INSTITUT Montaigne

Cleantech: Reducing Europe's Strategic Dependence on China

POLICY PAPER - JULY 2025

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Foreword

At the intersection of economic security and industrial policy, Europe's access to CRMs has, in recent years, emerged as a central pillar of global geopolitics. In the cleantech realm, China's strategic intent to foster dependencies that strengthen its geopolitical leverage is no longer a secret: Beijing alone controls 70 percent of global production of the critical materials—including rare earth elements—that are essential to our decarbonization efforts.

While the United States has begun preparing for radical adjustments, Europe continues to lag behind, struggling to organize a coherent response and failing to swiftly identify the room for maneuver it still possesses. Even within local industrial production on European soil, China maintains a firm grip, relying exclusively on its own value chains rather than those of its international partners.

Japan and South Korea, having been alerted earlier, have adopted a meticulous, project-by-project, sector-by-sector approach that has enabled them to diversify their supply chains wherever possible. Pooling risks, developing our internal market in the face of an ultra-competitive—and heavily subsidized—Chinese supply strategy, and addressing the entire value chain, from extraction and refining to recycling, are among the key avenues explored in this paper. It also advocates using access to the European market as a political lever in relations with third countries.

In line with our previous work on extraterritoriality, the Inflation Reduction Act, and Europe's foreign economic policy, this study makes a clear case: Europe's excessive dependencies are not inevitable. In the years ahead, safeguarding our economic security must become the shared and serious preoccupation of all European policymakers.

Marie-Pierre de Bailliencourt,
Institut Montaigne's Managing Director

Cleantech: Reducing Europe's Strategic Dependence on China

The European Union has set itself the goal of **achieving carbon neutrality by 2050**, a target enshrined in the European Climate Law. This ambition is unfolding in an unstable geopolitical context marked by the war in Ukraine and the return of Donald Trump, events that highlight Europe's **vulnerability due to its strategic dependencies**. This is particularly relevant regarding critical resources that are essential for the EU's energy transition goals.

To reduce these vulnerabilities while preserving its industrial base, the EU has adopted several key legislative frameworks, including the ***Net-Zero Industry Act*** and the ***Critical Raw Materials Act***. These measures aim to boost European production and secure the supply of strategic materials. The **Clean Industrial Deal** complements this toolkit by seeking to connect decarbonization with industrial competitiveness, with the goal of strengthening key sectors of the European economy, particularly the cleantech industries that are essential for decarbonization.

This drive for greater autonomy comes from the demands of the carbon-neutral transition, which depends on the large-scale deployment of clean energy technologies. The development of these technologies—solar panels, wind turbines, electrolyzers, batteries, and electric vehicles—requires a shift from dependence on hydrocarbons to increased reliance on "critical" materials, along with a complete overhaul of value chains. To meet its climate targets, the EU—like the rest of the world—will therefore need to contend with a significant **increase in extraction needs by 2040 and a full reorganization of value chains, which currently often fail to benefit the European industrial fabric**.

This anticipated rise in global and European demand raises pressing new geopolitical challenges, given that cleantech value chains are currently largely dominated by China.

This observation raises a fundamental question about the strategic choices the EU must make: **To what extent is the EU willing to depend on China for supplies that are essential to its energy transition?** This question, in turn, gives rise to other questions:

- *How much dependence can Europe tolerate in the development of its clean technologies?*

- *Can Europe accept a high concentration of critical raw material—resources that are also vital for strategic sectors such as defense—in the hands of any single supplier?*

- *Finally, to what extent is Europe willing to tie the success—including the financial viability—of its decarbonization efforts to China's industrial policy choices?*

These issues reveal a central dilemma in the context of a profound and costly transformation of energy infrastructures: **What role does Europe intend to play in the industrial value chains of tomorrow?**

To address this dilemma, it is essential to differentiate sectors based on their level of industrial maturity and their strategic importance to Europe. For certain emerging segments such as solar photovoltaics, Europe lacks a strong industrial base, while for other sectors, it could develop credible alternatives to China. In contrast, for foundational sectors such as batteries (for mobility and stationary storage) and electrolyzers (for the production of clean hydrogen, its derivatives, and for the chemical industry), **excessive dependence would be strategically risky**. These technologies determine the competitiveness of entire industries, including, in the long term, low-carbon chemical production.

In light of these challenges, two questions emerge as priorities for strengthening the EU's industrial sovereignty:

1. How can Europe secure the critical industrial sectors it aims to develop on its own territory (as identified in the *Net-Zero Industry Act*)?

2. How can it ensure access to the upstream segments of value chains—currently largely dominated by China—particularly regarding the extraction and refining of the critical raw materials needed for tomorrow's technologies?

THE STRATEGY BEHIND OUR DEPENDENCE TOWARD CHINA

Recent shocks, such as the COVID-19 pandemic and the war in Ukraine, have exposed the vulnerability of an EU that remains heavily dependent on China for access to most critical raw materials. Contrary to popular belief, China's dominance in this area is not based on geological advantage but rather on a long-term, coherent, and methodical industrial strategy that Beijing has been implementing for over two decades.

China has progressively secured the entire value chain, from extraction to refining, including processing, due to massive state support. The adoption of the Made in China 2025 plan marked a structural turning point by setting domestic content targets in many strategic sectors. This framework enabled the emergence of powerful vertically integrated national champions, capable of dominating future-oriented technological sectors such as batteries, solar panels, and electric vehicles.

To ensure a reliable supply of critical raw materials, Beijing combined the exploitation of its domestic resources—which are sometimes of low quality—with aggressive international expansion. Its state-owned enterprises, financed by major state banks, invested heavily

in Africa, Latin America, and Asia, securing access to deposits while simultaneously strengthening China's geopolitical influence in these regions. This strategy relies on assertive economic diplomacy, often built around partnerships that link natural resources to infrastructure projects, notably within the framework of the Belt and Road Initiative.

China does not limit itself to controlling the upstream segment of the value chain. It also dominates the industrial processing stages, particularly refining, where it holds an almost hegemonic position. It currently controls a large share of the global processing of lithium, cobalt, and manganese, and its capacity for large-scale production allows it to set standards on the global market. However, this dynamic also creates certain vulnerabilities, such as overcapacity in specific segments.

Finally, Beijing uses critical raw materials as a lever of strategic influence. By manipulating exports—through quotas, taxes, or targeted bans—China directs global flows and shields its domestic industry. These measures, sometimes justified by national security concerns, strengthen its ability to assert power in international power dynamics. The continued dependence of other industrial powers on Chinese resources limits their room for maneuver despite the trade tensions generated by this approach.

Faced with this comprehensive strategy—combining industrial power, economic diplomacy, and resource control—the EU is compelled to fundamentally rethink its supply policies. The challenges Europe faces are similar to those encountered by other countries, including South Korea and Japan; the efforts already undertaken by these two nations offer valuable lessons.

JAPAN'S INDUSTRIAL STRATEGY

Japan was a pioneer in implementing a strategy to gain autonomy over critical minerals, initially for semiconductors and later for green technologies. The 2010 diplomatic standoff with China over the Senkaku/Diaoyu Islands incident marked a turning point, exposing Japan's vulnerability to Chinese restrictions on rare earth exports. After filing a complaint with the WTO and drawing lessons from the dispute, the Japanese government released its strategy for securing resource supply, identifying thirty strategic minerals.

Japan's Strategy	
Structuring Objectives	The goal is to ensure a stable, diversified, and secure supply for national value chains (batteries, semiconductors, and renewable energy) while supporting carbon neutrality by 2050. Japan specifically aims to achieve the following: • 80 percent self-sufficiency in certain base metals by 2030. • A reduction in dependence on any single supplier to below 50 percent. • The creation of strategic stockpiles covering sixty days of domestic consumption for thirty-four critical metals. • Up to 750 GWh of domestic battery production capacity (150 GWh for the domestic market, 600 GWh for export).
Institutional Frameworks and Public Instruments	The strategy is led by the Ministry of Economy, Trade and Industry (METI), in partnership with JOGMEC, which can co-invest in overseas mining projects and support Japanese companies through guarantees and subsidies. • Since 2022, a ¥100 billion fund has been deployed to subsidize up to 50 percent of CAPEX for strategic projects, provided that the materials transit through Japan.
Operational Pillars for Securing Supply	Japan relies on a combination of levers: • Direct foreign investments (e.g., lithium in Chile, nickel in Indonesia, and uranium in Kazakhstan) through major conglomerates such as Sumitomo, Mitsui, and Sojitz. • Development of recycling (e.g., rare earths recovered from electronic waste). • R&D focused on substituting critical materials with breakthrough technologies (e.g., ceramics, polymers, nanomaterials). • Establishment of strategic stockpiles for thirty-four minerals.

Japan's Strategy	
Bilateral Partnerships and Multilateral Alliances	Japan pursues an active diplomacy based on the following: • Strategic bilateral partnerships (with Australia, India, Vietnam, and Kazakhstan) focused on access to minerals and joint development of value chains. • Enhanced cooperation with the United States within the framework of the Inflation Reduction Act (IRA) and the Minerals Security Partnership (MSP). • Dialogue with the EU aimed at ensuring the interoperability of supply chains.

Despite significant progress—increased capacity, innovation, and partnerships—Japan remains highly dependent on China. This is particularly true for graphite, 90 percent of which is imported from China. Domestic mining remains underdeveloped, and the value chains are still vulnerable to geopolitical tensions. Japan's industrial expertise must continue to grow in order to ensure lasting autonomy in critical minerals.

SOUTH KOREA'S INDUSTRIAL STRATEGY

South Korea, an economy that is heavily industry-driven and export-oriented, is particularly vulnerable to disruptions in critical resource supply chains due to its massive reliance on imports—up to 95 percent—notably from China. Indeed, China supplies 33.4 percent of Korea's industrial raw materials. This dependency is especially sensitive in strategic sectors such as batteries, semiconductors, and other cleantech industries such as wind turbines and solar photovoltaics.

South Korea's Strategy	
Structuring Objectives	• Reduce dependence on any single supplier for critical minerals (lithium, cobalt, graphite) from 80 percent to 50 percent by 2030. • Secure supply chains for strategic sectors such as batteries, hydrogen, and nuclear energy. - Target of 30 percent share of nuclear power in the energy mix by 2030, including the development of small modular reactors (SMR). - Target of 30 percent share of renewable energies in the energy mix by 2030. • Reach a 30 percent share of nuclear power in the energy mix by 2030, including the development of Small Modular Reactors (SMRs). • Reach a 30 percent share of renewable energy in the national energy mix. • Maintain a geopolitical balance between China and the United States while meeting decarbonization imperatives.
Institutional Frameworks and Public Instruments	• Creation in 2021 of KOMIR, an organization dedicated to supporting overseas mining projects. • Implementation of an early warning system for thirty-three critical minerals. • Government-led recycling strategy, with a target of 20 percent recycling rate by 2030. • Tax credits, financial support, public guarantees, and investment incentives for domestic companies.
Operational Pillars for Securing Supply	• Strengthening of strategic stockpiles, notably for lithium and cobalt. • Acceleration of domestic refining and recycling capacity development. • Planned government investment of ₩20 trillion (approximately €13.3 billion) in the electric vehicle sector, in cooperation with major national players such as LG Chem and LG Energy Solution. • Development of industrial projects led by private sector actors and supported by MOTIE and KOMIR (including precursors, cathodes, and solid-state batteries). • Financial support for the demonstration and domestic development of emerging technology sectors such as electrolysis and offshore wind, with a local content benchmark. • Growing integration of ESG standards to promote local content.
Bilateral Partnerships and Multilateral Alliances	• Agreement with Australia (2020, 2021). • MoU with Mongolia (2023). • Negotiations with Ecuador. • Industrial agreements with Canada (Avalon, Electra, Snow Lake). • Minilateral cooperation: Active participation in the Mineral Security Partnership (MSP), which South Korea now chairs following Donald Trump's return to the White House. • Bilateral cooperation with the EU and trilateral dialogue with the United States on critical minerals.

Nevertheless, South Korea remains exposed to several vulnerabilities. On the one hand, its structural dependence on China, particularly in the battery sector and intermediate goods, limits its diplomatic and economic room to maneuver, forcing it to adopt a cautious balancing act between Beijing and Washington. Additionally, the country faces long-term challenges: the slow scaling-up of electrolysis technologies, the complexity of international mining development, increasing competition over supply chains, and difficulties in forging partnerships as robust as those established by others, such as that of Japan with Australia. In this context, South Korea is striving to design a resilient energy and industrial strategy, but the success of this transition will depend on its ability to sustainably secure critical resources while maintaining its technological edge.

WHAT INDUSTRIAL STRATEGY FOR CLEANTECH IN EUROPE?

The analysis of China's strategy, along with the Japanese and South Korean responses, provides valuable insights to inform Europe's strategic thinking.

The European approach is primarily based on the Green Deal and the *Net-Zero Industry Act*, which reflect the ambition for the green transition to be driven by the domestic production of the technologies required for decarbonization. The agreement reached in May 2024 notably sets a target of **meeting 40 percent of the EU's annual net-zero technology needs by 2030** and **capturing 15 percent of global production value by 2040**. The agreement between the Council and the European Parliament also foresees a fourfold increase in renewable energy deployment and a fifteenfold increase in electric vehicle production in Europe by 2050. This objective is designed to address the "green development" component of the European Green Deal, which aims to align climate action with economic growth.

This momentum is reinforced by the Clean Industrial Deal, which proposes the use of financial, regulatory, and trade instruments to **support industrial investment in Europe, secure access to critical raw materials, and build resilient value chains**. The deal aims to address the vulnerabilities exposed by recent crises, including excessive dependence on third countries, fragmented innovation support, administrative complexity, and the competitive disadvantage of European industry due to high energy costs.

Despite this stated ambition, the implementation process reveals **a number of structural weaknesses**. Europe remains highly dependent on China, both for critical raw materials and for large parts of cleantech value chains. The EU now faces an existential dilemma: **Does it want to remain a mere customer of decarbonization or become a full-fledged industrial player?** A complete decoupling from China is neither realistic nor desirable, but China's dominance in cleantech value chains raises serious questions about the long-term sustainability of such dependency.

This calls for a strategic reassessment—**achieving genuine industrial sovereignty requires securing access to critical resources, including those beyond the Continent, and moving beyond a model based solely on assembling imported components**.

Clean energy manufacturing capacity by country (2024)

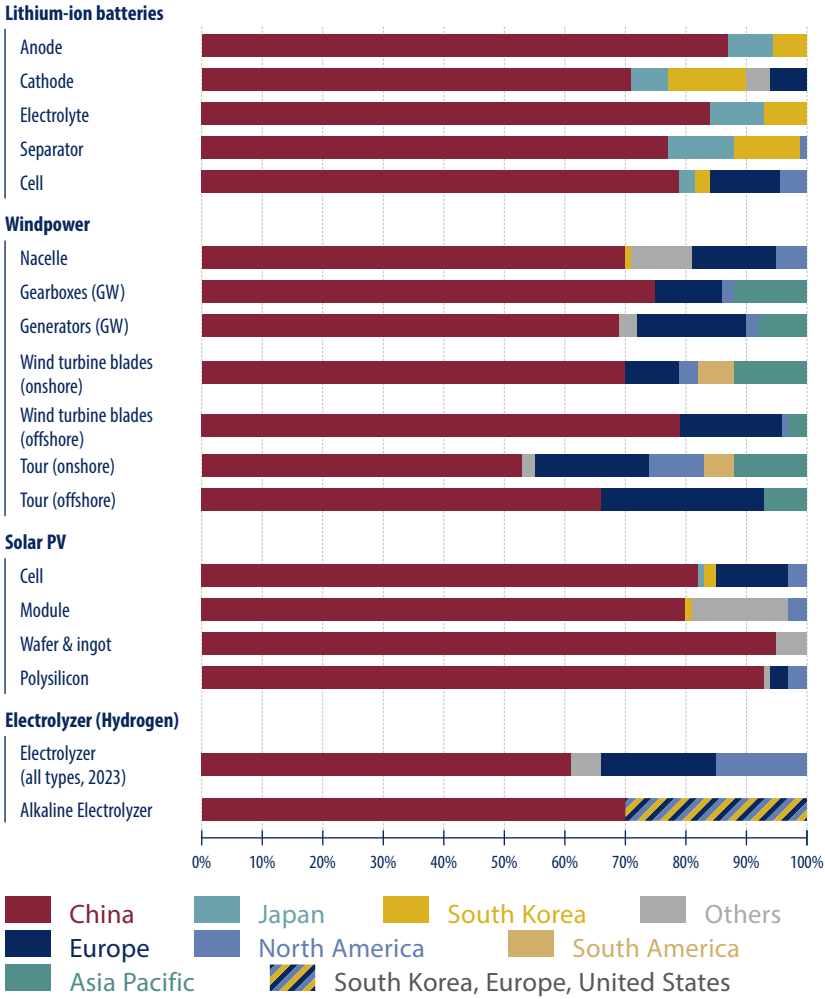


Chart based on data provided by MetaMarket Monitoring, the European Commission, Statista, Energy Trend, BNEF, Renewable Energy Institute, the International Energy Agency, Cheersonic, and through interviews.

Comparison of import volumes from China and production capacity in the EU for green technologies (2023)

Green Technology Categories	Volume of Imports from China (in Billions of Euros)	EU Production Capacity	Share of Imports from China
Batteries for electric vehicles	21.4	70 GWh in 2022; could reach 520 GWh by 2025	43.8%
Wind turbines	0.137	220 GW	53%
Solar panels	15.6	260 GW	97%
Electrolyzers	Electrolyzers have not been a significant area of trade between China and Europe. Currently, on both continents, the majority of stack components are supplied locally.	4.9 GWel	Europe currently ensures a large share of the production of key electrolyzer components locally. However, the main dependency in the value chain concerns iridium, 93 percent of which is mined and refined in South Africa and which is used in PEM electrolyzers. Europe is also dependent on Japanese companies such as Asahi Kasei and Toppan for the machinery needed to manufacture membranes.

Table based on data supplied by the Atlantic Council[1], the European Court of Auditors,[2] Motor,[3] WindEurope,[4] Eurostat,[5] the European Commission,[6] TNO and The Hague Centre for Strategic Studies[7], and on interviews.

[1] *Joseph Webster, "Without Tariffs, the EU Faces a Flood of Chinese Imports of the 'New Three,'" Atlantic Council, May 23, 2024, https://www.atlanticcouncil.org/blogs/energysource/without-tariffs-the-eu-faces-a-flood-of-chinese-imports-of-the-new-three.*

[2] *European Court of Auditors, Special Report 15/2023, The EU's Industrial Policy on Batteries: New Strategic Impetus Needed, 2023, https://www.eca.europa.eu/ECAPublications/SR-2023-15/SR-2023-15_EN.pdf.*

[3] *Morningstar DBRS, "Dependence on Chinese Battery Supplies Might Become Achilles' Heel of European EV Manufacturing," motor.com, July 30, 2024, https://www.motor.com/2024/07/dependence-on-chinese-battery-supplies-might-become-achilles-heel-of-european-ev-manufacturing.*

[4] *"Press Release: EU starts investigation into Chinese wind turbines under new Foreign Subsidies Regulation," WindEurope, April 9, 2024, https://windeurope.org/newsroom/press-releases/eu-starts-investigation-into-chinese-wind-turbines-under-new-foreign-subsidies-regulation.*

[5] *Eurostat, "International trade in products related to green energy," 2024, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_trade_in_products_related_to_green_energy.*

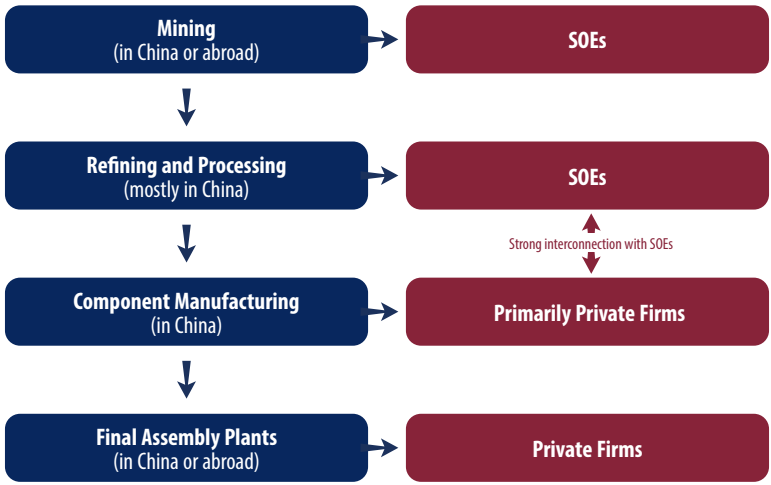
When it comes to critical raw materials, this structural dependency is largely due to a lack of domestic production capacity, technological expertise that is still under development, and a regulatory framework in Europe that is not conducive to mining. Although certain resources—such as lithium and rare earth elements—are present on European soil, the launch of mining projects is hindered by complex permitting procedures, environmental risks, and strong local opposition. Similarly, refining and recycling capacities—both essential to securing the value chain—remain limited due to their technical complexity and environmental impact.

In response to these challenges, the EU adopted the *Critical Raw Materials Act* (CRM Act) in 2024, which aims to structure an industrial strategy around critical materials. This legislation seeks to accelerate strategic industrial projects, support research and innovation, encourage private investment, and diversify supply sources through international partnerships. However, **the rise of protectionism in certain supplier countries**—such as Indonesia, Namibia, and Zimbabwe—**complicates the implementation of this strategy**. These states now require local processing of resources, often in partnership with Chinese companies that are already well established.

Meanwhile, China's industrial strategy—based on full vertical integration from extraction to finished product manufacturing—ensures Beijing's dominant position in clean technology value chains. **This dominance undermines European efforts toward industrial reshoring and deepens competitive imbalances**.

[6] *European Commission, "Solar Energy," 2023, https://energy.ec.europa.eu/topics/renewable-energy/solar-energy_en.*
[7] *TNO and The Hague Centre for Strategic Studies, "The EU's China Challenge: Rethinking Offshore Wind and Electrolysis Strategy," 2024, https://publications.tno.nl/publication/34642379/FD2Yc7/TNO-2024-R10732.pdf.*

Diagram of China's vertical industrial integration in cleantech and the role of state-owned enterprises (SOEs)



In light of Europe's ambitions to develop a clean technology industry, framed by the *Net-Zero Industry Act*, and given the limitations of the EU's current strategy to secure critical materials against the risks of disruption or manipulation of supply chains, Europe needs a strategy. This note proposes action along **three strategic lines for the EU**, starting with the upstream part of the value chains:

a. Using European Market Access as an Industrial Strategy

Recommendation 1

Leverage the European market in sectors where China is too dominant.

It is essential to **make access to the European market conditional on the local establishment of clean technology value chains**. This conditionality must be implemented through three levers:

- **Local content requirements:**
  - Set a threshold of **50 percent local content** for access to the European market (e.g., for EVs, which would include a significant proportion of critical vehicle components, including batteries).

- **Promote majority-European joint ventures:**
  - In sectors where Europe is lagging far behind (such as LFP batteries), priority should be given to **majority-European joint ventures**, with integration of local value chains to guarantee access to the European market.

- Impose local and progressive industrial integration by extending local content upstream in the chain:
  - **Moving beyond final assembly:** impose local integration of upstream components such as **precam materials** (PCAM) for batteries or permanent magnets for wind turbines and EVs.
  - **Couple this effort with the use of value chains in partner countries that have signed a Clean Trade and Investment Partnership (CTIP).**

Recommendation 2

Support this strategy with tools for industrial sovereignty.

If this strategy is to be effective, it must be accompanied by complementary industrial and social measures, in particular to ensure the security and competitiveness of European technologies, boost the skills of European workers, and combat forced technology transfers to China:

- **European industrial visa policy:**
  - Coordinate a visa policy with Member States to **limit the entry of Chinese engineers to the strict minimum number required**.
  - Require the **majority of engineers and technicians** in supported projects to be **locally recruited**.

- **Technological conditionality on production equipment:**
  - Require the use of **European assembly robots** in new cleantech factories. This would stimulate the local industrial equipment manufacturing ecosystem and strengthen European skills in these technologies.

b. Adapting European Rules
to the Reality of Value Chains

Recommendation 3

Mobilize structured financial support to boost mining investment in Europe.

The EU must activate robust financial support to secure private investment in the extraction and refining of critical materials. This includes:

- The **widespread provision of public guarantees on bank loans by Member States**, enabling companies to conclude purchase contracts with industrial partners.

- The **inclusion of mining activities in the European taxonomy**, subject to compliance with strict environmental standards, is also essential to encourage a sustainable revival of the European mining sector.

- **The European Investment Bank (EIB) must play a leading role in financing these capital-intensive projects**. The EIB's statutes should **allow it to exceed 10 percent investment outside Europe if projects are deemed strategic for the EU**.

Recommendation 4

Accelerate and harmonize the recycling of critical materials in Europe.

- The EU needs to **set differentiated recycling targets for each critical material and cleantech sector** in order to monitor value chains requiring greater efforts.

- **Harmonization of regulations between Member States on the management of waste containing critical materials is also essential**, as is the introduction of a more efficient Europe-wide collection system.

- Waste transport remains a major obstacle to recycling due to restrictive national rules. It is imperative to **liberalize transport between Member States, with a view to pooling the mass of critical materials to be recycled and recovered on the Continent**.

- The EU should also launch a **process to harmonize recycling standards with its partners who have signed a CTIP**, in order to encourage quality improvement and joint circularity.

- Finally, the EU should **introduce strict export quotas for waste containing critical materials, differentiated by material and by components used (starting with permanent magnets and black mass)**, intended exclusively for countries that have not signed a CTIP with Europe.

Recommendation 5

Mobilize the EIB to finance strategic reserves of critical minerals.

- The EU should draw inspiration from the Japanese JOGMEC model by **mandating the EIB to finance the creation of strategic reserves of critical minerals**. This role could include support for upstream exploration and the development of new mining projects, filling the gaps left by private investors in segments deemed too risky but essential to the EU's industrial security.

c. Establishing Strategic Partnerships through Clean Trade and Investment Partnerships

Recommendation 6

Adopt a "risk syndication" approach with partners that have converging interests.

It is necessary to assume that certain states, as well as their public financing institutions (such as the EIB, JOGMEC, or KOMIR), and certain companies will act as "buyer-investors." A coalition of these players—from the EU, Japan, and Korea, for example—would enable upstream project risks to be pooled, with a view to risk syndication. The aim of this approach would be to support projects led by states that are "sellers-developers" of critical resources. Joint ventures are the central tool in this strategy of structuring co-investment.

Recommendation 7

Make access to the European market conditional on the integration of extraction and refining projects in Europe and among its CTIP partners.

One common feature of the various Japanese and Korean strategies is the close link between investment in the extraction and refining of critical materials and the development of clean technology projects. This is particularly evident in North America, where gigafactory projects led by Japanese or Korean players are systematically paired with extraction

and refining projects, mostly located in Canada. This synergy has been made possible by the local content requirements introduced under the Inflation Reduction Act.

The EU would do well to follow suit by **making access to the European market (e.g., for batteries and EVs) conditional on the integration of strategic projects for the extraction and refining of critical materials located on its territory or that of a partner that has signed a Clean Trade and Investment Partnership**. This would create a powerful incentive for partners to sign a CTIP in order to integrate European value chains. **The introduction of a local content threshold for each section of the value chain** (e.g., 50 percent in batteries intended for the European market) would both secure the upstream part of the value chain and strengthen Europe's industrial competitiveness.

Recommendation 8

Deepen technological and regulatory cooperation between the EU, Japan, South Korea, Canada, and other CTIP partner countries.

- **This cooperation should focus more on innovation, through the pooling of resources** (particularly between public and private laboratories) and the **co-financing of joint research projects**. Joint efforts to develop **advanced recycling technologies and material efficiency solutions** would help build a resilient and competitive technological ecosystem, reducing vulnerabilities linked to dependence on a limited number of countries.

- Beyond disruptive technologies, there is also significant potential in **collaboration on refining and processing**. This lever is becoming

strategic in the face of increasing export controls, not only on critical minerals but also potentially on the technologies themselves.

- Another priority area is the **traceability of materials throughout the value chain**. The interoperability of traceability systems between partners is essential to ensure the transparency, trust, and sustainability of supply chains. The systematic integration of ESG criteria into these traceability systems would be a key lever for strengthening security of supply while promoting better integration of value chains between Europe, Asia, and North America.

Recommendation 9

Forge strategic industrial partnerships outside China.

Europe needs to rely on diverse international alliances, both to secure supplies and to build robust industrial alternatives. In clean technology value chains, several areas of cooperation should be prioritized, depending on the sector:

- **Batteries:** strengthen cooperation with Japan and South Korea through joint ventures and the signing of CTIP-type agreements, facilitating the co-integration of value chains.

- **Electrolyzers:** form coalitions of interest with Japan and the United States, particularly for critical components such as electrode membranes.

- **Wind power:** develop cooperation on permanent magnets with countries facing similar dependence on China, with a shared strategy of diversifying supply sources.

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Table of contents

Introduction

The European Union (EU) has set the goal of achieving carbon neutrality by 2050. This ambition is now enshrined as a legal obligation in European climate law[1] and is a central objective of the European Green Deal.[2] Russia's invasion of Ukraine and Donald Trump's return to the White House have highlighted the fragility of the European economy, which remains vulnerable to geopolitical manipulation by its partners—whether in terms of access to fossil fuels, critical defense materials, advanced technologies, or low-carbon energy sources.

