German Japanese Energy Transition Council

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Renewable Energy Sources and Critical Raw Materials

Fact Sheet and results of the discussions at the GJETC meeting on 18/19 February 2025

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METI
Ministry of Economy, Trade and Industry

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List of Abbreviations, Units and Symbols

Abbreviations

BDI	Federation of German Industries
CRM	Critical Raw Materials
CRMA	Critical Raw Materials Act
DERA	Federal Institute for Geosciences and Natural Resources
ESG	Environmental, Social and Governance
EU	European Union
EVs	Electric Vehicles
HVs	Hybrid Vehicles
IEA	International Energy Agency
JOGMEC	Japan Organization for Metals and Energy Security
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
PHEV	Plug-In-Hybrid Electric Vehicles
SDG	Sustainable Development Goals
WTO	World Trade Organization

Units and Symbols

$	US dollar
%	Per cent
€	Euro
GW	Gigawatt
GWh	Gigawatt hours
MT	Million tonnes
Kt	Kilo tonnes
T	Ton

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Executive Summary

Based on the necessity of critical raw materials (CRM) for the energy transition, this fact sheet analyses the current and future status and policies regarding CRM in Japan and Germany (EU). Focusing on battery storage and electric vehicles as an example, battery minerals like copper, lithium, nickel, manganese, cobalt, and graphite are covered. This fact sheet examines and compares the status and policies related to CRM in Japan and Germany, and identifies areas of cooperation not only between the two countries but also among like-minded countries. Further, this paper has, based on analysis of the current policies and several dialog formats of the 'German Japanese Energy Transition Council', developed six policy recommendations to increase reliability of the CRM supply for Japan and Germany. The policy recommendations are: (1) Establish regular CRM demand and supply outlooks, (2) Pursue demand reduction through substitution by innovative and alternative technologies, efficiency, and behavior change, (3) Implement circular economy principles, (4) Increase domestic production, (5) Ensure access to international markets, and (6) Establish a CRM Club of like-minded importing and exporting countries.

1 Introduction

The era of global trade predominantly detached from political influence and characterized by established rules and the optimization of supply chains in accordance with capitalist principles appears, at least temporarily, to be drawing to a close. At the latest the rising influence of geopolitics on the economy became evident with the Russian invasion of the Ukraine and the resulting increase in energy prices. With the inauguration of U.S. President Trump (and his tariff and resource policies), another uncertainty factor arises for international relations. This new reality holds true for fossil fuels and for critical raw materials (CRM) as well. CRM are essential for renewable energy technologies, which in turn are essential for the energy transition towards renewable energy sources and the digitalization. The emerging paradigm emphasizes the risk of a dependency 'away from fossil fuels and towards mineral raw materials', resulting in the need for industrialized countries, such as Japan and Germany, to address these emerging new dependencies. This fact sheet evaluates the dimensions of the dependency of Japan and Germany of CRM and provides policy recommendations to address the CRM dependency.

In order to narrow down the scope of this analysis, a focus is set on the CRM required for battery storage and electric vehicles (EVs) as representative technologies for the energy transition towards renewable energies. Furthermore, this fact sheet addresses the role of CRM for the energy transition in Japan and Germany by covering an analysis of the current and future demand of CRM, policy strategies for demand reduction and supply chain diversification in both countries and the potential areas of cooperation.

2 Status of critical material supply related to demand

2.1 Definition of critical raw materials in Germany and Japan and potential risks in supply chains

Research on the criticality of raw materials examines the economic and technical dependencies of materials that could potentially cause supply chain bottlenecks. These dependencies vary depending on the stakeholder group and the time frame in question (Schrijvers et al., 2020). The terms ‘critical minerals’ and ‘critical raw materials’ are often used interchangeably. Generally, what critical minerals are is defined by their supply risk and their economic significance, particularly for the production of clean energy technologies, such as batteries for energy storage and EVs. As a result, the definition of critical minerals is continually revised and expanded. In this fact sheet, the term critical raw materials (CRM) will be used referring to both critical minerals and critical raw materials. In Europe, CRM are defined in the Critical Raw Materials Act (CRMA), which initially identified 14 minerals in 2011 and has since been updated every three years. By 2023, the list includes 34 minerals as shown in Table 1. Copper and nickel, while not meeting the thresholds for CRM, are designated as strategic raw materials and included in the CRM list in accordance with the Critical Raw Materials Act (European Commission, 2024b).

Table 1: Critical Raw Materials for the EU

Bauxite	Coking Coal	Lithium	Phosphorus
Antimony	Feldspar	Light rare earth elements	Scandium
Arsenic	Fluorspar	Magnesium	Silicon metal
Baryte	Gallium	Manganese	Strontium
Beryllium	Germanium	Natural Graphite	Tantalum
Bismuth	Hafnium	Niobium	Titanium metal
Boron/Borate	Helium	Platinum group metals	Tungsten
Cobalt	Heavy rare earth elements	Phosphate Rock	Vanadium
		Copper	Nickel

Source: (European Commission, 2024b)

In Germany, the Federal Institute for Geosciences and Natural Resources (DERA) is responsible for identifying critical minerals; its list aligns with the EU definition. Similarly, Japan has classified 35 raw materials as critical (METI, 2023b). These include battery metals like lithium, nickel, manganese, cobalt, and graphite. There is no official definition of critical minerals, however the government designates a critical mineral in accordance with supply vulnerability and the necessity of government intervention. Table 2 represents critical minerals identified by the Japanese government.

