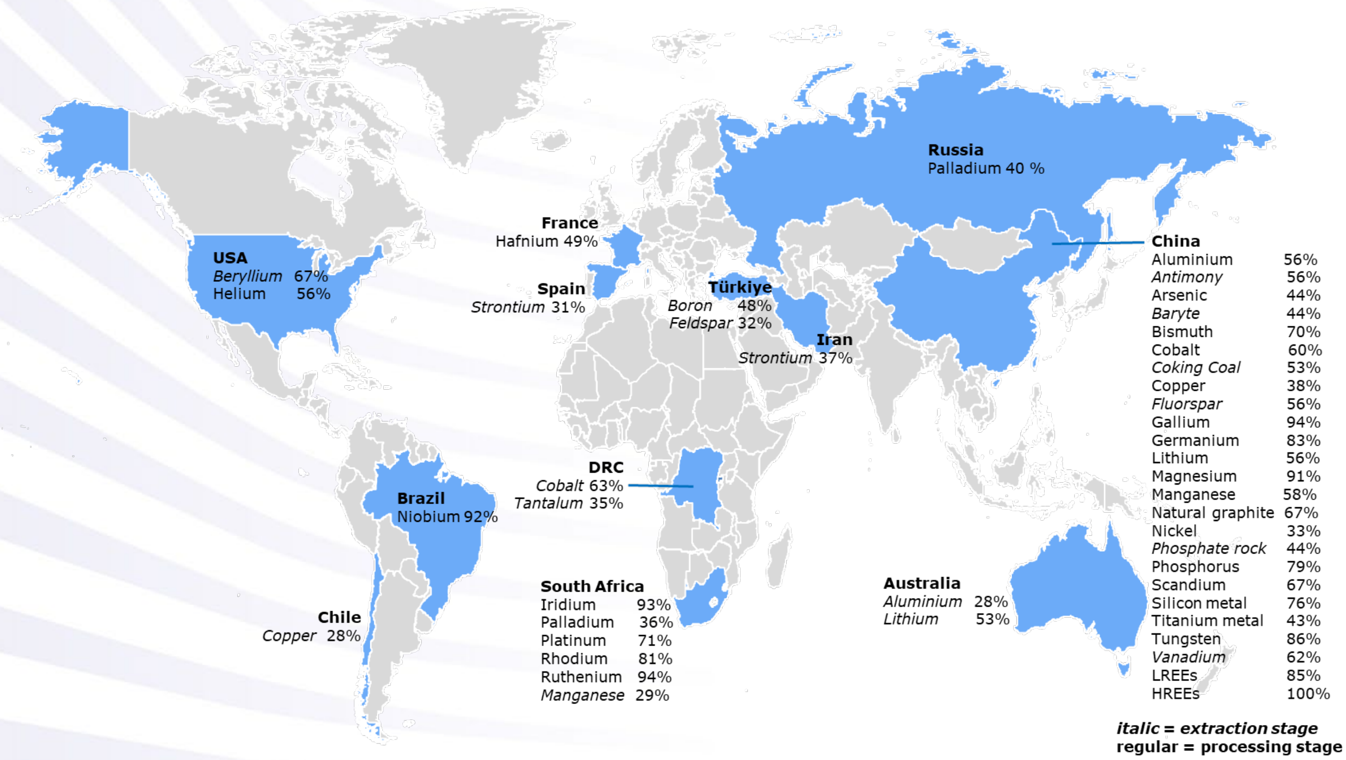
European Commission

Study on the Critical Raw Materials for the EU

2023

Final Report



Raw Materials

Authors: Milan Grohol, Constanze Veeh. DG GROW, European Commission.

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Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
Directorate GROW.I
Unit GROW.I.1 – Energy-intensive Industries, Raw Materials and Hydrogen

Contact: GROW CRM

E-mail: *GROW-CRM@ec.europa.eu*, Milan.GROHOL@ec.europa.eu, Constanze.VEEH@ec.europa.eu

European Commission
B-1049 Brussels

Study on the Critical Raw Materials for the EU 2023

Final Report

EXECUTIVE SUMMARY

Background of the EU criticality assessments

The EU assessment of Critical raw materials (CRMs) has been launched as the first action of the EU Raw Materials Initiative (RMI)[1] of 2008. This EU policy pursues a diversification strategy for securing non-energy raw materials for EU industrial value chains and societal well-being. Diversification of supply concerns reducing dependencies in all dimensions – by sourcing of primary raw materials from the EU and third countries, increasing secondary raw materials supply through resource efficiency and circularity, and finding alternatives to scarce raw materials.

One of the priority actions of the RMI was to establish a list of critical raw materials at EU level. The first list was published in 2011 and it is updated every three years to regularly assess the criticality of raw materials for the EU. CRMs are considered to be those that have high economic importance for the EU (based on the value added of corresponding EU manufacturing sectors, corrected by a substitution index) and a high supply risk (based on supply concentration at global and EU levels weighted by a governance performance index, corrected by recycling and substitution parameters).

The first assessment (2011) identified 14 CRMs out of the 41 candidate raw materials, in 2014, 20 out of 54 candidates, in 2017, 27 CRMs out of 78 candidates, and in 2020, 30 out of 83 candidates.

Context of the current assessment

Pressure on resources will increase - due to increasing global population, industrialisation, digitalisation, increasing demand from developing countries and the transition to climate neutrality with metals, minerals and biotic materials used in low-emission technologies and products. OECD forecasts that global materials demand will more than double from 79 billion tonnes today to 167 billion tonnes in 2060. Global competition for resources will become fierce in the coming decade. Dependence of critical raw materials may soon replace today's dependence on oil.

Raw materials are indispensable for the EU's industry and stand at the very beginning of each value chain. Amongst the non-energy, non-agricultural raw materials that are assessed by the European Commission, some are defined as critical based on objective criteria including their economic importance and their supply risk.[3] CRMs are often produced and used in relatively small quantities[4] but have special characteristics[5] that make them essential ingredients for products in strategic areas such as renewable energy, digital, aerospace and defence technologies. Well-known examples include the rare earths elements found in the permanent magnets used to manufacture wind turbines motors, lithium used for batteries, and silicon used for semiconductors.

In light of these applications, critical raw materials are key to enable the European industry to meet the political goals of the EU. The European Green Deal[6], the REPowerEU Communication[7], the Joint Communication on Defence Investment Gaps Analysis and Way Forward[8] and the Digital Strategy[9] have all established objectives or targets to achieve the green and digital transitions and strengthen the EU's resilience and strategic autonomy, which depend on the availability of critical raw materials, while the European Commission has already began the implementation of the action plan set up in the 2020 Communication on Critical Raw Materials.[10]

In 2022, the European Council's adopted the Versailles Declaration[11], which called to "take further decisive steps towards building our European sovereignty" and toward "reducing our dependencies". It called to secure EU supply of CRMs, particularly by building on the strengths of the Single Market. Similarly, the European Parliament called for an EU strategy for critical raw materials in its November 2021 resolution[12]. The Conference on the Future of Europe also recommended for the EU to reduce dependence

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[1] https://ec.europa.eu/growth/sectors/raw-materials/policy-strategy_en

on other countries for CRMs[13]. Against this background, the President of the European Commission announced in her State of the Union speech in 2022[14] a new legislative proposal, the European Critical Raw Materials Act, notably to identify strategic projects all along the value chain and to build up strategic reserves where supply is at risk.

This technical assessment 2023 is feeding into the legislative package of the Critical Raw Materials Act and serves as a base for definition of the list of CRMs for the EU.

Overview of the 2023 assessment

The study presents the results of the fifth technical assessment 2023 of critical raw materials for the EU. The assessment screens 70 candidate raw materials comprising 67 individual materials and three materials groups: ten heavy (HREEs) and five light (LREEs) rare earth elements, and five platinum-group metals (PGMs), 87 individual raw materials in total. Four new materials have been assessed: neon, krypton, xenon and roundwood. Titanium metal has been assessed in addition to titanium. Aluminium and bauxite have been merged for consistency reasons. For comparison, 41 candidate materials have been screened in 2011, 54 in 2014, 78 in 2017, and 83 in 2020.

Screened raw materials in 2023 assessment (new materials in blue)	
Industrial and construction minerals	aggregates, baryte, bentonite, borates, diatomite, feldspar, fluorspar, gypsum, kaolin clay, limestone, magnesite, natural graphite, perlite, phosphate rock, phosphorus, potash, silica sand, sulphur, talc
Iron and ferro-alloy metals	chromium, cobalt, manganese, molybdenum, nickel, niobium, tantalum, titanium, titanium metal, tungsten, vanadium
Precious metals	gold, silver, and Platinum Group Metals (iridium, palladium, platinum, rhodium, ruthenium)
Rare earths	heavy rare earths - HREE (dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium); light rare earths - LREE (cerium, lanthanum, neodymium, praseodymium and samarium); and scandium
Other non-ferrous metals	aluminium/bauxite, antimony, arsenic, beryllium, bismuth, cadmium, copper, gallium, germanium, gold, hafnium, indium, lead, lithium, magnesium, rhenium, selenium, silicon metal, silver, strontium, tellurium, tin, zinc, zirconium
Bio and other materials	natural cork, natural rubber, natural teak wood, sapele wood, coking coal, hydrogen, helium, roundwood, neon, krypton, xenon

The proposal of the CRM Act Regulation[2] contains the list of Strategic Raw Materials (SRMs) and the list of CRMs. The Regulation proposes to automatically add SRMs selected based on a new methodology (Annex 1 of the Regulation) on the CRMs list, defined by the established CRM methodology[3] (Annex 2 of the Regulation). The CRM methodology was developed by the European Commission in cooperation with the Ad hoc Working Group on Defining Critical Raw Materials (AHWG)[4] in 2017.

The methodology is based on the two main criteria of Economic Importance (EI) and Supply Risk (SR). The thresholds remain at SR ≥ 1.0 and EI ≥ 2.8 rounded to one decimal.

[2] Regulation proposal COM(2023) 160 - 2023/0079 (COD)
[3] Methodology for establishing the EU List of Critical Raw Materials, 2017, ISBN 978-92-79-68051-9
[4] The AHWG on Defining Critical Raw Materials is a sub-group of the Raw Materials Supply Group expert group.

Main results of the 2023 criticality assessment

The following 34 raw materials are proposed for the CRM list 2023:

2023 Critical Raw Materials (*new CRMs in italics)*			
aluminium/bauxite	coking coal	lithium	phosphorus
antimony	*feldspar*	LREE	scandium
arsenic	fluorspar	magnesium	silicon metal
baryte	gallium	*manganese*	strontium
beryllium	germanium	natural graphite	tantalum
bismuth	hafnium	niobium	titanium metal
boron/borate	*helium*	PGM	tungsten
cobalt	HREE	phosphate rock	vanadium
		*copper**	*nickel**

2023 Critical Raw Materials (*Strategic Raw Materials in italics)*			
aluminium/bauxite	coking coal	*lithium*	phosphorus
antimony	feldspar	*LREE*	scandium
arsenic	fluorspar	*magnesium*	*silicon metal*
baryte	*gallium*	*manganese*	strontium
beryllium	*germanium*	*natural graphite*	tantalum
bismuth	hafnium	niobium	*titanium metal*
boron/borate	helium	*PGM*	*tungsten*
cobalt	*HREE*	phosphate rock	vanadium
		*copper**	*nickel**

* Copper and nickel do not meet the CRM thresholds, but are included as Strategic Raw Materials.

The overall results of the 2023 criticality assessment are presented in Figure A. Critical raw materials (CRMs) are highlighted by red dots and are located within the criticality zone (SR ≥ 1.0 and EI ≥ 2.8 rounded to one decimal) of the graph. Copper and nickel do not meet the CRM thresholds, but are included as Strategic Raw Materials. Blue dots represent the non-critical raw materials.

All raw materials, even if not considered critical, are important for the EU economy. The fact that a given material is classed as non-critical does not imply that availability and importance to the EU economy can be neglected. Moreover, the availability of new data and possible evolutions in EU and international markets may affect the list in the future.

Main changes to the 2020 criticality assessment

Aluminium/bauxite assessment has been merged due to consistency reason and stays critical at its extraction stage (bauxite) as in the previous assessment.

Titanium metal, being a Strategic Raw material and used in aerospace and defence, stays critical as in 2020. *Titanium* in all forms, around 80% used as white pigment, is not critical.

Arsenic, used in metallurgy and semi-conductors, became critical due to increased EI from 2.6 to 3.0 caused by relatively higher increase in added value of application metals making NACE sectors C23 - Manufacture of other non-metallic mineral products and C24 - Manufacture of basic metals.

Feldspar used in glass and ceramics became critical due to increase in Supply Risk, particularly through higher import dependency and doubling imports from Türkiye now supplying 51% of the EU needs.

Helium used in cryogenics and semiconductors manufacturing had been critical in 2017, but not in 2020 due to small drop in Economic importance. In the 2023 assessment, Economic importance increased due to relative higher increase of value added in the most relevant NACE-sectors C32 - Other manufacturing, C24 - Manufacture of basic metals, C25 - Manufacture of fabricated metal products.

Manganese, being a Strategic Raw material, used in steelmaking and batteries became critical due to Supply Risk increase at the extraction stage caused by lower domestic supply dropping from 32t to 10t (Bulgaria and Hungary production stopped) increasing import reliance and by more concentrated imports from South Africa 41% (33% in 2020) and Gabon 39% (26% in 2020). EI has always been very high.

Supply Risk of *Natural rubber* used in tyres decreased below the threshold mainly due to increased recycling input rate from 1% to 5%, which could however still be underestimating the current efforts deployed by the industry to recycle end of life products; and by decrease of substitution parameter from 0.99 to 0.90 based on revised substitution possibilities. EU is 100% import reliant. Methodology however does not reflect a producer countries cartel.

Both Supply Risk and Economic Importance of *indium* used in flat panel displays have dropped below thresholds. In this assessment, the Supply Risk has been calculated with both Global Supply and EU sourcing data, while in 2020 only Global Supply was considered. Additionally, the EU indium production is higher that the consumption in the EU. Economic Importance dropped due to more precise allocations of uses to applications in the EU: Indium Tin Oxide (ITO) 0 % (no EU manufacturer), Solders 8 %, PV cells 7 %, Thermal interface material 5 %, Batteries (alkaline) 20 %, Alloys/compounds 25 %, semiconductors & LEDs 15 %, Others 20%. Globally, 60% of indium is used in ITO.

Nickel, being a Strategic Raw material, is the only battery material which has never been on the list because of good supply diversification for the assessed period. Assessment however neither reflects the concentration of ownership of the projects and production capacities, nor private contractual arrangements, which may become an issue for the future. Main global producers of ores and concentrates are Indonesia 26%, Philippines 14%, Russia 10%, New Caledonia 9%, Canada 8%, Australia 8% and several smaller producers; and EU sources 39% from Finland, 24% from Canada, 19% from Greece, 8% from South Africa, 4% from the US. Main refiners are China 33%, Indonesia 12%, Japan 9%, Russia 7% and several smaller producers; EU sources refined nickel from 29% from Russia, 18% from Finland, 11% from Norway, 7% from Canada, 7% from Australia, 4% from Greece and several smaller importers.

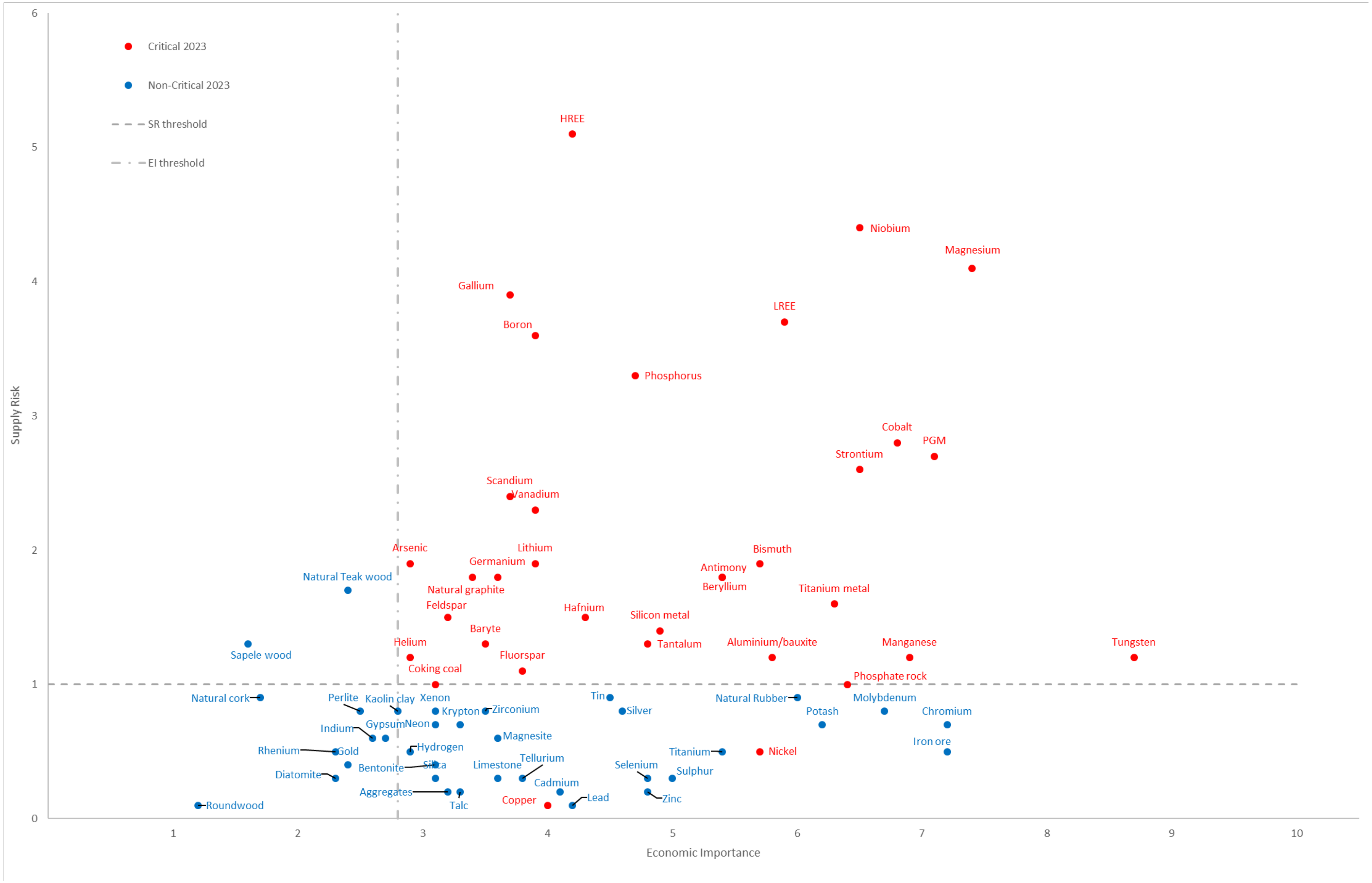
Copper, being a Strategic Raw material, is used in very large quantities of 20 Mt in 2020 for electrification across all strategic technologies. Its supply is very well diversified, therefore it has not been considered critical before. However, it is challenging to substitute due to its superior performance in electrical applications.

Compared to the list of 30 CRMs in 2020, there are 6 new CRMs (Arsenic, Feldspar, Helium and Manganese, plus Copper and Nickel provided they will be defined as SRMs) and two have dropped out (Indium and Natural rubber). None of the newly screened materials (neon, krypton, xenon and roundwood) is critical.

2023 CRMs vs. 2020 CRMs			
aluminium/bauxite	gallium	phosphate rock	vanadium
antimony	germanium	phosphorus	arsenic
baryte	hafnium	PGM	feldspar
beryllium	HREE	scandium	helium
bismuth	lithium	silicon metal	manganese
borate	LREE	strontium	copper
cobalt	magnesium	tantalum	nickel
coking coal	natural graphite	titanium metal	~~*indium*~~
fluorspar	niobium	tungsten	~~*natural rubber*~~

Legend:
Black: CRMs in 2023 and 2020
Red: CRMs in 2023, non-CRMs in 2020
~~*Strike:*~~ Non-CRMs in 2023 that were critical in 2020

Figure A: Results of the 2023 EU criticality assessment[5]



[5] Copper and nickel do not meet the CRM thresholds, but are on the CRM list as Strategic Raw Materials.

Selected outcomes

The following tables present the major global supplier of the 2023 critical raw materials. Table A presents the results for individual raw materials. Table B presents the averaged figures on global primary supply for the 3 material groups: HREEs, LREEs, and PGMs.

Table A: Major global supplier countries of CRMs – individual materials

	Material	Stage *	Main global supplier	Share		Material	Stage *	Main global supplier	Share
1	aluminium	E	Australia	28%	27	magnesium	P	China	91%
2	antimony	E	China	56%	28	manganese	P	S. Africa	29%
3	arsenic	P	China	44%	29	natural graphite	E	China	67%
4	baryte	E	China	44%	30	neodymium	P	China	85%
5	beryllium	E	USA	88%	31	niobium	P	Brazil	92%
6	bismuth	P	China	70%	32	nickel	P	China	33%
7	boron	E	Türkiye	48%	33	palladium	P	Russia	40%
8	cerium	P	China	85%	34	phosphate rock	E	China	48%
9	cobalt	E	DRC	63%	35	phosphorus	P	China	74%
10	coking coal	E	China	53%	36	platinum	P	S. Africa	71%
11	copper	E	Chile	28%	37	praseodymium	P	China	85%
12	dysprosium	P	China	100%	38	rhodium	P	S. Africa	81%
13	erbium	P	China	100%	39	ruthenium	P	S. Africa	94%
14	europium	P	China	100%	40	samarium	P	China	85%
15	feldspar	E	Türkiye	32%	41	scandium	P	China	67%
16	fluorspar	E	China	56%	42	silicon metal	P	China	76%
17	gadolinium	P	China	100%	43	strontium	E	Spain	31%
18	gallium	P	China	94%	44	tantalum	E	DRC	35%
19	germanium	P	China	83%	45	terbium	P	China	100%
20	hafnium	P	France	49%	46	thulium	P	China	100%
21	helium		USA	56%	47	titanium metal	P	China	43%
22	holmium	P	China	100%	48	tungsten	P	China	86%
23	iridium	P	S. Africa	93%	49	vanadium	E	China	62%
24	lanthanum	P	China	85%	50	ytterbium	P	China	100%
25	lithium	P	Australia	53%	51	yttrium	P	China	100%
26	lutetium	P	China	100%					

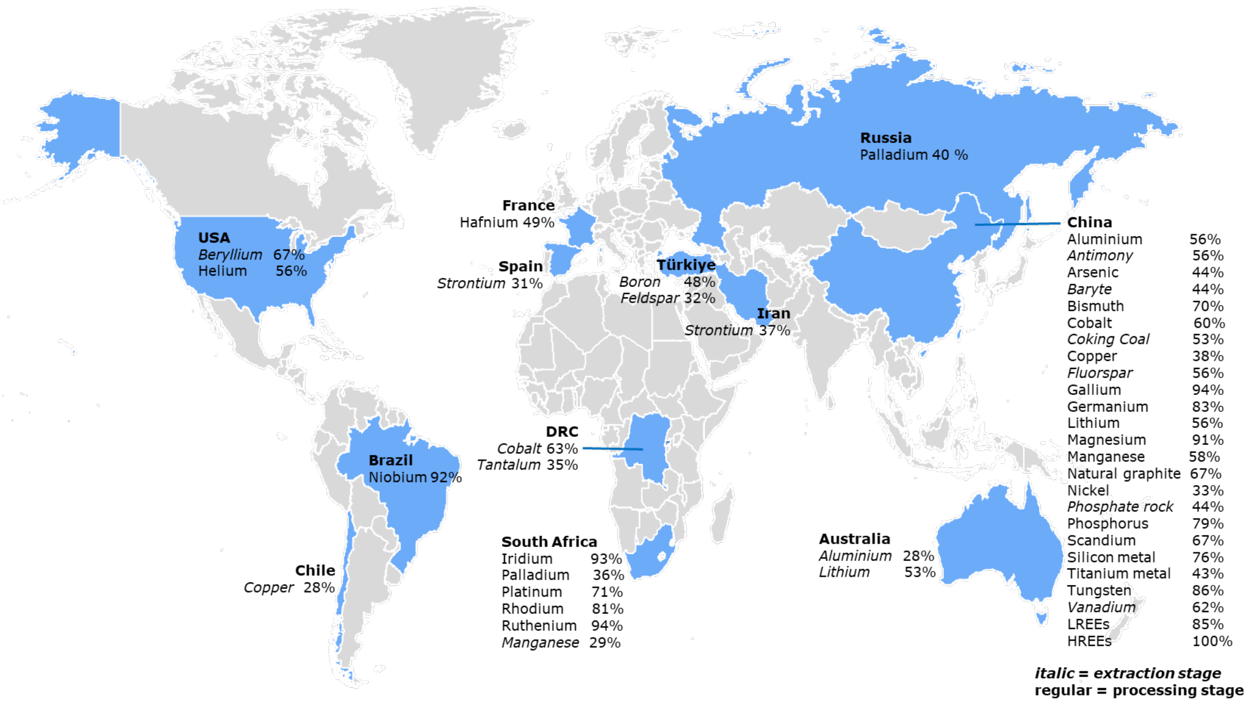
Grouped materials	Stage	Main global supplier	Share
HREEs	P	China	100%
LREEs	P	China	85%
PGMs[6] (iridium, platinum, rhodium, ruthenium)	P	South Africa	75%
PGMs (palladium)	P	Russia	40%

Legend	
Stage	E = Extraction stage P = Processing stage
HREEs	Dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium
LREEs	Cerium, lanthanum, neodymium, praseodymium and samarium
PGMs	Iridium, palladium, platinum, rhodium, ruthenium

6 Calculating the average for the largest global supplier for all the PGMs is not possible because the major producing country is not the same for each of the five PGMs.

Figure B shows the world map of the main global producers of the raw materials listed as critical for the EU in 2023.

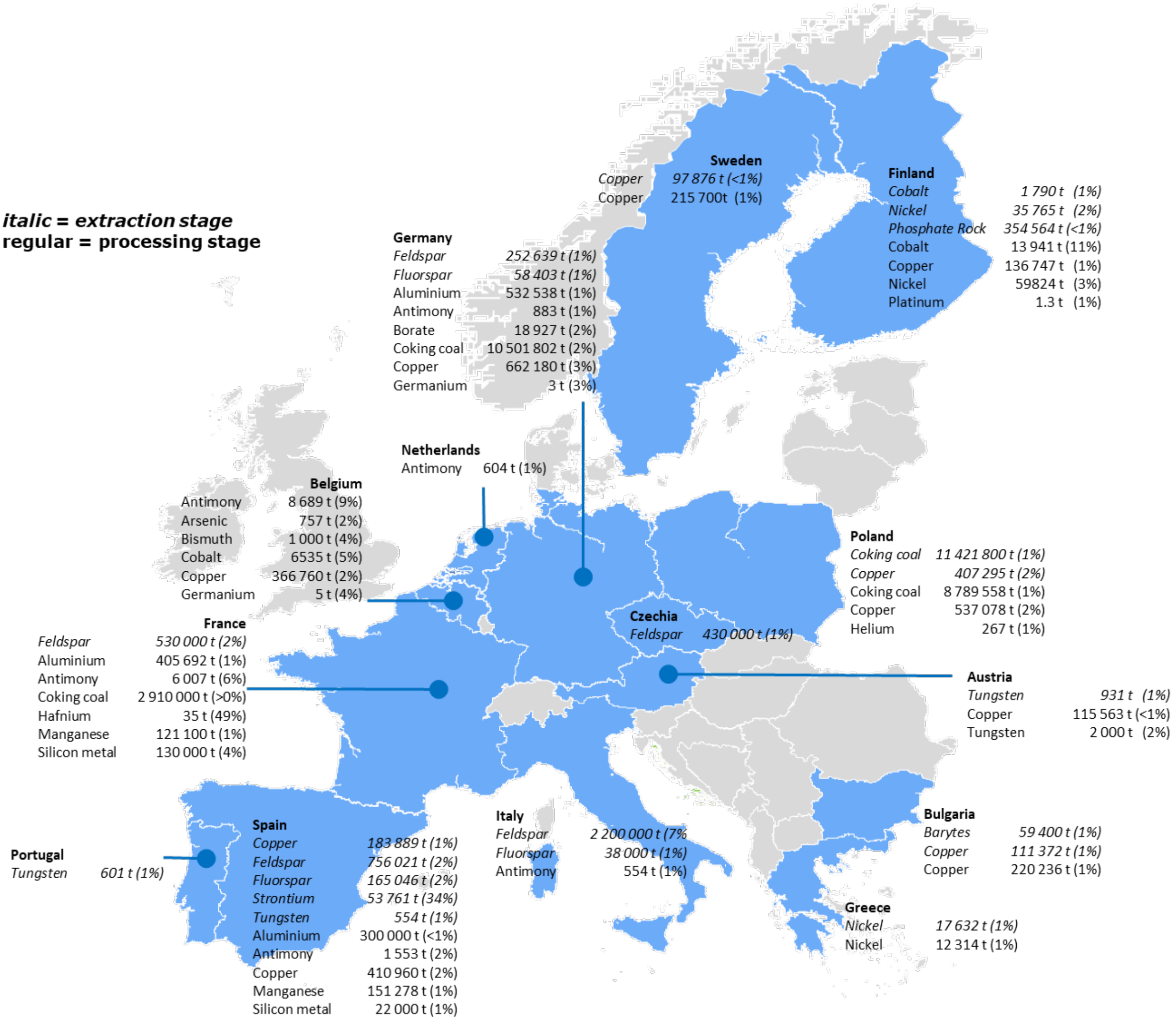
Figure B: Countries accounting for largest share of global supply of CRMs



An analysis of global supply confirms that China is the largest supplier of several critical raw materials. Other countries are also important global suppliers of specific materials. For instance, Russia and South Africa are the largest global suppliers for platinum group metals, Australia for lithium, the USA for beryllium and helium, and Brazil for niobium.

Figure C provides an overview of the EU producers of CRMs with a global share of over 0.5%. It is worth mentioning that the EU extracts 34% of global supply of strontium in Spain; 14% of feldspar in Italy, Spain, France, Czechia, Germany and others; 3% of tungsten in Austria, Portugal and Spain. The EU processes and refines 49% of global supply of hafnium in France; 18% of antimony in Belgium, France, Spain and many others; 17% of cobalt in Finland, Belgium and France; 7% of germanium in Germany and Belgium; 5% of silicon metal in France, Spain and Slovakia; 4% of nickel in Finland, Greece and France.

Figure C: EU producers of CRMs, in brackets shares of global supply, 2016-2020[7]



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[7] DG GROW elaboration on multiple sources

The following table presents the main countries from which the EU is sourcing critical raw materials (EU sourcing) for individual raw materials and the averaged figures for 3 material groups: HREEs, LREEs, and PGMs.

Table B: Major EU sourcing countries of CRMs – individual materials

	Material	Stage *	Main EU supplier	Share		Material	Stage *	Main EU supplier	Share
1	aluminium	E	Guinea	63%	27	magnesium	P	China	97%
2	antimony	E	Türkiye	63%	28	manganese	e	S. Africa	41%
3	arsenic	P	Belgium	59%	29	natural graphite	E	China	40%
4	baryte	E	China	45%	30	neodymium	P	China	85%
5	beryllium	E	USA	60%	31	niobium	P	Brazil	92%
6	bismuth	P	China	65%	32	nickel	e	Finland	38%
7	boron	E	Türkiye	99%	33	palladium	P	N/A*	N/A*
8	cerium	P	China	85%	34	phosphate rock	E	Morocco	27%
9	cobalt	E	N/A*	N/A*	35	phosphorus	P	Kazakhstan	65%
10	coking coal	E	Poland	26%	36	platinum	P	N/A*	N/A*
11	copper	E	Poland	19%	37	praseodymium	P	China	85%
12	dysprosium	P	China	100%	38	rhodium	P	N/A*	N/A*
13	erbium	P	China	100%	39	ruthenium	P	N/A*	N/A*
14	europium	P	China	100%	40	samarium	P	China	85%
15	feldspar	E	Türkiye	51%	41	scandium	P	China	67%
16	fluorspar	E	Mexico	33%	42	silicon metal	P	Norway	35%
17	gadolinium	P	China	100%	43	strontium	E	Spain	99%
18	gallium	P	China	71%	44	tantalum	E	Congo, D.R.	35%
19	germanium	P	China	45%	45	terbium	P	China	100%
20	hafnium	P	France	76%	46	thulium	P	China	100%
21	helium	P	Qatar	35%	47	titanium metal	P	Kazakhstan	36%
22	holmium	P	China	100%	48	tungsten	P	China	32%
23	iridium	P	N/A*	N/A*	49	vanadium	E	China	62%
24	lanthanum	P	China	85%	50	ytterbium	P	China	0%
25	lithium	P	Chile	79%	51	yttrium	P	China	100%
26	lutetium	P	China	100%					

Grouped materials	Stage	Main EU supplier	Share
HREEs	P	China	100%
LREEs	P	China	85%
PGMs (iridium, platinum, palladium, rhodium, ruthenium)	P	N/A*	N/A*

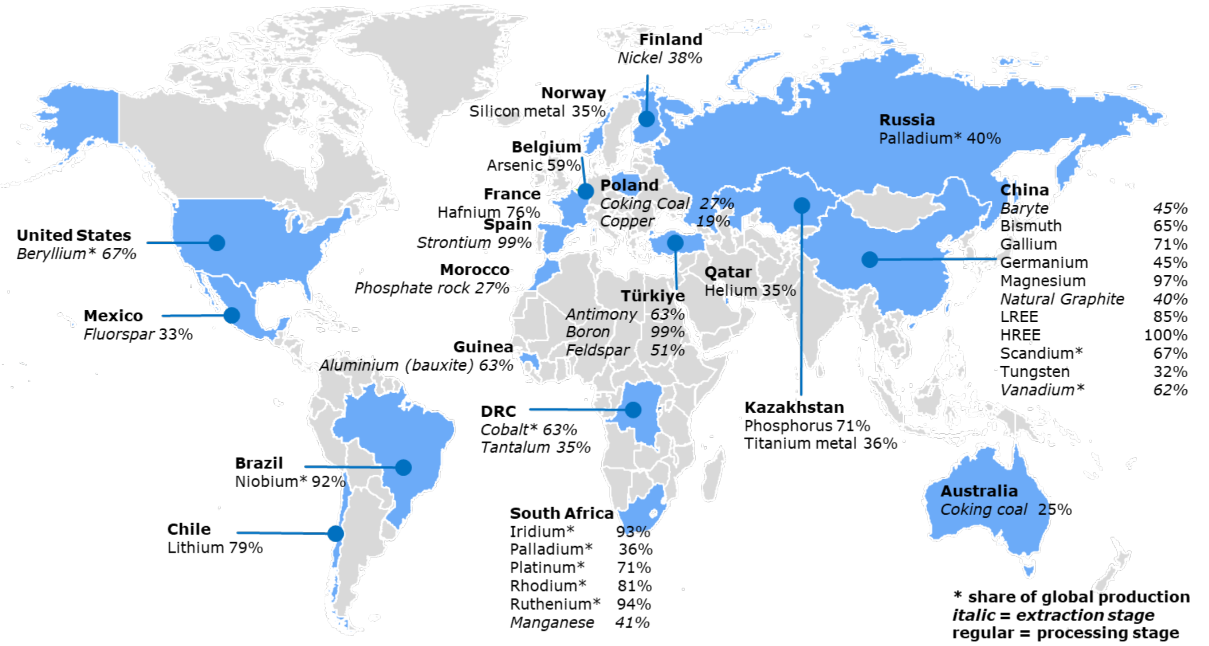
Legend	
Stage	E = Extraction stage P = Processing stage
HREEs	Dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium
LREEs	Cerium, lanthanum, neodymium, praseodymium and samarium
PGMs	Iridium, palladium, platinum, rhodium, ruthenium

Figure D shows the world map of the main CRM suppliers to the EU. China is both the largest global and the EU supplier for the majority of the CRMs, including baryte, bismuth, gallium, germanium, magnesium, natural graphite, all rare earths (HREE and LREE), tungsten and vanadium.

Although China remains a major EU supplier, for a number of countries the EU sources differs, e.g. coking coal and copper from Poland, arsenic from Belgium, hafnium from

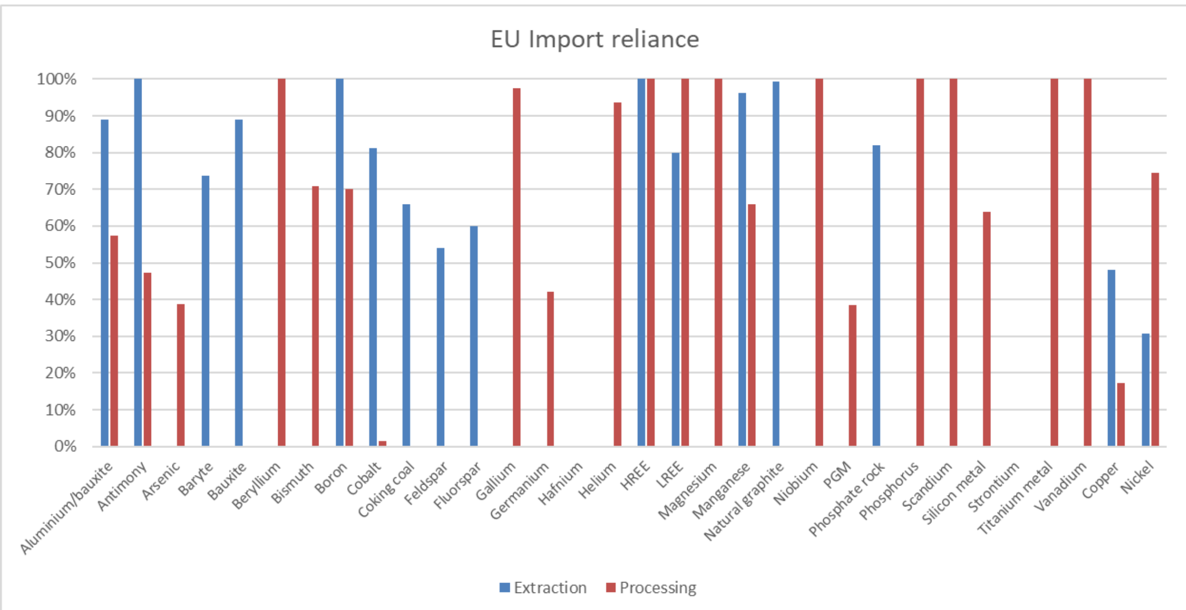
France, strontium from Spain or nickel from Finland. There are several third countries supplying the EU with CRMs, such as Chile (lithium), Guinea (bauxite), Kazakhstan (titanium, phosphorus), Mexico (fluorspar), Norway (silicon metal), Türkiye (antimony, boron, feldspar), US (beryllium). EU sourcing however lacks reliable trade data for the five platinum group metals produced mostly in South Africa, cobalt mined mostly in DRC, beryllium supplied by the US, niobium from Brazil, vanadium produced in China.

Figure D: Major EU suppliers of CRMs



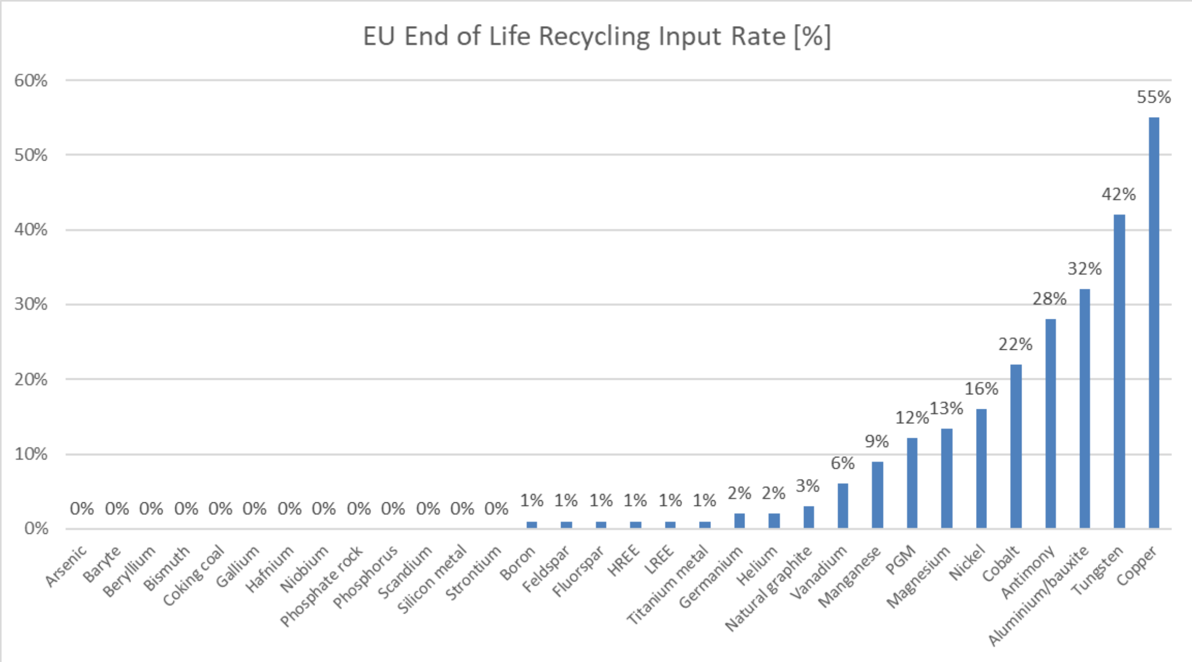
There are several differences on the map compared to the situation in the previous assessment: Belgium appears as the major EU supplier of arsenic (59%); major production of germanium in Finland ceased in 2015; Finnish production of nickel doubled and supplies 38% of the EU consumption; Germany ceased gallium production in 2016 and China became major supplier to the EU with 71%; Qatar appears as the main supplier of helium (35%); South Africa is our main supplier of manganese with 41%.

Figure E: EU Import reliance for extracted and processed CRMs



The EU is at the forefront of the circular economy and has already increased its use of secondary raw materials. For example, as shown in the Figure F, more than 50% of some metals such as iron, zinc, or platinum are recycled and they cover more than 25% of the EU's consumption. For others, however, especially those needed in renewable energy technologies or high-tech applications such as rare earths, gallium, or indium, secondary production makes only a marginal contribution.

Figure F: Recycling's contribution to meeting materials demand (End of Life Recycling Input Rate)[8]



8 The Recycling Input Rate (RIR) is the percentage of overall demand that can be satisfied through secondary raw materials. Figure from: Study on the EU's list of Critical Raw Materials (2020) Final Report

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1. INTRODUCTION

1.1. CONTENT AND PURPOSE OF THE REPORT

This DG GROW report serves as the background document in support of defining the 2023 list of Critical Raw Materials (CRMs) for the EU.

The report is the result of cooperation with the Ad hoc Working Group on Defining Critical Raw Materials (AHWG)[9], consultants and key industry and scientific experts identified through the Horizon project SCRREEN[10], including two validation workshops in 2022.

This report includes information on the criticality assessments carried out on the materials covered for this 2023 exercise and is divided into the following chapters and annexes:

- Chapter 1 – Introduction to the report: objectives and context of critical raw materials in Europe;
- Chapter 2 – Criticality assessment approach: scope of the criticality assessments, application of the EC criticality methodology, data sources used and stakeholder consultation;
- Chapter 3 – Criticality assessment outcome: results and key findings, comparison with previous assessments and limitations of the assessment results, conclusions and recommendations; and
- Annexes – Additional supporting information on the methodology, quantitative assessment and related data, stakeholder consultations

The report will accompany the Critical Raw Materials Act, together with the raw materials factsheets updated by project SCRREEN[11] for both critical and non-critical materials, and the Foresight report developed by DGs JRC and GROW.

1.2. OBJECTIVES OF THE REPORT

This report presents the results of the criticality assessment of 87 raw materials for the EU based on the methodology developed by the European Commission[12]. The report builds upon the work carried out in the previous assessments (2011[13], 2014[14], 2017[15] and 2020[16]). The report takes into account feedback gathered from the previous and 2023 exercises and establishes the technical basis for the updated list of critical raw materials for the EU.

The objectives of this assessment were to:

- Assess the criticality of a selection of raw materials following the EC quantitative criticality methodology.

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9 The AHWG on Defining Critical Raw Materials is a sub-group of the Raw Materials Supply Group expert group. The list of its members and observers is available here: http://ec.europa.eu/transparency/regexpert/index.cfm?do=groupDetail.groupDetail&groupID=1353

10 http://scrreen.eu/the-project/

11 The factsheets for critical and non-critical materials are provided as separate documents and are available at the SCRREEN project wepbpage.

12 Methodology for establishing the EU List of Critical Raw Materials, 2017, ISBN 978-92-79-68051-9

13 2011 assessment refers to the study on Critical Raw Materials for the EU published in 2010 and the Commission's Communication COM(2011)25 adopted in 2011.

14 2014 assessment refers to the study on Critical Raw Materials at EU level published in 2013 and the Commission's Communication COM(2014)297 adopted in 2014.

15 2017 assessment refers to the study on Critical Raw Materials at EU level published in 2016 and the Commission’s Communication COM(2017)0490 final adopted in 2017.

16 2020 assessment refers to the study on Critical Raw Materials at EU level published in 2020 and the Commission’s Communication COM/2020/474 final adopted in 2020.

- Analyse the production, key trends, trade flows and barriers of the raw materials with the aim to identify potential bottlenecks by assessing extraction and processing stages[17] and supply risks throughout the value chain.
- Used data and projections are based on the reference period of the last 5 years - 2016-2020 (to the extent possible).
- Provide a list of data sources.
- Continue to improve the quality and availability of data.
- Analysis of a wider range of raw materials (4 new candidates: neon, krypton, xenon and roundwood).

1.3. PURPOSE OF THE LIST OF CRITICAL RAW MATERIALS FOR THE EU

The 2023 list of CRMs is embedded in the Critical Raw Materials Act and serves as a reference for its legislative provisions and actions.

The CRMs assessment and the list are intended to flag raw materials supply risks and their economic importance for the whole EU economy.

The CRM list has already helped to incentivise the investment into production of CRMs in the EU and abroad. The list has also being used to help prioritise needs and actions; for example, as a supporting element when negotiating trade agreements, challenging trade distortion measures or promoting research and innovation actions under EU Horizon and Member States' programmes.

It is also worth emphasising that all raw materials, even if not classed as critical, are important for the European economy and that a given raw material and its availability to the European economy should therefore not be neglected just because it is not classed as critical.

[17] A bottleneck is considered to be the point in the value chain for a specific material where the supply risk is highest, i.e. the stage (either extraction/harvesting or processing/refining), that has the highest numerical criticality score for the Supply Risk.

2. CRITICALITY ASSESSMENT APPROACH

2.1 SCOPE OF THE ASSESSMENT

2.1.1 Screened raw materials

The 2023 assessment covers a larger number of materials: 87 screened individual materials resulting in 70 candidate raw materials (67 individual and 3 grouped materials: ten individual heavy (HREEs) and five light (LREEs) rare earth elements, and five platinum-group metals (PGMs)). Five new materials have been assessed, including neon, krypton, xenon, roundwood, and titanium metal (in addition to titanium). The 87 screened individual materials are listed in Table 1.

Table 1: List of materials/groupings covered in the 2023 assessment

Individual materials		
Aggregates	Helium	Rhenium
Aluminium/bauxite	Hydrogen	Scandium
Antimony	Indium	Selenium
Arsenic	Iron Ore	Sulphur
Baryte	Krypton	Potash
Bentonite	Lead	Silica Sand
Beryllium	Limestone	Silicon Metal
Bismuth	Gold	Silver
Boron	Gypsum	Strontium
Cadmium	Lithium	Talc
Chromium	Magnesite	Tantalum
Kaolin clay	Magnesium	Tellurium
Cobalt	Manganese	Tin
Coking coal	Molybdenum	Titanium
Copper	Natural Graphite	Tungsten
Diatomite	Neon	Vanadium
Feldspar	Nickel	Xenon
Fluorspar	Niobium	Zinc
Gallium	Perlite	Zirconium
Germanium	Phosphorus	Titanium metal
Hafnium	Phosphate rock	
Platinum group metals (PGMs)		
Iridium	Platinum	Ruthenium
Palladium	Rhodium	
Rare earth elements (REEs)		
LREEs	HREEs	
Cerium	Dysprosium	Lutetium
Lanthanum	Erbium	Terbium
Neodymium	Europium	Thulium
Praseodymium	Gadolinium	Ytterbium
Samarium	Holmium	Yttrium
Biotic materials		
Natural Rubber	Natural cork	Roundwood
Sapele wood	Natural Teak wood	

Legend:	
Green boxes =	*Materials covered in 2014 assessment but not in 2011*
Orange boxes =	*Materials covered in 2017 but not in 2014*
Light blue boxes =	*Materials covered in 2020 but not in 2017*
Yellow boxes	*Materials covered in 2023 but not in 2020*

To facilitate coherence, materials from previous assessments are included (with the exception of osmium, pulpwood and sawn softwood[18]). This allows for the identification of any key materials that may move from the non-critical to critical status or vice versa.

2.1.2 Bottleneck screening

Since the 2020 exercise, it was decided to systematically include a two stage supply risk assessment for those materials where two clear extraction and processing stages could be identified and data is available. Table 2 indicates 40 individual raw materials screened at both stages.

The extraction stage covers the production of ores and concentrates, or wood extraction. The processing stage covers the separation, refining, chemical and metallurgical modification of raw materials.

Table 2: List of materials covered by a two stages supply risk assessment

2023 Raw materials assessed at two stages			
aluminium	erbium	lutetium	tin
antimony	europium	manganese	titanium
beryllium	gadolinium	molybdenum	titanium metal
boron	holmium	neodymium	tungsten
cerium	hydrogen	nickel	vanadium
chromium	iron ore	niobium	terbium
cobalt	kaolin	praseodymium	thulium
coking coal	lanthanum	samarium	yttrium
copper	lead	silver	ytterbium
dysprosium	lithium	terbium	zinc

In accordance with the EC methodology, the stage with a higher Supply Risk (SR) score has been used in the results. Annex 3 provides further information and the rationale on the stages assessed.

2.1.3 Reference period

The reference period for data used in the assessments is the 5-year average for 2016-2020, where possible.

2.2 THE EC CRITICALITY METHODOLOGY

The proposal of the CRM Act Regulation[19] contains the list of Strategic Raw Materials (SRMs) and the list of CRMs. The Regulation proposes to automatically add SRMs selected based on a new methodology (Annex 1 of the Regulation) on the CRMs list, defined by the established CRM methodology[20] (Annex 2 of the Regulation). The CRM methodology was developed by the European Commission in cooperation with the Ad hoc Working Group on Defining Critical Raw Materials (AHWG)[21] in 2017.

The 2023 assessment applies the EC criticality methodology, while ensuring comparability with the previous methodology used in 2011, 2014 and 2017. The methodology is based on the two main criteria Economic Importance (EI) and Supply

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18 Osmium was nominally assessed in 2011 and 2014 as part of the PGM group; however it cannot be assessed in its own right because of the lack of data specific to osmium. It was, therefore, excluded from the 2017, 2020 and 2023 exercises. Complementary information on osmium is provided in the PGMs factsheet. Pulpwood and sawn softwood were assessed only in 2014.

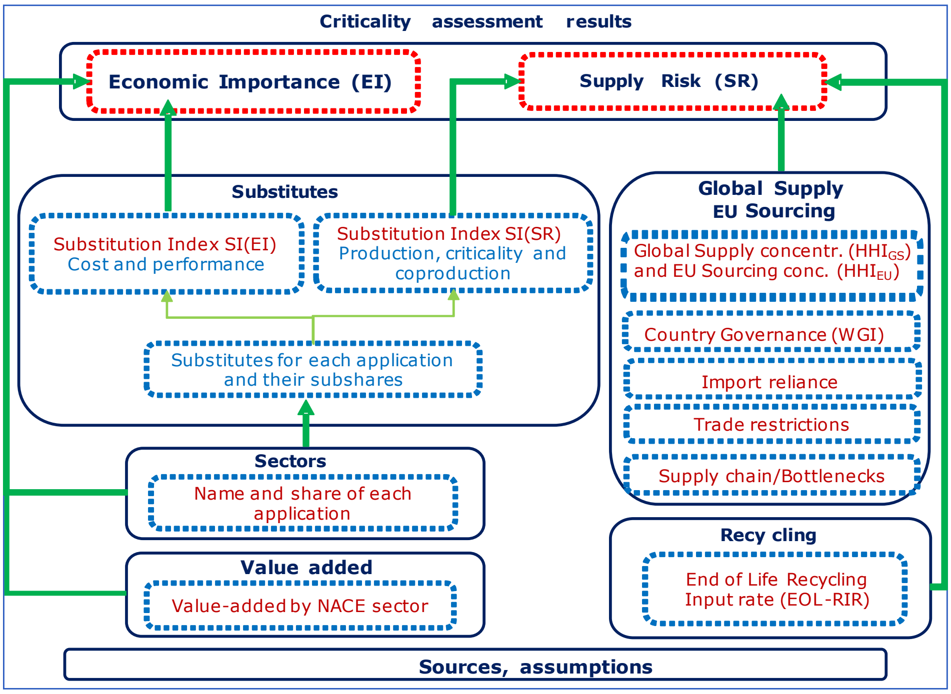
19 Regulation proposal COM(2023) 160 - 2023/0079 (COD)

20 Methodology for establishing the EU List of Critical Raw Materials, 2017, ISBN 978-92-79-68051-9

21 The AHWG on Defining Critical Raw Materials is a sub-group of the Raw Materials Supply Group expert group.

Risk (SR). The thresholds remain at SR ≥ 1.0 and EI ≥ 2.8 rounded to one decimal. An overview of the EC's criticality methodology is reported in Figure 2.

Figure 1: Overall structure of the criticality methodology[22]



2.3 DATA AVAILABILITY, QUALITY AND USE

The data availability and reliability required to complete the criticality assessment is essential to ensure the robustness and comparability of the results and to maximise the quality of the outputs of the study. A detailed list of the sources used in the criticality assessment are provided in the Annex 11.

Regarding the overall availability and reliability of the data sources, in general, there is good public data availability for global supply (e.g. from the WMD, BGS or USGS) at least for one of the screened stages. There is also improvement in PRODCOM data provided by Eurostat for the EU countries due to disaggregation of production codes; however, confidentiality of some data remains an issue.