For several years, the EU has recognized the need for increased support for its industrial sector is necessary, particularly to ensure access to critical materials essential to its resilience and competitiveness in the context of major global economic shifts. This is especially true for the energy industry, as demonstrated by the adoption of the ***Net Zero Industry Act***[3] and the ***Critical Raw Materials Act***,[4] both of which aim to promote European production and to secure access to the materials needed for the transition to clean technologies. Moreover, with the publication of the **Clean Industrial Deal**,[5] the EU intends to link decarbonization and industrial competitiveness, highlighting entire sectors of its economy that will need support to maintain a dynamic industrial base.

[1] *European Commission, Regulation of the European Parliament and of the Council, COM (2021) 555 final, July 14, 2021, https://eur-lex.europa.eu/legal-content/FR/TXT/HTML/?uri=CELEX:52021PC0555&from=FR.*

[2] *European Commission, The Green Deal for Europe, n.d., https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_fr.*

[3] *European Commission. (2024). The Net-Zero Industry Act Regulation – EU – 2024/1735 – EN – EUR – Lex. Europa.eu. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:L_202401735.*

[4] *European Commission. (2023). European Critical Raw Materials Act. Single-Market-Economy. ec.europa.eu. https://single-market-economy.ec.europa.eu/publications/european-critical-raw-materials-act_en.*

[5] *Clean Industrial Deal. (2023). European Commission. https://commission.europa.eu/topics/eu-competitiveness/clean-industrial-deal_en.*

The transition to a carbon-neutral economy relies on the widespread deployment of clean technologies. However, developing photovoltaic solar panels, wind farms, electrolyzers, and electric vehicles (EVs) requires shifting from a hydrocarbon-dependent economy to one based on the extraction of "critical" materials.[6] On average, the production of an EV requires six times more critical materials than a conventional vehicle, and an onshore wind farm requires nine times more minerals than a gas-fired power plant.[7]

A sixfold increase in critical mineral extraction by 2040 will be necessary if the Paris Agreement targets are to be achieved.[8] In detail, such an increase would translate into increased extraction levels: **40 percent for copper, 60–70 percent for cobalt and nickel, 90 percent for lithium, and 40 percent for rare earth elements (REEs)** compared to 2020 levels. **This new dependence on critical materials marks the gradual end of the era of dependence on hydrocarbons and raises new industrial and geopolitical challenges**.

[6] *Energy Transitions Commission, "Material and Resource Requirements for the Energy Transition," July 2023, https://www.energy-transitions.org/wp-content/uploads/2023/08/ETC-Materials-Report_highres-1.pdf.*

[7] *International Energy Agency (IEA), "Executive Summary – The Role of Critical Minerals in Clean Energy Transitions," May 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.*

[8] *IEA, "Executive Summary – The Role of Critical Minerals in Clean Energy Transitions."*

1 Critical and Strategic Materials

Several countries have recently classified certain raw materials as "critical" or "strategic". These decisions reflect, first and foremost, an awareness of critical and strategic minerals' essential role in emerging energy technologies, particularly for decarbonization. They also demonstrate these countries' increasing awareness of the high levels of risk of disruption to supply chains, given the significant concentration of players involved in extracting and processing these resources.

The distinction between "critical minerals" and "strategic minerals" varies from one country to another, reflecting different economic priorities, security concerns, and geopolitical strategies. Resource-rich countries tend to prioritize securing supply chains to ensure their economic stability, whereas the major industrial powers tend to be focused on accessing materials essential to advanced technologies.

In the **United States**, the *Critical Mineral Consistency Act* of February 2025 aims to align the Department of Energy's list of critical materials with the Department of the Interior's list of critical minerals; it includes **fifty minerals and eighteen materials that are considered strategic**.[9] The EU, through the *Critical Raw Materials Act*, distinguishes between critical raw materials (CRMs), which are essential to industry and technology, and strategic raw materials, which are necessary for the defense, aerospace, and green technology sectors.

In its CMP legislation adopted in May 2024, the **EU** listed **thirty-four minerals and metals as being of critical and/or strategic importance**.[10] Japan and South Korea are also focusing on securing critical minerals

[9] *United States Congress, House, H.R. 755 – Critical Mineral Consistency Act of 2025, 119th Cong., 1st sess. (2025), https://www.congress.gov/bill/119th-congress/house-bill/755/text.*

[10] *European Commission, "Critical Raw Materials," 2023, https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/critical-raw-materials_en.*

and metals for their high-tech industries, particularly semiconductors and batteries for EVs. **In 2012, Japan's** resource security strategy[11] identified **thirty strategic minerals; thirty-four "rare metals" were later added to its Basic Energy Plan (2020)**.[12] China, meanwhile, does not formally distinguish between these categories but tightly controls exports of certain minerals, indicating their strategic nature.

Despite the **lack of international consensus regarding the exact definition of critical materials**, some materials—notably **cobalt**, **graphite**, **nickel**, **lithium**, and REEs such as **neodymium and dysprosium—appear repeatedly in the lists** published by most countries.[13]

The relatively small size of the market for most critical materials, compared to that of base metals such as iron and aluminum, effectively amplifies the challenges faced by countries in establishing stable and resilient supply chains. This small market size also has an impact on price volatility, thus increasing economic uncertainty for industries that depend on these materials. The situation is further complicated by the fact that the supply of critical materials often depends on the extraction of other primary minerals, from which they are extracted as by-products.[14]

In 2022, it was estimated that only 10 million tons of critical materials needed to be produced for the manufacture of clean energy technologies.[15] The limited production needed creates a direct tension between

[11] Japanese Government, "Resources Security Strategy," 2012, http://web.archive.org/web/20220120153939/https://www.kantei.go.jp/jp/singi/package/dai15/sankou01.pdf.

[12] Japanese Ministry of Economy, Trade and Industry (METI), "Japan's New International Resource Strategy to Secure Rare Metals," July 31, 2020, https://www.enecho.meti.go.jp/en/category/special/article/detail_158.html.

[13] Bundesanstalt für Geowissenschaften und Rohstoffe (BGR), Deutsche Rohstoffagentur [German Mineral Resources Agency] (DERA), "Rohstoffe für Zukunftstechnologien 2021" [Raw materials for future technologies], 2021, https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-50.pdf.

[14] METI, "Japan's New International Resource Strategy to Secure Rare Metals."

[15] International Renewable Energy Agency (IRENA), "Geopolitics of the Energy Transition: Critical Materials," 2023, https://wwfint.awsassets.panda.org/downloads/irena_geopolitics_energy_transition_critical_materials_2023_1.pdf.

the demand for finished clean technology products and the availability of critical materials. This, *ipso facto*, restricts the flexibility of the clean technology supply in the event of sudden demand fluctuations. The challenge is all the more acute given that these materials are essential to many advanced technologies—not only in the renewable energy sector but also in electronics and defense—intensifying international competition for access to these resources.

2 What materials do we need for decarbonization?

There has been a significant increase in global demand for critical materials, driven by production of batteries for EVs, photovoltaic solar cells, wind turbines, and electrolyzers. Although each of these sectors has its own specific characteristics, **a large part of their value chain is concentrated in the hands of Chinese companies**.

One of the major questions facing Europe today is: **How dependent does it want to remain on its main supplier of equipment essential to its clean energy production?** This question actually covers several other questions:

1. **How much dependence on a single supplier is Europe willing to accept for its clean technologies?**
2. **To what extent can it tolerate concentrated dependence on the supply of critical materials** that are essential not only for the energy transition but also for strategic sectors such as defense?
3. **Finally, to what extent is Europe prepared to accept that the success—including financial success—of its decarbonization depends on industrial policy choices made elsewhere?**

In a context in which the low-carbon transition requires a profound—and costly—reorganization of energy infrastructure, these questions ultimately boil down to a strategic choice: **What place does Europe want to occupy in the industrial value chains of tomorrow?**

An important distinction must be made between sectors. In certain "emerging" segments, such as photovoltaic panels, Europe has never really developed a robust industrial base, and other players would be better placed to develop alternatives to the sole Chinese supplier. Conversely, other sectors are **fundamental** to the future of European industry: This is the case for **batteries**—first for EVs, then for stationary storage—and **electrolyzers**, which are essential not only for the production of clean hydrogen and its derivatives but also, in the long term, for technologies for using captured carbon, i.e., a significant part of the future of industrial chemistry.

In these key sectors, excessive external dependence is not a viable option. While some form of dependence in the photovoltaic sector may be envisaged, **total dependence would be strategically risky for electrolysis or battery technologies**, given that these technologies are crucial to the competitiveness of entire industrial sectors.

Reflection on European industrial needs is, therefore, crystallizing around two axes:

- **How to control and sustain the critical sectors that Europe wishes to develop on its territory** and which are listed in the *Net Zero Industry Act*;
- **How to secure the upstream parts of value chains** that are currently dominated by China, whose lead is based on a long-term industrial strategy aimed at controlling the extraction and refining of critical materials essential to the technologies of tomorrow.

2.1. MINERALS IN BATTERY CATHODES

Strong demand and steadily falling prices have driven rapid growth in the global battery market. In 2024, electric car sales rose by 25 percent to seventeen million vehicles. The resulting annual demand for batteries exceeded 1 terawatt hour (TWh)—a historic milestone.[16] At the same time, the average cost of a battery pack for an EV fell below $100 per kilowatt hour, a key level for competing on price with traditional combustion engine models.[17]

The decline in the price of materials used in batteries is playing a major role in this trend. Lithium, in particular, has seen its price fall by more than 85 percent from its peak in 2022. However, technological advances in the battery industry are also contributing to this cost reduction. After years of investment, global battery production capacity reached 3 TWh in 2024. If all announced projects come to fruition, this capacity could triple over the next five years.[18]

> Mastering a battery production chain depends on mastering *precursors of active cathode materials* **(pCAM)**. This is a powdery substance used in the manufacture of cathodes for lithium-ion batteries that contains critical elements such as nickel, cobalt, and manganese. **pCAM is an essential intermediate step in the lithium-ion battery production chain**. It is synthesized before being **converted into cathode active material (CAM)**, which is then integrated into batteries. The quality and composition of pCAM directly influence batteries' performance, safety, and lifespan.

[16] *International Energy Agency (IEA), "The Battery Industry Has Entered a New Phase," March 5, 2025, https://www.iea.org/commentaries/the-battery-industry-has-entered-a-new-phase.*
[17] *IEA, "The Battery Industry Has Entered a New Phase."*
[18] *IEA, "The Battery Industry Has Entered a New Phase."*

The production of pCAM may require primary raw materials, such as mixed hydroxide precipitate (MHP), or recycled materials from end-of-life batteries, known as **"black mass"**. This approach promotes a circular economy by reintegrating valuable materials into the battery production cycle.

There are several major types of batteries in common use. Lithium-iron-phosphate (LFP), nickel-manganese-cobalt (NMC), and nickel-cobalt-aluminum (NCA) batteries all use a liquid electrolyte in their standard design. All of these technologies **rely heavily on lithium, and some rely on cobalt, manganese, and nickel, for the manufacture of cathodes**, which determine the overall performance of these batteries.

NMC and NCA batteries, which are mainly developed by Korean (e.g., LGensol), Japanese (Panasonic), and Chinese (CATL) companies, have the advantage of higher energy density. LFP technology, which is booming on the global market, is **dominated by Chinese players**.

The global lithium-ion battery market is evolving rapidly, with market share shifting between different technologies. Historically, NMC cathodes dominated the market, accounting for around 60 percent of the market in 2022.[19] Recently, the market share of NMC cathodes has declined in favor of LFP batteries, which are less expensive and are renowned for their increased safety. LFP batteries exceeded 38 percent of the market share in 2023, compared to 37 percent for NMC batteries.[20]

[19] *International Energy Agency (IEA), "Trends in Batteries – Global EV Outlook 2023," 2023, https://www.iea.org/reports/global-ev-outlook-2023/trends-in-batteries.*
[20] *Alex Holland, "Battery Material Shifts in the Li-ion Market," IDTechEx, November 7, 2024, https://www.idtechex.com/en/research-article/battery-material-shifts-in-the-li-ion-market/32015.*

This rapid growth makes LFP batteries one of the most dynamic technologies in the sector today, particularly for EVs, where they account for more than 40 percent of global demand in terms of capacity.[21] The exponential growth of Chinese LFP, despite its lower theoretical range, is mainly due to its lower cost, longer life, and improved safety, as it is less prone to fire than either NMC or NCA batteries.[22] Although considered less technologically advanced (due to its lower energy density), LFP is significantly cheaper to produce, with a cost of around $90/kWh, compared to $110/kWh for NMC and NCA technologies.[23]

At the same time, the market share of NCA batteries reached 19 percent, while lithium-cobalt-oxide (LCO) batteries, which were once dominant in portable electronics, now account for only 6 percent of the market.[24]

By 2030, projections indicate that NMC batteries could remain dominant with 81 percent of the global market, while NCA batteries are expected to stabilize at around 8 percent.[25] This trend clearly reflects the **technological trade-offs between cost, performance, and availability of raw materials that must be made in order to pursue an effective and realistic public policy**.

These batteries require a significant supply of critical materials, particularly nickel, which accounts for nearly 80 percent of the composition of NCA cathodes and 33 percent of NMC cathodes.[26] Cobalt is also vital,

[21] *International Energy Agency (IEA), "Trends in Electric Vehicle Batteries – Global EV Outlook 2024," 2024, https://www.iea.org/reports/global-ev-outlook-2024/trends-in-electric-vehicle-batteries.*

[22] *CRomain Capliez, Carl Grekou, Emmanuel Hache, and Valérie Mignon, Batteries lithium-ion: cartographie dynamique de la chaîne de valeur et perspectives [Lithium-ion batteries: dynamic mapping of the value chain and outlook], CEPII Policy Brief no 48 (October 2024), https://www.cepii.fr/PDF_PUB/pb/2024/pb2024-48_FR.pdf.*

[23] *Thunder Said Energy, "Lithium Ion Battery Costs: Materials and Manufacturing?" September 6, 2024, https://thundersaidenergy.com/downloads/lithium-ion-batteries-for-electric-vehicles-what-costs/.*

[24] *Holland, "Battery Material Shifts in the Li-ion Market."*

[25] *Statista, "Projected Distribution of Lithium-Ion Battery Production Worldwide in 2030, by Chemistry," 2024, https://www.statista.com/statistics/1495713/forecast-battery-production-share-by-chemistry/.*

as is, of course, lithium—for which demand could increase tenfold by 2030.[27] Ni-Mh[28] batteries, meanwhile, require large quantities of cobalt and nickel due to their nickel-based composition and use of nickel hydroxide cathodes.

The demand for critical materials has been rising steadily since 2017. With the continued growth of the electric vehicle market, demand for EV batteries will increase significantly. In 2023, nearly 85 percent of global demand for lithium, 70 percent for cobalt, and 10 percent for nickel was already linked to batteries for EVs.[29] As a result, in 2023, demand for lithium reached 165 kt (+22%), cobalt 214 kt (+13%), and nickel 3,700 kt (+32%).[30]

Table 1 • Types of lithium-ion batteries with dominant players

Battery type	Advantages	Disadvantages	Applications	Dominant countries
Nickel-manganese-cobalt (NMC) (37% of the global market)[31]	Good compromise among energy density, cost, and lifespan.	Less thermally stable than LFP.	EVs (VW, BMW, Hyundai, some Tesla models).	China accounts for more than three-quarters of installed NMC battery production,[32] with companies such as CATL. South Korea accounts for 20%, with companies such as LG Energy Solution and Samsung SDI.

[26] *Nickel Institute, "Nickel in Batteries," n.d., https://nickelinstitute.org/en/about-nickel-and-its-applications/nickel-in-batteries/.*

[27] *Lambert Toxé, Claire Mauduit, Albane Gautier, Anna Montagner, and Ksenia Ternovykh, "Le cobalt : Une ressource minérale indispensable de la transition écologique" [Cobalt: an essential mineral resource for the ecological transition], Institut Supérieur d'Ingénierie et de Gestion de l'Environnement (ISIGE), n.d., https://www.isige.minesparis.psl.eu/wp-content/uploads/Cobalt-post-DG-comments.pdf.*

[28] *Christopher Iacò, "Lithium Battery: Material Breakdown," LinkedIn, May 13, 2023, https://www.linkedin.com/pulse/lithium-battery-material-breakdown-cristopher-iac%C3%B2/.*

[29] *IEA, "Trends in Electric Vehicle Batteries – Global EV Outlook 2024."*

[30] *International Energy Agency (IEA), "Global EV Outlook 2024: Moving towards Increased Affordability," 2024, https://iea.blob.core.windows.net/assets/a9e3544b-0b12-4e15-b407-65f5c8ce1b5f/GlobalEVOutlook2024.pdf.*

Battery type	Advantages	Disadvantages	Applications	Dominant countries
Nickel-cobalt-aluminum (NCA) (19% of the global market)[33]	High energy density.	Less thermally stable than NMC, high cost.	Tesla-Panasonic (longer range).	Japan (Panasonic, used by Tesla; Sumitomo Metal Mining Co) South Korea (Samsung SDI, Ecopro, POSCO).
Lithium-iron-phosphate (LFP) (38% of the global market)[34]	Durable, safe, low cost, no cobalt.	Lower energy density, reduced range.	Tesla (standard models), BYD, CATL, Chinese EVs.	China accounts for almost 100% of LFP battery production capacity[35], with companies such as CATL and BYD. It is increasingly used in Europe and the US.
Lithium-manganese-oxide (LMO)	Good safety and power.	Lower energy density.	Hybrids, stationary storage.	Japan (historical, less commonly used today).
Lithium-titanate (LTO)	Long service life, ultra-fast charging.	Low energy density.	Electric buses, stationary storage.	Japan (Toshiba), used for specific applications.
Lithium-cobalt-oxide (LCO)	High energy density.	Short lifespan, relatively high cost.	Mobile phones, computers.	China (Tianjin B&M Science and Technology Co. Ltd.). Japan (Sony Corporation). South Korea (LG Chem, Samsung SDI). Europe (Umicore).

2.2. ELECTROLYSIS

The production of electrolyzers requires more than forty raw materials and sixty processed materials. The main suppliers of these raw materials are China (37%), South Africa (11%), and Russia (7%). The EU accounts for only 2 percent.[36]

[31] *Holland, "Battery Material Shifts in the Li-ion Market."*
[32] *IEA, "Trends in Electric Vehicle Batteries – Global EV Outlook 2024."*
[33] *Holland, "Battery Material Shifts in the Li-ion Market."*
[34] *Holland, "Battery Material Shifts in the Li-ion Market."*
[35] *IEA, "Trends in Electric Vehicle Batteries – Global EV Outlook 2024."*
[36] *European Commission, Joint Research Centre (JRC), "Water Electrolysis and Hydrogen: Growing Deployment Prospects in Europe and Beyond," November 24, 2023, https://joint-research-centre.ec.europa.eu/jrc-news-and-updates/water-electrolysis-and-hydrogen-growing-deployment-prospects-europe-and-beyond-2023-11-24_en.*

More specifically, the industry relies on four main technologies, each with its own specific requirements in terms of the materials used. Some, such as nickel, manganese, chromium, and iron, are common to all electrolysis technologies, while others, such as aluminum, cobalt, copper, lanthanum, molybdenum, natural graphite, and zirconium, are present in three of them.[37]

Each technology also has its own specific materials:

- **Proton exchange membrane (PEM)** electrolyzers require metals from the platinum group for catalysts, mainly iridium, platinum, or titanium—which are rare resources whose supply is largely dominated by South Africa and Russia.[38]
- Conversely, **solid oxide electrolysis (SOEC)** relies on ceramic electrolytes, thus avoiding the use of critical metals, although this technology is still in the early stages of development.[39]
- **Alkaline electrolyzers**, the most mature technology, which is dominated by China, use electrodes made of copper, aluminum, or stainless steel, which are widely available materials.[40]
- Finally, **anion exchange membrane (AEM) technology** combines certain advantages of alkaline and PEM approaches while favoring more affordable catalysts such as nickel or stainless steel, although its development remains limited.[41]

[37] *European Commission, Joint Research Centre (JRC), "Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study," 2023, https://single-market-economy.ec.europa.eu/system/files/2023-03/Raw%20Materials%20Foresight%20Study%202023.pdf.*

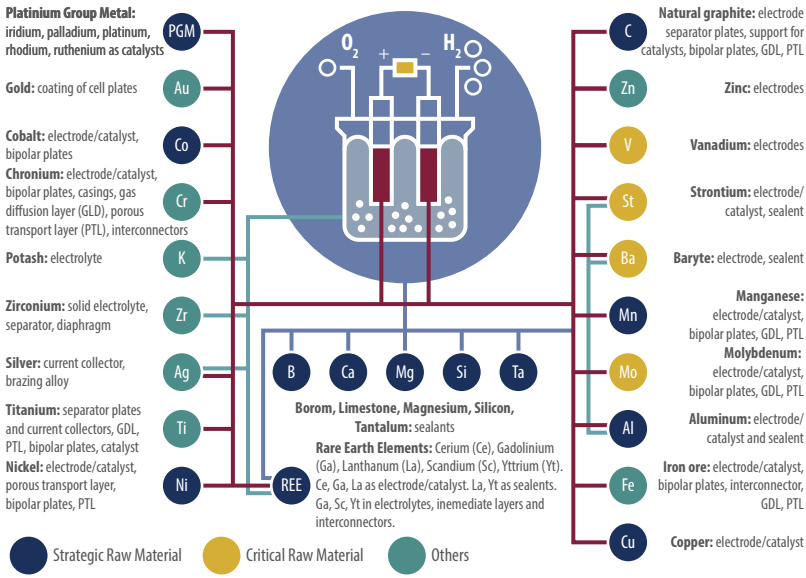
[38] *Interview with the hydrogen sector (2024).*

[39] *Interview with the hydrogen sector (2024).*

[40] *Interview with the hydrogen sector (2024).*

[41] *Alaa Y. Faid and Svein Sunde, "Anion Exchange Membrane Water Electrolysis from Catalyst Design to the Membrane Electrode Assembly," Energy Technology 10, no. 9 (2022): 2200506, https://doi.org/10.1002/ente.202200506.*

Figure 1 • Main materials used in the four types of electrolyzers



Source: JRC analysis.[42]

The electrolyzer industry is expanding rapidly, with production capacity in Europe set to rise from 2 GW to 10 GW by the end of 2024[43] and projected to reach 21 GW by 2026.[44] However, these figures reflect theoretical potential rather than a guaranteed reality, as the **main challenge lies not in industrial capacity but in the lack of structured demand**.

[42] *JRC, "Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study."*

[43] *European Hydrogen Observatory. (2024). Electrolyser manufacturing capacity | European Hydrogen Observatory. European Hydrogen Observatory. https://observatory.clean-hydrogen.europa.eu/hydrogen-landscape/technology-manufacturing/electrolyser-manufacturing-capacity.*

[44] *Rachel Parkes, "Europe on Track to Deliver 21GW Green Hydrogen Electrolyser Factory Capacity by 2025," Hydrogeninsight.com, 2023, https://www.hydrogeninsight.com/electrolysers/europe-on-track-to-deliver-21gw-green-hydrogen-electrolyser-factory-capacity-by-2025/2-1-1476501.*

Without clear signals and regulatory incentives, particularly for green hydrogen, large-scale projects are struggling to emerge in Europe, the US, and the Gulf countries.

Unlike the solar and battery sectors, where China has taken a considerable lead, electrolysis remains a contested area. Europe retains a dominant position, with nine of the world's fifteen leading electrolyzer manufacturers, while China has between 100 and 200 players, which are mainly focused on alkaline technology. The United States and Japan also occupy prominent places in the electrolysis value chain.

Within the value chain, Europe retains a strong industrial presence in the manufacture of essential electrolyzer components—derived from chemistry—particularly in Belgium, Italy, France, and Germany. However, the situation is more mixed for subcomponents. Solvay is one of the few European producers of fluorinated polymers (PFSA), which are essential for electrolytic membranes,[45] a market in which the United States, Japan, and China are also present. The transformation of these polymers into membranes is carried out by a few players, including GORE in the United States and Fumatech in Europe (Germany/Italy). The manufacture of these membranes requires precision equipment, a field in which Japanese machines dominate (e.g., Asahi Keisei), leaving Europe in a position of having to catch up.

Europe, on the other hand, is well established in catalyst production, with companies such as Heraeus in Germany, Umicore in Belgium, and Johnson Matthey in the United Kingdom competing with Japanese players such as Tanaka. As for gas diffusion layers, which are essential to the operation of electrolyzers, there are only a limited number of specialized players, mainly in Europe (GKD Group),[46] Japan (Mitsubishi Chemical Group),[47] and the US (Mott Corporation),[48] although some Chinese manufacturers already occupy an important place in this market.

[45] *Solvay. Solvay, an advanced materials and specialty chemicals company. Solvay. https://www.solvay.com/en/.*

While Europe and Japan retain a certain degree of technological and industrial leadership, their dependence on strategic raw materials and the rapid rise of China, particularly in alkaline electrolysis, remain major challenges. Structuring demand and strengthening industrial sovereignty in critical links will be decisive in ensuring a competitive position in the long term.

2.3. "RARE EARTHS" IN PERMANENT MAGNETS

Electric motors in EVs often require the use of **NdFeB permanent magnets** (permanent magnets made of neodymium-iron-boron), which are commonly used by many manufacturers (e.g., Tesla, Toyota, BMW).[49] Crucial for energy efficiency, they are **mainly composed of "rare earths" such as praseodymium, neodymium, dysprosium, and titanium**.

In terms of wind turbines, while onshore wind turbines generally use copper-based electromagnetic generators (except for the largest ones), **offshore wind turbines** require the use of **permanent magnet synchronous generators (PMSGs) that require the use of NdFeB permanent magnets**, which are composed of "rare earths."[50] With the rapid

[46] *GKD Group. Hydrogen – Mesh for electrolysis. GKD Group. https://www.gkd-group.com/en/industry/markets/energy/electrolysis/.*

[47] *Mitsubishi Chemical Corporation. Carbon Fiber Paper (GDL) | Products | Mitsubishi Chemical Corporation. Mitsubishi Chemical Corporation. https://www.m-chemical.co.jp/en/products/departments/mcc/composite-products/product/1201231_7508.html.*

[48] *Mott Corp. Gas Diffusion & Transport Layers | Mott Corp. Mott Corporation. https://mottcorp.com/product/gas-diffusion-transport-layers/.*

[49] *Adrijana Buljan, "New Partnership to Extract Rare Earth Magnets from Retired Wind Turbines for Use in New Ones," Offshore WIND, September 12, 2023. https://www.offshorewind.biz/2023/09/12/new-partnership-to-extract-rare-earth-magnets-from-retired-wind-turbines-for-use-in-new-ones/.*

[50] *Buljan, A. (12 septembre 2023). New Partnership to Extract Rare Earth Magnets from Retired Wind Turbines for Use in New Ones. Offshore WIND. https://www.offshorewind.biz/2023/09/12/new-partnership-to-extract-rare-earth-magnets-from-retired-wind-turbines-for-use-in-new-ones/.*

expansion of wind energy and EVs, **demand for critical materials for NdFeB magnets** is expected to grow at an average annual rate of 7.5 percent between 2030 and 2040, representing a **fivefold increase in the current market size by 2040**.[51]

2.4. COPPER AND ALUMINUM AS STRUCTURAL MATERIALS

Photovoltaic (PV) solar panels and wind turbines require **large amounts of copper and aluminum**, which are essential for manufacturing cells, frames, and electrical networks. Copper, in particular, plays a crucial role not only in clean energy technologies but also in the production of other CRMs.[52] The significant expansion planned for solar PV and wind energy capacity, as well as for electrical grid infrastructure, is expected to **boost copper demand by nearly 20 percent by 2035**.[53]

2.5. GRAPHITE

Finally, **graphite**, thanks to its resistance to extreme heat, plays a role in solar panels, where it is commonly used in silicon processing furnaces during the production of PV wafers.[54]

[51] *Adamas Intelligence, "Rare Earth Magnet Market Outlook to 2040," May 2, 2023, https://www.adamasintel.com/rare-earth-magnet-market-outlook-to-2040/.*

[52] *European Commission, Joint Research Centre (JRC), "Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study," 2020, https://rmis.jrc.ec.europa.eu/uploads/CRMs_for_Strategic_Technologies_and_Sectors_in_the_EU_2020.pdf.*

[53] *Katya Bouckley, "Global Copper Demand to Rise 20% by 2035 to 30 Million mt/Year: Nornickel," S&P Global, October 10, 2023, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/101023-global-copper-demand-to-rise-20-by-2035-to-30-million-mtyear-nornickel.*

[54] *Corina Hebestreit, "Why the Renewable Energy Industry Requires Carbon and Graphite," Innovation News Network, May 16, 2022, https://www.innovationnewsnetwork.com/renewable-energy-industry-carbon-graphite/21456/.*

Graphite is also central as a conductive material in **hydrogen fuel cells**, which power certain EVs, as well as in **alkaline electrolyzers used in the manufacture of hydrogen by electrolysis**.[55] However, the most advanced electrolyzers (PEM, SOEC) tend to use catalysts coated with precious metals **(platinum, iridium)**.

