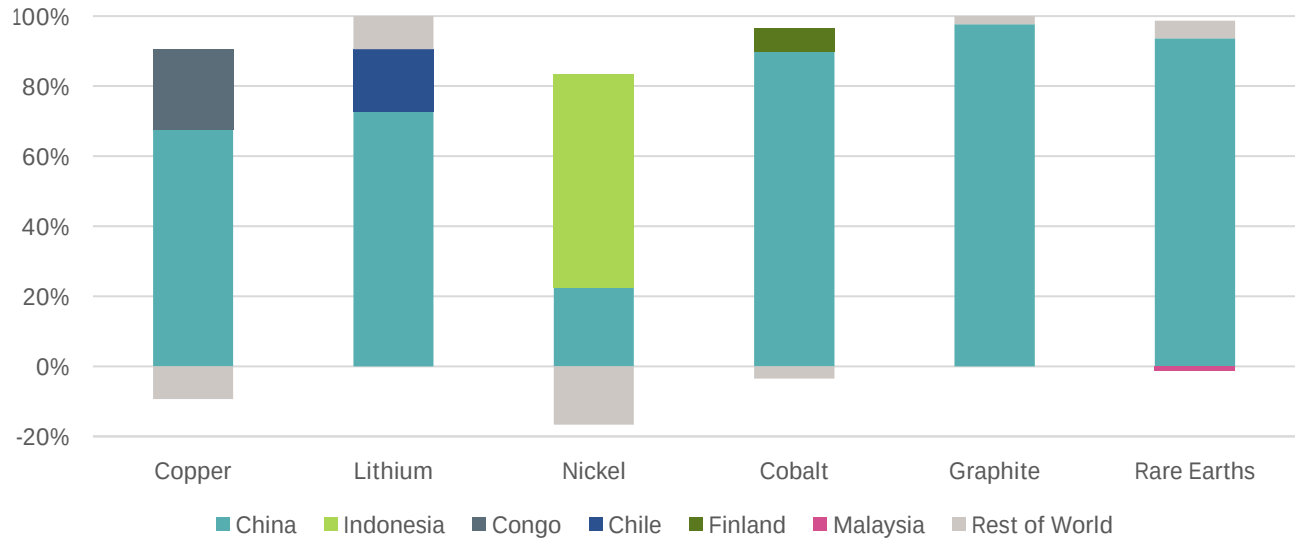
1 / Definition and significance of critical minerals

1.1 Highly relevant to economic and national security

Critical minerals are defined as non-fuel minerals that are essential for economic and national security, particularly in the field of energy technologies. In 2020 the U.S. defined critical materials in the Energy Act as all minerals, elements, substances, or materials that are not used as fuel and that are certified by the Department of Energy as (i) having a high risk of supply chain disruption and (ii) performing an essential function in one or more energy technologies, including technologies for the generation, transmission, storage, and conservation of energy.[3] In addition to this, a list of 50 minerals classified as critical by the U.S. Department of the Interior was published in 2022. Examples include copper, lithium, nickel, cobalt, and rare earths, which are essential for clean energy technologies such as wind turbines, electric vehicles, and power grids.[4] Given the increasing demand for clean energy, we believe that the demand for these minerals is likely to rise significantly.

Rising geopolitical tensions complicate the task of sourcing critical minerals for the global energy transition and are making them the focus of not only political but also social interest. Critical minerals can be seen as the Achilles' heel of the energy transition. Should geopolitical conflicts escalate, we believe there is a high risk of supply bottlenecks, which must be avoided at all costs. To achieve net zero[5] by 2050, annual demand for these minerals will increase sixfold by 2040, according to calculations by the International Energy Agency.[6] To put this into context, 300 new mines will be needed in the next ten years just to supply the minerals required for batteries.[7]

Change in refined copper, lithium, nickel, cobalt, graphite and rare earths production by country, 2020-2024



Sources: International Energy Agency, DWS Investment GmbH as of May 2025

The European Union (EU) also maintains a list of critical raw materials that are considered strategic for the EU's economic development and, according to experts, are subject to increased supply risk. Since the first list of this kind was published in 2011 there have been updates at irregular intervals, with the number of raw materials mentioned steadily increasing.[8] Among

[3] U.S. Department of Energy as of 6/11/25
[4] 2022 Final List of Critical Minerals, Federal Register as of 2/24/22
[5] Currently Net Zero and Engagement policies are not applicable in the U.S. for DWS.
[6] World Economic Forum as of 2/5/24
[7] More than 300 new mines required to meet battery demand by 2035, Benchmark Source as of 9/6/22
[8] Critical raw materials, European Commission as of 6/11/25

other things, the list includes a group of elements collectively known as rare earths, some of which are essential for the production of low-carbon and other advanced technologies. The EU is almost entirely dependent on China for the supply and processing of these rare earths and sees this as a serious economic threat. The dependence on rare earths is a prominent example of the general challenge facing Europe in achieving its ambitious climate targets without jeopardizing its geopolitical autonomy and economic competitiveness.