Table 2: Critical minerals identified in Japan

Lithium	Magnesium	Beryllium	Silicon	Zircon
Cobalt	Titanium	Vanadium	Boron	Molybdenum
Nickel	Manganese	Niobium	Phosphorus	Indium
Graphite	Germanium	Antimony	Chromium	Tellurium
Rare earth	Tungsten	Barium	Rubidium	Cesium
Gallium	Bismuth	Hafnium	Selenium	Thallium
Platinum	Fluorine	Tantalum	Strontium	Rhenium

Source: (METI, 2023b)

Rare earth elements, essential for renewable energy production, are often discussed alongside CRM. To address and mitigate supply chain shortages, various summits and agreements have been organized. One of the most significant platforms regarding CRM is the International Energy Agency (IEA). The IEA identifies four key challenges in relation to the supply of critical minerals: 'increasing demand, volatile price movements, supply chain bottlenecks and geopolitical concerns' (IEA, 2024a). The increasing demand for critical minerals is primarily driven by the transition from fossil fuels to renewable energy sources. To enable this shift, the demand for these materials is expected to rise significantly.

Price fluctuations in recent years have been largely due to instances where market supply has exceeded demand. Conversely, an oversupply of stocks, such as battery cells, has suppressed raw material prices. The offshore wind sector, on the other hand, experienced a shortage of critical minerals during the COVID-19 pandemic. However, according to IEA scenarios, this situation is projected to change by 2035, as according to projections only 70% of the global copper demand and 50% of lithium demand may be met. While materials like graphite and rare earth elements do not currently face a supply shortage, they are affected by high market concentration. For instance, 90% of the graphite used in battery cell production is mined in China. According to the IEA, supply concentration is expected to increase in the coming years, with approximately 75% of the global supply of nickel, cobalt, lithium, and rare earth elements sourced from just three production regions or countries. This poses significant risks, including potential geopolitical conflicts and disruptions due to extreme weather events(IEA, 2024a).

High market concentration in production is particularly evident in regions such as Latin America, Indonesia, and various African countries. In the refining sector, China holds a dominant position, accounting for over 50% of global capacity (IEA, 2024b). In addition, the Federation of German Industries (BDI) highlighted that import dependency has also increased in recent years for several critical minerals essential to the production of batteries in the German industry. Especially the dependency on lithium poses a significant risk in the event of import disruptions. According to the BDI, a supply chain disruption could result in a loss of €42 billion in value creation within the German automotive industry (Bernhart et al., 2024).

As illustrated in Figure 1, a significant portion of the projected increase in critical mineral demand is driven by the growing need for storage technologies and batteries. For this reason, this fact sheet focuses on batteries for EVs and energy storage systems, with an emphasis on critical minerals and rare earth elements that are most essential for their production such as lithium, cobalt, nickel, manganese, graphite and copper.

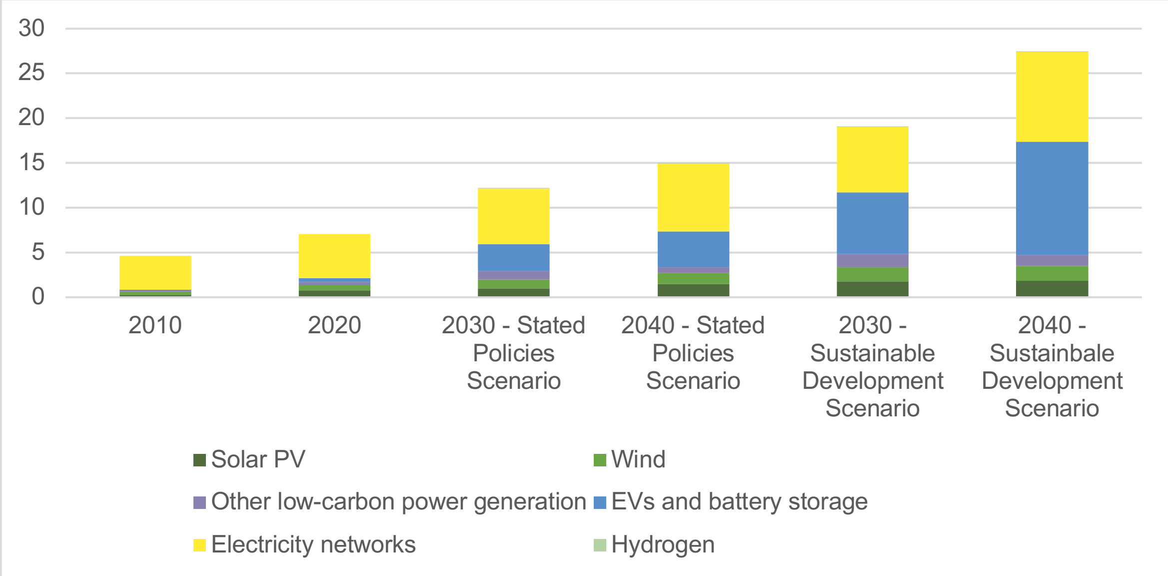

Figure 1: Total mineral demand for clean energy technologies by scenario, 2010-2040 (Mt)

Source: (IEA, 2021)

2.2 Current and future status in Germany

According to the Climate Change Act (2021) Germany aims to reduce its greenhouse gas emission by 65% of 1990 levels by 2030. A key component in achieving this overarching goal is the expansion of battery storage and EVs. For the electromobility, the sub-target of 15 million fully electric vehicles[1] has been defined. In addition to back-charging electric vehicles, large-and small-scale battery storage facilities (commercial storage facilities, home storage unit) are increasingly required to stabilize the energy supply in Germany with a growing share[2] of renewable electricity in the grid (BMWK, 2023b). Germany's current total stationary battery power stands at 11.2 GWh[3] (Figgener et al., 2024). Figure 2 shows the rapid development of battery power in Germany.