Graphite is also an essential component of lithium-ion batteries with graphite anodes, enabling **efficient energy storage** for both EVs and energy storage systems associated with intermittent renewable energy sources.[56] In addition, its use in thermal management systems improves the performance and lifespan of renewable technologies, while in the **nuclear field**, it serves as a **moderator in certain reactors** (particularly high-temperature gas-cooled reactors, HTGRs). The increase in demand for renewable energy and the rapid development of the EV market, combined with other diverse applications, are expected to drive demand for graphite, with **an annual growth rate that could reach 7.5 percent between 2024 and 2036**.[57]

[55] *Semco Carbon, "Industrial Uses of Graphite in the Clean Energy Field," n.d., https://www.semcocarbon.com/blog/industrial-uses-of-graphite-in-the-clean-energy-field.*
[56] *Research Nester, "Graphite Market Size & Share – Forecast Report 2024–2036," February 7, 2024, https://www.researchnester.com/reports/graphite-market/181.*
[57] *RResearch Nester, "Graphite Market Size & Share – Forecast Report 2024–2036."*

Table 2 • Relative importance of minerals in transition technologies

	Copper	Cobalt	Nickel	Lithium	Rare Earths	Alumi-num	Graphite
Solar PV	●	●	●	●	●	●	●
Wind	●	●	●	●	●	●	●
Nuclear	●	●	●	●	●	●	●
Electricity Grids	●	●	●	●	●	●	●
EV and Battery	●	●	●	●	●	●	●
Electrolyzer	●	●	●	●	●	●	●

● High ● Moderate ● Low

Source: International Energy Agency, "The Role of Critical Minerals in Clean Energy Transitions".[58]

3 The Strategy behind Our Dependence on China

The disruptions to supply chains caused by the COVID-19 pandemic and Russia's invasion of Ukraine have led to significant increases in raw material prices. These events have highlighted **the EU's heavy dependence on China for the supply of critical materials**. As the market leader, **China has pursued a targeted and structured industrial policy for more than twenty years to establish itself as the central player in future technologies**.

[58] *International Energy Agency (IEA), "Mineral Requirements for Clean Energy Transitions – The Role of Critical Minerals in Clean Energy Transitions," 2021, https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/mineral-requirements-for-clean-energy-transitions.*

China does not owe its dominant position in transition metals to exceptional domestic resources. On the contrary, this position is largely the result of a long-term, consistent, and forward-looking industrial policy aimed at placing the Chinese economy at the heart of value chains for future technologies—in particular, clean energy technologies that are essential for global decarbonization and China's own energy self-sufficiency.

In 2015, Beijing adopted *Made in China 2025*, an industrial roadmap aimed at achieving self-sufficiency in high-tech sectors by 2025—including cleantech areas such as EVs and renewable energy. One of the central objectives of this plan was to localize supply chains for essential components and materials, with a target of 70 percent domestic content in strategic areas by 2025[59]—a goal that has been achieved in only a few sectors (such as PV). **What is often overlooked is that behind this industrial strategy was a clear ambition to place China at the heart of global value chains—making it as indispensable as possible, with the goal of securing markets for domestic production and financing it without being outpaced by competitors**. This strategy was explicitly articulated by Xi Jinping on numerous occasions: *"The goal should be to increase the dependence of global value chains on China, while developing strong retaliatory and deterrent capabilities against foreign powers that might attempt to disrupt those supply lines."*[60]

To achieve this, China has deployed an aggressive strategy around critical minerals (lithium, cobalt, graphite, rare earths, nickel, etc.) that are essential to the energy transition industries (batteries, EVs, wind turbines, solar panels). This strategy can be summarized in three points:

[59] *State Council of the People's Republic of China,* 国务院关于印发《中国制造*2025*》的通知_机械制造与重工业_中国政府网 *[Notice of the State Council on issuing 'Made in China 2025'], May 8, 2015, https://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm.*

[60] *Xi Jinping,* 国家中长期经济社会发展战略若干重大问题 *[Several major issues concerning the national medium- and long-term economic and social development strategy], Qiushi, October 31, 2020, http://www.qstheory.cn/dukan/qs/2020-10/31/c_1126680390.htm.*

- A strategy for supply chains
- A strategy for acquiring resources abroad and achieving overwhelming dominance in refining
- An export policy with geopolitical objectives

3.1. AN INDUSTRIAL STRATEGY FOR CREATING AND SUPPORTING SUPPLY CHAINS LED BY STATE-OWNED ENTERPRISES

Driven by the strategy defined by the central government and supported by state-owned enterprises, Chinese industry is now investing heavily in projects to extract critical resources. The goal is clear: to gain strategic leverage in international power relations in order to establish its hegemony over the entire clean technology value chain.

China is also demonstrating strategic consistency by investing heavily in downstream value chains, which are the main outlets for its critical materials, making these two facets of its industrial strategy complementary. **In 2024, China alone accounted for 75 percent of global investment in clean technologies** and dominated the battery, EV, photovoltaic panel, and related key industrial process sectors.

China has pursued a multipronged strategy to ensure a stable supply of essential minerals, combining domestic efforts with large-scale initiatives abroad.

The strategy is primarily domestic. China is, therefore, stepping up the extraction and processing of local resources as much as possible. As part of *Made in China 2025*, the authorities have encouraged the exploration of domestic deposits (e.g., low-grade lepidolite lithium mines) and invested in refining infrastructure. **The government has also consolidated certain industries**, notably by merging some state-owned enterprises in the rare earth sector, in order to better control

production and reduce inefficiencies.[61] This approach **ensures large-scale production and refining of strategic minerals within China**, while giving state-owned enterprises a central role.

The international dimension of this strategy spans the last two decades, during which Chinese companies—backed by the state—have invested heavily in mining projects abroad, particularly in Africa, Latin America, Australia, and Southeast Asia. Beijing actively supports its companies in acquiring and developing assets related to critical materials, using a combination of financial tools and industrial policy instruments.

At least twenty-six Chinese state-backed financial institutions have granted a total of nearly $57 billion in loans to resource-rich countries in order to secure access to critical minerals.[62] These "subsidized loans," which are 25 percent or more below market rates, allow state-owned mining companies, an important tool in China's strategy for hegemony, to expand their portfolios through concessions and exploit countries much more easily than their Western competitors who depend on the market.

Major Chinese state-owned banks such as ICBC and Eximbank **provide low-interest loans and guarantees to finance mining projects abroad**.[63] Chinese financing largely benefits state-controlled mining companies (83% of financing), to the detriment of private actors (17%), reflecting the strategic importance attached to critical materials. Beijing also heavily favors financing exclusively Chinese projects (98%). This approach is a deliberate choice by the Chinese government and is one of the central components of its industrial strategy.[64]

[61] *Tom Daly, "Minmetals Confirms China Rare Earths Merger, Creating New Giant," Reuters, December 22, 2021, https://www.reuters.com/world/china/minmetals-unit-confirms-china-rare-earths-merger-2021-12-22/.*

[62] *EBrooke Escobar, Ammar A. Malik, Sheng Zhang, Katherine Walsh, Alexandra Joosse, Bradley C. Parks, Jacqueline Zimmerman, and Rory Fedorochko, "Power Playbook: Beijing's Bid to Secure Overseas Transition Minerals," AIDDATA, January 2025, https://docs.aiddata.org/reports/china-transition-minerals-2025/FULL_REPORT_Power_Playbook.pdf.*

[63] *Meeting with the Chinese Ministry of Industry, Beijing, December 2024.*

These investments often take the form of majority shareholdings or joint ventures that guarantee China extraction rights and long-term supply contracts. For example, in 2020, Chinese companies held stakes in fifteen of the nineteen cobalt mines in the Democratic Republic of Congo (the DRC accounts for around 70 percent of global cobalt production).[65] These investments cover a wide range of strategic minerals, including cobalt in the DRC, nickel in Indonesia, and lithium in South America. In 2023 alone, Chinese companies invested around $16 billion in mines abroad, a record high for the last decade.

As part of its strategy to secure access to critical materials, **China frequently combines resource agreements with infrastructure projects, particularly through the Belt and Road Initiative (BRI)**. It enters into long-term agreements with governments—such as in Argentina, Bolivia, and Zimbabwe—to develop local mining resources in exchange for secure access to raw materials. These partnerships generally involve Chinese state-owned enterprises and local actors, with financial support from Chinese development banks. **More than 75 percent of Chinese mining investments abroad are structured as joint ventures or special purpose vehicles, giving Chinese entities control over mineral extraction and processing**.[66]

[64] *Escobar et al., "Power Playbook: Beijing's Bid to Secure Overseas Transition Minerals."*
[65] *Gracelin Baskaran, "A Window of Opportunity to Build Critical Mineral Security in Africa," CSIS, 2023, https://www.csis.org/analysis/window-opportunity-build-critical-mineral-security-africa.*
[66] *Cecilia Jamasmie, "China Funnelled $57 Billion to Control the Critical Mineral Supply Chain," Mining.com, January 29, 2025, https://www.mining.com/china-funnelled-57-billion-to-control-critical-mineral-supply-chain/.*

Table 3 • Chinese government debt financing for five types of transition minerals under the BRI (2000-2021)

Minerals Concerned	Loans and Grants	Amount of Commitment (in Billions of US Dollars)	Mining Sites	Processing Sites	Host Country / Host Countries
Copper	81	47.3 $	38	2	17
Cobalt	25	15.9 $	11	1	5
Nickel	11	7.2 $	5	1	5
Lithium	3	3.2 $	1	0	1
Rare Earths	1	0.3 $	1	0	1

Source: Escobar et al.[67]

The country's foreign exchange reserves are also being mobilized to secure long-term supply contracts. At the national level, the government is providing **tax incentives and research support for the development of refining technologies that enable the economical processing of minerals, including those with low critical material content**.

Finally, the state also plays a central role in **building up strategic reserves** by purchasing critical materials in bulk when prices are low in order to protect itself against potential shortages.[68] This coherent mix of industrial and financial levers has enabled China to build a particularly resilient supply network.

[67] *Escobar et al., "Power Playbook: Beijing's Bid to Secure Overseas Transition Minerals."*
[68] *Zhou Weihuan, "China's Strategy on Critical Minerals Surpasses Geopolitics," World Economic Forum, November 19, 2024, https://www.weforum.org/stories/2024/11/china-critical-mineral-strategy-beyond-geopolitics/.*

Table 4 • Summary of China's industrial strategy for critical materials

Objective	Instruments Used
Help Chinese companies overcome barriers to market entry (significant initial investment).	• Subsidized loan program (making access to credit conditional on the provision of equity capital by the borrowing institutions in order to guarantee profitability).
Help Chinese companies expand their market share.	• Provision of aid and loans for infrastructure projects. • Use of JVs/SPVs involving loans. • Lend mainly to 100% Chinese companies. • Give priority to granting subsidized loans.
Ensure that production is maintained.	• Provision of additional loans to maintain production (OPEX subsidy). • Use of serial financing.
Limit risks related to loan repayment.	• Use of sovereign guarantees. • Collateralization of loans with the concession. • Syndication (several creditors to guarantee the loan).

3.2. A STRATEGY FOR ACQUIRING RESOURCES AND ACHIEVING OVERWHELMING DOMINANCE IN REFINING

For certain critical minerals, domestic production in China plays a key role. However, it is in refining that China exercises most of its dominance. It has massively developed its domestic processing capabilities, establishing itself as the world's leading center for processing critical materials. This position gives it the leverage it needs to control/influence the downstream value chains, including cleantech.

In addition, **China has significantly increased its participation in major lithium, cobalt, and manganese mining projects**, mainly located in Africa,[69] Indonesia,[70] and South America.[71] **Through its state-owned enterprises, it has acquired nearly half of the lithium**

mines available on the market since 2018, underscoring its ambition to maintain and expand its control over essential mineral resources at the global level.[72] In this regard, taking into account assets owned by Chinese companies, particularly in the Democratic Republic of Congo, Peru, and Zambia, **China now accounts for 65 percent of global production and 33 percent of production of cobalt-based intermediate materials**.[73] This **Chinese strategy also faces significant implementation challenges** and, in certain cases such as that of cobalt, investments that outpace demand growth, leading to overcapacity.[74]

The intensity of Chinese investment in Africa and Latin America is having growing geopolitical repercussions in these regions. In Africa, **China's "resources for infrastructure" strategy has made Beijing the preferred partner of many countries**. In the Democratic Republic of Congo, for example, around 70 percent of the mining sector is now reportedly financed by Chinese capital, raising concerns[75] about excessive dependence of local economies on China.[76]

[69] *Lauren Herzer Risi and Claire Doyle, "Examining China's Impact on Mining in Africa: Critiques and Credible Responses," Wilson Center, July 18, 2023, https://www.wilsoncenter.org/blog-post/examining-chinas-impact-mining-africa-critiques-and-credible-responses.*

[70] *Angela Tritto, "How Indonesia Used Chinese Industrial Investments to Turn Nickel into the New Gold," Carnegie Endowment for International Peace, April 11, 2023, https://carnegieendowment.org/2023/04/11/how-indonesia-used-chinese-industrial-investments-to-turn-nickel-into-new-gold-pub-89500.*

[71] *Sabina Nicholls, "China Goes After South America's New Treasure: Lithium," Diálogo Americas, July 29, 2023, https://dialogo-americas.com/articles/china-goes-after-south-americas-new-treasure-lithium-part-i/.*

[72] *FElouise Fowler, "China Buys Half of the Lithium Mines on the Market," Financial Review, August 23, 2023, https://www.afr.com/companies/mining/china-buys-half-of-the-lithium-mines-on-the-market-20230825-p5dzhc.*

[73] *Andrew L. Gulley, "One Hundred Years of Cobalt Production in the Democratic Republic of the Congo," Resources Policy 79 (2022): 103007, https://www.sciencedirect.com/science/article/pii/S0301420722004500.*

[74] *Harry Dempsey, "Cobalt Market Stung by Record Oversupply," Financial Times, March 1, 2024, https://www.ft.com/content/e6f131c8-4945-45f9-84ad-18eec58df0d9.*

[75] *"La RDC veut limiter la domination de la Chine dans les mines" [The DRC wants to limit China's dominance in the mines], TRT Afrika, January 15, 2025, https://trtafrika.com/fr/business/la-rdc-veut-limiter-la-domination-de-la-chine-dans-les-mines-18253917.*

[76] *Polly Bindman, "Weekly Data: China Seeks to Extend Its Critical Minerals Dominance with Overseas Investment Surge," Energy Monitor, August 21, 2023, https://www.energymonitor.ai/industry/weekly-data-china-seeks-to-extend-its-critical-minerals-dominance-with-overseas-investment-surge/#?cf-view.*

Faced with this situation, some African and Latin American leaders are beginning to demand better contractual terms or seeking Western investment to counterbalance Chinese influence. This competition for access to resources is becoming increasingly visible: The DRC recently expressed its openness to partnerships with the US to diversify its mining sector.[77] Nevertheless, China's ability to invest heavily in extractive projects, often with fewer environmental or governance requirements, gives it a significant comparative advantage in securing agreements. This imbalance is gradually reshaping diplomatic relations, with resource-producing countries needing to weigh the attractiveness of Chinese financing against the risk of long-term dependence.

Lithium • Chinese domination mainly through refining

- The lithium industry in China has experienced rapid growth. **In 2023, the country accounted for around a quarter (25%) of global lithium production, compared with just 13 percent a few years earlier**, thanks in particular to the intensive mining of lepidolite ore in provinces such as Jiangxi.[78]
- This domestic production, which comes from hard rock deposits and salt lakes, is supplemented by significant imports of raw ore from African countries, Australia, Chile, and Argentina.

[77] *Vivien Latour, "RDC-USA : un accord minier en échange d'un appui militaire?" [DRC-USA: a mining agreement in exchange for military support?] Le Point, March 20, 2025, https://www.lepoint.fr/afrique/rdc-usa-un-accord-minier-en-echange-d-un-appui-militaire-20-03-2025-2585257_3826.php?utm.*

[78] *Siyi Liu and Andrew Hayley, "China Lithium Boom Slows as Sagging Prices Batter High-Cost Miners," Reuters, March 14, 2024, https://www.reuters.com/markets/commodities/china-lithium-boom-slows-sagging-prices-batter-high-cost-miners-2024-03-13/.*

- However, China's real strength lies in lithium refining, i.e., converting ore into liquid chemicals that can be used in batteries. **China alone accounts for more than 60 percent of global lithium processing capacity**.[79]
- Large companies such as Tianqi[80] and Ganfeng[81] have built or expanded their refining plants, bringing the production capacity of lithium carbonate and hydroxide to around 1.8 million tons per year in 2023—nearly double the previous year.[82]
- This position **gives China a central role in supplying refined lithium to battery manufacturers, regardless of the initial source of the ore, as China depends on imports for 57 percent of its raw lithium supply**.[83]

[79] *International Energy Agency (IEA), "Energy Technology Perspectives 2023: Clean Energy Supply Chains Vulnerabilities," 2023, https://www.iea.org/reports/energy-technology-perspectives-2023/clean-energy-supply-chains-vulnerabilities#.*

[80] *Tianqi Lithium Corporation, 2023 Annual Report, March 28, 2024, https://static.cninfo.com.cn/finalpage/2024-03-28/1219430741.pdf.*

[81] *Gangfeng Lithium Group Co. Ltd., 2023 Annual Report, April 25, 2024, https://www1.hkexnews.hk/listedco/listconews/sehk/2024/0425/2024042503486_c.pdf.*

[82] *Lucy Tang, "FACTBOX: China Set to Raise African Lithium Output in 2024 with Diversification Plans," S&P Global Commodity Insights, April 12, 2024, https://www.spglobal.com/commodity-insights/en/news-research/latest-news/metals/041224-factbox-china-set-to-raise-african-lithium-output-in-2024-with-diversification-plans.*

[83] *Tang, "FACTBOX: China set to raise African lithium output in 2024 with diversification plans."*

Cobalt • An imported mineral

- China has very low domestic reserves of cobalt, but it has secured its supply by **controlling most production in the Democratic Republic of Congo (where 70 percent of the world's cobalt is mined) by owning or taking stakes in fifteen of the DRC's nineteen cobalt mines**.[84]
- This strategy enables China to produce **between 70 and 80 percent of the world's refined cobalt chemicals**. In 2022, its refineries produced around 140,000 tons of refined cobalt, **77 percent of the global total**.[85]
- China's refining capacity, concentrated mainly in the provinces of Zhejiang (the Dayushan Island refinery and the Zhenhai Refinery (Sinopec))[86] and Jiangsu (GEM),[87] far exceeds that of any other country.
- The strategy is similar to that for lithium, with an even greater dependence on imports of the resource: It consists of **importing raw cobalt (concentrated or intermediate) and re-exporting cobalt sulfate ready for use in cleantech**.
- In recent years, Chinese companies have significantly expanded their cobalt refining and recycling capacities to meet growing demand from EVs and other cleantech applications, despite price volatility.

[84] *Gracelin Baskaran, "A Window of Opportunity to Build Critical Mineral Security in Africa," CSIS, 2023, https://www.csis.org/analysis/window-opportunity-build-critical-mineral-security-africa.*
[85] *Institute for Energy Research (IER), "China Expected to Increase Control Over Global Lithium and Cobalt Supply," March 22, 2023, https://www.instituteforenergyresearch.org/international-issues/china-expected-to-increase-control-over-global-lithium-and-cobalt-supply/#.*
[86] *Enerdata, "CNPC starts operations for a 400 kb/d refinery complex in Guangdong (China)," June 13, 2023, https://www.enerdata.net/publications/daily-energy-news/cnpc-starts-operations-400-kbd-refinery-complex-guangdong-china.html.*
[87] *Zihao Li and Alexander Cook, "China's GEM Resumes Cobalt Production at Jiangsu Metal Refinery," Fastmarkets, February 28, 2023, https://www.fastmarkets.com/insights/chinas-gem-resumes-cobalt-production/.*

Graphite • Overwhelming dominance and an industrial priority

- China is the world's leading producer of natural graphite, accounting for around **75 percent of global production in 2024**,[88] with **major mines located in Heilongjiang and Inner Mongolia**.
- But it is in processing/refining that China's dominance is overwhelming: **more than 90 percent of global graphite refining—particularly battery-grade spherical graphite—is carried out in China.**
- In concrete terms, this means that **almost all anode materials for lithium-ion batteries come from Chinese refineries**[89] and that China also dominates other uses of graphite, for which demand is skyrocketing.
- **Beijing has made graphite an industrial priority, investing in improved purification techniques and scaling up synthetic graphite production**.[90]
- At the same time, Chinese companies have acquired stakes in graphite mines in Africa, particularly in Madagascar and Mozambique, in order to secure their supply of ore.

[88] *Statista, "Graphite Mine Production Top Countries 2019," March 10, 2025, https://www.statista.com/statistics/267366/world-graphite-production/.*

[89] *Ashitha Shivaprasad, Amy Lv, and Lewis Jackson, "Snapshot of China's Critical Mineral Export Controls," Reuters, June 4, 2025, https://www.reuters.com/world/china/chinas-curbs-exports-strategic-minerals-2025-02-04/.*

[90] *African Mining Week, "Surge in Global Investment Fuels Africa's Graphite Industry," September 23, 2024, https://african-miningweek.com/news/surge-global-investment-fuels-africas-graphite-industry.*

Rare Earths • A virtual monopoly

- China **accounts for around 60 percent of global rare earth mineral production**, mainly from **deposits located in Inner Mongolia and Sichuan**.[91]
- The country's dominance is even more pronounced in refining, where it **accounts for between 85 percent and 90 percent of global production of rare earth oxides and metals**.[92]
- This supremacy is based on **several decades of investment in rare earth separation technologies, as well as more flexible environmental standards that have long disadvantaged its competitors**.
- This strategy allows China to remain at the heart of the rare earth permanent magnet value chain, largely thanks to its massive refining capabilities and growing desire to restrict the export of its technological know-how in this field.
- In recent years, China has begun to **consolidate its rare earth industry**. In 2021, it merged three of the six major state-owned companies in the sector to create the **China Rare Earth Group**, which is now **responsible for around 70 percent of China's heavy rare earth production**.[93]

[91] *IEA, "Energy Technology Perspectives 2023: Clean Energy Supply Chains Vulnerabilities."*

[92] *Tom Daly, "Minmetals Confirms China Rare Earths Merger, Creating New Giant," Reuters, December 22, 2021, https://www.reuters.com/world/china/minmetals-unit-confirms-china-rare-earths-merger-2021-12-22/.*

[93] *Tan Feng, 1+1+1 > 3,* 中国稀土集团成立重塑产业发展新格局 *[1+1+1>3: The founding of China Rare Earth Group reshapes the industry's development landscape], Sohu.com, February 14, 2022, https://www.sohu.com/a/522791456_100082376.*

- At the same time, the government **sets annual quotas for extraction and refining in order to control supply and extend its control over a sector in which the country has a monopoly**. In 2023, these quotas were raised by around 20 percent, before a more modest increase of 4 percent was announced for 2024 in response to oversupply and in order to "stabilize prices."[94]

Nickel • A textbook case of China's industrial strategy

- Nickel mining production in China remains relatively modest, accounting for well **under 10 percent of global supply**.
- **China dominates nickel processing thanks to an aggressive investment strategy in Indonesia** and other producing countries. Chinese metallurgical groups such as Tsingshan Group **have pioneered the processing of Indonesian laterite ore** into nickel pig iron and nickel matte, supplying both the stainless steel and battery industries.[95]
- Today, **China accounts for about 68 percent of global nickel refining, largely through joint ventures in Indonesia's nickel industrial zones**.[96] These facilities produce intermediates **that are then shipped to China for refining into nickel sulfate, which is used in EV batteries**.

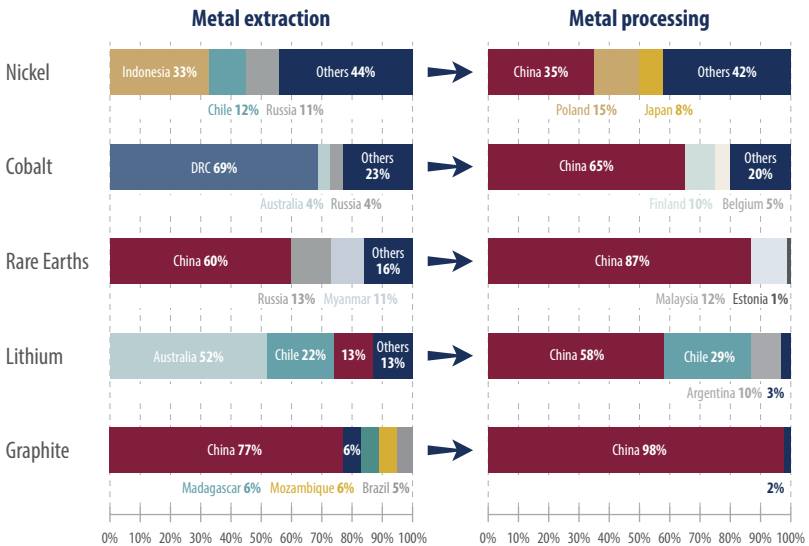
[94] *Amy Lv and Emily Chow, "China 2024 Rare Earths Quota Growth Set to Slow Amid Supply Glut," Mining.com, May 29, 2024, https://www.mining.com/web/chinas-2024-rare-earth-mining-output-smelting-and-separation-quotas-set-to-rise/.*

[95] *C4ADS, "Refining Power," February 5, 2025, https://c4ads.org/commentary/refining-power/.*

[96] *Bindman, "Weekly Data: China Seeks to Extend Its Critical Minerals Dominance with Overseas Investment Surge."*

- By developing **smelting capacity abroad and refining capacity at home**, China has consolidated its dominant position in the supply of battery-grade nickel, despite its dependence on ore imports. This **strategy, focused on controlling the processing stage**, mirrors the one implemented for other critical materials.

Figure 2 • Main global players in the extraction and refining of strategic metals (2024)



Source: International Energy Agency, Statista, IER.[97]

[97] *Statista. (2024). Leading graphite producing countries worldwide in 2024. Statista. https://www.statista.com/statistics/267366/world-graphite-production/. IER. (7 juillet 2023). Graphite, Dominated by China, Requires the Largest Production Increase of Any Battery Mineral. IER. https://www.instituteforenergyresearch.org/international-issues/graphite-dominated-by-china-requires-the-largest-production-increase-of-any-battery-mineral/.*

3.3. AN EXPORT STRATEGY WITH GEOPOLITICAL AIMS

China's policies on the export of critical materials have gradually evolved to protect the country's strategic interests and promote the development of high-value-added processing activities within its borders. Among the measures used are the introduction of **export controls, a quota and taxation policy**, and **incentive subsidies** aimed at keeping these materials within China. The objective is to retain in China the maximum possible amounts of critical materials necessary for clean technologies in order to stimulate domestic manufacturing production.

China has repeatedly demonstrated its willingness **to use its dominant position** in global supply chains for critical materials to **engage in economic coercion and advance its geopolitical objectives** *vis-à-vis* the United States, Japan, and Europe. With this in mind, the Chinese government has worked to consolidate its national system of control over the export of rare earths, critical materials, and related technologies, thereby strengthening its influence in this sector.[98]

[98] *Ministry of Commerce of the People's Republic of China and General Administration of Customs, "商务部 海关总署公告2023年第23号 关于对镓、锗相关物项实施出口管制的公告" [Announcement No. 23 (2023) of the Ministry of Commerce and General Administration of Customs: Announcement on the Implementation of Export Controls on Gallium and Germanium-Related Items], July 3, 2023, http://www.mofcom.gov.cn/article/zwgk/gkzcfb/202307/20230703419666.shtml; "China to Restrict Exports of Chipmaking Materials as US Mulls New Curbs," Reuters, July 4, 2023, https://www.reuters.com/markets/commodities/china-restrict-exports-chipmaking-materials-us-mulls-new-curbs-2023-07-04.*

On **October 20, 2023**, China's Ministry of Commerce announced the introduction of **export restrictions for certain graphite products**,[99] an essential component in the manufacture of batteries for EVs and many other cleantech products.[100] In addition, China has drastically restricted the export of key technologies for the production and processing of rare earths. On **December 21, 2023**, it announced a **ban on the export of rare earth magnet manufacturing technologies**, as well as **technologies for the production of rare earth metals and alloy materials**, adding them to its **"list of banned and restricted export technologies"**[101] and citing considerations relating to the protection of its national security.[102] These measures are in addition to the **existing ban on the export of rare earth extraction and separation technologies**, and appear to be a response to efforts by the USA and Japan to reduce their dependence on Chinese suppliers.[103]

[99] *Ministry of Commerce of the People's Republic of China and General Administration of Customs. "商务部 海关总署公告2023年第39号 关于优化调整石墨物项临时出口管制措施的公告" [Announcement No. 39 (2023) of the Ministry of Commerce and General Administration of Customs: Announcement on the Optimization and Adjustment of Temporary Export Control Measures for Graphite Items]. October 20, http://www.mofcom.gov.cn/article/zcfb/zcdwmy/202310/20231003447368.shtml.*

[100] *Siyi Liu and Dominique Patton, "China, World's Top Graphite Producer, Tightens Exports of Key Battery Material," Reuters, October 20, 2023, https://www.reuters.com/world/china/china-require-export-permits-some-graphite-products-dec-1-2023-10-20/.*

[101] *Ministry of Commerce of the People's Republic of China and Ministry of Science and Technology, "商务部 科技部公告2023年第57号 关于公布《中国禁止出口限制出口技术目录》的公告" [Announcement No. 57 (2023) of the Ministry of Commerce and Ministry of Science and Technology: Announcement on the Publication of the Catalogue of Technologies Prohibited and Restricted from Export of China], December 21, 2023, http://web.archive.org/web/20240527220806/http://www.mofcom.gov.cn/zfxxgk/article/gkml/202312/20231203462079.shtml.*

[102] *"China Bans Export of Rare Earth Processing Tech Over National Security," Voice of America News (Reuters), December 21, 2023, https://www.voanews.com/a/7407629.html.*

[103] *Edward White, "China Bans Export of Rare Earth Processing Technologies," Financial Times, December 21, 2023, https://www.ft.com/content/5b031db7-23dd-43d3-afe1-cef14817296f.*

Table 5 • Chinese measures targeting the export of critical materials

Policy Area	Key Measures	Objectives and Results
Export controls	• **Export license required for gallium and germanium** since July 2023; ban on exports to the United States.[104] • Since October 2023, **government approval has been required to export certain types of battery-grade graphite**. • **Introduction of export restrictions on certain graphite products** (October 2023). • **Ban on exports of advanced rare earth permanent magnet technologies** (end 2023).[105] • History of similar restrictions on rare earths: - In February 2025, China announced that it would restrict exports of five critical minerals: tungsten, tellurium, bismuth, indium, and molybdenum.[106] - In December 2024, China's Ministry of Commerce said it had banned exports of key minerals such as **gallium, germanium, and antimony** to the US, after the latter tightened export restrictions on chip-making equipment to China and sanctioned dozens of Chinese companies.[107] - In September 2010, China **restricted its exports of rare earths to Japan** by imposing additional duties, quotas, and administrative procedures, three months after a Chinese trawler collided with Japanese patrol boats near the Senkaku/Diaoyu Islands.[108]	• Encourage industrial transformation in China. • Respond to Western technological restrictions. • Maintain a technological advantage in critical value chains and avoid transferring know-how to competitors.