The main source for trade data used for calculating the EU sourcing Supply Risk was Eurostat COMEXT data. Data still are of variable quality due to aggregated trade codes, confidentiality or significant inconsistencies between the world producers and the EU suppliers. Data for calculating trade parameter has been obtained from the OECD Inventory on export restrictions on Industrial Raw Materials.

There is acceptable quality of data for the EU recycling input rates obtained from the EC Materials Systems Analyses mostly for CRMs, however, for other some of the screened materials only global or older EU data was available.

In addition, there is a general difficulty obtaining public data on the shares of applications of materials, as well as their substitutes. Stakeholders were therefore consulted to validate or provide additional inputs regarding the data used for the assessments.

In general, the criticality methodology prioritises official EU (Eurostat) and Member States (world Mining Data (WMD), DERA reports) data over other public data, trade/industry sources and other special interest groups. Where possible, it also

[22] Study on the review of the list of critical raw materials, 2017, ISBN 978-92-79-47937-3

prioritises the use of data for Europe over datasets that relate to the whole world e.g. global data. Public data from organisations such as the United States Geological Survey (USGS), British Geological Survey (BGS) or International Energy Agency (IEA) are used in the cases where no other comparable sources exist or are of better quality. Data from private sources (industry, trade associations, private data providers etc.) may also be considered in the absence or insufficient quality of other data, under the condition that such data can be shared and published.

2.4 STAKEHOLDER CONSULTATION

In addition to the use of data sources described in the previous section, the involvement of stakeholders was of utmost importance in order to maximise the quality of the outputs of the study and to ensure transparency. The aim of the stakeholder consultation was to ensure that industrial and scientific stakeholders are given the opportunity to provide their expert feedback on specific materials and eventually improve the results. Consultation with stakeholders ensures that the outcomes of this study, especially the conclusions, are optimally validated and subsequently disseminated and applied, where relevant.

The dedicated Commission Expert Group AHWG has been consulted on the data inputs and the results to ensure that the assessment reflect the body of knowledge available throughout the EU on the topic of raw materials.

Additionally, the Horizon project SCRREEN2 co-organised with DG GROW two validation workshops on 31 May-3 June and on 20-23 September 2022 to collect, review and validate the data used for the purpose of criticality calculations and information used in the factsheets. The stakeholder workshops also provided the opportunity to present the data sources used and contributions delivered by stakeholders as well as to discuss any recommendations to improve results. Experts were also asked to contribute to relevant sections of the factsheets.

Several follow-up actions were carried out after the workshops, which included a summary of key stakeholder feedback received from the validation workshops and follow-up with individual stakeholders who indicated willingness and capability to contribute relevant data and input for the criticality assessments. Based on this feedback, some of the criticality assessments were improved while others were consolidated with more accurate data.

A summary report of the stakeholder validation workshops is provided in Annex 13 and includes details of the preparation and organisation of the workshops as well as the list of participants.

3. CRITICALITY ASSESSMENT OUTCOME

3.1 CRITICALITY ASSESSMENT RESULTS

Of the 70 candidate raw materials assessed, the following 34 raw materials are proposed for the CRM list 2023.

Table 3: 2023 Critical raw materials for the EU

2023 Critical Raw Materials (*new CRMs in italics*)			
aluminium/bauxite	coking coal	lithium	phosphorus
antimony	*feldspar*	LREE	scandium
arsenic	fluorspar	magnesium	silicon metal
baryte	gallium	*manganese*	strontium
beryllium	germanium	natural graphite	tantalum
bismuth	hafnium	niobium	titanium metal
boron/borate	*helium*	PGM	tungsten
cobalt	HREE	phosphate rock	vanadium
		*copper**	*nickel**

* Copper and Nickel do not meet the CRM thresholds, but are included as SRMs.

Table 4: 2023 Critical raw materials 2023, including Strategic Raw Materials

2023 Critical Raw Materials (*Strategic Raw Materials in italics*)			
aluminium/bauxite	coking coal	*lithium*	phosphorus
antimony	feldspar	LREE	scandium
arsenic	fluorspar	*magnesium*	*silicon metal*
baryte	*gallium*	*manganese*	strontium
beryllium	*germanium*	*natural graphite*	tantalum
bismuth	hafnium	niobium	*titanium metal*
boron/borate	helium	*PGM*	*tungsten*
cobalt	*HREE*	phosphate rock	vanadium
		*copper**	*nickel**

* Copper and Nickel do not meet the CRM thresholds, but are included as SRMs.

The list of critical raw materials (CRM) is established on the basis of the raw materials which reach or exceed the thresholds for both parameters. There is no ranking order of the raw materials in terms of criticality.

Annex 2 provides the scaled results of the Economic Importance (EI) and the Supply Risk (SR) for extraction and processing stages, as well indicates the supply data that was used (global supply and/or EU sourcing) in the calculations of SR. 0 provides Substitution Indexes for EI and SR. Annex 10 provides Import Reliance (IR) for both stages. Annex 11 provides End-of-life Recycling Input Rate (EOL-RIR) used for each of the candidate materials.

Figure 2 presents the overall results of the criticality assessments mapped against the criticality thresholds. Critical raw materials are highlighted by red dots and are located within the criticality zone (SR ≥ 1 and EI ≥ 2.8). Blue dots represent the non-critical raw materials.

Figure 2: Criticality assessment results (individual materials and grouped HREEs, LRREs and PGMs)

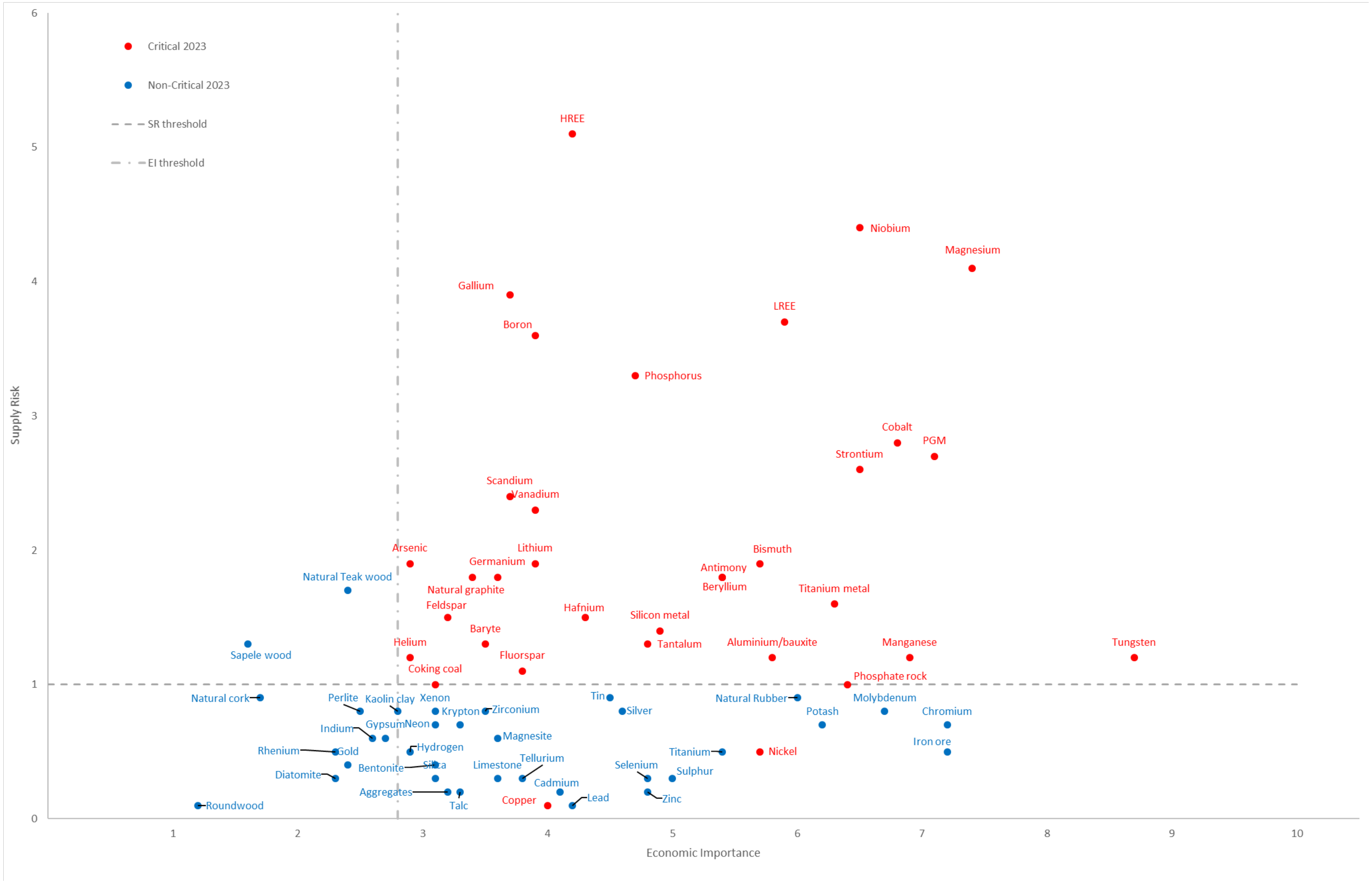
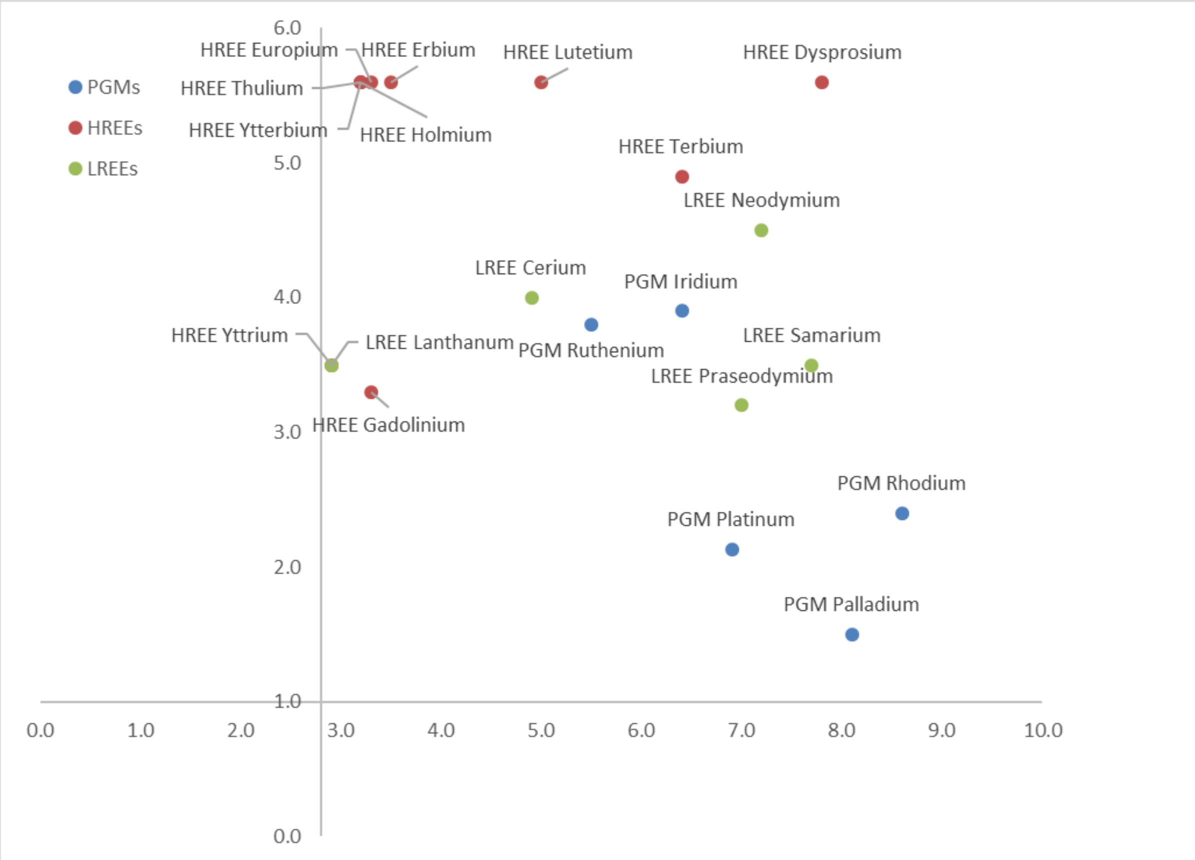


Figure 3 presents the individual results for the grouped materials. The blue dots represent the platinum group metals (PGMs), the light green dot indicate the light rare earth metals (LREEs) and the red dots present the heavy rare earth metals (HREEs).

Figure 3: Criticality results for individual materials grouped as PGMs, LREEs and HREEs



3.2 ANALYSIS OF THE ASSESSMENT RESULTS

3.2.1 Global supply

Figure 4 and Table 5 present the results for the 2023 CRMs as individual materials and the averaged figures for the groups HREEs (10 materials), LREEs (5 materials) and PGMs (5 materials).

Table 5: Global supply of the CRMs, individual materials

	Material	Stage	Main global supplier	Share		Material	Stage	Main global supplier	Share
1	aluminium	E	Australia	28%	27	magnesium	P	China	91%
2	antimony	E	China	56%	28	manganese	P	S. Africa	29%
3	arsenic	P	China	44%	29	natural graphite	E	China	67%
4	baryte	E	China	44%	30	neodymium	P	China	85%
5	beryllium	E	USA	88%	31	niobium	P	Brazil	92%
6	bismuth	P	China	70%	32	nickel	P	China	33%
7	boron	E	Türkiye	48%	33	palladium	P	Russia	40%
8	cerium	P	China	85%	34	phosphate rock	E	China	48%
9	cobalt	E	DRC	63%	35	phosphorus	P	China	74%
10	coking coal	E	China	53%	36	platinum	P	S. Africa	71%
11	copper	E	Chile	28%	37	praseodymium	P	China	85%
12	dysprosium	P	China	100%	38	rhodium	P	S. Africa	81%
13	erbium	P	China	100%	39	ruthenium	P	S. Africa	94%
14	europium	P	China	100%	40	samarium	P	China	85%
15	feldspar	E	Türkiye	32%	41	scandium	P	China	67%
16	fluorspar	E	China	56%	42	silicon metal	P	China	76%
17	gadolinium	P	China	100%	43	strontium	E	Spain	31%
18	gallium	P	China	94%	44	tantalum	E	DRC	35%
19	germanium	P	China	83%	45	terbium	P	China	100%
20	hafnium	P	France	49%	46	thulium	P	China	100%
21	helium	P	USA	56%	47	titanium metal	P	China	43%
22	holmium	P	China	100%	48	tungsten	P	China	86%
23	iridium	P	S. Africa	93%	49	vanadium	E	China	62%
24	lanthanum	P	China	85%	50	ytterbium	P	China	100%
25	lithium	P	Australia	53%	51	yttrium	P	China	100%
26	lutetium	P	China	100%					

Grouped materials	Stage	Main global supplier	Share
HREEs	P	China	100%
LREEs	P	China	85%
PGMs[23] (iridium, platinum, rhodium, ruthenium)	P	South Africa	75%
PGMs (palladium)	P	Russia	40%

Legend	
Stage	E = Extraction stage P = Processing stage
HREEs	Dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium
LREEs	Cerium, lanthanum, neodymium, praseodymium and samarium
PGMs	Iridium, palladium, platinum, rhodium, ruthenium

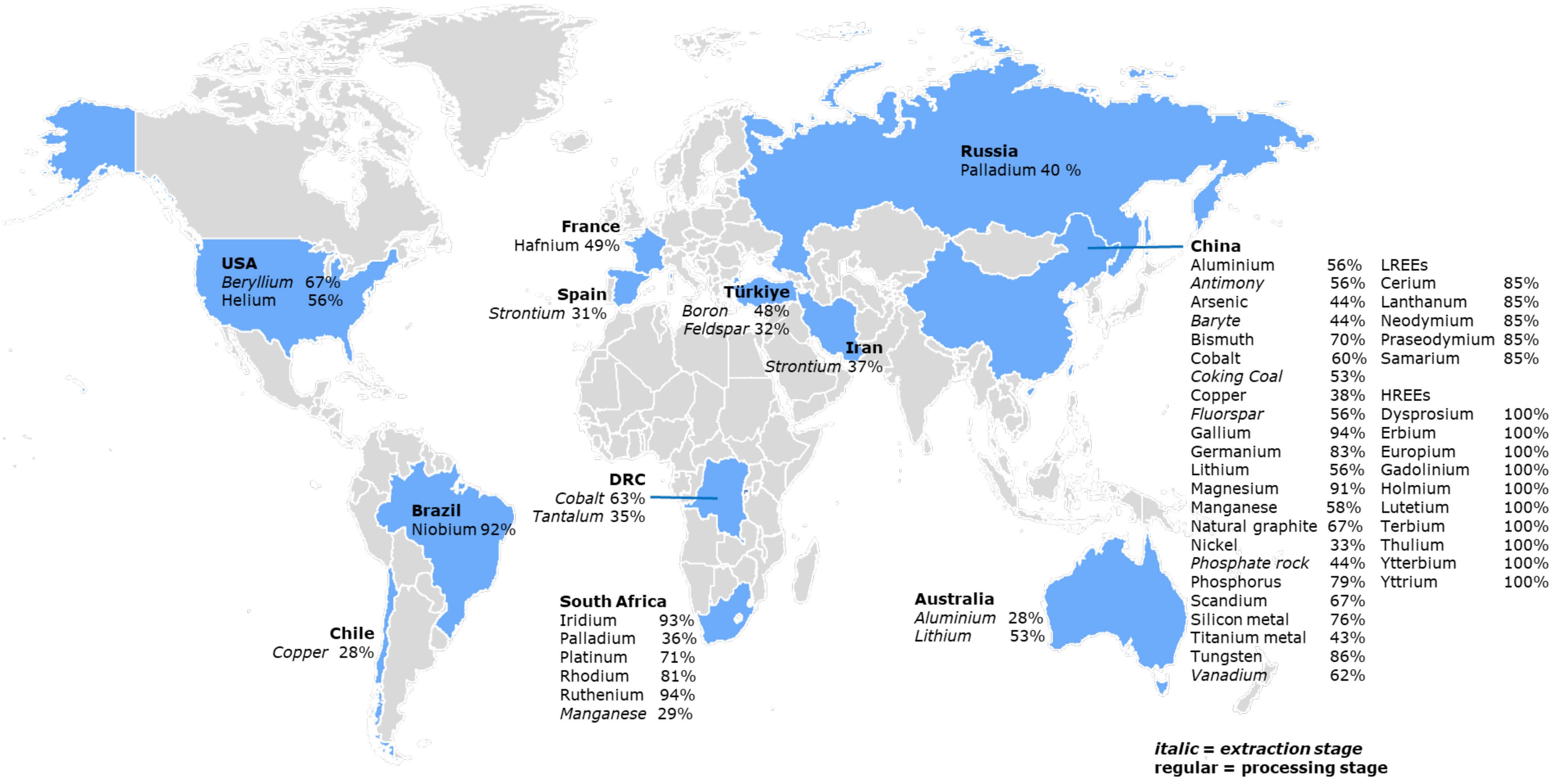
23 Calculating the average for the largest global supplier for all the PGMs is not possible because the major producing country is not the same for each of the five PGMs.

It should be noted, that in Table 5 it is not possible to calculate the average for the largest global supplier of all the PGMs because the major producing country is not the same for the five PGMs. For iridium, platinum, rhodium and ruthenium, the major global supplier is South Africa, whereas for palladium the major global supplier is Russia.

The analysis of the global supply excludes aggregates, limestone and roundwood at the extraction stage due to lack of data for all countries. Data for the following materials were available, but not considered as the EU Import reliance is 0: magnesite and natural cork at the extraction stage, hafnium, hydrogen, krypton, neon, xenon and zinc at the processing stage.

The analysis indicates that China is the largest global supplier of the critical raw materials. In terms of the total number of CRMs, China is the major supplier of 21 CRMs. This includes light and heavy REEs, refined cobalt, natural graphite, nickel and other CRMs: antimony, arsenic, baryte, bismuth, coking coal, refined copper, fluorspar, gallium, germanium, phosphate rock, phosphorus, scandium, silicon metal, titanium, tungsten and vanadium. In addition to China, several other countries are also important global suppliers of specific materials. For instance, South Africa and Russia are the largest global suppliers of platinum group metals, DRC of cobalt and tantalum, USA of beryllium and Brazil for niobium.

Figure 4: Main global suppliers of individual CRMs



3.2.2 EU supply

Table 6 and Figure 4: Main global suppliers of individual CRMs show the main CRM suppliers to the EU. China is both the largest global and the EU supplier for the majority of the CRMs, including baryte, bismuth, gallium, germanium, magnesium, natural graphite, all rare earths (HREE and LREE), tungsten and vanadium. Trade data for PGMs are likely not to reflect reality, therefore are disregarded in the Table 5.

Table 6: Main EU suppliers of the CRMs, individual materials

	Material	Stage	Main EU supplier	Share		Material	Stage	Main EU supplier	Share
1	aluminium	E	Guinea	63%	27	magnesium	P	China	97%
2	antimony	E	Türkiye	63%	28	manganese	E	S. Africa	41%
3	arsenic	P	Belgium	59%	29	natural graphite	E	China	40%
4	baryte	E	China	45%	30	neodymium	P	China	85%
5	beryllium	E	USA	60%	31	niobium	P	Brazil	92%
6	bismuth	P	China	65%	32	nickel	E	Finland	38%
7	boron	E	Türkiye	99%	33	palladium	P	N/A*	N/A*
8	cerium	P	China	85%	34	phosphate rock	E	Morocco	27%
9	cobalt	E	N/A*	N/A*	35	phosphorus	P	Kazakhstan	65%
10	coking coal	E	Poland	26%	36	platinum	P	N/A*	N/A*
11	copper	E	Poland	19%	37	praseodymium	P	China	85%
12	dysprosium	P	China	100%	38	rhodium	P	N/A*	N/A*
13	erbium	P	China	100%	39	ruthenium	P	N/A*	N/A*
14	europium	P	China	100%	40	samarium	P	China	85%
15	feldspar	E	Türkiye	51%	41	scandium	P	China	67%
16	fluorspar	E	Mexico	33%	42	silicon metal	P	Norway	35%
17	gadolinium	P	China	100%	43	strontium	E	Spain	99%
18	gallium	P	China	71%	44	tantalum	E	Congo, D.R.	35%
19	germanium	P	China	45%	45	terbium	P	China	100%
20	hafnium	P	France	76%	46	thulium	P	China	100%
21	helium	P	Qatar	35%	47	titanium metal	P	Kazakhstan	36%
22	holmium	P	China	100%	48	tungsten	P	China	32%
23	iridium	P	N/A*	N/A*	49	vanadium	E	China	62%
24	lanthanum	P	China	85%	50	ytterbium	P	China	0%
25	lithium	P	Chile	79%	51	yttrium	P	China	100%
26	lutetium	P	China	100%					

Grouped materials	Stage	Main EU supplier	Share
HREEs	P	China	100%
LREEs	P	China	85%
PGMs (iridium, platinum, palladium, rhodium, ruthenium)	P	N/A*	N/A*

Legend	
Stage	E = Extraction stage P = Processing stage
HREEs	Dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium
LREEs	Cerium, lanthanum, neodymium, praseodymium and samarium
PGMs	Iridium, palladium, platinum, rhodium, ruthenium

*trade data likely do not reflect reality

Despite China being the largest global supplier for the majority of the critical raw materials, the analysis of the primary EU sourcing (i.e. domestic production plus imports) paints a different picture. China remains the major EU supplier of REEs, baryte, gallium, germanium, magnesium, natural graphite, scandium, tungsten and vanadium, as illustrated by Figure 5. Several EU countries represent main shares of the supply for specific critical raw materials, such as coking coal and copper from Poland, arsenic from Belgium, hafnium from France, strontium from Spain or nickel from Finland. There are several third countries supplying the EU with CRMs, such as Chile (lithium), Guinea (bauxite), Kazakhstan (titanium, phosphorus), Mexico (fluorspar), Norway (silicon metal), Türkiye (antimony, boron, feldspar), US (beryllium). EU sourcing however lacks reliable trade data for the five platinum group metals produced mostly in South Africa, cobalt mined mostly in DRC, beryllium supplied by the US, niobium from Brazil, vanadium produced in China.

The analysis of the EU sourcing excludes beryllium, cobalt, lithium, niobium, perlite, vanadium at the extraction stage and PGMs, HREEs at the processing stage due to lack of reliable data or negligible imports.

There are several differences on the map in Figure 5 compared to the situation in the previous assessment: Belgium appears as the major EU supplier of arsenic (59%); major production of germanium in Finland ceased in 2015; Finnish production of nickel doubled and supplies 38% of the EU consumption; Germany ceased gallium production in 2016 and China became major supplier to the EU with 71%; Qatar appears as the main supplier of helium (35%); South Africa is our main supplier of manganese with 41%.

Figure 6 shows that the EU still produces a number of CRMs in many Member States. The EU extracts 34% of global supply of strontium in Spain; 14% of feldspar in Italy, Spain, France, Czechia, Germany and others; 3% of tungsten in Austria, Portugal and Spain. The EU processes and refines 49% of global supply of hafnium in France; 18% of antimony in Belgium, France, Spain and many others; 17% of cobalt in Finland, Belgium and France; 7% of germanium in Germany and Belgium; 5% of silicon metal in France, Spain and Slovakia; 4% of nickel in Finland, Greece and France. The other materials are produced in smaller shares, usually under 2% of global supply.

Figure 5: Main EU suppliers of individual CRMs

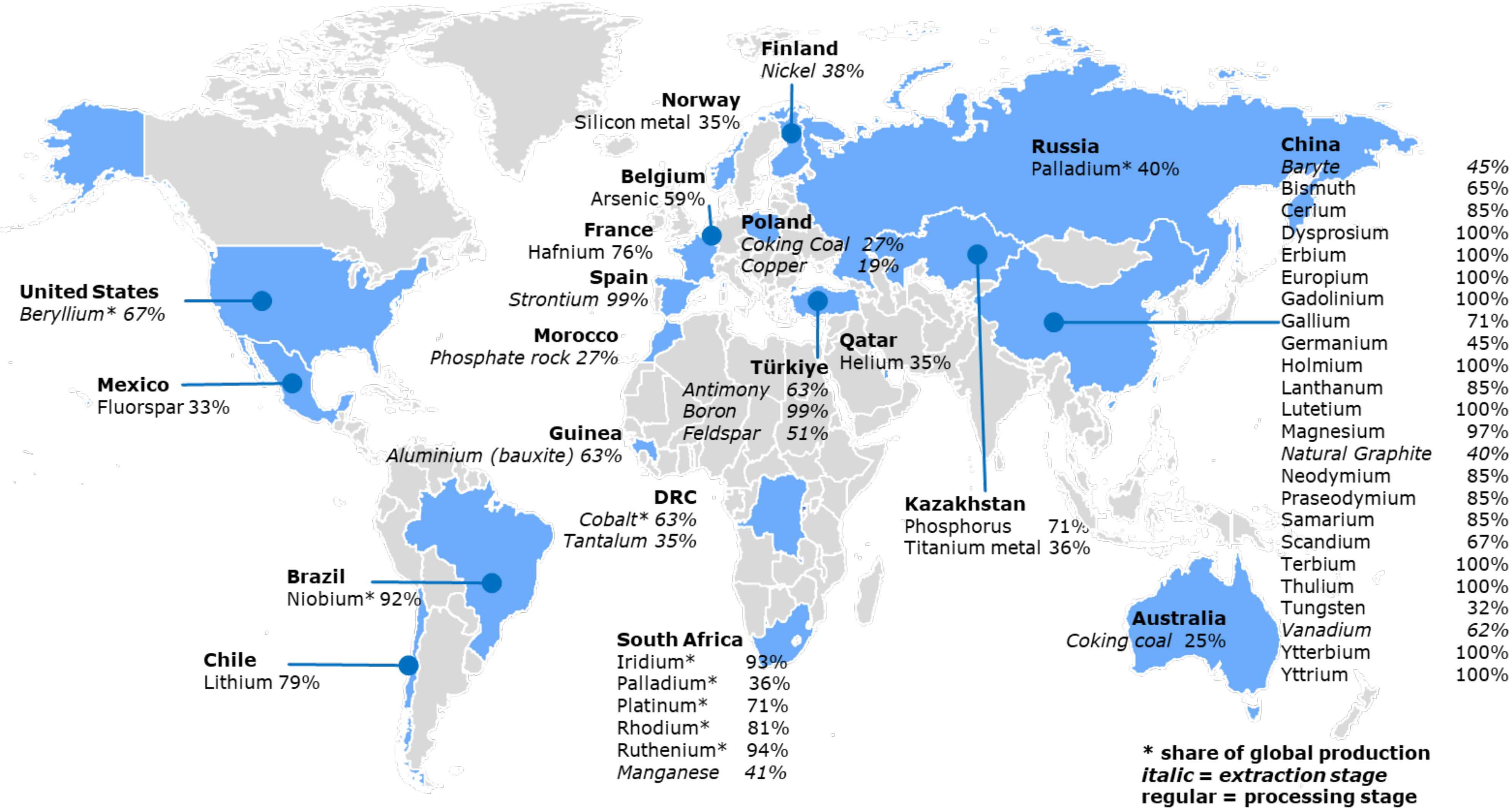
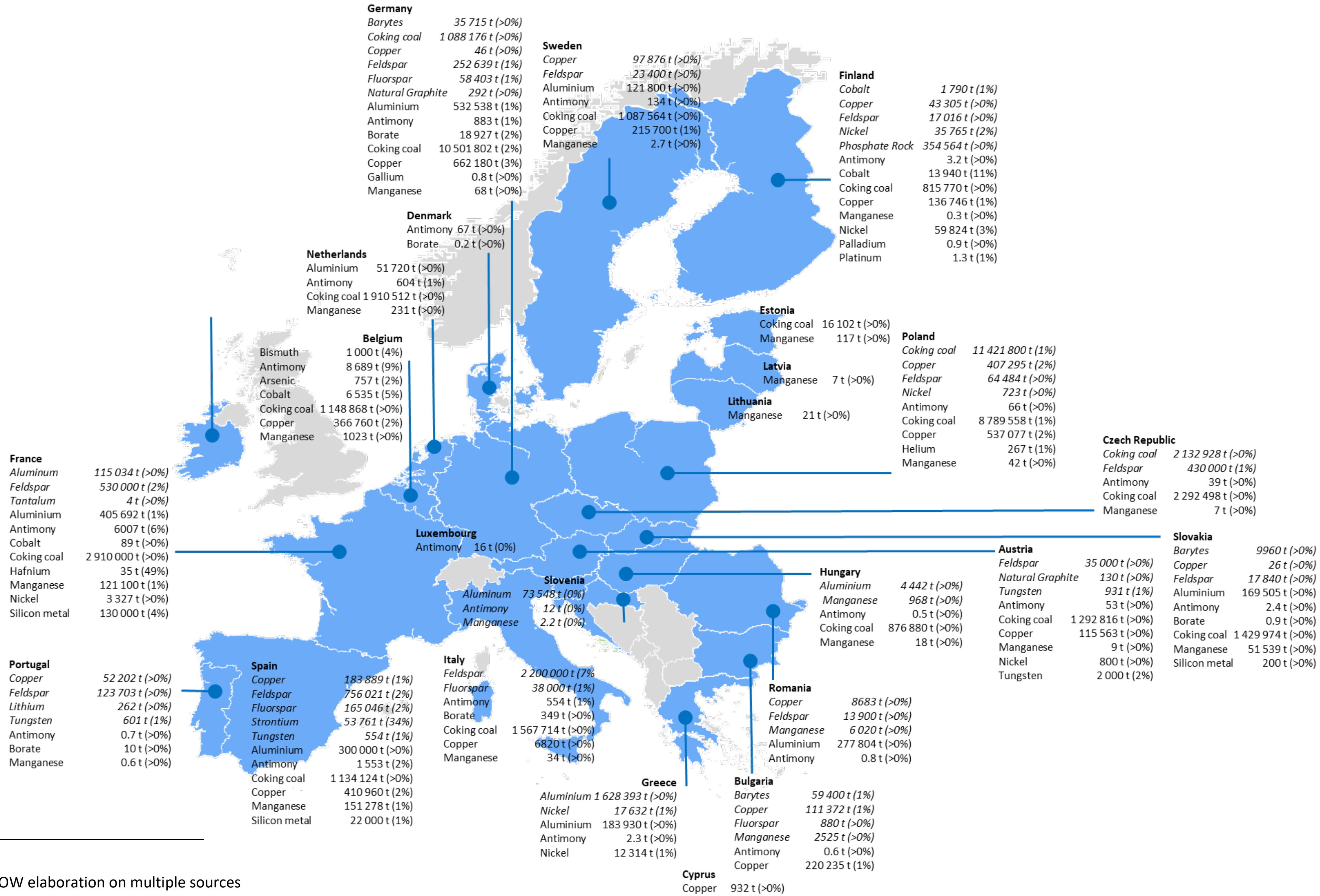


Figure 6: EU producers of CRMs (shares of global supply, 2016-2020[24])



[24] DG GROW elaboration on multiple sources

3.2.3 Summary of other criticality assessment results

Analysis of Supply risk results (global vs EU sourcing)

The methodology calculates the Supply risk based on the actual supply to the EU (EU sourcing) used in combination with the global supply. Detailed results are in the Annex 7 and Annex 8. The methodology uses the Import Reliance (IR) indicator to combine the two measures of Supply Risk, i.e. the one based on global supply and the one based on actual EU sourcing. Averages of 2026-2020 Worldwide Governance Indicators[25] per country scaled to 0-10 for the use in the methodology are in the Annex 9.

Due to concerns over sufficiently available high-quality data, the methodology recommends that in the case of trade or domestic production data unavailability and/or low quality, the SR should be estimated based on global supply only. This is based on the rationale that although it is not a true measure of the risk specific to the EU, the risk calculated using global supply is probably a more stable calculation and more reliable in terms of data quality. Moreover, the mix of global suppliers is generally more stable in time, whereas the exporters to the EU might change more rapidly.

Import reliance results for specific materials

Figure 7 and Annex 10 present the full set of Import Reliance values for all candidate CRMs, in several cases made available at two stages.

For some materials, the import reliance is negative or zero. This means that exports from the EU are higher than imports to the EU. As stipulated in the methodology, when IR is 100%, the Supply Risk calculation should take the average of the two indicators, i.e. 50% based on global supply and 50% based on actual EU sourcing. In the few cases where the EU is independent, or almost independent, of imports, the global supply mix is disregarded and the risk is entirely calculated based on the actual sourcing of the material to the EU.

A 0% or <0% IR means that the SR result is calculated based on EU sourcing data only.

End-of-Life recycling input rates (EoL RIR) results

Figure 8 and Annex 11 present the full set of EOL-RIR. EOL-RIR is the selected recycling indicator used as a Supply risk reducing parameter in the EC criticality methodology. A remarkable effort was paid to search for or to develop better data for such a key parameter, for which low availability, inadequate quality or representativeness is a well-known problem. Synergies were identified and substantial improvements of EOL-RIR results, using higher quality EU based data, were made possible thanks to 30 new Material System Analyses (MSAs) are run in parallel to this criticality assessment.

[25] https://info.worldbank.org/governance/wgi/

Figure 7: Import reliance

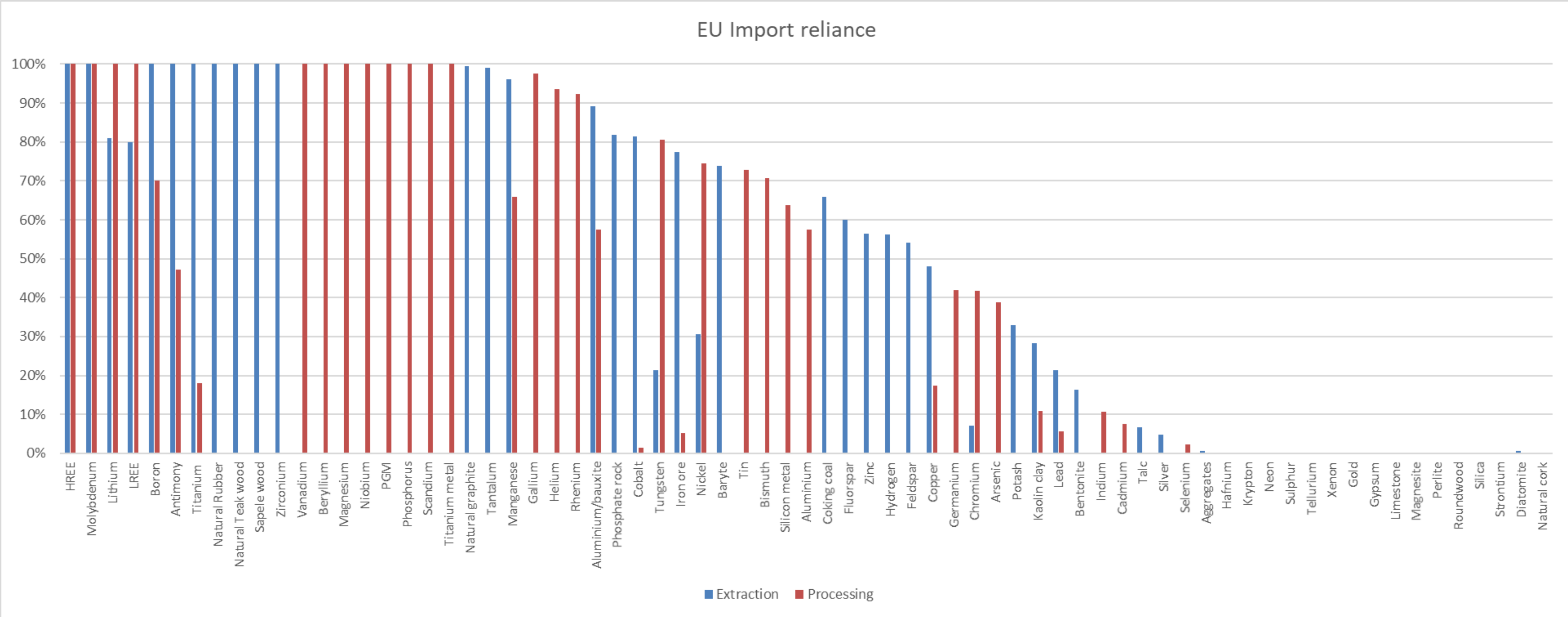
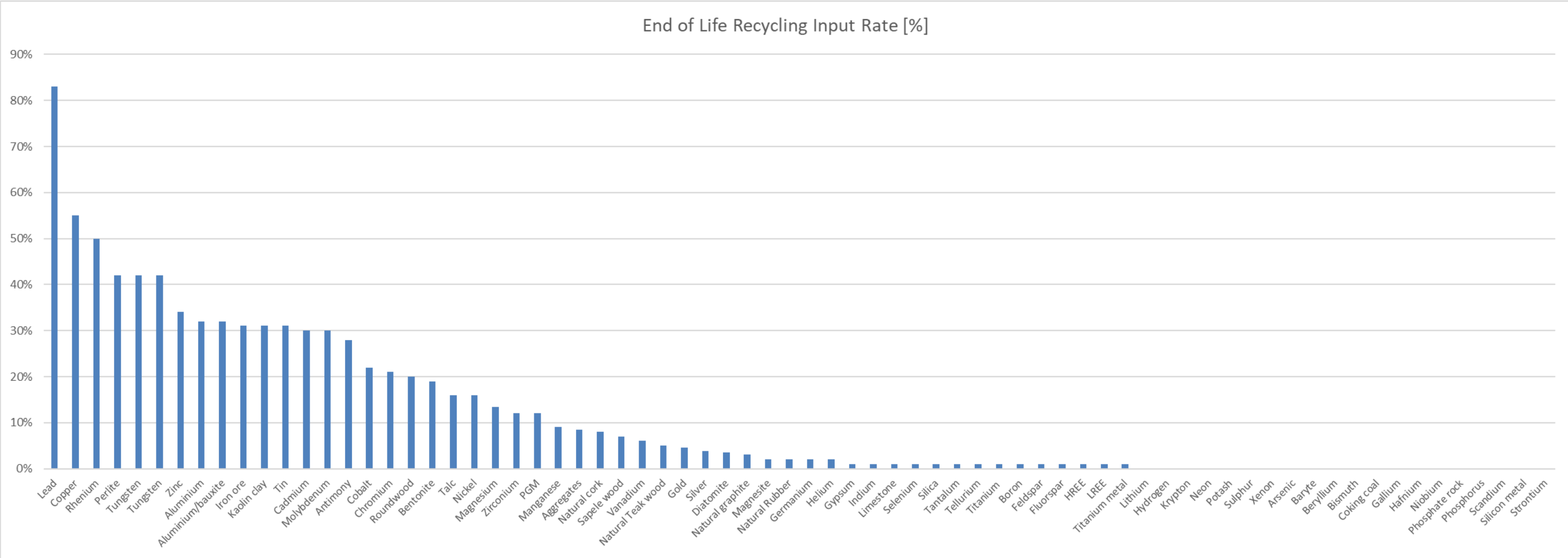


Figure 8: End of life recycling input rate (EOL-RIR)



3.3 COMPARISON WITH THE RESULTS OF PREVIOUS ASSESSMENTS

3.3.1 Overview 2011-2023

This chapter provides a comparison of the 2023 assessments against the previous lists. A good level of backwards compatibility and consistency with the previous criticality assessments remains priority for the EC. The complete comparison of the results for all screened raw materials is in the Annex 4. Figure 9 highlights the changes of the 2023 results in comparison to 2020.

The materials that have remained critical in all assessments are listed in Table 7. Other key differences in the assessments across the exercises are further discussed in the following section.

Table 7: Materials identified as critical in 2011, 2014, 2017, 2020 and 2023

Critical raw materials in 2011, 2014, 2017, 2020 and 2023		
Antimony	Germanium	Natural graphite
Beryllium	Heavy rare earth elements	Niobium
Cobalt	Indium	PGMs
Fluorspar	Light rare earth elements	Tungsten
Gallium	Magnesium	

Compared to the 30 CRMs in 2020, there are 6 new CRMs (Arsenic, Feldspar, Helium and Manganese, plus Copper and Nickel as SRMs) and two have dropped out (Indium and Natural rubber). None of the newly screened materials (neon, krypton, xenon and roundwood) is critical.

Table 8: CRMs in 2023 compared to CRMs in 2020

2023 CRMs vs. 2020 CRMs			
aluminium/bauxite	germanium	PGM	arsenic
antimony	hafnium	scandium	feldspar
baryte	HREE	silicon metal	helium
beryllium	lithium	strontium	manganese
bismuth	LREE	tantalum	copper
boron	magnesium	titanium metal	nickel
cobalt	natural graphite	tungsten	
coking coal	niobium	vanadium	
fluorspar	phosphate rock	~~*indium*~~	
gallium	phosphorus	~~*natural rubber*~~	

Legend:

Black: CRMs in 2023 and 2020
Red: CRMs in 2023, non-CRMs in 2020
Green: CRMs assessed in 2023 that were not assessed in 2020
~~*Strike:*~~ Non-CRMs in 2023 that were critical in 2020

The table below summarises the key changes in the 2023 CRMs list compared to the 2017 CRMs list. The 2023 assessment confirmed 25 CRMs from the 2017 list.

Table 9: CRMs in 2023 compared to CRMs in 2017

2023 CRMs vs. 2017 CRMs			
antimony	germanium	phosphate rock	aluminium/bauxite
baryte	hafnium	phosphorus	feldspar
beryllium	helium	scandium	lithium

bismuth	HREE	silicon metal	manganese
boron	LREE	tantalum	titanium metal
cobalt	magnesium	tungsten	copper
coking coal	natural graphite	vanadium	nickel
fluorspar	niobium	~~indium~~	arsenic
gallium	PGM	~~natural rubber~~	strontium

Legend:

Black: CRMs in 2023 and 2017
Red: CRMs in 2023, non-CRMs in 2017
Green: CRMs assessed in 2023 that were not assessed in 2017
~~Strike:~~ Non-CRMs in 2023 that were critical in 2017

The table below summarises the key changes in the 2023 CRMs list compared to the 2014 CRMs list. The 2023 assessment confirmed 17 CRMs from the 2014 list.

Table 10: CRMs in 2023 compared to CRMs in 2014

2023 CRMs vs. 2014 CRMs			
antimony	LREE	aluminium/bauxite	vanadium
beryllium	magnesium	baryte	copper
boron	natural graphite	feldspar	nickel
cobalt	niobium	hafnium	arsenic
coking coal	PGM	lithium	bismuth
fluorspar	phosphate rock	manganese	helium
gallium	silicon metal	natural rubber	phosphorus
germanium	tungsten	scandium	strontium
HREE	~~indium~~	tantalum	titanium metal

Legend
Black: CRMs in 2023 and 2014
Red: CRMs in 2023 that were not CRMs in 2014
Green: CRMs in 2023 that were not included in the assessment in 2014
~~Strike:~~ Non-CRMs in 2023 that were critical in 2014

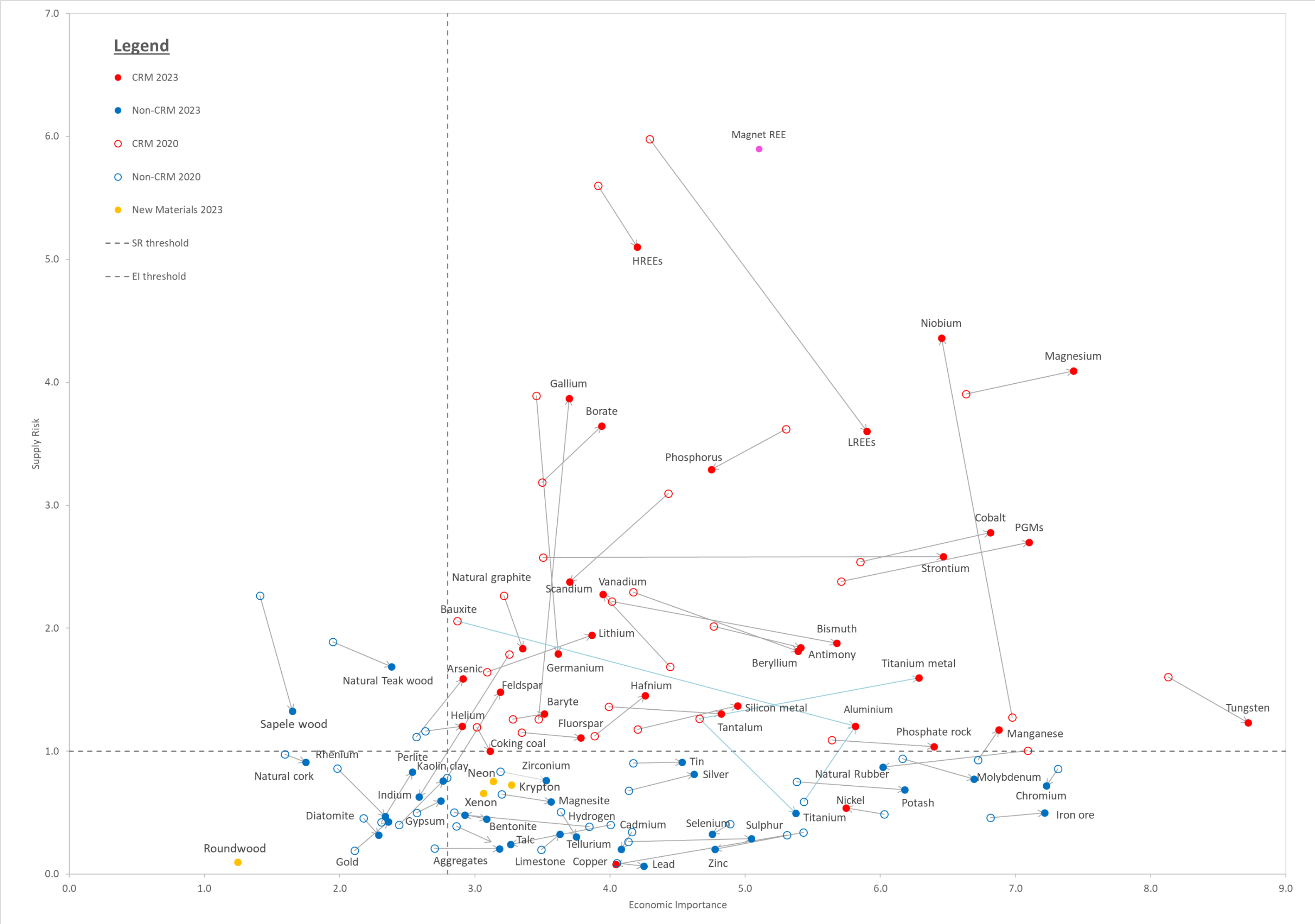
The table below summarises the key changes in the 2023 CRMs list compared to the 2014 CRMs list. The 2023 assessment confirmed 17 CRMs from the 2011 list.

Table 11: CRMs in 2023 compared to CRMs in 2011

2023 CRMs vs. 2014 CRMs			
antimony	natural graphite	feldspar	coking coal
beryllium	niobium	lithium	hafnium
cobalt	PGM	manganese	helium
fluorspar	tungsten	scandium	natural rubber
gallium	~~indium~~	vanadium	phosphate rock
germanium	~~tantalum~~	copper	phosphorus
HREE	aluminium/bauxite	nickel	silicon metal
LREE	baryte	arsenic	strontium
magnesium	boron	bismuth	titanium metal

Legend
Black: CRMs in 2023 and 2011
Red: CRMs in 2023 that were not CRMs in 2011
Green: CRMs in 2023 that were not included in the assessment in 2011
~~Strike:~~ Non-CRMs in 2023 that were critical in 2011

Figure 9: 2023 Criticality assessment results compared to the 2020 assessment[26]



26 Copper and nickel do not meet the Supply risk threshold, but as SRMs, they are on the list of CRMs. Individual REEs used for permanent magnets (Nd, Pr, Tb, Dy, Gd, Sm, and Ce) have been grouped in the figure for information only, but they do not represent an additional grouped material under the CRM assessment.

3.3.2 Summary of the main changes compared to the previous assessment

This section highlights the changes compared to the last assessment, newly assessed candidate materials and battery raw materials.

Aluminium/bauxite assessment has been merged due to consistency reason, and stays critical at its extraction stage (bauxite) as in the previous assessment.

Titanium metal, being a Strategic Raw material and used mainly in aerospace and defence, is critical as in 2020. *Titanium* in all forms, around 80% used as white pigment, is not critical.

Arsenic, used in metallurgy and semi-conductors, became critical due to increased EI from 2.6 to 3.0 caused by relatively higher increase in added value of application metals making NACE sectors C23 - Manufacture of other non-metallic mineral products and C24 - Manufacture of basic metals.

Feldspar used in glass and ceramics became critical due to increase in Supply Risk, particularly through higher import dependency and doubling imports from Türkiye now supplying 51% of the EU needs.

Helium used in cryogenics and semiconductors manufacturing had been critical in 2017, but not in 2020 due to small drop in Economic importance. In the 2023 assessment, Economic importance increased due to relative higher increase of value added in the most relevant NACE-sectors C32 - Other manufacturing, C24 - Manufacture of basic metals, C25 - Manufacture of fabricated metal products.

Manganese, being a Strategic Raw material, used in steelmaking and batteries became critical due to Supply Risk increase at the extraction stage caused by lower domestic supply dropping from 32t to 10t (Bulgaria and Hungary production stopped) increasing import reliance and by more concentrated imports from South Africa 41% (33% in 2020) and Gabon 39% (26% in 2020). EI has always been very high.

Supply Risk of *Natural rubber* used in tyres decreased below the threshold mainly due to increased recycling input rate from 1% to 5%, which could however still be underestimating the current efforts deployed by the industry to recycle end of life products; and by decrease of substitution parameter from 0.99 to 0.90 based on revised substitution possibilities. EU is 100% import reliant. Methodology however does not reflect a producer countries cartel.

Both Supply Risk and Economic Importance of *indium* used in flat panel displays have dropped below thresholds. In this assessment, the Supply Risk has been calculated with both Global Supply and EU sourcing data, while in 2020 only Global Supply was considered. Additionally, the EU indium production is higher that the consumption in the EU. Economic Importance dropped due to more precise allocations of uses to applications in the EU: Indium Tin Oxide (ITO) 0 % (no EU manufacturer), Solders 8 %, PV cells 7 %, Thermal interface material 5 %, Batteries (alkaline) 20 %, Alloys/compounds 25 %, semiconductors & LEDs 15 %, Others 20%. Globally, 60% of indium is used in ITO.

Nickel, being a Strategic Raw material, is the only battery material which has never been on the list because of good supply diversification for the assessed period. Assessment however neither reflects the concentration of ownership of the projects and production capacities, nor private contractual arrangements, which may become an issue for the future. Main global producers of ores and concentrates are Indonesia 26%, Philippines 14%, Russia 10%, New Caledonia 9%, Canada 8%, Australia 8% and several smaller producers; and EU sources 39% from Finland, 24% from Canada, 19% from Greece, 8%

from South Africa, 4% from the US. Main refiners are China 33%, Indonesia 12%, Japan 9%, Russia 7% and several smaller producers; EU sources refined nickel from 29% from Russia, 18% from Finland, 11% from Norway, 7% from Canada, 7% from Australia, 4% from Greece and several smaller importers.

Copper, being a Strategic Raw material, is used in very large quantities of 20 Mt in 2020 for electrification across all strategic technologies. Its supply is very well diversified, therefore it has not been considered critical before. However, it is challenging to substitute due to its superior performance in electrical applications and improve secondary supply due to very long lifecycle of copper in products.

In several cases of screened raw materials, such as bismuth, beryllium, cobalt, PGMs, there was an increase of Economic Importance due to higher proportional increase of value added of several NACE 2 2-digit level sectors (e.g. C24 - Manufacture of basic metals; C25 - Manufacture of fabricated metal products; C26 Manufacture of computer, electronic and optical products; C32 - Other manufacturing) against the largest C28 Manufacture of machinery and equipment n.e.c.

