Deutsche Bank
Corporate Bank

Commodities security in a volatile world

Commodities security is key to economic resilience, as well as digital and sustainable transformation – and this means rethinking commodities strategy

flow
SPECIAL

Contents

Published April 2022

Introduction

The Russian invasion of Ukraine has increased the focus on Europe's energy sovereignty and security and emphasised the need for a strategic approach in securing access to important commodities. The conflict has highlighted the geopolitical reasons for reassessing uncomfortable supply chain dependencies. Germany, exposed as particularly dependent on Russian supplies of fossil fuels, is rapidly accelerating its renewable energy and (green) hydrogen production plans to diversify away from gas, oil, and coal.

While issues of energy supply and security are being reassessed by many economies in the light of the Russia/Ukraine crisis, this paper addresses the specific issue of Germany's procurement of key metals. Batteries, semiconductors, wind power plants, solar panels, and electrolysis massively increase the demand for certain (refined) metals.[1] Hence, metals procurement will be a fundamental determinant of future economic growth as certain metals will continue to play an essential role in major economies' sustainable and digital transformation.

These challenges arise at a time when Germany depends heavily on commodities imports from a handful of countries that control concentrated deposits as well as refining capacity. Of the 30 critical raw materials that the European Commission identifies, 10 are mostly sourced from China and eight from the African continent, where China increasingly invests in commodity-related infrastructure.[2] At the same time, Germany also sources many commodities from Russia, which, for example is the source of more than 40% of the country's refined nickel imports.[3]

These import dependencies make it necessary to identify the relevant raw materials for future technologies and to secure access to these materials. As this paper will outline, multilateral partnerships are vital towards this goal. Depending on the availability and origin of the metals, various strategies should be pursued to secure the supply. These include building up strategic reserves for key commodities such as lithium or cobalt and increasing recycling rates.

A strategic approach will be of particular importance as major suppliers have already begun to cut commodities production in response to decarbonisation commitments.[4] Recycling commodities such as copper from scrap is becoming increasingly important and is less CO_2 intensive than mining. This also goes some way to protect against supply shortages.

Moreover, for each metal a key task will be assessing the full vertical value chain – from securing raw materials to refinery, to semi-finished products and implementing them into finished products such as batteries, semiconductors, or wind turbines.

Rethinking Germany's commodities strategy also requires new approaches towards financing. This paper brings to the table several preliminary suggestions as to how the German government, capital markets, banks and corporates might work together to define a commodities strategy, enabling the transformation and ensuring stability of supply chains.

With these considerations in mind, this paper discusses three themes covering the development of commodities procurement:

Theme 1: No commodities – no transformation

Theme 2: Geopolitics as well as ESG considerations provide new challenges to Germany's commodities security

Theme 3: Think vertically – a new commodities strategy should look at the full value and supply chain

Theme 1:
No commodities – no transformation

When looking at today's global markets, it can be observed that increasing global demand for digital appliances coupled with overall economic growth have a significant impact on pricing movement in metallic commodities (see Figure 1).

Figure 1: BGR Price Index for Metallic Commodities (BGR-MPI)[5]
Source: Bundesanstalt für Geowissenschaften und Rohstoffe

Demand is still far from peaking; by 2050 it is expected to have grown 215% for aluminium, 140% for both copper and nickel, 86% for iron, 81% for zinc and 46% for lead relative to 2010 levels.[6] This is driven by economies' ambition to become carbon-neutral and progressively more digitised as illustrated in Figure 2, which maps commodity needs against technologies expected to have a significant impact on the economic landscape over the next 20 years. These technologies heavily rely on rare earth metals and finished products such as computer chips and batteries.