The European Union's Critical Raw Materials Act, published in May 2024, aims to strengthen all stages of European value chains for critical raw materials and ensure that critical raw materials are supplied to European industry in a secure and sustainable manner.[9] The EU wants also to significantly reduce the bloc's dependence on imports from individual countries. The list of critical raw materials has been expanded to include strategic raw materials that are important for technologies essential to achieving Europe's environmental and digital ambitions, as well as for defense and space applications, and which are vulnerable to potential supply risks in the future.

In order to secure longer-term access to important raw materials, more agreements are being signed between individual countries, such as the treaty between the U.S. and Ukraine in April this year, which involves setting up a joint investment fund for the reconstruction of Ukraine.[10] The fund will be financed in part by revenues from the future extraction of natural resources. However, its effectiveness depends on long-term peace and stable investment conditions. Aside from the continuing war with Russia, the most important obstacles include outdated geological surveys and dilapidated energy infrastructure. The agreement reflects the Trump administration's transactional approach to mineral policy and could even serve as a template for similar cooperation agreements.

It is crucial for Ukraine that the country retains full ownership of its natural resources and infrastructure, including the decision on what is extracted. The joint reconstruction investment fund will be managed jointly by both countries on the basis of an equal partnership. The agreement does not provide for the United States to receive large quantities of Ukrainian minerals as quasi-repayment for military aid, as Trump had originally demanded. Instead, a clause provides for the extraction of future mineral resources by the U.S. on competitive terms.

2 / Critical minerals in a geopolitical context

2.1 Geopolitical upheavals are increasingly revolving around critical minerals

Diversification of supply chains to counter excessive dependence, for example on China

The interrelationship between geopolitical conflicts and critical minerals is complex and multifaceted. Geopolitical tensions, for example between the U.S. and China, have led to increased export restrictions on critical minerals to certain countries. This has an impact on global supply chains. However, competition for control over critical minerals is also intensifying. Countries such as China dominate the refining and processing of minerals such as lithium and rare earths. China's dominance in the processing of critical minerals and its willingness to use these resources as leverage in trade disputes have recently exacerbated global geopolitical tensions. Various countries are making efforts to diversify their supply chains and reduce their dependence on China in a variety of ways – with varying degrees of success.

Geopolitical competition has led to a partial realignment of industrial policy and new strategic partnerships as many countries seek to diversify their supply chains and reduce their dependence on a single source for critical minerals. However, it should also be noted that the geopolitical impact of critical minerals is not only economic, but often also social and environmental. For example, the race to obtain these minerals, especially in regions already struggling with domestic conflicts or economic instability, can provoke human rights violations and worsen existing inequalities. For example, China is investing heavily in

[9] European Critical Raw Materials Act, European Commission as of 6/11/25
[10] What to Know About the Signed U.S.-Ukraine Minerals Deal, CSIS as of 5/1/25

developing new mines in emerging economies, but many of the local companies in which China invests are guilty of human rights violations and are subject to sanctions.[11] Many developing countries are keen to work with Western investors to develop their mining industries but, over the past decade, only China has proven willing to turn a blind eye to abuses, invest in these projects and build the necessary infrastructure in Africa, Southeast Asia and Latin America.

The extraction and trade of critical minerals are often seen as the root cause of geopolitical tensions, exacerbating long-standing problems of exploitation and posing a new challenge for a just global energy transition. That demand for these minerals is likely to rise brings both opportunities and risks. The energy transition requires a drastic increase in supply. But it needs to be met as easily and cost-effectively as possible, without the negative side effects that have often been associated with exploitation of minerals and metals. In our view the energy transition offers an opportunity to make the value chains for critical minerals more inclusive, ethical, and sustainable.

Alliances such as the Minerals Security Partnership, involving the U.S., the EU, and other nations, are being formed to strengthen supply chains for critical minerals.[12] The participating countries are investing in research and development to improve extraction and processing technologies, and make it more sustainable and environmentally friendly.