Table 12: Rationale for the changes in the results compared to 2020

Raw material	Changes in SR and EI from 2020 to 2023	Reason for the changes
Beryllium	SR: 2.3 to 1.6 EI: 4.2 to 5.4	SR dropped due to slightly better diversification, though EU is 100% import reliant. EI increased due to changes in the value-added of NACE Rev. 2 sectors and reallocation of uses shares towards batteries and lubricating greases.
Feldspar	SR: 0.8 to 1.5	SR increased above the threshold due to doubling of imports from Türkiye supplying half of the EU needs.
Gallium	SR: 1.3 to 3.9	Strong increase in SR due to higher global production concentration in China and stopping a major domestic production.
Germanium	SR: 3.9 to 1.8	Decrease is due to applying the same approach as in 2017, calculating SR also with EU supply data, not only Global supply as in 2020 assessment. The global supply of germanium is still highly concentrated in China.
Helium	EI: 2.6 to 2.9	EI increased slightly above the threshold due to relatively higher increase of value added in the most relevant NACE-sectors.
Hydrogen	EI: 3.8 to 2.9	EI dropped due to more precise allocation of uses shares at the EU, compared to the global shares used in the previous assessment.
Indium	SR: 1.8 to 0.6	SR decreased below the threshold due to calculating with both GS and EU sourcing data, while in 2020 only GS was considered. EU domestic production largely covers the EU needs.
Niobium	SR: 3.9 to 4.4	SR calculated at both stages, in the previous assessment only at the processing stage. SR is higher at the extraction stage, where only global supply is considered.
PGM Iridium	SR: 3.2 to 3.9 EI: 4.2 to 6.4	SR increased marginally for all PGMs, for iridium mostly due to update of the EoL RIR.

Raw material	Changes in SR and EI from 2020 to 2023	Reason for the changes
PGM Palladium	EI: 7.0 to 8.1	EI increased due to changes in the value-added of NACE Rev. 2 sectors and updated allocation of uses shares.
PGM Platinum	EI: 5.9 to 6.9	
PGM Rhodium	EI: 7.4 to 8.6	
PGM Ruthenium	EI: 4.1 to 5.5	
HREE Gadolinium	SR: 6.1 to 3.3 EI: 4.6 to 3.3	In general for LREEs, SR dropped significantly due to diversification of global supply at both extraction and processing stages. HREEs generally SR dropped less, due to processing monopoly of China. For europium, SR increased due to updated EoL RIR. For gadolinium, SR and EI dropped mostly due to decrease of Substitution Indexes for the updated applications towards increased magnets uses, and decreased lighting. EI increase for lanthanum due to the split of the FCC into FCC and autocatalysts, with autocatalysts having a higher GVA than FCC Strong EI increase for terbium, neodymium and praseodymium was due to the evolution of end uses shares towards magnet sector.
HREE Europium	SR: 3.7 to 5.6	
LREE Lanthanum	SR: 6.0 to 3.5 EI: 1.5 to 2.9	
LREE Neodymium LREE Praseodymium HREE Terbium	EI: 4.8 to 7.2 EI: 4.3 to 7.0 EI: 4.1 to 6.4	
Sapele wood	SR: 2.3 to 1.3	SR decreased mainly due to a different approach to estimate of production quantities derived from trade data, instead of a bottom-up acre-based estimation followed in 2020.
Scandium	SR: 3.1 to 2.4 EI: 4.4 to 3.7	SR decreased mainly due to decrease of Russian share on global supply and elimination of Chinese export taxes and quota in 2015. EI slightly decreased due to an updated allocation of uses shares.
Strontium	EI: 3.5 to 6.5	EI increased due to an updated allocation of uses shares, mainly towards magnets and pyrotechnics.
Sulphur	EI: 4.1 to 5.0	EI increased due to changes in the value-added of NACE Rev. 2 sectors.
Tantalum	EI: 4.0 to 4.8	EI increased due to changes in the value-added of NACE Rev. 2 sectors and updated allocation of uses shares.
Titanium	SR: 1.3 to 0.5	SR decreased as titanium assessment has been split to titanium and titanium metal. SR results are consistent with 2017. In 2020 assessment, the metal stage has been considered (titanium sponge, essential in high-tech applications).
Tungsten	SR: 1.6 to 1.2	SR decreased due to the fact that the export quotas imposed by China and reflected in the last assessment, were lifted in 2015.
Vanadium	SR: 1.7 to 2.3	SR increased mainly due to production concentration, even more dominated by China.

For the main raw materials used in batteries:

Raw material	Changes in SR and EI from 2017 to 2020	Reason for the change
Cobalt	SR: 2.5 to 2.8	SR slightly increased compared to the 2020 assessment, as the EU supply data for extraction stage have been disregarded. Trade data for 81052000 Cobalt mattes and other intermediate products of cobalt metallurgy; unwrought cobalt; cobalt powders are confidential since 2015 and mask major imports from DRC.
	EI: 5.8 to 6.8	EI increased due to changes in the value-added of NACE Rev. 2 sectors. Batteries still represent only 3% of use over the reference period.
Lithium	SR: 1.6 to 1.9	SR at the processing stage increased slightly due to more precise information on the processing data at global level.
	EI: 3.1 to 3.9	EI increased due to changes in the value-added of NACE Rev. 2 sectors and reallocation of uses shares towards batteries and lubricating greases.
Manganese	SR: 0.9 to 1.2	SR increased over the threshold at the extraction stage due to decreased domestic supply and increased import reliance;
	EI: 6.7 to 6.9	Results are similar to the previous assessment
Natural graphite	SR:2.3 to 1.8	The SR has decreased mainly due to diversification of both the global and the EU supply.
	EI: 3.2 to 3.4	Results are similar to the previous assessment. More precise allocation to NACE-2 (2-digit) sectors.
Nickel	SR: 0.5 to 0.5	Results are similar to the previous assessment
	EI: 4.9 to 5.7	EI increased due to relative higher increase of the VA and more precise allocation to the NACE-2 (2-digit) sectors:

Table 13: Criticality assessment results for new materials

Material	Stage assessed	Supply Risk	Economic Importance	Import Reliance (%)	EOL-RIR (%)
neon	P	0.7	3.1	0%	0%
krypton	P	0.7	3.3	0%	0%
xenon	P	0.8	3.1	0%	0%
roundwood	E	0.1	1.2	0%	0%
titanium metal	P	1.6	6.3	100%	1%

Raw material	Comment
neon krypton xenon	Noble gases are important in a range of high-tech applications from lighting, laser technology, chips manufacturing etc. also used in aerospace and defence sectors. They are produced by separation from air gases.
roundwood	Roundwood is a very high volume raw materials used across the economy in products as paper, wood panels, furniture etc.
titanium metal	Titanium metal has been assessed as a specific and critical form of titanium, due to its strategic applications and a very concentrated production.

3.4 LIMITATIONS OF THE CRITICALITY ASSESSMENTS

Even though the criticality assessment is based on the most robust and comprehensive data available, it remains a screening exercise. Thus, it is important to take into account the data limitations when interpreting the results of this criticality assessment. Key limitations can help to understand the robustness of the 2023 assessment results and the comparability of the results across the four assessments.

Regarding the robustness of the analysis and corresponding results, despite the use of data of optimal quality, the following **limitations on data** are noted:

- **Data on materials uses shares**: For several raw materials, the EU uses shares were not available, therefore hypotheses and assumptions were used based on available global shares instead. Moreover, there were some issues with the use of NACE 2-digit codes, since a single code had to be selected per application; and in some cases more than one code was applicable to a specific application.
- **Cases with issues on data to assess the EU supply**: Similar to the previous exercises, this assessment integrates data on EU sourcing (when available and of acceptable quality) to calculate the Supply Risk. Taking into account actual sourcing to the EU provides a more realistic picture of the situation for each material. 2011 and 2014 assessments considered only the global supply to calculate SR. In general, there was good public data availability for global supply for the majority of the materials assessed, however, data on EU sourcing were not always available or were of poor quality for some materials. Further, for some materials, there were also challenges related to inconsistencies in the type of data reported (for example for REEs, cobalt and PGMs) e.g. units, % of the material contained, time period covered, life-cycle stage covered, etc. between world production and EU sourcing data. In these cases, only more reliable global supply data was used or stakeholders were consulted to provide additional inputs to develop possible justified assumptions and hypothesis, where relevant.
- **Data on shares of material applications and substitution**: In general, it was difficult to identify or obtain public data on the shares of material applications, as well as their substitutes. The reason for the lack of available and reliable data on the sub-share of substitutes for a given application is that there are very few cases where substitutes are actually already being used in practice. As a consequence, in many cases, feedback was sought from experts to further develop acceptable assumptions and hypotheses for the shares of material applications, potential substitutes and their sub-shares.
- **Data on End-of-life Recycling Input Rates (EOL-RIR):** The role of recycling as a Supply risk reducing parameter remains unchanged compared to the previous EC criticality exercises. Efforts were thus focused on expanding Material System Analysis (MSA) data availability and integrating available high-quality EU based data. Priority remained on EU sources of data such as the MSAs to maintain the highest possible comparability with previous EC criticality reports. In the cases where MSA data were not available, data or assumptions were used based on information provided in other sources e.g. the 2011 report 'Recycling Rates of Metals' by the International Resource Panel of the United Nations Environment Programme (UNEP), sectorial reports, expert judgement and stakeholder inputs. Therefore, the Supply risk result of the materials which use an EOL-RIR figure that does not stem from the MSA should be considered carefully.
- **Bottleneck screening:** uncertainty related to which stage is more critical has been reduced using a systematic two-stage supply risk assessment as far as possible.

3.5 RECOMMENDATIONS FOR FUTURE ASSESSMENTS

In the Communication on raw materials of 2011[27], the EC committed to regularly update the CRM list; every three years. A second and third criticality assessment were therefore published in 2014 and 2017. This study supports the fourth, 2020 list of CRMs for the EU, which is part of the process to maintain and update important information and findings on a regular basis. With this in mind, the following recommendations should be considered in order to facilitate further updates and the robustness of the exercises on criticality in the future.

Table 14: Summary of conclusions and recommendations to further strengthen future criticality exercises

Topics	Conclusions and recommendations
Materials and scope definitions	**Conclusions:** The scope of the screened materials has been again expanded by four new raw materials. Definitions of materials have been further improved. Assessment of titanium has been split to reflect a specific from of metal, and aluminium has been merged with bauxite to further harmonise the assessment. **Recommendations:** Further harmonise nomenclature and terms used to define materials and concepts related to the material life cycles would help in to define the scopes of the assessments. It is important for instance to define a priori the scope of each life cycle stage.
Life-cycle stages accessed	**Conclusions:** A key issue with all criticality assessments is the scope of each assessment made. Two stages extraction and processing have been considered where possible. This reduced the risk of missing the stage with more supply risk in the material's life cycle. However, some raw materials may include an intermediate stage between mining and refining stages that may also be important for the assessment. Information on materials across their life cycle and their supply chains is provided in the factsheets. **Recommendations:** Systematic assessment of both extraction and refining stages should continue in the next assessments. A third intermediate stage could be considered for the next assessment.
End-of-life Recycling Input Rates (EOL-RIR)	**Conclusions: T**he EOL-RIR parameter used in the methodology serves only as a substitute of a Supply risk related to secondary raw materials, which cannot yet be calculated due to missing data. Imports of “wastes and scraps” are not considered as part of the Supply Risk parameter. Additionally, recycling is considered as a riskless supply of secondary raw materials, which may not realistically reflect the reality. Material System Analyses (MSA) serve as the best tool for data gathering for EOL-RIR, unfortunately they are not available for all screened materials. **Recommendations:** Further expansion of MSA studies and updates are needed.
Allocation of end-use per sector	**Conclusions:** It was not always straightforward to determine to what extent a specific material is used directly in a manufacturing sector or used in downstream" sectors" towards the final product. MSA studies help to determine the flows of materials through manufacturing and end uses.

[27] Communication *'Tackling the challenges in commodity markets and on raw materials'* (COM(2011)25)

Topics	Conclusions and recommendations
	Recommendations: Further expansion of MSA studies and updates are needed. Better differentiation between material uses in the EU manufacturing sectors (used in methodology) and in the end uses/products (relevant to materials stocks) is needed.
Public data gaps	**Conclusions:** Official European statistics are prioritised over other sources of data, however there were some data gaps that did not allow proper use of these data sources. **Recommendations:** Continue improving production and trade statistics and address confidentiality issues.
Development of database	**Conclusions:** Project SCRREEN helped to develop the first database solution for gathering the data for the assessment and to facilitate the future assessments, allowing for recording long term and alternative data from different sources. **Recommendations:** Continue updating and developing the database with better data analysis, reporting functionality and a user friendly interface to facilitate the future assessments and a real time evidence making for policy use.

ABBREVIATIONS AND GLOSSARY

General abbreviations

AHWG	Ad-Hoc Working Group on Defining Critical Raw Materials
BGS	British Geological Survey
COMEXT	Eurostat's reference database for detailed statistics on international trade in goods.
CRM	Critical Raw Material
DG GROW	European Commission's Directorate General Internal market, Industry, Entrepreneurship, SMEs
EC	European Commission
EI	Economic Importance
EOL-RIR	End-of-life Recycling Input Rate
FTA	Free Trade Agreements
GVA	Gross Value Added
HHI	Herfindahl-Hirschman-Index
HREE	Heavy rare earth element
IR	Import Reliance
JRC	European Commission's Directorate General Joint Research Centre
LREE	Light rare earth element
NACE	Nomenclature statistique des activités économiques dans la Communauté européenne
OECD	Organisation for Economic Co-operation and Development
PGM	Platinum group metal
PRODCOM	Eurostat's statistics on the production of manufactured goods carried out by enterprises on the national territory of the reporting countries. The term comes from the French "PRODuction COMmunautaire" (Community Production).
REE	Rare earth element
RMSG	Raw Materials Supply Group
SI	Substitution Index
SI(EI)	Substitution Index for Economic Importance
SI(SR)	Substitution Index for Supply Risk
SR	Supply Risk
SRM	Strategic Raw Material
USGS	US Geological Survey
WGI	Worldwide Governance Indicators of the World Bank
WMD	World Mining Data provided by Austrian Federal Ministry of Finance, Directorate VI/5 - Mineral Resources Policy.

Glossary

Term	Definition in the context of this report
Bottleneck	A bottleneck is considered to be the point in value chain for a specific material where the supply risk is highest, i.e. the stage (either extraction/harvesting or processing/refining), that has the highest numerical criticality score for the Supply Risk.
Critical Raw Materials (CRMs)	Critical raw materials (CRMs) are raw materials of a high importance to the economy of the EU and whose supply is associated with a high risk. The main two parameters: Economic Importance (EI) and Supply Risk (SR) are used to determine the criticality of the material for the EU. The list of CRMs is established on the basis of the raw materials which reach or exceed the thresholds for both parameters.
Economic Importance (EI)	One of the two main assessment parameters (in addition to Supply Risk) of the EC methodology to measure the criticality of a raw material. In the EC methodology, the Economic Importance is calculated based on the importance of a given material in the EU for end-use applications and on the performance of available substitutes in these applications.
End-of-life Recycling Input Rate	The end-of-life recycling input rate (EOL-RIR) since the 2017 assessment refers to the ratio of recycling of old scrap in the EU to the EU supply of raw material. In other words, EOL-RIR is production of secondary material from post-consumer functional recycling (old scrap) sent to processing and manufacturing and replacing primary material input. In the previous EC criticality assessments (EC 2011, 2014), recycling rates and EOL-RIR refer only to functional recycling i.e. the portion of EOL recycling in which the material in a discarded product is separated and sorted to obtain recyclates.
Extraction stage	Refers to the process of obtaining (extracting) raw materials from our environment and is also referred to as the mining or harvesting stage. This may involve discovering where these raw materials are located (often achieved with knowledge of geology) and developing processes to extract them from these locations (e.g. mining the ores).
Heavy rare earth elements (HREEs)	Heavy rare earth elements (HREEs) are one of the two sub-categories of the rare earth elements (REEs) group. HREEs are part of the lanthanide elements and have higher atomic weights (hence "heavier") compared to the light rare earth elements (LREEs). HREEs are currently used in a few niche applications, which are mostly related to their optical properties (Laser dopants, radiography, etc.). The HREEs (10) covered by the study include dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium and yttrium.
Herfindahl-Hirschman-Index (HHI)	The Herfindahl-Hirschman-Index is a commonly accepted measure of market concentration. In the context of the 2020 exercise, the Herfindahl-Hirschmann-Index (HHI_{WGI}), based on the world governance index (WGI), is used to calculate the Supply Risk as a parameter quantifying the stability of and level of concentration in producing countries.
Import Reliance (IR)	Import reliance (or import dependency) is part of the Supply Risk calculation in the EC methodology for updating the list of critical raw materials for the EU. It takes into account actual EU sourcing (net imports divided by a sum of domestic production with net imports) and the level of import dependency in the calculation of Supply Risk.
Light rare earth elements (LREEs)	Light rare earth elements (LREEs) are one of the two sub-categories of the REEs group. LREEs are part of the lanthanide elements and are characterised by lower atomic weights (hence "lighter") compared to HREEs. Generally, LREEs are more abundant in the earth's crust compared to HREEs. LREEs can be used in a wide variety of applications according to the individual REEs and regional specificities, but they are in general used in sectors such as catalysts, metallurgy, glass/polishing and magnets. The LREEs (5) covered by the study include cerium, lanthanum, neodymium, praseodymium and samarium.
Mineral deposit	A natural concentration of material of possible economic interest in the earth's crust.
New scrap / Old scrap	New scrap refers to the scrap generated from processing and manufacturing processes and it is also sometimes regarded as pre-consumer scrap. It has a known composition, normally high purity, and origin, and can be often recycled within the processing facility. Old scrap, also regarded as post-consumer scrap, is the amount of material contained in products that have reached their end of life (EOL). It is often mixed with other materials such as plastics or alloys, therefore its recycling requires

Term	Definition in the context of this report
	further detailed processing for proper recovery.
Platinum group metals (PGMs)	Five platinum group metals are covered by the assessment: ruthenium, rhodium, palladium, iridium and platinum. They have similar physical and chemical properties, tend to be found together, and are commonly associated with ores of nickel and copper. The PGMs are generally derived from the same types of ore deposit in which they occur together, commonly in the same mineral phases. For this reason, they are classed as co-products, because they have to be mined together. They rarely occur in native form. The PGMs are highly resistant to wear, tarnish, chemical attack and high temperature. The PGMs are regarded as precious metals, like gold and silver. All PGMs, commonly alloyed with one another or with other metals, can act as catalysts which are exploited in a wide range of applications. Platinum and palladium are of major commercial significance, with rhodium the next most important. The main use of PGMs is in autocatalysis, but other major applications include jewellery, chemical manufacture, petroleum refining and electrical products.
Primary raw material / Secondary raw material	Primary raw materials are virgin materials, natural inorganic or organic substance, such as metallic ores, industrial minerals, construction materials or energy fuels, used for the first time. Secondary raw materials are defined as materials produced from other sources other than primary. Secondary raw materials can also be obtained from the recycling of raw (i.e. primary) materials. Examples: steel or aluminium scrap.
Processing / refining stage	Refers to a series of operations and treatments that transform raw materials from a raw-material state into substances which are then used to make semi-finished and finished products. Also referred to as the post-mining or post-harvesting stage.
PRODCOM / NACE 2	EUROSTAT Prodcom survey provides statistics on the production of manufactured goods. The term comes from the French "PRODuction COMmunautaire" (Community Production) for mining, quarrying and manufacturing: sections B and C of the Statistical Classification of Economy Activity in the European Union (NACE 2). The first four digits refer to the equivalent class within the Statistical classification of NACE, and the next two digits refer to subcategories within the Statistical classification of products by activity (CPA). Most PRODCOM headings correspond to one or more Combined nomenclature (CN) codes related to EU trade.
Rare earth elements (REEs)	Refers to a set of 15 elements in the Lanthanide series and two other elements: scandium and yttrium (see definitions for HREEs and LREEs). In the context of this study, yttrium is considered a rare earth element since it tends to occur in the same ore deposits as the lanthanides and exhibits similar chemical properties. However, scandium is not considered as part of the REEs in the study because its properties are not similar enough to classify it as either a heavy rare earth element or light rare earth element. The REEs are typically sub-divided into two groups, the light rare earth elements (LREEs) and heavy rare earth elements (HREEs), both for commercial reasons and their physical-chemical properties. The main uses of REEs are in automotive, telecom and electronics sectors, as well as in the aerospace, defence and renewable energy sectors. REEs find uses in a large variety of applications linked with their magnetic, catalytic and optical properties.
Rare earth elements for magnets	Rare earths elements which are used in permanent magnets (neodymium, praseodymium, terbium, dysprosium, samarium, gadolinium, cerium)
Raw material	Natural or processed resources which are used as an input to a production operation for subsequent transformation into semi-finished and finished good. Primary raw materials are, as opposed to semi-finished products, extracted directly from the planet and can be traded with no, or very little, further processing.
Regulation	Regulation proposal COM(2023) 160 - 2023/0079 (COD) 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

Term	Definition in the context of this report
Reserves	The term is synonymously used for "mineral reserve", "probable mineral reserve" and "proven mineral reserve". In this case, confidence in the reserve is measured by the geological knowledge and data, while at the same time the extraction would be legally, economically and technically feasible and a licensing permit is certainly available.
Resources	The term is synonymously used for "mineral resource", "inferred mineral resource", "indicated mineral resource" and "measured mineral resource". In this case, confidence in the existence of a resource is indicated by the geological knowledge and preliminary data, while at the same time the extraction would be legally, economically and technically feasible and a licensing permit is probable.
Strategic raw materials (SRMs)	Raw materials important for technologies that support the twin green and digital transition and defence and aerospace objectives. The list is defined by the Article 3 and Annex 1 of the Regulation proposal COM (2023) 160 - 2023/0079 (COD).
Substitution	In the EC methodology for updating the list of CRMs for the EU, substitution is considered to reduce the potential consequences in the case of a supply disturbance based on the rationale that the availability of substitute materials could mitigate the risk of supply disruptions. It is therefore incorporated in both the Economic Importance (EI) and Supply Risk (SR) dimension as a substitution index. Since the 2017 assessment, only proven substitutes that are readily-available today (snapshot in time) and that would subsequently alter the consequences of a disruption are considered. As a result, only substitution, and not substitutability or potential future substitution is considered in the EC methodology.
Supply Risk (SR)	One of the two main assessment parameters (along with Economic Importance) of the EC methodology to measure the criticality of a raw material. In the EC methodology, the Supply Risk is calculated based on factors that measure the risk of a disruption in supply of a specific material (e.g. global supply and EU sourcing countries mixes, import reliance, supplier countries' governance performance measured by the World Governance Indicator, trade restrictions and agreements, availability and criticality of substitutes).
Value chain	The value chain describes the full range of activities required to bring a raw material through the different phases of production, transformation, delivery to final consumers and final disposal or recovery after use.

ANNEXES

Annex 1. Critical Raw Materials overview

Raw materials	Stage	Main global producers		Main EU sourcing[28] countries		Import reliance[29]	EoL-RIR[30]	Selected Uses
Aluminium/ bauxite	Extraction	Australia China Guinea	28% 21% 18%	Guinea Brazil Greece	62% 12% 10%	55%	32%	Lightweight structures High-tech engineering
Antimony	Extraction	China Tajikistan Russia	56% 20% 12%	Türkiye Bolivia China	63% 26% 6%	100%	28%	Flame retardants Defence applications Lead-acid batteries
Arsenic	Processing	China Peru Morocco	44% 40% 11%	Belgium China	60% 39%	39%	0%	Semiconductors Alloys
Baryte	Extraction	China India Morocco	32% 25% 9%	China Morocco Bulgaria Germany Slovakia	44% 28% 11% 7% 2%	74%	0%	Medical applications Radiation protection Chemical applications
Beryllium	Extraction	United States China Mozambique	67% 26% 4%	n/a		n/a[31]	0%	Electronic and Communications Equipment automotive, aero-space and defence components
Bismuth	Processing	China Vietnam Japan	70% 18% 5%	China Thailand Laos	65% 12% 8%	100%	0%	Pharmaceuticals Medical applications Low-melting point alloys Solid rocket propellant
Boron	Extraction	Türkiye United States Chile	48% 25% 11%	Türkiye	99%	100%	1%	High performance glass Fertilisers Permanent magnets
Cobalt	Extraction	Congo, D.R. Russia Canada	63% 7% 4%	n/a		81%	22%	Batteries Super alloys Catalysts Magnets
Coking coal	Extraction	China Australia Russia United States	53% 18% 9% 6%	Poland Australia United States Russia Canada Czechia Germany	26% 24% 20% 8% 5% 5% 2%	66%	0%	Coke for steel Carbon fibres Battery electrodes

28 Based on Domestic production and Import (Export excluded)
29 IR = (Import – Export) / (Domestic production + Import – Export)
30 The End of Life Recycling Input Rate (EoL-RIR) is the percentage of overall demand that can be satisfied through secondary raw materials
31 The EU import reliance cannot be calculated for beryllium, as there is no production and trade for beryllium ores and concentrates in the EU

Raw materials	Stage	Main global producers		Main EU sourcing[28] countries		Import reliance[29]	EoL-RIR[30]	Selected Uses
Copper	Extraction	Chile Peru China	28% 12% 8%	Poland Chile Peru Spain Bulgaria Sweden Finland Portugal	19% 14% 10% 8% 5% 4% 2% 2%	48%	55%	Electrical infrastructure
Feldspar	Extraction	Türkiye India China Italy	32% 20% 8% 7%	Türkiye Italy Spain France Czechia Germany Portugal Poland	51% 22% 7% 5% 4% 2% 1% 1%	54%	1%	Glass including fibreglass Ceramics
Fluorspar	Extraction	China Mexico Mongolia	56% 21% 7%	Spain Germany Italy	62% 22% 14%	60%	1%	Steel and iron making Refrigeration and Air-conditioning Aluminium making and other metallurgy
Gallium	Processing	China Ukraine Russia	94% 2% 2%	China United States United Kingdom	69% 10% 9%	98%	0%	Semiconductors Photovoltaic cells
Germanium	Processing	China Russia United States	90% 5% 2%	China Belgium Germany	45% 32% 19%	42%	2%	Optical fibres and Infrared optics Satellite solar cells Polymerisation catalysts
Hafnium	Processing	France Ukraine China Russia	76% 14% 5% 3%	France United States Russia	49% 44% 3%	0%[32]	0%	Super alloys Nuclear control rods Refractory ceramics
Helium	Processing	United States Qatar Algeria	56% 30% 8%	Qatar Algeria United States Poland	34% 29% 21% 5%	94%	2%	Controlled atmospheres Semiconductors MRI
Lithium	Processing	China Chile Argentina	56% 32% 11%	Chile Switzerland Argentina United States	79% 7% 6% 5%	100%	0%	Batteries Glass and ceramics Steel and aluminium metallurgy
Magnesium	Processing	China United States	91% 3%	China Israel	97% 1%	100%	13%	Lightweight alloys for automotive, electronics, packaging or construction Desulphurisation agent in steelmaking

[32] EU is a net exporter of Hafnium and Indium

Raw materials	Stage	Main global producers		Main EU sourcing[28] countries		Import reliance[29]	EoL-RIR[30]	Selected Uses
Manganese	Extraction	South Africa Australia Gabon China	29% 16% 14% 9%	South Africa Gabon Brazil Ukraine	41% 39% 8% 3%	96%	9%	Steel-making Batteries
Natural Graphite	Extraction	China Brazil Mozambique India Korea, North	67% 8% 5% 5% 5%	China Brazil Mozambique Norway Ukraine	40% 13% 12% 8% 7%	99%	3%	Batteries Refractories for steelmaking
Nickel	Processing	China Indonesia Japan Russia Canada Australia	33% 12% 9% 7% 6% 5%	Russia Finland Norway Canada Australia	29% 17% 10% 6% 6%	75%	16%	• Batteries • Steel making • Automotive
Niobium	Processing	Brazil Canada	89% 11%	n/a		100%	0%	High-strength steel and super alloys for transportation and infrastructure High-tech applications (capacitors, superconducting magnets, etc.)
Phosphate rock	Extraction	China Morocco United States Russia	44% 14% 10% 7%	Morocco Russia Finland Algeria	27% 24% 17% 10%	82%	17%	Mineral fertilizer Phosphorous compounds
Phosphorus	Processing	China United States Kazakhstan Vietnam	79% 11% 6% 5%	Kazakhstan Vietnam China	62% 22% 13%	100%	0%	Chemical applications Defence applications
Scandium	Processing	China Russia	67% 17%	n/a		100%	0%	Solid Oxide Fuel Cells Lightweight alloys
Silicon metal	Processing	China Brazil Norway France	76% 7% 6% 4%	Norway France Brazil	34% 29% 9%	64%	0%	Semiconductors Photovoltaics Electronic components Silicones
Strontium	Extraction	Iran Spain China	37% 34% 16%	Spain	99%	0%	0%	Ceramic magnets Aluminium alloys Medical applications Pyrotechnics
Tantalum	Extraction	Congo, D.R. Rwanda Brazil Nigeria	35% 17% 16% 11%	N/a		99%	0%	Capacitors for electronic devices Super alloys

Raw materials	Stage	Main global producers		Main EU sourcing[28] countries		Import reliance[29]	EoL-RIR[30]	Selected Uses
Titanium metal[33]	Processing	China South Africa Australia Mozambique Canada Ukraine	25% 13% 12% 10% 8% 6%	n/a		100%	19%	Lightweight high-strength alloys for e.g. aeronautics, space and defence Medical applications
Tungsten[34]	Processing	China United States Russia Vietnam Austria	86% 4% 3% 3% 2%	China Austria Vietnam Russia	31% 19% 14% 9%	n/a	42%	Alloys e.g. for aeronautics, space, defence, electrical technology Mill, cutting and mining tools
Vanadium[35]	Processing	China Russia South Africa Brazil	62% 20% 11% 8%	n/a		n/a	1%	High-strength-low-alloys for e.g. aeronautics, space, nuclear reactors Chemical catalysts
Platinum Group Metals[36]	Processing	South Africa - iridium, platinum, rhodium, ruthenium Russia - palladium	94% 40%	n/a		96%	10%	Chemical and automotive catalysts Fuel Cells Electronic applications
Heavy Rare Earth Elements[37]	Processing	China	100%	n/a		100%	4%	Permanent Magnets for electric motors and electricity generators Lighting Phosphors Catalysts Batteries Glass and ceramics
Light Rare Earth Elements	Processing	China Malaysia	85% 11%	China	75%	100%	3%	

[33] For Titanium metal sponge there are no trade codes available for the EU

[34] The distribution of tungsten smelters and refiners has been used as a proxy of the production concentration. Trade data are not completely available for commercial confidentiality reason.

[35] The EU import reliance cannot be calculated for the vanadium, as there is no production and trade for vanadium ores and concentrates in the EU

[36] The trade data include metal from all sources, both primary and secondary. It was not possible to identify the source and the relative contributions of primary and secondary materials.

[37] Global production refers to Rare Earth Oxides concentrates for both Light and Heavy Rare Earth Elements.

Annex 2. Overview of the assessment results

2023 assessment					Extraction		Processing	
Material	Supply Risk (SR)	Economic Importance (EI)	Stage used in SR	Stages assessed	Supply used in SR	Supply Risk	Supply used in SR	Supply Risk
Aggregates	0.2	3.2	Extraction	E	EU only	0.2	-	-
Aluminium/bauxite	1.2	5.8	Extraction	E+P	GS+EU	1.2	GS+EU	0.5
Antimony	1.8	5.4	Extraction	E+P	GS+EU	1.8	GS+EU	0.7
Arsenic	1.9	2.9	Processing	P	-		GS+EU	1.9
Baryte	1.3	3.5	Extraction	E	GS+EU	1.3	-	-
Bentonite	0.4	3.1	Extraction	E	GS+EU	0.4	-	-
Beryllium	1.8	5.4	Extraction	E+P	GS only	1.8	GS+EU	1.2
Bismuth	1.9	5.7	Processing	P	-	-	GS+EU	1.9
Boron	3.6	3.9	Extraction	E+P	GS+EU	3.6	GS+EU	1.4
Cadmium	0.2	4.1	Processing	P	-	-	GS+EU	0.2
Chromium	0.7	7.2	Extraction	E+P	GS+EU	0.7	GS+EU	0.6
Cobalt	2.8	6.8	Extraction	E+P	GS only	2.8	GS+EU	0.5
Coking coal	1.0	3.1	Extraction	E+P	GS+EU	1.0	GS+EU	0.4
Copper	0.1	4.0	Extraction	E+P	GS+EU	0.1	GS+EU	0.1
Diatomite	0.3	2.3	Extraction	E	GS+EU	0.3	-	-
Feldspar	1.5	3.2	Extraction	E	GS+EU	1.5	-	-
Fluorspar	1.1	3.8	Extraction	E	GS+EU	1.1	-	-
Gallium	3.9	3.7	Processing	P	-	-	GS+EU	3.9
Germanium	1.8	3.6	Processing	P	-	-	GS+EU	1.8
Gold	0.4	2.4	Extraction	E	GS+EU	0.4	-	-
Gypsum	0.6	2.7	Extraction	E	GS+EU	0.6	-	-
Hafnium	1.5	4.3	Processing	P	-	-	EU only	1.5
Helium	1.2	2.9	Processing	P	-	-	GS+EU	1.2
HREE	5.1	4.2	Processing	E+P	GS+EU	2.3	GS only	5.1
HREE Dysprosium	5.6	7.8	Processing	E+P	GS+EU	5.3	GS only	5.6
HREE Erbium	5.6	3.5	Processing	E+P	GS+EU	2.2	GS only	5.6
HREE Europium	5.6	3.3	Processing	E+P	GS+EU	2.2	GS only	5.6
HREE Gadolinium	3.3	3.3	Processing	E+P	GS+EU	1.1	GS only	3.3
HREE Holmium	5.6	3.2	Processing	E+P	GS+EU	2.2	GS only	5.6
HREE Lutetium	5.6	5.0	Processing	E+P	GS+EU	2.2	GS only	5.6
HREE Terbium	4.9	6.4	Processing	E+P	GS+EU	2.5	GS only	4.9
HREE Thulium	5.6	3.2	Processing	E+P	GS+EU	2.2	GS only	5.6
HREE Ytterbium	5.6	3.2	Processing	E+P	GS+EU	2.2	GS only	5.6
HREE Yttrium	3.5	2.9	Processing	E+P	GS+EU	1.4	GS only	3.5
Hydrogen	0.5	2.9	Extraction	E+P	GS+EU	0.5	EU only	0.3
Indium	0.6	2.6	Processing	P	-	-	GS+EU	0.6
Iron ore	0.5	7.2	Extraction	E+P	GS+EU	0.5	GS+EU	0.2
Kaolin clay	0.8	2.8	Extraction	E+P	GS+EU	0.8	GS+EU	0.5

2023 assessment					Extraction		Processing	
Material	Supply Risk (SR)	Economic Importance (EI)	Stage used in SR	Stages assessed	Supply used in SR	Supply Risk	Supply used in SR	Supply Risk
Krypton	0.7	3.3	Processing	P	-	-	EU only	0.7
Lead	0.1	4.2	Extraction	E+P	GS+EU	0.1	GS+EU	0.0
Limestone	0.3	3.6	Extraction	E	EU only	0.3	-	-
Lithium	1.9	3.9	Processing	E+P	GS only	0.8	GS+EU	1.9
LREE	3.7	5.9	Processing	E+P	GS+EU	281%	GS+EU	3.58
LREE Cerium	4.0	4.9	Processing	E+P	GS only	3.9	GS only	4.0
LREE Lanthanum	3.5	2.9	Processing	E+P	GS+EU	2.0	GS+EU	3.5
LREE Neodymium	4.5	7.2	Extraction	E+P	GS+EU	4.5	GS+EU	3.7
LREE Praseodymium	3.2	7.0	Processing	E+P	GS+EU	1.8	GS+EU	3.2
LREE Samarium	3.5	7.7	Processing	E+P	GS+EU	2.0	GS+EU	3.5
Magnesite	0.6	3.6	Extraction	E	EU only	0.6	-	-
Magnesium	4.1	7.4	Processing	P	-	-	GS+EU	4.1
Manganese	1.2	6.9	Extraction	E+P	GS+EU	1.2	GS+EU	1.0
Molybdenum	0.8	6.7	Extraction	E+P	GS+EU	0.8	EU	0.2
Natural cork	0.9	1.7	Extraction	E	EU only	0.9	-	-
Natural graphite	1.8	3.4	Extraction	E	GS+EU	1.8	-	-
Natural Rubber	0.9	6.0	Extraction	E	GS+EU	0.9	-	-
Natural Teak wood	1.7	2.4	Extraction	E	GS+EU	1.7	-	-
Neon	0.7	3.1	Processing	P	-	-	EU only	0.7
Nickel	0.5	5.7	Processing	E+P	GS+EU	0.4	GS+EU	0.5
Niobium	4.4	6.5	Extraction	E+P	GS only	4.4	GS+EU	3.8
Perlite	0.8	2.5	Extraction	E	GS only	0.8	-	
PGM	2.7	7.1	Processing	P	-	-	GS only	2.74
PGM Iridium	3.9	6.4	Processing	P	-	-	GS only	3.9
PGM Palladium	1.5	8.1	Processing	P	-	-	GS only	1.5
PGM Platinum	2.13	6.9	Processing	P	-	-	GS only	2.1
PGM Rhodium	2.4	8.6	Processing	P	-	-	GS only	2.4
PGM Ruthenium	3.8	5.5	Processing	P	-	-	GS only	3.8
Phosphate rock	1.0	6.4	Extraction	E	GS+EU	1.0	-	
Phosphorus	3.3	4.7	Processing	P	-	-	GS+EU	3.3
Potash	0.7	6.2	Extraction	E	GS+EU	0.7	-	-
Rhenium	0.5	2.3	Processing	P	-	-	GS only	0.5
Roundwood	0.1	1.2	Extraction	E	GS+EU	0.1	-	-
Sapele wood	1.3	1.6	Extraction	E	GS+EU	1.3	-	-
Scandium	2.4	3.7	Processing	P	-	-	GS only	2.4
Selenium	0.3	4.8	Processing	P	-	-	GS+EU	0.3
Silica	0.3	3.1	Extraction	E	GS+EU	0.3	-	-
Silicon metal	1.4	4.9	Processing	P	-	-	GS+EU	1.4

2023 assessment					Extraction		Processing	
Material	Supply Risk (SR)	Economic Importance (EI)	Stage used in SR	Stages assessed	Supply used in SR	Supply Risk	Supply used in SR	Supply Risk
Silver	0.8	4.6	Extraction	E	GS+EU	0.8	-	-
Strontium	2.6	6.5	Extraction	E	GS+EU	2.6	-	-
Sulphur	0.3	5.0	Processing	P	-		EU only	0.3
Talc	0.2	3.3	Extraction	E	GS+EU	0.2	-	-
Tantalum	1.3	4.8	Extraction	E	GS+EU	1.3	-	-
Tellurium	0.3	3.8	Processing	P	-		GS+EU	0.3
Tin	0.9	4.5	Processing	E+P	GS+EU	0.5	GS+EU	0.9
Titanium	0.5	5.4	Extraction	E+P	GS+EU	0.5	GS+EU	0.4
Titanium metal	1.6	6.3	Processing	E+P	GS+EU	0.5	GS+EU	1.6
Tungsten	1.2	8.7	Processing	E+P	GS+EU	0.5	GS+EU	1.2
Vanadium	2.3	3.9	Extraction	E+P	GS only	2.3	GS+EU	1.7
Xenon	0.8	3.1	Processing	P	-	-	GS+EU	0.8
Zinc	0.2	4.8	Extraction	E+P	GS+EU	0.2	EU only	0.1
Zirconium	0.8	3.5	Extraction	E	GS+EU	0.8	-	-

Annex 3. Stages assessed and rationale

Material	Stages assessed	Stage used in SR	Rationale for stages assessed	
			Data quality and availability on EU and global supply	Additional information
Aggregates	E	Extraction	No data on global supply, just Europe. Therefore, the Supply risk is calculated only based on the EU supply. Superior quality industrial data was available at the extraction stage for the EU. Public trade data was available.	Aggregates are globally abundant and due to very large quantities they are typically transported over short distances. Therefore the relevant scope is the EU and the neighbours.
Aluminium/ bauxite	E+P	Extraction	Data was available for both stages.	The criticality of aluminium is assessed for two different life cycle stages, the extraction and refining. Data on global and EU supply was available and used in the assessment.
Antimony	E+P	Extraction	Data was available for both stages.	EU is 100% import dependent.
Arsenic	P	Processing	Global and EU supply data was available for the processing stage.	Arsenic is a by-product, mainly of copper, zinc
Baryte	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Bentonite	E	Extraction	Global and EU supply data was available at the extraction stage only.	Europe is a major producer of bentonite hence the sector is important for the EU economy.
Beryllium	E+P	Extraction	Beryllium was assessed at both stages. For the extraction stage, the trade data were not reliable, only global supply was considered.	EU is 100% import dependent.
Bismuth	P	Processing	Global supply data was available at the refining stage only, therefore this stage was selected for the criticality assessment. Public data for the EU production were complemented by the experts.	-
Boron	E+P	Extraction	Data available for the extraction stage. Absence of processing stage production data at the global level. The production was estimated by experts based on the same distribution per countries as the extraction, and with a total production equal to 80% of total extraction.	-
Cadmium	P	Processing	Global and EU supply data was available at the processing stage only.	Cadmium is a by-product, mainly of zinc
Chromium	E+P	Extraction	Data was available for both stages.	-

Material	Stages assessed	Stage used in SR	Rationale for stages assessed	
			Data quality and availability on EU and global supply	Additional information
Cobalt	E+P	Extraction	Data was available for the global supply and for EU supply at the processing stage. At the extraction stage, global supply data was available, but part of the import data was confidential, therefore only global supply has been considered.	-
Coking coal	E+P	Extraction	Data available for both stages.	-
Copper	E+P	Extraction	Data available for both stages.	-
Diatomite	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Feldspar	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Fluorspar	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Gallium	P	Processing	Global and EU supply data was available at the processing stage only.	Ga is a by-product, mostly of aluminium.
Germanium	P	Processing	Global supply and EU supply data was available at the processing stage only, therefore this stage was selected for the criticality assessment. Public data for the EU production were complemented by the experts.	Ge is a by-product, mostly of zinc.
Gold	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Gypsum	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Hafnium	P	Processing	Only processing stage has been assessed. Global production data is confidential, previous assessment commercial data were used. Trade data available.	Hafnium is a by-product, mainly of zirconium.
Helium	P	Processing	Global and EU supply data was available at the processing stage only.	Helium is a by-product, mainly of natural gas.
HREE Dysprosium	E+P	Processing	Both stages have been assessed, but availability and quality of data was variable. For the extraction stage, global supply was available from the public and commercial data, while for the EU supply aggregated trade codes had to be split based on experts' advice. For the processing stage, only global supply was considered as data was available from the public and commercial sources, while the trade data were of no acceptable	EU is highly dependent on the rare earths imports, particularly heavy rare earths.

Material	Stages assessed	Stage used in SR	Rationale for stages assessed	
			Data quality and availability on EU and global supply	Additional information
HREE Erbium	E+P	Processing	quality.	
HREE Europium	E+P	Processing		
HREE Gadolinium	E+P	Processing		
HREE Holmium	E+P	Processing		
HREE Lutetium	E+P	Processing		
HREE Terbium	E+P	Processing		
HREE Thulium	E+P	Processing		
HREE Ytterbium	E+P	Processing		
HREE Yttrium	E+P	Processing		
Hydrogen	E+P	Extraction	Both stages have been assessed and data was available. For the extraction stage, global and the EU supply of natural gas have been considered. For the processing stage, global and the EU supply of hydrogen produced in captive plants, merchant plants and as by-product processes data was available, but only EU supply has been assessed.	Hydrogen in the EU is produced mainly from natural gas (65%), petroleum (27%), coal (5%) and only 3% by electrolysis. EU is a net exporter of hydrogen.
Indium	P	Processing	Global and EU supply data was available at the processing stage only.	Indium is a by-product, mainly of zinc and copper.
Iron ore	E+P	Extraction	Data was available for both stages.	-
Kaolin clay	E+P	Extraction	Kaolin clay was assessed at both stages. For the extraction stage (raw kaolin) public sources and expert advice have been used and for processing (beneficiated kaolin) public sources have been used.	-
Krypton	P	Processing	Global and EU supply data was available at the processing stage only. Global production data is available from an older public report. EU sourcing data is based on an aggregated trade code and expert advice.	Krypton is produced from air.
Lead	E+P	Extraction	Data was available for both stages.	Lead is highly recycled.

Material	Stages assessed	Stage used in SR	Rationale for stages assessed	
			Data quality and availability on EU and global supply	Additional information
Limestone	E	Extraction	No data on global supply, just Europe. Import reliance was 0. Therefore, the Supply risk was calculated only based on the EU supply.	Limestone is globally abundant and typically used locally.
Lithium	E+P	Processing	Both stages have been assessed. Data was available at sufficient quality except for the trade data at the extraction stage. More precise data on global production of processed lithium.	
LREE Cerium	E+P	Processing	Both stages have been assessed, but availability and quality of data was variable. For the extraction stage, global supply was available from the public and commercial data, while for the EU supply aggregated trade codes had to be split based on experts' advice. For the processing stage, only global supply was considered as data was available from the public and commercial sources, while the trade data were of no acceptable quality.	EU is highly dependent on imports.
LREE Lanthanum	E+P	Processing		
LREE Neodymium	E+P	Extraction		
LREE Praseodymium	E+P	Processing		
LREE Samarium	E+P	Processing		
Magnesite	E	Extraction	Global and EU supply data was available at the extraction stage only. Import reliance is 0, therefore only EU supply has been considered.	EU is self-sufficient in magnesite.
Magnesium	P	Processing	Global and EU supply data was available at the processing stage only.	Magnesium is produced mostly from a very abundant mineral dolomite and salt brines. EU is 100% import dependent.
Manganese	E+P	Extraction	Data was available for both stages.	-
Molybdenum	E+P	Extraction	Both stages have been assessed, but for the processing stage only EU supply was considered due to lack of processed molybdenum production data.	EU is 100% import dependent.
Natural cork	E	Extraction	Global and EU supply data was available at the extraction stage only. Import reliance is 0, therefore only EU supply has been considered.	EU is self-sufficient in cork.
Natural graphite	E	Extraction	Global and EU supply data was available at the extraction stage only.	EU is highly dependent on imports.
Natural Rubber	E	Extraction	Global and EU supply data was available at the extraction stage only.	EU is 100% import dependent.

Material	Stages assessed	Stage used in SR	Rationale for stages assessed	
			Data quality and availability on EU and global supply	Additional information
Natural Teak wood	E	Extraction	Only extraction stage was assessed. Public data for extraction was not available, trade data have been used instead. EU supply has been based on aggregated trade codes split using expert advice.	EU is 100% import dependent.
Neon	P	Processing	Global and EU supply data was available at the processing stage only. Global production data is available from an older public report. EU sourcing data is based on an aggregated trade code and expert advice.	Neon is produced from air.
Nickel	E+P	Processing	Data was available for both stages.	-
Niobium	E+P	Extraction	Data was available for both stages. For the extraction, only global supply has been considered, as EU supply data is not available due to an aggregated trade code.	EU is 100% import dependent.
Perlite	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
PGM Iridium	P	Processing	Almost all platinum group metals derived from primary source materials (i.e. mine production) are traded in the form of refined metal produced from integrated mining/metallurgical operations. There is only very limited international trade of ores and concentrates, therefore the processing stage was considered for the criticality assessment.	EU is highly dependent on imports.
PGM Palladium	P	Processing		
PGM Platinum	P	Processing		
PGM Rhodium	P	Processing		
PGM Ruthenium	P	Processing		
Phosphate rock	E	Extraction	Global and EU supply data was available at the extraction stage only.	To highlight the difference between an extracted product and a refined product, both phosphate rock and phosphorus (P4 as one of many products) are assessed.
Phosphorus	P	Processing	Global and EU supply data was available at the processing stage only.	
Potash	E	Extraction	Global and EU supply data was available at the extraction stage only.	
Rhenium	P	Processing	Global and EU supply data was available at the processing stage only. However, only global supply was considered, while	

Material	Stages assessed	Stage used in SR	Rationale for stages assessed	
			Data quality and availability on EU and global supply	Additional information
			the trade data were of no acceptable reliability.	
Roundwood	E	Extraction	Global and EU supply data was available at the extraction stage only. Import reliance is 0, therefore only EU supply has been considered.	EU is self-sufficient.
Sapele wood	E	Extraction	Global and EU supply data was available at the extraction stage only. Approach to calculate the production has been changed from surface based assumptions to trade data, in absence of production data.	EU is 100% import dependent.
Scandium	P	Processing	Processing stage has been assessed. No official data is available on global production of scandium, only expert estimates have been used. EU sourcing supply risk disregarded, as trade data is unreliable.	Scandium is a by-product, mainly of aluminium.
Selenium	P	Processing	Global and EU supply data was available at the processing stage only.	Selenium is a by-product, mainly of copper.
Silica	E	Extraction	Global and EU supply data was available at the extraction stage only.	EU is self-sufficient.
Silicon metal	P	Processing	Global and EU supply data was available at the processing stage only.	-
Silver	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Strontium	E	Extraction	Global and EU supply data was available at the extraction stage only. Import reliance is 0, therefore only EU supply has been considered.	EU is self-sufficient.
Sulphur	P	Processing	Global and EU supply data was available at the processing stage only. Import reliance is 0, therefore only EU supply has been considered.	EU is self-sufficient.
Talc	E	Extraction	Global and EU supply data was available at the extraction stage only.	-
Tantalum	E	Extraction	Global and EU supply data was available at the extraction stage only. Trade data has been adapted according to the expert advice.	EU is highly dependent on imports.
Tellurium	P	Processing	Global and EU supply data was available at the processing stage only. Import reliance is 0, therefore only EU supply has been considered.	Tellurium is a by-product, mainly of copper. EU is self-sufficient.

Material	Stages assessed	Stage used in SR	Rationale for stages assessed	
			Data quality and availability on EU and global supply	Additional information
Tin	E+P	Processing	Data was available for both stages.	-
Titanium	E+P	Extraction	Data was available for both stages.	-
Titanium metal	E+P	Processing	Data was available for both stages.	-
Tungsten	E+P	Processing	Data was available for both stages.	-
Vanadium	E+P	Extraction	Data was available for both stages. For the extraction, only global supply has been considered, as EU supply data is not available due to an aggregated trade code.	EU is 100% import dependent.
Xenon	P	Processing	Global and EU supply data was available at the processing stage only. Global production data is available from an older public report. EU sourcing data is based on an aggregated trade code and expert advice.	Xenon is produced from air.
Zinc	E+P	Extraction	Global and EU supply data was available for both stages. For the processing stage, Import reliance is 0, therefore only EU supply has been considered.	-
Zirconium	E	Extraction	Global and EU supply data was available at the extraction stage only.	EU is 100% import dependent.

Annex 4. Comparison of 2023 results and previous assessments

Table 15: Comparison of 2023 results and previous assessments[38]

Criticality studies	2011		2014		2017		2020		2023	
Material	**SR***	**EI**	**SR***	**EI**	**SR**	**EI**	**SR**	**EI**	**SR**	**EI**
Aggregates	-	-	-	-	0.2	2.3	0.2	2.7	0.2	3.2
Aluminium	0.2	8.9	0.4	7.6	0.5	6.5	0.6	5.4	1.1	5.5
Antimony	2.6	5.8	2.5	7.1	4.3	4.3	2.0	4.8	1.8	5.4
Arsenic	-	-	-	-	-	-	1.2	2.6	1.9	2.9
Baryte	1.7	3.7	1.7	2.8	1.6	2.9	1.3	3.3	1.3	3.5
Bauxite[39]	0.3	9.5	0.6	8.6	2	2.6	2.1	2.9	-	-
Bentonite	0.3	5.5	0.4	4.6	0.2	2.1	0.5	2.8	0.4	3.1
Beryllium	1.3	6.2	1.5	6.7	2.4	3.9	2.3	4.2	1.8	5.4
Bismuth	-	-	-	-	3.8	3.6	2.2	4.0	1.9	5.7
Boron	0.6	5	1	5.7	3	3.1	3.2	3.5	3.6	3.9
Cadmium	-	-	-	-	-	-	0.3	4.2	0.2	4.1
Chromium	0.8	9.9	1	8.9	0.9	6.8	0.9	7.3	0.7	7.2
Cobalt	1.1	7.2	1.6	6.7	1.6	5.7	2.5	5.9	2.8	6.8
Coking coal	-	-	1.2	9	1	2.3	1.2	3.0	1.0	3.1
Copper	0.2	5.7	0.2	5.8	0.2	4.7	0.3	5.3	0.1	4.0
Diatomite	0.3	3.7	0.2	3	0.3	3.8	0.5	2.2	0.3	2.3
Feldspar	0.2	5.2	0.4	4.8	0.6	2.4	0.8	2.8	1.5	3.2
Fluorspar	1.6	7.5	1.7	7.2	1.3	4.2	1.2	3.3	1.1	3.8
Gallium	2.5	6.5	1.8	6.3	1.4	3.2	1.3	3.5	3.9	3.7
Germanium	2.7	6.3	1.9	5.5	1.9	3.5	3.9	3.5	1.8	3.6
Gold	-	-	0.2	3.8	0.2	2	0.2	2.1	0.4	2.4
Gypsum	0.4	5	0.5	5.5	0.5	2.2	0.5	2.6	0.6	2.7
Hafnium	-	-	0.4	7.8	1.3	4.2	1.1	3.9	1.5	4.3
Helium	-	-	-	-	1.6	2.8	1.2	2.6	1.2	2.9
HREEs	4.9	5.8	4.7	5.4	4.9	3.7	5.6	3.9	5.1	4.2
Hydrogen	-	-	-	-	-	-	0.4	3.8	0.5	2.9
Indium	2	6.7	1.8	5.6	2.4	3.1	1.8	3.3	0.6	2.6
Iron ore	0.4	8.1	0.5	7.4	0.8	6.2	0.5	6.8	0.5	7.2
Kaolin clay	0.3	4.4	0.3	4.8	0.5	2.3	0.4	2.4	0.8	2.8
Krypton	-	-	-	-	-	-	-	-	0.7	3.3
Lead	-	-	-	-	0.1	3.7	0.1	4.0	0.1	4.2
Limestone	0.7	6	0.4	5.8	0.1	2.5	0.2	3.5	0.3	3.6
Lithium	0.7	5.6	0.6	5.5	1	2.4	1.6	3.1	1.9	3.9
LREEs	4.9	5.8	3.1	5.2	5	3.6	6.0	4.3	3.7	5.9
Magnesite	0.9	8.9	2.2	8.3	0.7	3.7	0.6	3.2	0.6	3.6
Magnesium	2.6	6.5	2.5	5.5	4	7.1	3.9	6.6	4.1	7.4

38 The 2011 assessment used the following material groups: PGMs - palladium, platinum, iridium, rhodium, ruthenium and osmium. - REEs - yttrium, scandium, lanthanum, cerium, praseodymium, neodymium, promethium, samarium, europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium and lutetium. Heavy Rare Earth Elements, Light Rare Earth Elements and Scandium were considered together as Rare Earth Elements. The 2014 assessment used the following material groups: PGMs - palladium, platinum, rhodium, ruthenium, iridium and osmium. - LREEs - lanthanum, cerium, praseodymium, neodymium, and samarium. - HREEs - dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium.