Key Industry	Key technology	Applications (examples)	Required commodities
Industrials	Industry 4.0	Sensor technology, chip performance, edge computing, robotics, 3D printers, Internet of Things	Silicon, copper, mineral oil, natural gas, aluminium, cobalt, nickel, rare earth metals, gallium, indium, germanium, lithium, niobium, tantalum, iron/steel, chrome, titanium, magnesium, manganese, molybdenum, scandium, vanadium, zirconium, iridium, platinum, lead, terbium, ruthenium
	Automated driving	Developments in the areas of on-board network, 5G, antenna technologies, electronics, control software	Iron/steel, chrome, aluminium, copper, rare earth metals, cobalt, gold, gallium, lithium, germanium, niobium, tantalum, iridium
	Carbon-neutral inputs	Green steel/aluminium	Iron/steel, chrome, aluminium, copper, rare earth metals, iridium
	Aerospace	Alloy for airframe lightweight construction; aircraft for 3D mobility, synthetic fuels, batteries	Iron/steel, chrome, tungsten, aluminium, copper, mineral oil, natural gas, lithium, hydrogen, manganese, titanium, silver, scandium, cobalt, silicon, rhenium, platinum, palladium, rhodium, magnesium, iridium, ruthenium
	Electrification Powertrain	Development of production capacities and increased production	Lithium, rare earth metals, vanadium, cobalt, aluminium, copper, zinc, nickel, mineral oil, natural gas, graphite, manganese
	EV charging infrastructure	Network infrastructure	Copper, aluminium, iron/steel, lead
	Green hydrogen production	Development of scalable technologies and establishment of (pilot) productions	Platinum, iron/steel, iridium, titanium, aluminium, copper, zirconium, scandium, rare earth metals, lanthanum, nickel, cobalt, manganese, chrome
	Green hydrogen infrastructure	Development of an infrastructure in which green hydrogen can be transported and stored	Synthetic methane, copper, aluminium, iron/steel
	Power generation plants	Cogeneration operated with natural gas, (green) hydrogen or waste wood	Natural Gas, (green) hydrogen, iron/steel, nickel, rare earth metals, zirconium, lanthanum, manganese, chrome, aluminium, cobalt, scandium
	Building renovation	Energy efficiency, heating systems, energy supply systems by means of contracting	Sand, gravel, broken stone, natural stone, lime, dolomite, marlstone, gypsum stone, anhydrite stone, copper

Key Industry	Key technology	Applications (examples)	Required commodities
Tech	IT and sustainability	Saving energy, reducing emissions and noise pollution	Iron/steel, lead, copper, nickel, silver, aluminium, silicon, iridium
	IT and society	Digitisation school teaching/ universities/ further education	Molybdenum, rare earth metals, copper
	Hardware devices & related software	Display technology, quantum computing, optoelectronics/ photonics	Molybdenum, rare earth metals, copper, indium, tin, aluminium, silicon, niobium, gallium, iridium
	(Big) data	Data storage and analytics	Silicon, aluminium, cobalt, chrome, platinum, ruthenium, rare earth metals, tantalum, iridium
	Energy production	Expansion and improvement of energy technologies such as photovoltaics, wind energy	Iron/steel, molybdenum, rare earth metals, copper, lead, chrome, silicon, silver, aluminium, nickel, cobalt, concrete, zinc, manganese, molybdenum, boron
	Energy storage	Electricity storage capacity e.g., batteries, pumped-storage plants	Lithium, nickel, iron/steel, cobalt, manganese, nickel, aluminium, silicon, copper, titanium, lanthanum, ruthenium
	Decarbonisation	Direct air capture, carbon capture utilisation and storage, synthetic fuels, electrification	Lead, copper, nickel, silver, aluminium, cobalt, hydrogen, silicon, steel, concrete, cadmium, tellurium, gallium, indium, tin, silver, vanadium, niobium, manganese, chrome, molybdenum
	Circular economy and water management	Recycle key raw materials e.g., seawater desalination, raw material recycling	Iron/steel, titanium, copper, rare earth metals, cobalt, lithium, aluminium, nickel, manganese, chrome, molybdenum, titanium, palladium, concrete, sand, vanadium
	IT location Germany/Europe	Expansion of power grid, fibre optic cables and data centres	Copper, silicon, germanium, boron, aluminium, iron/steel, magnesium, tin, concrete, zinc, lead

Figure 2: Key transformational technologies and associated commodities needs, non-exhaustive list
Source: Deutsche Bank Research & Deutsche Rohstoffagentur, Rohstoffe für Zukunftstechnologien[7]

As per Figure 2, the successful transformation of economies could rely on a few critical commodities. To secure long-term access, it is vital to understand supply and demand dynamics, as well as potential concentration risks.