[1] Status as of Oct. 2023: 2.11 mil. electric vehicles (1.21 mil. Fully electric vehicles & 903.000 Plug-in-hybrid) registered

[2] Goal: By 2030 80% renewable energies of Germany´s gross electricity consumption (BMWK, 2023b)

[3] Large-scale storage 1.5 GWh, Industrial storage 330.3 MWh, Home storage 9.3 GWh (Sum of storage energy - battery energy in Germany is reported at 17.1 GWh)

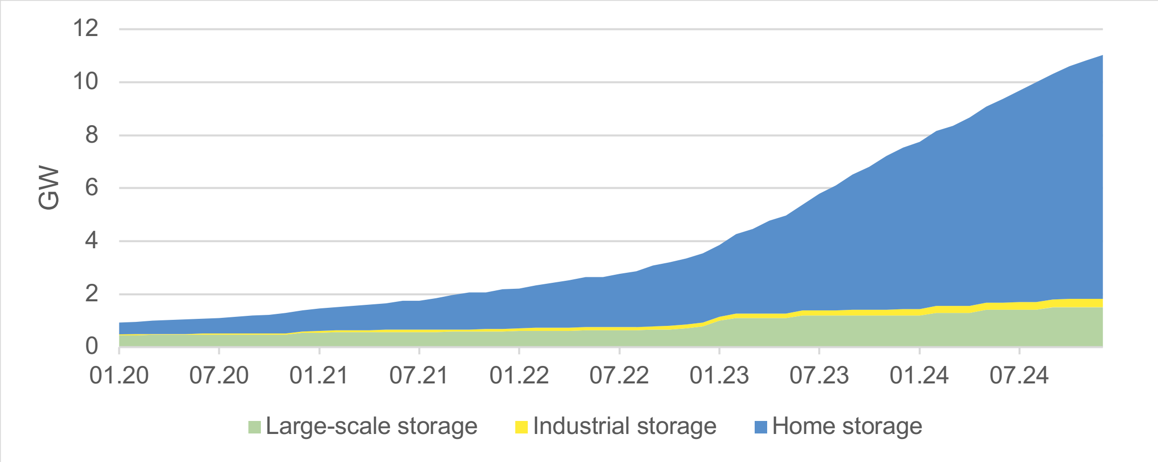

Figure 2: Battery power in Germany (All stationary battery technologies)

Source: (Figgener et al., 2024)

Even though a rise in the battery storage capacity can be observed, no official expansion target has been issued by the German government. A study by (Frontier Economics, 2023) determines the potential large-scale battery storage capacity of 57 GW in Germany by 2030. A further scenario analysis conducted by (Willie-Haussmann et al., 2022) forecasts a required stationary storage capacity of 100 GW by 2030 (180 GW by 2045) for Germany. Despite such differences in the literature in terms of required battery storage capacity by 2030, a consensus can be observed that the battery storage capacity needs to be significantly expanded in Germany. This expansion of battery storage capacity will only be possible, if the required CRM are available at reasonable conditions.

Figure 3 shows the total sales of BEVs in Germany per year. The market share of BEVs has declined in 2024 to 13.5% from previously 18.4% in 2023 (ADAC, 2025). In January 2025, it rose to 16.6%. In addition, PHEVs (Plug-In-Hybrid Electric Vehicles) achieved a market share of 8.5%, and HVs (Hybrid Vehicles) reached 28.6%. The official target of the German government is to bring 15 mn electric cars on the roads in 2030 (Federal Government, 2024).

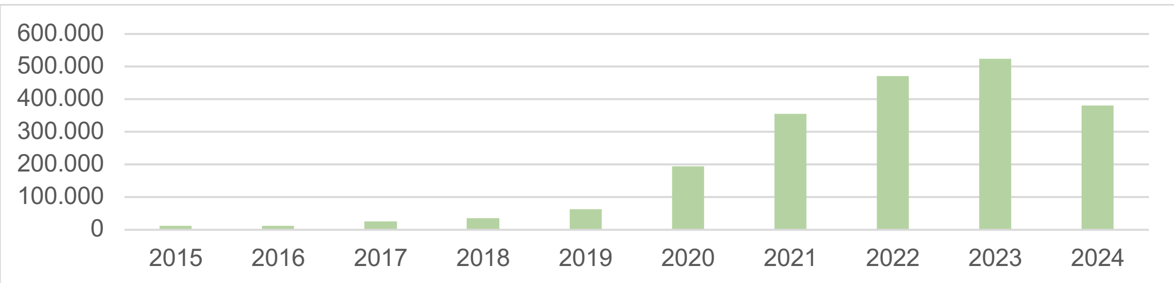

Figure 3: BEVs sales in Germany

Source: (Federal Motor Transport Authority, 2023; ADAC, 2025)

As described in the previous chapter, this fact sheet focuses on lithium, cobalt, nickel, manganese graphite and copper as the CRM for batteries, therefore within the scope of this input paper the current and future demand of only these CRM will be considered. Table 3 shows the current (2022) import, export and net import of these CRM in Germany.

Table 3: Germany net import of CRM 2022 (t)

	Import	Export	Net Import
Lithium	7,660	2,106	5,554
Cobalt	11	67	-56
Nickel	1.227	1.210	18
Manganese	22,252	3,493	18,759
Graphite	66,165	15,322	50,843
Copper	964,197	41,170	923,027

Source: (Bastian et al., 2023)

Germany does have occurrences of graphite, copper and lithium. While most of the lithium is currently not mined, with approximately 3.8 mn t Germany holds the seventh largest lithium resources globally. With approximately 2.4 mn t, Germany's copper resources are highly limited (Henning et al., 2024). The domestic production of CRM is gaining importance in particular if the future demand of CRM is considered.