The U.S. government is also working to promote domestic production and has increased funding for research and development in the field of critical minerals. The EU is integrating mineral supply chain security into its Global Gateway strategy and has launched initiatives to promote sustainable mining practices.[13] China has concluded long-term trade agreements and made strategic investments in mineral resources in Africa, Latin America, and Southeast Asia. Canada, with its rich mineral resources, plays an important role in mitigating Chinese dominance and is actively working to secure its own supply chains.

The International Energy Agency's Global Critical Minerals Outlook 2025 highlights concentration risks

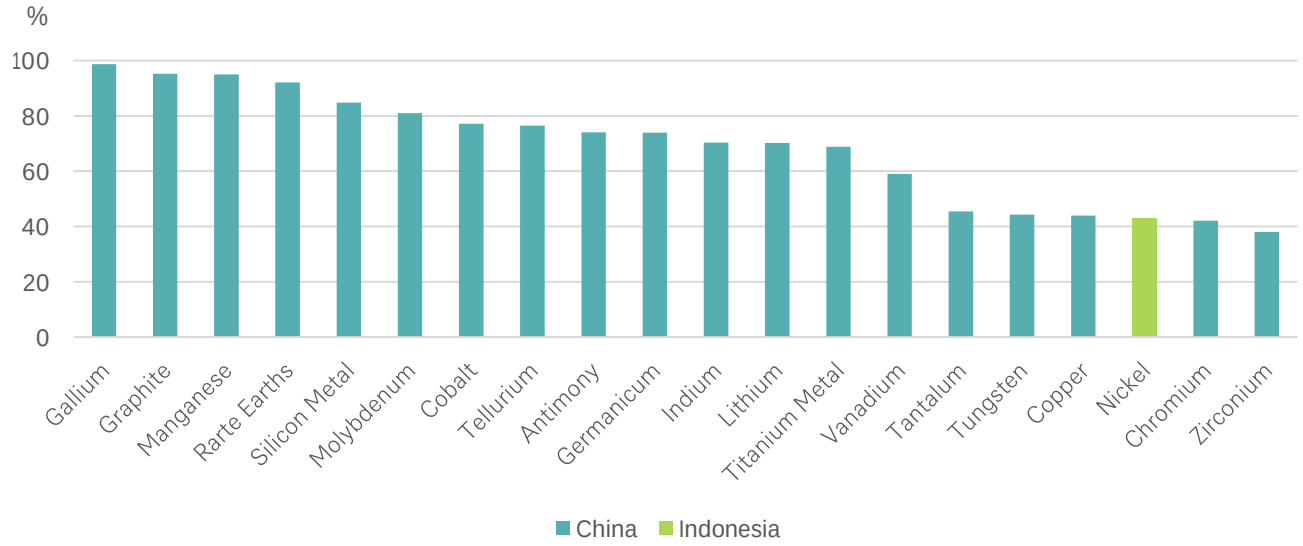
In its latest annual report, "Global Critical Minerals Outlook," the International Energy Agency (IEA) has pointed out that the increasing concentration of supply in a handful of countries and the expansion of export restrictions have increased the risks for the global market. Critical minerals have become one of the top priorities for ensuring global energy and economic security.[14] The report concludes that the market for critical minerals has tended to become even more concentrated, particularly in the areas of smelting and processing. It argues that the average market share of the three leading refining countries for key energy minerals has risen from around 82 percent in 2020 to 86 percent in 2024, with around 90 percent of supply growth coming from the largest single supplier in each case – Indonesia for nickel, and China for cobalt, graphite, and rare earths.

Although policymakers seem to be increasingly aware of these challenges, the IEA's detailed analysis shows that diversification of supply chains for critical minerals is progressing slowly. Under current policy frameworks and investment trends, the average share of the three largest supplier countries will decline only slightly over the next decade and is unlikely to return to 2020 concentration levels. Even if market supply is sufficient, supply chains for critical minerals remain vulnerable to supply shocks, whether from extreme weather events, technical failures, or trade disruptions, which would lead to price increases for consumers or a reduction in industrial competitiveness, according to the IEA.

The report shows that demand for critical energy minerals has grown significantly in recent years. In 2024 annual demand for lithium rose by almost 30 percent, significantly exceeding the average annual growth rate of 10 percent in the 2010s. The report also highlights risks to the balance between supply and demand over the next ten years. Investment in critical minerals is weakening and is expected to grow by only 5 percent in 2024, significantly less than the 14 percent in 2023. Exploration activity remained largely unchanged in 2024, slowing the growth momentum observed since 2020. There are also signs of a slowdown in start-up financing.