Theme 2:
Geopolitics as well as ESG considerations provide new challenges to Germany's commodities security

To understand the status quo of metals procurement in Germany, this paper analyses future demand and supply dynamics as well as the regional and economic market dominance for selected commodities (see Figures 3, 4 and 5). Based on the above-mentioned key technologies and the German Federal Institute for Geosciences and Natural Resources' estimate of likely supply and demand for these critical resources, seven commodities are worth investigating further: cobalt, germanium, heavy rare earths (HRE), iridium, light rare earths (LRE), lithium and ruthenium.

Each of the identified seven metals will be key to enabling a digital and decarbonised German industry, being essential for renewable energy generation and storage, hydrogen applications and data centres as well as high-speed data infrastructures.

Figure 3 compares current supply-to-demand relations with anticipated demand in 2040. Given the expected shortage of supply, the question arises how long-term access to these and other critical commodities can be ensured. Germany will be particularly challenged as these commodities are not available locally and must be sourced from countries such as Democratic Republic of the Congo, China, and Chile.

The analysis focuses on the above-mentioned commodities that are sourced from highly concentrated markets but further deep-dives into the procurement of mass commodities (e.g. nickel, copper, aluminium) will be required as these metals are equally important to the German economy.

Raw material	Demand 2018/ Production 2018 quota	Demand 2040/Production 2018 quota		
		ESG path	Middle path	Fossil path (unlikely)
Cobalt	0.4	3.9	2.9	1.2
Germanium	0.4	1.7	1.7	1.9
Heavy rare earths (HRE)	0.6	5.5	6.9	6.4
Iridium	0.0	5.0	2.9	0.3
Light rare earths (LRE)	0.3	2.2	2	2.2
Lithium	0.1	5.9	4	0.9
Ruthenium	0.4	2.4	5.9	19

Figure 3: Global demand to production quota for selected key commodities in 2018 vs. 2040 outlook[8]
Source: Deutsche Rohstoffagentur, Rohstoffe für Zukunftstechnologien

Securing long-term critical commodities supply for the German economy requires developing a new sourcing strategy, for which it is important to understand the current producer and exporter landscape. Figure 4 relates the exporting countries' risk to the market concentration of the respective commodity.

For example, cobalt in both its mined and refined form is considered "high risk" as it is produced in politically unstable regions (weighted country risk) where the commodity offer is concentrated on relatively few players (market concentration). Lithium, by contrast, is only considered "medium risk" because it is sourced in countries that are considered more stable, such as Chile and Australia.