39 Bauxite has been merged with aluminium as its ore, titanium has been split to titanium and titanium metal in 2023.

Manganese	0.5	9.8	0.4	7.8	0.9	6.1	0.9	6.7	1.2	6.9
Molybdenum	0.5	8.9	0.9	5.9	0.9	5.2	0.9	6.2	0.8	6.7
Natural cork	-	-	-	-	1.1	1.5	1.0	1.6	0.9	1.7
Natural graphite	1.3	8.7	2.2	7.4	2.9	2.9	2.3	3.2	1.8	3.4
Natural Rubber	-	-	0.9	7.7	1	5.4	1.0	7.1	0.9	6.0
Natural Teak wood	-	-	-	-	0.9	2	1.9	2.0	1.7	2.4
Neon	-	-	-	-	-	-	-	-	0.7	3.1
Nickel	0.3	9.5	0.2	8.8	0.3	4.8	0.5	4.9	0.5	5.7
Niobium	2.8	9	2.5	5.9	3.1	4.8	3.9	6.0	4.4	6.5
Perlite	0.3	4.2	0.3	4.6	0.4	2.1	0.4	2.3	0.8	2.5
PGMs	3.6	6.7	1.2	6.6	2.5	5	2.4	5.7	2.7	7.1
Phosphate rock	-	-	1.1	5.8	1	5.1	1.1	5.6	1.0	6.4
Phosphorus	-	-	-	-	4.1	4.4	3.5	5.3	3.3	4.7
Potash	-	-	0.2	8.6	0.6	4.8	0.8	5.4	0.7	6.2
Rhenium	0.8	7.7	0.9	4.5	1	2	0.5	2.0	0.5	2.3
Roundwood	-	-	-	-	-	-	-	-	0.1	1.2
Sapele wood	-	-	-	-	1.4	1.3	2.3	1.4	1.3	1.6
Scandium	4.9	5.8	1.1	3.8	2.9	3.7	3.1	4.4	2.4	3.7
Selenium	-	-	0.2	6.9	0.4	4.5	0.4	4.9	0.3	4.8
Silica sand	0.2	5.8	0.3	5.8	0.3	2.6	0.4	2.9	0.3	3.1
Silicon metal	-	-	1.6	7.1	1	3.8	1.2	4.2	1.4	4.9
Silver	0.3	5.1	0.7	4.8	0.5	3.8	0.7	4.1	0.8	4.6
Strontium	-	-	-	-	-	-	2.6	3.5	2.6	6.5
Sulphur	-	-	-	-	0.6	4.6	0.3	4.1	0.3	5.0
Talc	0.3	4	0.3	5.1	0.4	3	0.4	4.0	0.2	3.3
Tantalum	1.1	7.4	0.6	7.4	1	3.9	1.4	4.0	1.3	4.8
Tellurium	0.6	7.9	0.2	6	0.7	3.4	0.5	3.6	0.3	3.8
Tin	-	-	0.9	6.7	0.8	4.4	0.9	4.2	0.9	4.5
Titanium[2]	0.1	5.4	0.1	5.5	0.3	4.3	1.3	4.7	0.5	5.4
Titanium metal[2]	-	-	-	-	-	-	-	-	1.6	6.3
Tungsten	1.8	8.8	2	9.1	1.8	7.3	1.6	8.1	1.2	8.7
Vanadium	0.7	9.7	0.8	9.1	1.6	3.7	1.7	4.4	2.3	3.9
Xenon	-	-	-	-	-	-	-	-	0.8	3.1
Zinc	0.4	9.4	0.5	8.7	0.3	4.5	0.3	5.4	0.2	4.8
Zirconium	-	-	-	-	-	-	0.8	3.2	0.8	3.5

Legend	
	Exceeding thresholds
	Below thresholds
PGMs	*Iridium, palladium, platinum, rhodium, ruthenium*
LREEs	*Cerium, lanthanum, neodymium, praseodymium and samarium*
HREEs	*Dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium*
-	*Not assessed*
*SR**	*In 2011 and 2014 assessments, the SR calculation was based on Global supply only*

Annex 5. Substitution indexes

The following table provides Substitution indexes (SI) used for calculating the Supply risk (SR) and Economic importance (EI).

Material	SI (EI)	SI (SR)	Material	SI (EI)	SI (SR)
Aggregates	1.00	1.00	Natural cork	0.91	0.91
Aluminium/bauxite	0.82	0.86	Natural graphite	0.97	0.98
Antimony	0.92	0.94	Natural Rubber	0.80	0.90
Arsenic	0.86	0.96	Natural Teak wood	0.96	0.96
Baryte	0.87	0.92	Neodymium	0.97	0.99
Bentonite	0.88	0.89	Neon	0.95	0.96
Beryllium	0.99	0.99	Nickel	0.88	0.92
Bismuth	0.95	0.92	Niobium	0.93	0.96
Boron	0.99	0.99	Palladium	0.92	0.99
Cadmium	0.92	0.90	Perlite	0.88	0.92
Cerium	0.93	0.97	Phosphate rock	0.96	0.99
Chromium	0.93	0.93	Phosphorus	0.95	0.98
Cobalt	0.97	0.98	Platinum	0.96	0.95
Coking coal	1.00	1.00	Potash	0.95	0.98
Copper	0.70	0.71	Praseodymium	0.96	0.98
Diatomite	0.91	0.90	Rhenium	0.98	0.99
Dysprosium	0.98	0.99	Rhodium	0.99	1.00
Erbium	1.00	1.00	Roundwood	0.79	0.82
Europium	1.00	1.00	Ruthenium	0.94	0.94
Feldspar	0.99	0.99	Samarium	0.98	0.98
Fluorspar	0.91	0.91	Sapele wood	0.96	0.97
Gadolinium	0.59	0.59	Scandium	0.86	0.87
Gallium	0.98	0.98	Selenium	0.90	0.94
Germanium	0.92	0.94	Silica sand	0.97	0.93
Gold	0.98	0.99	Silicon metal	0.99	0.99
Gypsum	0.86	0.95	Silver	0.97	0.99
Hafnium	0.91	0.96	Strontium	0.98	0.97
Helium	0.94	0.97	Sulphur	0.99	0.99
Holmium	1.00	1.00	Talc	0.71	0.71
Hydrogen	0.81	0.81	Tantalum	0.96	0.98
Indium	0.87	0.89	Tellurium	0.87	0.94
Iridium	0.94	0.97	Terbium	0.84	0.92
Iron ore	0.92	0.95	Thulium	1.00	1.00
Kaolin clay	0.92	0.95	Tin	0.90	0.92
Krypton	0.96	0.98	Titanium	0.92	0.95
Lanthanum	0.92	0.97	Titanium metal	1.00	1.00
Lead	0.94	0.99	Tungsten	0.95	0.96
Limestone	0.99	0.99	Vanadium	0.90	0.92
Lithium	0.91	0.94	Xenon	0.98	0.99
Lutetium	1.00	1.00	Ytterbium	1.00	1.00
Magnesite	0.98	0.99	Yttrium	0.90	0.90
Magnesium	0.94	0.94	Zinc	0.77	0.80
Manganese	1.00	1.00	Zirconium	0.96	0.97
Molybdenum	1.00	1.00			

Annex 6. Material uses shares, NACE2 sectors assignment and Value added (VA)

Material	Application	Share	NACE sector	VA in million €
Aggregates	Construction and infrastructures	100%	C23 - Manufacture of other non-metallic mineral products	64,990
Aluminium	Construction	21%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Aluminium	Automotive industry	19%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Aluminium	Transport equipment	19%	C30 - Manufacture of other transport equipment	55,777
Aluminium	Packaging	15%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Aluminium	High tech engineering	11%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Aluminium	Consumer durables	5%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Aluminium	Refractories	3%	C23 - Manufacture of other non-metallic mineral products	64,990
Aluminium	Cement	3%	C23 - Manufacture of other non-metallic mineral products	64,990
Aluminium	Abrasives	2%	C23 - Manufacture of other non-metallic mineral products	64,990
Antimony	Flame retardants	43%	C20 - Manufacture of chemicals and chemical products	132,361
Antimony	Lead-acid batteries	32%	C27 - Manufacture of electrical equipment	89,422
Antimony	Lead alloys	14%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Antimony	Plastics (catalysts and stabilisers)	6%	C20 - Manufacture of chemicals and chemical products	132,361
Antimony	Glass and ceramics	5%	C23 - Manufacture of other non-metallic mineral products	64,990
Arsenic	Zinc production (Electrowinning of zinc)	69%	C24 - Manufacture of basic metals	64,561
Arsenic	Glassmaking	18%	C23 - Manufacture of other non-metallic mineral products	64,990
Arsenic	Chemicals	7%	C20 - Manufacture of chemicals and chemical products	132,361
Arsenic	Alloys	5%	C24 - Manufacture of basic metals	64,561
Arsenic	Electronics	1%	C26 - Manufacture of computer, electronic and optical products	77,000
Barytes	Filler in rubbers, plastics, paints & paper	70%	C22 - Manufacture of rubber and plastic products	86,487

Material	Application	Share	NACE sector	VA in million €
Barytes	Weighting agent in oil and gas well drilling fluids	20%	C23 - Manufacture of other non-metallic mineral products	64,990
Barytes	Chemical industry	5%	C20 - Manufacture of chemicals and chemical products	132,361
Barytes	Radioactive radiation absorber	5%	C32 - Other manufacturing	45,912
Beryllium	Industrial Components	23%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Beryllium	Aerospace and Defence	17%	C30 - Manufacture of other transport equipment	55,777
Beryllium	Automotive	17%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Beryllium	Other	14%		0
Beryllium	Consumer Electronics	12%	C26 - Manufacture of computer, electronic and optical products	77,000
Beryllium	Telecommunication Infrastructure	11%	C26 - Manufacture of computer, electronic and optical products	77,000
Beryllium	Energy	5%	C26 - Manufacture of computer, electronic and optical products	77,000
Beryllium	Semiconductor	1%	C24 - Manufacture of basic metals	64,561
Bismuth	Chemicals	84%	C20 - Manufacture of chemicals and chemical products	132,361
Bismuth	Low-melting alloys	9%	C24 - Manufacture of basic metals	64,561
Bismuth	Metallurgical additives	7%	C24 - Manufacture of basic metals	64,561
Borate	Glass	55%	C23 - Manufacture of other non-metallic mineral products	64,990
Borate	Frits and ceramics	17%	C23 - Manufacture of other non-metallic mineral products	64,990
Borate	Fertilizers	15%	C20 - Manufacture of chemicals and chemical products	132,361
Borate	Chemical manufacture	4%	C20 - Manufacture of chemicals and chemical products	132,361
Borate	Construction materials (flame retardants, plasters, wood preservatives)	4%	C20 - Manufacture of chemicals and chemical products	132,361
Borate	Metals	4%	C24 - Manufacture of basic metals	64,561
Borate	Magnets	0%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Borate	Semiconductors	0%	C26 - Manufacture of computer, electronic and optical products	77,000
Cadmium	Batteries	91%	C27 - Manufacture of electrical equipment	89,422
Cadmium	Alloys	5%	C24 - Manufacture of basic metals	64,561
Cadmium	Coatings	3%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568

Material	Application	Share	NACE sector	VA in million €
Cadmium	Solar Application	1%	C26 - Manufacture of computer, electronic and optical products	77,000
Cerium	Autocatalysts	60%	C20 - Manufacture of chemicals and chemical products	132,361
Cerium	Polishing powders	20%	C23 - Manufacture of other non-metallic mineral products	64,990
Cerium	Glass & ceramics	12%	C23 - Manufacture of other non-metallic mineral products	64,990
Cerium	Fluid cracking catalysts	4%	C19 - Manufacture of coke and refined petroleum products	28,295
Cerium	Batteries	2%	C27 - Manufacture of electrical equipment	89,422
Cerium	Metal (excl. Batteries)	2%	C24 - Manufacture of basic metals	64,561
Chromium	stainless steel	74%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Chromium	Products made of alloy steel	19%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Chromium	Casting moulds	3%	C24 - Manufacture of basic metals	64,561
Chromium	chromium chemicals	3%	C20 - Manufacture of chemicals and chemical products	132,361
Chromium	Refractory bricks and mortars	1%	C23 - Manufacture of other non-metallic mineral products	64,990
Cobalt	Superalloys, hardfacing/HSS and other alloys	36%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Cobalt	Hard materials (carbides and diamond tools)	14%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Cobalt	Pigments and inks	13%	C20 - Manufacture of chemicals and chemical products	132,361
Cobalt	Catalysts	12%	C20 - Manufacture of chemicals and chemical products	132,361
Cobalt	Tyre adhesives and paint dryers	11%	C20 - Manufacture of chemicals and chemical products	132,361
Cobalt	Magnets	7%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Cobalt	Other	6%		0
Cobalt	Batteries	3%	C27 - Manufacture of electrical equipment	89,422
Coking coal	Iron and steel (coke in blast furnace)	89%	C24 - Manufacture of basic metals	64,561
Coking coal	Iron and steel (other uses)	6%	C24 - Manufacture of basic metals	64,561
Coking coal	Industrial energy use (other than Iron and steel)	3%	C19 - Manufacture of coke and refined petroleum products	28,295
Coking coal	Chemicals	1%	C20 - Manufacture of chemicals	132,361

Material	Application	Share	NACE sector	VA in million €
			and chemical products	
Coking coal	Non-industrial energy use	1%	C19 - Manufacture of coke and refined petroleum products	28,295
Copper	Building construction, Electrical power	21%	C27 - Manufacture of electrical equipment	89,422
Copper	Manufacture, other, diverse	13%	C32 - Other manufacturing	45,912
Copper	Building construction, plumbing	10%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Copper	Manufacture, Transport, Automotive, Electrical	10%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Copper	Manufacture, Industrial, non-electrical	10%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Copper	Manufacture, other, Consumer & general products	8%	C32 - Other manufacturing	45,912
Copper	Infrastructure, Power utility	7%	C27 - Manufacture of electrical equipment	89,422
Copper	Manufacture, Industrial, Electrical	6%	C27 - Manufacture of electrical equipment	89,422
Copper	Manufacture, Transport, other transport	4%	C30 - Manufacture of other transport equipment	55,777
Copper	Manufacture, other, cooling	3%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Copper	Infrastructure, Telecommunications	3%	C27 - Manufacture of electrical equipment	89,422
Copper	Manufacture, other, electronic	2%	C26 - Manufacture of computer, electronic and optical products	77,000
Copper	Building construction, Architecture	2%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Copper	Building construction, Communications	1%	C27 - Manufacture of electrical equipment	89,422
Copper	Manufacture, Transport, Automotive, non-electrical	1%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Copper	Building construction, building plant	>0%	C32 - Other manufacturing	45,912
Diatomite	Food industry	48%	C11 - Manufacture of beverages	39,443
Diatomite	Pelletizing iron ore	23%	C23 - Manufacture of other non-metallic mineral products	64,990
Diatomite	Activated raw granules	13%	C23 - Manufacture of other non-metallic mineral products	64,990
Diatomite	Pet litter	7%	C23 - Manufacture of other non-metallic mineral products	64,990
Diatomite	Civil engineering	6%	C23 - Manufacture of other non-metallic mineral products	64,990

Material	Application	Share	NACE sector	VA in million €
Diatomite	Drilling fluids	2%	B09 - Mining support service activities	3,769
Diatomite	Foundry moulding sands	1%	C24 - Manufacture of basic metals	64,561
Erbium	Glass	74%	C23 - Manufacture of other non-metallic mineral products	64,990
Erbium	Other	26%		0
Europium	Other	90%		0
Europium	Lighting	10%	C27 - Manufacture of electrical equipment	89,422
Feldspar	Ceramics (tiles, glazes)	79%	C23 - Manufacture of other non-metallic mineral products	64,990
Feldspar	Glass (container, float, fiberglass, specialties)	10%	C23 - Manufacture of other non-metallic mineral products	64,990
Feldspar	Ceramics (sanitaryware, tableware)	8%	C23 - Manufacture of other non-metallic mineral products	64,990
Feldspar	Others (filler, extender, adhesive, etc.)	3%	C20 - Manufacture of chemicals and chemical products	132,361
Fluorspar	Steel and iron making	36%	C24 - Manufacture of basic metals	64,561
Fluorspar	Aluminium making and other metallurgy	15%	C24 - Manufacture of basic metals	64,561
Fluorspar	Fluorochemicals	11%	C20 - Manufacture of chemicals and chemical products	132,361
Fluorspar	Solid fluoropolymers (cookware coating and cable insulation)	11%	C27 - Manufacture of electrical equipment	89,422
Fluorspar	Refrigeration and air conditioning	9%	C27 - Manufacture of electrical equipment	89,422
Fluorspar	Others (cement, ceramics, glass, melting rods, glazes)	7%	C23 - Manufacture of other non-metallic mineral products	64,990
Fluorspar	UF6 in nuclear fuel	7%	C24 - Manufacture of basic metals	64,561
Fluorspar	HF in alkylation process for oil refining	4%	C19 - Manufacture of coke and refined petroleum products	28,295
Gadolinium	Magnets	10%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Gadolinium	Lighting	0%	C27 - Manufacture of electrical equipment	89,422
Gadolinium	Metal (excl. Batteries)	10%	C24 - Manufacture of basic metals	64,561
Gadolinium	Magnetic Resonance Imaging - MRI	40%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	101,943
Gadolinium	Others	40%	C20 - Manufacture of chemicals and chemical products	132,361
Gallium	Integrated circuits	70%	C26 - Manufacture of computer, electronic and optical products	77,000
Gallium	Lighting	25%	C27 - Manufacture of electrical	89,422

Material	Application	Share	NACE sector	VA in million €
			equipment	
Gallium	CIGS solar cells	5%	C26 - Manufacture of computer, electronic and optical products	77,000
Gold	Jewellery	85%	C32 - Other manufacturing	45,912
Gold	Electronics	13%	C26 - Manufacture of computer, electronic and optical products	77,000
Gold	Decorative	2%	C32 - Other manufacturing	45,912
Gold	Dental	1%	C32 - Other manufacturing	45,912
Hafnium	Superalloys	61%	C30 - Manufacture of other transport equipment	55,777
Hafnium	Plasma cutting tips	15%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Hafnium	Nuclear control rod	11%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Hafnium	Catalyst precursor	7%	C20 - Manufacture of chemicals and chemical products	132,361
Hafnium	Oxide for Optical	3%	C26 - Manufacture of computer, electronic and optical products	77,000
Hafnium	Semiconductors	3%	C26 - Manufacture of computer, electronic and optical products	77,000
Holmium	Ceramics	100%	C23 - Manufacture of other non-metallic mineral products	64,990
Indium	Alloys/compounds	25%	C24 - Manufacture of basic metals	64,561
Indium	Batteries (alkaline)	20%	C27 - Manufacture of electrical equipment	89,422
Indium	Semiconductors & LEDs	15%	C26 - Manufacture of computer, electronic and optical products	77,000
Indium	Others	10%		0
Indium	Solders	8%	C26 - Manufacture of computer, electronic and optical products	77,000
Indium	PV cells	7%	C26 - Manufacture of computer, electronic and optical products	77,000
Indium	Thermal interface material	5%	C26 - Manufacture of computer, electronic and optical products	77,000
Indium	Indium Tin Oxide (ITO)	0%	C26 - Manufacture of computer, electronic and optical products	77,000
Iridium	Other	34%		0
Iridium	Electrochemical	32%	C20 - Manufacture of chemicals and chemical products	132,361
Iridium	Electronics	26%	C26 - Manufacture of computer, electronic and optical products	77,000
Iridium	Chemical	8%	C20 - Manufacture of chemicals and chemical products	132,361
Iron ore	Construction	38%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Iron ore	Automotive	16%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448

Material	Application	Share	NACE sector	VA in million €
Iron ore	Mechanical engineer	15%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Iron ore	Metalware	14%	C24 - Manufacture of basic metals	64,561
Iron ore	Tubes	10%	C24 - Manufacture of basic metals	64,561
Iron ore	other	3%		0
Iron ore	Domestic appliances	2%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Iron ore	Transport	2%	C30 - Manufacture of other transport equipment	55,777
Kaolin	Ceramics	48%	C23 - Manufacture of other non-metallic mineral products	64,990
Kaolin	Paper	24%	C17 - Manufacture of paper and paper products	44,278
Kaolin	Cement	7%	C23 - Manufacture of other non-metallic mineral products	64,990
Kaolin	Paints and adhesives	5%	C20 - Manufacture of chemicals and chemical products	132,361
Kaolin	Refractories	5%	C23 - Manufacture of other non-metallic mineral products	64,990
Kaolin	Fiberglass	4%	C23 - Manufacture of other non-metallic mineral products	64,990
Kaolin	Catalysts	3%	C19 - Manufacture of coke and refined petroleum products	28,295
Kaolin	Other	2%		0
Kaolin	Rubber and plastics	1%	C22 - Manufacture of rubber and plastic products	86,487
Lanthanum	Fluid cracking catalysts	60%	C19 - Manufacture of coke and refined petroleum products	28,295
Lanthanum	Autocatalysts	29%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Lanthanum	Glass & ceramics	5%	C23 - Manufacture of other non-metallic mineral products	64,990
Lanthanum	Batteries	3%	C27 - Manufacture of electrical equipment	89,422
Lanthanum	Polishing powders	2%	C23 - Manufacture of other non-metallic mineral products	64,990
Lanthanum	Metal (excl. Batteries)	1%	C24 - Manufacture of basic metals	64,561
Limestone	Portland cement, mortar and concrete	32%	C23 - Manufacture of other non-metallic mineral products	64,990
Limestone	Manufacture of basic metals	20%	C24 - Manufacture of basic metals	64,561
Limestone	Quicklime and lime	14%	C23 - Manufacture of other non-metallic mineral products	64,990
Limestone	Flue Gas Desulphurisation	8%	B06 - Extraction of crude petroleum and natural gas	13,132
Limestone	Paints, coatings, adhesives	6%	C20 - Manufacture of chemicals and chemical products	132,361
Limestone	Plastics and rubber	6%	C20 - Manufacture of chemicals and chemical products	132,361
Limestone	Agriculture	5%	C23 - Manufacture of other non-	64,990

Material	Application	Share	NACE sector	VA in million €
			metallic mineral products	
Limestone	Feed	4%	C10 - Manufacture of food products	174,551
Limestone	Paper	2%	C17 - Manufacture of paper and paper products	44,278
Limestone	Glass	1%	C23 - Manufacture of other non-metallic mineral products	64,990
Lutetium	Other	99%		0
Lutetium	Lighting	1%	C27 - Manufacture of electrical equipment	89,422
Magnesite	Steel making	57%	C24 - Manufacture of basic metals	64,561
Magnesite	Paper industry	12%	C17 - Manufacture of paper and paper products	44,278
Magnesite	Cement making	9%	C23 - Manufacture of other non-metallic mineral products	64,990
Magnesite	Agriculture (1 of 2)	7%	C20 - Manufacture of chemicals and chemical products	132,361
Magnesite	Agriculture (2 of 2)	7%	C10 - Manufacture of food products	174,551
Magnesite	Ceramic industry	5%	C23 - Manufacture of other non-metallic mineral products	64,990
Magnesite	Glass making	3%	C23 - Manufacture of other non-metallic mineral products	64,990
Magnesite	Other	0%		0
Magnesium	Transportation (automotive)	48%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Magnesium	Packaging	23%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Magnesium	Construction	13%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Magnesium	Construction	13%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Magnesium	Desulphurisation agent	12%	C24 - Manufacture of basic metals	64,561
Magnesium	Transportation (air, marine, etc.)	4%	C30 - Manufacture of other transport equipment	55,777
Manganese	Building and construction	43%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Manganese	Metalware	14%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	64,561
Manganese	Transportation (motor vehicles)	10%	C30 - Manufacture of other transport equipment	194,448
Manganese	Transportation (other transport equipment)	10%	C25 - Manufacture of fabricated metal products, except machinery and equipment	55,777
Manganese	Engineering (industrial)	8%	C28 - Manufacture of machinery and equipment n.e.c.	163,568
Manganese	Engineering	8%	C24 - Manufacture of basic metals	204,200

Material	Application	Share	NACE sector	VA in million €
	(machinery & equipment)			
Manganese	Domestic appliances	2%	C27 - Manufacture of electrical equipment	89,422
Manganese	Miscellaneous	2%	C24 - Manufacture of basic metals	64,561
Natural rubber	Tires automotive	67%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Natural rubber	(Tires) other transport vehicles	16%	C30 - Manufacture of other transport equipment	55,777
Natural rubber	Machinery: tubes, frames, ledges, profiles etc.	11%	C22 - Manufacture of rubber and plastic products	86,487
Natural rubber	Household appliances and furniture	4%	C27 - Manufacture of electrical equipment	89,422
Natural rubber	Packaging	1%	C22 - Manufacture of rubber and plastic products	86,487
Natural rubber	Sports gear	1%	C32 - Other manufacturing	45,912
Neodymium	Magnets	80%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Neodymium	Autocatalysts	9%	C20 - Manufacture of chemicals and chemical products	132,361
Neodymium	Batteries	4%	C27 - Manufacture of electrical equipment	89,422
Neodymium	Ceramics	3%	C23 - Manufacture of other non-metallic mineral products	64,990
Neodymium	Glass	2%	C23 - Manufacture of other non-metallic mineral products	64,990
Neodymium	Metal (excl. Batteries)	2%	C24 - Manufacture of basic metals	64,561
Palladium	Autocatalysts	88%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Palladium	Electronics	4%	C26 - Manufacture of computer, electronic and optical products	77,000
Palladium	Chemicals	3%	C20 - Manufacture of chemicals and chemical products	132,361
Palladium	Dental	2%	C32 - Other manufacturing	45,912
Palladium	Jewellery	2%	C32 - Other manufacturing	45,912
Palladium	Other	1%		0
Phosphate Rock	Fertilizer	86%	C20 - Manufacture of chemicals and chemical products	132,361
Phosphate Rock	Animal feed	10%	C10 - Manufacture of food products	174,551
Phosphate Rock	Detergents, chemicals, food additives	4%	C20 - Manufacture of chemicals and chemical products	132,361
Platinum	Autocatalysts	67%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Platinum	Other	10%		0

Material	Application	Share	NACE sector	VA in million €
Platinum	Jewellery	8%	C32 - Other manufacturing	45,912
Platinum	Chemicals	5%	C20 - Manufacture of chemicals and chemical products	132,361
Platinum	Medical and biomedical	3%	C32 - Other manufacturing	45,912
Platinum	Electronics	2%	C26 - Manufacture of computer, electronic and optical products	77,000
Platinum	Petroleum	2%	C19 - Manufacture of coke and refined petroleum products	28,295
Platinum	Electrolysers	1%	C27 - Manufacture of electrical equipment	89,422
Platinum	Fuel Cells	1%	C27 - Manufacture of electrical equipment	89,422
Platinum	Glass	1%	C23 - Manufacture of other non-metallic mineral products	64,990
Potash	Fertiliser	92%	C20 - Manufacture of chemicals and chemical products	132,361
Potash	Chemicals	8%	C20 - Manufacture of chemicals and chemical products	132,361
Praseodymium	Magnets	80%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Praseodymium	Autocatalysts	5%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Praseodymium	Ceramics	5%	C23 - Manufacture of other non-metallic mineral products	64,990
Praseodymium	Batteries	4%	C27 - Manufacture of electrical equipment	89,422
Praseodymium	Glass	2%	C23 - Manufacture of other non-metallic mineral products	64,990
Praseodymium	Metal (excl. Batteries)	2%	C24 - Manufacture of basic metals	64,561
Praseodymium	Polishing powders	2%	C23 - Manufacture of other non-metallic mineral products	64,990
Praseodymium	Polishing powders	2%	C26 - Manufacture of computer, electronic and optical products	77,000
Rhodium	Autocatalyst	85%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Rhodium	Glass	7%	C23 - Manufacture of other non-metallic mineral products	64,990
Rhodium	Chemical	6%	C20 - Manufacture of chemicals and chemical products	132,361
Rhodium	Other	2%		0
Rhodium	Electronics	0%	C26 - Manufacture of computer, electronic and optical products	77,000
Ruthenium	Chemical	37%	C20 - Manufacture of chemicals and chemical products	132,361
Ruthenium	Electronics	37%	C26 - Manufacture of computer, electronic and optical products	77,000

Material	Application	Share	NACE sector	VA in million €
Ruthenium	Electrochemical	13%	C20 - Manufacture of chemicals and chemical products	132,361
Ruthenium	Other	13%		0
Samarium	Magnets	97%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Samarium	Medical and optical applications	3%	C26 - Manufacture of computer, electronic and optical products	77,000
Selenium	Glass manufacturing	30%	C23 - Manufacture of other non-metallic mineral products	64,990
Selenium	Agriculture/biological	15%	C20 - Manufacture of chemicals and chemical products	132,361
Selenium	Electronics	15%	C26 - Manufacture of computer, electronic and optical products	77,000
Selenium	Metallurgy	15%	C24 - Manufacture of basic metals	64,561
Selenium	Pigments	15%	C20 - Manufacture of chemicals and chemical products	132,361
Selenium	Other uses	10%	C20 - Manufacture of chemicals and chemical products	132,361
Silica sand	Construction and soil	37%	C23 - Manufacture of other non-metallic mineral products	64,990
Silica sand	Container glass	17%	C23 - Manufacture of other non-metallic mineral products	64,990
Silica sand	Miscellaneous	16%	C23 - Manufacture of other non-metallic mineral products	64,990
Silica sand	Flat glass	14%	C23 - Manufacture of other non-metallic mineral products	64,990
Silica sand	Foundry	13%	C24 - Manufacture of basic metals	64,561
Silica sand	Filler, extender, sealant	3%	C22 - Manufacture of rubber and plastic products	86,487
Silicon metal	Chemical applications	54%	C20 - Manufacture of chemicals and chemical products	132,361
Silicon metal	Aluminium alloys	38%	C24 - Manufacture of basic metals	64,561
Silicon metal	Solar applications	6%	C26 - Manufacture of computer, electronic and optical products	77,000
Silicon metal	Electronic applications	2%	C26 - Manufacture of computer, electronic and optical products	77,000
Silver	Jewellery	24%	C32 - Other manufacturing	45,912
Silver	Photovoltaics	14%	C27 - Manufacture of electrical equipment	89,422
Silver	Automotive industry	8%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Silver	Batteries	7%	C27 - Manufacture of electrical equipment	89,422
Silver	Brazing and soldering	7%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Silver	Catalysts	7%	C20 - Manufacture of chemicals and chemical products	132,361
Silver	Silverware	7%	C32 - Other manufacturing	45,912
Silver	Bearings	6%	C28 - Manufacture of machinery	204,200

Material	Application	Share	NACE sector	VA in million €
			and equipment n.e.c.	
Silver	Electronic parts	6%	C26 - Manufacture of computer, electronic and optical products	77,000
Silver	Glass	6%	C23 - Manufacture of other non-metallic mineral products	64,990
Silver	Medicine	4%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	101,943
Silver	Photography	4%	C20 - Manufacture of chemicals and chemical products	132,361
Strontium	Magnets	40%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Strontium	Pyrotechnics and signals	40%	C20 - Manufacture of chemicals and chemical products	132,361
Strontium	Glass	5%	C23 - Manufacture of other non-metallic mineral products	64,990
Strontium	Master alloys	5%	C24 - Manufacture of basic metals	64,561
Strontium	Pigments and fillers	5%	C20 - Manufacture of chemicals and chemical products	132,361
Strontium	Zinc production	5%	C24 - Manufacture of basic metals	64,561
Strontium	Drilling fluids	0%	B09 - Mining support service activities	3,769
Sulphur	Chemical applications	71%	C20 - Manufacture of chemicals and chemical products	132,361
Sulphur	Petroleum refining	24%	C19 - Manufacture of coke and refined petroleum products	28,295
Sulphur	Metallurgy	4%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Sulphur	Paper production	1%	C17 - Manufacture of paper and paper products	44,278
Talc	Polymer for car industry	34%	C22 - Manufacture of rubber and plastic products	86,487
Talc	Paper	21%	C17 - Manufacture of paper and paper products	44,278
Talc	Paint and coatings	18%	C20 - Manufacture of chemicals and chemical products	132,361
Talc	Feed	8%	C10 - Manufacture of food products	174,551
Talc	Building material	7%	C23 - Manufacture of other non-metallic mineral products	64,990
Talc	Fertilizers	4%	C20 - Manufacture of chemicals and chemical products	132,361
Talc	Other	4%		0
Talc	Rubber	2%	C22 - Manufacture of rubber and plastic products	86,487
Talc	Cosmetics	1%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	101,943
Talc	Pharmaceuticals	1%	C21 - Manufacture of basic	101,943

Material	Application	Share	NACE sector	VA in million €
			pharmaceutical products and pharmaceutical preparations	
Terbium	Magnets	90%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Terbium	Lighting	10%	C27 - Manufacture of electrical equipment	89,422
Thulium	Ceramics	100%	C23 - Manufacture of other non-metallic mineral products	64,990
Tin	Solders	52%	C26 - Manufacture of computer, electronic and optical products	77,000
Tin	Chemicals	18%	C20 - Manufacture of chemicals and chemical products	132,361
Tin	Tinplate	13%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Tin	Copper alloys	6%	C24 - Manufacture of basic metals	64,561
Tin	Lead acid batteries	6%	C27 - Manufacture of electrical equipment	89,422
Tin	Other	5%		0
Titanium	Aerospace	45%	C30 - Manufacture of other transport equipment	55,777
Titanium	Medical equipment	25%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Titanium	Automotive	10%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	194,448
Titanium	Hand held objects	10%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Titanium	Nuclear heat exchanger	5%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Titanium	Plant engineering (e.g. seawater desalination)	5%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Tungsten	Mill and cutting tools	33%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Tungsten	Mining and construction tools	23%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Tungsten	Other wear tools	18%	C28 - Manufacture of machinery and equipment n.e.c.	204,200
Tungsten	Catalysts and pigments	8%	C20 - Manufacture of chemicals and chemical products	132,361
Tungsten	High speed steels applications	6%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Tungsten	Lighting and electronic uses	6%	C27 - Manufacture of electrical equipment	89,422
Tungsten	Aeronautics and energy uses	5%	C28 - Manufacture of machinery and equipment n.e.c.	204,200

Material	Application	Share	NACE sector	VA in million €
Vanadium	High-strength low-alloy steels	64%	C24 - Manufacture of basic metals	64,561
Vanadium	Special steel	21%	C25 - Manufacture of fabricated metal products, except machinery and equipment	163,568
Vanadium	Chemicals and battery oxides	5%	C20 - Manufacture of chemicals and chemical products	132,361
Vanadium	Stainless steel	4%	C24 - Manufacture of basic metals	64,561
Vanadium	Energy storage	3%	C27 - Manufacture of electrical equipment	89,422
Vanadium	Super alloys for high-end uses	3%	C24 - Manufacture of basic metals	64,561
Ytterbium	Ceramics	100%	C23 - Manufacture of other non-metallic mineral products	64,990
Yttrium	Ceramics	72%	C23 - Manufacture of other non-metallic mineral products	64,990
Yttrium	Automotive catalysts	9%	C20 - Manufacture of chemicals and chemical products	132,361
Yttrium	Other	8%		0
Yttrium	Metal (excl. Batteries)	7%	C24 - Manufacture of basic metals	64,561
Yttrium	Glass	4%	C23 - Manufacture of other non-metallic mineral products	64,990
Zirconium	Ceramics	50%	C23 - Manufacture of other non-metallic mineral products	64,990
Zirconium	Foundry	13%	C24 - Manufacture of basic metals	64,561
Zirconium	Refractories	13%	C23 - Manufacture of other non-metallic mineral products	64,990
Zirconium	Chemicals	11%	C20 - Manufacture of chemicals and chemical products	132,361
Zirconium	Other	7%		0
Zirconium	Pigments	3%	C20 - Manufacture of chemicals and chemical products	132,361
Zirconium	Superalloys, Nuclear	3%	C24 - Manufacture of basic metals	64,561

Annex 7. Global supply shares and trade-related variable

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Aluminium	Australia	28.4%	1.0	Aluminium	China	55.6%	1.1
Aluminium	China	20.8%	1.0	Aluminium	Russia	6.0%	1.1
Aluminium	Guinea	17.9%	1.1	Aluminium	India	5.5%	1.0
Aluminium	Brazil	10.4%	1.0	Aluminium	Canada	4.9%	1.0
Aluminium	India	6.8%	1.1	Aluminium	United Arab Emirates	4.1%	1.0
Aluminium	Indonesia	3.3%	1.0	Aluminium	Australia	2.5%	1.0
Aluminium	Jamaica	2.6%	1.0	Aluminium	Norway	2.1%	1.0
Aluminium	Russia	1.9%	1.0	Aluminium	Bahrain	1.9%	1.0
Aluminium	Saudi Arabia	1.4%	1.0	Aluminium	United States	1.5%	1.0
Aluminium	Kazakhstan	1.4%	1.0	Aluminium	Malaysia	1.2%	1.0
Aluminium	Vietnam	0.9%	1.0	Aluminium	Saudi Arabia	1.2%	1.0
Aluminium	Malaysia	0.6%	1.0	Aluminium	Argentina	1.2%	1.0
Aluminium	Sierra Leone	0.5%	1.0	Aluminium	Brazil	1.1%	1.0
Aluminium	Türkiye	0.5%	1.0	Aluminium	Iceland	1.1%	1.0
Aluminium	Greece	0.5%	0.8	Aluminium	South Africa	1.1%	1.0
Aluminium	Guyana	0.4%	1.0	Aluminium	Qatar	1.0%	1.0
Aluminium	Ghana	0.4%	1.0	Aluminium	Mozambique	0.9%	1.0
Aluminium	Solomon Islands	0.3%	1.0	Aluminium	Germany	0.9%	0.8
Aluminium	Iran	0.3%	1.0	Aluminium	France	0.7%	0.8
Aluminium	Bosnia and Herzegovina	0.2%	1.0	Aluminium	Oman	0.6%	1.0
Aluminium	Montenegro	0.2%	1.0	Aluminium	New Zealand	0.5%	1.0
Aluminium	United States	0.1%	1.0	Aluminium	Iran	0.5%	1.0
Aluminium	Venezuela	0.0%	1.0	Aluminium	Spain	0.5%	0.8
Aluminium	France	0.0%	0.8	Aluminium	Egypt	0.5%	1.0
Aluminium	Pakistan	0.0%	1.0	Aluminium	Romania	0.4%	0.8
Aluminium	Cote d'Ivoire	0.0%	1.0	Aluminium	Kazakhstan	0.4%	1.0
Aluminium	Fiji	0.0%	1.0	Aluminium	Indonesia	0.4%	1.0
Aluminium	Mexico	0.0%	1.0	Aluminium	Greece	0.3%	0.8
Aluminium	Croatia	0.0%	0.8	Aluminium	Slovakia	0.3%	0.8
Aluminium	Tanzania	0.0%	1.0	Aluminium	Sweden	0.2%	0.8
Aluminium	Dominican Republic	0.0%	1.0	Aluminium	Tajikistan	0.2%	1.0
Aluminium	Mozambique	0.0%	1.0	Aluminium	Bosnia and Herzegovina	0.1%	1.0
Aluminium	Hungary	0.0%	0.8	Aluminium	Slovenia	0.1%	0.8
Aluminium	Colombia	0.0%	1.0	Aluminium	Türkiye	0.1%	1.0
Antimony	China	56.4%	1.1	Aluminium	Venezuela	0.1%	1.0
Antimony	Tajikistan	20.3%	1.0	Aluminium	Cameroon	0.1%	1.0
Antimony	Russia	11.6%	1.0	Aluminium	Netherlands	0.1%	0.8
Antimony	Myanmar	2.9%	1.0	Aluminium	United Kingdom	0.1%	1.0
Antimony	Türkiye	2.5%	1.0	Aluminium	Montenegro	0.1%	1.0
Antimony	Australia	2.2%	1.0	Aluminium	Ghana	0.1%	1.0
Antimony	Bolivia	2.0%	1.1	Aluminium	Azerbaijan	0.1%	1.0
Antimony	Iran	0.9%	1.0	Antimony	China	51.8%	1.1
Antimony	Kyrgyzstan	0.6%	1.0	Antimony	Belgium	8.6%	0.8
Antimony	Vietnam	0.2%	1.0	Antimony	Vietnam	6.4%	1.0
Antimony	Mexico	0.2%	1.0	Antimony	France	5.9%	0.8
Antimony	Kazakhstan	0.2%	1.0	Antimony	Thailand	3.6%	1.0
Antimony	Laos	0.1%	1.0	Antimony	Myanmar	3.6%	1.0
Antimony	South Africa	0.1%	1.0	Antimony	Tajikistan	3.5%	1.0
Antimony	Ecuador	0.0%	1.0	Antimony	Bolivia	2.2%	1.1
Antimony	Guatemala	0.0%	1.0	Antimony	Korea, South	2.2%	1.0
Antimony	Honduras	0.0%	1.0	Antimony	India	2.0%	1.0
Antimony	Pakistan	0.0%	1.0	Antimony	Japan	2.0%	1.0
Antimony	Thailand	0.0%	1.0	Antimony	Spain	1.5%	0.8
Antimony	Canada	0.0%	1.0	Antimony	United States	0.9%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Barytes	China	31.5%	1.0	Antimony	Germany	0.9%	0.8
Barytes	India	25.1%	1.0	Antimony	Netherlands	0.6%	0.8
Barytes	Morocco	8.9%	1.0	Antimony	Mexico	0.6%	1.0
Barytes	Iran	6.6%	1.0	Antimony	Italy	0.6%	0.8
Barytes	Kazakhstan	6.5%	1.0	Antimony	Indonesia	0.5%	1.0
Barytes	Mexico	4.0%	1.0	Antimony	Peru	0.5%	1.0
Barytes	Türkiye	4.0%	1.0	Antimony	United Kingdom	0.5%	1.0
Barytes	United States	3.3%	1.0	Antimony	Hong Kong	0.3%	1.0
Barytes	Russia	3.0%	1.0	Antimony	Türkiye	0.2%	1.0
Barytes	Pakistan	1.1%	1.0	Antimony	Malaysia	0.2%	1.0
Barytes	Thailand	1.1%	1.0	Antimony	Singapore	0.2%	1.0
Barytes	Vietnam	0.7%	1.1	Antimony	Sweden	0.1%	0.8
Barytes	Bulgaria	0.7%	0.8	Antimony	Oman	0.1%	1.0
Barytes	United Kingdom	0.6%	1.0	Antimony	Russia	0.1%	1.0
Barytes	Laos	0.6%	1.0	Antimony	Poland	0.1%	0.8
Barytes	Canada	0.5%	1.0	Antimony	Canada	0.1%	1.0
Barytes	Germany	0.4%	0.8	Antimony	United Arab Emirates	0.1%	1.0
Barytes	Algeria	0.4%	1.0	Antimony	Austria	0.1%	0.8
Barytes	Bolivia	0.3%	1.0	Antimony	Czechia	0.0%	0.8
Barytes	Peru	0.1%	1.0	Antimony	Luxembourg	0.0%	0.8
Barytes	Brazil	0.1%	1.0	Antimony	Morocco	0.0%	1.0
Barytes	Tunisia	0.1%	1.0	Antimony	Chile	0.0%	1.0
Barytes	Slovakia	0.1%	0.8	Antimony	Argentina	0.0%	1.0
Barytes	Argentina	0.1%	1.0	Antimony	Slovenia	0.0%	0.8
Barytes	Myanmar	0.1%	1.0	Antimony	Ireland	0.0%	0.8
Barytes	Korea, North	0.1%	1.0	Antimony	Denmark	0.0%	0.8
Barytes	Australia	0.1%	1.0	Antimony	Korea, North	0.0%	1.0
Barytes	Egypt	0.0%	1.0	Antimony	Brazil	0.0%	1.0
Barytes	Colombia	0.0%	1.0	Antimony	Switzerland	0.0%	1.0
Barytes	Ecuador	0.0%	1.0	Antimony	San Marino	0.0%	1.0
Barytes	Nigeria	0.0%	1.0	Antimony	Colombia	0.0%	1.0
Barytes	Guatemala	0.0%	1.0	Antimony	South Africa	0.0%	1.0
Bentonite	China	26.6%	1.0	Antimony	Australia	0.0%	1.0
Bentonite	United States	20.7%	1.0	Antimony	Bulgaria	0.0%	0.8
Bentonite	India	16.5%	1.0	Antimony	Greece	0.0%	0.8
Bentonite	Türkiye	7.4%	1.0	Antimony	Ukraine	0.0%	1.0
Bentonite	Greece	5.6%	0.8	Antimony	Cape Verde	0.0%	1.0
Bentonite	Russia	3.2%	1.0	Antimony	Costa Rica	0.0%	1.0
Bentonite	Iran	2.6%	1.0	Antimony	Cyprus	0.0%	0.8
Bentonite	Brazil	2.1%	1.0	Antimony	Finland	0.0%	0.8
Bentonite	Germany	1.8%	0.8	Antimony	Croatia	0.0%	0.8
Bentonite	Czechia	1.4%	0.8	Antimony	Portugal	0.0%	0.8
Bentonite	Japan	1.2%	1.0	Antimony	Kenya	0.0%	1.0
Bentonite	Slovakia	1.1%	0.8	Antimony	Kyrgyzstan	0.0%	1.0
Bentonite	Spain	0.9%	0.8	Antimony	Hungary	0.0%	0.8
Bentonite	Azerbaijan	0.8%	1.0	Antimony	Norway	0.0%	1.0
Bentonite	Ukraine	0.7%	1.0	Antimony	Uruguay	0.0%	1.0
Bentonite	Morocco	0.7%	1.0	Antimony	Philippines	0.0%	1.0
Bentonite	Colombia	0.7%	1.0	Antimony	Kazakhstan	0.0%	1.0
Bentonite	Argentina	0.7%	1.0	Antimony	Romania	0.0%	0.8
Bentonite	South Africa	0.6%	1.0	Antimony	Rwanda	0.0%	1.0
Bentonite	Mexico	0.6%	1.0	Antimony	Saudi Arabia	0.0%	1.0
Bentonite	Cyprus	0.5%	0.8	Antimony	Serbia	0.0%	1.0
Bentonite	Kazakhstan	0.5%	1.0	Antimony	Panama	0.0%	1.0
Bentonite	Bosnia and Herzegovina	0.4%	1.0	Antimony	Slovakia	0.0%	0.8
Bentonite	Italy	0.4%	0.8	Arsenic	China	44.3%	1.0
Bentonite	Australia	0.3%	1.0	Arsenic	Peru	40.0%	1.0
Bentonite	Denmark	0.3%	0.8	Arsenic	Morocco	11.4%	1.0
Bentonite	Pakistan	0.3%	1.0	Arsenic	Belgium	1.8%	0.8