Forecasts for future CRM demand in the EU indicate a significant upward trend. For lithium, the EU expects a twelve-fold increase by 2030 and a twenty-one-fold by 2050 (European Commission, 2024a). The cobalt demand is expected to increase threefold by 2050 (Cobalt Institute, 2024; Gregoir et al., 2022). The forecast for the graphite demand varies in the literature, nevertheless all available data indicate an increase in the predicted graphite demand for the EU. Figure 4 shows the estimated material demand in the EU of copper, nickel and manganese based on a high demand scenario.

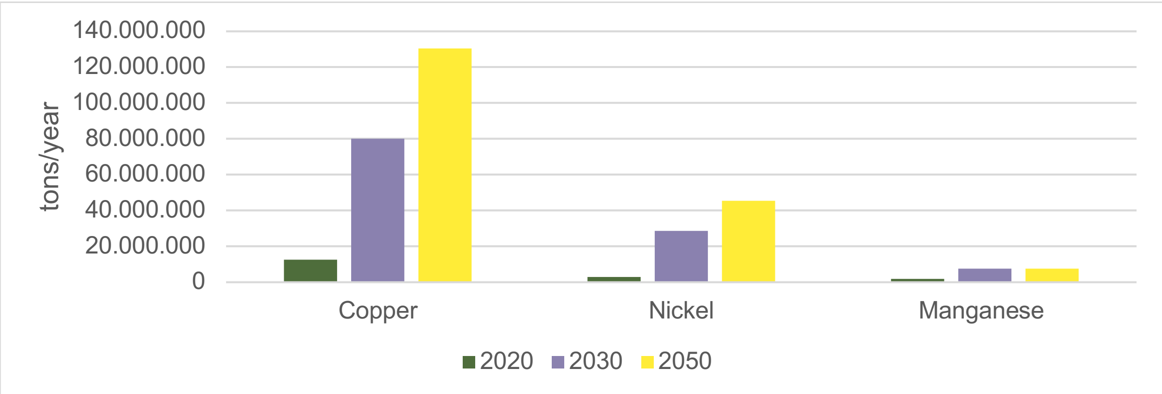

Figure 4: Material demand in the EU (high demand scenario)

Source: (European Council, 2024)

The forecasts for all the considered CRM within the scope of this fact sheet in Germany and the EU show a strong increase in the future demand. This raises concerns, as they were pointed out for the EU i.a. by the Draghi report (European Commission, 2024c).

2.3 Current status in Japan

Targeting net zero in 2050, Japan intends to expand various low carbon technologies like solar, wind, hydrogen and its derivatives, EVs, and battery storage. EVs, including HV, already shares 64% of the new car sales in 2024, and the government aims to increase the share to 100% by 2035 (METI, 2021a). Figure 5 represents new passenger EV sales in Japan. BEV and PHEV shared a mere 1.3% and 1.7% of the new car sales in 2023 (JADA, 2025). HV, however, accounted for as much as 61.1% in the same year (ibid).

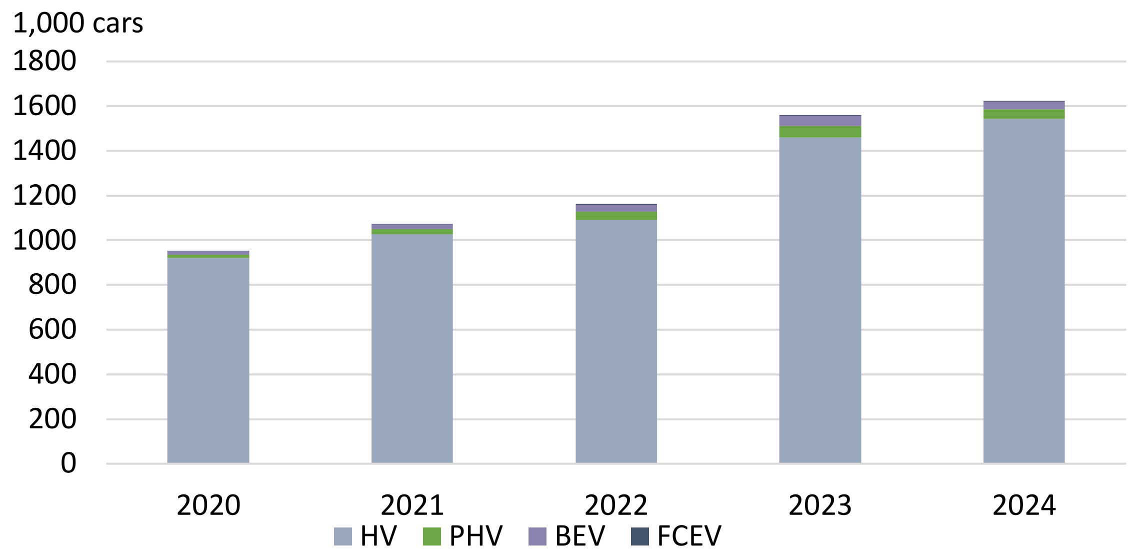

Figure 5: New passenger EV sales in Japan

Source: (JADA, 2025)

Power supply from battery storage is currently very limited. However, the government predicts 14.1-23.8 GWh could be supplied from on-grid storages, and 24.2 GWh from off-grid ones by 2030, as indicated in Figure 6.