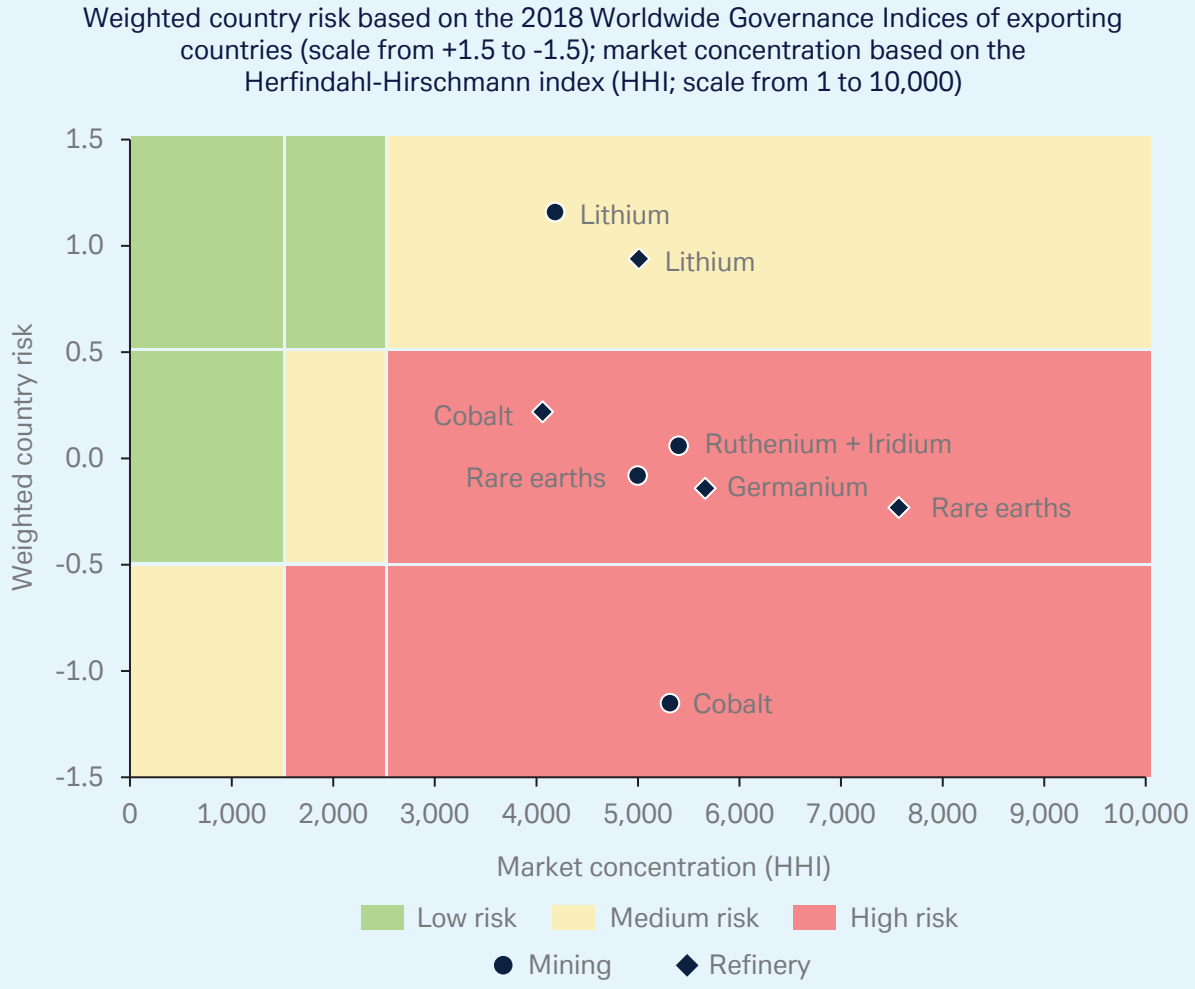

Figure 4: Selected commodities by producing country risk and market concentration
Source: Data taken from Deutsche Rohstoffagentur, Rohstoffliste 2021[9] ; illustration by Deutsche Bank

Besides the overall dependency on imports, the key commodities happen to be particularly concentrated among a few top exporting nations. Figure 5 compares the global share per top ten countries in the mining and refining industry.