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Bentonite	France	0.2%	0.8	Arsenic	Russia	1.2%	1.0
Bentonite	Bulgaria	0.2%	0.8	Arsenic	Namibia	1.0%	1.0
Bentonite	Korea, South	0.2%	1.0	Arsenic	Bolivia	0.2%	1.0
Bentonite	Algeria	0.2%	1.0	Arsenic	Iran	0.2%	1.0
Bentonite	Romania	0.2%	0.8	Arsenic	Japan	0.1%	1.0
Bentonite	Mozambique	0.2%	1.0	Beryllium	United States	50.2%	1.0
Bentonite	Hungary	0.1%	0.8	Beryllium	Kazakhstan	25.0%	1.0
Bentonite	Peru	0.1%	1.0	Beryllium	Japan	16.9%	1.0
Bentonite	Guatemala	0.1%	1.0	Beryllium	China	7.9%	1.0
Bentonite	Turkmenistan	0.1%	1.0	Bismuth	China	69%	1.0
Bentonite	Uruguay	0.0%	1.0	Bismuth	Laos	9%	1.0
Bentonite	Armenia	0.0%	1.0	Bismuth	Vietnam	8%	1.0
Bentonite	Egypt	0.0%	1.0	Bismuth	Belgium	4%	0.8
Bentonite	Philippines	0.0%	1.0	Bismuth	Korea S.	4%	1.0
Bentonite	New Zealand	0.0%	1.0	Bismuth	Japan	2%	1.0
Bentonite	North Macedonia	0.0%	1.0	Bismuth	Mexico	1%	1.0
Bentonite	Slovenia	0.0%	0.8	Bismuth	Kazakhstan	1%	1.0
Bentonite	Norway	0.0%	1.0	Bismuth	Peru	1%	1.0
Bentonite	Myanmar	0.0%	1.0	Bismuth	Russia	0%	1.0
Bentonite	Poland	0.0%	0.8	Bismuth	Bolivia	0%	1.0
Bentonite	Bolivia	0.0%	1.0	Bismuth	Canada	0%	
Bentonite	Chile	0.0%	1.0	Borate	Türkiye	44.8%	1.0
Bentonite	Cuba	0.0%	1.0	Borate	United States	23.4%	1.0
Beryllium	United States	67.3%	1.0	Borate	Chile	10.0%	1.0
Beryllium	China	26.0%	1.0	Borate	Bolivia	4.9%	1.0
Beryllium	Mozambique	3.6%	1.0	Borate	China	3.3%	1.0
Beryllium	Brazil	1.5%	1.0	Borate	Argentina	3.0%	1.0
Beryllium	Uganda	0.6%	1.0	Borate	Russia	1.9%	1.0
Beryllium	Nigeria	0.4%	1.0	Borate	Germany	1.7%	0.8
Beryllium	Rwanda	0.4%	1.0	Borate	Peru	1.3%	1.0
Beryllium	Madagascar	0.3%	1.0	Borate	Kazakhstan	0.7%	1.0
Borate	Türkiye	48.4%	1.0	Borate	Italy	0.0%	0.8
Borate	United States	24.9%	1.0	Borate	Iran	0.0%	1.0
Borate	Chile	10.7%	1.0	Borate	Slovakia	0.0%	0.8
Borate	Bolivia	5.2%	1.0	Borate	Portugal	0.0%	0.8
Borate	China	3.5%	1.0	Borate	Croatia	0.0%	0.8
Borate	Argentina	3.2%	1.0	Borate	Denmark	0.0%	0.8
Borate	Russia	2.0%	1.0	Cadmium	China	35.9%	1.0
Borate	Peru	1.4%	1.0	Cadmium	Korea, South	17.4%	1.0
Borate	Kazakhstan	0.7%	1.0	Cadmium	Japan	7.5%	1.0
Borate	Iran	0.0%	1.0	Cadmium	Canada	7.3%	1.0
Cerium	China	68.3%	1.0	Cadmium	Kazakhstan	6.8%	1.0
Cerium	Australia	9.9%	1.0	Cadmium	Mexico	4.3%	1.0
Cerium	United States	9.2%	1.0	Cadmium	Russia	4.2%	1.0
Cerium	Myanmar	7.5%	1.0	Cadmium	Netherlands	3.5%	0.8
Cerium	Russia	1.5%	1.0	Cadmium	Peru	2.8%	1.0
Cerium	Thailand	1.1%	1.0	Cadmium	Germany	2.3%	0.8
Cerium	India	1.0%	1.0	Cadmium	Norway	1.4%	1.0
Cerium	Brazil	0.8%	1.0	Cadmium	United States	1.3%	1.0
Cerium	Vietnam	0.4%	1.0	Cadmium	Bulgaria	1.3%	0.8
Cerium	Malaysia	0.3%	1.0	Cadmium	Uzbekistan	1.2%	1.0
Cerium	Burundi	0.1%	1.0	Cadmium	Brazil	0.9%	1.0
Chromium	South Africa	55.5%	1.0	Cadmium	Poland	0.8%	0.8
Chromium	Kazakhstan	15.7%	1.0	Cadmium	Korea, North	0.7%	1.0
Chromium	India	12.4%	1.0	Cadmium	Argentina	0.3%	1.0
Chromium	Türkiye	3.8%	1.0	Cadmium	India	0.1%	1.0
Chromium	Finland	3.4%	0.8	Cerium	China	84.9%	1.0
Chromium	Zimbabwe	2.3%	1.0	Cerium	Malaysia	10.5%	1.0
Chromium	Albania	1.5%	1.0	Cerium	Russia	1.9%	1.0
Chromium	Brazil	1.5%	1.0	Cerium	India	1.6%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Chromium	Oman	1.2%	1.0	Cerium	Vietnam	1.0%	1.0
Chromium	Pakistan	1.1%	1.0	Cerium	Norway	0.1%	1.0
Chromium	Iran	0.9%	1.0	Cerium	Australia	0.1%	1.0
Chromium	Madagascar	0.4%	1.0	Chromium	China	40.4%	1.1
Chromium	Papua New Guinea	0.2%	1.0	Chromium	South Africa	24.1%	1.0
Chromium	Russia	0.1%	1.0	Chromium	Kazakhstan	13.9%	1.0
Chromium	Philippines	0.1%	1.0	Chromium	India	8.8%	1.0
Cobalt	Congo, D.R.	62.8%	1.1	Chromium	Finland	3.4%	0.8
Cobalt	Russia	6.6%	1.0	Chromium	Russia	3.3%	1.1
Cobalt	Canada	4.1%	1.0	Chromium	Brazil	1.2%	1.0
Cobalt	Australia	3.9%	1.0	Chromium	Türkiye	1.1%	1.0
Cobalt	China	3.8%	1.0	Chromium	Zimbabwe	1.1%	1.0
Cobalt	Cuba	3.6%	1.0	Chromium	Sweden	0.9%	0.8
Cobalt	Philippines	2.7%	1.0	Chromium	Albania	0.5%	1.0
Cobalt	Papua New Guinea	2.1%	1.0	Chromium	Oman	0.5%	1.0
Cobalt	Madagascar	2.0%	1.0	Chromium	Indonesia	0.4%	1.0
Cobalt	Zambia	1.7%	1.1	Chromium	Germany	0.2%	0.8
Cobalt	Morocco	1.6%	1.0	Chromium	Japan	0.2%	1.0
Cobalt	Finland	1.3%	0.8	Chromium	Iran	0.0%	1.0
Cobalt	South Africa	0.8%	1.0	Cobalt	China	59.6%	1.0
Cobalt	United States	0.4%	1.0	Cobalt	Finland	11.4%	0.8
Cobalt	Zimbabwe	0.4%	1.0	Cobalt	Belgium	5.3%	0.8
Cobalt	Indonesia	0.3%	1.0	Cobalt	Canada	4.9%	1.0
Cobalt	Brazil	0.2%	1.0	Cobalt	Norway	3.3%	1.0
Cobalt	Türkiye	0.1%	1.0	Cobalt	Japan	3.2%	1.0
Cobalt	Botswana	0.0%	1.0	Cobalt	Australia	2.7%	1.0
Cobalt	Vietnam	0.0%	1.0	Cobalt	Madagascar	2.1%	1.0
Coking coal	China	52.7%	1.1	Cobalt	Russia	1.7%	1.0
Coking coal	Australia	18.2%	1.0	Cobalt	Morocco	1.7%	1.0
Coking coal	Russia	8.8%	1.0	Cobalt	Zambia	1.7%	1.0
Coking coal	United States	5.9%	1.0	Cobalt	South Africa	0.8%	1.0
Coking coal	India	4.1%	1.0	Cobalt	Brazil	0.1%	1.0
Coking coal	Canada	2.7%	1.0	Cobalt	France	0.1%	0.8
Coking coal	Mongolia	2.5%	1.1	Cobalt	Congo, D.R.	0.0%	1.1
Coking coal	Poland	1.2%	0.8	Cobalt	India	0.0%	1.0
Coking coal	Mozambique	0.6%	1.0	Coking coal	China	69.0%	1.0
Coking coal	Colombia	0.5%	1.0	Coking coal	Russia	6.4%	1.1
Coking coal	Indonesia	0.4%	1.0	Coking coal	Japan	5.0%	1.0
Coking coal	Ukraine	0.4%	1.0	Coking coal	India	3.9%	1.0
Coking coal	Kazakhstan	0.4%	1.0	Coking coal	Korea, South	2.7%	1.0
Coking coal	Mexico	0.4%	1.0	Coking coal	United States	2.2%	1.0
Coking coal	South Africa	0.4%	1.0	Coking coal	Germany	1.7%	0.8
Coking coal	Czechia	0.2%	0.8	Coking coal	Ukraine	1.6%	1.0
Coking coal	Iran	0.1%	1.0	Coking coal	Poland	1.4%	0.8
Coking coal	Germany	0.1%	0.8	Coking coal	Taiwan	1.0%	1.0
Coking coal	New Zealand	0.1%	1.0	Coking coal	Türkiye	0.7%	1.0
Coking coal	United Kingdom	0.1%	1.0	Coking coal	France	0.5%	0.8
Coking coal	Türkiye	0.1%	1.0	Coking coal	Australia	0.4%	1.0
Coking coal	Zimbabwe	0.0%	1.0	Coking coal	Czechia	0.4%	0.8
Coking coal	Vietnam	0.0%	1.0	Coking coal	Netherlands	0.3%	0.8
Copper	Chile	27.7%	1.0	Coking coal	Vietnam	0.3%	1.0
Copper	Peru	11.5%	1.0	Coking coal	Italy	0.3%	0.8
Copper	China	8.4%	1.1	Coking coal	Indonesia	0.2%	1.0
Copper	Congo, D.R.	6.4%	1.1	Coking coal	Slovakia	0.2%	0.8
Copper	United States	6.2%	1.0	Coking coal	Austria	0.2%	0.8
Copper	Australia	4.4%	1.0	Coking coal	Belgium	0.2%	0.8
Copper	Zambia	4.0%	1.1	Coking coal	Spain	0.2%	0.8
Copper	Russia	4.0%	1.0	Coking coal	Sweden	0.2%	0.8
Copper	Mexico	3.7%	1.0	Coking coal	United Kingdom	0.2%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Copper	Indonesia	2.8%	1.2	Coking coal	Hungary	0.1%	0.8
Copper	Canada	2.8%	1.0	Coking coal	Bosnia and Herzegovina	0.1%	1.0
Copper	Kazakhstan	2.7%	1.0	Coking coal	Finland	0.1%	0.8
Copper	Poland	2.0%	0.8	Coking coal	Estonia	0.0%	0.8
Copper	Brazil	1.8%	1.0	Copper	China	38.3%	1.0
Copper	Mongolia	1.5%	1.2	Copper	Chile	10.0%	1.0
Copper	Iran	1.5%	1.0	Copper	Japan	6.4%	1.0
Copper	Spain	0.9%	0.8	Copper	United States	4.5%	1.0
Copper	Myanmar	0.8%	1.0	Copper	Congo, D.R.	4.1%	1.0
Copper	Laos	0.7%	1.0	Copper	Russia	4.1%	1.0
Copper	Uzbekistan	0.6%	1.0	Copper	India	3.0%	1.0
Copper	Bulgaria	0.5%	0.8	Copper	Germany	2.7%	0.8
Copper	Sweden	0.5%	0.8	Copper	Korea, South	2.7%	1.0
Copper	Türkiye	0.5%	1.0	Copper	Poland	2.2%	0.8
Copper	Papua New Guinea	0.5%	1.0	Copper	Kazakhstan	1.8%	1.0
Copper	Armenia	0.4%	1.0	Copper	Mexico	1.8%	1.0
Copper	Philippines	0.4%	1.0	Copper	Australia	1.7%	1.0
Copper	Panama	0.3%	1.0	Copper	Spain	1.7%	0.8
Copper	Saudi Arabia	0.3%	1.0	Copper	Zambia	1.7%	1.0
Copper	Portugal	0.3%	0.8	Copper	Belgium	1.5%	0.8
Copper	South Africa	0.3%	1.0	Copper	Peru	1.3%	1.0
Copper	Finland	0.2%	0.8	Copper	Canada	1.2%	1.0
Copper	Serbia	0.2%	1.0	Copper	Indonesia	1.1%	1.0
Copper	Morocco	0.2%	1.0	Copper	Iran	0.9%	1.0
Copper	Ecuador	0.2%	1.0	Copper	Bulgaria	0.9%	0.8
Copper	India	0.1%	1.0	Copper	Sweden	0.9%	0.8
Copper	Mauritania	0.1%	1.0	Copper	Philippines	0.8%	1.0
Copper	Vietnam	0.1%	1.0	Copper	Brazil	0.7%	1.0
Copper	Argentina	0.1%	1.1	Copper	Myanmar	0.7%	1.0
Copper	Eritrea	0.1%	1.0	Copper	Finland	0.6%	0.8
Copper	Namibia	0.1%	1.0	Copper	Uzbekistan	0.5%	1.0
Copper	Tanzania	0.1%	1.0	Copper	Austria	0.5%	0.8
Copper	Congo	0.1%	1.0	Copper	Türkiye	0.4%	1.0
Copper	Pakistan	0.1%	1.0	Copper	Serbia	0.3%	1.0
Copper	Korea, North	0.1%	1.0	Copper	Laos	0.3%	1.0
Copper	Colombia	0.0%	1.0	Copper	South Africa	0.2%	1.0
Copper	Dominican Republic	0.0%	1.0	Copper	Ukraine	0.1%	1.0
Copper	Georgia	0.0%	1.0	Copper	Norway	0.1%	1.0
Copper	Zimbabwe	0.0%	1.0	Copper	Vietnam	0.1%	1.0
Copper	Kyrgyzstan	0.0%	1.0	Copper	Argentina	0.1%	1.0
Copper	North Macedonia	0.0%	1.0	Copper	Namibia	0.1%	1.0
Copper	Romania	0.0%	0.8	Copper	Mongolia	0.1%	1.0
Copper	Bolivia	0.0%	1.0	Copper	Italy	0.0%	0.8
Copper	Tajikistan	0.0%	1.0	Copper	Egypt	0.0%	1.0
Copper	Botswana	0.0%	1.0	Copper	Bolivia	0.0%	1.0
Copper	Albania	0.0%	1.0	Copper	North Macedonia	0.0%	1.0
Copper	Azerbaijan	0.0%	1.0	Copper	Zimbabwe	0.0%	1.0
Copper	Germany	0.0%	0.8	Copper	Oman	0.0%	1.0
Copper	Slovakia	0.0%	0.8	Copper	Cyprus	0.0%	0.8
Copper	Cyprus	0.0%	0.8	Dysprosium	China	100.0%	1.0
Copper	Korea, South	0.0%	1.0	Erbium	China	100.0%	1.0
Diatomite	United States	36.3%	1.0	Europium	China	100.0%	1.0
Diatomite	China	17.4%	1.0	Gadolinium	China	100.0%	1.0
Diatomite	Türkiye	7.2%	1.0	Gallium	China	93.8%	1.0
Diatomite	Mexico	5.7%	1.0	Gallium	Ukraine	2.2%	1.0
Diatomite	Denmark	5.0%	0.8	Gallium	Russia	1.9%	1.0
Diatomite	Peru	4.3%	1.0	Gallium	Japan	1.0%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Diatomite	France	4.1%	0.8	Gallium	Korea, South	0.9%	1.0
Diatomite	Argentina	3.6%	1.0	Gallium	Germany	0.3%	0.8
Diatomite	Spain	2.8%	0.8	Germanium	China	89.6%	1.0
Diatomite	Korea, South	2.6%	1.0	Germanium	Russia	5.4%	1.0
Diatomite	Germany	2.5%	0.8	Germanium	United States	2.1%	1.0
Diatomite	Russia	2.3%	1.0	Germanium	Japan	1.9%	1.0
Diatomite	Czechia	1.6%	0.8	Germanium	Ukraine	1.0%	1.0
Diatomite	Mozambique	1.3%	1.0	Hafnium	France	49.3%	0.8
Diatomite	Chile	1.1%	1.0	Hafnium	United States	43.7%	1.0
Diatomite	Brazil	1.1%	1.0	Hafnium	Russia	2.8%	1.1
Diatomite	Armenia	0.4%	1.0	Hafnium	China	2.8%	1.0
Diatomite	Costa Rica	0.3%	1.0	Hafnium	Ukraine	1.4%	1.0
Diatomite	Ethiopia	0.2%	1.0	Helium	United States	55.8%	1.0
Diatomite	Algeria	0.1%	1.0	Helium	Qatar	29.8%	1.0
Diatomite	Kenya	0.1%	1.0	Helium	Algeria	8.3%	1.0
Diatomite	Australia	0.0%	1.0	Helium	Australia	2.5%	1.0
Diatomite	Poland	0.0%	0.8	Helium	Russia	2.4%	1.0
Diatomite	Iran	0.0%	1.0	Helium	Poland	1.0%	0.8
Dysprosium	China	84.4%	1.0	Helium	China	0.1%	1.0
Dysprosium	Myanmar	9.3%	1.0	Holmium	China	100.0%	1.0
Dysprosium	Russia	1.9%	1.0	Hydrogen	China	94.6%	1.0
Dysprosium	Thailand	1.3%	1.0	Hydrogen	Germany	1.5%	0.8
Dysprosium	India	1.2%	1.0	Hydrogen	Netherlands	0.7%	0.8
Dysprosium	Brazil	1.0%	1.0	Hydrogen	Poland	0.4%	0.8
Dysprosium	Vietnam	0.5%	1.0	Hydrogen	Spain	0.4%	0.8
Dysprosium	Malaysia	0.3%	1.0	Hydrogen	France	0.3%	0.8
Dysprosium	Burundi	0.2%	1.0	Hydrogen	Finland	0.3%	0.8
Erbium	China	68.3%	1.0	Hydrogen	Italy	0.3%	0.8
Erbium	Australia	9.9%	1.0	Hydrogen	Czechia	0.3%	0.8
Erbium	United States	9.2%	1.0	Hydrogen	Japan	0.2%	1.0
Erbium	Myanmar	7.5%	1.0	Hydrogen	Taiwan	0.2%	1.0
Erbium	Russia	1.5%	1.0	Hydrogen	United Kingdom	0.1%	1.0
Erbium	Thailand	1.1%	1.0	Hydrogen	Hungary	0.1%	0.8
Erbium	India	1.0%	1.0	Hydrogen	Slovakia	0.0%	0.8
Erbium	Brazil	0.8%	1.0	Hydrogen	Mexico	0.0%	1.0
Erbium	Vietnam	0.4%	1.0	Indium	China	50.3%	1.0
Erbium	Malaysia	0.3%	1.0	Indium	Korea, South	25.9%	1.0
Erbium	Burundi	0.1%	1.0	Indium	Japan	8.2%	1.0
Europium	China	68.3%	1.0	Indium	Canada	7.6%	1.0
Europium	Australia	9.9%	1.0	Indium	France	3.6%	0.8
Europium	United States	9.2%	1.0	Indium	Belgium	2.4%	0.8
Europium	Myanmar	7.5%	1.0	Indium	Russia	0.7%	1.0
Europium	Russia	1.5%	1.0	Indium	Peru	0.7%	1.0
Europium	Thailand	1.1%	1.0	Indium	Germany	0.5%	0.8
Europium	India	1.0%	1.0	Indium	Brazil	0.2%	1.0
Europium	Brazil	0.8%	1.0	Iridium	South Africa	93.5%	1.0
Europium	Vietnam	0.4%	1.0	Iridium	Zimbabwe	4.9%	1.0
Europium	Malaysia	0.3%	1.0	Iridium	Canada	1.4%	1.0
Europium	Burundi	0.1%	1.0	Iridium	Russia	0.1%	1.0
Feldspar	Türkiye	31.8%	1.0	Iron ore	China	52.3%	1.1
Feldspar	India	19.8%	1.0	Iron ore	India	6.2%	1.0
Feldspar	China	7.7%	1.0	Iron ore	Japan	5.6%	1.0
Feldspar	Italy	6.9%	0.8	Iron ore	United States	4.6%	1.0
Feldspar	Iran	5.0%	1.0	Iron ore	Russia	4.1%	1.0
Feldspar	Thailand	3.8%	1.0	Iron ore	Korea, South	3.9%	1.0
Feldspar	Indonesia	3.4%	1.0	Iron ore	Germany	2.3%	0.8
Feldspar	Spain	2.4%	0.8	Iron ore	Türkiye	2.0%	1.0
Feldspar	Mexico	2.0%	1.0	Iron ore	Brazil	1.9%	1.0
Feldspar	Korea, South	1.8%	1.0	Iron ore	Italy	1.3%	0.8
Feldspar	France	1.7%	0.8	Iron ore	Ukraine	1.2%	1.1
Feldspar	Brazil	1.6%	1.0	Iron ore	Taiwan	1.2%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Feldspar	United States	1.5%	1.0	Iron ore	Iran	1.1%	1.0
Feldspar	Czechia	1.4%	0.8	Iron ore	Mexico	1.1%	1.0
Feldspar	Malaysia	1.1%	1.0	Iron ore	France	0.8%	0.8
Feldspar	Pakistan	0.9%	1.0	Iron ore	Vietnam	0.8%	1.0
Feldspar	Russia	0.9%	1.0	Iron ore	Spain	0.8%	0.8
Feldspar	Germany	0.8%	0.8	Iron ore	Canada	0.7%	1.0
Feldspar	Egypt	0.7%	1.0	Iron ore	Poland	0.5%	0.8
Feldspar	Saudi Arabia	0.6%	1.0	Iron ore	Belgium	0.4%	0.8
Feldspar	Algeria	0.5%	1.0	Iron ore	United Kingdom	0.4%	1.0
Feldspar	Colombia	0.5%	1.0	Iron ore	Austria	0.4%	0.8
Feldspar	Portugal	0.4%	0.8	Iron ore	Egypt	0.4%	1.0
Feldspar	Morocco	0.3%	1.0	Iron ore	Netherlands	0.4%	0.8
Feldspar	Argentina	0.3%	1.0	Iron ore	Indonesia	0.4%	1.0
Feldspar	South Africa	0.3%	1.0	Iron ore	Saudi Arabia	0.4%	1.0
Feldspar	Norway	0.3%	1.0	Iron ore	South Africa	0.3%	1.0
Feldspar	Sri Lanka	0.2%	1.0	Iron ore	Thailand	0.3%	1.0
Feldspar	Ecuador	0.2%	1.0	Iron ore	Australia	0.3%	1.0
Feldspar	Poland	0.2%	0.8	Iron ore	Malaysia	0.3%	1.0
Feldspar	Philippines	0.2%	1.0	Iron ore	Sweden	0.3%	0.8
Feldspar	Ukraine	0.1%	1.0	Iron ore	Czechia	0.3%	0.8
Feldspar	Austria	0.1%	0.8	Iron ore	Argentina	0.3%	1.0
Feldspar	Venezuela	0.1%	1.0	Iron ore	Slovakia	0.3%	0.8
Feldspar	Sudan	0.1%	1.0	Iron ore	Kazakhstan	0.2%	1.0
Feldspar	Nigeria	0.1%	1.0	Iron ore	Pakistan	0.2%	1.0
Feldspar	Guatemala	0.1%	1.0	Iron ore	Finland	0.2%	0.8
Feldspar	Peru	0.1%	1.0	Iron ore	Romania	0.2%	0.8
Feldspar	Sweden	0.1%	0.8	Iron ore	United Arab Emirates	0.2%	1.0
Feldspar	North Macedonia	0.1%	1.0	Iron ore	Belarus	0.1%	1.0
Feldspar	Slovakia	0.1%	0.8	Iron ore	Qatar	0.1%	1.0
Feldspar	Finland	0.1%	0.8	Iron ore	Portugal	0.1%	0.8
Feldspar	Romania	0.0%	0.8	Iron ore	Luxembourg	0.1%	0.8
Feldspar	Cuba	0.0%	1.0	Iron ore	Algeria	0.1%	1.0
Feldspar	Australia	0.0%	1.0	Iron ore	Serbia	0.1%	1.0
Feldspar	Chile	0.0%	1.0	Iron ore	Switzerland	0.1%	1.0
Feldspar	Dominican Republic	0.0%	1.0	Iron ore	Hungary	0.1%	0.8
Feldspar	Uruguay	0.0%	1.0	Iron ore	Philippines	0.1%	1.0
Fluorspar	China	55.6%	1.0	Iron ore	Greece	0.1%	0.8
Fluorspar	Mexico	20.5%	1.0	Iron ore	Colombia	0.1%	1.0
Fluorspar	Mongolia	7.4%	1.1	Iron ore	Chile	0.1%	1.0
Fluorspar	Vietnam	3.4%	1.0	Iron ore	Peru	0.1%	1.0
Fluorspar	South Africa	3.1%	1.0	Iron ore	Korea, North	0.1%	1.0
Fluorspar	Spain	2.5%	0.8	Iron ore	Uzbekistan	0.0%	1.0
Fluorspar	Kazakhstan	1.2%	1.0	Iron ore	Bosnia and Herzegovina	0.0%	1.0
Fluorspar	Morocco	1.1%	1.0	Iron ore	New Zealand	0.0%	1.0
Fluorspar	Germany	0.9%	0.8	Iron ore	Libya	0.0%	1.0
Fluorspar	Iran	0.9%	1.0	Iron ore	Ecuador	0.0%	1.0
Fluorspar	Italy	0.6%	0.8	Iron ore	Morocco	0.0%	1.0
Fluorspar	Myanmar	0.5%	1.0	Iron ore	Bulgaria	0.0%	0.8
Fluorspar	Canada	0.5%	1.0	Iron ore	Norway	0.0%	1.0
Fluorspar	Afghanistan	0.4%	1.0	Iron ore	Singapore	0.0%	1.0
Fluorspar	Argentina	0.3%	1.0	Iron ore	Slovenia	0.0%	0.8
Fluorspar	Brazil	0.2%	1.0	Iron ore	Jordan	0.0%	1.0
Fluorspar	Thailand	0.2%	1.0	Iron ore	Israel	0.0%	1.0
Fluorspar	Türkiye	0.2%	1.0	Iron ore	Guatemala	0.0%	1.0
Fluorspar	United Kingdom	0.2%	1.0	Iron ore	Myanmar	0.0%	1.0
Fluorspar	Kenya	0.2%	1.0	Iron ore	Azerbaijan	0.0%	1.0
Fluorspar	Korea, North	0.1%	1.0	Iron ore	Moldova	0.0%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Fluorspar	Pakistan	0.1%	1.0	Iron ore	North Macedonia	0.0%	1.0
Fluorspar	Russia	0.1%	1.0	Iron ore	Nigeria	0.0%	1.0
Fluorspar	Kyrgyzstan	0.1%	1.0	Iron ore	El Salvador	0.0%	1.0
Fluorspar	India	0.0%	1.0	Iron ore	Venezuela	0.0%	1.0
Fluorspar	Egypt	0.0%	1.0	Iron ore	Cuba	0.0%	1.0
Fluorspar	Bulgaria	0.0%	0.8	Iron ore	Ghana	0.0%	1.0
Fluorspar	Namibia	0.0%	1.0	Iron ore	Uganda	0.0%	1.0
Gadolinium	China	68.3%	1.0	Iron ore	Croatia	0.0%	0.8
Gadolinium	Australia	9.9%	1.0	Iron ore	Congo, D.R.	0.0%	1.0
Gadolinium	United States	9.2%	1.0	Iron ore	Paraguay	0.0%	1.0
Gadolinium	Myanmar	7.5%	1.0	Iron ore	Uruguay	0.0%	1.0
Gadolinium	Russia	1.5%	1.0	Iron ore	Syria	0.0%	1.0
Gadolinium	Thailand	1.1%	1.0	Iron ore	Montenegro	0.0%	1.0
Gadolinium	India	1.0%	1.0	Iron ore	Dominican Republic	0.0%	1.0
Gadolinium	Brazil	0.8%	1.0	Iron ore	Tunisia	0.0%	1.0
Gadolinium	Vietnam	0.4%	1.0	Iron ore	Sri Lanka	0.0%	1.0
Gadolinium	Malaysia	0.3%	1.0	Iron ore	Albania	0.0%	1.0
Gadolinium	Burundi	0.1%	1.0	Iron ore	Mongolia	0.0%	1.0
Gold	China	12.3%	1.0	Iron ore	Mauritania	0.0%	1.0
Gold	Australia	9.4%	1.0	Iron ore	Zimbabwe	0.0%	1.0
Gold	Russia	8.6%	1.0	Iron ore	Kenya	0.0%	1.0
Gold	United States	6.6%	1.0	Iron ore	Ethiopia	0.0%	1.0
Gold	Canada	5.5%	1.0	Iron ore	Latvia	0.0%	0.8
Gold	Ghana	4.2%	1.0	Kaolin	United States	30.7%	1.0
Gold	Mexico	4.1%	1.0	Kaolin	India	25.7%	1.0
Gold	Peru	4.0%	1.0	Kaolin	China	19.2%	1.0
Gold	South Africa	3.6%	1.0	Kaolin	Brazil	9.3%	1.0
Gold	Indonesia	3.1%	1.1	Kaolin	Germany	3.8%	0.8
Gold	Uzbekistan	3.0%	1.0	Kaolin	Mexico	3.0%	1.0
Gold	Kazakhstan	2.9%	1.0	Kaolin	Spain	2.2%	0.8
Gold	Brazil	2.7%	1.0	Kaolin	Portugal	1.9%	0.8
Gold	Sudan	2.4%	1.0	Kaolin	France	1.2%	0.8
Gold	Papua New Guinea	1.9%	1.0	Kaolin	Uzbekistan	1.2%	1.0
Gold	Mali	1.8%	1.0	Kaolin	Poland	0.8%	0.8
Gold	Argentina	1.6%	1.0	Kaolin	Thailand	0.5%	1.0
Gold	Burkina Faso	1.5%	1.0	Kaolin	New Zealand	0.2%	1.0
Gold	Tanzania	1.4%	1.0	Kaolin	Nigeria	0.1%	1.0
Gold	Colombia	1.4%	1.0	Kaolin	Pakistan	0.1%	1.0
Gold	Guinea	1.3%	1.0	Kaolin	Argentina	0.1%	1.0
Gold	Chile	1.2%	1.0	Kaolin	Peru	0.1%	1.0
Gold	Dominican Republic	1.0%	1.0	Kaolin	Austria	0.0%	0.8
Gold	Congo, D.R.	1.0%	1.0	Kaolin	Slovakia	0.0%	0.8
Gold	Türkiye	0.9%	1.0	Kaolin	United Kingdom	0.0%	1.0
Gold	Bolivia	0.9%	1.0	Kaolin	Philippines	0.0%	1.0
Gold	Cote d'Ivoire	0.9%	1.0	Kaolin	Czechia	0.0%	0.8
Gold	Zimbabwe	0.8%	1.0	Kaolin	Bulgaria	0.0%	0.8
Gold	Kyrgyzstan	0.7%	1.0	Kaolin	Indonesia	0.0%	1.0
Gold	Suriname	0.7%	1.0	Kaolin	Venezuela	0.0%	1.0
Gold	Philippines	0.6%	1.0	Krypton	RUS	35%	1.0
Gold	Guyana	0.6%	1.0	Krypton	UKR	33%	1.0
Gold	Mongolia	0.6%	1.0	Krypton	DEU	15%	0.8
Gold	Egypt	0.5%	1.0	Krypton	USA	9%	1.0
Gold	Saudi Arabia	0.3%	1.0	Krypton	CHN	6%	1.0
Gold	Mauritania	0.3%	1.0	Lanthanum	China	84.9%	1.0
Gold	Senegal	0.3%	1.0	Lanthanum	Malaysia	10.5%	1.0
Gold	Korea, North	0.3%	1.0	Lanthanum	Russia	1.9%	1.0
Gold	Togo	0.3%	1.0	Lanthanum	India	1.6%	1.0
Gold	New Zealand	0.3%	1.0	Lanthanum	Vietnam	1.0%	1.0
Gold	Finland	0.3%	0.8	Lanthanum	Norway	0.1%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Gold	Bulgaria	0.3%	0.8	Lanthanum	Australia	0.1%	1.0
Gold	Nicaragua	0.3%	1.0	Lead	China	43.2%	1.0
Gold	Sweden	0.2%	0.8	Lead	United States	9.5%	1.0
Gold	Ecuador	0.2%	1.0	Lead	Korea, South	6.7%	1.0
Gold	Venezuela	0.2%	1.0	Lead	India	5.3%	1.0
Gold	Iran	0.2%	1.0	Lead	Mexico	3.5%	1.0
Gold	Namibia	0.2%	1.0	Lead	Germany	2.8%	0.8
Gold	Nigeria	0.2%	1.0	Lead	United Kingdom	2.6%	1.0
Gold	Tajikistan	0.2%	1.0	Lead	Japan	2.0%	1.0
Gold	Japan	0.2%	1.0	Lead	Brazil	2.0%	1.0
Gold	Laos	0.2%	1.0	Lead	Canada	1.9%	1.0
Gold	Liberia	0.2%	1.0	Lead	Spain	1.5%	0.8
Gold	Ethiopia	0.2%	1.0	Lead	Australia	1.5%	1.0
Gold	Armenia	0.2%	1.0	Lead	Italy	1.4%	0.8
Gold	Zambia	0.1%	1.0	Lead	Poland	1.3%	0.8
Gold	Azerbaijan	0.1%	1.0	Lead	Russia	1.2%	1.0
Gold	Georgia	0.1%	1.0	Lead	Kazakhstan	1.1%	1.0
Gold	Niger	0.1%	1.0	Lead	Belgium	1.1%	0.8
Gold	Costa Rica	0.1%	1.0	Lead	Iran	1.0%	1.0
Gold	Malaysia	0.1%	1.0	Lead	Bulgaria	0.9%	0.8
Gold	Eritrea	0.1%	1.0	Lead	Thailand	0.7%	1.0
Gold	Honduras	0.1%	1.0	Lead	Sweden	0.6%	0.8
Gold	Rwanda	0.1%	1.0	Lead	France	0.6%	0.8
Gold	Greece	0.1%	0.8	Lead	Saudi Arabia	0.6%	1.0
Gold	Madagascar	0.1%	1.0	Lead	Türkiye	0.5%	1.0
Gold	Spain	0.1%	0.8	Lead	South Africa	0.5%	1.0
Gold	India	0.1%	1.0	Lead	Taiwan	0.4%	1.0
Gold	Fiji	0.0%	1.0	Lead	Indonesia	0.4%	1.0
Gold	Serbia	0.0%	1.0	Lead	Colombia	0.4%	1.0
Gold	French Guiana	0.0%	1.0	Lead	Czechia	0.4%	0.8
Gold	Myanmar	0.0%	1.0	Lead	Netherlands	0.3%	0.8
Gold	Panama	0.0%	1.0	Lead	Argentina	0.3%	1.0
Gold	Thailand	0.0%	1.0	Lead	Vietnam	0.3%	1.0
Gold	Guatemala	0.0%	1.0	Lead	Malaysia	0.3%	1.0
Gold	Botswana	0.0%	1.0	Lead	Ukraine	0.2%	1.0
Gold	Burundi	0.0%	1.0	Lead	Greece	0.2%	0.8
Gold	Romania	0.0%	0.8	Lead	Egypt	0.2%	1.0
Gold	Uganda	0.0%	1.0	Lead	Austria	0.2%	0.8
Gold	North Macedonia	0.0%	1.0	Lead	Israel	0.2%	1.0
Gold	Vietnam	0.0%	1.0	Lead	United Arab Emirates	0.2%	1.0
Gold	Poland	0.0%	0.8	Lead	Romania	0.2%	0.8
Gold	Cameroon	0.0%	1.0	Lead	Pakistan	0.2%	1.0
Gold	Central African Republic	0.0%	1.0	Lead	Lebanon	0.1%	1.0
Gold	Uruguay	0.0%	1.0	Lead	Ireland	0.1%	0.8
Gold	Mozambique	0.0%	1.0	Lead	Peru	0.1%	1.0
Gold	Kenya	0.0%	1.0	Lead	Chile	0.1%	1.0
Gold	Gabon	0.0%	1.0	Lead	Serbia	0.1%	1.0
Gold	Morocco	0.0%	1.0	Lead	Guatemala	0.1%	1.0
Gold	Korea, South	0.0%	1.0	Lead	Slovenia	0.1%	0.8
Gold	Sierra Leone	0.0%	1.0	Lead	Venezuela	0.1%	1.0
Gold	Slovakia	0.0%	0.8	Lead	Philippines	0.1%	1.0
Gold	Algeria	0.0%	1.0	Lead	Myanmar	0.1%	1.0
Gold	Congo	0.0%	1.0	Lead	Nigeria	0.1%	1.0
Gypsum	United States	13.2%	1.0	Lead	Portugal	0.1%	0.8
Gypsum	China	12.9%	1.0	Lead	Costa Rica	0.1%	1.0
Gypsum	Iran	9.3%	1.0	Lead	Morocco	0.1%	1.0
Gypsum	Spain	6.8%	1.0	Lead	Algeria	0.1%	1.0
Gypsum	Thailand	6.7%	1.0	Lead	Estonia	0.1%	0.8

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Gypsum	Türkiye	6.1%	1.0	Lead	Dominican Republic	0.1%	1.0
Gypsum	Oman	5.8%	1.0	Lead	Zambia	0.0%	1.0
Gypsum	Mexico	5.4%	1.0	Lead	Honduras	0.0%	1.0
Gypsum	Germany	2.9%	1.0	Lead	Croatia	0.0%	0.8
Gypsum	Russia	2.7%	1.0	Lead	Senegal	0.0%	1.0
Gypsum	Australia	2.4%	1.0	Lead	Mozambique	0.0%	1.0
Gypsum	Saudi Arabia	2.1%	1.0	Lead	Sri Lanka	0.0%	1.0
Gypsum	Brazil	1.9%	1.0	Lead	Korea, North	0.0%	1.0
Gypsum	France	1.8%	1.0	Lead	Uganda	0.0%	1.0
Gypsum	Canada	1.7%	1.0	Lead	Kenya	0.0%	1.0
Gypsum	India	1.6%	1.0	Lead	Ghana	0.0%	1.0
Gypsum	Japan	1.5%	1.0	Lead	Bolivia	0.0%	1.0
Gypsum	Algeria	1.5%	1.0	Lead	Tanzania	0.0%	1.0
Gypsum	Pakistan	1.4%	1.0	Lead	Cuba	0.0%	1.0
Gypsum	United Kingdom	0.9%	1.0	Lead	Bosnia and Herzegovina	0.0%	1.0
Gypsum	Ukraine	0.9%	1.0	Lead	Slovakia	0.0%	0.8
Gypsum	Poland	0.7%	1.0	Lithium	China	56.2%	1.0
Gypsum	Iraq	0.6%	1.0	Lithium	Chile	32.1%	1.0
Gypsum	Argentina	0.6%	1.0	Lithium	Argentina	10.5%	1.1
Gypsum	Chile	0.6%	1.0	Lithium	United States	1.2%	1.0
Gypsum	Tunisia	0.6%	1.0	Lutetium	China	100.0%	1.0
Gypsum	Romania	0.5%	1.0	Magnesium	China	90.6%	1.0
Gypsum	Austria	0.5%	1.0	Magnesium	United States	3.4%	1.0
Gypsum	Egypt	0.5%	1.0	Magnesium	Israel	2.2%	1.0
Gypsum	Greece	0.5%	1.0	Magnesium	Brazil	1.8%	1.0
Gypsum	Cyprus	0.4%	1.0	Magnesium	Russia	1.5%	1.0
Gypsum	Laos	0.4%	1.0	Magnesium	Türkiye	0.4%	1.0
Gypsum	Bhutan	0.2%	1.0	Magnesium	Korea, South	0.1%	1.0
Gypsum	Jordan	0.2%	1.0	Magnesium	Malaysia	0.0%	1.0
Gypsum	Colombia	0.2%	1.0	Manganese	China	58.2%	1.1
Gypsum	Italy	0.2%	1.0	Manganese	India	13.1%	1.0
Gypsum	Switzerland	0.2%	1.0	Manganese	Ukraine	4.4%	1.0
Gypsum	Latvia	0.2%	1.0	Manganese	Norway	3.4%	1.0
Gypsum	Myanmar	0.2%	1.0	Manganese	Japan	2.8%	1.0
Gypsum	Moldova	0.2%	1.0	Manganese	Korea, South	2.7%	1.0
Gypsum	Morocco	0.2%	1.0	Manganese	Malaysia	2.4%	1.0
Gypsum	South Africa	0.2%	1.0	Manganese	South Africa	2.1%	1.0
Gypsum	Peru	0.2%	1.0	Manganese	Russia	1.7%	1.0
Gypsum	Tanzania	0.2%	1.0	Manganese	Brazil	1.6%	1.0
Gypsum	Sudan	0.2%	1.0	Manganese	Georgia	1.3%	1.0
Gypsum	North Macedonia	0.2%	1.0	Manganese	Mexico	1.2%	1.0
Gypsum	Croatia	0.1%	1.0	Manganese	Australia	1.2%	1.0
Gypsum	Ireland	0.1%	1.0	Manganese	Spain	1.1%	0.8
Gypsum	Portugal	0.1%	1.0	Manganese	France	0.9%	0.8
Gypsum	Libya	0.1%	1.0	Manganese	Kazakhstan	0.6%	1.0
Gypsum	Dominican Republic	0.1%	1.0	Manganese	Slovakia	0.4%	0.8
Gypsum	Guatemala	0.1%	1.0	Manganese	Saudi Arabia	0.3%	1.0
Gypsum	Azerbaijan	0.1%	1.0	Manganese	Myanmar	0.2%	1.0
Gypsum	Ethiopia	0.1%	1.0	Manganese	Gabon	0.2%	1.0
Gypsum	Albania	0.1%	1.0	Manganese	Indonesia	0.1%	1.0
Gypsum	Bosnia and Herzegovina	0.1%	1.0	Manganese	Egypt	0.1%	1.0
Gypsum	Uzbekistan	0.1%	1.0	Manganese	Venezuela	0.1%	1.0
Gypsum	Angola	0.1%	1.0	Manganese	Zambia	0.0%	1.0
Gypsum	Guinea	0.1%	1.0	Manganese	United States	0.0%	1.0
Gypsum	Kazakhstan	0.1%	1.0	Manganese	Colombia	0.0%	1.0
Gypsum	Mauritania	0.1%	1.0	Manganese	Argentina	0.0%	1.0
Gypsum	Israel	0.1%	1.0	Manganese	Peru	0.0%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Gypsum	Georgia	0.1%	1.0	Manganese	Belgium	0.0%	0.8
Gypsum	Cuba	0.1%	1.0	Manganese	Canada	0.0%	1.0
Gypsum	Norway	0.1%	1.0	Manganese	Singapore	0.0%	1.0
Gypsum	Bulgaria	0.1%	1.0	Manganese	Bahrain	0.0%	1.0
Gypsum	Nicaragua	0.0%	1.0	Manganese	Serbia	0.0%	1.0
Gypsum	Slovakia	0.0%	1.0	Manganese	Sweden	0.0%	0.8
Gypsum	Jamaica	0.0%	1.0	Manganese	Italy	0.0%	0.8
Gypsum	Kyrgyzstan	0.0%	1.0	Manganese	Slovenia	0.0%	0.8
Gypsum	Syria	0.0%	1.0	Manganese	Portugal	0.0%	0.8
Gypsum	Honduras	0.0%	1.0	Manganese	Poland	0.0%	0.8
Gypsum	Yemen	0.0%	1.0	Manganese	Pakistan	0.0%	1.0
Gypsum	Mongolia	0.0%	1.0	Manganese	United Arab Emirates	0.0%	1.0
Gypsum	Nigeria	0.0%	1.0	Manganese	Austria	0.0%	0.8
Gypsum	Afghanistan	0.0%	1.0	Manganese	Türkiye	0.0%	1.0
Gypsum	Tajikistan	0.0%	1.0	Manganese	Estonia	0.0%	0.8
Gypsum	Armenia	0.0%	1.0	Manganese	Thailand	0.0%	1.0
Gypsum	Czechia	0.0%	1.0	Manganese	Netherlands	0.0%	0.8
Gypsum	Eritrea	0.0%	1.0	Manganese	Hungary	0.0%	0.8
Gypsum	Niger	0.0%	1.0	Manganese	Kenya	0.0%	1.0
Gypsum	Uganda	0.0%	1.0	Manganese	Kuwait	0.0%	1.0
Gypsum	Sri Lanka	0.0%	1.0	Manganese	Sri Lanka	0.0%	1.0
Gypsum	Bolivia	0.0%	1.0	Manganese	Finland	0.0%	0.8
Gypsum	Kenya	0.0%	1.0	Manganese	United Kingdom	0.0%	1.0
Gypsum	Hungary	0.0%	1.0	Manganese	Lithuania	0.0%	0.8
Gypsum	Paraguay	0.0%	1.0	Manganese	Latvia	0.0%	0.8
Gypsum	Madagascar	0.0%	1.0	Manganese	Denmark	0.0%	0.8
Holmium	China	68.3%	1.0	Manganese	Germany	0.0%	0.8
Holmium	Australia	9.9%	1.0	Manganese	Czechia	0.0%	0.8
Holmium	United States	9.2%	1.0	Manganese	Chile	0.0%	1.0
Holmium	Myanmar	7.5%	1.0	Neodymium	China	84.9%	1.0
Holmium	Russia	1.5%	1.0	Neodymium	Malaysia	10.5%	1.0
Holmium	Thailand	1.1%	1.0	Neodymium	Russia	1.9%	1.0
Holmium	India	1.0%	1.0	Neodymium	India	1.6%	1.0
Holmium	Brazil	0.8%	1.0	Neodymium	Vietnam	1.0%	1.0
Holmium	Vietnam	0.4%	1.0	Neodymium	Norway	0.1%	1.0
Holmium	Malaysia	0.3%	1.0	Neodymium	Australia	0.1%	1.0
Holmium	Burundi	0.1%	1.0	Neon	United States	46.6%	1.0
Hydrogen	United States	22.2%	1.0	Neon	Ukraine	29.7%	1.0
Hydrogen	Russia	17.5%	1.0	Neon	China	23.6%	1.0
Hydrogen	Iran	5.9%	1.0	Neon	Taiwan	0.1%	1.0
Hydrogen	Canada	4.4%	1.0	Nickel	China	33.4%	1.0
Hydrogen	Qatar	4.3%	1.0	Nickel	Indonesia	12.2%	1.0
Hydrogen	China	4.2%	1.0	Nickel	Japan	8.6%	1.0
Hydrogen	Australia	3.4%	1.0	Nickel	Russia	7.1%	1.0
Hydrogen	Norway	3.1%	1.0	Nickel	Canada	6.5%	1.0
Hydrogen	Saudi Arabia	3.0%	1.0	Nickel	Australia	5.3%	1.0
Hydrogen	Algeria	2.4%	1.0	Nickel	Norway	3.5%	1.0
Hydrogen	Turkmenistan	1.8%	1.0	Nickel	Brazil	3.0%	1.0
Hydrogen	Indonesia	1.8%	1.0	Nickel	Finland	2.8%	0.8
Hydrogen	Malaysia	1.7%	1.0	Nickel	Korea, South	1.7%	1.0
Hydrogen	United Arab Emirates	1.5%	1.0	Nickel	Serbia	1.6%	1.0
Hydrogen	Uzbekistan	1.5%	1.0	Nickel	Colombia	1.5%	1.0
Hydrogen	Egypt	1.4%	1.0	Nickel	South Africa	1.4%	1.0
Hydrogen	Nigeria	1.3%	1.0	Nickel	Madagascar	1.4%	1.0
Hydrogen	Pakistan	1.1%	1.0	Nickel	United Kingdom	1.0%	1.0
Hydrogen	United Kingdom	1.1%	1.0	Nickel	Ukraine	0.8%	1.0
Hydrogen	Argentina	1.1%	1.0	Nickel	Dominican Republic	0.7%	1.0
Hydrogen	Thailand	1.0%	1.0	Nickel	Myanmar	0.6%	1.0
Hydrogen	Netherlands	1.0%	0.8	Nickel	Cuba	0.6%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Hydrogen	Oman	0.9%	1.0	Nickel	Greece	0.6%	0.8
Hydrogen	Trinidad and Tobago	0.9%	1.0	Nickel	Guatemala	0.5%	1.0
Hydrogen	Kazakhstan	0.8%	1.0	Nickel	Zimbabwe	0.3%	1.0
Hydrogen	Mexico	0.8%	1.0	Nickel	North Macedonia	0.3%	1.0
Hydrogen	India	0.8%	1.0	Nickel	France	0.2%	0.8
Hydrogen	Venezuela	0.8%	1.0	Nickel	Kosovo	0.1%	1.0
Hydrogen	Bangladesh	0.7%	1.0	Nickel	Austria	0.0%	0.8
Hydrogen	Brazil	0.7%	1.0	Nickel	Morocco	0.0%	1.0
Hydrogen	Azerbaijan	0.6%	1.0	Niobium	Brazil	88.8%	1.0
Hydrogen	Ukraine	0.5%	1.0	Niobium	Canada	11.2%	1.0
Hydrogen	Bolivia	0.5%	1.0	Palladium	Russia	40.4%	1.0
Hydrogen	Myanmar	0.5%	1.0	Palladium	South Africa	36.1%	1.0
Hydrogen	Kuwait	0.5%	1.0	Palladium	Canada	10.0%	1.0
Hydrogen	Bahrain	0.4%	1.0	Palladium	United States	6.6%	1.0
Hydrogen	Libya	0.4%	1.0	Palladium	Zimbabwe	5.7%	1.0
Hydrogen	Peru	0.3%	1.0	Palladium	China	0.6%	1.0
Hydrogen	Brunei Darussalam	0.3%	1.0	Palladium	Finland	0.4%	0.8
Hydrogen	Colombia	0.3%	1.0	Palladium	Australia	0.2%	1.0
Hydrogen	Iraq	0.3%	1.0	Palladium	Serbia	0.0%	1.0
Hydrogen	Vietnam	0.3%	1.0	Palladium	Uzbekistan	0.0%	1.0
Hydrogen	Romania	0.3%	0.8	Phosphorous	China	78.5%	1.1
Hydrogen	Israel	0.3%	1.0	Phosphorous	United States	10.6%	1.0
Hydrogen	Germany	0.2%	0.8	Phosphorous	Kazakhstan	6.4%	1.0
Hydrogen	Equatorial Guinea	0.2%	1.0	Phosphorous	Vietnam	4.5%	1.0
Hydrogen	Angola	0.1%	1.0	Platinum	South Africa	70.8%	1.0
Hydrogen	Italy	0.1%	0.8	Platinum	Russia	12.1%	1.1
Hydrogen	Mozambique	0.1%	1.0	Platinum	Zimbabwe	8.0%	1.0
Hydrogen	Poland	0.1%	0.8	Platinum	Canada	4.5%	1.0
Hydrogen	New Zealand	0.1%	1.0	Platinum	United States	2.2%	1.0
Hydrogen	Philippines	0.1%	1.0	Platinum	China	1.4%	1.0
Hydrogen	Denmark	0.1%	0.8	Platinum	Finland	0.7%	0.8
Hydrogen	Syria	0.1%	1.0	Platinum	Colombia	0.3%	1.0
Hydrogen	Papua New Guinea	0.1%	1.0	Platinum	Australia	0.1%	1.0
Hydrogen	Japan	0.1%	1.0	Platinum	Poland	0.0%	0.8
Hydrogen	Ireland	0.1%	0.8	Praseodymium	China	84.9%	1.0
Hydrogen	Cote d'Ivoire	0.1%	1.0	Praseodymium	Malaysia	10.5%	1.0
Hydrogen	Tunisia	0.1%	1.0	Praseodymium	Russia	1.9%	1.0
Hydrogen	Hungary	0.1%	0.8	Praseodymium	India	1.6%	1.0
Hydrogen	Tanzania	0.0%	1.0	Praseodymium	Vietnam	1.0%	1.0
Hydrogen	Cuba	0.0%	1.0	Praseodymium	Norway	0.1%	1.0
Hydrogen	Cameroon	0.0%	1.0	Praseodymium	Australia	0.1%	1.0
Hydrogen	Ghana	0.0%	1.0	Rhenium	Chile	49.0%	1.0
Hydrogen	Chile	0.0%	1.0	Rhenium	United States	19.2%	1.0
Hydrogen	Croatia	0.0%	0.8	Rhenium	Poland	14.9%	0.8
Hydrogen	Austria	0.0%	0.8	Rhenium	Kazakhstan	5.9%	1.0
Hydrogen	Congo, D.R.	0.0%	1.0	Rhenium	China	5.7%	1.0
Hydrogen	South Africa	0.0%	1.0	Rhenium	Russia	3.2%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Hydrogen	Korea, South	0.0%	1.0	Rhenium	Uzbekistan	1.6%	1.0
Hydrogen	Yemen	0.0%	1.0	Rhenium	Armenia	0.6%	1.0
Hydrogen	Taiwan	0.0%	1.0	Rhodium	South Africa	81.1%	1.0
Hydrogen	Serbia	0.0%	1.0	Rhodium	Russia	9.7%	1.0
Hydrogen	Türkiye	0.0%	1.0	Rhodium	Zimbabwe	5.7%	1.0
Hydrogen	Belarus	0.0%	1.0	Rhodium	Canada	3.1%	1.0
Hydrogen	Ecuador	0.0%	1.0	Rhodium	United States	0.4%	1.0
Hydrogen	Gabon	0.0%	1.0	Ruthenium	South Africa	93.5%	1.0
Hydrogen	Greece	0.0%	0.8	Ruthenium	Zimbabwe	4.9%	1.0
Hydrogen	Czechia	0.0%	0.8	Ruthenium	Canada	1.4%	1.0
Hydrogen	Georgia	0.0%	1.0	Ruthenium	Russia	0.1%	1.0
Hydrogen	Morocco	0.0%	1.0	Samarium	China	84.9%	1.0
Hydrogen	France	0.0%	0.8	Samarium	Malaysia	10.5%	1.0
Hydrogen	Afghanistan	0.0%	1.0	Samarium	Russia	1.9%	1.0
Hydrogen	Albania	0.0%	1.0	Samarium	India	1.6%	1.0
Hydrogen	Bulgaria	0.0%	0.8	Samarium	Vietnam	1.0%	1.0
Hydrogen	Barbados	0.0%	1.0	Samarium	Norway	0.1%	1.0
Hydrogen	Spain	0.0%	0.8	Samarium	Australia	0.1%	1.0
Hydrogen	Slovakia	0.0%	0.8	Scandium	China	66.7%	1.0
Hydrogen	Senegal	0.0%	1.0	Scandium	Russia	16.7%	1.0
Hydrogen	Slovenia	0.0%	0.8	Scandium	Ukraine	4.2%	1.0
Hydrogen	Tajikistan	0.0%	1.0	Scandium	Philippines	4.2%	1.0
Hydrogen	Kyrgyzstan	0.0%	1.0	Scandium	Canada	4.2%	1.0
Hydrogen	Jordan	0.0%	1.0	Scandium	Kazakhstan	4.2%	1.0
Iron ore	Australia	36.6%	1.0	Selenium	China	25.7%	1.0
Iron ore	Brazil	17.8%	1.0	Selenium	Japan	20.3%	1.0
Iron ore	China	14.5%	1.1	Selenium	Korea, South	11.4%	1.0
Iron ore	India	8.7%	1.1	Selenium	Germany	10.2%	0.8
Iron ore	Russia	4.2%	1.0	Selenium	Belgium	5.4%	0.8
Iron ore	South Africa	3.0%	1.0	Selenium	Russia	5.2%	1.0
Iron ore	Ukraine	2.8%	1.0	Selenium	United States	3.7%	1.0
Iron ore	Canada	2.1%	1.0	Selenium	Mexico	3.1%	1.0
Iron ore	United States	1.9%	1.0	Selenium	Canada	2.9%	1.0
Iron ore	Iran	1.7%	1.0	Selenium	Finland	2.7%	0.8
Iron ore	Sweden	1.3%	0.8	Selenium	Philippines	2.6%	1.0
Iron ore	Kazakhstan	0.8%	1.0	Selenium	Poland	2.0%	0.8
Iron ore	Chile	0.6%	1.0	Selenium	Sweden	1.6%	0.8
Iron ore	Peru	0.6%	1.0	Selenium	Peru	1.4%	1.0
Iron ore	Mexico	0.6%	1.0	Selenium	Uzbekistan	0.7%	1.0
Iron ore	Türkiye	0.6%	1.0	Selenium	Serbia	0.6%	1.0
Iron ore	Mauritania	0.5%	1.0	Selenium	India	0.4%	1.0
Iron ore	Mongolia	0.3%	1.0	Selenium	Kazakhstan	0.4%	1.0
Iron ore	Venezuela	0.2%	1.0	Selenium	Armenia	0.0%	1.0
Iron ore	Vietnam	0.2%	1.0	Silicon metal	China	76.4%	1.0
Iron ore	Malaysia	0.2%	1.0	Silicon metal	Brazil	7.2%	1.0
Iron ore	Korea, North	0.2%	1.0	Silicon metal	Norway	6.4%	1.0
Iron ore	New Zealand	0.1%	1.0	Silicon metal	France	4.3%	0.8
Iron ore	Liberia	0.1%	1.0	Silicon metal	Russia	1.6%	1.0
Iron ore	Indonesia	0.1%	1.0	Silicon metal	United States	1.2%	1.0
Iron ore	Sierra Leone	0.1%	1.0	Silicon metal	Canada	1.0%	1.0
Iron ore	Norway	0.1%	1.0	Silicon metal	Bosnia and Herzegovina	0.9%	1.0
Iron ore	Austria	0.1%	0.8	Silicon metal	Spain	0.7%	0.8

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Iron ore	Bosnia and Herzegovina	0.1%	1.0	Silicon metal	Iceland	0.3%	1.0
Iron ore	Algeria	0.0%	1.0	Silicon metal	Slovakia	0.0%	0.8
Iron ore	Saudi Arabia	0.0%	1.0	Sulphur	China	17.8%	1.0
Iron ore	Laos	0.0%	1.0	Sulphur	United States	11.5%	1.0
Iron ore	Korea, South	0.0%	1.0	Sulphur	Russia	8.8%	1.0
Iron ore	Egypt	0.0%	1.0	Sulphur	Saudi Arabia	8.1%	1.0
Iron ore	Colombia	0.0%	1.0	Sulphur	United Arab Emirates	6.5%	1.0
Iron ore	Guinea	0.0%	1.0	Sulphur	Canada	6.5%	1.0
Iron ore	Tunisia	0.0%	1.0	Sulphur	India	4.6%	1.0
Iron ore	Pakistan	0.0%	1.0	Sulphur	Kazakhstan	4.4%	1.0
Iron ore	Germany	0.0%	0.8	Sulphur	Japan	4.2%	1.0
Iron ore	Malawi	0.0%	1.0	Sulphur	Iran	2.8%	1.0
Iron ore	Uruguay	0.0%	1.0	Sulphur	Korea, South	2.5%	1.0
Iron ore	Uganda	0.0%	1.0	Sulphur	Qatar	2.5%	1.0
Iron ore	Philippines	0.0%	1.0	Sulphur	Chile	2.2%	1.0
Iron ore	Thailand	0.0%	1.0	Sulphur	Poland	1.5%	0.8
Iron ore	Argentina	0.0%	1.0	Sulphur	Philippines	1.3%	1.0
Iron ore	Nepal	0.0%	1.0	Sulphur	Australia	1.1%	1.0
Iron ore	Namibia	0.0%	1.0	Sulphur	Finland	1.1%	0.8
Iron ore	Tanzania	0.0%	1.0	Sulphur	Italy	1.1%	0.8
Iron ore	Morocco	0.0%	1.0	Sulphur	Zambia	1.0%	1.0
Iron ore	Congo, D.R.	0.0%	1.0	Sulphur	Kuwait	0.8%	1.0
Iron ore	Guatemala	0.0%	1.0	Sulphur	Spain	0.8%	0.8
Iron ore	Bolivia	0.0%	1.0	Sulphur	Venezuela	0.7%	1.0
Iron ore	Azerbaijan	0.0%	1.0	Sulphur	Peru	0.7%	1.0
Iron ore	Bhutan	0.0%	1.0	Sulphur	Indonesia	0.6%	1.0
Iron ore	Nigeria	0.0%	1.0	Sulphur	Brazil	0.6%	1.0
Kaolin	Ukraine	24.2%	1.0	Sulphur	Mexico	0.6%	1.0
Kaolin	China	17.6%	1.0	Sulphur	Germany	0.6%	0.8
Kaolin	Türkiye	14.7%	1.0	Sulphur	France	0.6%	0.8
Kaolin	India	13.7%	1.0	Sulphur	Bulgaria	0.6%	0.8
Kaolin	Germany	10.2%	0.8	Sulphur	South Africa	0.6%	1.0
Kaolin	France	7.0%	0.8	Sulphur	Sweden	0.5%	0.8
Kaolin	Spain	4.2%	0.8	Sulphur	Turkmenistan	0.5%	1.0
Kaolin	United States	3.2%	1.0	Sulphur	Cuba	0.4%	1.0
Kaolin	Italy	2.1%	0.8	Sulphur	Greece	0.3%	0.8
Kaolin	Thailand	1.3%	1.0	Sulphur	Ukraine	0.3%	1.0
Kaolin	Argentina	1.1%	1.0	Sulphur	Taiwan	0.2%	1.0
Kaolin	Portugal	0.7%	0.8	Sulphur	Türkiye	0.2%	1.0
Kaolin	Poland	0.1%	0.8	Sulphur	Bahrain	0.2%	1.0
Kaolin	Iran	0.0%	1.0	Sulphur	United Kingdom	0.2%	1.0
Kaolin	Indonesia	0.0%	1.0	Sulphur	Libya	0.2%	1.0
Kaolin	Malaysia	0.0%	1.0	Sulphur	Norway	0.1%	1.0
Kaolin	Czechia	0.0%	0.8	Sulphur	Colombia	0.1%	1.0
Kaolin	Hungary	0.0%	0.8	Sulphur	Lithuania	0.1%	0.8
Kaolin	United Kingdom	0.0%	1.0	Sulphur	Egypt	0.1%	1.0
Kaolin	Russia	0.0%	1.0	Sulphur	Namibia	0.1%	1.0
Kaolin	Serbia	0.0%	1.0	Sulphur	Oman	0.1%	1.0
Kaolin	Slovakia	0.0%	0.8	Sulphur	Iraq	0.1%	1.0
Kaolin	Brazil	0.0%	1.0	Sulphur	Jordan	0.0%	1.0
Kaolin	South Africa	0.0%	1.0	Sulphur	Pakistan	0.0%	1.0
Kaolin	Vietnam	0.0%	1.0	Sulphur	Korea, North	0.0%	1.0
Kaolin	Colombia	0.0%	1.0	Sulphur	Algeria	0.0%	1.0
Kaolin	Venezuela	0.0%	1.0	Sulphur	Denmark	0.0%	0.8
Kaolin	Romania	0.0%	0.8	Sulphur	Austria	0.0%	0.8
Lanthanum	China	68.3%	1.0	Sulphur	Armenia	0.0%	1.0
Lanthanum	Australia	9.9%	1.0	Tellurium	China	46%	1.0
Lanthanum	United States	9.2%	1.0	Tellurium	Korea, South	24%	1.0