[104] *Ashitha Shivaprasad, Amy Lv, and Lewis Jackson, "Snapshot of China's Critical Mineral Export Controls," Reuters, June 4, 2025, https://www.reuters.com/world/china/chinas-curbs-exports-strategic-minerals-2025-02-04/.*

[105] *Ministry of Commerce of the People's Republic of China and General Administration of Customs, Announcement No. 39 (2023) on the Optimization and Adjustment of Temporary Export Control Measures for Graphite Items.*

[106] *Amy Lv, Lewis Jackson, and Ashitha Shivaprasad, "China Expands Key Mineral Export Controls after US Imposes Tariffs," Reuters, February 4, 2025, https://www.reuters.com/world/china/china-expands-critical-mineral-export-controls-after-us-imposes-tariffs-2025-02-04/.*

[107] *The Bureau of Industrial Security and Import and Export Controls (产业安全与进出口管制局; 安全与管制局) of the Chinese Ministry of Commerce (MOFCOM; 商务部). (2024, December 3). Ministry of Commerce Notice 2024 No. 46: Notice Concerning Strengthening Controls on Exports of Relevant Dual-Use Items to the United States | Center for Security and Emerging Technology. Center for Security and Emerging Technology. https://cset.georgetown.edu/publication/china-rare-earth-export-ban/.*

[108] *Shunseke Tabeta, "China Tightens Rare-Earth Export Curbs amid Tension with U.S.," Nikkei Asia, November 7, 2023, https://asia.nikkei.com/Spotlight/Supply-Chain/China-tightens-rare-earth-export-curbs-amid-tension-with-U.S.*

Policy Area	Key Measures	Objectives and Results
Quotas and taxation	• Quotas for the first period of 2024 for rare earth extraction and refining at 135,000 tons and 127,000 tons,[109] respectively, 12.5% and 10.4% higher than the quotas for the first period published in March 2023. • Replacement of direct export quotas in 2015 (following WTO disputes) with **controls via production quotas**. • **Higher export taxes on raw minerals**. • **Tax refunds for processed products** (e.g., chemical compounds for batteries, rather than raw materials).	• Indirectly regulate exports through production control. • Maximize local added value. • Attract industrial investment to China. • Reduce dependence on exports of unprocessed raw materials.
Grants and incentives	• Subsidies/tax breaks for cleantech, particularly EVs (extended until 2027), which massively supports demand for battery minerals.[110] • Direct support for battery and critical materials companies (e.g., more than $200 million to a single group in 2023).[111] • Credit insurance and public loan programs for overseas mining projects. • Aid for innovation, refining capacity development, and maintaining production during periods of low prices.	• Stimulate domestic demand for critical materials. • Strengthen international competitiveness. • Ensure continuity of supply despite price volatility. • Expand Chinese-controlled value chains globally.

China's dominant position in critical material supply chains gives it significant power over global markets. **By increasing production or imposing export restrictions, Beijing can cause surpluses or shortages, directly influencing commodity prices**. This strategy may stem from a government decision—sometimes indirectly—or from a coalition of public sector interest groups (particularly in the mining sector through public industry associations), with the aim of maintaining Chinese hegemony in these sectors.

[109] *Ministry of Industry and Information Technology and Ministry of Natural Resources of the People's Republic of China, "工业和信息化部 自然资源部关于下达2024年第一批稀土开采、冶炼分离总量控制指标的通知" [Notice of the Ministry of Industry and Information Technology and the Ministry of Natural Resources on Issuing the First Batch of 2024 Rare Earth Mining and Smelting Separation Total Control Quotas], February 2, 2024, https://www.miit.gov.cn/zwgk/zcwj/wjfb/tz/art/2024/art_46a7c7115e924bde8f118322341444d4.html.*

[110] *State Council of the People's Republic of China, "新能源汽车车辆购置税减免政策延长至2027年年底" [Extension of the New Energy Vehicle Purchase Tax Reduction and Exemption Policy to the End of 2027], June 21, 2023, https://www.gov.cn/zhengce/202306/content_6887717.htm.*

[111] *Scott Kennedy, "The Chinese EV Dilemma: Subsidized Yet Striking," CSIS, June 20, 2024, https://www.csis.org/blogs/trustee-china-hand/chinese-ev-dilemma-subsidized-yet-striking.*

For example, when China raised its export quotas for rare earths, prices fell; conversely, mere announcements of restrictions were enough to cause sharp increases.[112] **This ability to influence markets is an economic lever in its own right**. It also fuels persistent trade tensions: In 2012, the United States, Japan, and the EU, for example, filed a joint complaint with the World Trade Organization (WTO) against China's export restrictions.[113] For their part, Chinese officials denounce Western efforts at "decoupling" as discriminatory, warning that excluding China could disrupt global value chains.[114] The result is a fragile balance: Despite geopolitical rivalries, Chinese materials remain indispensable in the short term, including for Beijing's competitors, which limits their room for maneuver to challenge its hegemony and restrictions head-on without compromising their own industries.

4 The Japanese Strategy

Japan is probably the first country in the world to have adopted a strategy for self-reliance in critical minerals—first to support its semiconductor industry and more recently to support its battery and clean technology industries.

The 2010 maritime incident in which a Chinese fishing boat collided with two Japanese coast guard patrol boats near the Senkaku/Diaoyu Islands—territories under Japanese control but claimed by China—marked a turning point in Japan's management of critical materials.[115]

[112] *Jennifer Kary, "China's New Rare Earths Restrictions Now in Effect," MetalMiner, October 4, 2024, https://agmetalminer.com/2024/10/04/rare-earths-mmi-chinas-restrictions/.*
[113] *World Trade Organization (WTO), "Dispute Settlement: The Disputes — Chronological List of Dispute Cases," accessed June 21, 2025, https://www.wto.org/english/tratop_e/dispu_e/dispu_status_e.htm.*
[114] *Zhou, "China's Strategy on Critical Minerals Surpasses Geopolitics."*
[115] *Tabeta, "China Tightens Rare-Earth Export Curbs amid Tension with U.S."*

In response to this event, **China imposed restrictions on rare earth exports to Japan in September of the same year, introducing export duties and quotas**, as well as additional administrative procedures for managing these quotas.[116]

This situation **highlighted the vulnerability of Japanese supply chains to China**, prompting Japan to reconsider its strategy for securing critical materials—which the country lacks.[117] In response to these practices, Japan filed a complaint against China with the WTO in 2012. Following this dispute, the Japanese government published a **strategy to secure the supply of resources, identifying thirty strategic minerals**.[118]

4.1. A GROWING LEVEL OF SOPHISTICATION

Japan's strategy is based on the following **four main pillars:**[119]

- the **acquisition of mining interests in third countries** that are rich in materials;
- **recycling** from industrial processes and end-of-life products;
- the **development of substitute materials**;
- and the creation of **strategic stocks**.

[116] *Simon Evenett and Johannes Fritz, "Revisiting the China–Japan Rare Earths Dispute of 2010," CEPR, July 19, 2023, https://cepr.org/voxeu/columns/revisiting-china-japan-rare-earths-dispute-2010.*

[117] *Andrew DeWit, "Decarbonization and Critical Raw Materials: Some Issues for Japan," Rikkyo Economic Review 74, no. 4 (March 2012): 1–25, https://rikkyo.repo.nii.ac.jp/record/20914/files/AN00248808_74-4_06.pdf.*

[118] *Japanese Government, "Resources Security Strategy."*

[119] *Hiroki Hatayama and Kiyotaka Tahara, "Criticality Assessment of Metals for Japan's Resource Strategy," Materials Transactions 56, no. 2, (2015): 229–235, https://www.jstage.jst.go.jp/article/matertrans/56/2/56_M2014380/_pdf/-char/en.*

This plan has been implemented in particular through the **establishment of partnerships**[120] between the **Japan Organization for Metals and Energy Security (JOGMEC),** which is part of the Ministry of Economy, Trade and Industry (METI), and **various countries with critical resources such as Australia, Kazakhstan, Namibia, and Vietnam**.[121]

These efforts are part of Japan's energy policy shift **toward achieving the "3E+S" goals** (energy security, economic efficiency, and environmental protection)[122] following the update of its *Basic Energy Plan* in 2014[123] (last updated in February 2025).[124] JOGMEC has rolled out a wide range of support programs, from coordinating exploration projects and transferring mining interests to Japanese companies to equity investments, loan guarantees, and subsidies, with a view to creating an investment strategy aligned with the activities and interests of commercial companies and mining enterprises.[125]

[120] *Sophia Kalantzakos, China and the Geopolitics of Rare Earths (Oxford University Press, 2021).*

[121] *Anela Dokso, "JOGMEC and Western Australia Cooperation to Include Hydrogen," EnergyNews, December 2013, 2023, https://energynews.biz/jogmec-and-western-australia-cooperation-to-include-hydrogen; Robin Paxton, "Kazakh Nuclear Firm and Japan's Sumitomo Launch Rare Earth Plant," Reuters, November 2, 2012, https://www.reuters.com/article/rareearths-kazakhstan-japan-idINL5E8M25UR20121102; Ichiko Fuyuno, "Japan and Vietnam Join Forces to Exploit Rare Earth Elements," Scientific American, July 13, 2012, https://www.scientificamerican.com/article/japan-vietnam-join-forces-exploit-rare-earth-minerals; Nyasha Nyaungwa, "Japan Signs Deal with Namibia to Explore for Rare Earth Minerals," Reuters, August 8, 2023, https://www.reuters.com/markets/commodities/japan-signs-deal-with-namibia-explore-rare-earth-minerals-2023-08-08.*

[122] *Japan 2050 Low Carbon Navigator, "Japan's "3E+S" Energy Policy Objectives," n.d., https://www.en-2050-low-carbon-navi.jp/assets/onepage/3epluss.pdf.*

[123] *Japanese Ministry of Economy, Trade and Industry (METI), "4th Strategic Energy Plan Japan (2014)," Climate Policy Database, https://climatepolicydatabase.org/policies/4th-strategic-energy-plan.*

[124] *Japan Aims for Increased Use of Nuclear in Latest Energy Plan," World Nuclear News, February 18, 2025, https://www.world-nuclear-news.org/articles/japan-aims-for-increased-use-of-nuclear-in-latest-energy-plan.*

[125] *Japanese Government, "JOGMEC Action Plan," n.d., https://www.jogmec.go.jp/content/300372218.pdf.*

JOGMEC and the Impact of the IRA

JOGMEC has two main financial tools to support the security of critical value chains:

- **Direct subsidies** via the budget allocated by the Economic Security Promotion Act, intended to support projects deemed strategic for national security.
- **A capital investment fund** (equity investment) of ¥100 billion, covering up to **50 percent of CAPEX** for projects ranging from exploration to production, provided that a Japanese company is involved.

Eligibility criteria and strategic rationale:

- **Decision taken directly by METI**, based on a priority criterion:

➙ *Minerals must physically transit through Japan for refining or processing*.

- This requirement is part of an industrial strategy aimed at:
  - Developing **150 GWh** of battery production capacity for the domestic market;
  - Reaching **600 GWh** of capacity for export;
  - To achieve these objectives, annual critical material requirements are estimated at approximately 480,000 tons of lithium, 400,000 tons of nickel, 750,000 tons of graphite, 70,000 tons of manganese, and 60,000 tons of cobalt.[126]

[126] *International Energy Agency (IEA), "Policy on Initiatives for Ensuring Stable Supply of Critical Minerals," 2023, https://www.iea.org/policies/18004-policy-on-initiatives-for-ensuring-stable-supply-of-critical-minerals.*

However, **barely 10 percent of the investment fund had been mobilized by 2024**, due to eligibility conditions that companies considered too restrictive and the competing attractiveness of US incentives. In particular, many Japanese companies preferred to take advantage of the more generous subsidies offered by the **Inflation Reduction Act** for their investments in North America—credits that are, however, incompatible with Japan's requirement for physical transit through its national territory. In addition, like Korean companies, Japanese groups **are not considered "foreign entities of concern"** under the IRA regulations, making them fully eligible for these subsidies, unlike their Chinese competitors. This creates **a knock-on effect** in favor of Japanese and Korean projects in Canada, Mexico, and especially the United States, further limiting Tokyo's ability to relocate critical value chains to its own territory.

4.2. LINK BETWEEN CARBON NEUTRALITY BY 2050 AND SECURE ACCESS TO CRITICAL MATERIALS

Initiatives to secure critical materials **are part of a broader effort, starting in 2020, to achieve the goals of the Green Growth Strategy** (GGS), which **aims to reduce greenhouse gas emissions by 46 percent by 2030 and achieve carbon neutrality by 2050**.[127] In its new Nationally Determined Contribution (NDC), Japan has further committed to reducing its greenhouse gas emissions by 60 percent by 2035 compared to 2013, a target that exceeds its previous commitments.[128]

[127] *Japanese Ministry of Economy, Trade and Industry (METI), "Green Growth Strategy through Achieving Carbon Neutrality in 2050," October 17, 2022, https://www.meti.go.jp/english/policy/energy_environment/global_warming/ggs2050/index.html.*

[128] *"Japan Adjusts Its Energy Strategy by Focusing on Nuclear Power and Renewables," Energynews, 2025, https://energynews.pro/le-japon-ajuste-sa-strategie-energetique-en-misant-sur-le-nucleaire-et-les-renouvelables/.*

Japan's strategy is based on the recognition that achieving such targets will require the widespread deployment of clean energy technologies, which are highly dependent on critical materials. The Japanese government therefore considers this to be a major challenge for the country, which is seeking to move from an economic model that is currently based on carbon-intensive manufacturing, accounting for 20 percent of its economy, to one focused on the clean industries of the future.[129]

In response to global supply chain disruptions, the Japanese Cabinet also approved the seventh Strategic Energy Plan, marking a major revision of its energy policy in February 2025.[130] Among the major changes, the plan sets an ambitious target for renewable energy, aiming for a 40–50 percent share of the energy mix by 2040, positioning it as a dominant energy source. It also introduces a shift in nuclear policy, emphasizing the need to maximize its use as a complement to renewable energy. The plan aims to meet a dual imperative: ensuring energy supply stability while accelerating decarbonization, during a time when electricity demand is rising due to the digital transformation and the green transition.[131] One of the main objectives is to increase **the self-sufficiency rate for basic metals**, which stood at 37.7 percent in 2022 **to over 80 percent by 2030** and to continue to make progress in this direction.[132]

With the aim of linking these new energy goals to its critical minerals strategy, METI updated its strategy for securing critical materials in July 2020.[133] This strategy is based on support for mineral resource

[129] *Agency for Natural Resources and Energy, METI (Japan), "Outline of Strategic Energy Plan," October 2021, https://www.enecho.meti.go.jp/en/category/others/basic_plan/pdf/6th_outline.pdf.*

[130] *Japanese Ministry of Economy, Trade and Industry (METI), "Cabinet Decision on the Seventh Strategic Energy Plan," 2025, https://www.meti.go.jp/english/press/2025/0218_001.html.*

[131] *Edelman Global Advisory Japan, "Japan's Seventh Strategic Energy Plan," Edelman, January 7, 2025, https://www.edelmanglobaladvisory.com/japans-seventh-strategic-energy-plan.*

[132] *MJapanese Ministry of Economy, Trade and Industry (METI), 第7次エネルギー基本計画. ["Seventh Strategic Energy Plan], February 2025, https://www.enecho.meti.go.jp/category/others/basic_plan/pdf/20250218_01.pdf.*

development projects, **in particular through JOGMEC, which can finance up to 75 percent of equity investments in minerals deemed high risk and in the acquisition of upstream interests, particularly in smelting facilities for these resources**.[134] It also emphasizes the **importance of joint venture rare earth exploration projects overseas,** targeting mainly nickel and cobalt, and of strengthening emergency reserves of critical metals, with a **target of maintaining sixty days of standard domestic consumption for thirty-four critical metals in public stocks**, adjustable according to the political situation in producing countries.[135]

The strategy emphasizes the need to **strengthen international cooperation through JOGMEC** with countries involved in the mining, smelting, and manufacturing of rare metals, as well as cooperation between industry, government, and academia to enhance industrial and technological infrastructure related to rare metals.[136] This approach aims to ensure the resilience of supply chains while adhering to Japan's high environmental and social standards, thereby enabling Japan to continue diversifying its sources of critical materials and clean energy.

The Japanese government has also pledged to contribute $25 million to the WTO initiative on *Strengthening the Resilience and Inclusiveness of Supply Chains*, which aims to support the sustainable development of emerging countries and boost their participation in the mining industry.[137] The strategy also set a target—which has not been achieved—

[133] *METI, "Japan's New International Resource Strategy to Secure Rare Metals."*

[134] *Japan Organization for Metals and Energy Security (JOGMEC), "Promotion and Decarbonization of Mineral Resource Development," n.d., https://www.jogmec.go.jp/english/carbonneutral/carbonneutral_15_00007.html.*

[135] *Japan Organization for Metals and Energy Security (JOGMEC), "Geological Survey," n.d., https://www.jogmec.go.jp/english/stockpiling/metal_10_000001.html.*

[136] *Japan Organization for Metals and Energy Security (JOGMEC), "Technological Development," n.d., https://www.jogmec.go.jp/english/stockpiling/metal_10_000002.html.*

[137] *World Bank, "World Bank and Japan to Boost Mineral Investments and Jobs in Clean Energy," October 11, 2023, https://www.worldbank.org/en/news/press-release/2023/10/11/world-bank-and-japan-to-boost-mineral-investments-and-jobs.*

of reducing dependence on any single supplier country to less than 50 percent by 2025, marking an important step toward securing supplies of critical materials and clean energy.[138]

As part of its efforts to harmonize its various strategies, the Japanese government has committed to actively **promoting the development of fourteen strategic industrial sectors**. These sectors, which are prioritized for research and development (R&D) subsidies, **include offshore wind energy, solar photovoltaic energy, and batteries for EVs**.[139] In 2023, Japan clarified its strategy for transitioning to carbon neutrality by publishing its Green Transformation (GX) policy.[140] This policy reaffirms the commitment to the "3E+S" targets and directly links the achievement of carbon neutrality to the imperative of a stable and economical supply of critical materials with resilient value chains.

In this context, in **2022**, METI unveiled its **strategy for the battery sector**, aimed at **consolidating supply chains and increasing the competitiveness of the domestic industry**.[141] In September 2024, the Japanese government announced a package of up to $2.4 billion to support the development of domestic production of batteries for EVs. This investment is expected to increase annual production capacity by 50 percent, from 80 to 150 gigawatt hours (GWh).[142]

[138] *Ryosuke Hanafusa, "Japan to Pour Investment into Non-China Rare-Earth Projects," Nikkei Asia, February 15, 2020, https://asia.nikkei.com/Politics/International-relations/Japan-to-pour-investment-into-non-China-rare-earth-projects.*

[139] *Japanese Ministry of Economy, Trade, and Industry (METI), "Green Growth Strategy through Achieving Carbon Neutrality in 2050," 2020, https://www.meti.go.jp/english/policy/energy_environment/global_warming/ggs2050/index.html.*

[140] *Japanese Ministry of Economy, Trade, and Industry (METI), "The Basic Policy for the Realization of GX – A Roadmap for the Next 10 Years," February 2023, https://www.meti.go.jp/english/press/2023/pdf/0210_003a-2.pdf.*

[141] *Japanese Ministry of Economy, Trade, and Industry (METI), "Battery Industry Strategy: Interim Summary," April 22, 2022, https://www.meti.go.jp/english/report/pdf/0520_001a.pdf.*

[142] *Japanese Ministry of Economy, Trade, and Industry (METI), 蓄電池産業戦略の推進に向けて [Towards promoting the battery industry strategy]," March 12, 2025, https://www.meti.go.jp/policy/mono_info_service/joho/conference/battery_strategy2/shiryo03.pdf.*

In addition, Japan's wind and solar energy strategy, presented in March 2023, aims to significantly increase domestic production capacity, from 10 GW to 30–45 GW for offshore wind power by 2040**—with 60 percent local production—**and to reach between 150 GW for solar photovoltaic power by 2040.[143]

The implementation of these capabilities requires the intensive development of key technologies, particularly for floating wind turbines equipped with permanent magnet synchronous generators (PMSG—using NdFeB permanent magnets).[144] These components require intensive use of rare earths such as praseodymium, neodymium, dysprosium, and titanium. These initiatives reveal the vital importance of significantly increasing the volumes of the necessary critical materials and highlight the interdependence between Japan's energy strategies and the security of supplies of critical materials for achieving decarbonization targets.

4.3. DIVERSIFICATION AND INTERNATIONAL COOPERATION

Japan, a country with no significant reserves of critical materials on its territory, is heavily dependent on imports. This vulnerability is intensified by international competition for access to these strategic resources, in a context where demand often outpaces the establishment of new mining capacities.[145] Faced with rapidly growing demand for cobalt, lithium, and certain REEs, supply tensions are emerging, and structural

[143] *Japanese Ministry of Economy, Trade, and Industry (METI), "Introduction of Japan's Offshore Wind Policy," March 2023, https://www.renewable-ei.org/pdfdownload/activities/S4-2_METI_REvision2023_EN.pdf; Renewable Energy Institute, "Offshore Wind Power in Japan, Too," 2023, https://www.renewable-ei.org/en/activities/projects/osw_message_202304.php; Karah Howard, "Japan Sets Out Ambitious Energy Investment Plans in Move towards Sustainability," Pinsent Masons, March 11, 2025, https://www.pinsentmasons.com/out-law/news/japan-energy-investment-sustainability.*

[144] *Buljan, "New Partnership to Extract Rare Earth Magnets from Retired Wind Turbines for Use in New Ones."*

[145] *DeWit, "Decarbonization and Critical Raw Materials: Some Issues for Japan."*

imbalances are feared if supply does not evolve in a flexible manner. The Japanese government therefore considers it imperative to secure substantial international supplies of critical materials.[146]

In line with this approach, METI has stepped up its diversification initiatives, placing international cooperation on critical materials with strategic partners sharing similar objectives at the heart of its cleantech strategy in order to reduce China's control over supply chains. In December 2011, METI signed a Memorandum of Understanding (MoU) with India's Department of Atomic Energy, recognizing that India has the world's fifth-largest rare earth deposits,[147] with a view to strengthening bilateral cooperation in this area. Japan began importing uranium, thorium, lanthanum, cerium, and praseodymium in 2014.[148] In 2012, JOGMEC also strengthened its partnership with Vietnam by participating in the construction of a research center in Hanoi[149] to improve extraction and refining techniques for critical materials. It has also sought to develop its partnership with Kazakhstan. In November 2012, Sumitomo Corporation and the company Kazatomprom inaugurated a heavy rare earth production plant with an annual production capacity of 1,500 tons of rare earth oxides, mainly for the Japanese market.

More recently, in July 2023, an administrative arrangement was concluded between METI, the European Commission, and JOGMEC to strengthen **Europe–Japan cooperation in the field**.[150] This agreement,

[146] *LJiashou Li, Kun Peng, Peng Wang, …, Jing Meng, Wendong Wei, Qing Yang, "Critical Rare-Earth Elements Mismatch Global Wind-Power Ambitions," One Earth, July 24, 2020, https://www.cell.com/one-earth/pdf/S2590-3322(20)30298-0.pdf.*

[147] *DAndrew DeWit, Rajib Shaw, Saki Isetani, and Satoka Shimizu, "Indo-Japanese Collaboration on Energy Security and Critical Raw Materials (CRM)," Asia-Pacific Journal, November 15, 2022, https://apjjf.org/2022/18/Isetani-Shimizu-DeWit-Shaw.*

[148] *Japan to Import Rare Earth from India," Reuters, August 28, 2014, https://www.reuters.com/article/rare-earths-japan-india/japan-to-import-rare-earth-from-india-nikkei-idINKBN0GS04L20140828/.*

[149] *Fuyuno, "Japan and Vietnam Join Forces to Exploit Rare Earth Elements."*

[150] *European Commission, "Press Release: EU and Japan Strengthen Strategic Cooperation on Digital Issues and Critical Raw Material Supply Chains," July 13, 2023, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_3831.*

at the crossroads of industrial cooperation and economic intelligence, aims to strengthen bilateral relations and deepen the understanding of risks related to supply chains, technological innovation, and material circularity.

In addition, a **strategic partnership with the United States and the Biden administration was consolidated in March 2023** through the signing of a cooperation agreement on the extraction, smelting, and processing of critical minerals essential to battery production, covering cobalt, graphite, lithium, manganese, and nickel.[151] The agreement aims to strengthen the resilience of supply chains for critical materials with trusted allies and **offers Japanese companies the opportunity to benefit from tax credits for EVs if they meet the criteria set out in the Inflation Reduction Act (IRA)**.[152] This provision has not yet been called into question by the Trump administration, despite its desire to scrap much of the IRA.

Japan is also involved in the Mineral Security Partnership (MSP) initiated by the United States, which aims to improve cooperation to secure supply chains for critical minerals and reduce dependence on China.[153] India's accession to this partnership in 2023 follows a joint statement by the United States, Australia, Japan, and India within the framework of the Quad in March 2021, which announced the strengthening of joint projects and rare earth refining technologies to limit Chinese hegemony in this sector.[154]

[151] *Government of the United States of America and Government of Japan, Agreement between the Government of the United States of America and the Government of Japan on Strengthening Critical Minerals Supply Chains, March 28, 2023, https://ustr.gov/sites/default/files/2023-03/US%20Japan%20Critical%20Minerals%20Agreement%202023%2003%2028.pdf.*

[152] *KTakeo Kumagai and Megan Gordon, "Japan, US in Pact for Critical Minerals Supply Chain; Tokyo Expects EV Tax Benefits," S&P Global, March 28, 2023, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/energy-transition/032823-japan-us-in-pact-for-critical-minerals-supply-chain-tokyo-expects-ev-tax-benefits.*

[153] *U.S. Department of State, "Minerals Security Partnership," n.d., https://www.state.gov/minerals-security-partnership/.*

The Case of Rare Earth Elements

Japan's strategy to diversify its supply of strategic minerals has been **very successful**, with a **big drop in how much it relies on rare earth imports from China**, falling from 91.3 percent in 2008 to 58 percent in 2018.[155] This success has been achieved through the diversification and strengthening of partnerships with countries rich in critical materials, through investment in mining projects, human resource development, and industrial and technological infrastructure. In this context, collaboration between **JOGMEC and Australia** has proven successful, particularly through financial and technical support for the **"Lynas Rare Earths" project**, which now **accounts for one-third of Japan's rare earth needs and, at full capacity, could supply all of Japan's rare earth requirements**. JOGMEC has thus been a pillar in the success of this diversification strategy.[156]

[154] *"Critical Minerals June '23 Megatrend: Japan's Deal and India's Induction in Critical Minerals Alliance," Markets and Markets, June 26, 2023, https://www.marketsandmarkets.com/industry-news/Japan-Deal-And-India-Induction-In-Critical-Minerals-Alliance; Mark Ferguson, "Infographic: The Big Picture 2024 – Energy Transition Outlook," S&P Global, December 6, 2023, https://www.spglobal.com/marketintelligence/en/news-insights/blog/infographic-the-big-picture-2024-energy-transition-outlook.*

[155] *CSIS. (12 mai 2021). Does China Pose a Threat to Global Rare Earth Supply Chains? https://chinapower.csis.org/china-rare-earths/.*

[156] *MFumi Matsumoto, "US and Australia Team Up against China's Dominance in Rare Earths," Nikkei Asia, July 28, 2019, https://asia.nikkei.com/Business/Markets/Commodities/US-and-Australia-team-up-against-China-s-dominance-in-rare-earths.*

Table 6 • Dependence on Chinese rare earth imports (2023)

	Imports from China (metric tons)	Total imports (metric tons)	% of imports from China
EU	6,000	12,956	100% for heavy rare earth elements and 85% for light rare earth elements.[157]
United States	6,336	8,800	72%
South Korea	1,473	2,900	50.8%[158]
Japan	4,867	8,391	58%

Table created using data from Eurostat,[159] the U.S. Geological Survey,[160] Business Korea,[161] the World Bank[162] and New Security Beat.[163]

[157] *While China is officially listed as the country of origin for 46.3% of rare earth imports by weight, this figure likely underestimates China's actual role in the supply chain. A significant share of rare earth imports attributed to other countries—most notably Malaysia (19.9%) and Russia (28.4%)—may in fact originate from China. In Malaysia's case, much of the material is processed at the Lynas plant using Chinese or Australian-sourced feedstock, and subsequently re-exported. Russia, meanwhile, depends heavily on Chinese refining capacity for rare earth separation. As a result, the proportion of rare earth elements that are in practice sourced from or refined in China is likely far higher than customs declarations alone suggest.*

[158] *This figure may underestimate China's actual influence in the supply chain. A significant share of the rare earth elements imported from countries like Japan (which accounted for 40.2% in 2020) may in fact originate from China, given its dominant position in upstream extraction and Japan's specialization in high-purity refining and processing. In such cases, Chinese raw materials are exported to Japan for processing and then re-exported to South Korea, appearing in trade data as Japanese in origin. This transnational processing chain complicates the interpretation of national shares in import statistics.*

[159] *Eurostat. "Imports of rare earth elements saw a 30% drop in 2024," 2025, @EU_Eurostat; Eurostat. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20250409-1, Grohol, M., & Veeh, C. "Study on the critical raw materials for the EU 2023: final report," (2023). In Publications Office of the European Union. Publications Office of the European Union. https://op.europa.eu/en/publication-detail/-/publication/57318397-fdd4-11ed-a05c-01aa75ed.*

[160] *U.S. Geological Survey, "Mineral Commodity Summaries 2024," 2024, https://pubs.usgs.gov/periodicals/mcs2024/mcs2024-rare-earths.pdf.*

[161] *Min-hee, J. "South Korea on Alert as China Tightens Grip on Rare Earth Exports. Businesskorea," 2025. https://www.businesskorea.co.kr/news/articleView.html?idxno=239279.*

Despite these successes, current interactions between Japan and Africa, a continent rich in REEs and CRMs, remain limited, with investment considered insufficient.[164] To move forward with "sovereign decarbonization," it will likely be imperative for Japan to intensify mutually beneficial investments with various countries in the Global South, notably Zambia and the Democratic Republic of Congo (for cobalt), Guinea (for aluminum), Zimbabwe (for platinum), and Rwanda (for tungsten).