[11] Business & Human Rights Resource Centre as of July 2023
[12] Minerals Security Partnership, U.S. Department of State as of 6/11/25
[13] Global Gateway overview, European Commission as of 6/11/25
[14] Global Critical Minerals Outlook 2025, IEA as of May 2025

China dominates refining in 19 of 20 energy-related minerals (share of top refining country)



Sources: International Energy Agency, DWS Investment GmbH as of May 2025

The IEA report highlights the risks for the copper market in particular. As countries expand their power grids, copper demand is expected to rise sharply and current forecasts for copper mining projects point to a 30 percent supply deficit by 2035. Increasingly stringent export restrictions are also likely to affect the security of supply. According to the IEA, 55 percent of the energy-related strategic minerals covered in the report are subject to some form of export controls. More importantly, the restrictions cover not only raw ore and smelted products, but also processing technologies. An analysis of 20 energy-related strategic minerals has shown that, despite their relatively small market size, supply disruptions can still have serious economic consequences. The prices of 15 minerals would fluctuate even more than crude oil prices.

3 / Critical minerals and artificial intelligence

2.1 Technology leadership increasingly dependent on critical minerals

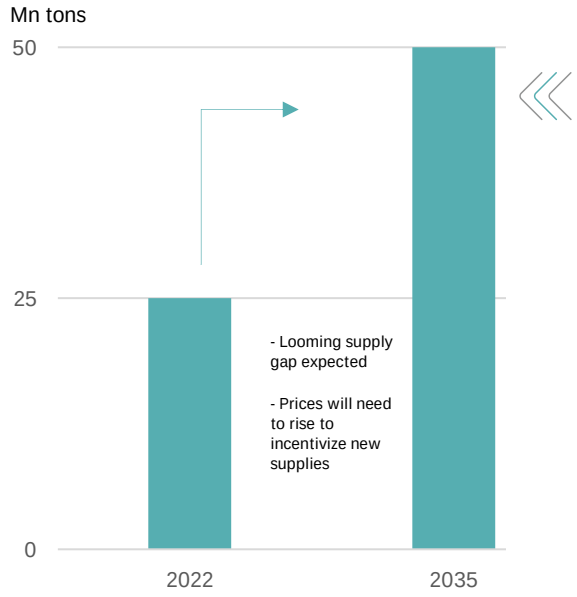
Critical minerals are extremely important for artificial intelligence (AI) and digital technologies in general and fresh innovations will probably make them even more important in the future. A complex ecosystem of critical minerals plays a vital role in digital performance, energy efficiency, data storage, and high-speed networking and are likely to be indispensable for building the smart, electrified systems of the future. Silicon is the basis for microchips, cobalt for improving memory and logic components, and rare earths for high-performance magnets and semiconductors which, in turn, are essential for AI algorithms and machine learning applications. This is leading to intensified competition between nations to secure stable sources of supply, influencing global market dynamics and driving innovation in extraction and processing technology. In the race between nations for digital sovereignty and the expansion of clean technologies, securing reliable, ethical, and resilient supply chains for these inputs has become a strategic priority.

Since AI involves high energy consumption, for example in operating data centers, the importance of critical minerals in building power generation capacity is becoming increasingly recognized. This applies not only to nuclear power plants and renewable energies, but also to grid infrastructure, which is very metal-intensive. Not only are data center operators increasingly signing power purchase agreements, but they are also building their own renewable energy facilities. Many data

centers already use electric batteries for emergency power supplies or uninterruptible power supplies (UPS) and are abandoning conventional lead-acid batteries in favor of lithium-ion batteries.[15] As data centers expand rapidly, the global market for UPS systems is expected to grow from 6.1 billion U.S. dollars in 2022 to 9.1 billion U.S. dollars in 2028.[16] Furthermore, rare earths are not the only minerals with a wide range of direct applications in data centers.