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Lanthanum	Myanmar	7.5%	1.0	Tellurium	Japan	6%	1.0
Lanthanum	Russia	1.5%	1.0	Tellurium	Sweden	5%	0.8
Lanthanum	Thailand	1.1%	1.0	Tellurium	Belgium	5%	0.8
Lanthanum	India	1.0%	1.0	Tellurium	Russia	4%	1.0
Lanthanum	Brazil	0.8%	1.0	Tellurium	Germany	4%	0.8
Lanthanum	Vietnam	0.4%	1.0	Tellurium	Canada	2%	1.0
Lanthanum	Malaysia	0.3%	1.0	Tellurium	United States	1%	1.0
Lanthanum	Burundi	0.1%	1.0	Tellurium	Finland	1%	0.8
Lead	China	43.4%	1.2	Tellurium	Bulgaria	0.4%	0.8
Lead	Australia	9.8%	1.0	Tellurium	Uzbekistan	0.3%	1.0
Lead	United States	6.4%	1.0	Terbium	China	100.0%	1.0
Lead	Peru	6.3%	1.0	Thulium	China	100.0%	1.0
Lead	Mexico	5.8%	1.0	Tin	China	50.1%	1.5
Lead	Russia	4.4%	1.0	Tin	Indonesia	19.7%	1.0
Lead	India	4.1%	1.0	Tin	Malaysia	7.0%	1.0
Lead	Bolivia	2.0%	1.0	Tin	Peru	5.1%	1.0
Lead	Türkiye	1.6%	1.0	Tin	Brazil	4.5%	1.0
Lead	Kazakhstan	1.5%	1.0	Tin	Bolivia	4.1%	1.1
Lead	Sweden	1.5%	0.8	Tin	Thailand	2.9%	1.0
Lead	Poland	1.5%	0.8	Tin	Belgium	2.5%	0.8
Lead	Iran	1.2%	1.0	Tin	Vietnam	1.5%	1.0
Lead	Tajikistan	1.1%	1.0	Tin	Poland	1.0%	0.8
Lead	North Macedonia	0.9%	1.0	Tin	Taiwan	0.9%	1.0
Lead	South Africa	0.8%	1.0	Tin	Japan	0.4%	1.0
Lead	Argentina	0.7%	1.0	Tin	Russia	0.3%	1.0
Lead	Morocco	0.7%	1.0	Tin	Rwanda	0.1%	1.1
Lead	Myanmar	0.7%	1.0	Tin	Australia	0.0%	1.0
Lead	Korea, North	0.6%	1.0	Tin	India	0.0%	1.0
Lead	Uzbekistan	0.5%	1.0	Titanium metal	China	42.8%	1.0
Lead	Cuba	0.4%	1.0	Titanium metal	Japan	26.0%	1.0
Lead	Nigeria	0.4%	1.0	Titanium metal	Russia	20.3%	1.1
Lead	Bulgaria	0.4%	0.8	Titanium metal	Kazakhstan	6.7%	1.0
Lead	Ireland	0.4%	0.8	Titanium metal	Ukraine	3.8%	1.1
Lead	Portugal	0.4%	0.8	Titanium metal	Saudi Arabia	0.3%	1.0
Lead	Canada	0.3%	1.0	Titanium metal	India	0.2%	1.0
Lead	Greece	0.3%	0.8	Titanium	China	35.3%	1.0
Lead	Mongolia	0.2%	1.0	Titanium	United States	13.9%	1.0
Lead	Honduras	0.2%	1.0	Titanium	South Africa	9.3%	1.0
Lead	Indonesia	0.2%	1.0	Titanium	Canada	8.9%	1.0
Lead	Spain	0.2%	0.8	Titanium	Germany	4.7%	0.8
Lead	Vietnam	0.2%	1.0	Titanium	Japan	4.4%	1.0
Lead	Brazil	0.2%	1.0	Titanium	United Kingdom	3.2%	1.0
Lead	Namibia	0.1%	1.0	Titanium	Mexico	3.1%	1.0
Lead	Bosnia and Herzegovina	0.1%	1.0	Titanium	Australia	2.6%	1.0
Lead	Kosovo	0.1%	1.0	Titanium	Ukraine	1.4%	1.1
Lead	Pakistan	0.1%	1.0	Titanium	Russia	1.4%	1.1
Lead	Serbia	0.1%	1.0	Titanium	Saudi Arabia	1.3%	1.0
Lead	Guatemala	0.1%	1.0	Titanium	India	1.1%	1.0
Lead	Montenegro	0.1%	1.0	Titanium	Belgium	0.4%	0.8
Lead	Korea, South	0.1%	1.0	Titanium	Kazakhstan	0.3%	1.0
Lead	Nepal	0.0%	1.0	Titanium	Italy	0.3%	0.8
Lead	Chile	0.0%	1.0	Titanium	Finland	0.3%	0.8

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Lead	Romania	0.0%	0.8	Titanium	France	0.1%	0.8
Lead	Laos	0.0%	1.0	Tungsten	China	85.6%	1.0
Lead	Finland	0.0%	0.8	Tungsten	United States	4.4%	1.0
Lead	Slovakia	0.0%	0.8	Tungsten	Russia	2.8%	1.0
Lead	United Kingdom	0.0%	1.0	Tungsten	Vietnam	2.8%	1.1
Lead	Georgia	0.0%	1.0	Tungsten	Austria	2.3%	0.8
Lead	Congo, D.R.	0.0%	1.0	Tungsten	Japan	2.2%	1.0
Limestone	Türkiye	18.5%	1.0	Vanadium	China	61.5%	1.0
Limestone	Spain	15.5%	0.8	Vanadium	Russia	9.0%	1.0
Limestone	Italy	11.9%	0.8	Vanadium	South Africa	8.2%	1.0
Limestone	United Kingdom	10.1%	1.0	Vanadium	Brazil	4.8%	1.0
Limestone	Germany	9.3%	0.8	Vanadium	Japan	2.3%	1.0
Limestone	France	8.5%	0.8	Vanadium	India	1.4%	1.0
Limestone	Poland	8.2%	0.8	Vanadium	Vietnam	0.8%	1.0
Limestone	Austria	2.5%	0.8	Vanadium	Korea, South	0.4%	1.0
Limestone	Romania	2.0%	0.8	Vanadium	Taiwan	0.3%	1.0
Limestone	Czechia	2.0%	0.8	Ytterbium	China	100.0%	1.0
Limestone	Portugal	1.3%	0.8	Yttrium	China	100.0%	1.0
Limestone	Denmark	1.2%	0.8	Zinc	China	45.0%	1.0
Limestone	Sweden	1.2%	0.8	Zinc	Korea, South	7.3%	1.0
Limestone	Greece	1.1%	0.8	Zinc	India	5.2%	1.0
Limestone	Bulgaria	1.0%	0.8	Zinc	Canada	4.8%	1.0
Limestone	Slovakia	0.9%	0.8	Zinc	Japan	3.8%	1.0
Limestone	Ireland	0.6%	0.8	Zinc	Spain	3.7%	0.8
Limestone	Slovenia	0.5%	0.8	Zinc	Australia	3.4%	1.0
Limestone	Cyprus	0.4%	0.8	Zinc	Mexico	2.6%	1.0
Limestone	Hungary	0.4%	0.8	Zinc	Peru	2.5%	1.0
Limestone	Serbia	0.4%	1.0	Zinc	Kazakhstan	2.4%	1.0
Limestone	Finland	0.4%	0.8	Zinc	Finland	2.2%	0.8
Limestone	Bosnia and Herzegovina	0.4%	1.0	Zinc	Belgium	1.9%	0.8
Limestone	Netherlands	0.3%	0.8	Zinc	Netherlands	1.9%	0.8
Limestone	Croatia	0.3%	0.8	Zinc	Brazil	1.9%	1.0
Limestone	Lithuania	0.3%	0.8	Zinc	Russia	1.7%	1.0
Limestone	Belgium	0.2%	0.8	Zinc	Norway	1.4%	1.0
Limestone	North Macedonia	0.2%	1.0	Zinc	Germany	1.3%	0.8
Limestone	Latvia	0.2%	0.8	Zinc	Poland	1.2%	0.8
Limestone	Norway	0.2%	1.0	Zinc	France	1.2%	0.8
Limestone	Luxembourg	0.1%	0.8	Zinc	Iran	1.0%	1.0
Limestone	Estonia	0.1%	0.8	Zinc	United States	1.0%	1.0
Limestone	Montenegro	0.0%	1.0	Zinc	Italy	1.0%	0.8
Lithium	Australia	53.0%	1.0	Zinc	Bulgaria	0.6%	0.8
Lithium	Chile	24.1%	1.0	Zinc	Uzbekistan	0.5%	1.0
Lithium	China	10.2%	1.0	Zinc	Namibia	0.5%	1.0
Lithium	Argentina	7.9%	1.1	Zinc	Thailand	0.2%	1.0
Lithium	Zimbabwe	1.3%	1.0	Zinc	Korea, North	0.1%	1.0
Lithium	Canada	1.2%	1.0	Zinc	Vietnam	0.1%	1.0
Lithium	Brazil	0.9%	1.0	Zinc	Algeria	0.0%	1.0
Lithium	United States	0.9%	1.0	Zinc	Ukraine	0.0%	1.0
Lithium	Portugal	0.3%	0.8				
Lithium	Namibia	0.1%	1.0				
Lithium	Bolivia	0.0%	1.0				
Lithium	Nigeria	0.0%	1.0				
Lutetium	China	68.3%	1.0				
Lutetium	Australia	9.9%	1.0				
Lutetium	United States	9.2%	1.0				
Lutetium	Myanmar	7.5%	1.0				
Lutetium	Russia	1.5%	1.0				
Lutetium	Thailand	1.1%	1.0				
Lutetium	India	1.0%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Lutetium	Brazil	0.8%	1.0				
Lutetium	Vietnam	0.4%	1.0				
Lutetium	Malaysia	0.3%	1.0				
Lutetium	Burundi	0.1%	1.0				
Magnesite	China	66.0%	1.0				
Magnesite	Türkiye	7.1%	1.0				
Magnesite	Brazil	6.4%	1.0				
Magnesite	Russia	4.6%	1.0				
Magnesite	Slovakia	3.2%	0.8				
Magnesite	Austria	2.6%	0.8				
Magnesite	Spain	2.4%	0.8				
Magnesite	Australia	1.5%	1.0				
Magnesite	Greece	1.4%	0.8				
Magnesite	United States	1.0%	1.0				
Magnesite	Iran	0.6%	1.0				
Magnesite	India	0.6%	1.0				
Magnesite	Saudi Arabia	0.6%	1.0				
Magnesite	Canada	0.5%	1.0				
Magnesite	Korea, North	0.5%	1.0				
Magnesite	Poland	0.3%	0.8				
Magnesite	Finland	0.2%	0.8				
Magnesite	Mexico	0.2%	1.0				
Magnesite	Pakistan	0.1%	1.0				
Magnesite	Guatemala	0.0%	1.0				
Magnesite	South Africa	0.0%	1.0				
Magnesite	Bosnia and Herzegovina	0.0%	1.0				
Magnesite	Philippines	0.0%	1.0				
Magnesite	Colombia	0.0%	1.0				
Magnesite	Cuba	0.0%	1.0				
Manganese	South Africa	29.3%	1.0				
Manganese	Australia	16.3%	1.0				
Manganese	Gabon	14.4%	1.0				
Manganese	China	8.9%	1.0				
Manganese	Ghana	6.4%	1.0				
Manganese	Brazil	6.1%	1.0				
Manganese	India	4.6%	1.0				
Manganese	Ukraine	3.4%	1.0				
Manganese	Malaysia	2.3%	1.0				
Manganese	Cote d'Ivoire	1.7%	1.0				
Manganese	Kazakhstan	1.4%	1.0				
Manganese	Myanmar	1.2%	1.0				
Manganese	Mexico	1.2%	1.0				
Manganese	Georgia	0.9%	1.0				
Manganese	Vietnam	0.6%	1.0				
Manganese	Iran	0.2%	1.0				
Manganese	Morocco	0.2%	1.0				
Manganese	Türkiye	0.2%	1.0				
Manganese	Zambia	0.1%	1.0				
Manganese	Indonesia	0.1%	1.0				
Manganese	Nigeria	0.1%	1.0				
Manganese	Peru	0.1%	1.0				
Manganese	Namibia	0.1%	1.0				
Manganese	Russia	0.1%	1.0				
Manganese	Egypt	0.0%	1.0				
Manganese	Kenya	0.0%	1.0				
Manganese	Romania	0.0%	0.8				
Manganese	Oman	0.0%	1.0				
Manganese	Hungary	0.0%	0.8				
Manganese	Bolivia	0.0%	1.0				
Manganese	Bulgaria	0.0%	0.8				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Manganese	Sudan	0.0%	1.0				
Manganese	Congo, D.R.	0.0%	1.0				
Manganese	Thailand	0.0%	1.0				
Manganese	Senegal	0.0%	1.0				
Manganese	Bosnia and Herzegovina	0.0%	1.0				
Manganese	Pakistan	0.0%	1.0				
Manganese	Colombia	0.0%	1.0				
Molybdenum	China	38.3%	1.0				
Molybdenum	Chile	21.3%	1.0				
Molybdenum	United States	15.4%	1.0				
Molybdenum	Peru	10.5%	1.0				
Molybdenum	Mexico	6.4%	1.0				
Molybdenum	Armenia	2.6%	1.0				
Molybdenum	Canada	1.4%	1.0				
Molybdenum	Iran	1.4%	1.0				
Molybdenum	Mongolia	0.9%	1.0				
Molybdenum	Russia	0.9%	1.0				
Molybdenum	Uzbekistan	0.3%	1.0				
Molybdenum	Kazakhstan	0.2%	1.0				
Molybdenum	Korea, North	0.2%	1.0				
Molybdenum	Argentina	0.1%	1.0				
Molybdenum	Türkiye	0.1%	1.0				
Molybdenum	Korea, South	0.1%	1.0				
Molybdenum	Norway	0.0%	1.0				
Natural cork	Portugal	48.1%	0.8				
Natural cork	Spain	31.5%	0.8				
Natural cork	Morocco	6.0%	1.0				
Natural cork	Algeria	5.1%	1.0				
Natural cork	Tunisia	3.6%	1.0				
Natural cork	Italy	3.2%	0.8				
Natural cork	France	2.7%	0.8				
Natural Graphite	China	66.7%	1.0				
Natural Graphite	Brazil	7.5%	1.0				
Natural Graphite	Mozambique	5.4%	1.0				
Natural Graphite	India	5.1%	1.0				
Natural Graphite	Korea, North	4.6%	1.0				
Natural Graphite	Madagascar	3.4%	1.0				
Natural Graphite	Russia	1.5%	1.0				
Natural Graphite	Canada	1.4%	1.0				
Natural Graphite	Ukraine	1.2%	1.0				
Natural Graphite	Türkiye	0.9%	1.0				
Natural Graphite	Norway	0.9%	1.0				
Natural Graphite	Mexico	0.7%	1.0				
Natural Graphite	Sri Lanka	0.3%	1.0				
Natural Graphite	Vietnam	0.2%	1.0				
Natural Graphite	Zimbabwe	0.1%	1.0				
Natural Graphite	Namibia	0.1%	1.0				
Natural Graphite	Korea, South	0.1%	1.0				
Natural Graphite	Germany	0.0%	0.8				
Natural Graphite	Austria	0.0%	0.8				
Natural Graphite	Colombia	0.0%	1.0				
Natural rubber	Thailand	32.2%	1.0				
Natural rubber	Indonesia	24.0%	1.0				
Natural rubber	Vietnam	7.8%	1.0				
Natural rubber	India	6.6%	1.0				
Natural rubber	China	5.5%	1.0				
Natural rubber	Cote d'Ivoire	4.7%	1.0				
Natural rubber	Malaysia	4.4%	1.0				
Natural rubber	Philippines	2.8%	1.0				
Natural rubber	Guatemala	2.7%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Natural rubber	Myanmar	1.7%	1.0				
Natural rubber	Cambodia	1.7%	1.0				
Natural rubber	Brazil	1.4%	1.0				
Natural rubber	Nigeria	1.0%	1.0				
Natural rubber	Laos	0.7%	1.0				
Natural rubber	Sri Lanka	0.6%	1.0				
Natural rubber	Mexico	0.5%	1.0				
Natural rubber	Liberia	0.4%	1.0				
Natural rubber	Cameroon	0.3%	1.0				
Natural rubber	Ghana	0.3%	1.0				
Natural rubber	Gabon	0.2%	1.0				
Natural rubber	Bangladesh	0.2%	1.0				
Natural rubber	Ecuador	0.1%	1.0				
Natural rubber	Guinea	0.1%	1.0				
Natural rubber	Congo, D.R.	0.1%	1.0				
Natural rubber	Colombia	0.1%	1.0				
Natural rubber	Papua New Guinea	0.0%	1.0				
Natural rubber	Bolivia	0.0%	1.0				
Natural rubber	Congo	0.0%	1.0				
Natural rubber	Central African Republic	0.0%	1.0				
Natural rubber	Brunei Darussalam	0.0%	1.0				
Natural rubber	Dominican Republic	0.0%	1.0				
Natural teak wood	Myanmar	47.5%	1.5				
Natural teak wood	Indonesia	34.4%	1.0				
Natural teak wood	India	17.4%	1.0				
Natural teak wood	Thailand	0.6%	1.0				
Neodymium	China	68.3%	1.0				
Neodymium	Australia	9.9%	1.0				
Neodymium	United States	9.2%	1.0				
Neodymium	Myanmar	7.5%	1.0				
Neodymium	Russia	1.5%	1.0				
Neodymium	Thailand	1.1%	1.0				
Neodymium	India	1.0%	1.0				
Neodymium	Brazil	0.8%	1.0				
Neodymium	Vietnam	0.4%	1.0				
Neodymium	Malaysia	0.3%	1.0				
Neodymium	Burundi	0.1%	1.0				
Nickel	Indonesia	26.3%	1.3				
Nickel	Philippines	14.0%	1.0				
Nickel	Russia	9.9%	1.0				
Nickel	Canada	8.5%	1.0				
Nickel	Australia	7.5%	1.0				
Nickel	China	4.4%	1.0				
Nickel	Brazil	3.0%	1.0				
Nickel	Cuba	2.0%	1.0				
Nickel	Guatemala	2.0%	1.0				
Nickel	South Africa	1.9%	1.0				
Nickel	Colombia	1.7%	1.0				
Nickel	Finland	1.5%	0.8				
Nickel	Papua New Guinea	1.4%	1.0				
Nickel	Madagascar	1.3%	1.0				
Nickel	Myanmar	0.9%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Nickel	Dominican Republic	0.8%	1.0				
Nickel	United States	0.8%	1.0				
Nickel	Greece	0.8%	0.8				
Nickel	Zimbabwe	0.7%	1.0				
Nickel	Türkiye	0.5%	1.0				
Nickel	Cote d'Ivoire	0.4%	1.0				
Nickel	Kosovo	0.2%	1.0				
Nickel	Albania	0.2%	1.0				
Nickel	Botswana	0.1%	1.0				
Nickel	Zambia	0.1%	1.0				
Nickel	Vietnam	0.0%	1.0				
Nickel	Poland	0.0%	0.8				
Nickel	Norway	0.0%	1.0				
Nickel	Morocco	0.0%	1.0				
Niobium	Brazil	91.8%	1.0				
Niobium	Canada	6.6%	1.0				
Niobium	Russia	0.6%	1.0				
Niobium	Congo, D.R.	0.6%	1.0				
Niobium	Rwanda	0.2%	1.0				
Niobium	Nigeria	0.1%	1.0				
Niobium	China	0.0%	1.0				
Niobium	Ethiopia	0.0%	1.0				
Niobium	Uganda	0.0%	1.0				
Niobium	Mozambique	0.0%	1.0				
Niobium	Burundi	0.0%	1.0				
Perlite	China	29.9%	1.0				
Perlite	Türkiye	23.9%	1.0				
Perlite	Greece	17.3%	0.8				
Perlite	United States	11.2%	1.0				
Perlite	Iran	10.7%	1.0				
Perlite	Hungary	1.6%	0.8				
Perlite	Italy	1.3%	0.8				
Perlite	Russia	1.0%	1.0				
Perlite	Slovakia	0.7%	0.8				
Perlite	Mexico	0.5%	1.0				
Perlite	Georgia	0.5%	1.0				
Perlite	Argentina	0.4%	1.0				
Perlite	Ukraine	0.4%	1.0				
Perlite	Philippines	0.4%	1.0				
Perlite	Thailand	0.3%	1.0				
Perlite	Bulgaria	0.1%	0.8				
Perlite	Chile	0.1%	1.0				
Perlite	Australia	0.0%	1.0				
Perlite	South Africa	0.0%	1.0				
Perlite	Armenia	0.0%	1.0				
Phosphate Rock	China	43.6%	1.4				
Phosphate Rock	Morocco	14.2%	1.0				
Phosphate Rock	United States	9.5%	1.0				
Phosphate Rock	Russia	6.9%	1.0				
Phosphate Rock	Peru	5.0%	1.0				
Phosphate Rock	Jordan	3.7%	1.0				
Phosphate Rock	Brazil	2.6%	1.0				
Phosphate Rock	Saudi Arabia	2.5%	1.0				
Phosphate Rock	Vietnam	1.7%	1.0				
Phosphate Rock	Israel	1.4%	1.0				
Phosphate Rock	Tunisia	1.3%	1.0				
Phosphate Rock	Egypt	1.2%	1.0				
Phosphate Rock	Senegal	1.1%	1.0				
Phosphate Rock	South Africa	0.9%	1.0				
Phosphate Rock	Mexico	0.6%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Phosphate Rock	Algeria	0.6%	1.0				
Phosphate Rock	Kazakhstan	0.5%	1.0				
Phosphate Rock	Finland	0.5%	0.8				
Phosphate Rock	Togo	0.5%	1.0				
Phosphate Rock	India	0.4%	1.0				
Phosphate Rock	Iraq	0.3%	1.0				
Phosphate Rock	Australia	0.3%	1.0				
Phosphate Rock	Syria	0.2%	1.0				
Phosphate Rock	Uzbekistan	0.2%	1.0				
Phosphate Rock	Türkiye	0.2%	1.0				
Phosphate Rock	Iran	0.1%	1.0				
Phosphate Rock	Nauru	0.1%	1.0				
Phosphate Rock	Venezuela	0.0%	1.0				
Phosphate Rock	Colombia	0.0%	1.0				
Phosphate Rock	Sri Lanka	0.0%	1.0				
Phosphate Rock	Pakistan	0.0%	1.0				
Phosphate Rock	Zimbabwe	0.0%	1.0				
Phosphate Rock	Philippines	0.0%	1.0				
Phosphate Rock	Chile	0.0%	1.0				
Phosphate Rock	Cuba	0.0%	1.0				
Phosphate Rock	Malawi	0.0%	1.0				
Phosphate Rock	Tanzania	0.0%	1.0				
Phosphate Rock	Thailand	0.0%	1.0				
Potash	Canada	30.2%	1.0				
Potash	Russia	17.2%	1.0				
Potash	Belarus	16.8%	1.1				
Potash	China	13.3%	1.0				
Potash	Germany	6.6%	0.8				
Potash	Israel	5.1%	1.0				
Potash	Jordan	3.4%	1.0				
Potash	Chile	2.5%	1.0				
Potash	Spain	1.4%	0.8				
Potash	United States	1.2%	1.0				
Potash	Laos	0.8%	1.0				
Potash	Brazil	0.7%	1.0				
Potash	United Kingdom	0.6%	1.0				
Potash	Uzbekistan	0.4%	1.0				
Potash	Iran	0.1%	1.0				
Potash	Turkmenistan	0.0%	1.0				
Potash	Bolivia	0.0%	1.0				
Praseodymium	China	68.3%	1.0				
Praseodymium	Australia	9.9%	1.0				
Praseodymium	United States	9.2%	1.0				
Praseodymium	Myanmar	7.5%	1.0				
Praseodymium	Russia	1.5%	1.0				
Praseodymium	Thailand	1.1%	1.0				
Praseodymium	India	1.0%	1.0				
Praseodymium	Brazil	0.8%	1.0				
Praseodymium	Vietnam	0.4%	1.0				
Praseodymium	Malaysia	0.3%	1.0				
Praseodymium	Burundi	0.1%	1.0				
Roundwood	United States	18%	1.0				
Roundwood	China	16%	1.0				
Roundwood	Russia	9%	1.0				
Roundwood	Brasilia	7%	1.0				
Roundwood	Canada	7%	1.0				
Roundwood	Indonesia	4%	1.0				
Roundwood	Sweden	3%	0.8				
Roundwood	Finland	3%	0.8				
Roundwood	Germany	2%	0.8				
Roundwood	India	2%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Roundwood	Chile	2%	1.0				
Roundwood	Poland	2%	0.8				
Roundwood	Vietnam	2%	1.0				
Roundwood	New Zealand	2%	1.0				
Roundwood	Auatralia	1%	1.0				
Roundwood	France	1%	0.8				
Roundwood	Japan	1%	1.0				
Roundwood	Turkyie	1%	1.0				
Roundwood	Czechia	1%	0.8				
Roundwood	South Africa	1%	1.0				
Roundwood	Belarus	1%	1.0				
Roundwood	Spain	1%	0.8				
Roundwood	Thailand	1%	1.0				
Roundwood	Malaysia	1%	1.0				
Roundwood	URY	1%	1.0				
Roundwood	Argentina	1%	1.0				
Roundwood	Austria	1%	0.8				
Roundwood	Portugal	1%	1.0				
Samarium	China	68.3%	1.0				
Samarium	Australia	9.9%	1.0				
Samarium	United States	9.2%	1.0				
Samarium	Myanmar	7.5%	1.0				
Samarium	Russia	1.5%	1.0				
Samarium	Thailand	1.1%	1.0				
Samarium	India	1.0%	1.0				
Samarium	Brazil	0.8%	1.0				
Samarium	Vietnam	0.4%	1.0				
Samarium	Malaysia	0.3%	1.0				
Samarium	Burundi	0.1%	1.0				
Sapele wood	Cameroon	52.3%	1.0				
Sapele wood	Congo	21.8%	1.0				
Sapele wood	Gabon	8.7%	1.0				
Sapele wood	Congo, D.R.	5.8%	1.0				
Sapele wood	Equatorial Guinea	3.8%	1.0				
Sapele wood	Malaysia	3.6%	1.0				
Sapele wood	Central African Republic	1.2%	1.0				
Sapele wood	Indonesia	1.1%	1.0				
Sapele wood	Ghana	0.5%	1.0				
Sapele wood	Angola	0.2%	1.0				
Sapele wood	China	0.2%	1.0				
Sapele wood	Cote d'Ivoire	0.2%	1.0				
Sapele wood	Brazil	0.2%	1.0				
Sapele wood	India	0.2%	1.0				
Sapele wood	Guyana	0.1%	1.0				
Sapele wood	South Africa	0.1%	1.0				
Sapele wood	Guinea	0.0%	1.0				
Sapele wood	Colombia	0.0%	1.0				
Sapele wood	Liberia	0.0%	1.0				
Sapele wood	Nigeria	0.0%	1.0				
Sapele wood	Türkiye	0.0%	1.0				
Silica sand	United States	41.0%	1.0				
Silica sand	China	8.4%	1.0				
Silica sand	India	5.0%	1.0				
Silica sand	Türkiye	4.4%	1.0				
Silica sand	Germany	4.4%	0.8				
Silica sand	France	4.3%	0.8				
Silica sand	Bulgaria	3.3%	0.8				
Silica sand	Spain	2.6%	0.8				
Silica sand	Malaysia	2.3%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Silica sand	Poland	2.0%	0.8				
Silica sand	United Kingdom	1.9%	1.0				
Silica sand	Canada	1.6%	1.0				
Silica sand	Mexico	1.5%	1.0				
Silica sand	Indonesia	1.4%	1.0				
Silica sand	Australia	1.3%	1.0				
Silica sand	Italy	1.1%	0.8				
Silica sand	Japan	1.0%	1.0				
Silica sand	South Africa	0.9%	1.0				
Silica sand	Argentina	0.9%	1.0				
Silica sand	Netherlands	0.8%	0.8				
Silica sand	Guatemala	0.7%	1.0				
Silica sand	Korea, South	0.7%	1.0				
Silica sand	New Zealand	0.6%	1.0				
Silica sand	Austria	0.6%	0.8				
Silica sand	Saudi Arabia	0.6%	1.0				
Silica sand	Thailand	0.6%	1.0				
Silica sand	Chile	0.6%	1.0				
Silica sand	Czechia	0.6%	0.8				
Silica sand	Norway	0.5%	1.0				
Silica sand	Portugal	0.5%	0.8				
Silica sand	Philippines	0.4%	1.0				
Silica sand	Sweden	0.3%	0.8				
Silica sand	Kyrgyzstan	0.3%	1.0				
Silica sand	Egypt	0.3%	1.0				
Silica sand	Colombia	0.3%	1.0				
Silica sand	Latvia	0.3%	0.8				
Silica sand	Pakistan	0.2%	1.0				
Silica sand	Slovakia	0.2%	0.8				
Silica sand	Hungary	0.2%	0.8				
Silica sand	Peru	0.2%	1.0				
Silica sand	Israel	0.2%	1.0				
Silica sand	Denmark	0.2%	0.8				
Silica sand	Slovenia	0.1%	0.8				
Silica sand	Oman	0.1%	1.0				
Silica sand	Finland	0.1%	0.8				
Silica sand	Serbia	0.1%	1.0				
Silica sand	Jordan	0.1%	1.0				
Silica sand	Romania	0.1%	0.8				
Silica sand	Croatia	0.1%	0.8				
Silica sand	Taiwan	0.1%	1.0				
Silica sand	Greece	0.0%	0.8				
Silica sand	Ecuador	0.0%	1.0				
Silica sand	Algeria	0.0%	1.0				
Silica sand	Angola	0.0%	1.0				
Silica sand	Bosnia and Herzegovina	0.0%	1.0				
Silica sand	Kosovo	0.0%	1.0				
Silica sand	Estonia	0.0%	0.8				
Silica sand	Sri Lanka	0.0%	1.0				
Silica sand	Dominican Republic	0.0%	1.0				
Silica sand	Lithuania	0.0%	0.8				
Silica sand	Jamaica	0.0%	1.0				
Silica sand	Nigeria	0.0%	1.0				
Silica sand	Kenya	0.0%	1.0				
Silica sand	Ethiopia	0.0%	1.0				
Silica sand	Cuba	0.0%	1.0				
Silica sand	Venezuela	0.0%	1.0				
Silica sand	Cameroon	0.0%	1.0				
Silver	Mexico	24.3%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Silver	Peru	14.2%	1.0				
Silver	China	12.8%	1.1				
Silver	Chile	5.2%	1.0				
Silver	Russia	5.1%	1.0				
Silver	Australia	4.7%	1.0				
Silver	Poland	4.6%	0.8				
Silver	Bolivia	4.3%	1.1				
Silver	Kazakhstan	3.8%	1.0				
Silver	United States	3.7%	1.0				
Silver	Argentina	3.6%	1.0				
Silver	India	2.2%	1.0				
Silver	Sweden	1.6%	0.8				
Silver	Canada	1.3%	1.0				
Silver	Indonesia	1.2%	1.0				
Silver	Guatemala	0.9%	1.0				
Silver	Morocco	0.8%	1.0				
Silver	Uzbekistan	0.7%	1.0				
Silver	Türkiye	0.6%	1.0				
Silver	Dominican Republic	0.5%	1.0				
Silver	Papua New Guinea	0.4%	1.0				
Silver	Spain	0.3%	0.8				
Silver	Mongolia	0.3%	1.0				
Silver	Portugal	0.3%	0.8				
Silver	Korea, North	0.2%	1.0				
Silver	South Africa	0.2%	1.0				
Silver	Iran	0.2%	1.0				
Silver	Brazil	0.2%	1.0				
Silver	Bulgaria	0.2%	0.8				
Silver	Greece	0.1%	0.8				
Silver	Laos	0.1%	1.0				
Silver	Honduras	0.1%	1.0				
Silver	Eritrea	0.1%	1.0				
Silver	Philippines	0.1%	1.0				
Silver	Finland	0.1%	0.8				
Silver	Kyrgyzstan	0.1%	1.0				
Silver	Romania	0.1%	0.8				
Silver	Armenia	0.1%	1.0				
Silver	Panama	0.1%	1.0				
Silver	North Macedonia	0.1%	1.0				
Silver	Nicaragua	0.1%	1.0				
Silver	Georgia	0.1%	1.0				
Silver	Colombia	0.1%	1.0				
Silver	Serbia	0.1%	1.0				
Silver	Tanzania	0.1%	1.0				
Silver	Azerbaijan	0.0%	1.0				
Silver	Tajikistan	0.0%	1.0				
Silver	Korea, South	0.0%	1.0				
Silver	Thailand	0.0%	1.0				
Silver	Burkina Faso	0.0%	1.0				
Silver	Saudi Arabia	0.0%	1.0				
Silver	Namibia	0.0%	1.0				
Silver	New Zealand	0.0%	1.0				
Silver	Germany	0.0%	0.8				
Silver	Ghana	0.0%	1.0				
Silver	Japan	0.0%	1.0				
Silver	Congo, D.R.	0.0%	1.0				
Silver	Mali	0.0%	1.0				
Silver	Cyprus	0.0%	0.8				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Silver	Fiji	0.0%	1.0				
Silver	Cote d'Ivoire	0.0%	1.0				
Silver	Ethiopia	0.0%	1.0				
Silver	Ecuador	0.0%	1.0				
Silver	Slovakia	0.0%	0.8				
Silver	Senegal	0.0%	1.0				
Silver	Sudan	0.0%	1.0				
Silver	Ireland	0.0%	0.8				
Silver	Malaysia	0.0%	1.0				
Silver	Niger	0.0%	1.0				
Strontium	Iran	37.5%	1.0				
Strontium	Spain	34.2%	0.8				
Strontium	China	16.4%	1.0				
Strontium	Mexico	11.2%	1.0				
Strontium	Argentina	0.7%	1.0				
Talc	India	21.9%	1.0				
Talc	China	19.5%	1.1				
Talc	Brazil	9.6%	1.0				
Talc	United States	8.1%	1.0				
Talc	Korea, South	5.7%	1.0				
Talc	France	4.9%	0.8				
Talc	Finland	4.7%	0.8				
Talc	Japan	3.5%	1.0				
Talc	Türkiye	3.3%	1.0				
Talc	Canada	3.2%	1.0				
Talc	Italy	2.3%	0.8				
Talc	Russia	2.1%	1.0				
Talc	Pakistan	2.1%	1.0				
Talc	Australia	1.9%	1.0				
Talc	Austria	1.7%	0.8				
Talc	South Africa	1.2%	1.0				
Talc	Iran	1.0%	1.0				
Talc	Thailand	0.7%	1.0				
Talc	Saudi Arabia	0.6%	1.0				
Talc	Slovakia	0.6%	0.8				
Talc	Peru	0.6%	1.0				
Talc	Egypt	0.2%	1.1				
Talc	Portugal	0.2%	0.8				
Talc	Argentina	0.2%	1.0				
Talc	Spain	0.1%	0.8				
Talc	Mexico	0.1%	1.0				
Talc	Nepal	0.1%	1.0				
Talc	Sudan	0.0%	1.0				
Talc	United Kingdom	0.0%	1.0				
Talc	Nigeria	0.0%	1.0				
Talc	Guatemala	0.0%	1.0				
Talc	Colombia	0.0%	1.0				
Talc	Bhutan	0.0%	1.0				
Talc	Uruguay	0.0%	1.0				
Talc	Taiwan	0.0%	1.0				
Tantalum	Congo, D.R.	35.4%	1.1				
Tantalum	Rwanda	17.3%	1.0				
Tantalum	Brazil	15.9%	1.1				
Tantalum	Nigeria	10.6%	1.0				
Tantalum	China	6.9%	1.0				
Tantalum	Ethiopia	4.1%	1.0				
Tantalum	Mozambique	3.4%	1.0				
Tantalum	Russia	2.5%	1.0				
Tantalum	Australia	2.1%	1.0				
Tantalum	Burundi	0.6%	1.0				
Tantalum	Malaysia	0.5%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Tantalum	Bolivia	0.4%	1.0				
Tantalum	France	0.3%	0.8				
Terbium	China	84.4%	1.0				
Terbium	Myanmar	9.3%	1.0				
Terbium	Russia	1.9%	1.0				
Terbium	Thailand	1.3%	1.0				
Terbium	India	1.2%	1.0				
Terbium	Brazil	1.0%	1.0				
Terbium	Vietnam	0.5%	1.0				
Terbium	Malaysia	0.3%	1.0				
Terbium	Burundi	0.2%	1.0				
Thulium	China	68.3%	1.0				
Thulium	Australia	9.9%	1.0				
Thulium	United States	9.2%	1.0				
Thulium	Myanmar	7.5%	1.0				
Thulium	Russia	1.5%	1.0				
Thulium	Thailand	1.1%	1.0				
Thulium	India	1.0%	1.0				
Thulium	Brazil	0.8%	1.0				
Thulium	Vietnam	0.4%	1.0				
Thulium	Malaysia	0.3%	1.0				
Thulium	Burundi	0.1%	1.0				
Tin	China	28.9%	1.1				
Tin	Indonesia	23.5%	1.0				
Tin	Myanmar	17.0%	1.0				
Tin	Peru	6.4%	1.0				
Tin	Bolivia	5.7%	1.1				
Tin	Brazil	5.4%	1.0				
Tin	Congo, D.R.	3.4%	1.1				
Tin	Australia	2.5%	1.0				
Tin	Nigeria	2.2%	1.0				
Tin	Vietnam	1.9%	1.0				
Tin	Malaysia	1.3%	1.0				
Tin	Rwanda	1.0%	1.1				
Tin	Russia	0.6%	1.0				
Tin	Laos	0.2%	1.0				
Tin	Thailand	0.1%	1.0				
Tin	Burundi	0.0%	1.0				
Tin	United Kingdom	0.0%	1.0				
Tin	Portugal	0.0%	0.8				
Tin	Tanzania	0.0%	1.0				
Tin	Namibia	0.0%	1.0				
Tin	Spain	0.0%	0.8				
Tin	Uganda	0.0%	1.0				
Tin	Mongolia	0.0%	1.0				
Tin	India	0.0%	1.0				
Tin	Colombia	0.0%	1.0				
Titanium metal	China	25.4%	1.1				
Titanium metal	South Africa	13.1%	1.0				
Titanium metal	Australia	12.1%	1.0				
Titanium metal	Mozambique	10.1%	1.0				
Titanium metal	Canada	7.6%	1.0				
Titanium metal	Ukraine	6.3%	1.0				
Titanium metal	Kenya	4.1%	1.0				
Titanium metal	Senegal	3.7%	1.1				
Titanium metal	Norway	3.0%	1.0				
Titanium metal	India	2.9%	1.1				
Titanium metal	Madagascar	2.9%	1.0				
Titanium metal	Sierra Leone	2.1%	1.1				
Titanium metal	Korea, South	1.7%	1.0				
Titanium metal	Vietnam	1.5%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Titanium metal	United States	1.1%	1.0				
Titanium metal	Brazil	0.9%	1.0				
Titanium metal	Kazakhstan	0.8%	1.0				
Titanium metal	Sri Lanka	0.3%	1.0				
Titanium metal	Iran	0.2%	1.0				
Titanium metal	Malaysia	0.1%	1.0				
Titanium metal	Türkiye	0.1%	1.0				
Titanium metal	Russia	0.1%	1.0				
Titanium metal	Thailand	0.0%	1.0				
Titanium	China	25.4%	1.1				
Titanium	South Africa	13.1%	1.0				
Titanium	Australia	12.1%	1.0				
Titanium	Mozambique	10.1%	1.0				
Titanium	Canada	7.6%	1.0				
Titanium	Ukraine	6.3%	1.0				
Titanium	Kenya	4.1%	1.0				
Titanium	Senegal	3.7%	1.1				
Titanium	Norway	3.0%	1.0				
Titanium	India	2.9%	1.1				
Titanium	Madagascar	2.9%	1.0				
Titanium	Sierra Leone	2.1%	1.1				
Titanium	Korea, South	1.7%	1.0				
Titanium	Vietnam	1.5%	1.0				
Titanium	United States	1.1%	1.0				
Titanium	Brazil	0.9%	1.0				
Titanium	Kazakhstan	0.8%	1.0				
Titanium	Sri Lanka	0.3%	1.0				
Titanium	Iran	0.2%	1.0				
Titanium	Malaysia	0.1%	1.0				
Titanium	Russia	0.1%	1.0				
Titanium	Türkiye	0.1%	1.0				
Titanium	Thailand	0.0%	1.0				
Tungsten	China	82.6%	1.1				
Tungsten	Vietnam	6.4%	1.2				
Tungsten	Russia	2.7%	1.1				
Tungsten	Bolivia	1.4%	1.1				
Tungsten	Rwanda	1.2%	1.1				
Tungsten	Austria	1.1%	0.8				
Tungsten	Korea, North	0.8%	1.0				
Tungsten	Portugal	0.7%	0.8				
Tungsten	Spain	0.6%	0.8				
Tungsten	United Kingdom	0.6%	1.0				
Tungsten	Mongolia	0.5%	1.0				
Tungsten	Brazil	0.4%	1.0				
Tungsten	Myanmar	0.2%	1.0				
Tungsten	Congo, D.R.	0.2%	1.0				
Tungsten	Burundi	0.2%	1.0				
Tungsten	Uganda	0.1%	1.0				
Tungsten	Uzbekistan	0.1%	1.0				
Tungsten	Australia	0.1%	1.0				
Tungsten	Thailand	0.1%	1.0				
Tungsten	Peru	0.0%	1.0				
Tungsten	Nigeria	0.0%	1.0				
Tungsten	Mexico	0.0%	1.0				
Tungsten	Zimbabwe	0.0%	1.0				
Tungsten	Colombia	0.0%	1.0				
Tungsten	Korea, South	0.0%	1.0				
Vanadium	China	61.6%	1.0				
Vanadium	Russia	19.8%	1.0				
Vanadium	South Africa	10.6%	1.0				
Vanadium	Brazil	7.6%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Vanadium	India	0.4%	1.0				
Vanadium	United States	0.1%	1.0				
Ytterbium	China	68.3%	1.0				
Ytterbium	Australia	9.9%	1.0				
Ytterbium	United States	9.2%	1.0				
Ytterbium	Myanmar	7.5%	1.0				
Ytterbium	Russia	1.5%	1.0				
Ytterbium	Thailand	1.1%	1.0				
Ytterbium	India	1.0%	1.0				
Ytterbium	Brazil	0.8%	1.0				
Ytterbium	Vietnam	0.4%	1.0				
Ytterbium	Malaysia	0.3%	1.0				
Ytterbium	Burundi	0.1%	1.0				
Yttrium	China	68.3%	1.0				
Yttrium	Australia	9.9%	1.0				
Yttrium	United States	9.2%	1.0				
Yttrium	Myanmar	7.5%	1.0				
Yttrium	Russia	1.5%	1.0				
Yttrium	Thailand	1.1%	1.0				
Yttrium	India	1.0%	1.0				
Yttrium	Brazil	0.8%	1.0				
Yttrium	Vietnam	0.4%	1.0				
Yttrium	Malaysia	0.3%	1.0				
Yttrium	Burundi	0.1%	1.0				
Zinc	China	31.6%	1.0				
Zinc	Peru	11.6%	1.0				
Zinc	Australia	9.1%	1.0				
Zinc	United States	6.4%	1.0				
Zinc	India	6.2%	1.0				
Zinc	Mexico	5.8%	1.0				
Zinc	Bolivia	4.0%	1.0				
Zinc	Kazakhstan	2.8%	1.0				
Zinc	Canada	2.7%	1.0				
Zinc	Russia	2.2%	1.0				
Zinc	Sweden	2.0%	0.8				
Zinc	Brazil	1.4%	1.0				
Zinc	Türkiye	1.2%	1.0				
Zinc	Iran	1.2%	1.0				
Zinc	Ireland	1.1%	0.8				
Zinc	Portugal	1.0%	0.8				
Zinc	Namibia	0.9%	1.0				
Zinc	Eritrea	0.8%	1.0				
Zinc	Burkina Faso	0.7%	1.0				
Zinc	Spain	0.7%	0.8				
Zinc	South Africa	0.6%	1.0				
Zinc	Tajikistan	0.6%	1.0				
Zinc	Finland	0.5%	0.8				
Zinc	Mongolia	0.4%	1.0				
Zinc	Morocco	0.4%	1.0				
Zinc	Poland	0.4%	0.8				
Zinc	Korea, North	0.3%	1.0				
Zinc	Uzbekistan	0.3%	1.0				
Zinc	Myanmar	0.3%	1.0				
Zinc	Cuba	0.3%	1.0				
Zinc	North Macedonia	0.2%	1.0				
Zinc	Chile	0.2%	1.0				
Zinc	Saudi Arabia	0.2%	1.0				
Zinc	Honduras	0.2%	1.0				
Zinc	Nigeria	0.2%	1.0				
Zinc	Pakistan	0.2%	1.0				

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Zinc	Greece	0.2%	0.8				
Zinc	Argentina	0.2%	1.0				
Zinc	Indonesia	0.1%	1.0				
Zinc	Bulgaria	0.1%	0.8				
Zinc	Vietnam	0.1%	1.0				
Zinc	Montenegro	0.1%	1.0				
Zinc	Serbia	0.1%	1.0				
Zinc	Congo, D.R.	0.1%	1.0				
Zinc	Bosnia and Herzegovina	0.1%	1.0				
Zinc	Thailand	0.1%	1.0				
Zinc	Armenia	0.1%	1.0				
Zinc	Guatemala	0.0%	1.0				
Zinc	Dominican Republic	0.0%	1.0				
Zinc	Korea, South	0.0%	1.0				
Zinc	Kosovo	0.0%	1.0				
Zinc	Laos	0.0%	1.0				
Zinc	Algeria	0.0%	1.0				
Zinc	Romania	0.0%	0.8				
Zinc	Congo	0.0%	1.0				
Zinc	Slovakia	0.0%	0.8				
Zinc	Georgia	0.0%	1.0				
Zinc	Zambia	0.0%	1.0				
Zirconium	Australia	33.6%	1.0				
Zirconium	South Africa	23.4%	1.0				
Zirconium	Mozambique	11.2%	1.0				
Zirconium	China	9.0%	1.1				
Zirconium	Senegal	5.5%	1.1				
Zirconium	United States	3.6%	1.0				
Zirconium	Indonesia	3.6%	1.0				
Zirconium	Kenya	2.5%	1.0				
Zirconium	Madagascar	1.7%	1.0				
Zirconium	Ukraine	1.6%	1.0				
Zirconium	Brazil	1.2%	1.0				
Zirconium	India	0.9%	1.0				
Zirconium	Russia	0.7%	1.0				
Zirconium	Vietnam	0.6%	1.0				
Zirconium	Sierra Leone	0.4%	1.1				
Zirconium	Sri Lanka	0.3%	1.0				
Zirconium	Nigeria	0.1%	1.0				
Zirconium	Malaysia	0.1%	1.0				
Zirconium	Türkiye	0.1%	1.0				

Annex 8. EU Sourcing shares (≥1%) and trade-related variable

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Aggregates	Germany	23%	0.8	Aluminium	Russia	19%	1.1
Aggregates	France	15%	0.8	Aluminium	Germany	10%	0.8
Aggregates	Poland	12%	0.8	Aluminium	Mozambique	9%	1
Aggregates	Italy	6%	0.8	Aluminium	Iceland	8%	1
Aggregates	Spain	4%	0.8	Aluminium	France	8%	0.8
Aggregates	Austria	4%	0.8	Aluminium	Spain	6%	0.8
Aggregates	Netherlands	3%	0.8	Aluminium	Romania	5%	0.8
Aggregates	Romania	3%	0.8	Aluminium	Greece	3%	0.8
Aggregates	Finland	3%	0.8	Aluminium	Slovakia	3%	0.8
Aggregates	Sweden	3%	0.8	Aluminium	Canada	2%	1
Aggregates	Belgium	3%	0.8	Aluminium	Sweden	2%	0.8
Aggregates	Hungary	2%	0.8	Aluminium	United Arab Emirates	2%	1
Aggregates	Czechia	2%	0.8	Aluminium	United Kingdom	1%	1
Aggregates	Denmark	2%	0.8	Aluminium	India	1%	1
Aggregates	Bulgaria	1%	0.8	Aluminium	Kazakhstan	1%	1
Aggregates	Ireland	1%	0.8	Aluminium	South Africa	1%	1
Aggregates	Slovakia	1%	0.8	Aluminium	Norway	1%	1
Aggregates	Greece	1%	0.8	Aluminium	Slovenia	1%	0.8
Aggregates	Lithuania	1%	0.8	Aluminium	Netherlands	1%	0.8
Aggregates	Croatia	1%	0.8	Aluminium	Cameroon	1%	1
Aggregates	Norway	1%	1	Aluminium	Egypt	1%	1.0
Aggregates	Estonia	1%	0.8	Aluminium	Saudi Arabia	1%	1
Aluminium	Guinea	62%	1.1	Aluminium	Bahrain	1%	1
Aluminium	Brazil	12%	1	Aluminium	Brazil	1%	1
Aluminium	Greece	10%	0.8	Aluminium	Ghana	1%	1
Aluminium	Sierra Leone	8%	1	Aluminium	Montenegro	1%	1
Aluminium	Türkiye	1%	1	Aluminium	Oman	1%	1
Aluminium	Guyana	1%	1	Antimony	China	30%	1.1
Aluminium	China	1%	1	Antimony	Belgium	21%	0.8
Aluminium	France	1%	0.8	Antimony	France	14%	0.8
Aluminium	Ghana	1%	1	Antimony	Tajikistan	8%	1
Antimony	Türkiye	63%	1	Antimony	Vietnam	7%	1
Antimony	Bolivia	26%	1.1	Antimony	Spain	3%	0.8
Antimony	China	6%	1.1	Antimony	Korea, South	3%	1
Antimony	Guatemala	3%	1	Antimony	Germany	2%	0.8
Antimony	United Kingdom	1%	1	Antimony	Italy	1%	0.8
Barytes	China	44%	1	Antimony	Myanmar	1%	1
Barytes	Morocco	28%	1	Antimony	Netherlands	1%	0.8
Barytes	Bulgaria	11%	0.8	Antimony	Thailand	1%	1
Barytes	Germany	7%	0.8	Antimony	Bolivia	1%	1.1
Barytes	Türkiye	4%	1	Arsenic	United Kingdom	44%	1
Barytes	Slovakia	2%	0.8	Arsenic	Belgium	24%	0.8
Barytes	Canada	1%	1	Arsenic	China	16%	1
Bentonite	Greece	35%	0.8	Arsenic	Morocco	14%	1
Bentonite	Türkiye	12%	1	Arsenic	Hong Kong	1%	1
Bentonite	Germany	11%	0.8	Beryllium	United States	60%	1
Bentonite	Czechia	8%	0.8	Beryllium	Kazakhstan	25%	1
Bentonite	Slovakia	7%	0.8	Beryllium	Japan	10%	1
Bentonite	Spain	5%	0.8	Beryllium	China	5%	1
Bentonite	India	3%	1	Bismuth	China	50%	1
Bentonite	Cyprus	2%	0.8	Bismuth	Belgium	26%	0.8
Bentonite	Italy	2%	0.8	Bismuth	Thailand	9%	1
Bentonite	Bulgaria	1%	0.8	Bismuth	Laos	5%	1
Bentonite	Romania	1%	0.8	Bismuth	Korea, South	5%	1
Bentonite	Denmark	1%	0.8	Bismuth	Vietnam	3%	1
Bentonite	France	1%	0.8	Bismuth	Japan	2%	1
Bentonite	Morocco	1%	1	Borate	Türkiye	46%	1