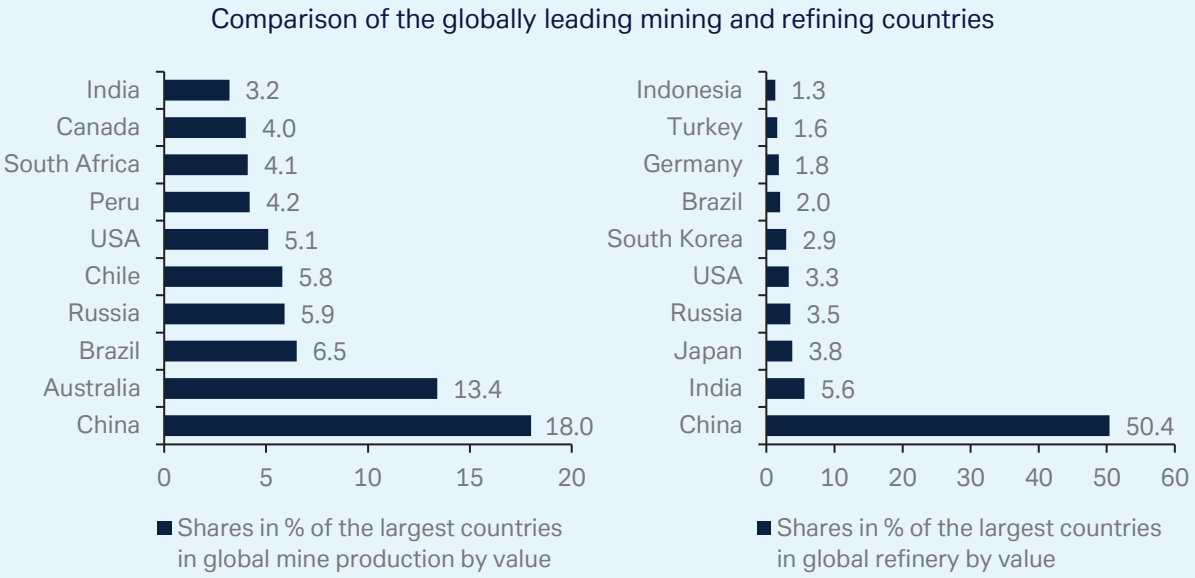

Figure 5: Comparison of the globally leading mining and refining countries
Source: Data taken from Deutsche Rohstoffagentur, Rohstoffliste 2021[10] ; illustration by Deutsche Bank

Two geographic dependencies – towards China and Russia – are illustrated in detail. However, it should be noted that other significant dependencies exist, depending on the respective commodity. These include, for example, the mining of lithium in Chile (78% global market share) or the sourcing of niobium from Brazil (86% of global market share).[11]

1. China

Of the 30 critical raw materials that the European Commission identifies, 10 are mostly sourced from China and eight from the African continent, where China increasingly invests in commodity-related infrastructure.[12] While raw material mining is relatively diversified globally and substantially in private hands, most of the final refining and production happens in China (see Figure 5). This potentially creates two risks: First, in a trade war China could use supply stoppages as a bargaining chip. Second, local exporters could be forced to cut production due to increased ESG and CO_2 reduction ambitions of the Chinese government.

These are not only theoretical risks. The Chinese sustainability agenda has already materialised and disrupted the supply of refined magnesium; in September 2021 the Chinese government ordered two-thirds of its 50 magnesium smelters to stop their production until year's-end.[13]

Furthermore, China plans to reduce its energy consumption over the next five years, which will be supported by the reduction of metals refining and concentration on domestic consumption rather than exports. Between 2021 and 2025, China is aiming to reduce energy and emissions intensity (per unit of GDP) by 3–4% per annum. According to Deutsche Bank Research, "these targets should still limit output growth over the medium term" as steel, metals, minerals and chemicals account for approximately 25% of electricity consumption and related emissions.[14]

At the same time, decarbonisation is becoming a material demand driver for several metals, such as aluminium, copper and lithium as internal combustion engine (ICE) vehicles are replaced by battery-pack driven electric ones, and clean energy installations (such as wind and solar farms) proliferate. As the World Economic Forum (WEF) reported on 8 December 2021, "The clean energy transition needed to avoid the worst effects of climate change could unleash unprecedented metals demand in coming decades, requiring as much as three billion tons."[15]

In other words, the sustainability agenda is changing the commodities market from both sides – increasing demand and lowering supply for certain raw materials.

2. Russia

For certain refined raw materials, Germany is particularly dependent on Russia for imports. Figure 6 highlights import quotas as well as volumes in Euro (mEUR) for selected commodities.[16]

Figure 6: Selected German imports from Russia
Source: Deutsche Rohstoffagentur [17]

The Russian invasion in Ukraine has not only caused an unprecedented supply shock in commodities markets, but also led to rapidly rising prices. Depending on further developments and its duration, the war could have a major impact on commodity prices and disrupt existing import structures. In its Commodities Outlook published on 5 April 2022, Deutsche Bank Research

anticipates “tight physical conditions to persist”, but analysts also raise hope “for some price moderation by year end as international trade flows adjust”.

3. Further supply chain considerations

In addition to the impact of geopolitics and national government decisions on supply chains, the events of 2021 further underlined how global supply chains can be vulnerable to external shocks such as the pandemic-induced lockdowns of ports or the blockage of important seaway transport routes (such as the March 2021 *Ever Given* container ship incident in the Suez Canal).