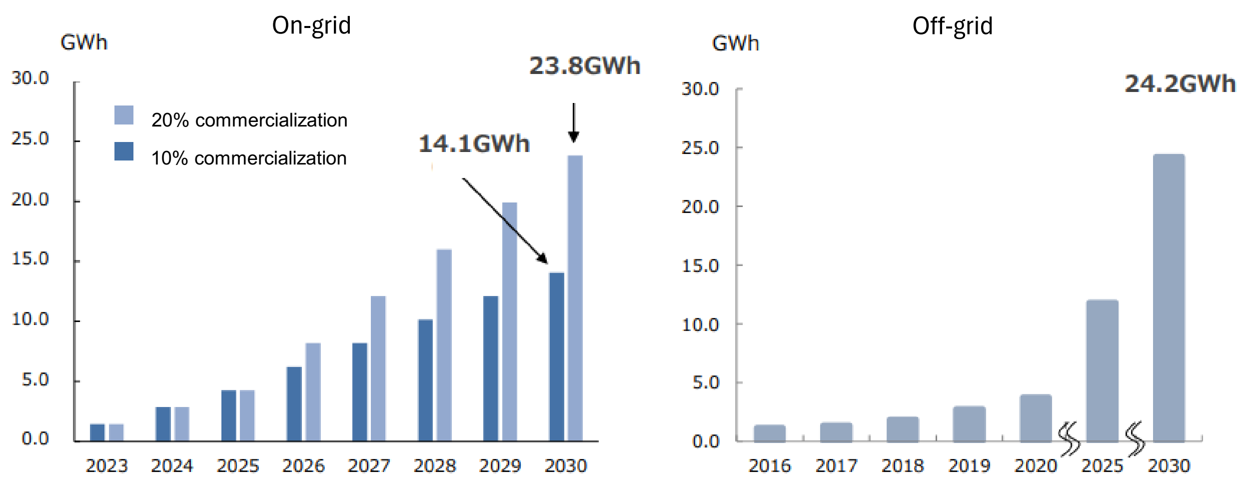

Figure 6: Power stored in battery storages

Source: (METI, 2024b)

Japan generally lacks critical mineral resources and depends for almost all battery minerals on imports. Some minerals, like copper, manganese and graphite are imported mainly in the form of ore, while others, like lithium, nickel, cobalt are imported in the form of both ore and various products. While the overall imported quantities differed significantly between minerals in 2023, import sources are generally concentrated on one or a few countries. Figure 7 indicates import quantities of battery minerals into Japan. Looking at each mineral, copper import is the largest in quantity of 4.8 million tons, and the import sources are more diversified than for the others. Cobalt import volume, on the other hand, is the smallest at 6.5 kilo tons. The highest dependency on a single country is found in graphite, where China supplies as much as 91% of the total import volume. Nickel import sources are also very concentrated where New Caledonia, Philippines, and Indonesia shared 95% of the total in 2023. Lithium and manganese sources are also concentrated, where the share of the top 3 exporters is over 90% (Ministry of Finance, 2025).