Japan's broader industrial strategy—aimed at avoiding excessive dependence on China in the downstream segments of cleantech value chains—remains closely linked to domestic technology deployment dynamics:

- EVs remain a small minority compared to domestic hybrids (dominated by Toyota and Honda), with comparatively low deployment of charging stations.
- Photovoltaic production is imported from China but also carried out locally, supported by high tariffs on Chinese imports and **increasingly sophisticated non-tariff barriers designed to favor niche technologies—which are more efficient but also more expensive (e.g., perovskite solar cells)—where Japanese players retain a technological advantage**.
- The wind power sector, still in its infancy, is mainly supporting the rise of the domestic industry thanks to local content requirements.

[162] *World Bank, "China Compounds, Inorganic or Organic, of Rare-Earth Exports by Country in 2023," 2023, https://wits.worldbank.org/trade/comtrade/en/country/CHN/year/2023/tradeflow/Exports/partner/ALL/product/284690.*

[163] *Nayan Seth, "How to Diversify Mineral Supply Chains – A Japanese Agency has Lessons for All," New Security Beat, 2024, https://www.newsecuritybeat.org/2024/08/how-to-diversify-mineral-supply-chains-a-japanese-agency-has-lessons-for-all/.*

[164] *Harry Dempsey, "Japan Inc's Frustrations in Africa Demand a New Approach," Tokyo Review, September 3, 2019, https://tokyoreview.net/2019/09/japan-frustration-africa/.*

- Electrolysis is a strategic industrial stronghold, with certain Japanese companies occupying dominant positions in several segments of the value chain.

4.4. SOME SUCCESSES BUT STILL MANY CHALLENGES AHEAD

JOGMEC is currently supporting initiatives to explore mineral resources on the seabed, using technologies that are **controversial due to their potentially catastrophic impact on the aquatic environment**.[165] Initial explorations of hydrothermal deposits in Japan's exclusive economic zone (EEZ) have produced results that the government considers promising, opening up the prospect of future exploitation.[166] This approach is now also strongly supported by the Trump administration and could eventually open up a new geopolitical front over the ownership of the best deposits.[167]

The Japanese government's financial commitment to businesses has played a crucial role in developing a significant comparative technological advantage, particularly in the field of nanotechnology. This advance could enable Japan to replace certain critical metals, such as vanadium, with more abundant materials.[168] However, despite initiatives to reduce dependence on imports of critical minerals from China, Japan remains significantly vulnerable to supply chain disruptions. This vulnerability is particularly pronounced in the graphite sector, where

[165] *Oliver Ashford, Jonathan Baines, Melissa Barbanell, and Ke Wang, "What We Know About Deep-Sea Mining – And What We Don't," World Resources Institute, February 23, 2024, https://www.wri.org/insights/deep-sea-mining-explained.*

[166] *Tatsuo Nozaki et al., "Rapid Growth of Mineral Deposits at Artificial Seafloor Hydrothermal Vents," Scientific Reports, 6, 22163 (2016), https://doi.org/10.1038/srep22163.*

[167] *Graceline Baskaran and Meredith Schwartz, "Trump's Deep-Sea Mining Executive Order: The Race for Critical Minerals Enters Uncharted Waters," CSIS, 2025, https://www.csis.org/analysis/trumps-deep-sea-mining-executive-order-race-critical-minerals-enters-uncharted-waters.*

[168] *L. Reijnders, "Conserving Functionality of Relatively Rare Metals Associated with Steel Life Cycles: A Review," Journal of Cleaner Production 131 (September 10, 2016): 76–96, https://www.sciencedirect.com/science/article/abs/pii/S0959652616305376.*

Japan's imports are 90 percent dependent on China, despite graphite being a vital component in decarbonization processes.[169]

Although Japan has established a stockpiling system for strategic resources, **it still lacks a flexible stockpiling system that is fully integrated with domestic industry**. In addition, the country faces an **uncompetitive mining industry**, which limits the availability of the knowledge and industrial infrastructure necessary to engage in public discussions on the exploitation of CRMs.[170]

The gap between energy transition targets and uncertainty surrounding demand for critical materials is currently preventing the development of sufficient industrial expertise in mining to offset dependencies on Chinese extraction and refining processes. This situation is all the more critical given that China, which has developed advanced technological expertise in the processing and refining of rare earths through solvent extraction, regularly announces restrictions and bans on the export of technologies essential to the manufacture of rare earth magnets and the production of metals and alloys based on these elements.[171]

[169] *Wataru Miyamoto, Shoki Kosai, and Seiji Hashimoto, "Evaluating Metal Criticality for Low-Carbon Power Generation Technologies in Japan," Minerals 9, no. 2 (2019): 95, https://www.mdpi.com/2075-163X/9/2/95.*

[170] *Arnold Tukker, "Resilient Supply of Critical Commodities by 2030 to the EU and Japan, South Korea, China, and Taiwan," HCSS, October 2023, https://hcss.nl/report/resilient-supply-of-critical-commodities-by-2030-to-the-eu-and-japan-south-korea-china-and-taiwan/.*

[171] *Shunsuke Tabeta, "China Bans Exports of Rare-Earth Magnet Technologies," Nikkei Asia, December 21, 2023, https://asia.nikkei.com/Economy/Trade/China-bans-exports-of-rare-earth-magnet-technologies; Reuters, "China Bans Export of Rare Earth Processing Technologies," The Hindu, December 22, 2023, https://www.thehindu.com/news/international/china-bans-export-of-rare-earth-processing-technologies/article67667281.ece; Shashwat Sankranti, "China Tightens Grip on Rare Earths Industry, Bans Key Technology Exports for National Security," WION, December 22, 2023, https://www.wionews.com/business-economy/china-tightens-grip-on-rare-earths-industry-bans-key-technology-exports-for-national-security-672401.*

5 The Korean Strategy

While there are certain similarities with Japan, **South Korea** is, given the nature of its industry, even more vulnerable to supply chain disruptions, considering that it is **95 percent dependent on imports of critical minerals**.[172] This dependence is particularly evident in its **trade relations with China, which accounts for 33.4 percent of its industrial raw materials**, a percentage higher than the G7 average.[173] This situation therefore exposes South Korea to increased risks in the event of restrictions or bans on Chinese exports of rare earths and critical materials.

In 2023, **Korea had critical levels of dependence on China** for the supply of **natural graphite (94%), rare earths for permanent magnets (86%), and ternary battery precursors (97%)**.[174] This dependence is more concerning for Korea than for Japan, given the **Korean economy's focus on carbon-intensive industries** and manufactured exports.

5.1. THE MOON ADMINISTRATION AS A TIMID PIONEER

Under the **Moon administration** (2017–2022), South Korea initiated ambitious efforts to **strengthen cooperation with nations rich in strategic resources**. The launch of the **Green New Deal** in 2020 marked a turning point, with the government committing to intensify its

[172] *Song Kyung-jin, "Securing Critical Mineral Supply Chains," The Korea Times, June 13, 2023, https://www.koreatimes.co.kr/www/opinion/2024/02/638_352816.html.*

[173] *Lee Jae Young, "US-China Supply Chain Competition and Korea's Economic Security Diplomacy," Kinu.or.kr., 2015, https://repo.kinu.or.kr/handle/2015.oak/13421.*

[174] *Nina Hu, "South Korea to Reduce Dependence on Other Countries for Key Materials by 2030," Fastmarkets, December 15, 2023, https://www.fastmarkets.com/insights/south-korea-to-reduce-dependence-on-other-countries-for-key-materials-by-2030; Caroline Messecar, "Rare Earths Prices and News," Fastmarkets, n.d., https://www.fastmarkets.com/metals-and-mining/rare-earths-prices-and-news.*

climate action and accelerate the transition to a green economy.[175] This has resulted in significant **investments in decentralized and low-carbon energy**, with a particular focus on the development of **solar, wind, and hydroelectric power**. However, expanding domestic capacity in these areas **requires a substantial increase to secure the supply of critical materials**.

Faced with supply chain disruptions exacerbated by the pandemic and increased competition for access to strategic resources, against the backdrop of Sino-US rivalry, the Korean government has actively **sought new sources of supply**. It has initiated **diplomatic missions to establish strategic cooperations with third countries**, notably by leveraging the structure of the US-led **Mineral Security Partnership**.[176] This approach aims to **encourage Korean companies to invest internationally in strategic mining projects**, particularly in Australia and Canada. In December 2020, to strengthen its ties with **Australia**, **South Korea** signed a **MoU** focused on **cooperation in essential mineral supply chains**.[177] This partnership was expanded in December 2021 with a **second agreement** focused on **cooperation in critical mineral supply chains**.

[175] *Ministry of Economy and Finance (Korea), "Korea's Green New Deal: Towards a Low-carbon Society," 2020, https://www.greenclimate.fund/sites/default/files/event/koreas-green-new-deal-moef-international-conference-green-new-deal.pdf.*

[176] *Hu, "South Korea to Reduce Dependence on Other Countries for Key Materials by 2030."*

[177] *Department of Foreign Affairs and Trade (Australia), "Partnering with Korea on Clean Energy Technology and Critical Minerals," February 2022, https://www.dfat.gov.au/about-us/publications/trade-investment/business-envoy/business-envoy-february-2022/partnering-korea-clean-energy-technology-and-critical-minerals.*

5.2. THE YOON ADMINISTRATION'S CHANGE OF COURSE ON ENERGY TRANSITION

The **conservative administration of Yoon Suk-yeol (March 2022–removed from office in December 2024) responded** to supply chain disruptions triggered by the war in Ukraine by drastically accelerating the implementation of public policies aimed at ensuring the country's energy security.[178] **Applying the concept of economic security to the field of energy and critical minerals**, the Yoon administration **sought to diversify its sources of supply and strengthen stockpiling and energy efficiency** while accelerating decarbonization with a major shift toward a strong return to nuclear power in the Korean energy mix and a move away from renewable energies.

As part of the **national framework plan for carbon neutrality and green growth**[179] published in April 2023, the government **revised its renewable energy targets**, reducing the share of renewables in the South Korean energy mix to **30 percent by 2030, compared with the 34 percent envisaged under the previous administration**, in order to prioritize the development of nuclear power.[180] While the Moon administration had envisaged a gradual reduction in dependence on nuclear power, in July 2022, the Ministry of Economy, Trade and Industry revealed its intention to **maintain a significant share of nuclear power—at 30 percent—in the energy mix** and to implement the development of a small modular reactor (SMR) by 2030.[181] This shift back to nuclear power, while marking a setback in the expansion of

[178] *James Bowen, "The Raw Materials of Economic Security: South Korea's Evolving Energy and Critical Minerals Policies in an Era of Disruption," Korea Economic Institute of America, November 2023, https://keia.org/wp-content/uploads/2024/01/Korea-Policy-V1-I3_James-Bowen.pdf.*

[179] *2050 Carbon Neutrality and Green Growth Commission (South Korea), "Carbon Neutrality and Green Growth National Strategy and 1st National Basic Plan," 2023, https://www.2050cnc.go.kr/base/board/read?boardManagementNo=2&boardNo=1462&menuLevel=2&menuNo=16.*

[180] *Ministry of Trade, Industry and Energy (South Korea), "Korea's Renewable Energy 3020 Plan," October 2018, https://gggi.org/site/assets/uploads/2018/10/Presentation-by-Mr.-Kyung-ho-Lee-Director-of-the-New-and-Renewable-Energy-Policy-Division-MOTIE.pdf.*

[181] *Kim & Chang, "New Administration's Energy Policies," May 20, 2022, https://www.kimchang.com/en/insights/detail.kc?sch_section=4&idx=25101.*

renewable energy, **has not diminished the need—as stated by the Moon administration—to secure substantial supplies of critical materials** to achieve the planned expansion of domestic solar and wind power generation capacity.

In February 2023, the Korean government unveiled its ***Strategy for securing critical minerals supply.***[182] This strategy aims to **reduce the country's dependence on imports of lithium, cobalt, and graphite from any single supplier from 80 percent to 50 percent by 2030** and to **increase the recycling rate of these critical minerals from 2 percent to 20 percent for thirty-three essential minerals**, ten of which are specifically identified as strategic.[183] The **first pillar of this strategy** builds on the efforts of the Center for Economic Security and Foreign Affairs, which has established an early warning system to assess and mitigate the risk of supply chain disruptions by **monitoring the supply of these thirty-three critical minerals**.[184]

5.3. THE CASE OF THE KOREAN BATTERY INDUSTRY

The **second part of the strategy** is supported by the introduction of **incentives to stimulate the Korean battery industry**, such as investment **tax credits, expanded credit lines, interest rate reductions, and lower insurance premiums for domestic companies**.[185] In addition, **new safety regulations concerning the removal, storage, and**

[182] *International Energy Agency (IEA), "The Strategy for Securing Reliable Critical Minerals Supply," December 8, 2023, https://www.iea.org/policies/17942-the-strategy-for-securing-reliable-critical-minerals-supply.*

[183] *Oh Seok-min, "S. Korea Designates 10 'Strategic' Minerals, Introduces Early Warning System for Stable Supplies," Yonhap, February 27, 2023, https://en.yna.co.kr/view/AEN20230227003300320.*

[184] *"Economic Security and Diplomacy Center Opens; IPEF Response Team to Launch," Herald Business, May 30, 2022, http://news.heraldcorp.com/military/view.php?ud=20220530000685.*

[185] *MKyung Mi, "South Korea Unveils $29 Billion Financial Boost for Battery Industry Over 5 Years," KoreaTechToday, December 13, 2023, https://www.koreatechtoday.com/south-korea-unveils-29-billion-financial-boost-for-battery-industry-over-5-years/.*

transportation of used batteries have been established, aiming to secure a **sufficient volume of minerals to produce the equivalent of 170,000 EVs** while establishing domestic supply chains for lithium.[186]

These initiatives are aimed in particular at **strengthening the competitiveness of the domestic industry in the EVs battery materials sector**, an area in which the country already excels. Companies such as LG, SK, and Samsung have established themselves as global leaders, **capturing nearly 20 percent of global market share and positioning South Korea as the world's second-largest producer**, just behind China, particularly in the NMC battery segment.[187] However, the viability and resilience of the Korean battery sector remain **hampered by a very high degree of dependence on imports of critical minerals from China**.

Aware of this situation and the strategic importance of this economic position for the future, the Yoon administration took several measures concerning the battery sector. In close collaboration with the private sector, **the government plans to invest ₩20 trillion ($14.6 billion) in the EV sector** to ensure access to advanced battery technologies by 2030.[188]

In this context, the Korean chemical company **LG Chem** plans to build a **nickel-cobalt-manganese precursor production plant** in Saemangeum, with a target production of 332,000 tons by 2028. **LG Energy Solution** has also announced the establishment of a **manufacturing facility in Ochang for 4,680 cylindrical batteries**, with the **goal of developing the first lithium-iron-phosphate solid-state batteries by 2025**.

[186] *Nina Hu, "South Korea to Invest $29 Billion in Domestic Battery Materials Industry," Fastmarkets, December 13, 2023, https://www.fastmarkets.com/insights/south-korea-to-invest-29-billion-in-domestic-battery-materials-industry/.*

[187] *José Pontes, "Top 10 Battery Producers in the World," CleanTechnica, September 18, 2023, https://cleantechnica.com/2023/09/18/top-battery-producers-in-the-world/.*

[188] *Shin Ha-Nee, "Korea to Commit $15 Billion to EV Battery Making," Korea JoongAng Daily, April 20, 2023, https://koreajoongangdaily.joins.com/2023/04/20/business/industry/Korea-Battery-EV-Battery/20230420173022606.html.*

In addition, alongside the recycling policy, a **strategy has been put in place to increase emergency reserves of rare metals** such as lithium and cobalt. This will facilitate the development of the domestic battery materials production and/or recycling industry, with an **announced investment of $29 billion**.[189] **LG Energy Solution** aims to **quadruple its domestic cathode production capacity** in order to create a nationally integrated system and achieve a **100 percent recycling rate for its EV batteries by 2030**.[190]

5.4. THE EMERGENCE OF COOPERATION WITH COUNTRIES RICH IN CRITICAL RESOURCES

As part of its strategy to secure critical minerals, the Yoon administration has actively worked to **strengthen ties with resource-rich countries**.[191] The government has strongly **encouraged Korean companies to diversify their supply sources** by strengthening cooperation with partners in **Southeast Asia**, **Central Asia**, **South America**, and **Canada**.[192]

In April 2023, negotiations were initiated with **Ecuador** to establish an **initial bilateral trade agreement focused primarily on mining cooperation**. In May 2023, Korea established several **agreements with Canada**[194] to benefit from **financial support for investments in**

[189] *"Battery Raw Materials," Fastmarkets, n.d., https://www.fastmarkets.com/metals-and-mining/battery-raw-materials/.*
[190] *Shin, "Korea to Commit $15 Billion to EV Battery Making."*
[191] *International Energy Agency (IEA), "The Strategy for Securing Reliable Critical Minerals Supply," December 8, 2023, https://www.iea.org/policies/17942-the-strategy-for-securing-reliable-critical-minerals-supply.*
[192] *Bowen, "The Raw Materials of Economic Security: South Korea's Evolving Energy and Critical Minerals Policies in an Era of Disruption."*
[193] *Korea, Ecuador Begin New Round of Talks for Bilateral Trade Deal," The Korea Times, April 4, 2023, https://www.koreatimes.co.kr/foreignaffairs/20230403/korea-ecuador-begin-new-round-of-talks-for-bilateral-trade-deal.*

manufacturing facilities in accordance with the provisions of the US Inflation Reduction Act (IRA) and involving Korean companies such as LG Energy Solution and Canadian companies Avalon, Electra, and Snow Lake. This initiative was completed at the end of **January 2024** with the **publication of a "prospectus" detailing fifty-two investment projects in critical minerals**, targeting **Australia**, **Canada**, and **Mongolia** in particular.[195]

The example of Mongolia is characteristic of the Korean strategy. In **February 2023, a MoU was signed with Mongolia**,[196] marking an important step in bilateral cooperation on rare earths and copper. This agreement aims to **strengthen joint projects and technological cooperation, as well as to facilitate information exchange**. In June 2023, Korea also initiated a **trilateral dialogue with the United States**, focused on cooperation on critical minerals.[197]

South Korea has nevertheless **faced greater challenges than Japan** in establishing strong strategic partnerships with countries rich in critical minerals, mainly due to the **relatively recent nature of its economic diplomacy**. This dynamic began to change with the creation of the **Korea Mine Rehabilitation and Mineral Resources Corporation (KOMIR) in August 2021**, an entity dedicated to **encouraging the development of international mining projects by Korean companies** while providing support to reduce the associated risks.[198] KOMIR

[194] *International Energy Agency (IEA), "Critical Minerals Supply Chain Cooperation MOUs," 2022, https://www.iea.org/policies/16674-critical-minerals-supply-chain-cooperation-mous.*

[195] *Melanie Burton and Katya Golubkova, "Australia's Resources Minister Seeks Investment from S. Korea, Japan," Reuters, January 29, 2024, https://www.reuters.com/markets/commodities/australias-resources-minister-seeks-investment-skorea-japan-2024-01-29/.*

[196] *Josh Smith, "Mongolian PM Sees South Korea as Customer and Gateway for Rare Metals Trade," Reuters, February 17, 2023, https://www.reuters.com/markets/commodities/mongolian-pm-sees-south-korea-customer-gateway-rare-metals-trade-2023-02-17/.*

[197] *U.S. Department of State, "The Launch of the United States–Mongolia–Republic of Korea Trilateral Meeting," June 2, 2023, https://www.state.gov/the-launch-of-the-united-states-mongolia-republic-of-korea-trilateral-meeting/.*

[198] *Bowen, "The Raw Materials of Economic Security: South Korea's Evolving Energy and Critical Minerals Policies in an Era of Disruption."*

has focused on **forging robust diplomatic ties** to improve the system for gathering information on potential supply chain disruptions and build close relationships with the local mining industry.[199]

KOMIR vs. JOGMEC

In this regard, **KOMIR performs a function similar to that of JOGMEC, but without comparable financial and institutional resources**. In Japan, **JOGMEC has had full authority over the storage system**[200] since 2020 and is also responsible for a **wide range of support programs for the development of exploration projects**, the transfer of mining interests to Japanese companies, the acquisition of shares, and loan guarantees. By comparison, in Korea, **KOMIR is still struggling to meet the government's target of ensuring sixty days of standard domestic consumption of critical minerals**. This is mainly due to a lack of coordination between the dual stock management systems[201] of the Korean Public Procurement Service (PPS),[202] which is responsible for stabilizing the prices of critical materials, and KOMIR—further complicating the task of building up inventories to meet industry demand. As a result, in the first half of 2023, national lithium stocks did not exceed six days of consumption, and cobalt stocks did not exceed thirteen days—statistics that are all the more worrying given that these elements

[199] *Song, "Securing Critical Mineral Supply Chains."*
[200] *METI, "Japan's New International Resource Strategy to Secure Rare Metals."*
[201] *Emmanuel Hache, Sami Ramdani, Frédéric Jeannin, and David Amsellem, "Les stocks stratégiques de métaux critiques" [Strategic Stocks of Critical Metals], Observatoire de la sécurité des flux et des matières énergétiques (OSFME), IRIS, October 2023, https://www.iris-france.org/wp-content/uploads/2023/10/Rapport15_OSFME.pdf.*
[202] *Organisation for Economic Co-operation and Development (OECD), "The Korean Public Procurement Service," January 15, 2016, https://www.oecd-ilibrary.org/governance/the-korean-public-procurement-service_9789264249431-en.*

are essential for the production of electric batteries, of which Korea is the world's second largest manufacturer.[203] Conversely, JOGMEC has committed since 2020 to ensuring only sixty days of domestic consumption for national stocks,[204] not including industry stocks. It is even considering setting a higher target of 180 days for minerals with high geopolitical risk.[205] In addition to the overlap between the missions of the PPS and KOMIR, there is the problem of KOMIR's lack of funding to support its stockpiling missions, despite a 30 percent increase in the budget allocated to public stocks of essential minerals in 2024.[206] **The gap in resources is clearly visible when comparing Japan's** allocated budgets. While **JOGMEC had a budget of $16.44 billion in 2024,[207] KOMIR had a budget of only $170 million for the same year**.[208]

[203] *"S. Korea Targets Stockpiling 100 Days' Worth of Rare Metals," The Dong-A Ilbo, July 25, 2023, https://www.donga.com/en/east/article/all/20230725/4311880/1.*

[204] *Japan Organization for Metals and Energy Security (JOGMEC), "JOGMEC REPORT: Integrated Report 2024," 2024, https://www.jogmec.go.jp/content/300374576.pdf.*

[205] *Daniel Pereira, "Japan Challenges China with Rare Earth Metal Extraction from Seabed by 2024," ODA Loop, May 14, 2023, https://www.oodaloop.com/ooda-original/2023/05/14/japan-challenges-china-with-rare-earth-metal-extraction-from-seabed-by-2024/.*

[206] *"Fitch Assigns Korea Mine Rehabilitation and Mineral Resources First-Time 'A+' Rating," Fitch Ratings, March 24, 2023, https://www.fitchratings.com/research/international-public-finance/fitch-assigns-korea-mine-rehabilitation-mineral-resources-first-time-a-rating-outlook-stable-24-03-2023.*

[207] *JOGMEC, "JOGMEC REPORT: Integrated Report 2024."*

[208] *"Korea Mine Rehabilitation and Mineral Resources Corp. Upgraded To 'A+' On Expanding Policy Role," S&P Global, November 23, 2023, https://disclosure.spglobal.com/ratings/es/regulatory/article/-/view/type/HTML/id/3093784.*

The relationship with Australia, which is emblematic of Japan's success, is also different for South Korea. The initiatives launched under the Moon administration to increase imports of critical minerals from Australia were stepped up by KOMIR from 2022. In particular, it committed $3 million to a new lithium exploration project in Australia,[209] which is seen as a potential source of supply for LG Energy Solution. Bilateral cooperation between Korea and Australia remains modest compared to the strategic partnership established between Japan and the Australian company Lynas,[210] as well as Japanese support for the development of mining projects in Australia.[211] Nevertheless, these recent agreements mark significant progress in diversifying Korea's sources of critical materials.

South Korea is also focusing its strategy on developing cooperation projects with **partners that share common values and interests**, particularly the **United States**, **Canada**, and the **EU**. It has thus **participated in several multilateral initiatives** aimed at coordinating policies to secure supply chains for critical materials, with a particular **emphasis on adherence to the highest environmental, social, and governance (ESG)** standards. Korea is an **active member of the Mineral Security Partnership**, which promotes ***government and private investment in strategic opportunities across the value chain*, in accordance with rigorous ESG standards**.[212] Furthermore, Korea has established a **cooperation strategy with the EU** under European legislation on critical minerals.[213]

[209] *Abhishek Sharma, "The Challenges Ahead for South Korea's Critical Minerals Strategy," Korea Pro, May 11, 2023, https://koreapro.org/2023/05/the-challenges-ahead-for-south-koreas-critical-minerals-strategy/.*

[210] *David Fickling, "Lynas, Sojitz to Distribute Rare Earths in Japan," The Wall Street Journal, November 24, 2010, https://www.wsj.com/articles/SB10001424052748703572404575634070483388694.*

[211] *"Can Europe Go Green Without China's Rare Earths?" The Financial Times, September 20, 2023, https://ig.ft.com/rare-earths/.*

[212] *U.S. Department of State, "Minerals Security Partnership," n.d., https://www.state.gov/minerals-security-partnership.*

[213] *Tukker, "Resilient Supply of Critical Commodities by 2030 to the EU and Japan, South Korea, China, and Taiwan."*

5.5. A CAUTIOUS STRATEGY TOWARD CHINESE PARTNERS IN CLEANTECH SUPPLY CHAINS

Korea's strategy also differs from that of Japan in maintaining strong economic ties with China. Indeed, the **Korean strategy on critical minerals is more cautious**, given the **significant economic interconnection of its battery sector with China**. Given that the **structure of bilateral trade between China and Korea is focused on intermediate goods, Korea is even more economically vulnerable to China than Japan**. On the other hand, Korea is also facing pressure from the US, linked initially to the IRA and then to the Trump administration's measures.[214] The US has banned government subsidies for companies producing semiconductors smaller than 28 nanometers in China,[215] which impacts the country given its critical dependence on China, particularly for rare earth magnets.[216] Seoul has therefore implemented a **cautious balancing strategy** to avoid further disruption to its trade relations with the US and China.

The cautious approach taken by South Korea and this balancing act reflect the need for Seoul to take into account the Korean economy's heavy dependence on these resources, the importance of its manufacturing industry, and its export model.

However, the geopolitical situation, particularly the rivalry between China and the US, continues to represent a vulnerability for Korea, especially in light of potential restrictions on exports of rare earths and other

[214] 팹4(FAB4), 삼성이 중국의 덤핑 피할 해법 *[FAB4, Samsung's Solution to Avoid Chinese Dumping]*, *Hankook Ilbo*, *August 17, 2022*, *https://www.hankookilbo.com/News/Read/A2022081610590001978*.