Moreover, the increasing focus on the environmental, social and governance (ESG) impact in supply chains will also affect commodities sourcing. From January 2023, German companies with more than 3,000 employees as well as foreign companies based in Germany, will be responsible for compliance with human rights and environmental requirements in their supply chains under the new supply chain act (“Lieferkettengesetz”). Companies with more than 1,000 employees must comply with these requirements from January 2024.[18]

The new legislation requires companies to track the origin of their raw materials all the way back to the mine. This might make it beneficial for German companies to near-shore production and processing facilities. It would also shorten transportation distances, which could have a positive impact on Scope 3 emissions that currently account for around 70% of a company’s carbon footprint.[19]

Theme 3:
Think vertically – a new commodity strategy should look at the full value and supply chain

The increasing demand for geographically concentrated commodities requires a strategic and coordinated approach to ensure long-term supply. Such a commodities procurement strategy should bring together stakeholders in the German economy, political decision-makers and other parties such as trade associations. Building blocks could include:

- Securing the access to commodities;
- Recycling the final product at the end of its lifecycle; and
- Substituting key commodities where possible.

When setting up the strategy, one should differentiate between the need for raw materials (e.g., cobalt) and refined products (e.g., light and heavy rare earth metals). While many metals have their origins spread across the world and are owned by public companies and institutions, the refineries of those metals (for example copper, aluminium, lithium, and rare earths) are located in China (see Figure 5). So, in order to diversify supply, Germany's focus should be on building up its own refining capacities. For other commodities, such as cobalt the concentration risk lies in the raw material mining location (in this case, Democratic Republic of the Congo), rather than the refinery.

Bearing these differences in mind, a strategy for access to commodities could entail:

a) Diversification of refined and semi-finished metals

- Offshore (ex-EU) refinery capacity: Support the build-up of metals refinery capacities in other countries by enabling viable business plans. This enablement can have different forms: prepayment or loans to finance the infrastructure capital expenditure, which would be repaid by the metals' delivery. Alternatively, equipment could be financed with (export credit agency backed) export finance.
- Onshore (inner-EU) refinery capacity: Build-up and enhance refinery capacity in Germany and in Europe. As metals refining has a high energy consumption with a potential (negative) sustainability impact, this would require further acceleration of renewable and alternative energy production. For example, China's refineries are already transitioning away from coal-fired electricity to renewables-powered plants.

b) Offshore (ex-EU) raw material sourcing

The diversification of refining capacity offers the possibility to tap into a broader pool of raw materials providers and countries. It includes combinations of long-term offtake arrangements such as:

- Offering scope for prepayments and loans to be repaid with raw materials supplies. In that context, the German Ministry of Economic Affairs provides so-called untied financing ("Ungebundener Finanzkredit", UFK). These loans can be used for cross-border investments to secure commodity import capacities based on long-term offtake agreements with a German offtaker. To reduce the economic and political risks of such undertakings, the German government provides the lending banks with a guarantee ("UFK-Garantie").[20]
- Providing infrastructure in exchange for the provision of commodities rights.
- Making equity investments in companies that own commodities resources.
- Building up sourcing partnerships with reputable commodity traders.

c) Onshore (inner-EU) raw material sourcing

- Germany and its European neighbours have metals reserves which have not been mined over recent years.[21] However, the number of initiatives and companies performing exploration studies to develop mining for critical metals have grown.[22] Apart from commodities security, this also addresses sustainability requirements regarding European working conditions and substantially reduced transportation distances.
- Alongside the benefits, sourcing raw materials onshore would also come with new challenges as the bureaucracy levels in Europe are usually greater than those in emerging markets; there are more environmental and community requirements to be dealt with. Also, labour and energy costs are higher.
- Moreover, Europe lacks the availability of appropriate risk capital when it comes to financing commodities exploitation. To build up and scale those projects, a stronger European Venture Capital community for the raw materials industry should be established. This can be accompanied by public subsidies, prepayment of offtakers and debt financing at a more advanced stage.

d) Build up strategic reserves

Further to the approaches outlined in a) to c) above aiming at a diversification, commodity offtakers should consider the possibility to build up reserves for critical input materials. When engaging in strategic stockpiling, companies should act in an anticyclical way and secure larger quantities in favourable market conditions. If implemented, lacking or delayed imports can be accommodated for longer. However, this accumulation comes with significant storage, transportation, and insurance costs which result in additional financing needs.