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Bentonite	Hungary	1%	0.8	Borate	Germany	25%	0.8
Bentonite	United States	1%	1	Borate	United States	20%	1
Bentonite	Canada	1%	1	Borate	United Kingdom	3%	1
Borate	Türkiye	99%	1	Borate	Russia	1%	1
Chromium	South Africa	7%	1	Borate	Peru	1%	1
Chromium	Türkiye	2%	1	Borate	China	1%	1
Coking coal	Poland	26%	0.8	Borate	Chile	1%	1
Coking coal	Australia	24%	1	Borate	Italy	1%	0.8
Coking coal	United States	20%	1	Cadmium	Netherlands	24%	0.8
Coking coal	Russia	8%	1	Cadmium	Canada	21%	1
Coking coal	Canada	5%	1	Cadmium	Germany	16%	0.8
Coking coal	Czechia	5%	0.8	Cadmium	Norway	8%	1
Coking coal	Mozambique	2%	1	Cadmium	Bulgaria	8%	0.8
Coking coal	Germany	2%	0.8	Cadmium	Poland	5%	0.8
Coking coal	Colombia	1%	1	Cadmium	Mexico	4%	1
Copper	Poland	19%	0.8	Cadmium	Russia	4%	1
Copper	Chile	14%	1	Cadmium	Japan	3%	1
Copper	Peru	10%	1	Cadmium	China	1%	1
Copper	Brazil	9%	1	Cadmium	United Kingdom	1%	1
Copper	Spain	8%	0.8	Cerium	China	69%	1
Copper	Bulgaria	5%	0.8	Cerium	Russia	8%	1
Copper	Canada	4%	1	Cerium	United Kingdom	6%	1
Copper	Sweden	4%	0.8	Cerium	Japan	4%	1
Copper	Georgia	3%	1	Cerium	United States	1%	1
Copper	United States	3%	1	Cerium	Norway	1%	1
Copper	Finland	2%	0.8	Chromium	Finland	34%	0.8
Copper	Portugal	2%	0.8	Chromium	South Africa	31%	1
Copper	Mexico	1%	1	Chromium	Sweden	9%	0.8
Copper	Panama	1%	1	Chromium	Russia	4%	1.1
Copper	Morocco	1%	1	Chromium	Kazakhstan	3%	1
Copper	Indonesia	1%	1.2	Chromium	Germany	2%	0.8
Copper	Argentina	1%	1.1	Chromium	Türkiye	2%	1
Copper	Armenia	1%	1	Chromium	Zimbabwe	2%	1
Copper	Türkiye	1%	1	Chromium	India	1%	1
Copper	Australia	1%	1	Chromium	Albania	1%	1
Copper	North Macedonia	1%	1	Cobalt	Finland	62%	0.8
Diatomite	Denmark	28%	0.8	Cobalt	Belgium	29%	0.8
Diatomite	France	23%	0.8	Cobalt	Congo, D.R.	2%	1.1
Diatomite	Spain	16%	0.8	Cobalt	China	2%	1
Diatomite	Germany	14%	0.8	Cobalt	Norway	1%	1
Diatomite	Czechia	9%	0.8	Cobalt	United Kingdom	1%	1
Diatomite	United States	4%	1	Coking coal	Germany	28%	0.8
Diatomite	Mexico	1%	1	Coking coal	Poland	24%	0.8
Diatomite	Russia	1%	1	Coking coal	France	8%	0.8
Feldspar	Türkiye	51%	1	Coking coal	Czechia	6%	0.8
Feldspar	Italy	22%	0.8	Coking coal	Netherlands	5%	0.8
Feldspar	Spain	7%	0.8	Coking coal	Italy	4%	0.8
Feldspar	France	5%	0.8	Coking coal	Austria	3%	0.8
Feldspar	Czechia	4%	0.8	Coking coal	Belgium	3%	0.8
Feldspar	Norway	3%	1	Coking coal	Sweden	3%	0.8
Feldspar	Germany	2%	0.8	Coking coal	Slovakia	3%	0.8
Feldspar	Portugal	1%	0.8	Coking coal	Spain	3%	0.8
Feldspar	Poland	1%	0.8	Coking coal	Finland	2%	0.8
Fluorspar	Spain	62%	0.8	Coking coal	Hungary	2%	0.8
Fluorspar	Germany	22%	0.8	Coking coal	Russia	1%	1.1
Fluorspar	Italy	14%	0.8	Copper	Germany	17%	0.8
Gold	Finland	28%	0.8	Copper	Poland	14%	0.8
Gold	Bulgaria	28%	0.8	Copper	Spain	11%	0.8
Gold	Sweden	25%	0.8	Copper	Belgium	9%	0.8
Gold	Greece	6%	0.8	Copper	Russia	7%	1
Gold	Spain	5%	0.8	Copper	Chile	7%	1

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Gold	Romania	2%	0.8	Copper	Bulgaria	6%	0.8
Gold	Poland	2%	0.8	Copper	Sweden	5%	0.8
Gold	Slovakia	1%	0.8	Copper	Austria	3%	0.8
Gypsum	Spain	45%	1	Copper	Finland	3%	0.8
Gypsum	Germany	19%	1	Copper	Congo	2%	1
Gypsum	France	11%	1	Copper	Congo, D.R.	2%	1
Gypsum	Poland	4%	1	Copper	Peru	1%	1
Gypsum	Austria	3%	1	Copper	Namibia	1%	1
Gypsum	Greece	3%	1	Copper	Zambia	1%	1
Gypsum	Romania	3%	1	Copper	Kazakhstan	1%	1
Gypsum	Cyprus	2%	1	Copper	Serbia	1%	1
Gypsum	Latvia	1%	1	Copper	South Africa	1%	1
Gypsum	Italy	1%	1	Copper	Norway	1%	1
Gypsum	Croatia	1%	1	Gallium	China	69%	1
Gypsum	Portugal	1%	1	Gallium	United States	10%	1
Gypsum	Ireland	1%	1	Gallium	United Kingdom	9%	1
Heavy Rare earths Elements	Japan	55%	1	Gallium	Taiwan	2%	1
Heavy Rare earths Elements	China	43%	1	Gallium	Germany	2%	0.8
Heavy Rare earths Elements	United States	2%	1	Gallium	Ukraine	2%	1
Heavy Rare earths Elements	United Kingdom	1%	1	Gallium	Russia	1%	1
Hydrogen	Russia	26%	1	Gallium	Hong Kong	1%	1
Hydrogen	Netherlands	21%	0.8	Germanium	China	88%	1
Hydrogen	Algeria	13%	1	Germanium	United Kingdom	4%	1
Hydrogen	Norway	9%	1	Germanium	Taiwan	1%	1
Hydrogen	Romania	5%	0.8	Germanium	Japan	1%	1
Hydrogen	Germany	4%	0.8	Germanium	Russia	1%	1
Hydrogen	United Kingdom	4%	1	Germanium	Hong Kong	1%	1
Hydrogen	Italy	3%	0.8	Hafnium	France	76%	0.8
Hydrogen	Denmark	2%	0.8	Hafnium	Ukraine	14%	1
Hydrogen	Libya	2%	1	Hafnium	China	5%	1
Hydrogen	Poland	2%	0.8	Hafnium	Russia	3%	1.1
Hydrogen	Hungary	1%	0.8	Helium	Qatar	34%	1
Hydrogen	Ireland	1%	0.8	Helium	Algeria	29%	1
Hydrogen	Croatia	1%	0.8	Helium	United States	21%	1
Hydrogen	Austria	1%	0.8	Helium	Poland	5%	0.8
Iron ore	Brazil	33%	1	Helium	China	4%	1
Iron ore	Sweden	21%	0.8	Helium	United Arab Emirates	2%	1
Iron ore	Canada	13%	1	Helium	Russia	1%	1
Iron ore	Ukraine	12%	1	Hydrogen	Germany	34%	0.8
Iron ore	South Africa	6%	1	Hydrogen	Netherlands	16%	0.8
Iron ore	Liberia	3%	1	Hydrogen	Poland	9%	0.8
Iron ore	Russia	2%	1	Hydrogen	Spain	8%	0.8
Iron ore	Mauritania	2%	1	Hydrogen	France	7%	0.8
Iron ore	Norway	1%	1	Hydrogen	Finland	7%	0.8
Iron ore	Austria	1%	0.8	Hydrogen	Italy	6%	0.8
Iron ore	Argentina	1%	1	Hydrogen	Czechia	6%	0.8
Kaolin	France	28%	0.8	Hydrogen	Hungary	2%	0.8
Kaolin	Spain	17%	0.8	Indium	France	38%	0.8
Kaolin	Italy	8%	0.8	Indium	Belgium	25%	0.8
Kaolin	Portugal	2%	0.8	Indium	China	14%	1
Lanthanum	China	43%	1	Indium	Taiwan	9%	1
Lanthanum	Japan	30%	1	Indium	Germany	5%	0.8
Lanthanum	United States	16%	1	Indium	United States	2%	1
Lanthanum	Malaysia	6%	1	Indium	United Kingdom	2%	1
Lanthanum	India	5%	1	Indium	Hong Kong	1%	1
Lead	Poland	17%	0.8	Iron ore	Germany	25%	0.8

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Lead	Sweden	17%	0.8	Iron ore	Italy	14%	0.8
Lead	North Macedonia	8%	1	Iron ore	Spain	8%	0.8
Lead	United States	7%	1	Iron ore	France	8%	0.8
Lead	Mexico	6%	1	Iron ore	Poland	5%	0.8
Lead	Peru	6%	1	Iron ore	Belgium	4%	0.8
Lead	Portugal	4%	0.8	Iron ore	Austria	4%	0.8
Lead	Ireland	4%	0.8	Iron ore	Netherlands	4%	0.8
Lead	Bulgaria	4%	0.8	Iron ore	Czechia	2%	0.8
Lead	Morocco	3%	1	Iron ore	Finland	2%	0.8
Lead	Argentina	3%	1	Iron ore	Russia	2%	1
Lead	Greece	3%	0.8	Iron ore	Slovakia	2%	0.8
Lead	Spain	2%	0.8	Iron ore	Sweden	2%	0.8
Lead	Bolivia	2%	1	Iron ore	Romania	2%	0.8
Lead	Serbia	1%	1	Iron ore	Hungary	1%	0.8
Lead	Türkiye	1%	1	Iron ore	Luxembourg	1%	0.8
Lead	Chile	1%	1	Iron ore	Portugal	1%	0.8
Lead	Burkina Faso	1%	1	Iron ore	Ukraine	1%	1.1
Lead	Australia	1%	1	Iron ore	Greece	1%	0.8
Limestone	Spain	21%	0.8	Iron ore	Brazil	1%	1
Limestone	Italy	16%	0.8	Kaolin	Germany	37%	0.8
Limestone	Germany	13%	0.8	Kaolin	Spain	22%	0.8
Limestone	Poland	11%	0.8	Kaolin	Portugal	19%	0.8
Limestone	France	11%	0.8	Kaolin	France	11%	0.8
Limestone	Austria	3%	0.8	Kaolin	Poland	8%	0.8
Limestone	Czechia	2%	0.8	Krypton	Germany	63%	0.8
Limestone	Romania	2%	0.8	Krypton	Switzerland	19%	1
Limestone	Greece	1%	0.8	Krypton	Trinidad and Tobago	5%	1
Limestone	Portugal	1%	0.8	Krypton	Ukraine	5%	1
Limestone	Denmark	1%	0.8	Krypton	Russia	4%	1
Limestone	Bulgaria	1%	0.8	Krypton	China	2%	1
Limestone	Slovakia	1%	0.8	Krypton	Mauritius	1%	1
Limestone	Sweden	1%	0.8	Krypton	Dominican Republic	1%	1
Limestone	Ireland	1%	0.8	Lanthanum	China	69%	1
Limestone	Norway	1%	1	Lanthanum	Russia	8%	1
Limestone	Slovenia	1%	0.8	Lanthanum	United Kingdom	6%	1
Limestone	Hungary	1%	0.8	Lanthanum	Japan	4%	1
Limestone	Cyprus	1%	0.8	Lanthanum	United States	1%	1
Limestone	Finland	1%	0.8	Lanthanum	Norway	1%	1
Magnesite	Slovakia	31%	0.8	Lead	Germany	21%	0.8
Magnesite	Austria	25%	0.8	Lead	Spain	11%	0.8
Magnesite	Spain	23%	0.8	Lead	Poland	10%	0.8
Magnesite	Greece	13%	0.8	Lead	Italy	10%	0.8
Magnesite	Poland	3%	0.8	Lead	Belgium	8%	0.8
Magnesite	Finland	2%	0.8	Lead	Bulgaria	6%	0.8
Magnesite	Türkiye	1%	1	Lead	Sweden	4%	0.8
Manganese	South Africa	41%	1	Lead	United Kingdom	4%	1
Manganese	Gabon	39%	1	Lead	France	4%	0.8
Manganese	Brazil	8%	1	Lead	Czechia	2%	0.8
Manganese	Ukraine	3%	1	Lead	Netherlands	2%	0.8
Manganese	Romania	2%	0.8	Lead	Lebanon	1%	1
Manganese	Bulgaria	1%	0.8	Lead	Greece	1%	0.8
Manganese	Australia	1%	1	Lead	Ireland	1%	0.8
Manganese	Mexico	1%	1	Lead	Russia	1%	1
Manganese	Cote d'Ivoire	1%	1	Lead	Romania	1%	0.8
Manganese	Bosnia and Herzegovina	1%	1	Lead	Austria	1%	0.8
Molybdenum	United States	59%	1	Lead	Korea, South	1%	1
Molybdenum	Chile	16%	1	Lead	Slovenia	1%	0.8
Molybdenum	Peru	8%	1	Lead	Kazakhstan	1%	1
Molybdenum	Canada	5%	1	Lead	Portugal	1%	0.8
Molybdenum	Mexico	1%	1	Lead	Ukraine	1%	1

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Molybdenum	Armenia	1%	1	Lead	Estonia	1%	0.8
Molybdenum	China	1%	1	Lithium	Chile	79%	1
Natural cork	Spain	36%	0.8	Lithium	Switzerland	7%	1
Natural cork	Italy	3%	0.8	Lithium	Argentina	6%	1.1
Natural cork	France	3%	0.8	Lithium	United States	5%	1
Natural Graphite	China	40%	1	Lithium	China	1%	1
Natural Graphite	Brazil	13%	1	Magnesium	China	97%	1
Natural Graphite	Mozambique	12%	1	Magnesium	Israel	1%	1
Natural Graphite	Norway	8%	1	Magnesium	United Kingdom	1%	1
Natural Graphite	Ukraine	7%	1	Manganese	Norway	21%	1
Natural Graphite	Madagascar	6%	1	Manganese	Ukraine	19%	1
Natural Graphite	Russia	2%	1	Manganese	Spain	14%	0.8
Natural Graphite	United States	1%	1	Manganese	France	11%	0.8
Natural Graphite	Zimbabwe	1%	1	Manganese	South Africa	10%	1
Natural Graphite	Canada	1%	1	Manganese	India	5%	1
Natural Graphite	Japan	1%	1	Manganese	Slovakia	5%	0.8
Natural Graphite	Korea, South	1%	1	Manganese	Korea, South	3%	1
Natural Graphite	Sri Lanka	1%	1	Manganese	Malaysia	3%	1
Natural Rubber	Indonesia	30%	1	Manganese	Georgia	1%	1
Natural Rubber	Thailand	21%	1	Manganese	Brazil	1%	1
Natural Rubber	Cote d'Ivoire	19%	1	Manganese	Gabon	1%	1
Natural Rubber	Malaysia	12%	1	Manganese	Zambia	1%	1
Natural Rubber	Vietnam	8%	1	Molybdenum	Chile	28%	1
Natural Rubber	Cameroon	2%	1	Molybdenum	United Kingdom	14%	1
Natural Rubber	Nigeria	2%	1	Molybdenum	Korea, South	13%	1
Natural Rubber	Liberia	1%	1	Molybdenum	United States	12%	1
Natural Rubber	Gabon	1%	1	Molybdenum	Armenia	11%	1
Natural Rubber	Ghana	1%	1	Molybdenum	China	4%	1
Natural teak wood	Canada	43%	1	Molybdenum	Mexico	3%	1
Natural teak wood	Ghana	22%	1	Molybdenum	Luxembourg	2%	0.8
Natural teak wood	DRC	6%	1	Molybdenum	Russia	1%	1
Natural teak wood	Laos	5%	1	Molybdenum	Iran	1%	1
Natural teak wood	Mauritius	4%	1	Molybdenum	Uzbekistan	1%	1
Natural teak wood	Costa Rica	3%	1	Neodymium	China	69%	1
Natural teak wood	Grenada	3%	1	Neodymium	Russia	8%	1
Natural teak wood	Indonesia	3%	1	Neodymium	United Kingdom	6%	1
Natural teak wood	Cote d'Ivoire	3%	1	Neodymium	Japan	4%	1
Natural teak wood	Cameroon	2%	1	Neodymium	United States	1%	1
Natural teak wood	Nicaragua	2%	1	Neodymium	Norway	1%	1
Natural teak wood	Brasil	1%	1	Neon	Switzerland	51%	1
Neodymium	China	43%	1	Neon	Ukraine	14%	1
Neodymium	Japan	30%	1	Neon	Russia	11%	1
Neodymium	United States	16%	1	Neon	Tinidad and Tobago	12%	1
Neodymium	Malaysia	6%	1	Neon	Dominican Republic	2%	1
Neodymium	India	5%	1	Neon	Mauritius	2%	1
Nickel	Finland	38%	0.8	Neon	Hongkong	1%	1
Nickel	Canada	24%	1	Neon	Surinam	1%	1
Nickel	Greece	19%	0.8	Neon	Germany	0.01%	0.8
Nickel	South Africa	7%	1	Nickel	Russia	29%	1

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Nickel	United States	3%	1	Nickel	Finland	17%	0.8
Nickel	Guatemala	2%	1	Nickel	Norway	10%	1
Nickel	Norway	1%	1	Nickel	Canada	6%	1
Nickel	Poland	1%	0.8	Nickel	Australia	6%	1
Perlite	Greece	62%	1	Nickel	United Kingdom	4%	1
Perlite	Türkiye	14%	1	Nickel	Brazil	4%	1
Perlite	Hungary	5%	1	Nickel	Greece	3%	0.8
Perlite	South Africa	5%	1	Nickel	South Africa	2%	1
Perlite	Italy	4%	1	Nickel	Colombia	1%	1
Perlite	Slovakia	2%	1	Nickel	Madagascar	1%	1
Perlite	United Kingdom	1%	1	Nickel	France	1%	0.8
Perlite	Zimbabwe	1%	1	Nickel	Ukraine	1%	1
Perlite	Brazil	1%	1	Nickel	Guatemala	1%	1
Phosphate Rock	Morocco	27%	1	Nickel	Dominican Republic	1%	1
Phosphate Rock	Russia	24%	1	Nickel	Botswana	1%	1
Phosphate Rock	Finland	17%	1	Nickel	North Macedonia	1%	1
Phosphate Rock	Algeria	10%	1	Niobium	Brasil	82%	1
Phosphate Rock	Israel	6%	1	Niobium	Canada	16%	1
Phosphate Rock	South Africa	5%	1	Niobium	United Kingdom	2%	1
Phosphate Rock	Senegal	4%	0.8	Phosphorous	Kazakhstan	62%	1
Phosphate Rock	Egypt	3%	1	Phosphorous	Vietnam	22%	1
Potash	Russia	11%	0.8	Phosphorous	China	13%	1.1
Potash	Spain	11%	1	Phosphorous	United Kingdom	1%	1
Potash	Belarus	9%	0.8	Phosphorous	India	1%	1
Potash	Canada	5%	0.8	Praseodymium	China	69%	1
Potash	Israel	3%	1	Praseodymium	Russia	8%	1
Potash	Chile	1%	1	Praseodymium	United Kingdom	6%	1
Potash	Jordan	1%	1	Praseodymium	Japan	4%	1
Praseodymium	China	43%	1	Praseodymium	United States	1%	1
Praseodymium	Japan	30%	1	Praseodymium	Norway	1%	1
Praseodymium	United States	16%	1	Rhenium	Poland	100%	0.8
Praseodymium	Malaysia	6%	1	Samarium	China	69%	1
Praseodymium	India	5%	1	Samarium	Russia	8%	1
Roundwood	Sweden	17%	0.8	Samarium	United Kingdom	6%	1
Roundwood	Finland	13%	0.8	Samarium	Japan	4%	1
Roundwood	Germany	12%	0.8	Samarium	United States	1%	1
Roundwood	France	6%	0.8	Samarium	Norway	1%	1
Roundwood	Czechia	5%	0.8	Scandium	United Kingdom	85%	1
Roundwood	Spain	4%	0.8	Scandium	China	6%	1
Roundwood	Russia	4%	1	Scandium	United States	4%	1
Roundwood	Austria	3%	0.8	Scandium	Hong Kong	1%	1
Roundwood	Belarus	3%	1	Selenium	Germany	34%	0.8
Roundwood	Latvia	3%	0.8	Selenium	Belgium	18%	0.8
Roundwood	Portugal	3%	0.8	Selenium	Finland	9%	0.8
Roundwood	Estonia	2%	0.8	Selenium	Poland	6%	0.8
Samarium	China	43%	1	Selenium	Russia	6%	1
Samarium	Japan	30%	1	Selenium	Sweden	5%	0.8
Samarium	United States	16%	1	Selenium	Japan	4%	1
Samarium	Malaysia	6%	1	Selenium	Korea, South	4%	1
Samarium	India	5%	1	Selenium	Taiwan	3%	1
Sapele wood	Cameroon	25%	1	Selenium	Canada	2%	1
Sapele wood	Congo	10%	1	Selenium	Switzerland	1%	1
Sapele wood	Congo, D.R.	2%	0.8	Selenium	Serbia	1%	1
Sapele wood	Malaysia	1%	1	Selenium	China	1%	1
Sapele wood	Central African Republic	1%	1	Selenium	Chile	1%	1
Sapele wood	Indonesia	1%	1	Silicon metal	Norway	34%	1
Silica sand	France	20%	1	Silicon metal	France	29%	0.8
Silica sand	Germany	20%	1	Silicon metal	Brazil	9%	1
Silica sand	Bulgaria	15%	1	Silicon metal	Bosnia and Herzegovina	4%	1

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Silica sand	Spain	11%	0.8	Silicon metal	Spain	4%	0.8
Silica sand	Poland	9%	1.1	Silicon metal	Russia	3%	1
Silica sand	Italy	5%	1	Silicon metal	Australia	3%	1
Silica sand	Netherlands	3%	1	Silicon metal	China	2%	1
Silica sand	Austria	2%	1	Silicon metal	Iceland	1%	1
Silica sand	Portugal	2%	1	Silicon metal	South Africa	1%	1
Silica sand	Czechia	2%	1	Silicon metal	Kazakhstan	1%	1
Silica sand	Slovakia	1%	1	Silicon metal	Malaysia	1%	1
Silica sand	Sweden	1%	1	Sulphur	Poland	19%	0.8
Silica sand	Latvia	1%	1	Sulphur	Finland	13%	0.8
Silica sand	Hungary	1%	1	Sulphur	Italy	13%	0.8
Silica sand	Denmark	1%	1	Sulphur	Spain	10%	0.8
Silica sand	Slovenia	1%	0.8	Sulphur	France	7%	0.8
Silica sand	Finland	1%	0.8	Sulphur	Germany	7%	0.8
Silver	Sweden	20%	0.8	Sulphur	Bulgaria	7%	0.8
Silver	Mexico	3%	0.8	Sulphur	Sweden	6%	0.8
Silver	Spain	3%	0.8	Sulphur	Russia	4%	1
Silver	Portugal	3%	0.8	Sulphur	Greece	3%	0.8
Silver	Argentina	2%	0.8	Sulphur	United Kingdom	2%	1
Silver	Bulgaria	2%	0.8	Sulphur	Lithuania	1%	0.8
Silver	Peru	1%	0.8	Sulphur	Kazakhstan	1%	1
Silver	Finland	1%	0.8	Tellurium	Canada	27%	1
Silver	Greece	1%	0.8	Tellurium	Belgium	18%	0.8
Silver	Bolivia	1%	0.8	Tellurium	Germany	16%	0.8
Silver	Romania	1%	0.8	Tellurium	Sweden	16%	0.8
Strontium	Spain	99%	0.8	Tellurium	Philippines	9%	1
Talc	France	31%	0.8	Tellurium	Finland	4%	0.8
Talc	Finland	28%	0.8	Tellurium	Russia	3%	1
Talc	Italy	10%	0.8	Tellurium	Bulgaria	2%	0.8
Talc	Austria	9%	0.8	Tellurium	Japan	1%	1
Talc	Pakistan	5%	1	Tin	Indonesia	33%	1
Talc	Netherlands	4%	0.8	Tin	Belgium	18%	0.8
Talc	Slovakia	2%	0.8	Tin	Peru	10%	1
Talc	India	2%	1	Tin	Poland	7%	0.8
Talc	Australia	2%	0.8	Tin	Malaysia	6%	1
Talc	China	1%	1	Tin	Brazil	5%	1
Talc	Portugal	1%	0.8	Tin	Bolivia	5%	1.1
Tantalum	DRC	35%	1	Tin	China	3%	1.492
Tantalum	Rwanda	17%	1	Tin	Thailand	3%	1
Tantalum	Brazil	16%	1	Tin	United Kingdom	2%	1
Tantalum	Nigeria	11%	1	Tin	Singapore	2%	1
Tantalum	China	7%	1	Tin	Russia	1%	1
Tantalum	Ethiopia	4%	1	Titanium metal	Kazakhstan	36%	1
Tantalum	Mozambique	3%	1	Titanium metal	Russia	34%	1.1
Tantalum	Australia	2%	1	Titanium metal	China	9%	1
Tantalum	Russia	2%	1	Titanium metal	Switzerland	5%	1
Tantalum	Burundi	1%	1	Titanium metal	Japan	5%	1
Tantalum	France	1%	0.8	Titanium metal	Ukraine	2%	1.1
Tin	France	100%	0.8	Titanium metal	Canada	1%	1
Tin	Portugal	38%	1.1	Titanium metal	Türkiye	1%	1
Tin	Spain	26%	0.8	Titanium metal	Norway	1%	1
Tin	Russia	17%	0.8	Titanium metal	Morocco	1%	1
Tin	United States	7%	0.8	Titanium	Germany	64%	0.8
Tin	Thailand	3%	0.8	Titanium	Canada	9%	1
Tin	Argentina	1%	0.8	Titanium	Italy	4%	0.8
Tin	United Kingdom	1%	0.8	Titanium	China	4%	1
Tin	Peru	1%	1	Titanium	Belgium	4%	0.8
Titanium ores	Zambia	1%	0.8	Titanium	Finland	3%	0.8
Titanium ores	Norway	23%	0.8	Titanium	Russia	2%	1.1
Titanium ores	South Africa	15%	1	Titanium	France	1%	0.8
Titanium ores	Canada	14%	1	Titanium	Kazakhstan	1%	1

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t
Titanium ores	Mozambique	9%	1.1	Titanium	Norway	1%	1
Titanium ores	United Kingdom	9%	0.8	Tungsten	China	31%	1
Titanium ores	Ukraine	9%	0.8	Tungsten	Austria	19%	0.8
Titanium ores	Australia	6%	0.8	Tungsten	Vietnam	14%	1.1
Titanium ores	Sierra Leone	5%	0.8	Tungsten	Russia	9%	1
Titanium ores	India	3%	1	Tungsten	United States	9%	1
Titanium ores	Brazil	2%	1	Tungsten	United Kingdom	3%	1
Tungsten	Finland	1%	1	Tungsten	Korea, South	3%	1
Tungsten	Austria	34%	1	Tungsten	Canada	1%	1
Tungsten	Portugal	22%	1	Tungsten	Brazil	1%	1
Zinc	Spain	20%	1	Tungsten	Israel	1%	1
Zinc	Peru	13%	1	Vanadium	Russia	44%	1
Zinc	Sweden	12%	1	Vanadium	South Korea	17%	1
Zinc	United States	10%	1	Vanadium	South Africa	16%	1
Zinc	Australia	8%	1	Vanadium	China	12%	1
Zinc	Mexico	6%	1	Vanadium	Brazil	7%	1
Zinc	Ireland	6%	1	Vanadium	Libanon	1%	1
Zinc	Portugal	6%	1	Vanadium	Latvia	1%	0.8
Zinc	Bolivia	5%	1	Vanadium	Morocco	1%	1
Zinc	Spain	4%	1.1	Xenon	France	49%	0.8
Zinc	Türkiye	4%	1.1	Xenon	Germany	36%	0.8
Zinc	Finland	3%	1	Xenon	Switzerland	8%	1
Zinc	Burkina Faso	3%	0.8	Xenon	Russia	2%	1
Zinc	Poland	2%	0.8	Xenon	Trinidad and Tobago	2%	1
Zinc	Namibia	1%	0.8	Xenon	Ukraine	2%	1
Zinc	North Macedonia	1%	0.8	Xenon	China	1%	1
Zinc	Greece	1%	1	Ytterbium	China	61%	1
Zinc	Chile	1%	1	Ytterbium	Russia	31%	1
Zinc	Honduras	1%	1	Ytterbium	United States	4%	1
Zinc	Serbia	1%	1	Ytterbium	Korea, South	1%	1
Zinc	Bulgaria	1%	1	Ytterbium	Singapore	1%	1
Zinc	Montenegro	1%	1	Yttrium	China	61%	1
Zirconium	Morocco	1%	1.1	Yttrium	Russia	31%	1
Zirconium	South Africa	38%	1	Yttrium	United States	4%	1
Zirconium	Australia	30%	1	Yttrium	Singapore	1%	1
Zirconium	Senegal	11%	1	Yttrium	Korea, South	1%	1
Zirconium	Mozambique	10%	1	Zinc	Spain	22%	0.8
Zirconium	Morocco	2%	1	Zinc	Finland	12%	0.8
Zirconium	Kenya	2%	1	Zinc	Belgium	11%	0.8
Zirconium	Ukraine	1%	1	Zinc	Netherlands	11%	0.8
Zirconium	Madagascar	1%	1	Zinc	Germany	7%	0.8
Zirconium	United States	1%	1	Zinc	Poland	7%	0.8
Zirconium	Indonesia	1%	0.8	Zinc	France	6%	0.8
				Zinc	Italy	5%	0.8
				Zinc	Norway	4%	1
				Zinc	Peru	4%	1
				Zinc	Bulgaria	3%	0.8
				Zinc	Mexico	1%	1
				Zinc	Namibia	1%	1
				Zinc	Kazakhstan	1%	1

Extraction stage				Processing stage			
Material	Country	Share	t	Material	Country	Share	t

Annex 9. Worldwide Governance Indicators (WGI) scaled 0-10

Countries	WGI scaled	Countries	WGI scaled	Countries	WGI scaled	Countries	WGI scaled
Afghanistan	8.18	Djibouti	6.69	Lebanon	6.76	Rwanda	5.01
Albania	5.07	Dominica	3.93	Lesotho	5.66	Saint Kitts and Nevis	3.83
Algeria	6.72	Dominican Republic	5.40	Liberia	6.49	Saint Lucia	3.85
American Samoa	3.07	Ecuador	5.94	Libya	8.83	Saint Vincent and the Grenadines	3.83
Andorra	2.15	Egypt	6.70	Liechtenstein	1.74	Samoa	3.74
Angola	6.87	El Salvador	5.59	Lithuania	3.13	San Marino	2.96
Anguilla	3.23	Equatorial Guinea	7.71	Luxembourg	1.61	Sao Tome and Principe	5.46
Antigua and Barbuda	4.08	Eritrea	8.24	Macau	3.10	Saudi Arabia	5.49
Argentina	5.11	Estonia	2.55	Madagascar	6.46	Senegal	5.12
Armenia	5.35	Ethiopia	6.75	Malawi	5.94	Serbia	5.11
Aruba	2.59	Fiji	4.66	Malaysia	4.21	Seychelles	4.23
Australia	1.92	Finland	1.47	Maldives	5.73	Sierra Leone	6.20
Austria	2.10	France	2.82	Mali	6.84	Singapore	1.75
Azerbaijan	6.39	French Guiana	2.83	Malta	3.02	Slovakia	3.68
Bahamas	3.77	Gabon	6.46	Marshall Islands	5.30	Slovenia	3.12
Bahrain	5.33	Gambia	5.93	Martinique	3.01	Solomon Islands	5.38
Bangladesh	6.63	Georgia	4.15	Mauritania	6.46	Somalia	9.21
Barbados	3.30	Germany	2.07	Mauritius	3.43	South Africa	4.69
Belarus	6.17	Ghana	4.92	Mexico	5.70	South Sudan	9.14
Belgium	2.59	Greece	4.45	Micronesia	4.37	Spain	3.34
Belize	5.53	Greenland	2.25	Moldova	5.70	Sri Lanka	5.25
Benin	5.64	Grenada	4.29	Monaco	2.93	Sudan	8.12
Bermuda	2.84	Guam	3.41	Mongolia	4.97	Suriname	5.35
Bhutan	3.92	Guatemala	6.22	Montenegro	4.80	Swaziland	6.25
Bolivia	6.26	Guinea	6.81	Morocco	5.57	Sweden	1.65
Bosnia and Herzegovina	5.75	Guinea-Bissau	7.27	Mozambique	6.61	Switzerland	1.49
Botswana	3.81	Guyana	5.45	Myanmar	6.84	Syria	8.97
Brazil	5.40	Haiti	7.39	Namibia	4.40	Taiwan	2.73
Brunei Darussalam	3.77	Honduras	6.30	Nauru	5.21	Tajikistan	7.33
Bulgaria	4.59	Hong Kong	2.36	Nepal	6.21	Tanzania	6.05
Burkina Faso	5.94	Hungary	4.03	Netherlands	1.71	Thailand	5.51
Burundi	7.81	Iceland	1.95	New Zealand	1.38	Timor-Leste	5.96
Cambodia	6.54	India	5.27	Nicaragua	6.61	Togo	6.49
Cameroon	7.11	Indonesia	5.32	Niger	6.50	Tonga	4.58
Canada	1.79	Iran	7.04	Nigeria	7.09	Trinidad and Tobago	4.81
Cape Verde	3.97	Iraq	8.01	Niue	2.44	Tunisia	5.43
Cayman Islands	3.29	Ireland	2.24	North Macedonia	5.05	Türkiye	5.93
Central African Republic	8.13	Israel	3.58	Norway	1.43	Turkmenistan	7.82
Chad	7.71	Italy	3.95	Oman	4.70	Tuvalu	4.40
Chile	3.08	Jamaica	4.59	Pakistan	6.95	Uganda	6.20
China	5.68	Japan	2.31	Palau	4.52	Ukraine	6.29
Colombia	5.33	Jersey	2.52	Panama	4.77	United Arab Emirates	3.70
Comoros	6.77	Jordan	5.17	Papua New Guinea	6.18	United Kingdom	2.25
Congo	7.30	Kazakhstan	5.72	Paraguay	5.73	United States	2.68
Congo, D.R.	8.22	Kenya	6.13	Peru	5.20	Uruguay	3.23

Countries	WGI scaled	Countries	WGI scaled	Countries	WGI scaled	Countries	WGI scaled
Cook Islands	2.93	Kiribati	4.34	Philippines	5.66	Uzbekistan	6.97
Costa Rica	3.78	Korea, North	8.25	Poland	3.70	Vanuatu	4.81
Cote d'Ivoire	6.10	Korea, South	3.23	Portugal	2.90	Vanuatu	6.38
Croatia	4.12	Kosovo	5.67	Puerto Rico	4.22	Venezuela	8.38
Cuba	5.91	Kuwait	5.22	Qatar	4.18	Vietnam	5.69
Cyprus	3.39	Kyrgyzstan	6.30	Reunion	3.35	Virgin Islands (U.S.)	3.27
Czechia	3.09	Laos	6.49	Romania	4.50	Yemen	8.89
Denmark	1.65	Latvia	3.37	Russia	6.29	Zambia	5.83
						Zimbabwe	7.42

Annex 10. Import Reliance

Material	Import reliance (%)		Material	Import reliance (%)	
	Extraction	Processing		Extraction	Processing
Aggregates	1%	-	Manganese	96%	66%
Aluminium	-	58%	Molybdenum	100%	100%
Aluminium/bauxite	89%	58%	Natural cork	0%	-
Antimony	100%	47%	Natural graphite	99%	-
Arsenic	-	39%	Natural Rubber	100%	-
Baryte	74%	-	Natural Teak wood	100%	-
Bentonite	16%	-	Neon	-	0%
Beryllium	-	100%	Nickel	31%	75%
Bismuth	-	71%	Niobium	-	100%
Boron	100%	70%	Perlite	0%	-
Cadmium	-	8%	PGM	-	100%
Chromium	7%	42%	Phosphate rock	82%	-
Cobalt	81%	1%	Phosphorus	-	100%
Coking coal	66%	0%	Potash	33%	-
Copper	48%	17%	Rhenium	-	92%
Diatomite	0%	-	Roundwood	0%	-
Feldspar	54%	-	Sapele wood	100%	-
Fluorspar	60%	-	Scandium	-	100%
Gallium	-	98%	Selenium	-	2%
Germanium	-	42%	Silica	0%	-
Gold	0%	-	Silicon metal	-	64%
Gypsum	0%	-	Silver	5%	-
Hafnium	-	0%	Strontium	0%	-
Helium	-	94%	Sulphur	-	0%
HREE	100%	100%	Talc	7%	-
Hydrogen	56%	0%	Tantalum	99%	-
Indium	-	11%	Tellurium		0%
Iron ore	77%	5%	Tin	0%	73%
Kaolin clay	28%	11%	Titanium	100%	18%
Krypton	-	0%	Titanium metal		100%
Lead	21%	6%	Tungsten	21%	80%
Limestone	0%	-	Vanadium	0%	100%
Lithium	81%	100%	Xenon		0%
LREE	80%	100%	Zinc	56%	0%
Magnesite	0%	-	Zirconium	100%	-
Magnesium	-	100%			

Annex 11. End of life recycling input rate (EOL-RIR)

Material	EoL-RIR (%)	Material	EoL-RIR (%)	Material	EoL-RIR (%)
Aggregates	9%	*HREE*	1%	Phosphorus	0%
Aluminium	32%	Hydrogen	0%	Potash	0%
Aluminium/bauxite	32%	Indium	1%	Rhenium	50%
Antimony	28%	Iron ore	31%	Roundwood	20%
Arsenic	0%	Kaolin clay	31%	Sapele wood	7%
Baryte	0%	Krypton	0%	Scandium	0%
Bentonite	19%	Lead	83%	Selenium	1%
Beryllium	0%	Limestone	1%	Silica	1%
Bismuth	0%	Lithium	0%	Silicon metal	0%
Boron	1%	*LREE*	1%	Silver	4%
Cadmium	30%	Magnesite	2%	Strontium	0%
Chromium	21%	Magnesium	13%	Sulphur	0%
Cobalt	22%	Manganese	9%	Talc	16%
Coking coal	0%	Molybdenum	30%	Tantalum	1%
Copper	55%	Natural cork	8%	Tellurium	1%
Diatomite	4%	Natural graphite	3%	Tin	31%
Feldspar	1%	Natural Rubber	2%	Titanium	1%
Fluorspar	1%	Natural Teak wood	5%	Titanium metal	1%
Gallium	0%	Neon	0%	Tungsten	42%
Germanium	2%	Nickel	16%	Tungsten	42%
Gold	5%	Niobium	0%	Vanadium	6%
Gypsum	1%	Perlite	42%	Xenon	0%
Hafnium	0%	*PGM*	12%	Zinc	34%
Helium	2%	Phosphate rock	0%	Zirconium	12%

Annex 12. List of references

ID	Short	Source Year	Reference	Source Type	DOI or URL
1	CRM Factsheets	2020	European Commission (2020). Study on the EU's list of Critical Raw Materials (2020): Critical Raw Materials Factsheets (final).	Official data (EU, MS)	https://op.europa.eu/en/publication-detail/-/publication/8dabb4c1-f894-11ea-991b-01aa75ed71a1
2	non-CRM Factsheets	2020	European Commission (2020). Study on the EU's list of Critical Raw Materials (2020): Critical Raw Materials Factsheets (final).	Official data (other)	https://op.europa.eu/en/publication-detail/-/publication/88f08133-f895-11ea-991b-01aa75ed71a1
3	World Bank WGI	2021	World Bank (2021): The Worldwide Governance Indicators, 2021 Update. Aggregate Governance Indicators 1996-2020.	Official data (EU, MS)	www.govindicators.org
4	World Mining Data	2022	Federal Ministry of Agriculture, Regions and Tourism of Austria (Ed.): World Mining Data (since 1986)	Official data (EU, MS)	https://www.world-mining-data.info
5	Eurostat NACE	2022	Annual enterprise statistics for special aggregates of activities (NACE Rev. 2). Update from 28/02/2022	Official data (EU, MS)	https://ec.europa.eu/eurostat/databrowser/view/SBS_NA_SCA_R2__custom_2282150/settings_1/table?lang=en
6	OECD Restrictions	2022	OECD Inventory of Restrictions on Exports of Industrial Raw Materials	Official data (other)	https://qdd.oecd.org/subject.aspx?Subject=ExportRestrictions_IndustrialRawMaterials
7	EU FTAs	2022	EU Negotiations and agreements: Agreements in place	Official data (EU, MS)	https://ec.europa.eu/trade/policy/countries-and-regions/negotiations-and-agreements/#_in-place
8	EU Access2Markets	2022	EU Trade Helpdesk and Market Access Database	Official data (EU, MS)	https://trade.ec.europa.eu/access-to-markets/en/home
9	BGS mineral production	2021	BGS (2021). World mineral production 2000–2020	Official data (other)	https://www2.bgs.ac.uk/mineralsuk/download/world_statistics/2010s/WMP_2016_2020.pdf
10	USGS mineral summaries	2000-2022	USGS (2000-2022). Mineral Commodity Summaries	Official data (other)	https://www.usgs.gov/centers/national-minerals-information-center/mineral-commodity-summaries
11	Eurostat International trade	2022	Eurostat database. EU trade since 1988 by HS2-4-6 and CN8 (DS-045409)	Official data (EU, MS)	http://epp.eurostat.ec.europa.eu/newxtweb/
12	Eurostat Total production	2022	Total production (DS-056121)	Official data (EU, MS)	http://epp.eurostat.ec.europa.eu/newxtweb/
13	Eurostat Sold production	2022	Sold production, exports and imports (DS-056120)	Official data (EU, MS)	http://epp.eurostat.ec.europa.eu/newxtweb/
14	WMD completed with USGS	2017-2022	Data for REO from 4 (Federal Ministry of Agriculture, Regions and Tourism of Austria (Ed.): World Mining Data (since 1986)) + data for REO from 10 (USGS (2017-2022). Mineral Commodity Summaries) but ONLY FOR VIETNAM AND THAILAND	Official data (EU, MS)	https://www.world-mining-data.info
15	ASTER	2015	Guyonnet D., Planchon M., Rollat A., Escalon V., Tuduri J., Charles N., Vaxelaire S., Dubois D., Fargier H. (2015) Material flow analysis applied to rare earth elements in Europe, Journal of Cleaner Production, Volume 107, 16 November 2015, Pages 215-228	Scientific publications	https://www.mineralinfo.fr/sites/default/files/documents/2021-01/aster_material_flow_analysis_applied_to_rare_earth_elements_in_europe_synthesis_paper.pdf
16	USGS mineral yearbooks	2000-2022	USGS. Mineral Yearbooks	Commercial providers	https://www.usgs.gov/centers/national-minerals-information-center/minerals-yearbook-metals-and-minerals

ID	Short	Source Year	Reference	Source Type	DOI or URL
17	EU MSA 2020 Report	2020	Matos C.T, Ciacci, L; Godoy León, M.F.; Lundhaug, M.; Dewulf, J.; Müller, D.B.; Georgitzikis, K.; Wittmer, D.; Mathieux, F., Material System Analysis of five battery-related raw materials: Cobalt, Lithium, Manganese, Natural Graphite, Nickel, EUR 30103 EN, Publication Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-16411-1, doi:10.2760/519827, JRC119950	Official data (EU, MS)	doi:10.2760/519827
18	Graedel et al.	2015	Graedel, T.E.; Harper, E.M.; Nassar, N.T.; Reck, B.K. On the materials basis of modern society. Proc Natl Acad Sci USA. 2015; 112(20): 6295–6300.	Scientific publications	doi: 10.1073/pnas.1312752110
19	Crundwell et al.	2011	Crundwell et al. Extractive metallurgy of nickel, cobalt, and platinum group metals. Elsevier	Scientific publications	doi.org/10.1016/C2009-0-63541-8
20	BGS World Mineral Production	2022	BGS World mineral statistics data	Official data (other)	https://www2.bgs.ac.uk/mineralsuk/statistics/wms.cfc?method=searchWMS
21	UEPG	2017-2021	UEPG, European Aggregates Industry, Annual Reviews 2017-2021	Commercial providers	https://uepg.eu/mediatheque/index/1.html
22	BGR	2017-2021	BGR – Bundesanstalt für Geowissenschaften und Rohstoffe (2017-2021): Deutschland – Rohstoffsituation, Hannover	Official data (EU, MS)	
23	Expert estimate	2022	Expert estimate		
24	IMY	2017-2020	Indian Mineral Yearbook (2017-2020) Part III: Mineral Reviews	Official data (other)	https://ibm.gov.in/?c=pages&m=index&id=107&mid=24372
25	GTK	2016-2020	Geological Survey of Finland, personal communication by courtesy of Seppo Leinonen	Official data (EU, MS)	
26	MCS	2017-2021	Mineral Commodities Survey of the Czech Republic - Czech Geological Survey	Official data (EU, MS)	http://www.geology.cz/extranet-eng/publications/online/mineral-commodity-summaries
27	PGI	2017-2022	Polish Geological Institute - Mineral Resources of Poland (website)	Official data (EU, MS)	http://geoportal.pgi.gov.pl/surowce
28	DGEG	2017-2022	Direção Geral de Energia e Geologia - Produção de Minérios Metálicos (2016 a 2020)	Official data (EU, MS)	https://www.dgeg.gov.pt/pt/estatistica/geologia/minas/producao-anual/
29	EME	2016-2020	Ministerio para la Transición Ecológica y el Reto Demográfico - Estadística Minera de España (2016-2020)	Official data (EU, MS)	https://energia.gob.es/mineria/Estadistica/Paginas/Consulta.aspx
30	BEME	2016-2020	Boletín Estadístico de Minas y Energía 2016-2020 de Colombia	Official data (other)	https://www1.upme.gov.co/InformacionCifras/Paginas/Boletin-estadistico-de-ME.aspx
31	AEP	2016-2020	Anuario Minero 2020 - Ministerio de Energía y Minas de Peru	Official data (other)	https://www.gob.pe/institucion/minem/colecciones/2400-anuario-minero
32	SIFIM	2016-2020	Sistema Federal de Información Minera 2016-2020, Ministerio de Desarrollo Productivo de Argentina	Official data (other)	http://informacionminera.produccion.gob.ar/
33	ceicdata	2016-2020	CEIC Data	Industry and other experts	https://www.ceicdata.com/en/about-us/introduction-ceic
34	AEMM	2016-2020	Anuario Estadístico de la Minería Mexicana 2020, Servicio Geológico Mexicano, 2021	Official data (other)	https://www.sgm.gob.mx/productos/pdf/Anuario_2020_Edicion_2021.pdf

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35	MAPEG	2016-2020	by courtesy of Istanbul Technical University	Industry and other experts	
36	GEUS	2016-2020	Geological Survey of Denmark and Greenland, personal communication	Official data (EU, MS)	
37	GSS	2016-2020	Geological Survey of Sweden, Bergverksstatistik		
38	BGS	2016	BGS, Lithium profile, June 2016	Official data (other)	https://www2.bgs.ac.uk/mineralsuk/download/mineralProfiles/lithium_profile.pdf
39	Henckens	2018	Henckens M.L.C.M., Driessen P.P.J., Worrell E. (2018), Molybdenum resources: Their depletion and safeguarding for future generations. Resources, Conservation & Recycling 134 (2018) 61–69.	Scientific publications	https://doi.org/10.1016/j.resconrec.2018.03.002
40	MSA	2015		Official data (EU, MS)	
41	Euromines	2010-2020	Euromines industry information	Industry and other experts	
42	Sel Te Association	2000	Selenium Tellurium Development Association (website)	Industry and other experts	https://www.stda.org
43	Zhang et al. (2020)	2020	Zhang R., Ma, X., Shen, X., Zhai, Y., Zhang, T., Ji, C., Hong, J.: Life cycle assessment of electrolytic manganese metal production. Journal of Cleaner Production 253(2020) 119951	Scientific publications	https://www.sciencedirect.com/science/article/abs/pii/S0959652619348218
44	JRC RM for Solar & PV	2020	Carrara, S., Alves Dias, P., Plazzotta, B., Pavel, C.: Raw materials demand for wind and solar PV technologies in the transition towards a decarbonised energy system	Official data (EU)	https://op.europa.eu/en/publication-detail/-/publication/19aae047-7f88-11ea-aea8-01aa75ed71a1/language-en
45	Fraunhofer Photovoltaics Report	2022	Fraunhofer Institute for Solar Energy Systems, ISE: Photovoltaics Report, 24 February 2022	Industry and other experts	https://www.ise.fraunhofer.de/content/dam/ise/de/documents/publications/studies/Photovoltaics-Report.pdf
46	Nuss (2019)	2019	Nuss, P.: Losses and environmental aspects of a byproduct metal: tellurium. Environmental Chemistry 16(4) 243-250	Scientific publications	https://doi.org/10.1071/EN18282
47	ILZSG	2017	International Lead and Zinc Study Group (2017). Lead and Zinc First Uses in Europe. An Oakdene Hollins study commissioned by the ILZSG"	Industry and other experts	
48	Rostek et al	2022	Rostek L, Tercero Espinoza LA, Goldmann D, Loibl A (2022). A dynamic material flow analysis of the global anthropogenic zinc cycle: Providing a quantitative basis for circularity discussions. Resources, Conservation & Recycling. Vol 180 (2022).	Scientific publications	https://doi.org/10.1016/j.resconrec.2022.106154
49	Das A. et al	2019	Das A., Krishnab P.S.R., Goswamia M., Krishnana M., Structural analysis of Al and Si substituted lithium germanium phosphate glass-ceramics using neutron and X-ray diffraction	Scientific publications	https://www.sciencedirect.com/science/article/abs/pii/S0022459618305796
50	London Metal Exchange	2022	London Metal Exchange	Industry and other experts	https://www.lme.com/en/Metals/Non-ferrous/LME-Aluminium#Trading+day+summary
51	Kharpukina, N. et al	2013	Kharpukina, N. et al, Effect of Sodium, potassium and zinc substitutions in lithium disilicate glass and glass-ceramics	Scientific publications	https://www.researchgate.net/publication/261020634_Effect_of_Sodium_potassium_and_zinc_substitut

ID	Short	Source Year	Reference	Source Type	DOI or URL
					ions_in_lithium_disilicate_glass_and_glass-ceramics
52	SCRREEN CRM profiles	2018	Tercero L., SCRREEN D5.1: CRM profiles	Official data (EU)	https://scrreen.eu/wp-content/uploads/2018/05/SCRREEN-D5.1-CRM-profiles.pdf
53	ArcelorMittal	2013	Metallic coated steel - User manual	Industry and other experts	https://www.infosteel.be/images/productfiches/brochures/Metallic-coated-user-manual-EN.pdf
54	FisherCast	2008	Composition and Properties of Zinc Alloys and Comparative Data for Other Materials.	Industry and other experts	http://www.fishercast.com/downloads/Composition_and_Properties_of_Zinc_2008.pdf
55	Avicenne	2021	EU battery demand and supply (2019-2030) in a global context	Industry and other experts	https://www.eurobat.org/images/Avicenne_EU_Market_-_summary_110321.pdf
56	FELD16	2016	Combined sources valid for FELDSPAR year 2016		
57	FELD17	2017	Combined sources valid for FELDSPAR year 2017		
58	FELD18	2018	Combined sources valid for FELDSPAR year 2018		
59	FELD19	2019	Combined sources valid for FELDSPAR year 2019		
60	FELD20	2020	Combined sources valid for FELDSPAR year 2020		
61	SAND16	2016	Combined sources valid for SILICA SAND year 2016		
62	SAND17	2017	Combined sources valid for SILICA SAND year 2017		
63	SAND18	2018	Combined sources valid for SILICA SAND year 2018		
64	SAND19	2019	Combined sources valid for SILICA SAND year 2019		
65	SAND20	2020	Combined sources valid for SILICA SAND year 2020		
66	USGS Professional Paper 1802	2017	Critical mineral resources of the United States—Economic and environmental geology and prospects for future supply	Commercial providers	https://pubs.er.usgs.gov/publication/pp1802
67	BIO by Deloitte	2015	BIO by Deloitte (2015) Study on Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials. Prepared for the European Commission, DG GROW.	Official data (EU, MS)	https://www.certifico.com/component/attachments/download/2886
68	Surovtseva et al.	2022	Toward a life cycle inventory for graphite production	Scientific publications	10.1111/jiec.13234
69	Ciacci, L	2022	Personal estimates based on source [17]. Underlying assumptions and explanations are given as comments in the XLS template.	Industry and other experts	
70	Pratt & Whitney	2018	Pratt & Whitney presentation, SafePort Funds, 2018	Industry and other experts	https://www.safeport-funds.com/Portal/UserFiles/files/Pratt_&_Whitney_PPT.pdf
71	Superalloys	2012 - 2017	Mix of authors, mix of articles on superalloys, 2012 - 2017	Scientific publications	https://www.sciencedirect.com/topics/chemistry/superalloys