[215] 한숨 돌린 삼성·SK…美 허가 없이도 中 공장에 1년 동안 반도체 장비 들여온다 *[Samsung and SK Take a Breather … Semiconductor Equipment Can Be Brought into Chinese Factories for 1 Year Without US Permission]*, *Hankook Ilbo*, *October 12, 2022*, *https://m.hankookilbo.com/News/Read/A2022101215140000777*.

[216] *Kim Bo-eun, "Korea on Track to Cut Dependency on China for Rare Earths," The Korea Times, June 28, 2022, https://www.koreatimes.co.kr/www/biz/2022/06/488_331765.html.*

critical materials. Against this backdrop, the Yoon administration has also focused on **technological diversification** and the implementation of a policy to support local industry.

This effort is reflected in particular in the development of hydrogen, as highlighted in its **strategy for a hydrogen economy** by 2040, which focuses on creating a market for hydrogen in Korea.[217] In July 2024, the Ministry of Science and Technology launched a National Hydrogen-Focused Combined Research Center. Research laboratories have been consolidated into a single entity to focus on developing domestic technologies for electrolyzers and improving the efficiency of R&D investments and **technological security in the field of electrolysis**. Finally, in 2024, the government launched a capacity auction dedicated to clean hydrogen, with the aim of structuring an emerging market and encouraging the gradual integration of hydrogen into the energy mix. In order to maximize local economic benefits, **local content requirements were also introduced**.

In 2024, South Korea also strengthened its support for the development of the offshore wind sector by introducing a regulatory framework focused on creating a national supply chain. **Projects must now meet an evaluation criterion titled "contribution to the industrial economy," and the government has raised the required local content threshold from 16 percent to 44 percent**.[218] Technological diversification also involves increasing the use of nuclear power, sometimes at the expense of renewable energies.[219]

[217] *ATng Yong Li, "South Korea Outlines Hydrogen Roadmap to Boost Industry," Argus Media, 2022, https://www.argusmedia.com/en/news-and-insights/latest-market-news/2389672-south-korea-outlines-hydrogen-roadmap-to-boost-industry.*

[218] *"Global Offshore Wind: South Korea," Norton Rose Fullbright, November 26, 2024, https://www.nortonrosefulbright.com/en/knowledge/publications/faee407b/global-offshore-wind-south-korea.*

[219] *James E. Platte, "South Korea's Evolving Quest for Energy Security," Journal of Indo-Pacific Affairs, October 2022, https://media.defense.gov/2022/Nov/08/2003110726/-1/-1/1/JIPA%20-%20PLATTE%2022.pdf.*

This diversification strategy is seen as crucial for the future of Korea's energy transition and security. The approach aims to **establish a new balance that minimizes the impact of potential disruptions on access to critical minerals**, thereby ensuring a sustainable and secure energy transition for the country. However, **the implementation of this diversification strategy faces major challenges**, such as the **limited substitution of these technologies, Korea's ability to remain a pioneer in the field of batteries**, and the **uncertainty surrounding the development of green hydrogen**, which in Korea's case could also represent a new dependence on foreign countries.

6 What Industrial Strategy for Cleantech in Europe?

The Green Deal and the ***Net Zero Industrial Act***[220] reflect Europe's commitment to supporting the **green transition by producing the technologies needed for decarbonization on European soil**. The May 2024 agreement set a target of **supplying 40 percent of the EU's annual net-zero technology needs by 2030 and achieving 15 percent of global production by value by 2040**.[221] The agreement between the Council and the European Parliament also provided for a **fourfold**

[220] *European Commission, "The Net-Zero Industry Act: Accelerating the Transition to Climate Neutrality," May 2024, https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act_en.*

[221] *European Commission, "The Net-Zero Industry Act: Accelerating the Transition to Climate Neutrality."*

[222] *European Commission, "Net-Zero Industry Act Political Agreement," March 16, 2023, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal/green-deal-industrial-plan/net-zero-industry-act_en. Now-GMBH.DE. (2024). Factsheet - Renewable Energy Directive III (RED III) Targets for Renewable Fuels in Transport. https://www.now-gmbh.de/wp-content/uploads/2024/01/Factsheet_REDIII.pdf/*

increase in the deployment of renewable energies and a **fifteenfold increase in the production of EVs in Europe by 2050**.[222] This objective is specifically intended to respond to the "green development" component of the European Green Deal, which aims to align action to combat climate change with economic development.

The **Clean Industrial Deal** reinforces this European ambition and seeks to give the EU the strategic means to achieve it **by mobilizing financial, regulatory, and commercial tools adapted to the new geopolitical and industrial realities**.[223] In particular, it aims to boost production capacity in Europe, guarantee secure and sustainable access to CRMs, and structure resilient industrial value chains. The Clean Industrial Deal aims to correct the structural weaknesses identified during the pandemic and the Sino-American trade tensions: **dependence on strategic imports, fragmentation of innovation support instruments, slow authorization procedures, and comparative disadvantage caused by energy costs**.

This European ambition must be built in the face of growing economic dependence on decarbonization technologies. Europe is **doubly dependent on China**, which exports its low-cost **clean technologies (PV, wind turbines, batteries)** to the European market and **controls the extraction and processing of the critical minerals needed to manufacture these technologies**.

[223] *European Commission. (2025). Clean Industrial Deal. European Commission. https://commission.europa.eu/topics/eu-competitiveness/clean-industrial-deal_en.*

Table 7 • Comparison of import volumes from China and production capacity in the EU for green technologies (2023)

Green Technology Categories	Volume of Imports from China (in Billions of Euros)	EU Production Capacity	Share of Imports from China
Batteries for electric vehicles	21.4	70 GWh in 2022; could reach 520 GWh by 2025	43.8%
Wind turbines	0.137	220 GW	53%
Solar panels	15.6	260 GW	97%
Electrolyzers	No trade in electrolyzers between China and Europe—on both continents, the majority of stack components are currently supplied locally.	4.9 GWel	Europe currently accounts for a large proportion of local production of the main components of electrolyzers. The main dependence in the value chain, however, concerns iridium, used in PEM electrolyzers, 93% of which is mined and refined in South Africa. Europe also depends on Japanese companies such as Asahi Kaisei and Toppan for membrane-making machinery.

Table based on data supplied by the Atlantic Council,[224] the European Court of Auditors,[225] Motor,[226] WindEurope,[227] Eurostat,[228] the European Commission,[229] TNO and The Hague Centre for Strategic Studies,[230] and on interviews.

[224] *Joseph Webster, "Without Tariffs, the EU Faces a Flood of Chinese Imports of the 'New Three,'" Atlantic Council, May 23, 2024, https://www.atlanticcouncil.org/blogs/energysource/without-tariffs-the-eu-faces-a-flood-of-chinese-imports-of-the-new-three/.*

[225] *European Court of Auditors, Special Report 15/2023, The EU's Industrial Policy on Batteries: New Strategic Impetus Needed, 2023, https://www.eca.europa.eu/ECAPublications/SR-2023-15/SR-2023-15_EN.pdf.*

[226] *Morningstar DBRS, "Dependence on Chinese Battery Supplies Might Become Achilles' Heel of European EV Manufacturing," motor.com, July 30, 2024, https://www.motor.com/2024/07/dependence-on-chinese-battery-supplies-might-become-achilles-heel-of-european-ev-manufacturing/.*

[227] *Press Release: EU starts investigation into Chinese wind turbines under new Foreign Subsidies Regulation," WindEurope, April 9, 2024, https://windeurope.org/newsroom/press-releases/eu-starts-investigation-into-chinese-wind-turbines-under-new-foreign-subsidies-regulation/.*

Against this backdrop, Europe is **lagging far behind** when it comes to **creating supply chains** for strategic resources **or even guaranteeing access to the necessary resources** if it is to ensure the creation of a cleantech industry on European soil that doesn't just involve assembling Chinese products. This delay is particularly glaring when compared with the progress made by other partners such as Japan.

Europe must therefore decide how much of a "customer" it wants to be in decarbonization and, above all, **where it wants to position itself in the clean technology value chain**. Today, **doing without China completely** for decarbonization technologies and critical minerals **is neither desirable nor objectively feasible**. Nevertheless, China's attempts to exploit its dominant position raise vital questions about Europe's autonomy to decarbonize, given its dependence on a single supplier. **The EU finds itself in a situation where, if it wants a clean technology industry in Europe, it has to develop the extraction and processing of the critical minerals it needs, essentially outside its territory**.

[228] *Eurostat, "International trade in products related to green energy," 2024, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=International_trade_in_products_related_to_green_energy&oldid=579764.*

[229] *European Commission, "Solar Energy," 2023, https://energy.ec.europa.eu/topics/renewable-energy/solar-energy_en.*

[230] *TNO and The Hague Centre for Strategic Studies, "The EU's China Challenge: Rethinking Offshore Wind and Electrolysis Strategy," 2024, https://publications.tno.nl/publication/34642379/FD2Yc7/TNO-2024-R10732.pdf.*

6.1. THE EU FACES A SHORTAGE OF PRODUCTION, REFINING AND RECYCLING CAPACITY FOR CRITICAL MATERIALS

Uncertainty in the market for the supply of European companies has been heightened by China's desire to control the evolution of supply and prices on the global market for critical materials, and the instrumentalization of their trade. In this respect, the EU is confronted both by the lack of production of rare earth resources and critical materials on the Continent (and in its partners) and by its **lack of technological expertise in the refining and recycling of certain critical materials**.[231]

On the one hand, **the extraction of strategic raw materials on European soil is likely to remain modest and to only meet the EU's growing demand to a limited extent**. Such production would be insufficient to implement a large-scale energy system powered by clean energy technologies.[233] This is due in particular to the Continent's low reserves and the fact that **exploiting new deposits remains a long, uncertain process, with environmental costs that many populations are unwilling to accept on their territory**.[233]

While the European continent has a wealth of as yet untapped reserves of raw materials used in EV batteries, such as lithium, cobalt, nickel, and manganese, the **lack of sufficient technological expertise prevents a comprehensive assessment of mining potential within the EU**.[234]

[231] *Minor Metals Trade Association (MMTA), "China's Ga, Ge Export Controls May Deter EU Trade," October 5, 2023, https://mmta.co.uk/chinas-ga-ge-export-controls-may-deter-eu-trade/.*

[232] *International Energy Agency (IEA), "Executive Summary: The Role of Critical Minerals in Clean Energy Transitions," n.d., https://www.iea.org/reports/the-role-of-critical-minerals-in-clean-energy-transitions/executive-summary.*

[233] *European Commission, "Proposal for a Regulation of the European Parliament and of the Council Establishing a Framework for Ensuring a Secure and Sustainable Supply of Critical Raw Materials and Amending Regulations (EU) 168/2013, (EU) 2018/858, 2018/1724 and (EU) 2019/1020," March 16, 2023, https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52023PC0160.*

Added to this is the **technical and economic complexity of initiating extractive mining projects**, faced with lengthy authorization procedures taking, on average, between ten and fifteen years.

European reserves of critical minerals are scattered unevenly across the Continent. In Northern Europe, Finland has small-scale nickel mining and processing capacity.[235] **Sweden, in particular, has significant reserves of rare earth oxides**,[236] revealed following the discovery of the new Per Geijer deposit in Kiruna in January 2023.[237] However, exploration of the site is still in its early stages, and the **economic feasibility and quality of the available resources remain unclear**.

Other lithium mining possibilities exist. This is the case in France, in the Allier region,[238] and in Jadar, Serbia,[239] where European companies nevertheless face major geopolitical and social challenges because Chinese companies are already well established there and have a virtual monopoly on copper and gold mining and processing.[240] Another obstacle is the reluctance of local Serbian communities to welcome production operations in their neighborhood, given the potential environmental damage to surrounding villages.[241]

[234] *Allianz, "Critical Raw Materials: Is Europe Ready to Go Back to the Future?" 2023, https://www.allianz.com/content/dam/onemarketing/azcom/Allianz_com/economic-research/publications/specials/en/2023/august/01_08_2023-Critical-Raw-Materials.pdf.*

[235] *IRENA, "Geopolitics of the Energy Transition: Critical Materials."*

[236] *Can Europe Go Green without China's Rare Earths?" The Financial Times.*

[237] *LKAB, "Europe's Largest Deposit of Rare Earth Metals Located in Kiruna Area," January 12, 2023, https://lkab.com/en/press/europes-largest-deposit-of-rare-earth-metals-is-located-in-the-kiruna-area/.*

[238] *Imerys, "EMILI: Beauvoir Lithium Mining Project," n.d., https://emili.imerys.com.*

[239] *Economist Intelligence Unit, "Serbia Revives Lithium Mining Plans with EU Agreement," December 5, 2023, https://www.eiu.com/n/serbia-revives-lithium-mining-plans-with-eu-agreement/.*

[240] *Stefan Vladisavljev, "How Did China Become the Largest Investor in Serbia?" CHOICE, August 8, 2023, https://chinaobservers.eu/how-did-china-become-the-largest-investor-in-serbia/.*

[241] *Stojan Ivanović, Jelena Tomićević-Dubljević, Ivana Bjedov, Ilija Đorđević, Ivana Živojinović, "Cultural Landscape Management in Context: Local Communities' Perceptions under Jadar Mineral Extraction Project in Serbia," The Extractive Industries and Society 16 (December 2023): 101361, https://www.sciencedirect.com/science/article/pii/S2214790X2300148X.*

Dependence on China is all the more blatant as it is not limited to Chinese ownership of the world's mineral deposits. Europe has leading-edge companies manufacturing extraction and refining technologies for many minerals. However, **the EU's capacity to separate, process, and recycle certain critical minerals, most notably rare earths, is virtually non-existent**.[242]

The treatment of critical minerals is often an energy- and chemical-intensive process, releasing large quantities of mine tailings and generating potentially radioactive waste, such as thorium and uranium.[243] In particular, sulfuric acid refining techniques generate on average between 9,600 and 12,000 cubic meters of gas per ton of rare earth produced, made up of combustion dust, hydrofluoric acid, sulfur dioxide, and sulfuric acid.[244]

Strong public opposition to mining activities across Europe due to their **environmental impact** is also a hindrance, as observed in the case of the Covas de Barroso lithium mining project in Portugal.[245] This resistance can lead to delays or even cancellation of mining projects. To overcome these obstacles, the trend is to put in place appropriate local policies, notably through information campaigns, and to apply the most rigorous environmental standards. However, **these requirements will only make mining operations economically viable if the price of CRMs on the global market reaches a sufficiently high threshold to cover the increased costs of complying with these strict standards**.

[242] *Graceline Baskaran, "What China's Ban on Rare Earths Processing Technology Exports Means," CSIS, January 8, 2024, https://www.csis.org/analysis/what-chinas-ban-rare-earths-processing-technology-exports-means.*

[243] *Petra Zapp, Andrea Schreiber, Josefine Marx, and Wilhelm Kuckshinrichs, "Environmental Impacts of Rare Earth Production," MRS Bulletin, March 2022, https://www.researchgate.net/publication/359314586_Environmental_impacts_of_rare_earth_production.*

[244] *Lisa Depraiter and Stéphane Goutte, "The Role and Challenges of Rare Earths in the Energy Transition," 2023, https://shs.hal.science/halshs-04199796v1/file/REE_in_Energy_Transition_DG.pdf.*

[245] *Francisco Norega, "Covas de Barroso: le plus grand projet d'exploitation de lithium d'Europe" [Barroso's Covas: Europe's largest lithium mining project], Lundimatin, September 20, 2021, https://lundi.am/Covas-de-Barroso-le-plus-grand-projet-d-exploitation-de-lithium-d-Europe.*

6.2. EUROPEAN INDUSTRIAL STRATEGY FOR CRITICAL MATERIALS

The EU has sought to equip itself with new instruments to ensure the realization of its ambitions and domestic production. First, the EU adopted the ***Critical Raw Materials Act*** in **May 2024**,[246] which **defines criteria for the extraction, processing, recycling, and sourcing of CRMs** and for the **diversification of EU supplies**, in order to **establish an intra-European value chain**. The text highlights the EU's role in providing **technical support and access to private finance** for European companies seeking to diversify sources of supply by investing in strategic mining and refining projects abroad.

The *CRM Act* calls for the establishment of a **European industrial ecosystem**, supported by administrative measures aimed at **accelerating the launch of strategic projects** by streamlining the licensing process within two years upstream of the value chains. In the central and downstream segments of the value chain, it aims to increase investment in research and innovation (R&I) for the development of extraction, refining, and, in particular, recycling technologies.

[246] *European Commission, "Critical Raw Materials: Ensuring Secure and Sustainable Supply Chains for EU's Green and Digital Future," March 16, 2023, https://ec.europa.eu/commission/presscorner/detail/en/ip_23_1661.*

It also seeks to **promote private-sector financing** of mining projects by facilitating access to public information, thereby reducing investors' perception of risk. It remains to be seen whether this model will be sufficient for European operations. Member states are also taking action at their own level, as illustrated by France, which is adopting a strategy based on a dual focus: downstream and upstream in the value chain. Public investment is being mobilized to support mining projects, particularly in lithium. In addition, public guarantees on bank loans are helping mining companies secure offtake agreements with industrial partners.

The *CRM Act* proposes an updated list identifying **thirty-four raw materials as critical** for the EU, including **seventeen strategic raw materials**. It also calls for the **EU to mobilize nearly €470 million[247] for projects to explore, extract, refine, and recycle** CRMs, for the period from 2021 to 2024, under the Horizon Europe framework program.[248]

[247] *Swisscore, "Commission Presents Critical Raw Materials Act," March 16, 2023, https://www.swisscore.org/commission-presents-critical-raw-materials-act/.*
[248] *Horizon Europe, n.d., https://www.horizon-europe.gouv.fr/.*

In March 2025, the Commission adopted a list of forty-seven strategic projects aimed at strengthening the Union's capabilities. These projects are designed to enable the EU to theoretically meet its 2030 targets for lithium and cobalt extraction, processing, and recycling, while making significant advances for graphite, nickel, and manganese.[249]

The European strategy also aims to **establish solid partnerships**. It has sought first to create a Critical Raw Materials Club,[250] pledging to invest over €20 billion by 2030,[251] facilitating trade between resource-rich and resource-dependent countries to diversify global supply chains for essential raw materials and promote investment and sustainable trade.

This idea of a club was gradually discarded in favor of collaboration within the MSP.[252] This platform, set up at Washington's initiative, brings together fifteen countries dependent on critical materials, including the EU, to facilitate cooperation on securing supply chains, promoting support for technology and industrial sectors while reducing their dependence on China.[253]

[249] *European Commission, "The Commission Selects 47 Strategic Projects to Secure and Diversify Access to Raw Materials in the EU," https://ec.europa.eu/commission/presscorner/detail/en/ip_25_864.*

[250] *European Council, "An EU Critical Raw Materials Act for the Future of EU Supply Chains, n.d., https://www.consilium.europa.eu/en/infographics/critical-raw-materials/.*

[251] *Francesco Findeisen, "The Club Approach: Towards Successful EU Critical Raw Materials Diplomacy," Hertie School – Jacques Delors Centre, 2023, https://www.delorscentre.eu/en/publications/critical-raw-materials-club.*

[252] *European Commission, "Press Release: EU and International Partners Agree to Expand Cooperation on Critical Raw Materials," April 5, 2024, https://ec.europa.eu/commission/presscorner/detail/en/IP_24_1807.*

[253] *U.S. Department of State, "Minerals Security Partnership."*

Table 8 • Summary of national strategies for securing critical materials (EU, Japan, South Korea, the US)

	List of materials defined as critical	Latest policies and legislation		Objectives	Mini- and multilateral initiatives
EU	**(March 2024)** **34 CRMs:** antimony, arsenic, barite, beryllium, coking coal, feldspar, hafnium, helium, magnesium, niobium, phosphorus, phosphorite, scandium, fluorspar, strontium, tantalum, vanadium. **Including 17 strategic raw materials:** aluminum/bauxite, boron/borate, bismuth, copper, cobalt, gallium, germanium, natural graphite, lithium, manganese, platinum group metals, nickel, metallic silicon, light rare earths, heavy rare earths, titanium metal, tungsten.	*Critical Raw Materials Act* (2023)		**By 2030:** Extract 10% locally, process **40%** of its annual consumption of key minerals, recycle **25%** of CRMs ending up in its waste, limit dependence on any one foreign supplier to **65%** per strategic raw material.	Member of the US-initiated Mineral Security Partnership (2022) and founder of the Critical Raw Materials Club (November 2023), both of which will become integral parts of the MSP Forum (2024), founder of the Global Gateway (December 2021), founder of the European Battery Alliance (2017). **MoUs concluded on cooperation in critical materials, including:** Australia (May 2024),[254] Rwanda (February 2024),[255] Zambia (November 2023), DRC (October 2023), Japan (July 2023), Argentina (June 2023), United States (June 2023), Kazakhstan (May 2023), Namibia (October 2022), Ukraine (July 2021), Canada (June 2021).
Japon	**34 critical metals:** antimony, barium, beryllium, bismuth, boron, cesium, cobalt, fluorine, gallium, germanium, hafnium, indium, lithium, magnesium, manganese, molybdenum, nickel, niobium, platinum group metals, rare earths, rhenium, rubidium, selenium, silicon, strontium, tantalum, tellurium, thallium, titanium, tungsten, vanadium, and zirconium.	Japan's New International Resource Strategy to Secure Rare Metals (2020), 7th Strategic Energy Plan (2025).		**By 2025:** Reduce dependence on any single supplier to below **50%**. Ensure **60** days of standard domestic consumption for **34** critical metals with inventories built up. **4 pillars:** • Acquisition of mining interests in material-rich third countries. • Recycling from industrial processes and end-of-life products. • Development of substitute materials. • Building up strategic stocks. Increase self-sufficiency in base metals to 80% by 2030, up from 50.1% in 2018.	Part of the Supply Chain Agreement (February 2024),[256] co-founder of the Enhancing Supply Chain Resilience and Inclusiveness Initiative (2023) with the WTO. Member of the Mineral Security Partnership (2022) initiated by the United States. Member of the Quad Rare Earth Refining Technology Cooperation (2021). **MoUs signed on cooperation in critical materials, including:** United States (March 2023),[257] Canada (October 2023), Namibia (August 2023), Chile (August 2023), European Commission (June 2023), Australia (2022), Kazakhstan (November 2021), Vietnam (2012), India (December 2011).

[254] *European Commission, Representation in France, "L'UE et l'Australie signent un partenariat sur les minerais critiques et stratégiques durables," [EU and Australia sign partnership on sustainable critical and strategic minerals], May 28, 2024, https://france.representation.ec.europa.eu/informations/lue-et-laustralie-signent-un-partenariat-sur-les-minerais-critiques-et-strategiques-durables-2024-05-28_fr.*

[255] *European Commission, "L'UE et le Rwanda signent un protocole d'accord sur les chaînes de valeur durables pour les matières premières" [The EU and Rwanda sign a memorandum of understanding on sustainable value chains for raw materials], February 19, 2024, https://ec.europa.eu/commission/presscorner/detail/fr/ip_24_822.*

[256] *Indo-Pacific Economic Framework for Prosperity (IPEF), "Supply Chain Agreement," 2024, https://www.ipef.gov.sg/supply-chain-agreement/.*

[257] *Kyla H. Kitamura, "U.S.-Japan Critical Minerals Agreement," CRS Report IF12517, January 8, 2025, https://www.congress.gov/crs_external_products/IF/PDF/IF12517/IF12517.13.pdf.*

Table 8 (con't) • Summary of national strategies for securing critical materials (EU, Japan, South Korea, the US)

	List of materials defined as critical	Latest policies and legislation	Objectives	Mini- and multilateral initiatives
South Korea	Aluminum, antimony, bismuth, chromium, copper, tin, indium, gallium, magnesium, molybdenum, niobium, palladium (MGP), platinum (PGM), lead, tantalum, titanium, tungsten, selenium, silicon, strontium, uranium (since 2024), vanadium, zinc, zirconium.[258] **Including 10 strategic critical minerals:** cerium (REE), cobalt, dysprosium (REE), graphite, lanthanum (REE), lithium, manganese, neodymium (REE), nickel, terbium (REE).	Strategy for securing reliable critical minerals supply (March 2025).	**By 2030:** Reduce its dependence on imports from any single partner for lithium, cobalt and graphite from **80% to 50%**. Increase the recycling ratio for critical minerals from the current **2%** to **20%** for **33 key minerals**. **Increase emergency reserves of critical metals** such as lithium and cobalt, facilitating the development of a domestic industry for the production and/or recycling of battery materials, with an announced investment of $29 billion.	Part of the Supply Chain Agreement (February 2024), member of the Mineral Security Partnership (2022) initiated by the US and which will become an integral part of the MSP Forum (2024), member of the Korea-Mongolia-US Trilateral Minerals Dialogue (June 2023) Cooperation strategy with the EU under the *Critical Raw Materials Act* (November 2023). **MoUs concluded on cooperation in critical materials, including:** Vietnam (December 2023), Canada (May 2023), Mongolia (February 2023), Australia (December 2020).
United States	**Critical minerals**: aluminum, antimony, arsenic, barium, beryllium, bismuth, cerium, cesium, chromium, cobalt, dysprosium, erbium, europium, fluorspar, gadolinium, gallium, germanium, graphite, hafnium, holmium, indium, iridium, lanthanum, lithium, lutetium, magnesium, manganese, neodymium, nickel, niobium, palladium, platinum, praseodymium, rhodium, rubidium, ruthenium, samarium, scandium, tantalum, tellurium, terbium, thulium, tin, titanium, tungsten, vanadium, ytterbium, yttrium, zinc, and zirconium. **Critical materials for energy ("the electric eighteen"):** aluminum, cobalt, copper, dysprosium, electrical steel, fluorine, gallium, iridium, lithium, magnesium, natural graphite, neodymium, nickel, platinum, praseodymium, silicon, silicon carbide, and erbium.	*Critical Mineral Consistency Act* of 2025 (February 2025),[259] Inflation Reduction Act .	**Harmonize lists:** The law aims to align the Department of Energy's (DOE) list of critical materials with the Department of the Interior's (DOI) list of critical minerals. **Strengthen the supply chain:** By synchronizing these lists, the law aims to streamline policies and strategies that can help strengthen the US supply chain for critical minerals.	EU–US critical minerals agreement (announced in 2023 but still under negotiation),[260] Part of the Supply Chain Agreement (February 2024), founder of the Mineral Security Partnership (2022), which will become an integral part of the MSP Forum (2024), Member of the Korea-Mongolia-United States Trilateral Dialogue on Minerals (June 2023) **MoUs concluded on cooperation in critical materials, including:** India (October 2024),[261] Australia (May 2023),[262] Canada (2020),[263] Japan (March 2023),[264] Chile (June 2023).[265]

Table created using data provided by the International Energy Agency on South Korea[266] and Japan,[267] the Council of the European Union,[268] and the US Department of Energy.[269]

[258] *International Energy Agency (IEA), "Critical Mineral List in Korea," 2024, https://www.iea.org/policies/17943-critical-mineral-list-in-korea.*

[259] *U.S. Senate Committee on Energy and Natural Resources, "Press Release: Lee, Kelly Introduce Bill to Strengthen the U.S. Critical Mineral Supply Chain," February 25, 2025, https://www.energy.senate.gov/2025/2/lee-kelly-introduce-bill-to-strengthen-the-u-s-critical-mineral-supply-chain.*

[260] *AShayerah Akhtar, "Proposed U.S.-EU Critical Minerals Agreement, CRS Report IN12145, April 2, 2024,https://www.congress.gov/crs-product/IN12145.*

[261] *Ministry of Commerce & Industry (India), "Commerce and Industry Minister Shri Piyush Goyal Co-Chairs 6th India-US Commercial Dialogue in Washington D.C.," October 4, 2024, https://pib.gov.in/PressReleasePage.aspx?PRID=2062127.*

[262] *Prime Minister of Australia, "Australia-United States Climate, Critical Minerals and Clean Energy Transformation Compact," May 20, 2023, https://www.pm.gov.au/media/australia-united-states-climate-critical-minerals-and-clean-energy-transformation-compact.*

[263] *International Energy Agency (IEA), "Canada-US Joint Action Plan on Critical Minerals Collaboration," October 27, 2022, https://www.iea.org/policies/16060-canada-us-joint-action-plan-on-critical-minerals-collaboration.*

[264] *Office of the United States Trade Representative, "Press Release: United States and Japan Sign Critical Minerals Agreement," March 28, 2023, https://ustr.gov/about-us/policy-offices/press-office/press-releases/2023/march/united-states-and-japan-sign-critical-minerals-agreement.*

[265] *Wilder Alejandro Sanchez, "Lithium Industry: US Senate Approves Critical Tax Treaty with Chile," July 11, 2023, Geopolitical Monitor, https://www.geopoliticalmonitor.com/lithium-industry-us-senate-approves-critical-tax-treaty-with-chile/.*

Table 9 • Diversification and clean industrialization targets – Comparative approaches (EU, Japan, South Korea)

	Energy and industrial objectives		Means implemented
EU	• Provide 40 percent of the EU's annual demand for net-zero technologies by 2030. These technologies include: - Solar photovoltaic and thermal technologies. - Renewable land and sea technologies (onshore and offshore wind). - Battery and energy storage technologies. - Heat pumps and geothermal energy technologies. - Hydrogen technologies, including electrolyzers and fuel cells. - Sustainable biogas/biomethane technologies. - Carbon capture and storage (CCS) technologies. - Electricity grid technologies. - Nuclear fission energy technologies, including those related to the nuclear fuel cycle. - Sustainable alternative fuel technologies. - Hydroelectric technologies. - Other renewable energy technologies. - Energy-efficiency technologies related to the energy system, including heat network technologies. - Renewable fuel technologies of non-biological origin. - Biotechnology solutions for climate and energy. - Other industrial transformative technologies for decarbonization. - CO_2 transport and utilization technologies. - Wind and electric propulsion technologies for transport. - Other nuclear technologies. • By 2030, the NZIA aims to create an EU market for CO_2 storage services. It sets an EU-wide target and requires an annual CO_2 storage capacity of at least 50 million tons. • Achieve an annual manufacturing capacity of at least **36 gigawatts (GW) for wind technologies and 31 GW for heat pumps**. • For batteries, the goal is for European manufacturers to cover **nearly 90 percent of the EU's annual demand**, which would translate into a production capacity of at least **550 gigawatt hours (GWh)** by 2030. • EU electrolyzer manufacturers should be able to increase their capacity so that the total installed electrolyzer capacity reaches at least **100 GW of hydrogen by 2030**. • Achieve an operational manufacturing capacity of at least **30 gigawatts (GW) in the field of solar photovoltaic** (PV) energy by 2030, covering the entire value chain. These targets are part of the effort to achieve climate neutrality by reducing net greenhouse gas emissions by at least 55 percent by 2030 compared to 1990 levels.		Faster permit-granting procedures for the construction, extension, modification, and operation of net-zero manufacturing projects: • 12 months for projects under 1 GW per year, • 18 months for larger projects, • support from a "one-stop shop." A simple legal framework for EU-based net-zero industries, **Encouraging innovation:** Member States will be able to support **innovation by creating "net-zero regulatory sandboxes"** to support early-stage innovations. **Access to markets** by stimulating consumer demand and **public procurement**. **Skills development (skills academies):** developing the skilled workforce and high-quality jobs needed for the net-zero industry in Europe. The NZIA is establishing the "Net-Zero Platform Europe,"[270] a governance body composed of the Commission and EU countries to monitor progress, discuss developments, and engage with civil society stakeholders. The platform advises on the financing of strategic net-zero projects and engages in international net-zero industrial partnerships to facilitate the global transition to clean energy.