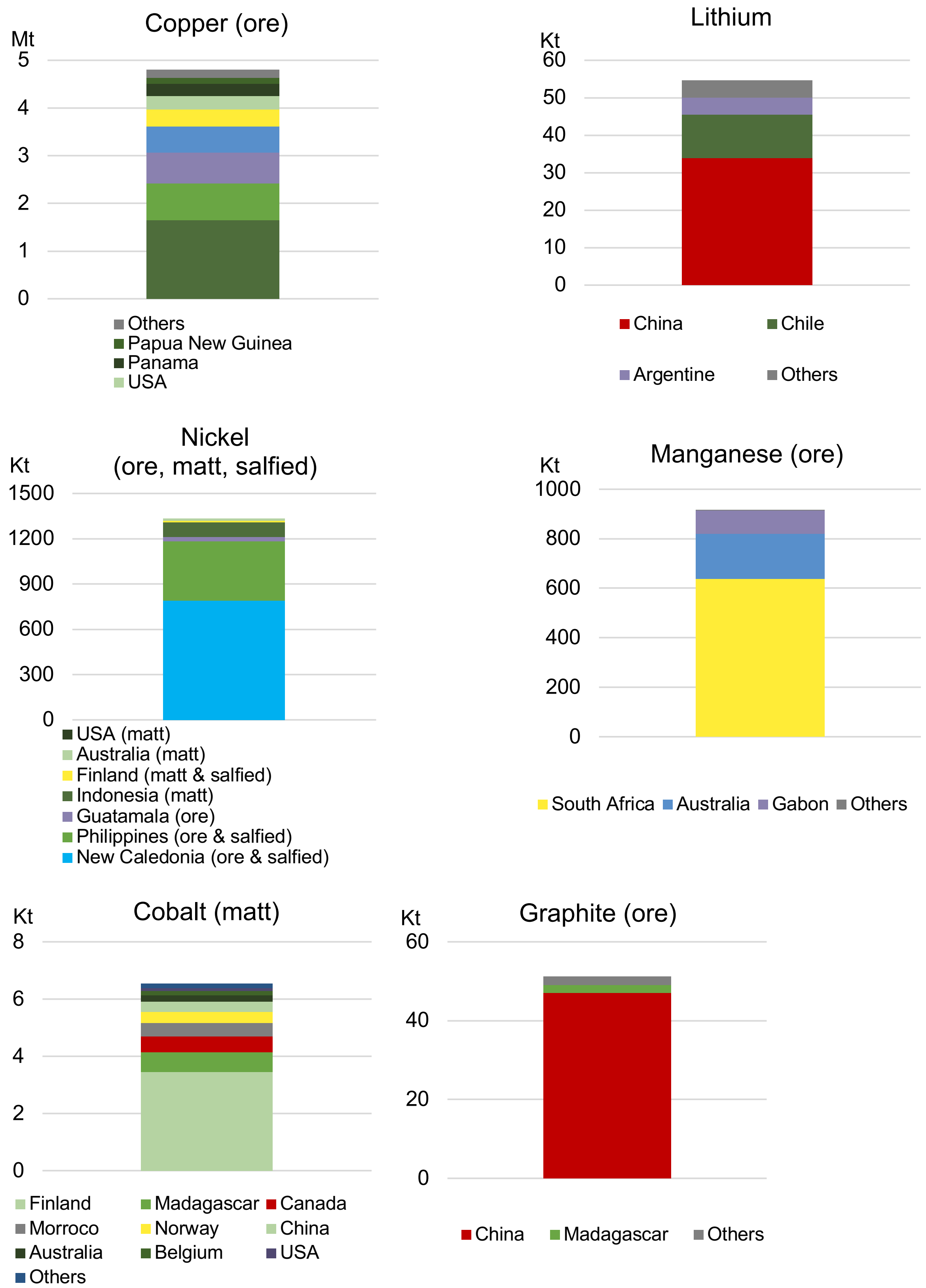

Figure 7: Japan's battery mineral imports in 2023

Source: (Ministry of Finance, 2025)

There are no official or reliable unofficial open-source statistics about how much of these minerals are consumed for batteries of EVs and storages. The only exception is lithium, and about 90% of the lithium in Japan is consumed for batteries in 2020 according to JOGMEC (Japan Organization for Metals and Energy Security) (JOGMEC, 2021). Similarly, there is no official forecast of critical minerals in Japan. However, the demand is highly likely to increase rapidly in the future, although the growth rate could alter significantly, mainly depending on domestic production of EVs and battery storage. As far as copper is concerned, a government document mentions that the demand for refined products could be close to 1.35 million tons in 2040, which is equivalent to about 5.5 million tons of imports. Therefore, security of battery metal supply will continue to be an issue for the government and industries in Japan.

3 Policy strategies for demand reduction and supply chain diversification

During its 17 & 18 council meetings, the German Japanese Energy Transition Council (GJETC) identified strategies for the demand reduction and supply chain diversification of CRM in Japan and Germany. Based on this exchange, this fact sheet considered the following six pillars to address this issue: (1) Establish regular CRM demand and supply outlooks, (2) Pursue demand reduction through substitution by innovative and alternative technologies, efficiency, and behavior change, (3) Implement circular economy principles, (4) Increase domestic production, (5) Ensure access to international markets, and (6) Establish a CRM Club of like-minded importing and exporting countries. Areas of cooperation can arise by further discussion on these pillars. Furthermore, the 'Five-Point Plan for Critical Minerals Security' of the G7 has been reviewed to identify additional areas of cooperation between Germany and Japan.

3.1 Existing and future Policy strategies in Germany

A secure supply of CRM is of utmost importance for Germany's economy as an industrialized nation in general, and for the energy transition in particular. With the first 'raw material strategy' from 2010, the German government set out a regulatory framework for the sustainable supply of mineral raw materials. Enterprises were considered responsible to ensure the supply of raw materials. Government intervention was seen as a political support for measures of raw material security. In the latest raw material strategy of the federal government from 2019, this market economy driven approach supported by a regulatory framework remains constant. Nevertheless, current challenges such as changes in demand due to disruptive technologies, trade disputes, high market power of individual players or countries and increased requirements to guarantee socially and environmentally responsible supply chains are leading to more government intervention (BMWi, 2019). The Federal government aims to support the German economy with 17 measures regarding raw material security. These 17 measures are based on three pillars: (1) Domestic raw materials, (2) Imports of raw materials, (3) Circular economy and secondary raw materials as a source of raw materials. These are to be supported by promoting and establishing responsible supply chains, increased domestic raw materials extraction, measures to improve the implementation of environmental and social standards, safeguarding and disclosure of geological data and increased acceptance of domestic raw material extraction (Henning et al., 2024).

Germany's CRM strategy has been expanded with the key issues paper 'Paths to a sustainable and resilient raw material supply' (BMWK, 2023a). The objective of this extension of the raw material strategy is to provide companies with greater support in securing a sustainable and long-term supply of raw materials. In particular due to changing market conditions based on the increasing importance of CRM for geopolitics. The new alignment of Germany's raw material policy is centered around: (1) Circular economy, resource efficiency and recycling, (2) Diversification of raw material supply chains, (3) Ensuring a fair and sustainable market framework. They include additional measures across the whole value chain, including development of international environmental, social, governance standards, processing and recycling of CRM, reduction of legal and bureaucratic obstacles and financing options. Additionally, to mitigate short-term risks due to external shocks in the supply of CRM, stockpiling is included (BMWK, 2023a). Currently no policy strategy exists which emphasizes demand reduction to address the supply and demand gap of CRM.

European Union

The Critical Raw Material Act (CRMA) entails the central policies and strategies of the EU to address the supply security of CRM. The aim of the CRMA is to "increase and diversify the EU's CRM supply, strengthen circularity, including recycling and support research and innovation on resource efficiency and the development of substitutes". In order to reach these goals, strengthening self-reliance and reducing the dependency on third countries for the supply of CRM, the EU has set the following objectives. By 2030, a minimum of 10% of the EU´s annual consumption of CRM should be based on EU extraction, 40% or more of the EU´s annual consumption should derive from processing within the EU and at least 25% of the EU´s annual consumption should originate from domestic recycling. Additionally, at most 65% of the EU's annual consumption of each CRM at any relevant stage of processing should originate from a single third country (European Council, 2024). To achieve this, the EU plans to enhance its trade actions, which includes:

- a Critical Raw Materials Club for all like-minded countries willing to strengthen global supply chains
- strengthening the World Trade Organization (WTO)
- expanding its network of Sustainable Investment Facilitation Agreements and Free Trade Agreements
- pushing harder on enforcement to combat unfair trade practices.