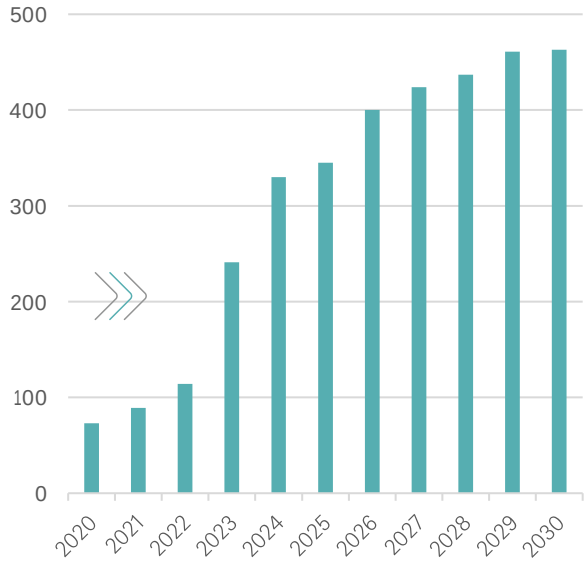
Copper and aluminum essential components in AI developments

Copper demand forecast



Sources: S&P, DWS Investment GmbH as of July 2022

Global growth in copper demand for data centers (Kt per GW of installed power in data centers)



Sources: Jefferies, DWS Investment GmbH as of June 2024

AI is on the rise worldwide and against this backdrop demand for critical minerals has skyrocketed, moving them to the forefront of technological progress. The geopolitical location of these resources adds to the complexity, making strategic planning and cooperation between nations urgently needed. In the future ensuring a sustainable supply chain for critical minerals will be crucial not only for the AI industry but also for maintaining technological competitiveness and promoting global economic stability. However, by prioritizing responsible sourcing and investing in alternative solutions, the companies involved can overcome the challenges and harness the potential of critical minerals to help shape the future of AI.

4 / Summary & Outlook

Critical minerals are already indispensable in the planned energy transition. But they are also essential to the further development of AI and technological progress more broadly. Geopolitical conflicts relating to them are confirmation of their importance. The high concentration of deposits of the most important critical minerals in a few countries, and especially China, means international cooperation is needed to avoid supply bottlenecks. Turning critical minerals into an economic weapon, as seen so far in a few, isolated cases, must be counteracted swiftly.

[15] Artificial Intelligence and the next Critical Mineral Supercycle, The Oregon Group as of April 2024
[16] Data Center UPS Global Market Outlook, 2023-2028, yahoo finance as of 1/9/24

It helps that significant mineral deposits are also found outside China in the U.S., northern Europe, Canada, Mexico and Australia. The problem is that the governments of these countries have made it almost impossible to obtain permits for development projects. Either the approval periods are far too long or projects are blocked completely. A prime example is the Resolution Copper Mine in Arizona, which has access to one of the world's largest undeveloped copper deposits. Although the deposit was discovered decades ago, it is unlikely to go into production until the 2030s as it has been blocked by court decisions for over a decade. The uncomfortable truth is that Western policy on critical minerals is one of the reasons why the West lacks access to them.

Alongside many other minerals and metals, copper plays a crucial role; some even refer to it as the linchpin of the green energy transition. Green technologies generally consume more copper than energy production using conventional technologies. Electric cars, for example, use two and a half times as much copper as vehicles with combustion engines, while wind farms and solar power plants can consume up to seven times more copper than conventional gas-fired power plants. An important factor here is that it is difficult to replace copper with any other element in the periodic table.

In our view the extraction of critical minerals offers attractive growth opportunities. However, it is essential to monitor the environmental impact of mining critically. Respect for human rights with regard to possible exploitation should also be a high priority. The processes involved in extracting critical minerals can have significant environmental consequences, such as habitat destruction, water pollution, and increased CO_2 emissions. Compliance with stricter environmental regulations therefore appears essential, and greater investment in recycling technologies and responsible sourcing practices should be encouraged. However, it must also be emphasized that mining companies in general have already made numerous commitments regarding decarbonization, water intensity, and land rehabilitation. For example, Chilean copper mining companies have invested billions in desalination plants, Australian companies mining bulk commodities have invested in electric transport vehicles and equipment, and African copper producers have financed hydroelectric power plants and solar power capacity. Though mining remains a dirty industry, it is improving rapidly.

Governments, the private sector and environmental organizations should work together globally to improve efficiency along supply chains and thus reconcile the economic benefits of using critical minerals with environmental responsibility.

Glossary

Decarbonization is the reduction or elimination of carbon dioxide emissions from a process such as manufacturing or the production of energy

The European Union (EU) is a political and economic union of 27 member states located primarily in Europe.

The International Energy Agency (IEA) is a autonomous intergovernmental organization which works to ensure reliable, affordable and clean energy for its 30 member countries and beyond.

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