[266] *International Energy Agency (IEA), "The Strategy for Securing Reliable Critical Minerals Supply," 2025, https://www.iea.org/policies/17942-the-strategy-for-securing-reliable-critical-minerals-supply.*

[267] *International Energy Agency (IEA), "International Resource Strategy – National Stockpiling System," April 9, 2025, https://www.iea.org/policies/16639-international-resource-strategy-national-stockpiling-system. METI, "Seventh Strategic Energy Plan."*

[268] *Council of the European Union, "Législation sur les matières premières critiques" [Legislation on critical raw materials], Consilium, January 28, 2025, https://www.consilium.europa.eu/fr/infographics/critical-raw-materials/.*

[269] *U.S. Department of Energy, "What Are Critical Materials and Critical Minerals?" 2023, https://www.energy.gov/cmm/what-are-critical-materials-and-critical-minerals.*

[270] *European Commission, "Net-Zero Europe Platform," 2023, https://single-market-economy.ec.europa.eu/industry/sustainability/net-zero-industry-act/net-zero-europe-platform_en.*

Table 9 (con't) • Diversification and clean industrialization targets – Comparative approaches (EU, Japan, South Korea)

	Energy and industrial objectives		Means implemented
Japan	• In its new Nationally Determined Contribution (NDC), Japan has committed to reducing its greenhouse gas emissions by 60 percent by 2035 compared to 2013 levels. • Achieve a share of renewable energy in its energy mix of between 40 percent and 50 percent, and a share of nuclear energy of 20 percent, by FY2040. • Achieve a domestic production capacity for EV batteries of 150 GWh by 2030. • Aim to significantly increase domestic wind and solar power generation capacity, from 10 GW to 30–45 GW for offshore wind by 2040—with 60 percent local production—and reach 108 GW for solar photovoltaic by 2030.		Green Growth Strategy, 7th Strategic Energy Plan. Substitutes, recycling, stocks, massive aid for R&D and investment, GGS, nuclear development.
South Korea	• In its Nationally Determined Contribution (NDC), South Korea has committed to reducing its greenhouse gas emissions by 40 percent by 2030 compared to 2018 levels.[271] • The goal is to have 30 percent of the energy mix come from renewable sources by 2030 and to prioritize the development of nuclear power. • The government plans to invest ₩20 trillion in the EV sector to ensure access to advanced battery technologies by 2030. • New safety regulations for the removal, storage, and transportation of used batteries have been established, aiming to secure sufficient minerals to produce the equivalent of 170,000 EVs, while establishing domestic supply chains for lithium. • Implement the development of a SMR by 2030.		Stimulate domestic industry through targeted incentives such as investment tax credits, expanded credit lines, reduced interest rates, and preferential insurance premiums.

[271] *Climate Action Tracker, "South Korea," July 17, 2023, https://climateactiontracker.org/countries/south-korea/.*

6.3. CHALLENGES OF COOPERATION WITH THIRD COUNTRIES

Europe nevertheless finds itself caught in a vicious circle, in which uncertainty linked to geopolitical realities hinders collective action and, in fact, the development of strategic partnerships with countries rich in critical materials and with other partners for the development of diversified value chains in cleantech.

First, in promoting an alternative to the Chinese model, the EU and European companies are **still struggling to respond to the call from resource-rich countries to move up the global value chain**. The economic growth of countries such as the DRC, Indonesia, and Namibia remains highly dependent on the extraction of strategic materials, while their industrial capacity to transform critical materials into value-added products remains underdeveloped compared to their potential,

not to mention their ability to industrialize clean technologies.[272] The **advantage** of diversification for these economies **is obviously not to replicate the Chinese model with European countries** but to extract and process materials on their own soil, or even to produce technologies (batteries, etc.) directly on site.

At present, these economies often benefit very little from foreign investment, including from the EU, in terms of promoting the emergence of a critical materials processing industry and thus remaining at a competitive disadvantage vis-à-vis developed economies.[273] The lack of added value and the absence of technological expertise in the processing and refining of CMPs in the projects proposed by European companies effectively limit these countries' interest in deeper cooperation with the EU.[274]

The EU is now faced with its **partners' determination to keep critical materials within their borders**. Indonesia banned exports of unprocessed minerals in January 2014, followed by nickel in 2022 and bauxite in June 2023.[275] Zimbabwe, meanwhile, banned the export of raw lithium in January 2023.[276] These examples demonstrate the determination of these countries to **force foreign companies to continue their**

[272] *Eve Warburton, "Nationalism, Developmentalism and Politics in Indonesia's Mining Sector," in Indonesia in the New World: Globalisation, Nationalism and Sovereignty, ed. Arianto Arif Patunru, Mari Pangestu, and M. Chatib Basri (ISEAS Publishing, 2018), https://www.degruyter.com/document/doi/10.1355/9789814818230-011/html.*

[273] *Findeisen, "The Club Approach: Towards Successful EU Critical Raw Materials Diplomacy."*

[274] *Stiftung Wissenschaft und Politik (SWP), "From Competition to a Sustainable Raw Materials Diplomacy," 2023, https://www.swp-berlin.org/10.18449/2023RP01.*

[275] *Sacha Winzenried and Fandy Adhitya, "Export Ban on Unprocessed Minerals Effective 12 January 2014 – Three-Year Reprieve For Some but Uncertainty Remains," PWC, 2014, https://www.pwc.com/id/en/publications/assets/eumpublications/newsflash/2014/eumnewsflash-50.pdf; John McBeth, "Indonesia's Mineral Export Bans Face Hot Global Fire," Asia Times, July 5, 2023, https://asiatimes.com/2023/07/indonesias-mineral-export-bans-face-hot-global-fire; Jayanty Nada Shofa, "Miners Were Given Window of 3 Years before Bauxite Export Ban: Gov't," Jakarta Globe, June 12, 2023, https://jakartaglobe.id/business/miners-were-given-window-of-3-years-before-bauxite-export-ban-govt.*

[276] *"Zimbabwe Bans Raw Lithium Exports," Electrive, 2023, https://www.electrive.com/2023/01/06/zimbabwe-bans-raw-lithium-exports/.*

processing and refining operations locally, often in partnership with well-established Chinese companies.

However, in the absence of credible supply commitments, it is unlikely that the EU will seek to invest in high-value-added projects in these countries, especially if the benefits of such investments accrue to China. As a result, **most of the agreements concluded** with countries such as Namibia,[277] Ukraine,[278] the DRC,[279] and Zambia[280] **have not yet yielded concrete results**. The MoU with Namibia[281] signed in October 2022 for the export of rare earth materials to the EU (supplemented by an MoU in December 2023[282] on cooperation for the resilience of CRMs and green hydrogen supply chains) has not yet resulted in any concrete projects. Worse still, despite this growing cooperation with Europe, Namibia banned the export of unprocessed critical minerals such as crushed lithium ore, cobalt, manganese, graphite, and rare earths in June 2023.[283]

In the case of Ukraine, the strategic partnership with the EU concluded in July 2021 on the sustainable and responsible exploitation of mineral resources and essential raw materials has not progressed since Russia's

[277] *Vitalio Angula, "Namibia, EU, Agree on Partnership for Sustainable Raw Materials," VOA, October 26, 2022, https://www.voanews.com/a/namibia-eu-agree-on-partnership-for-sustainable-raw-materials/6807397.html.*

[278] *European Commission, "Press Release: EU and Ukraine Kick-Start Strategic Partnership on Raw Materials," July 13, 2021, https://single-market-economy.ec.europa.eu/news/eu-and-ukraine-kick-start-strategic-partnership-raw-materials-2021-07-13_en.*

[279] *European Commission, "Press Release: Global Gateway: EU Signs Strategic Partnerships on Critical Raw Materials Value Chains with DRC and Zambia and Advances Cooperation with US and Other Key Partners to Develop the 'Lobito Corridor,'" October 26, 2023, https://ec.europa.eu/commission/presscorner/api/files/document/print/en/ip_23_5303/IP_23_5303_EN.pdf.*

[280] *European Commission, "Global Gateway: European Union and Zambia Sign Roadmap for the Implementation of the Forest Partnership," November 8, 2023, https://climate.ec.europa.eu/news-your-voice/news/global-gateway-european-union-and-zambia-sign-roadmap-implementation-forest-partnership-2023-11-08_en.*

[281] *Angula, "Namibia, EU, Agree on Partnership for Sustainable Raw Materials."*

[282] *International Energy Agency, "Namibia-EU Strategic Partnership on Raw Materials," December 11, 2023, https://www.iea.org/policies/17665-namibia-eu-strategic-partnership-on-raw-materials.*

[283] *Lazarus Amukeshe and Matthew Dlamini, "Namibia Bans Export of Unprocessed Lithium," The Namibian. June 12, 2023, https://www.namibian.com.na/namibia-bans-export-of-unprocessed-lithium/.*

invasion in February 2022.[284] The Trump administration, for its part, has made critical minerals one of its key arguments for continuing its support for Ukraine—thereby depriving Europe of access to the resources of this neighboring country. Nevertheless, the EU remains ahead of the US in terms of concrete implementation, even if the effective development of projects will still take time. Even after agreements have been signed, foreign investors still have to go through the usual administrative procedures before work can begin. As a result, large-scale projects, such as the opening of a mine, may take several years to become operational.[285]

More importantly, projects led by European companies **suffer from competition with Chinese investments, which sometimes makes it difficult to collaborate with other partners**.[286] In the context of the **Belt and Road Initiative (BRI)**[287] and thanks to its "Going Global" policy,[288] **China has steadily increased its presence in the international mining sector**. Through its large state-owned enterprises, it has increased its participation in mining projects, often **offering infrastructure in exchange for rights to exploit key resources**, including **lithium** and **cobalt**. This approach has enabled Chinese companies to extend their influence to all stages of critical material supply chains, giving China **significant strategic advantages in the allocation of mining concessions abroad**. These advantages over its European competitors

[284] *European Commission, "Press Release: EU and Ukraine Kick-Start Strategic Partnership on Raw Materials."*

[285] *Bárbara Machado and Jasper Steinlein, "Trump-Zelenskyy Blowup Opens Door to Revival of EU Minerals Deal with Ukraine," Euractiv, March 4, 2025, https://www.euractiv.com/section/eet/news/ukraine-raw-materials-deal-eu-strategic-partnership/.*

[286] *Anna Gelpern, Sebastian Horn, Scott Morris, Brad Parks, and Christoph Trebesch, "How China Lends: A Rare Look into 100 Debt Contracts with Foreign Governments," Economic Policy 38, no. 114 (April 2023): 345–416, https://academic.oup.com/economicpolicy/article-abstract/38/114/345/6827797.*

[287] *Christophe Nivelle, "China and Critical Raw Materials: A Strategy of Domination," Modern Diplomacy, August 3, 2023, https://moderndiplomacy.eu/2023/08/03/china-and-critical-raw-materials-a-strategy-of-domination/.*

[288] *Melanie Müller, Christina Saulich, Svenja Schöneich, and Meike Schulze, "From Competition to a Sustainable Raw Materials Diplomacy," SWP Comment 2023/C 02 (Berlin: Stiftung Wissenschaft und Politik, January 2023), https://doi.org/10.18449/2023RP01.*

are all the more pronounced as **these state-owned companies are more willing to invest in mining projects in countries where real or perceived risks** have deterred other investors.[289]

To achieve these objectives, **Europe must therefore invest financially to stimulate private investment** in key sectors. One of the roles of public authorities here is to agree to **cover part of the risk** associated with the fear of instability and economic risk that any investment in a nascent sector represents. One possible avenue is to **use the €300 billion raised under the Global Gateway initiative**, launched in 2021 to encourage the development of sustainable infrastructure projects.[290] These funds could **be used to provide financial support for establishing green partnerships that include critical materials**.[291]

These measures aim to **address structural weaknesses linked to the low added value of these countries' exports**.[292] By focusing the strategic partnership on the development of critical infrastructure and a broader energy transport system, this cooperation is part of the establishment of ambitious and broad partnerships that go beyond mining alone, while having the potential to structurally transform the mining industry in these third countries, in line with higher ESG standards.

[289] *International Resource Panel, Mineral Resource Governance in the 21st Century, UN Environment Programme, 2020, https://www.resourcepanel.org/reports/mineral-resource-governance-21st-century.*

[290] *European Commission, "Global Gateway," 2021, https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/stronger-europe-world/global-gateway_en.*

[291] *For example, in October 2023, the EU established a strategic partnership with Zambia and the Democratic Republic of Congo (DRC), targeting supply chains for critical materials. Under this agreement, the EU has committed to investing in the construction of the Lobito Corridor, which will cross Zambia, Angola, and the DRC, in order to facilitate the transport of goods and, by extension, their export to the EU. The initiative also plans to focus cooperation, within the framework of the Global Gateway, on establishing transport infrastructure and local processing facilities for raw materials; European Commission, "EU Signs Strategic Partnerships on Critical Raw Materials Value Chains with DRC and Zambia and Advances Cooperation with US and Other Key Partners to Develop the 'Lobito Corridor'".*

[292] *Sokona, Youba, Yacob Mulugetta, Meron Tesfamichael, Fadhel Kaboub, Niclas Hällström, Matthew Stilwell, Mohamed Adow, and Colin Besaans, Just Transition: A Climate, Energy and Development Vision for Africa (Independent Expert Group on Just Transition and Development, 2023), https://justtransitionafrica.org/wp-content/uploads/2023/05/Just-Transition-Africa-report-ENG_single-pages.pdf.*

This initiative also represents a positive step in demonstrating to countries in the "Global South" the EU's commitment to allocating the necessary funds for the development of industrial and technological capacities related to their climate transition.

6.4. THE IMPACT OF CHINESE INDUSTRIAL POLICY ON THE EUROPEAN CLEAN TECHNOLOGY STRATEGY

a. A Centrifugal Chinese Policy

Any European industrial strategy aimed at promoting cleantech manufacturing on the Continent faces the reality of the vertical integration of the Chinese value chain. Beyond the economies of scale that give Chinese industry a price advantage, attempts to relocate to Europe are hampered above all by the centrifugal logic of Beijing's industrial strategy. This extends from mining and refining to the finished product, giving China a structural competitive advantage over a large part of the value chain, making it difficult to circumvent and creating a major strategic risk.

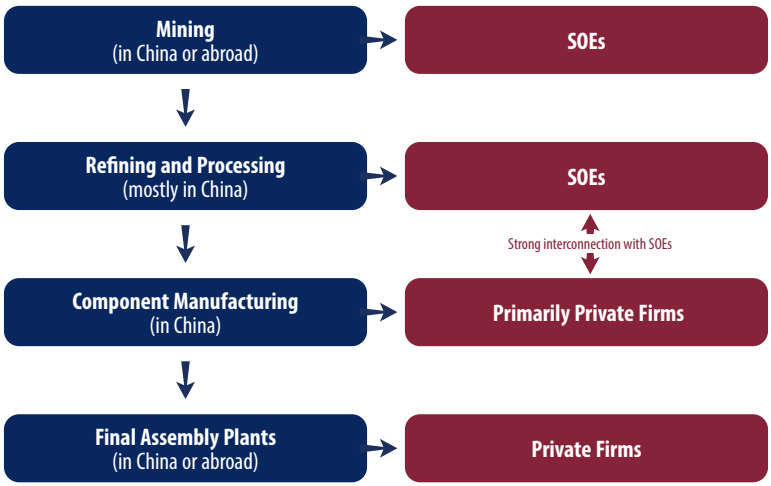
Thus, even if a battery assembly plant were to be set up in Europe, a substantial part of its value chain would remain under Chinese control—a dependency that, although economically attractive, often borders on a form of quasi-monopoly and results in the European finished product performing less well than its Chinese equivalent, which will therefore be favored.

The relocation of final assembly operations for clean technology abroad—starting with LFP batteries—is now part of China's industrial strategy. By way of comparison, in 2024, Chinese companies exported approximately $177 billion worth of clean energy technologies.

At the same time, they **committed at least $58 billion to building new factories abroad to produce these technologies**. Once operational, these facilities could generate an estimated annual production value of $111 billion. **This strategy encourages Chinese clean technology companies to invest in emerging countries with the fewest trade and investment restrictions—in other words, those that agree to fully integrate into the Chinese value chain**.

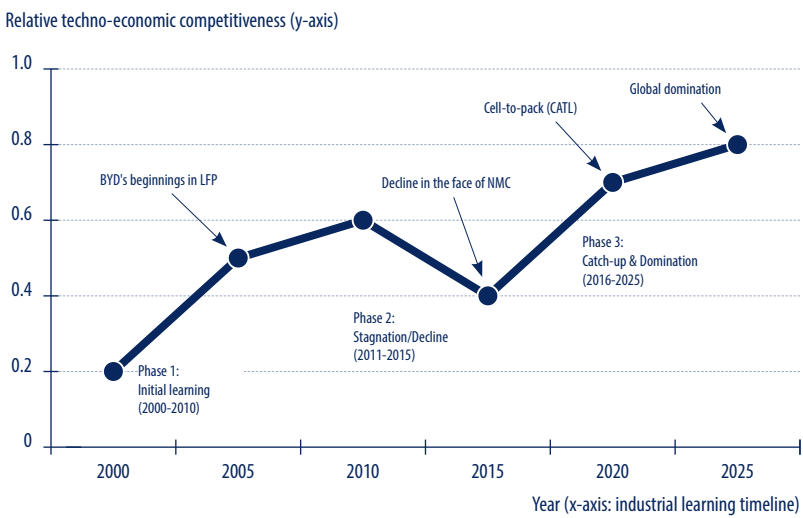
b. An Industrial Model That Transcends Different Clean Technologies

Figure 3 • Diagram of China's vertical industrial integration in cleantech and the role of state-owned enterprises



The trajectory of China's LFP battery industry is illustrative of China's strategy for cleantech. It shows an "N-shaped" learning curve, marked by three distinct phases: rapid initial learning in the 2000s thanks to strong public support, foreign technology transfer, and the emergence of numerous domestic players such as BYD; a period of stagnation between 2011 and 2015, linked to a loss of technological appeal for LFP compared to denser NMC batteries, which slowed its spread outside China, and a reduction in public support, which forced consolidation among the many players; followed by a spectacular catch-up phase starting in 2016, driven by integration innovations (e.g., cell-to-pack),[293] massive domestic demand for affordable EVs, and the rise of players such as CATL. This dynamic highlights the fact that technological advantage is neither linear nor irreversible and that well-orchestrated industrialization strategies can transform an initial disadvantage into global dominance.

Figure 4 • Industrial learning curve – LFP batteries in China[294]



China's ambition first manifested itself in low-value-added clean technologies that the country exports internationally, such as photovoltaic panels and first-generation batteries. It is now expanding into higher value-added segments such as EVs and wind turbines. China's strategy also aims to dominate the value chains for electrolyzers, whether for producing green hydrogen or later for carbon capture and utilization, a key issue for the future of global industry, particularly in the chemical and cement sectors.

c. Maintaining China's Centrality in Value Chains

These different levels of China's strategy should prompt **Europe** to secure **reliable and diversified access to critical minerals, the processing and extraction of which are largely controlled by Chinese companies**. This access is just as crucial as access to the various sections of the value chains, which are also increasingly dominated by specialized Chinese players.

[293] *Cell-to-pack (CTP) is an innovative lithium-ion battery architecture that allows cells to be integrated directly into the module or pack, without the need for an intermediate module structure. This configuration reduces the number of components, increases energy density at the system level, and lowers manufacturing costs. Introduced on a large scale by CATL starting in 2019, this technology has played a key role in the industrial rehabilitation of LFP in China; see "CATL Reveals Cell-To-Pack Battery Platform at IAA 2019," TaaS Magazine News, September 11, 2019, https://taas.news/article/108601/CATL_Reveals_Cell-to-pack_Battery_Platform_At_IAA_2019?utm.*

[294] *The y-axis (vertical axis) indicates relative techno-economic competitiveness, i.e., a qualitative and comparative measure of the technological and economic positioning of a given technology or sector.*

Clean energy manufacturing capacity by country (2024)

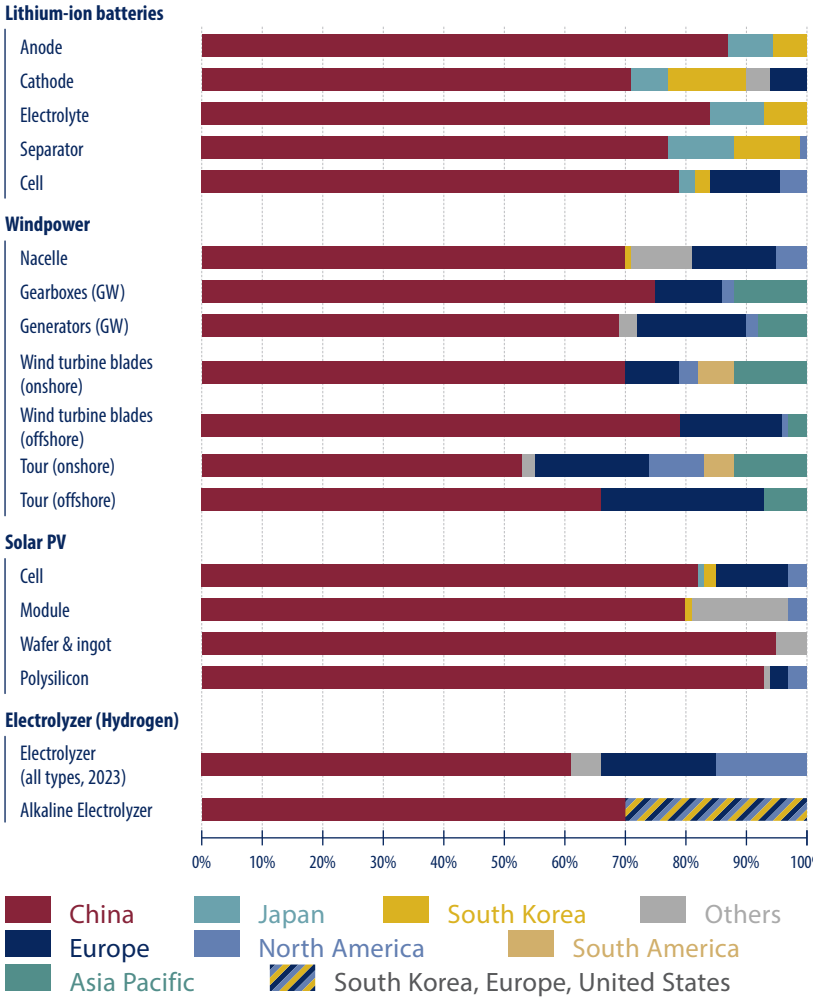


Chart based on data provided by MetaMarket Monitoring, the European Commission, Statista, Energy Trend, BNEF, Renewable Energy Institute, the International Energy Agency, Cheersonic, and through interviews.[295]

As illustrated in the figure above, Europe remains heavily dependent on China across the entire photovoltaic panel value chain and to a large extent for inputs for batteries; it is also increasingly dependent on China when it comes to wind turbines—particularly for permanent magnets and their components used in large infrastructure. The latter, particularly the minerals used in cathodes, can account for between 30 percent and 40 percent of the value of an EV and will also play a central role in storing the energy needed to manage the intermittency of renewable energies.[296]

The options available to Europe raise several questions. Should the European strategy aim for a presence across all value chains for key technologies, including those with low added value, such as photovoltaics? To what extent does Europe want to control the extraction of critical minerals, both outside its borders and domestically? To what extent can it develop competitive chains in refining? And how can it support these sectors for strategic reasons, even when they prove more expensive than their Chinese equivalents?

[295] *Meta Market Monitoring, "Material Supply," December 2024, https://metamarketmonitoring.de/en/materials/worldmap.php?&f2=0&f3=0&f4=1; S. Carrara et al., "Supply Chain Analysis and Material Demand Forecast in Strategic Technologies and Sectors in the EU – A Foresight Study," JRC Science for Policy Report, https://single-market-economy.ec.europa.eu/system/files/2023-03/Raw%20Materials%20Foresight%20Study%202023.pdf; Statista, "Global Wind Nacelle Manufacturing Shares By Region," 2024, https://www.statista.com/statistics/1475463/wind-turbine-nacelle-manufacturing-capacity-breakdown-countries-region; Energy Trend, "Global Distribution of Polysilicon Manufacturing," 2024, https://www.energytrend.com/news/20240407-46330.html; BNEF, "China Dominates Clean Technology Manufacturing Investment as Tariffs Begin to Reshape Trade Flows," BloombergNEF, April 28, 2025, https://about.bnef.com/insights/finance/china-dominates-clean-technology-manufacturing-investment-as-tariffs-begin-to-reshape-trade-flows-bloombergnef; Romain Zissler, Progress in Diversifying the Global Solar PV Supply Chain, Renewable Energy Institute 2024, https://www.renewable-ei.org/pdfdownload/activities/REI_SolarPVsupplychain2024_en.pdf; International Energy Agency (IEA), "Announced Electrolyser Manufacturing Capacity by Region and Manufacturing Capacity Needed in the Net Zero Scenario, 2021–2030," 2025, https://www.iea.org/data-and-statistics/charts/announced-electrolyser-manufacturing-capacity-by-region-and-manufacturing-capacity-needed-in-the-net-zero-scenario-2021-2030; Cheersonic, "2024 Electrolyzer Research Report," November 9, 2024, https://cheersonic-liquid.com/en/2024-electrolyzer-research-report.*

[296] *Institute for Energy Research, "Electric Vehicle Battery Costs Soar," April 25, 2022, https://www.instituteforenergyresearch.org/renewable/electric-vehicle-battery-costs-soar/.*

Japan and South Korea are interesting case studies for European strategy. Although their situations are relatively similar—with significant technological advances in batteries and heavy dependence on the Chinese value chain for critical minerals—their approaches offer concrete avenues for Europe, whether through partnerships with these countries or by drawing inspiration from their industrial strategies.

6.5. RECOMMENDATIONS FOR EUROPEAN INDUSTRIAL STRATEGY

In light of Europe's ambitions to develop a clean technology industry, framed by the *Net Zero Industrial Act*, and given the limitations of the EU's current strategy to secure critical materials against the risks of disruption or manipulation of supply chains, Europe needs a strategy. This note proposes action along three strategic lines for the EU, starting with the upstream part of the value chains:

a. Using European market access as an industrial strategy;
b. Adapting European rules to the reality of value chains;
c. Establishing strategic partnerships through Clean Trade and Investment Partnerships.

Figure 6 • Toward a Genuine European Industrial Strategy for Cleantech

A Using European Market Access as an Industrial Strategy

Recommendation 1
Leverage the European market in sectors where China is too dominant.

Recommendation 2
Support this strategy with tools for industrial sovereignty.

B Adapting European Rules to the Reality of Value Chains.

Recommendation 3
Mobilize structured financial support to boost mining investment in Europe.

Recommendation 4
Accelerate and harmonize the recycling of critical materials in Europe.

Recommendation 5
Mobilize the EIB to finance strategic reserves of critical minerals.

C Establishing Strategic Partnerships through Clean Trade and Investment Partnerships.

Recommendation 6
Adopt a "risk syndication" approach with partners that have converging interests.

Recommendation 7
Make access to the European market conditional on the integration of extraction and refining projects in Europe and among its CTIP partners.

Recommendation 8
Deepen technological and regulatory cooperation between the EU, Japan, South Korea, Canada, and other CTIP partner countries.