3.2 Existing and future policy strategies in Japan

The Japanese government recognized its vulnerability against supply disruption of metals, and established government stockpiling in 1983 (METI, 2020), although the stockpiling volume of each critical mineral is not disclosed. With the rising importance of metals and minerals, the government accelerated its effort on critical minerals in the 1990s, and expanded policy support on stockpiling, supply diversification, overseas and domestic resource development, recycling, and technology development for mineral efficiency and alternative materials.

Japan's 6th Strategic Energy Plan states that securing a stable supply of copper, rare metals, and other mineral resources is fundamental to manufacture storage batteries, motors, and semiconductors, etc. which serve as keys for the effective use of energy (METI, 2021b). Following this perception, the draft of the 7th Plan, which was authorized by the cabinet in February of 2025, states securing adequate stockpiling, supply diversification, and domestic resource development as main policy pillars, and intends to implement policies to enhance Japan's economic security (METI, 2024). Supply diversification measures include domestic and overseas mining and refining, recycling, resource diplomacy, strengthening the function of JOGMEC to support Japanese companies and to study policies in other countries. The 7th Plan mentions base metals such as copper, taking account of its potential supply insecurity, and intends to raise the self-sufficiency rate of base metals from 37.7% in 2022 to over 80% by 2030[4]. Other important policy papers include

[4] Meanwhile, the Plan does not set self-sufficiency targets for rare metals, because rare metals are often a biproduct of base metals and offtake right matters more than project ownership.

‘Policy measures to secure stable supply of critical minerals’[5] (METI, 2023a) and ‘Battery Industry Strategy’ (METI, 2022). For supply security of critical minerals, the ‘Policy measures to secure stable supply of critical minerals’ defines policy assistance on mining, refining, technological developments.

Specifically for battery metals, the Battery Industry Strategy considers that the supply chain, either for mineral resources or battery cells, needs to be maintained and strengthened not only for the supply security of battery metals but also enhancing industry competitiveness. The Battery Industry Strategy sets three targets: (1) Establishment of a domestic manufacturing base of 150 GWh of batteries and materials by 2030, (2) Securing manufacturing capacity of 600 GWh by Japanese companies in the global market in 2030, (3) Full-scale commercialization of all-solid-state batteries around 2030. Achieving these targets, Japan maintains and secures a leading technology position even after 2030. As far as critical minerals themselves are concerned, the Battery Industry Strategy considers strengthening policy support for securing resources, including the expansion of JOGMEC's risk capital supply (e.g. equity investment), to enable active resource development to diversify raw material procurement.

3.3 Comparison of Germany and Japan

The critical mineral policies of Germany and Japan show substantial similarities. Both countries identified 30+ CRMs (see chapter 2.1) and 21 of them, including battery minerals, are in common. Due to significant concerns over supply security, Japan introduced stockpiling in 1980s, and Germany is following the same path. Being net importers, both countries intend to promote more domestic mining and processing, and more access to the international market with consideration of ESG standards and fair trade. Considering very concentrated supply structures, the willingness towards more supply comes with an intention of supply diversification, which is also commonly understood. Both Germany and Japan emphasize the importance of demand management through circular economy principles, recycling, and resource efficiency. As far as international initiatives are concerned, both countries recognize the importance of WTO for the sake of fair trade.

Differences seem relatively minor. For example, while the EU set clear numerical targets for higher self-sufficiency of CRMs, Japan does not have those although it intends to raise self-sufficiency to a significant extent. While the EU (and Germany) intends to form a “CRM club” with like-minded countries, Japan’s policy papers emphasize on resource diplomacy with mining countries.

[5] The title in Japanese is 重要鉱物に係る安定供給確保を図るための取組方針.

4 Policy recommendations and potential areas of cooperation

This chapter presents policy recommendations which Japan and Germany could pursue individually, as well as in collaboration. CRMs are essential for the energy transition in Japan and Germany. However, the demand of CRM is currently increasing faster than supply can be expanded. Further, geopolitically motivated trade interventions also reduce the chances of a reliable supply, and a concentration of China controlling large parts of the value chain can be observed (BDI, 2024). Japan and Germany have taken measures to secure their domestic supply of CRM. Nevertheless, within this new geopolitical reality the future supply of CRM is not guaranteed. The following suggestions aim to increase reliability of the CRM supply.

We recommend that a policy framework addressing eventual supply-demand gaps, encompassing (1) Establishing regular CRM demand and supply outlooks, (2) Pursuing demand reduction through substitution by innovative and alternative technologies, efficiency, and behavior change, (3) Implementing circular economy principles, (4) Increasing domestic production, (5) Ensuring access to international markets, and (6) Establishing a CRM Club of like-minded importing and exporting countries, should be established.

1. CRM demand and supply outlooks

Any policy, strategy, and cooperation should be based on long-term outlook of CRM demand and supply. Given significant uncertainty, such outlooks should incorporate multiple scenarios and assumptions, and should be regularly updated. On the supply side, it is important to pay close attention not only to mining but processing and final products. In that sense, examining how China has become the dominant country in CRM supply chain is necessary. Formulating CRM outlooks will require regular monitoring and analysis of CRM industries and markets. Germany and Japan, and possibly member countries of CRM Club could cooperate and contribute to a demand and supply outlook so that they share insights and intelligence among each other to use CRMs wisely and secure stable supply while maintain high ESG standards.