In addition, clear priorities for which raw materials and refined products should be stored are needed. Countries such as the US and Japan have created a system of Public Private Partnerships which organises the commodities storage. This is based on national surveys covering what commodities are needed and tracks the quantities of the top 50 products that are bought and stored by state and private companies needed to withstand supply chain disruptions for up to

90 days.[23] Turning again to Germany, the national oil reserve could offer an example for other commodities as well.[24]

e) Enhance recycling capabilities and steer product design towards greater recyclability

A further pillar for a new commodity strategy should be the increase of recycling capabilities as well as the recyclability of the end product. For a few materials, such as platinum group metals and cobalt, which are both needed for electric car engines, the EU already recycles more than 20%. This share should be raised for other raw materials needed in the production, such as lithium and iridium, where the EU recycling rate is close to zero.[25]

To facilitate the increase in recycling capabilities several initiatives would be necessary – from increasing regulatory mandated recycling quotas to creating a legal framework that facilitates local recycling capacities (for example, adjustments to zoning laws).

As regards recyclability, there is an urgent need to design products in a way that enables them to be split up again back into original materials. This starts with a thorough control of input materials and their compositions and could possibly be strengthened if minimum recyclability standards per sector or product category were to be agreed.

To address this, the EU's strategic tool of "Important Projects of Common European Interest" (IPCEI) could be used to increase recycling activities for commodities where the reprocessing of materials is not yet economically feasible but strategically necessary. IPCEIs are a subsidy scheme designed to foster projects contributing to the growth, employment and competitiveness of European industry and the economy. This includes strategic funding projects for innovation in resource-intensive core market segments. [26]

f) Explore possibilities to replace key commodities in the value chain

Currently, with only a few commodities replaceable, the chances that substitution will ease the demand and price pressures are relatively low. In order to find more, economically viable substitutes for critical input materials, additional R&D investment is needed. Those R&D projects should focus on finding ways to use lower quantities but more readily available commodities. Also, research clusters – bringing together producing companies and academics – could be an important tool to drive R&D efforts.

Conclusion

When considering the ever-growing need for mined and refined metals, it will be crucial to reduce the dependency of Germany and other European economies on a few exporting countries. This could be achieved by "insourcing" the refineries and building up inner-European capacities. As metals refining is an energy-intensive process, the supply of renewable energy needs to be continuously expanded to reconcile the overall ambition of commodity security with a carbon-free economy. While building up refinery capacities, a diversification of raw materials supplies should be pursued.

The relevant players in the German economy need to define which raw and refined materials will be required to ensure long-term economic growth as well as a successful transformation. Following this analysis:

- A strategic approach to inner-European sourcing and mining should be set out. This requires a thorough analysis of natural resources on the European continent and corresponding studies regarding the environmental impact and economic feasibility of a potential exploitation.
- Germany and other EU members should secure commodity partnerships with countries in South America and Africa as well as with Australia to diversify the supplier basis for raw and refined materials. In that context, bilateral or multilateral government agreements could pave the way for private sector initiatives. The private partnerships could either be set up via traditional long-term supply agreements, or by creating a stronger link between the partners through e.g., direct (equity) investments. This, for example, encompasses financing the build-up of infrastructure for commodities in the partnership region or directly investing in foreign commodities producers.
- Recycling capacities should be built up in Germany and elsewhere in the European Union. The same applies for further research and development efforts needed to advance the substitution of critical raw materials.

However, ensuring European economic sovereignty should not be limited to securing access to clean energy, raw materials and refined components. Looking ahead, it could also make sense to integrate further parts of the value chain to reduce the dependency on single countries. For example, European production of key components such as computer chips and batteries should be increased as well. This policy has already gained some momentum due to the investment decisions of a few key players (mechanical and electrical companies, car makers, etc.) and dedicated state-backed subsidy schemes such as the European Chips Act.

Securing commodities access in times of geopolitical conflicts and decarbonisation commitments will be a challenge. Yet, as this whitepaper has outlined, there are several measures Europe can take to foster economic resilience. In order to define and implement a new commodity strategy, we need a close collaboration between governments, corporates, capital markets and banks.