Recommendation 9
Forge strategic industrial partnerships outside China.

a. Using European Market Access as an Industrial Strategy

The EU will not be able to achieve its industrial and climate objectives without radically rethinking its strategy with regard to cleantech value chains. **It will have to adopt a *"reverse Deng Xiaoping strategy,"* conditioning access to the European market for technology sectors dominated by China or in the process of being so**. This strategy will need to combine two pillars: **(1) the mobilization of European market power as a lever of attractiveness** and **(2) a requirement for local industrial integration, including upstream**.

Where China has an almost insurmountable industrial advantage—in LFP batteries for EVs, for example—Europe must rely on its main asset: the attractiveness of its domestic market. China prefers to invest in countries that accept the integration of its value chain without restriction and discourages investment in countries that are too demanding. Europe should see this not as an obstacle but as a **strategic lever:** its market represents a high-margin outlet that China cannot ignore.

Recommendation 1

Leverage the European market in sectors where China is too dominant.

It is essential to **make access to the European market conditional on the local establishment of clean technology value chains**. This conditionality must be implemented through three levers:

- **Local content requirements:**
  - Set a threshold of **50 percent local content** for access to the European market (e.g., for EVs, which would include a significant proportion of critical vehicle components, including batteries).

- **Promote majority-European joint ventures:**
  - In sectors where Europe is lagging far behind (such as LFP batteries), priority should be given to **majority-European joint ventures**, with integration of local value chains to guarantee access to the European market.

- Impose local and progressive industrial integration by extending local content upstream in the chain:
  - **Moving beyond final assembly:** impose local integration of upstream components such as **precam materials** (PCAM) for batteries or permanent magnets for wind turbines and EVs.
  - **Couple this effort with the use of value chains in partner countries that have signed a Clean Trade and Investment Partnership (CTIP)**.

Recommendation 2

Support this strategy with tools for industrial sovereignty.

If this strategy is to be effective, it must be accompanied by complementary industrial and social measures, in particular to ensure the security and competitiveness of European technologies, boost the skills of European workers, and combat forced technology transfers to China:

- **European industrial visa policy:**
  - Coordinate a visa policy with Member States to **limit the entry of Chinese engineers to the strict minimum number required**.
  - Require the **majority of engineers and technicians** in supported projects to be **locally recruited**.

- **Technological conditionality on production equipment:**
  - Require the use of **European assembly robots** in new cleantech factories. This would stimulate the local industrial equipment manufacturing ecosystem and strengthen European skills in these technologies.

b. Adapting European Rules to the Reality of Value Chains

From a domestic point of view, the European strategy must be based on three inseparable pillars: the targeted revival of mining activity on European soil, the acceleration of circularity through more efficient and integrated recycling, and the constitution of strategic reserves to cope with supply shocks. Each of these areas requires a strong public commitment, both regulatory and financial, in order to create the conditions for massive private investment in the riskiest or least mature segments. **The aim is not to reconstitute an illusory autonomy but to correct the blind spots of a European market that is too fragmented and passive in the face of the industrial organization of third-party powers**.

Boosting mining investment in Europe is a prerequisite for securing cleantech value chains. Despite the growing importance of critical materials for European industry, mining projects are struggling to get off the ground, hampered by their capital intensity, long payback periods, and current perceptions of the economic and social risks involved. To reverse this trend, the EU needs to put in place a structuring financial framework capable of reducing uncertainty for private investors while

guaranteeing high environmental standards. The following recommendations aim to establish the public support tools needed to unlock financing, notably through guarantees, favorable regulatory integration, and greater mobilization of the European Investment Bank.

Recommendation 3

Mobilize structured financial support to boost mining investment in Europe.

The EU must activate robust financial support to secure private investment in the extraction and refining of critical materials. This includes:

- The **widespread provision of public guarantees on bank loans by Member States**, enabling companies to conclude purchase contracts with industrial partners.

- The **inclusion of mining activities in the European taxonomy**, subject to compliance with strict environmental standards, is also essential to encourage a sustainable revival of the European mining sector.

- **The European Investment Bank (EIB) must play a leading role in financing these capital-intensive projects. The EIB's statutes should allow it to exceed 10 percent investment outside Europe if projects are deemed strategic for the EU**.

Promoting Recycling and Avoiding Raw Material Leakage Outside Europe

Beyond developing strategic partnerships, the decarbonization of the European economy should be based on a **more efficient use of strategic resources and the development of European recycling capacities.**[297] **These vital issues will inevitably require innovation**.

The EU, faced with a crying lack of capacity to separate and recycle rare earths and other critical materials, must also **contend with the loss of precious resources, notably "black mass," which is often exported to other regions for processing, notably China**.

This leakage of essential raw materials limits the development of a competitive and integrated European recycling industry. This issue is of the utmost importance, as the low level of recycling in Europe of technologies containing critical materials accentuates dependence on third countries, particularly China.

This situation is all the more problematic given the intrinsic value of these wastes, which transcends their mere economic value. The dual advantage of recycling PCMs should be recognized: It helps **to secure supplies of essential resources while reducing the environmental impact associated with the extraction and processing of raw materials in countries with looser environmental standards**.

Europe should therefore **harmonize existing regulations concerning the management of waste containing CRMs** and set up a more **efficient collection system**. At present, **the transportation of waste across Europe remains a major constraint**, hampering recycling

[297] *AHughes-Marie Aulanier and Clara Benedini, "Guerre et transformation bas-carbone: d'une dépendance des énergies fossiles vers celle des métaux?" [War and the low-carbon transition: from a dependency on fossil fuels to one on metals?] Carbone 4, April 27, 2022, https://www.carbone4.com/analyse-guerre-et-transformation-bas-carbone-dependance-metaux.*

efforts and exacerbating the loss of critical materials. This approach would therefore aim to **improve the circularity of resources**, a major issue highlighted by the *Critical Raw Materials Act*. The latter proposes the introduction of regulations for due diligence certification schemes and environmental footprint declarations, with the aim of promoting greater circularity of CRMs. **The aim is to achieve 15 percent of annual consumption from recycling**.

These targets for the use of recycled minerals remain a challenge, as the European market is often outperformed by Chinese companies, who manage to offer better prices for recycling, **leading to outsourcing of the second stage of the materials recovery process. This is a major obstacle to the indigenization of the value chain: Cleantech manufacturers, even those established in Europe, have more interest in relying on the existing Chinese chain than in encouraging the emergence of European competitors**.

Furthermore, **CRM recycling rates** vary widely, with some **averaging around 8.3 percent**, while others such as natural **graphite, gallium, and light rare earths have recycling rates close to 0 percent**.[298] On this point, the diversity of battery chemistries considerably complicates any recycling strategy: While NMC batteries are relatively simpler to reprocess, **60 percent of LFP battery components end up in landfills, often in China in areas with few environmental restrictions, making any competition impossible**.[299]

Improving the circularity of critical materials therefore requires **a robust legal framework that establishes clear recycling standards.**

[298] *Emma Watkins, Emma Bergeling, and Eline Blot, "Circularity and the European Critical Raw Materials Act: How Could the CRMA Better Promote Material Circularity?," IEEP, 2023, https://ieep.eu/wp-content/uploads/2023/10/Circularity-and-the-European-Critical-Raw-Materials-Act-IEEP-2023.pdf.*

[299] *Tianyu Zhao, Weilun Li, Michael Traversy, Yeonuk Choi, Ahmad Ghahreman, Zhongwei Zhao, Chao Zhang, Weiduo Zhao, and Yunfeng Song, "A Review on the Recycling of Spent Lithium Iron Phosphate Batteries," Journal of Environmental Management 351 (2024): 119670, https://doi.org/10.1016/j.jenvman.2023.119670.*

The European battery recycling industry could serve as an example for extending this circularity to other sectors.[300] The regulation on end-of-life vehicles, adopted in July 2023, aims to optimize the use, recycling, and reuse of CRMs in EVs, in particular permanent magnets. It sets the objective of designing EVs whose materials are 85 percent recyclable and 95 percent reusable.

Similarly, the August 2023 EV battery regulation introduces **ambitious sustainability criteria**, with specific targets for recycling efficiency, material recovery, recycled content, and minimum recycling efficiencies, to be phased in from 2025.[301] The regulation stipulates that by 2027, EV battery production processes must achieve a recycling rate of 90 percent for cobalt and nickel and 50 percent for lithium. In this context, **cooperation with Japan, for example, represents a strategic opportunity:** Although the country still has few end-of-life batteries, it is already investing in recycling infrastructures that, like the European sector, are difficult to sustain without public support. **Collaboration between the two regions could facilitate the development of common standards and the evaluation of the performance of used batteries, thus fostering the emergence of a structured market for their reuse**. This is an initiative that South Korea is also looking to join.

Finally, the EU should draw up **clear guidelines to promote investment in recycling infrastructure**, in particular by **introducing tax measures favorable to the transition to a circular economy**.[302] A substantial financial commitment by European institutions and Member States to improving the collection and recycling of critical materials can help create a competitive business model that reduces the costs associated

[300] *European Commission, "End-of-Life Vehicles," n.d., https://environment.ec.europa.eu/topics/waste-and-recycling/end-life-vehicles_en.*

[301] *European Commission, "Circular Economy: New Law on More Sustainable, Circular and Safe Batteries Enters into Force," August 17, 2023, https://environment.ec.europa.eu/news/new-law-more-sustainable-circular-and-safe-batteries-enters-force-2023-08-17_en.*

[302] *Fathi Birol and Pascal Canfin, "Why the European Union Needs Bold and Broad Strategies for Critical Minerals," International Energy Agency, March 7, 2023, https://www.iea.org/commentaries/why-the-european-union-needs-bold-and-broad-strategies-for-critical-minerals.*

with collection and logistics. Ideally, this funding could be **integrated into the Horizon Europe program**, which includes a section specifically dedicated to innovation in Europe. This initiative should also be carried out in synergy with Member States' national R&I programs.

In order to strengthen the Continent's autonomy, it is imperative to structure a complete recycling value chain in Europe, with a realistic target of 30–40 percent domestic production of critical materials, which would eventually include recycled materials. **The capture of used cleantech components—such as black mass from batteries, permanent magnets from wind turbines and EVs, and, in the long term, critical cathode components from electrolyzers—should therefore be the subject of policies aimed at limiting their export outside the EU and its strategic partners**.

Recommendation 4

Accelerate and harmonize the recycling of critical materials in Europe.

- The EU needs to **set differentiated recycling targets for each critical material and cleantech sector** in order to monitor value chains requiring greater efforts.

- **Harmonization of regulations between Member States on the management of waste containing critical materials is also essential**, as is the introduction of a more efficient Europe-wide collection system.

- Waste transport remains a major obstacle to recycling due to restrictive national rules. It is imperative to **liberalize transport between Member States, with a view to pooling the mass of**

critical materials to be recycled and recovered on the Continent.

- The EU should also launch a **process to harmonize recycling standards with its partners who have signed a CTIP**, in order to encourage quality improvement and joint circularity.

- Finally, the EU should **introduce strict export quotas for waste containing critical materials, differentiated by material and by components used (starting with permanent magnets and black mass)**, destined exclusively for countries that have not signed a CTIP with Europe.

Establish a Stockpile System for the Most Critical Materials

Following the example of Korea and Japan, **the EU and its Member States should consider building up stocks of these resources**. The case of Korea, which has set up an early warning system to monitor and manage the risks of disruption to thirty-three strategic minerals, could serve as an example.[303] Led by the Center for Economic Security and Foreign Affairs, this system has enabled Korea to better identify resources requiring emergency stockpiling, thus avoiding the shortage crises observed. The introduction of a **similar early warning system within the EU**, focused on analyzing the risks of shortages of critical materials, could **improve access to information on strategic resource requirements (which is currently lacking) and encourage specific investment in stocks**.[304] This would enable a detailed assessment to be

[303] *"Economic Security and Diplomacy Center Opens; IPEF Response Team to Launch," Herald Corp., May 30, 2022, http://news.heraldcorp.com/military/view.php?ud=20220530000685.*

[304] *European Parliament, "Securing Europe's Supply of Critical Raw Materials: The Material Nature of the EU's Strategic Goals," March 2023, https://www.europarl.europa.eu/RegData/etudes/BRIE/2023/739394/EPRS_BRI(2023)739394_EN.pdf.*

made of each critical material in order to understand the dependencies, risks, and innovations affecting demand.

At present, **the EU does not have an adequate storage system for these materials**. By comparison, by 2021, Korea had increased its stocks of rare metals to ensure 100 days' consumption, while Japan, by 2020, was aiming to secure 60 days' domestic consumption from its emergency reserves. In the face of price volatility, **establishing a European storage system for strategic materials**, identified in the *Critical Raw Materials Act*, **is essential if we are to guarantee the production of green transition technologies within the EU**. Emergency reserves, covering sixty days of domestic consumption, could alleviate access difficulties and price rises, reducing the vulnerability of European industries.

To **finance this storage system**, the EU could **exploit financial instruments to cover operational costs and part of the investment in critical materials, drawing inspiration from the 2021 *Conflict Minerals Regulation***.[305] These regulations, which **require companies to set up risk identification and mitigation systems for the supply of high-risk minerals**, could be **extended to other materials essential for decarbonization**. In addition, the EU should promote the development of its storage capacities by **engaging in dialogue with industries** to stimulate private investment in the reconfiguration of their supply chains and the storage of strategic resources, thereby adapting their operations to the volatility of market prices.

[305] *European Commission, "Conflict Minerals Regulation," 2021, https://policy.trade.ec.europa.eu/development-and-sustainability/conflict-minerals-regulation_en.*

Recommendation 5

Mobilize the EIB to finance strategic reserves of critical minerals.

- The EU should draw inspiration from the Japanese JOGMEC model by **mandating the EIB to finance the creation of strategic reserves of critical minerals**. This role could include support for upstream exploration and the development of new mining projects, filling the gaps left by private investors in segments deemed too risky but essential to the EU's industrial security.

c. Establishing Strategic Partnerships through Clean Trade and Investment Partnerships

Taking minilateral action without waiting for the United States

It is in Europe's interest to diversify its supply chains for critical materials by establishing new bilateral partnerships on this specific issue. **It is also in the interest of its partners to diversify their "customers"** so as **not to be exclusively dependent on Chinese processors but also to attract investment in order to create value locally and move up the value chain**. While the creation of a club on the initiative of the EU seems unlikely, the idea of minilateral action could nevertheless prove necessary. The EU needs to jointly design private investments while integrating third countries into global value chains, an essential objective in the context of a European clean industrial deal.

In April 2024, the EU, the US, and other partners in the **Minerals Security Partnership (MSP)**, joined by Kazakhstan, Namibia, Ukraine, and Uzbekistan, announced the launch of the **Minerals Security**

Partnership Forum (or "MSP Forum"), which will serve as a new platform for cooperation on CRMs.[306] The MSP Forum brings together both resource-rich countries and countries with high demand for these raw materials. The Critical Raw Materials Club, initially announced by the European Commission, is now fully integrated into the MSP Forum. This integration results in a broader and more ambitious joint initiative, in which the European Commission represents the EU.[307]

To date, the format has struggled to translate into concrete projects, and the MSP Forum remains in search of a flagship project to showcase. Above all, it is hampered by the free-rider behavior of the **Trump administration, which shows no interest in cooperating with the EU on critical minerals**. Washington openly favors its own interests, particularly those of the semiconductor sector, to the detriment of clean technologies and a balanced partnership. The US has also handed over the chairmanship of the MSP to South Korea.

In this context, **the idea of close cooperation with the US on clean technology value chains—from mining to the final product—seems illusory**. This considerably reduces the strategic interest of the minilateral framework for Europeans. **Closer cooperation with other MSP members, such as Japan, South Korea, India, or Australia, is more feasible**.

A group of countries seeking to consolidate their clean technology sectors, such as Japan, South Korea, and the EU, could thus co-invest in joint extraction and refining projects, allocating mining joint ventures to economic security projects that would meet their clean technology deployment objectives. This is particularly feasible in the lithium and rare earth sectors, both for extraction and refining.

[306] *European Commission, "Press Release: EU and International Partners Agree to Expand Cooperation on Critical Raw Materials," April 5 2024, https://ec.europa.eu/commission/presscorner/detail/en/IP_24_1807.*

[307] *European Commission, "Press Release: EU and International Partners Agree to Expand Cooperation on Critical Raw Materials."*

Recommendation 6

Adopt a "risk syndication" approach with partners that have converging interests.

It is necessary to assume that certain states, as well as their public financing institutions (such as the EIB, JOGMEC, or KOMIR), and certain companies will act as "buyer-investors." A coalition of these players—from the EU, Japan, and Korea, for example—would enable upstream project risks to be pooled, with a view to risk syndication. The aim of this approach would be to support projects led by states that are "sellers-developers" of critical resources. Joint ventures are the central tool in this strategy of structuring co-investment.

Frame the Clean Trade and Investment Partnerships

As already advocated within the Critical Raw Materials Club, the EU could take this logic further and seek to establish bilateral "win–win" partnerships with resource-rich countries.

The EU could, in particular, strengthen its partnerships with producing countries seeking to diversify their raw material extraction and refining activities. The EU currently has partnerships or agreements on CRMs with fourteen countries.[308] This is particularly the case for Zambia and the DRC for cobalt,[309] Zimbabwe for platinum,[310] Chile for lithium,[311]

[308] *European Commission, "Raw Materials Diplomacy," n.d., https://single-market-economy.ec.europa.eu/sectors/raw-materials/areas-specific-interest/raw-materials-diplomacy_en.*

[309] *European Commission, "Global Gateway: EU signs strategic partnerships on critical raw materials value chains with DRC and Zambia and advances cooperation with US and other key partners to develop the 'Lobito Corridor.'"*

and Indonesia for nickel, tin, and copper.[312] **Most of these countries are seeking to restructure foreign investment in the mining sector** in order to stimulate job creation and value-added industrial production.[313] Most of these players are seeking to avoid exclusive dependence on Chinese industry, particularly due to price volatility and the control exercised by Chinese state-owned enterprises over prices.

In this context, the EU has an opportunity to contribute not only to the development of local value-added industries but also to limiting the environmental and social impact of mining projects in resource-rich countries. However, this approach **does not address the challenge of risk aversion associated with investing in countries considered or perceived as politically and economically unstable**, a significant obstacle that prevents many projects initiated by European companies from being carried out.

Beyond these strategies, Europe would benefit greatly from establishing broader partnerships that transcend the simple issue of critical materials to encompass a wider framework for cooperation, combining investment, climate-specific financing (for both mitigation and adaptation), access to critical materials, and agreement on the deployment of clean technologies.

It is in this spirit that the Commission has announced its intention to launch the first **CTIPs** with the aim of diversifying supply chains and

[310] *Shalom Maurukira, "EU Reaffirms Duty-Free Trade Access for Zimbabwe," EquityAxis, April 28, 2025, https://equityaxis.net/post/18387/2025/4/eu-reaffirms-duty-free-trade-access-for-zimbabwe.*

[311] *Innovation News Network, "EU and Chile Sign Trade Agreement to Strengthen Critical Raw Material Security," December 15, 2023, https://www.innovationnewsnetwork.com/eu-and-chile-sign-trade-agreement-to-strengthen-critical-raw-material-security/41215/.*

[312] *The free trade agreement between the EU and Indonesia is still under negotiation. See: Julie Zalcman, "The Not-so-Clean Trade Deal between the EU and Indonesia," Friends of the Earth Europe, March 18, https://friendsoftheearth.eu/news/the-not-so-clean-trade-deal-between-the-eu-and-indonesia/.*

[313] *Filip Warwick, "Indonesian Resource Nationalism Could Spell Tough Times for Metals Sector: ANZ," S&P Global, January 20, 2022, https://www.spglobal.com/commodityinsights/en/market-insights/latest-news/metals/012022-indonesian-resource-nationalism-could-spell-tough-times-for-*

concluding **mutually beneficial** agreements.[314] By mobilizing private investment and public support (financial guarantees, technical assistance, and tailored procurement), they could become a **key lever for clean industrialization**.

The governance of these CTIPs remains unclear. Placed under the responsibility of the Commissioner for Trade and Economic Security, they do not fully integrate other key actors, such as the High Representative for Foreign Affairs or the Commissioners responsible for energy and partnerships. Without effective coordination, the CTIPs risk being an isolated initiative rather than a genuine strategic tool. Their success will also depend on the commitment of Member States and development banks, which is essential for setting clear investment conditions and avoiding intra-European competition.[315]

Finally, CTIPs should not be designed as transactional exchanges but should genuinely aim for transformative engagement that aligns with the priorities of third countries. To be credible and competitive with Chinese financing, these partnerships must offer more than market access: **a clear framework, an attractive offer combining trade in technology and clean goods, investment and technological support, and effective implementation without administrative red tape**. Finally, they should be long-term partnerships that include concrete project financing with the exchange of finished goods.

[314] *European Commission, "Clean Industrial Deal: A Plan for EU Competitiveness and Decarbonisation," 2025, https://commission.europa.eu/topics/eu-competitiveness/clean-industrial-deal_en.*

[315] *Simone Tagliapietra, "Making the Most of the New EU Clean Trade and Investment Partnerships," Bruegel, October 16, 2024, https://www.bruegel.org/first-glance/making-most-new-eu-clean-trade-and-investment-partnerships.*

Recommendation 7

Make access to the European market conditional on the integration of extraction and refining projects in Europe and among its CTIP partners.

One common feature of the various Japanese and Korean strategies is the close link between investment in the extraction and refining of critical materials and the development of clean technology projects. This is particularly evident in North America, where gigafactory projects led by Japanese or Korean players are systematically paired with extraction and refining projects, mostly located in Canada. This synergy has been made possible by the local content requirements introduced under the Inflation Reduction Act.

The EU would do well to follow suit by **making access to the European market (e.g., for batteries and EVs) conditional on the integration of strategic projects for the extraction and refining of critical materials located on its territory or that of a partner that has signed a Clean Trade and Investment Partnership**. This would create a powerful incentive for partners to sign a CTIP in order to integrate European value chains. **The introduction of a local content threshold for each section of the value chain** (e.g., 50 percent in batteries intended for the European market) would both secure the upstream part of the value chain and strengthen Europe's industrial competitiveness.

Establish Research & Innovation Partnerships with CTIP Countries to Promote Sobriety

Beyond the proposals set out in the *Critical Raw Materials Act*, the EU should seek to **strengthen its cooperation on R&I with other countries facing the same challenges** in order to acquire advanced techniques for separating and processing critical materials. As illustrated in this note, **Japan is an important potential partner** in this area. The country's recent innovations to advance the **substitution of certain critical metals** (or their significant reduction) with more abundant materials represent a path that should not be overlooked. Any reduction in the amount of ore needed in a technology (batteries, PV, wind turbines, etc.) represents ore that will not have to be extracted and will thus reduce dependence.

Initial progress has been made in this regard, following the conclusion of a MoU in July 2023 between **DG GROW and JOGMEC on cooperation in CRM supply chains**, seeking to **strengthen information sharing and mutual support for exploitation projects**.[316] The EU is committed to strengthening its collaboration with Canada and, more recently, concluded an MoU on **cooperation on CMP extraction and refining technologies** in September 2023.[317] As part of the Horizon Europe initiative, the agreement seeks to facilitate the exchange of information and joint innovation programs, in line with ESG best practices.

Although crucial, the **potential contribution of local extraction and production projects to the EU's critical raw material needs by 2030 will remain limited**. Establishing **R&I partnerships** focused on

[316] *Commission européenne. (6 juillet 2023). Enhancing cooperation with Japan on critical raw materials supply chains through a new Administrative Arrangement. https://single-market-economy.ec.europa.eu/news/enhancing-cooperation-japan-critical-raw-materials-supply-chains-through-new-administrative-2023-07-06_en.*

[317] *Horizon Europe. (2023). Technologies for extraction and processing of critical raw materials (IA). https://www.horizon-europe.gouv.fr/technologies-extraction-and-processing-critical-raw-materials-ia-32656#fn6.*

reducing the use intensity of CRMs is therefore essential. In the long term, these initiatives **will enable the EU to build technical expertise** and reduce its dependence on China as its sole partner.

In terms of innovation and research, cooperation with Japan, South Korea, and Canada should be a strategic priority for Europe. This need is particularly pressing in the battery sector, where, despite Chinese dominance, Japan and South Korea retain a technological advantage in several key segments of the value chain. Such cooperation is also crucial for next-generation electrolyzers in order to promote technological and industrial convergence with these partners. Strengthening these partnerships would lay the foundations for common standards among industrialized countries with high clean technology intensity.

Recommendation 8

Deepen technological and regulatory cooperation between the EU, Japan, South Korea, Canada, and other CTIP partner countries.

- **This cooperation should focus more on innovation, through the pooling of resources** (particularly between public and private laboratories) and the **co-financing of joint research projects**. Joint efforts to develop **advanced recycling technologies** and **material efficiency solutions** would help build a resilient and competitive technological ecosystem, reducing vulnerabilities linked to dependence on a limited number of countries.
- Beyond disruptive technologies, there is also significant potential in **collaboration on refining and processing**. This lever is becoming strategic in the face of increasing export controls, not only on critical minerals but also potentially on the technologies themselves.

- Another priority area is the **traceability of materials throughout the value chain**. The interoperability of traceability systems between partners is essential to ensure the transparency, trust, and sustainability of supply chains. The systematic integration of ESG criteria into these traceability systems would be a key lever for strengthening security of supply while promoting better integration of value chains between Europe, Asia, and North America.

When it comes to cleantech value chains, to reduce its dependence on China while consolidating its industrial capabilities, the EU needs to forge targeted partnerships with countries that share its strategic interests. Rather than aiming for illusory autonomy, we need to build industrial alliances differentiated according to technological segments, capable of ensuring the security of critical supplies and strengthening the resilience of value chains. This approach must be based on technological complementarity and regulatory convergence, through joint ventures, partnership agreements, and structuring joint projects.

Recommendation 9

Forge strategic industrial partnerships outside China.

Europe needs to rely on differentiated international alliances, both to secure supplies and to build robust industrial alternatives. In clean technology value chains, several areas of cooperation should be prioritized, depending on the sector:

- **Batteries:** strengthen cooperation with Japan and South Korea through joint ventures and the signing of CTIP-type agreements, facilitating the co-integration of value chains.

- **Electrolyzers:** form coalitions of interest with Japan and the United States, particularly for critical components such as electrode membranes.
- **Wind power:** develop cooperation on permanent magnets with countries facing similar dependence on China, with a shared strategy of diversifying supply sources.

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EUROPE

- Federal Ministry for Economic Affairs and Climate Action (BMWK), German Federal Republic
- Renault
- European Battery Association
- InnoEnergy
- Umicore
- Clean Tech for Europe
- Orano Batteries
- EIT InnoEnergy
- DG GROW, European Commission
- DG ENER, European Commission
- Northvolt
- Ondra
- DG CLIMA, European Commission
- Airliquide
- Battery Association for Supply Chain
- Institut Mobilités en Transition
- Hy24
- Minister of Industry, France
- Engie
- Breakthrough Energy
- Direction Générale des Entreprises, France
- Joint Research Centre, European Commission
- Strategic Perspectives
- Hydrogen Europe
- Siemens Energy
- Batteries European Partnership Association (BEPA)
- Demeter Investment Managers
- ZSW (Center for Solar Energy and Hydrogen Research)
- Dioxyle

- Valeo
- Délégation de l'Union européenne en Chine

JAPAN

- Toyota Motor Corporation
- Ministry of Economy, Trade, and Industry (METI), Government of Japan
- NEDO Europe
- NEDO Critical Raw Materials
- JOGMEC
- Special Advisor to METI
- Mitsui & Co. Global Strategic Studies Institute
- Embassy of Japan in France
- Emulsion Flow Technologies
- GS Yuasa International
- Kanadevia Corporation
- Asahi Kasei
- Panasonic
- Shimadzu
- The Institute of Energy Economics, Japan
- Marunouchi Innovation Partners
- RITE, Japan
- CRIEPI, Japan
- IGES, Japan
- Mitsubishi

TAIWAN

- ProLogium Technology

SOUTH KOREA

- KOMIR
- Korean Institute for International Economic Policy
- Presidential Committee for Net Zero and Green Growth of the Republic of Korea
- Ministry of Trade, Industry, and Economy (MOTIE), Government of the Republic of Korea
- Kim & Chang
- Embassy of the Republic of Korea in France
- LG Energy Solution
- Doosan Enerbility
- EcoPro BM

CHINA

- MIIT, Governement of the People Republic of China
- MEE, Governement of the People Republic of China
- BYD
- CATL
- Shanghai Institute of International Studies
- EDF, China
- Chinese Academy of Sciences
- Chinese Academy of Social Sciences
- China Council for Promotion of International Trade
- Chambre du Commerce Chinoise en Europe

OTHER

- International Energy Agency
- OECD
- Amazon

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Katalyse
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Kearney
KPMG S.A.
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La Banque Postale
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The European Union has committed to achieving carbon neutrality by 2050, an ambitious goal enshrined in European climate law. But this green transition comes with a major new strategic challenge: Europe's growing dependence on critical materials that are essential for clean technologies, whose supply chain is now largely controlled by China and its dominant position in the downstream industrial value chains of these technologies.

This note analyzes the geopolitical risks and challenges associated with this dependence; examines the industrial strategies adopted by China, Japan, and South Korea; and questions the crucial choices that Europe must make to secure its technological and economic autonomy and build its place in the net-zero economy. It also proposes levers for action to strengthen European industrial sovereignty and build a resilient, innovative, and competitive value chain.

Faced with rising international tensions and the climate emergency, the European Union is at a turning point: Will it remain a mere consumer or become a major sovereign industrial player in clean technologies?

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