2. Demand reduction

The demand of CRM can be reduced by substitution of conventional technologies with innovative and alternative technologies. Lithium-ion (Li-ion) batteries are the market dominant technology for energy storage applications and electric vehicles (EVs). R&D in alternative technologies e.g., Sodium-ion- or Iron-air-batteries and ultimately the substitution with alternative technologies can reduce the demand of CRM. Additionally, the substitution should be combined with efficiency measures and behavior change. The increasing CRM demand emphasizes the importance of efficiency measures and behavior change along the whole value chain. Energy efficiency measures e.g., in transport or electricity generation – not only save energy at best, but also reduce the need for CRM. It is crucial to consider the entire life-cycle of the raw materials used. Behavior change, enabled and induced through actions such as avoiding transport needs through innovative city planning, and shifting from private cars to public transport, car-pooling, cycling, and walking, can contribute to reducing the CRM demand. These measures should be accompanied by an optimal mix of technologies for a rational use of CRM. Lastly also innovative and resource-efficient design of products can reduce the demand of CRMs.

3. Circular economy principles

Recycling and the use of secondary raw materials will become increasingly important for the future raw material supply. Binding quotas for the use of secondary raw materials that increase over time should be established. Nevertheless, it has to be considered that exported goods are (at least temporarily) excluded from the resource cycle and larger quantities of CRM from the recycling of stationary batteries and the batteries of EVs will not be available for several years (European Commission, 2024c).

4. Domestic production

Increasing the domestic production of CRM is one central element of addressing the supply-demand gap. Essentially this will only be possible if domestic resources are available, such as it is the case for lithium in Germany and for cobalt and manganese in Japan. In order to accelerate access to the domestic resources, complex and lengthy permission processes need to be shortened and simplified. This reform of the permitting process should also include extending the permits of existing mines. Nevertheless, this should not be at the expense of high ESG (Environmental, Social and Governance) standards. Future deep-sea mining may offer further opportunity to tap into new sources of CRM. However, it also harbors risks for the sensitive ecosystems of the deep sea, which have been little researched to date. The environmental impact therefore needs to be investigated further before mining can begin on a commercial scale (BMWi, 2019). Therefore, the emphasis should be placed on land-based production. Artificial intelligence might be used to identify further resource sources and increase the efficacy of existing mining operations.

For the expansion of domestic production, Germany should not be considered separately but rather as part of the EU, which aims to increase the domestic production. Further, the local acceptance of mining should be considered, addressed and concepts for the subsequent utilization (including local value creation) should be developed.

The domestic production should not only consider the expansion of mining capacity, but also focus on increasing the processing capacity of CRMs.

5. Access to International Markets

The access to international markets can be limited by export control measures of production/exporting countries of CRM according to changing geopolitical strategies and priorities. International cooperation instead of competition to enhance import security for CRM should be emphasized and non-binding raw material fair partnerships should be updated as far as possible by clear long-term obligations and incentives respecting mutual interests. Japan and Germany should particularly consider the preservation of human rights and environmental standards when considering CRM partnerships. Countries committing human right violations can be urged to address this issue and may be incentivized by strengthening local value creation. In addition, a negative list for companies can be established if human rights or environmental standards are violated and excluded from such agreement. Access to credits to implement ESG standards can be a positive incentive.

6. Critical Raw Materials Club (CRM Partnership)

Based on the measure proposed by the EU, a 'CRM Club for like-minded countries willing to strengthen global supply chains' should be established by Japan and Germany (EU). This Club should by based on aligning values such as democracy, sustainability and competitiveness. The goal is to collaborate to strengthen the supply chains for CRM and renewable energy technologies. However, this approach can be further amplified to pursue common goals with regards to the energy transition or beyond. Founding countries could be a core of mid-size economies such as: Japan, Germany and other EU countries, UK, Canada, Australia and Korea. Additionally, key-producer countries of CRM could be invited to the Club. Fair conditions and benefits respecting the interests of the local communities in the mining regions should be established.

The advantages of such a Club lie in the establishment of an alternative supply chain independent of China, for both CRM exporting and importing countries. Additionally, the combined market size/influence can provide a leverage for negotiations, and know-how between the members can be shared, including on demand reduction and the circular economy. Stock piling of CRM should be considered by the CRM Club members. If one country is targeted by an export embargo, the other countries can assist in providing short term supply of CRM from their stockpiling. As the member countries share similar values, this Club should provide further support for implementing and enforcing ESG standards in mining and follow the SDGs (Sustainable Development Goals). The influence of China as a single country controlling large parts of the CRM value chain is rising. Therefore, the establishment of such a Club should start immediately as the process will take time.

At the same time, such a CRM Club should not preclude the potential development of broader cooperation up to UN-led initiatives or mechanisms, similar to the UNFCCC and the Paris Agreement for climate policy. The Club could be a predecessor or a complement with deeper ambition and commitment to fair trade and sustainability. It will also be useful to seek collaboration with existing worldwide initiatives, such as the International Resource Panel established by the United Nations Environment Programme (UNEP).

5 Conclusions

Based on an analysis of the current and future status and policies with regards to CRM in Japan and Germany (EU) this fact sheet has provided policy recommendations in six fields to increase reliability of the CRM supply for Japan and Germany:

1. Demand and supply outlooks
2. Demand reduction through substitution by innovative and alternative technologies, efficiency, and sufficiency measures
3. Circular economy principles,
4. Domestic production,
5. Access to international markets,
6. A CRM Club of like-minded countries.

As recent geopolitical developments, such as the declining influence of the WTO indicate, the global power dynamics are shifting. The emerging paradigm of a dependency ‘away from fossil fuels and towards mineral raw materials’ benefits in particular China as it controls large parts of the value and supply chain of CRMs. To avoid past dependency relations, such as it has been the case with the Russian gas, diversification of supply sources and the implementation of the suggested policy recommendations is of utmost importance. As most CRM resources are outside of Japan and Germany/EU, both countries will not reach self-sufficiency but should aim to diversify their supply and reduce the overall demand through accompanying measures. Japan and Germany, as two industrialized countries, can cooperate to secure the supply of CRM. In this context, a dialogue on joint long-term strategies and mutual commitments is necessary.

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