Endnotes

1 See Deutsche Bank Research Commodities Outlook, 11 January 2022

2 https://ec.europa.eu/docsroom/documents/42882

3 https://www.bgr.bund.de/DE/Themen/Min_rohstoffe/Downloads/rohsit-2020.pdf?__blob=publicationFile&v=4

4 https://flow.db.com/more/macro-and-markets/commodities-2022-a-transition-tinted-landscape

5 The BGR Price Index for Metallic Commodities (BGR-MPI) is based on the German metal usage. It includes the 20 metals: platinum, gold, silver, aluminum, copper, zinc, lead, tin, magnesium, nickel, molybdenum, chromium, silicon, titanium, Manganese, Vanadium, Cobalt, Tungsten, Tantalum, Iron. These commodities are particularly important for the German economy. Thus, the index reflects the exposure of German companies with demand for these commodities. The index reached its all-time high in May 2021 with 589 points; https://www.deutsche-rohstoffagentur.de/DERA/DE/Produkte/Rohstoffpreise/Preisindex/preisindex_node.html

6 https://www.sciencedirect.com/science/article/pii/S0921344920304249#sec0006

7 https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-50.html

8 https://www.deutscherohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-50.pdf?__blob=publicationFile&v=4

9 https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-49.pdf?__blob=publicationFile;

10 https://www.deutsche-rohstoffagentur.de/DERA/DE/Downloads/vortrag-rohstoffliste-2021-Maren%20Liedtke-Michael%20Schmidt.pdf?__blob=publicationFile&v=3

11 https://www.deutsche-rohstoffagentur.de/DERA/DE/Downloads/vortrag-rohstoffliste-2021-Maren%20Liedtke-Michael%20Schmidt.pdf?__blob=publicationFile&v=3

12 https://ec.europa.eu/docsroom/documents/42882

13 https://www.ft.com/content/1611e936-08a5-4654-987e-664f50133a4b

14 See Deutsche Bank Research Commodities Outlook, 5 April 2022

15 https://flow.db.com/more/macro-and-markets/commodities-2022-a-transition-tinted-landscape

16 https://www.bgr.bund.de/DE/Themen/Min_rohstoffe/Downloads/rohsit-2020.pdf?__blob=publicationFile&v=4

17 https://www.deutsche-rohstoffagentur.de/DERA/DE/Produkte/Chart_des_Monats/cdm_node.html

18 https://www.bundesregierung.de/breg-en/federal-government/supply-chain-act-1872076

19 https://www2.deloitte.com/uk/en/focus/climate-change/zero-in-on-scope-1-2-and-3-emissions.html

20 https://www.bmwi.de/Redaktion/DE/Artikel/Aussenwirtschaft/garantien-fuer-ungebundene-kredite.html

21 https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Nachrichten/Neuerscheinungen/2008_09_09_BSK1000.html;jsessionid=98BBB6F3882666A803903D83EBFF0E3E.1_cid331?nn=1797942

22 https://www.at-minerals.com/en/artikel/at_Metal_ore_mining_in_Europe_3257608.html

23 https://www.energy.gov/fecm/strategic-petroleum-reserve-9; https://www.gtai.de/de/trade/usa/wirtschaftsumfeld/strategische-vorraete-machen-us-wirtschaft-resistent-814372; https://www.jogmec.go.jp/english/index.html

24 https://www.bmwi.de/Redaktion/EN/Artikel/Energy/petroleum-emergency-oil-supply-and-oil-crisis-management.html

25 See Figure 12 “End of life recycling input rate 2020” on page 41 in Study on the EU's list of Critical Raw Materials: https://www.google.de/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwiXgZHtqIT3AhWVHuwKHdU6AO8QFnoECAUQAQ&url=https%3A%2F%2Fec.europa.eu%2Fdocsroom%2Fdocuments%2F42883%2Fattachments%2F1%2Ftranslations%2Fen%2Frenditions%2Fnative&usg=AOvVaw11beRfMw0F00jr9pi1JqS6

26 https://ec.europa.eu/commission/presscorner/detail/en/IP_21_6245

corporates.db.com
corporate.bank@db.com