ID	Short	Source Year	Reference	Source Type	DOI or URL
72	Mokhtari et al.	2017	K. Mokhtari and Sh. Salem, A novel method for the clean synthesis of nano-sized cobalt based blue pigments, 2017	Scientific publications	https://pubs.rsc.org/en/content/articlehtml/2017/ra/c7ra03771f
73	Liu B. et al.	2015	Bin Liu and Yong Liu, Powder metallurgy titanium aluminide alloys, 2015	Scientific publications	https://www.sciencedirect.com/science/article/pii/B9780128000540000277
74	Zografopoulos et al.	2015	D.C.Zografopoulos, A.Pitilakis, and E.E.Kriezis, Liquid crystal-infiltrated photonic crystal fibres for switching applications, 2015	Scientific publications	https://www.sciencedirect.com/science/article/pii/B9781782423294000035
75	Bowker R. H. et al.	2012	Richard H. Bowker, Mica C. Smith, Bo A. Carrillo & Mark E. Bussell, Synthesis and Hydrodesulfurization Properties of Noble Metal Phosphides: Ruthenium and Palladium, 2012	Scientific publications	https://link.springer.com/article/10.1007/s11244-012-9887-y
76	UNEP	2011	UNEP (2011) Recycling rates of metals	Official data (EU, MS)	https://www.resourcepanel.org/reports/recycling-rates-metals
77	VDKI	2022	Annual report 2021. Facts and Trends 2020/21. Verein der Kohlenimporteure	Industry and other experts	https://english.kohlenimporteure.de/publications/annual-report-2021.html?file=files/user_upload/jahresberichte_en/Annual_Report_2021.pdf
78	Ciacci, L	2022	Personal estimates based on source [2]. Underlying assumptions and explanations are given as comments in the XLS template.	Industry and other experts	
79	Comined sources	2022	Data collected from the previous exercise (1) and updated based on litterature review (49)	Official data (EU, MS)	
80	Comined sources	2022	Data collected from the previous exercise (1) and updated based on litterature review (51)	Official data (EU, MS)	
81	Graphite.	2022	(SCRREEN Expert). Personal communication. IMERYS Graphite & Carbon, ETH Zurich, Switzerland.	Industry and other experts	
82	Expert estimate	2022	Expert estimate based on sources [10, 83]. Underlying assumptions and explanations are given as comments in the XLS template.	Industry and other experts	
83	Vazirisereshk et al.	2019	Solid Lubrication with MoS2: A Review. Lubricants 2019, 7, 57	Scientific publications	10.3390/lubricants7070057
84	The International Molybdenum Association (IMOA)	2021	Uses of new Molybdenum	Industry and other experts	https://www.imoa.info/molybdenum-uses/molybdenum-uses.php
85	Euromines	2020	Uses of magnesite	Industry and other experts	
86	SE_APP_01	2022	Personal estimates on Se applications based on sources 2, 10, and 42	Industry and other experts	
87	Manganese Metal Company Ltd.	2022	Company webpage on se-free electrolytic manganese	Industry and other experts	https://www.mmc.co.za/process/selenium-free
88	IMNI Statistics	2018	International Manganese Institute Statistic	Commercial providers	https://www.manganese.org
89	SE2020	2020	Calculation sheet for 2020 CRM assessment	Official data (EU)	Teams Folder

ID	Short	Source Year	Reference	Source Type	DOI or URL
90	TE2020	2020	Calculation sheet for 2020 CRM assessment	Official data (EU)	Teams Folder
91	IMNI Annual Review	2018	International Manganese Institutute Annual Report	Commercial providers	https://www.manganese.org/wp-content/uploads/2021/04/2018-IMnI-Annual-Review.pdf
92	Indian Mineral Yearbook	2020	Indian Mineral Yearbook: Selenium and Tellurium	Commercial providers	https://ibm.gov.in/writereaddata/files/11292021123510Selenium_Tellurium%20_2020.pdf
93	World Gold Council	2022	World Gold Council (2022). Gold Mining Production Volumes	Official data (others)	https://www.gold.org/download/file/7593/Gold-Mining-Production-Volumes-Data.xlsx
94	IMA-Europe	2022	Personal communication from IMA-Europe on uses of Magnesium in the EU	Industry and other experts	
95	Sulphur removal in ironmaking and oxygen steelmaking	2017	Frank Nicolaas Hermanus Schrama, Elisabeth Maria Beunder, Bart Van den Berg, Yongxiang Yang & Rob Boom (2017) Sulphur removal in ironmaking and oxygen steelmaking, Ironmaking & Steelmaking, 44:5, 333-343	Scientific publications	10.1080/03019233.2017.1303914
96	The World Copper Fact Book	2021	The International Copper Study Group (2021): The World Copper Fact Book.	Industry and other experts	https://icsg.org/wp-content/uploads/2021/11/ICSG-Factbook-2021.pdf
97	Critical Minerals in Energy Transition	2022	IEA (2020, revised version): The Role of Critical Minerals in Clean Energy Transition	Official data (other)	https://iea.blob.core.windows.net/assets/ffd2a83b-8c30-4e9d-980a-52b6d9a86fdc/TheRoleofCriticalMineralsinCleanEnergyTransitions.pdf
98	End Use Summary - copper content	2022	IWCC Statistics and Data (2022): End Use Summary - copper content	Industry and other experts	http://www.coppercouncil.org/iwcc-statistics-and-data
99	Risikobewertung Kupfer	2020	DERA (2020): Rohstoffinformationen - Risikobewertung Kupfer.	Official data (others - Germany)	https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-45.pdf?__blob=publicationFile&v=2
100	World Silver Survey 2021	2021	The Silver Institute & Metal Focus (2021). World Silver Survey 2021, ISSN: 2372-2312	Official data (others)	https://www.silverinstitute.org/wp-content/uploads/2021/04/World-Silver-Survey-2021.pdf
101	Matos et al. 2021	2021	Matos, C. T., Devauze, C., Planchon, M., Wittmer, D., Ewers, B., Auberger, A., Dittrich, M., Latunussa, C., Eynard, U., Mathieux, F. (2021): Material System Analysis of Nine Raw Materials: Barytes, Bismuth, Hafnium, Helium, Natural rubber, Phosphorus, Scandium, Tantalum and Vanadium	official data (EU)	https://rmis.jrc.ec.europa.eu/uploads/material_system_analyses_9_materials_10052021_final-version.pdf
102	Nassar, Wilbur and Goonan	2016	Byproduct metal requriements for US wind and solar photovoltaic electricity generation up the the year 2040 under verious Clean Power Plan scenarios	Scientific publications	
103	CMRA	2017	China Nonferrous Metal Industry Association	Commercial providers	
104	USGS communication TE	2022	Communication with USGS on Te end uses	Industry and other experts	
105	Te_Sub_001	2022	Personal estimates on Se substitutes based on sources [10], [44], [45], [90], and additional literature reserach	Industry and other experts	

ID	Short	Source Year	Reference	Source Type	DOI or URL
106	SPIE Research	2021	Alan Symmons, Infrared optical material feedstocks, 2021	Scientific publications	https://www.spiedigitallibrary.org/conference-proceedings-of-spie/11737/1173705/Infrared-optical-material-feedstocks/10.1117/12.2585647.short?SSO=1
107	Calvez, 2017	2017	Laurent Calvez. Chalcogenide glasses and glass-ceramics: Transparent materials in the infrared for dual applications. Comptes Rendus. Physique, Académie des sciences (Paris), 2017, 18 (5-6), pp.314- 322. ff10.1016/j.crhy.2017.05.003ff. ffhal-01671262f	Scientific publications	https://hal-univ-rennes1.archives-ouvertes.fr/hal-01671262/document
108	Saayman		Melanie Saayman, MATERIALS FOR INFRARED OPTICS, University of Arizona	Scientific publications	https://wp.optics.arizona.edu/optomech/wp-content/uploads/sites/53/2016/10/Saayman-521-Tutorial.pdf
109	Zografopoulos et al. 2015	2015	D.C.Zografopoulos, A.Pitilakis, E.E.Kriezis, Liquid crystal-infiltrated photonic crystal fibres for switching applications, 2015	Scientific publications	https://www.sciencedirect.com/science/article/pii/B9781782423294000035
110	17th International Symposium on Solid Oxide Fuel Cells	2021	Anil Virkar, Michael Simpson, Examination of Gadolinium Doped Ceria Mixed with Yttrium Stabilized Zirconia Mixed Ionic Electronic Conducting Solid Electrolytes for Use As Reversible High Temperature Cells, University of Utah, 2021	Scientific publications	https://ecs.confex.com/ecs/sofc2021/meetingapp.cgi/Paper/148859
111	SOFCMAN	2017	Ms Zhang Yi, Dr Wang Weiguo, Yttria-Stabilized Zircoina (YSZ), 2017	Commercial providers	http://www.sofc.com.cn/ysz.asp
112	Longo et al. 2017	2017	Sonia Longo, Maurizio Cellura, Francesco Guarino, Marco Ferraro, Vincenzo Antonucci, Gaetano Squadrito, Life Cycle Assessment of Solid Oxide Fuel Cells and Polymer Electrolyte Membrane Fuel Cells: A Review, 2017	Scientific publications	https://www.sciencedirect.com/science/article/pii/B9780128111321000067
113	Komatsua et al. 2021	2021	Yosuke Komatsua, Anna Sciazkoa, Yasuhiko Suzukia, Zhufeng Ouyanga, Zhenjun Jiaob, Naoki Shikazono, Operando observation of patterned nickel - gadolinium doped ceria solid oxide fuel cell anode, 2021	Scientific publications	https://www.sciencedirect.com/science/article/pii/S0378775321011654#:~:text=Abstract,migrate%20and%20porous%20microstructure%20changes.
114	DERA 2018	2018	Deutsche Rohstoffagentur (DERA) (2018): Edelgase - Versorgung wirklich kritisch?	official data (others)	https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-39.pdf?__blob=publicationFile&v=3
115	IEA 2019	2019	IEA (2019): The Future of Hydrogen	official data	https://www.iea.org/reports/the-future-of-hydrogen
116	Horák et al. 2013	2013	Horák, T. et al. (2013): Advantages and disadvantages of substitution of helium as carrier gas in gas chromatography by hydrogen.	scientific literatur	https://kvasnyprumysl.cz/en/artkey/kpr-201307-0003_Vyhody_a_nevyhody_zameny_helia_jako_nosneho_plynu_v_plynove_chromatografii_za_vodik_Cast_II_-_Retencni_casy_a.php?l=en
117	Selenium	2022	Personal estimates on Se substites based on sources [10], [44], [45], [89], and additional literature research	Industry and other experts	
118	Zircomet, 2020	2020	Zircomet (2020): Zirconium Market Update 2020	Industry	http://www.zircomet.com/sec/11189/Zirconium-Market-Update/
119	PYX, 2020	2020	PYX Resources (2020): The emerging force in the Premium Zircon Industry	Industry	https://www.nsx.com.au/ftp/news/021738606.PDF
120	USGS communication SE	2022	Communication with USGS on Se end uses	Industry and other experts	

ID	Short	Source Year	Reference	Source Type	DOI or URL
121	Selenium	2022	Personal estimates on Se applications based on sources 2, 10, 42, 66. 103, 120		
122	Eurofer	2021	EUROFER (2021) European Steel in Figures 2021	Industry and other experts	https://aceroplatea.es/docs/European-Steel-in-Figures-2021.pdf
123	Gold Focus 2020	2020	Metal Focus (2020). Gold Focus 2020, ISBN 978-1-9162526-0-8	Industry and other experts	https://www.metalsfocus.com/wp-content/uploads/2020/11/GOLD-FOCUS-2020.pdf
124	Cobalt Institute report	2021	Cobalt Institute (2021), Cobalt: a socio-economic analysis of its contributions to european economy	Industry and other experts	https://www.cobaltinstitute.org/wp-content/uploads/2021/05/CI_Cobalt_SEA_Study_EEA_Exec_Summary.pdf
125	PlasticsEurope report	2021	PlasticsEurope (2021), Plastics – the Facts 2020	Industry and other experts	https://plasticseurope.org/fr/wp-content/uploads/sites/2/2021/11/Plastics_the_facts-WEB-2020_versionJun21_final-1.pdf
126	INSG	2022	International Nickel Study Group (INSG), The world nickel factbook 2021.	Industry and other experts	https://insg.org/index.php/publications-list/
127	Kamikoriyama et al 2018	2018	Kamikoriyama, Y., Imamura, H., Muramatsu, A. and Kanie, K. (2018). Ambient Aqueous-Phase Synthesis of Copper Nanoparticles and Nanopastes with Low-Temperature Sintering and Ultra-High Bonding Abilities, Scientific Reports, 9:899	Scientific publications	https://doi.org/10.1038/s41598-018-38422-5
128	Kim et al. 2022	2022	Kim, S.J., Kim, Y.I., Lamichhane, B. et al. Flat-surface-assisted and self-regulated oxidation resistance of Cu(111). Nature 603, 434–438 (2022)	Scientific publications	https://doi.org/10.1038/s41586-021-04375-5
129	Goodman 2002	2002	Goodman, P. Current and future uses of gold in electronics. Gold Bull 35, 21–26 (2002)	Scientific publications	https://doi.org/10.1007/BF03214833
130	Davey & Seymour1985	1985	Davey, N. M. and Seymour R. J. (1985). The Platinum Metals in Electronics; Key Area for Growth and New Technology, Platinum Metals Rev. 29(1), 2	Scientific publications	https://www.technology.matthey.com/article/29/1/2-11/
131	Antler, 1982	1982	Antler, M. (1982). The Application of Palladium in Electronic Connectors; Continuing Studies result in Growing use, Platinum Metals Rev., 26(3), 106	Scientific publications	https://www.technology.matthey.com/article/26/3/106-117/
132	Aindow et al 2010	2010	Aindow, M., Alpay, S. P., Liu, Y., Mantese, J. V. and Senturk, B.S. (2010). Base metal alloys with self-healing native conductive oxides for electrical contact materials, Applied Physics Letters, 2010; 97 (15): 152103	Scientific publications	DOI: 10.1063/1.3499369
133	Knosp et al 2003	2003	Knosp H., Holliday, R.J. and Corti, C.W. (2003). Gold in Dentistry: Alloys, Uses and Performance, Gold Bulletin, 36(3): 93-102	Scientific publications	https://doi.org/10.1007/BF03215496
134	Donaldson 1980	1980	Donaldson, J.A. (1980). The use of gold in dentistry, Gold Bulletin: 160-165	Scientific publications	https://doi.org/10.1007/BF03215462
135	Stock et al 2016	2016	Stock, V., Schmidlin, P.R., Merk, S., Wagner, C., Roos, M., Eichberger, M. and Stawarczyk, B. (2016). PEEK Primary crowns with cobalt-chromium, zirconia and galvanic secondary crowns with different tapers - A comparison of retention forces, Materials, 187(9):1-10	Scientific publications	DOI: 10.3390/ma9030187
136	DERA	2019	Deutsche Rohstoffagentur (2019) Chart des Monats, Oktober 2019	Industry	https://www.deutsche-rohstoffagentur.de/DERA/DE/Downloads/DERA%202

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					019_cdm_10_Titan.pdf;jsessionid=7CECD0D7DE2741E0839F9507E212CA37.1_cid321?__blob=publicationFile&v=3
137	Ding, Y., Cano, Z.P., Yu, A. et al.	2019	Automotive Li-Ion Batteries: Current Status and Future Perspectives. Electrochemical Energy Reviews volume 2, pages1–28 (2019)	Scientific publications	https://doi.org/10.1007/s41918-018-0022-z
138	UNEP	2019	Alternatives to Lead-acid Batteries.	Scientific publications	https://wedocs.unep.org/20.500.11822/27402
139	Dooley K, Mars C. and Pilli L	2020	Lead-Acid Battery Recycling Success: Policy + Reverse Supply Chains – a case study. December 2020, The Sustainability Consortium.	Scientific publications	https://sustainabilityconsortium.org/download/lead-acid-battery-recycling-success-policy-reverse-supply-chains/
140	HDIN Research	2019	Yellow Phosphorus Market Global Review and Outlook - 2019	Industry and other experts	https://hdinresearch.s3.us-east-2.amazonaws.com/Yellow+Phosphorus+Market+Global+Review+and+Outlook-Pulished+by+HDIN+Research.pdf
141	BILEWSKA K	2016	Report on refractory metal reduction potential ? potential substitutes. MSP-REFRAM report	Scientific publications	https://prometia.eu/wp-content/uploads/2020/12/MSP-REFRAM-D5.1-Report-on-refractory-metal-reduction-potential-potential-substitutes.pdf
142	CRM Foresight	2020	Critical Raw Materials for Strategic Technologies and Sectors in the EU: A Foresight Study	Official data (EU, MS)	https://ec.europa.eu/docsroom/documents/42881
143	JRC Technical Reports	2018	JRC Technical Reports (2018). Material Flow Analysis of Aluminium, Copper, and Iron in the EU-28	Official data (EU, MS)	https://publications.jrc.ec.europa.eu/repository/bitstream/JRC111643/jrc111643_mfa_final_report_june2018.pdf
144	Verma et al 2017	2017	Verma AS, Suri NM, Kant S. Applications of bauxite residue: A mini-review. Waste Manag Res. 2017 Oct;35(10):999-1012	Scientific publications	doi: 10.1177/0734242X17720290
145	Smirnov 1996	1996	Smirnov, V. (1996). Alumina production in Russia , JOM, 48 (8), pp. 24-26	Scientific publications	https://www.tms.org/pubs/journals/jom/9608/smirnov-9608.html
146	Jorjani and Amirhosseini 2007	2007	Jorjani, E. and Amirhosseini, M. (2007). Alumina Production Process from Nepheline Ore in Razgah (Iran), Mineral Processing Technology (MPT)	Scientific publications	https://www.researchgate.net/profile/E_Jorjani/publication/268188702_Alumina_Production_Process_from_Nepheline_Ore_in_Razgah_Iran_Alumina_Production_Process_from_Nepheline_Ore_in_Razgah_Iran/links/55292b990cf2e089a3a63b4e.pdf?origin=publication_detail
147	Metalary	2022	Metalary - Prices of different metals	Industry and other experts	https://www.metalary.com/
148	DERA	2022	Preismonitor Dezember 2021	Official data (EU, MS)	https://www.bgr.bund.de/DE/Themen/Min_rohstoffe/Produkte/Preisliste/pm_21_12.pdf?__blob=publicationFile&v=3
149	Roskill	2010	Rhenium : Market Outlook to 2015	Industry and other experts	
150	The Silver Institute	2022	The Silver Institute Official Webpage	Industry and other experts	https://www.silverinstitute.org/

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151	Goldfarb USGS	2014	Tellurium—The Bright Future of Solar Energy	Commercial providers	https://pubs.usgs.gov/fs/2014/3077/
152	Boliden	2021	Boliden Summary Report	Commercial providers	https://www.boliden.com/globalassets/operations/exploration/mineral-resources-and-mineral-reserves-pdf/2021/bol_main-1847687-v1-resources-and-reserves-kankberg-2021-12-31.pdf
153	International Zinc association (IZA)	2022	Zinc Diecasting Alloys - Comparison With Alternative Materials	Industry and other experts	https://diecasting.zinc.org/properties/en/alloy_properties/eng_prop_a_comparison-alternative-materials/
154	Aalco	2013	Special Product and Services	Industry and other experts	https://www.aalco.co.uk/literature/files/aalco-copper-brass-bronze.pdf
155	Ciacci et al.	2015	Ciacci L., Reck B., Graedel T.: Lost by Design	Scientific publications	https://pubs.acs.org/doi/abs/10.1021/es505515z
156	International Aluminium Institute	2020	International Aluminium Institute (2020). Aluminium Recycling, Factsheet	Industry and other experts	https://international-aluminium.org/resource/aluminium-recycling-fact-sheet/
157	Johnson Matthey PGM	2021	Johnson Matthey Pgm Market Report. Platinum Supply and Demand	Industry and other experts	https://platinum.matthey.com/documents/40646/41236/pgm-market-report-february-english-2021.pdf/c8d1bb71-caf8-65e0-ef62-761d5c25ebd6?t=1646739840100
158	ISE	2019	ISE website. Current prices of rare earths	Industry and other experts	https://en.institut-seltene-erden.de/aktuelle-preise-von-seltenen-erden/
159	FAOSTAT NR	2022	FAOSTAT	Official data (EU, MS)	https://www.fao.org/faostat/en/#data/QCL
160	FAOSTAT Industrial Roundwood production and recycling	2022	Complete Forest Products dataset | FAOSTAT	Official data (EU, MS)	https://www.fao.org/faostat/en/#data/FO
161	Hydrogen, IEA report	2021	IEA website	Official data, reviewed (EU, MS, others)	https://www.iea.org/reports/hydrogen
162	H2tools database		H2tools database	Official data, reviewed (EU, MS, others)	https://h2tools.org/hyarc/hydrogen-production
163	Fuel Cell Observatory		Hydrogen Demand	Official data, reviewed (EU, MS, others)	https://www.fchobservatory.eu/observatory/technology-and-market/hydrogen-demand
164	Wood use	2019	FAO Yearbook of Forest Products	Industry and other experts	https://www.fao.org/3/cb3795m/cb3795m.pdf
165	Natural rubber use	2022	ETRMA branch report	Industry and other experts	
166	Natural Teak production	2022	Newly created source based on COMEXT, branch report and expert judgement	Industry and other experts	https://www.fao.org/3/ac773e/ac773e07.htm

ID	Short	Source Year	Reference	Source Type	DOI or URL
167	Industrial Roundwood substitution	2021	Material substitution between coniferous, non-coniferous and recycled biomass – Impacts on forest industry raw material use and regional competitiveness	Scientific publications	https://www.sciencedirect.com/science/article/pii/S1389934121001945
168	Natural cork production	2020	APCOR Year Book 2020, 2019, 20	Industry and other experts	Realcork – Publications (apcor.pt)
169	Natural cork recycling	2022	APCOR website	Industry and other experts	Realcork – Recycling (apcor.pt)
170	ITIA market study	2018	Industry and other experts, ITIA, 2018	Industry and other experts	https://www.itia.info/assets/files/newsletters/ITIA_Newsletter_2018_05.pdf
171	Natural rubber substitutes	2021	Elastocaloric effect in vulcanized natural rubber and natural/wastes rubber blends	Scientific publications	https://www.sciencedirect.com/science/article/pii/S0032386121009320
172	Teak use	2021	Branch report on natural teak	Industry and other experts	https://www.forest-trends.org/wp-content/uploads/2022/03/Forest-Trends_Myanmars-Timber-Trade-One-Year-Since-the-Coup.pdf
173	Sapele use	2021	properties of sixteen wood sources	Scientific publications	https://agris.fao.org/agris-search/search.do?recordID=US202100126195
174	Vanadium applications	2020	Vanadium: Extraction, Manufacturing and Applications	Scientific publications	https://books.google.nl/books?id=cuTsDwAAQBAJ&pg=PR9&lpg=PR9&dq=global+vanadium+application&source=bl&ots=ku5gCcf_pB&sig=ACfU3U0s234Os7AnAmYhhz7tf4_DuT6G6A&hl=nl&sa=X&ved=2ahUKEwiKg6uUlu_3AhWPif0HHRtbD50Q6AF6BAguEAM#v=onepage&q=global%20vanadium%20application&f=false
175	Vanadium recycling	2021	A review on the metallurgical recycling of vanadium from slags: towards a sustainable vanadium production	Scientific publications	https://www.sciencedirect.com/science/article/pii/S2238785421001915
176	Hydrogen in North-Western Europe	2021		Industry and other experts	Hydrogen in North-Western Europe (windows.net)
177	FCHO Hydrogen molecule market	2020	FCH 2 JU, Fuel Cells and Hydrogen Observatory Chapter 2, Hydrogen molecule market	scientific Publications	https://www.fchobservatory.eu/reports
178	"Scienceviews.com"	2003-2008	Scienceviews website, on which is stated that 'information adapted from "Minerals in Your World", a cooperative effort between the U.S. Geological Survey and the Mineral Information Institute')	Website adapted from geological data	Barite (scienceviews.com)
179	The Barytes Association	2022	Website of The Barytes Association, a lobby association around Barytes, consituting of 25 members, based in Brussels	Industry and other experts	Barytes :: Home
180	Sapele production	2022	Newly created source based on COMEXT, branch report and expert judgement	Industry and other experts	https://www.fao.org/3/ac773e/ac773e07.htm
181	Cork applications	2014	CORK INDUSTRY FEDERATION - Product Index	Industry and other experts	The Cork Industry Federation (cork-products.co.uk)
182	STDA personal	2022	Personal communication with STDA	Industry and other experts	https://www.stda.org

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183	Nickel Institute	2019	Nickel Institute. The world of nickel	Industry and other experts	https://nickelinstitute.org/media/3933/australia-fact-sheet.pdf
184	Nickel	2022	Nickel Institute, communication at the SCRREEN Workshop	Industry and other experts	
185	manganese, nickel, and natural graphite	2022	Ciacci, L, Matos, CT, Reck, BK, Wittmer, D, Bernardi, E, Mathieux, F, Passarini, F. Material system analysis: Characterization of flows, stocks, and performance indicators of manganese, nickel, and natural graphite in the EU, 2012–2016. J Ind Ecol. 2022; 1– 14.	Scientific publications	10.1111/jiec.13226
186	Nassar et al.	2022	Nassar N., Kim H., Frenzel M., Moats M., Hayes S.: Global tellurium supply potential from electrolytic copper refining. Resources, Conservation and Recycling 184 /2022)	Scientiic publication	https://pubs.er.usgs.gov/publication/70232114
187	UN COMTRADE	2022	United Nations Commodity Trade Statistics Database	Official data (other)	https://comtrade.un.org/data/
188	USGS+UNCOMTRADE	2022	Combined reference for sources [16, 187]. Underlying assumptions and explanations are given as comments in the XLS template.	Official data (other)	
189	USGS+INSG	2022	Combined reference for sources [16, 126, 199]. Underlying assumptions and explanations are given as comments in the XLS template.	Official data (other)	
190	Niobium	2022	CBMM during expert workshop, Brussels, 2 June 2022		
191	BRGM	2020	Bureau de Recherches Geologiques et Minières	Scientific publication	
192	Renguo et al.	2020	Renguo et al. (2020), Development of Aluminium Alloy Materials: Current Status, Trend, and Prospects	Scientific publication	https://www.engineering.org.cn/en/10.15302/J-SSCAE-2020.05.013
193	Proative	2022	Challengers emerge: alternatives to lithium-ion batteries	Commercial providers	https://www.proactiveinvestors.com.au/companies/news/973718/challengers-emerge-alternatives-to-lithium-ion-batteries-973718.html
194	Tungsten recycling	2020	ITIA (2020), Recycling of tungsten: Current share, economic limitations, technologies and future potential	Scientific publication	https://www.sciencedirect.com/science/article/pii/S0263436821000780
195	Fraunhofer ISI	2009	Rohstoffe für Zukunftstechnologien - Einfluss des branchenspezifischen Rohstoffbedarfs in rohstoffintensiven Zukunftstechnologien auf die zukünftige Rohstoffnachfrage	Scientific publication	https://www.isi.fraunhofer.de/content/dam/isi/dokumente/ccn/2009/Schlussbericht_lang_20090515.pdf
196	U.S. Census Bureau	2022	USA Trade® Online	Official data (other)	https://usatrade.census.gov/
197	Talens Peiró L., Nuss P., Mathieux F., Blengini G.A.	2018	Towards Recycling Indicators based on EU flows and Raw Materials System Analysis data 2018	Official data (EU, MS)	https://publications.jrc.ec.europa.eu/repository/bitstream/JRC112720/kj-na-29435-en-n_recycling_report.pdf
198	IMnI	2022	2010-2020 IMnI Statistics Ferroalloys, IMnI	Industry and other experts	
199	INSG	2021	World directory of nickel production facilities 2020	Industry and other experts	

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200	EU MSA 2015 Report	2015	BIO by Deloitte (2015) Study on Data for a Raw Material System Analysis: Roadmap and Test of the Fully Operational MSA for Raw Materials. Prepared for the European Commission, DG GROW.	Official data (EU, MS)	https://rmis.jrc.ec.europa.eu/uploads/Final_2015_MSA_Report.pdf
201	EU MSA 2021 Report	2021	Matos, C..T; Devauze, C; Planchon, M; Ewers, B; Auberger, A; Dittrich, M; Wittmer, D; Latunussa, C; Eynard, U; Mathieux, F, Material System Analysis of Nine Raw Materials: Barytes, Bismuth, Hafnium, Helium, Natural Rubber, Phosphorus, Scandium, Tantalum and Vanadium, EUR 30704 EN, Publications Office of the European Union, Luxembourg, 2021, ISBN 978-92-76-37768-9, doi:10.2760/677981, JRC125101	Official data (EU, MS)	https://rmis.jrc.ec.europa.eu/uploads/Final_2015_MSA_Report.pdf
202	ILZSG	?	End Uses of Lead and Zinc	Industry and other experts	ILZSG - End Uses
203	ILZSG	2021	2021 Recycling Input Rates (RIR) for Lead	Industry and other experts	
204	2016		Eurogypsum and NERA Economic Consulting (2016). Data provided through stakeholder consultation.		
205			G to G: From production to recycling: a circular economy for the European Gypsum Industry with the Demolition and Recycling Industry; Report DA1: Inventory of current practices. http://gypsumtogypsum.org/news/donwload-the-gtog-reports-now/		
206		2010	DG Environment (2010). Green Public Procurement. Wall Panels Technical Background Report.		
207		2015	Eurogypsum (2015) Position letter Re: Assessment of FGD gypsmum as a separate raw material in the list of raw materials to be evaluated as critical by the Commission in 2016		
208	Indium: Eurostat International trade + correction Le gleuher	2022	Eurostat database. EU trade since 1988 by HS2-4-6 and CN8 (DS-045409)	Official data (EU, MS)	http://epp.eurostat.ec.europa.eu/newxtweb/
209	Indium recycling rate : validation worshop	2022	Indium End-of-Life recycling Recycling rate (EoL RIR)	Industry and other experts	
210	Boron in semiconductors	2015	Dilyara Timerkaeva (2015), Engineering of the light elements in silicon for the photovoltaic application	Scientific publication	https://tel.archives-ouvertes.fr/tel-01161948/document
211	Gallium subsitutes Boron	2020	Longi (2020), Gallium-doped monocrystalline silicon fully solves the problem of a PERC module's LID	Scientific publication	https://www.longi.com/en/news/6880/
212	Umicore	2022	Our metals	Industry and other experts	https://www.umicore.com/en/about/our-metals/indium/
213	Indium in alkaline batteries	2022	Mercury subshare : personal estimate		
214	BRGM Hafnium	2018	BRGM (2018): Fiche de synthèse sur la criticité des métaux - L'hafnium	official data (other)	https://www.mineralinfo.fr/sites/default/files/documents/2020-12/fichecriticitehf180702.pdf
215	Fan and Friedmann	2021	Low-carbon production of iron and steel: Technology options, economic assessment, and policy	Scientific publication	https://reader.elsevier.com/reader/sd/pii/S2542435121000957?token=7C02F57CB2171DFC1F342A69D504D6264DEE6339D1E5B0E126D6A7132841D022F3D45954431E5A9534BF4C6719B5161D&originRegion=

ID	Short	Source Year	Reference	Source Type	DOI or URL
					eu-west-1&originCreation=20220629121358
216	non CRM Factsheets + World Silver Survey 2021 + The Silver Institute 2022	2022	Combined reference for sources [2, 100, 150]. Underlying assumptions and explanations are given as comments in the XLS template and doc report	official data (other)	
217	Lyu et al.	2017	Effect of hydrogen addition on reduction behavior of iron oxides in gas-injection blast furnace	Scientific publication	https://www.sciencedirect.com/science/article/abs/pii/S0040603116303483
218	Eurostat data x Wolfram	2022	Eurostat data has been corrected with confidential Wolfram data for years 2015-2020	Industry and other experts	
219	STATBEL production	2022	Belgium national statistics: Value of industrial production in euros according to the main activity of the unit 2009 - 2020	Official data (MS)	https://statbel.fgov.be/sites/default/files/files/documents/Ondernemingen/7.3%20Industriële%20productie/BEL_H_FR_HISTO.xlsx
220	STATBEL trade	2022	Belgium national statistics: Deliveries in value and quanitity according to the NACE, the CPA, and the Prodcom list 2009-2022	Official data (MS)	https://statbel.fgov.be/sites/default/files/files/documents/Ondernemingen/7.3%20Industriële%20productie/BEL_H_FR_HISTO.xlsx
221	DESTATIS production	2022	German national statistics: Produktionswert, -menge, -gewicht und Unternehmen der Vierteljährlichen Produktionserhebung: Deutschland, Jahre, Güterverzeichnis (9-Steller)	Official data (MS)	https://www-genesis.destatis.de/genesis/online?operation=ergebnistabelleUmfang&levelindex=3&levelid=1656582392692&downloadname=42131-0003#abreadcrumb
222	First Solar	2021	First Solar Sustainability Report 2021	Commercial providers	https://www.firstsolar.com/-/media/First-Solar/Sustainability-Documents/FirstSolar_Sustainability-Report_2021.ashx
223	DESTATIS trade	2022	German national statistics: Aus- und Einfuhr (Außenhandel): Deutschland, Jahre, Land, Warenverzeichnis (8-Steller)	Official data (MS)	https://www-genesis.destatis.de/genesis//online?operation=table&code=51000-0015&bypass=true&levelindex=0&levelid=1656597304634
224	TE production	2022	Estimation of Te production and trade based on various sources (ESTAT, STDA, SCRREEN workshops)	Industry and other experts	
225	Umicore	2022	Sales: metals and products	Commercial providers	https://pmr.umicore.com/en/metals-products/minor-metals/
226	BGS and USGS	2022	Combined sources [in list 9 and 10] valid for Chromium processing of China and South Africa		
227	Te end use EU	2022	Estimations on EU end use share of Te	Industry and other experts	
228	Se end use EU	2022	Estimations on EU end use share of Se	Industry and other experts	
229	Se production Korea	2022	KITECH North America/KIRAM personal communication	Industry and other experts	
230	Alternatives to Cluming Clay Kitty Litters	2022	Alternatives to Cluming Clay Kitty Litters	Experts and industry associations	http://catmom.com/articles/natural.html)

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231	Cat litter -How products are made	2022	Cat litter -How products are made	Experts and industry associations	http://www.madehow.com/Volume-2/Cat-Litter.html
232	Statista	2022	Statista: Global wood pellet production from 2010 to 2020	Experts and industry associations	https://www.statista.com/statistics/243906/global-wood-pellet-production-outlook/
233	Energy	2022	Energy Informtion - Wood pellet prices	Experts and industry associations	https://www.energy.nh.gov/energy-information
234	Guide to Csting	2022	Guide to Casting and Molding Processes	Experts and industry associations	https://pdfs.semanticscholar.org/2fa7/9ad6d87450d1f12ffb718ed58199b1bc7240.pdf
235	Molding Sand: Constituents, Types and Properties	2022	Molding Sand: Constituents, Types and Properties	Experts and industry associations	https://mechanicalengineering.blog/molding-sand/
236	Polymer support fluids	2013	Polymer support fluids: use and misuse of innovative fluids in geotechnical works	Scientific publications, reviewed	https://www.research.manchester.ac.uk/portal/files/38007843/FULL_TEXT.PDF
237	Application of polimeric supporting fluids	2016	Application of polymeric supporting fluids for the construction of bored piles and diaphragm walls	Scientific publications, reviewed	https://www.irbnet.de/daten/baufo/20088034118/Short_Version.pdf
238	IMA Europe (2018) Recycling Industrial Minerals	2018	IMA Europe (2018) Recycling Industrial Minerals	Experts and industry associations	http://old.ima-europe.eu/sites/ima-europe.eu/files/publications/IMA-Europe_Recycling%20Sheets_2018.pdf
239	IMA data provided through consultation (2019).	2019	IMA data provided through consultation (2019).	Experts and industry associations	
240	GreenSpec	2022	GreenSpec - Aggregates for Concrete	Experts and industry associations	http://www.greenspec.co.uk/building-design/aggregates-for-concrete/
241	Industrial Minerals & Rocks. Commodities	2006	Kogel, J.E., Trivedi, N.C., Barker, J.M., Krukowski, S.T. 2006. Industrial Minerals & Rocks. Commodities, Markets, and Uses. 7th Edition. SME.	Scientific publications, reviewed	
242	Industrial Minerals Pricing Database	2022	IM Price database - Industrial Minerals	Experts and industry associations	https://www.indmin.com/Pricing.html
243	USGS Mineral Commodity Summary 2016 - Iron and Steel Slag	2020	USGS Mineral Commodity Summary 2016 - Iron and Steel Slag	Experts and industry associations	https://www.usgs.gov/centers/national-minerals-information-center/iron-and-steel-slag-statistics-and-information
244	Alternatives to Vermiculite & Perlite	2018	Alternatives to Vermiculite & Perlite	Experts and industry associations	https://homeguides.sfgate.com/alternatives-vermiculite-perlite-43502.html

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245	EUMEPS	2022	EUMEPS Construction	Experts and industry associations	http://www.eumeps.construction
246	Advances in filter aid and precoat filtration technology	2001	Sulpizio, T.E. 1999. Advances in filter aid and precoat filtration technology. Presentation at the American Filtration & Separation Society Annual Technical Conference.	Scientific publications, reviewed	https://www.semanticscholar.org/paper/ADVANCES-IN-FILTER-AID-AND-PRECOAT-FILTRATION-Sulpizio/8a0e15f9ba2518c788b52a2335e49e3cac90e3da
247	AFS	2022	American Filtration & Separations Society	Experts and industry associations	https://www.afssociety.org/
248	USGS	2022	Diatomite Statistics and Information	Experts and industry associations	https://www.usgs.gov/centers/national-minerals-information-center/diatomite-statistics-and-information
249	Production of high quality rice husk ash	1993	Kleih, U. and Hollingdale, A.C. (1993) Production of high quality rice husk ash. Technical Report.Natural Resources Institute, Chatham, UK.	Scientific publications, reviewed	https://gala.gre.ac.uk/id/eprint/12130/1/Doc-0494.pdf
250	Eurogypsum and Nera	2016	Eurogypsum and NERA Economic Consulting (2016). Data provided through stakeholder consultation	Experts and industry associations	
251	G to G: From production to recycling: a circular economy for the European Gypsum Industry	2015	G to G: From production to recycling: a circular economy for the European Gypsum Industry with the Demolition and Recycling Industry; Report DA1: Inventory of current practices. http://gypsumtogypsum.org/news/donwload-the-gtog-reports-now/	Scientific publications, reviewed	http://www.eurogypsum.org/wp-content/uploads/2015/04/151109-EU-construction-news-0215.pdf
252	DG Environment (2010). Green Public Procurement. Wall Panels Technical Background Report.	2022	DG Environment (2010). Green Public Procurement. Wall Panels Technical Background Report.	experts and industry associations	https://ec.europa.eu/environment/gpp/pdf/thermal_insulation_GPP_%20background_report.pdf
253	Eurogypsum (2015)	2016	Eurogypsum (2015) Position letter Re: Assessment of FGD gypsmum as a separate raw material in the list of raw materials to be evaluated as critical by the Commission in 2016	experts and industry associations	
254	Industrial Minerals & Rocks	2006	Industrial Minerals & Rocks: Commodities, Markets, and Uses	experts and industry associations	https://books.google.it/books/about/Industrial_Minerals_Rocks.html?id=zNicdkuulE4C&redir_esc=y
255	Soulier et al. (2018)	2018	Soulier, M., Glöser-Chahoud, S., Goldmann, D., Tercero Espinoza, L.A. (2018): Dynamic analysis of European copper flows. Resources, Conservation & Recycling, 129, 143-152 (incl. supplementary information)	scientific publication, reviewed	https://www.sciencedirect.com/science/article/abs/pii/S0921344917303324?via%3Dihub
256	Enghag, P. (2004)		Enghag, P. (2004). Encyclopedia of the elements: Technical data, history, processing, applications. Weinheim: Wiley-VCH.	Scientific publications, reviewed	https://www.wiley.com/en-us/Encyclopedia+of+the+Elements%3A+Technical+Data+History+Processing+Applications-p-9783527306664
257	2nd assessment of the CRM list	2014	REPORT ON CRITICAL RAW MATERIALS FOR THE EU, Report of the Ad hoc Working Group on defining critical raw materials	Official data (EU, MS)	https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&ved=2ahUKEwjEz_rP3uH4AhUKyKQKHcEeBs8QFnoECBUQAQ&url=https%3A%2F%2Fe

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					c.europa.eu%2Fdocsroom%2Fdocuments%2F10010%2Fattachments%2F1%2Ftranslations%2Fen%2Freditions%2Fpdf&usg=AOvVaw0wJWTi1phbJWSxhMT_1dnG
258	Eurostat Roundwood removals	2022	Roundwood, fuelwood and other basic products	Official data (EU, MS)	Statistics | Eurostat (europa.eu)
259	Rostek et al.	2022	A dynamic material flow model for the European steel cycle	scientific publication	https://www.econstor.eu/bitstream/10419/254322/1/1802128042.pdf
260	FAOSTAT Fuelwood production	2022	Complete Forest Products dataset | FAOSTAT	Official data (EU, MS)	https://www.fao.org/faostat/en/#data/FO
261	Hydrogen Europe, CLEAN HYDROGEN MONITOR	2021	Hydrogen Europe, CLEAN HYDROGEN MONITOR	Industry Association	https://hydrogeneurope.eu/product/clean-hydrogen-monitor-report-2021/
262	Workshop discussion on Cadmium	2022	Cadmium Association, Workshop discussion	Experts and Industry Association	
263	Österreichisches Montan-Handbuch	2016-2020	Bundesministerium für Landwirtschaft, Regionen und Tourismus	Official data (EU, MS)	
264	Statistics Denmark	2016-2020	RST01: Extraction of raw materials in Denmark by region and type of raw material	Official data (EU, MS)	https://www.statbank.dk/RST01
265	Inventory of mineral resources of Hungary	2016-2020	Mining and Geological Survey of Hungary	Official data (EU, MS)	
266	Cave e miniere : Risorse minerali estratte	2016-2020	ISTAT, Istituto Italiano di Statistica	Official data (EU, MS)	http://dati.istat.it/Index.aspx?QueryId=24070
267	Bulletin of Mineral Resources in Slovenia 2021	2016-2020	Geological Survey of Slovenia	Official data (EU, MS)	
268	LIMESTONE	2016-2021	Combined sources valid for Limestone	Official data (other)	
269	Industrial minerals and rocks	2006	Kogel, J. E., Trivedi, N. C., Barker, J. M., & Krukowski, S. T. (Eds.). (2006). Industrial minerals & rocks: commodities, markets, and uses. SME.	Scientific publications	
270	ISE Zirconium		Institut für Seltene Erden und strategische Metalle (without year): Zirconium prices, occurence, extraction and use.	industry	https://en.institut-seltene-erden.de/rare-earths-and-metals/strategic-metals-2/zirconium/
271	Asian Metal Zirconium		Asian Metal (without year): Zirconium uses	industry	http://metalpedia.asianmetal.com/metal/zirconium/application.shtml
272	ARM Zirconium		Advanced Refractory Metal (without year): 6 Uses of Zirconium you mightn't know.	industry	https://www.refractorymetal.org/uses-of-zirconium/
273	Zirconium	2022	Expert estimation (2022): zirconium use, estimation based on combined sources		
274	Rui et al.	2021	Dynamic material flow analysis of natural graphite in China for 2001-2018, Resources, Conservation and Recycling, 173, 2021, 105732	Scientific publications	10.1016/j.resconrec.2021.105732
275	EC	2022	Georgitzikis, K., D`elia, E. and Garbossa, E., Coking coal: Impact assessment for supply security, European Commission, 2022, JRC129975.	Scientific publications	https://publications.jrc.ec.europa.eu/repository/handle/JRC129975

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276	Wood Mackenzie / Roskill	2022	Rare Earths: Outlook to 2030	Commercial providers	
277	Minor Metals Trade Association (MMTA)	2018	Indium Phosphide Under RoHS	Industry Association	https://mmta.co.uk/2018/08/02/indium-phosphide-under-rohs/
278	GJ-JJ	2019	What are the Differences between PVC and Silicone?	Commercial providers	https://www.gs-jj.com/blog/what-are-the-differences-between-pvc-and-silicone/#:~:text=The%20difference%20between%20PVC%20rubber%20and%20silicone%20gel&text=Different%20in%20character%3A%20Silicone%20products,%2C%20while%20PVC%20can%27t.
279	Leonardo Fernandes Gomes et al 2021 Mater. Res. Express 8 016527	2021	Ag-containing aluminum-silicon alloys as an alternative for as-cast components of electric vehicles	Scientific publications	https://iopscience.iop.org/article/10.1088/2053-1591/abdabe
280	Roskill Rare Earth report	2021	Rare Earths: Outlook to 2030 - Twentieth Edition	Commercial providers	CONFIDENTIAL
281	WMD x Spanish data	2022	WMD combined with Spanish extraction statistics	Official data (EU, MS)	https://energia.gob.es/mineria/Estadistica/DatosBibliotecaConsumer/2020/Estadistica-Minera-Anual-2020.pdf
282	Eurostat Total production x ITIA tungsten production	2022	Eurostat data for Total production (DS-056121) combined with ITIA estimation of global production	Industry Association	https://www.sciencedirect.com/science/article/pii/S0263436821000780#bb0015
283	IWW; ICA	2022	IWCC; ICA (2022): EU Copper Use. Average 2016-2020. International Wrought Copper Council; International Copper Association.	Industry	
284	ICDA	2022	International Chromium Association Statistical Bulletin 2021	Industry Association	
285	FLUORSPAR	2016-2020	Combined sources for fluorspar (all grades)	Official data	
286	Coropciuc, M. & Hebestreit C.	2022	Mirona Coropciuc and Corina Hebestreit (ECGA), personal communication after II Validation Workshop	Industry and other experts	
287	Ciacci, L.; Coropciuc, M.; Hebestreit, C.	2022	Combined reference for sources [69, 286]. Underlying assumptions and explanations are given as comments in the XLS template.	Industry and other experts	
288	Wood Mackenzie	2022	Mirona Coropciuc (ECGA), personal communication after II Validation Workshop, based on Wood Mackenzie - Graphite supply detailed	Industry and other experts	
289	Comext adapted from France and Estonia Data	2016-2020	Eurostat Comext data, adapted using figures from France + Estonia, and Rest of EU27	Official data	http://epp.eurostat.ec.europa.eu/newxtweb/
290	Combined sources for kaolin	2016-2020	Combined sources for kaolin	Official data	
291	Combined sources for kaolinitic clays	2016-2020	Combined sources for kaolinitic clays	Official data	

ID	Short	Source Year	Reference	Source Type	DOI or URL
292	Ciacci, L. & Matos, C. et al. & Mistry, M.	2016-2020	Combined reference for sources [17, 184]. Underlying assumptions and explanations are given as comments in the XLS template.	Industry and other experts	
293	Combined opinions of experts in potash	2022	Combined opinions of experts in potash, extended discussions during the SCREEN evaluation workshops	Industry and other experts	
294	Copper Alliance: Stocks and Flows	2022	Copper Alliance (2022): Stocks and Flows	Industry and other experts	https://copperalliance.org/policy-focus/society-economy/circular-economy/stocks-flows/
295	WS discussions on REE	2022	Combined opinions of experts on REE during the second SCRREEN validation workshop	Industry and other experts	
296	Se production	2022	Estimation of Se production and trade based on various sources	Industry and other experts	
297	European production of Silicon	2022	Expertfrom Euroalliage	Industry and other experts	
298	Si substitute in electronic	2022	Expert from BRGM	Industry and other experts	
299	PGMs substitutes and recycling	2022	Expert in Workshop	Industry and other experts	
300	BeST Responses toMSA questions	2022	BeST	Industry and other experts	
301	Sept WS - Aurela Shtiza	2022	World production of borates can be estimated as 80% of borates extraction, with similar distribution per country, taking into account Eurostat PRODCOM Total production into account	Experts and industry associations	
302	Sept WS - Henk Van der Laan	2022	Expert estimation on data for scandium at the SCRREEN validation workshop	Experts and industry associations	
	DERA Lithium	2022	Rohstoffrisikobewertung – Lithium 2030 - Update (to be published)	Scientific publications	to be published
303	Sept WS - JSW	2022	Expert Workshop		
304	Natural Rubber, recycling devulcanization	2022	Reuse of devulcanized rubber in new tyres	Scientific publications	CLOSING THE LOOP: REUSE OF DEVULCANIZED RUBBER IN NEW TIRES (windesheim.nl)
305	ASD Europe experts on 16/09/2022	2022	discussion with ASD Europe experts on 16/09/2022		
306	DERA	2021	DERA Rohstoffinformationen - Rohstoffe für Zukunftstechnologien 2021	Scientific publications	https://www.deutsche-rohstoffagentur.de/DE/Gemeinsames/Produkte/Downloads/DERA_Rohstoffinformationen/rohstoffinformationen-50.pdf?__blob=publicationFile&v=4
307	Combined sources for Titanium metal	2022	Combined sources [1,305,306] for share of applications of Ti metal		
308	Nishida et al.	2021	Ikuko Nishida; Kazuhisa Fujita; Takaaki Togo; Takanori Yoshino; Tetsuro Sakamura (2021) Non-Phosphorus Treatment Technology for Cooling Water Systems	Scientific publications	https://onepetro.org/NACECORR/proceedings-abstract/CORR21/4-CORR21/D041S017R006/464135
309	Products Finishing	2006	Vanadate Conversion Coatings: Alternative to Phosphate?	Industry and other experts	https://www.pfonline.com/articles/vanadate-conversion-coatings-alternative-to-phosphate

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310	Lanxess	2019	Achieving flame-retardant properties without red phosphorus	Industry and other experts	https://lanxess.com/en/Media/Press-Releases/2020/10/Achieving-flame-retardant-properties-without-red-phosphorus
311	combined sources for phosphate rock	2022	Combined opinions of experts in phosphate rock, extended discussions during the SCREEN evaluation workshops	Industry and other experts	
313	Eurostat	2022	Supply, transformation and consumption of solid fossil fuels [NRG_CB_SFF__custom_3607504]	Official data	https://ec.europa.eu/eurostat/databrowser/bookmark/68a09d6a-42ef-4789-8ec9-d178be267a6c?lang=en
312	Combined data for Coking coal	2022	Combined production data for coke from VDKI [77] and Eurostat [312]		
314	combined data for Zirconium metal production	2022	Combined production data for zirconium metal based on sources 315 and 316		
315	MMTA	2022	Minor Metal Trade Association (2022): Zirconium	industry association	https://mmta.co.uk/metals/Zr/
316	World Nuclear Association	2021	World Nuclear Association (2021): World Nuclear Performance Report 2021	industry association	https://www.world-nuclear.org/getmedia/891c0cd8-2beb-4acf-bb4b-552da1696695/world-nuclear-performance-report-2021.pdf.aspx
317	Reade	2022	Zirconium (Zr) metal and Zirconium Powder	industry	https://www.reade.com/products/zirconium-zr-metal-zirconium-powder
318	Tungsten smelters	2022	Combined information on smelters from ITIA and Wolfram to estimate gloabl processing shares	Industry and other experts	https://www.responsiblemineralsinitiative.org/conformant-tungsten-smelters/?
319	UBA	2008	BROMIERTE FLAMMSCHUTZMITTEL – SCHUTZENGEL MIT SCHLECHTEN EIGENSCHAFTEN?	Industry and other experts	https://www.umweltbundesamt.de/sites/default/files/medien/publikation/long/3521.pdf
320	Lithium estimation of world processing	2022	Combined information on extraction from WMD and on processing from DERA, confirmed by UMICORE	Industry and other experts	
321	Expert feedback	2022	Expert feedback on noble gases	Industry and other experts	
322	Lithium use in lubricants	2022	The Lithium Crisis for the Grease Industry	Industry and other experts	https://www.nlgi.org/wp-content/uploads/2022/03/Mar-Apr-2022-NLGI-Spokesman.pdf
323	IHS Markit	2021	IHS Markit Hydrogen, Chemical Economics Handbook		
324	Rare earths	2022	Expert feedback on rare earth uses in Europe	Industry and other experts	
325	KITECH	2015	Material flows of Selenium and Tellurium. Extract from “Establishment of Material Flow Analysis Statistics for Metals” (VI), Hong-Yoon Kang et al., 2015, KITECH (Resource productivity foundation establishment project report funded by Ministry of Trade, Industry and Energy of Korea); unofficial translation by IRTC	Industry and other experts	https://irtc.info/wp-content/uploads/2023/01/Se_Te-Materials-Flow-Report_English-final.pdf
326	Eurogypsum	2014	plaster and plasterboards solutions	Industry and other experts	https://eurogypsum.org/
327	Gypsum Board Market Size & Growth Report	2019	Gypsum Board Market Size, Share & Trends Analysis Report	Industry and other experts	Market Research Reports & Consulting | Grand View Research, Inc.

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328	IMA-Europe	2022	Annual Report 2020–21	Industry and other experts	https://ima-europe.eu/wp-content/uploads/2022/02/IMA-Europe-Annual-Report-2020-2021.pdf
329	Xiaoyu Liang et al.	2017	Xiaoyu Liang, Yi Lu, Zhijuan Li, Chao Yang, Chunge Niu, Xintai SuBentonite/carbon composite as highly recyclable adsorbents for alkaline wastewater treatment and organic dye removal - Microporous and Mesoporous Materials 241 (2017) 107e114	Scientific publications	www.elsevier.com/locate/micromeso
330	Federal Ministry of Agriculture, Regions and Tourism	2021	World Mining Data 2021 - Volume 36 - C. Reichl, M. Schatz Minerals Production - ISBN 978-3-901074-50-9 Vienna, 2021. Last updated: 27 April 2021	Industry and other experts	https://www.world-mining-data.info/wmd/downloads/PDF/WMD2021.pdf
331	U.S. Geological Survey,	2022	Mineral Commodity Summaries, January 2022	Industry and other experts	https://pubs.usgs.gov/periodicals/mcs2022/mcs2022.pdf
332	Asia Industrial Gases Association	2019	PERLITE MANAGEMENT	Industry and other experts	http://www.asiaiga.org
333	Bismuth - expert feedback	2023	Production of bismuth in Belgium 2016-2020. Follow up of SCRREEN Valiadation workshops.	Industry and other experts	
334	Coal - EIA US 2023	2023	International - U.S. Energy Information Administration (EIA)	Official data (other)	https://www.eia.gov/international/data/world/coal-and-coke/coal-and-coke-production
335	HREEs - REIA 2023	2023	Communication with REIA on HREEs production and trade	Industry and other experts	
336	Houtvademecum	2011	Wood catalogues PROBOS 2014-2016 en Houtvademecum. Centrum Hout Almere. Sdu uitgevers bv, den Haag. ISBN 978 90 125 82162, NUR 833/835	Industry	https://www.houtvademecum.com/
337	Processed vanadium production	2022	Direct input from Terry Perles, TTP squared (same source as previous assessemnts, MSA, and the US GOV for 232 section investigation for Vanadium)	Industry and other experts	https://www.ferro-alloy.com/en/vanadium/TTP%20Squared%20market%20summary%203%20April%202020.pdf
338	Coal - IEA 2022	2022	IEA, World Energy Statistics, 2022	Official data (other)	
339	Beryllium - BEST 2023	2023	Communication with BEST association on Beryllium. Follow up of SCRREEN Valiadation workshops.	Industry and other experts	
340	Indium - IC 2023	2023	Communication with Indium Corporation 2023. Follow up of SCRREEN Valiadation workshops.	Industry and other experts	
341	Uncomtrade import data antimony	2023	Download from UN Comtrade Database for Imports of Antimony 28258000 and 81101000	Official data	https://comtradeplus.un.org/TradeFlow?Frequency=A&Flows=X&CommodityCodes=282580&Partners=0&Reporters=all&period=2016&AggregateBy=none&BreakdownMode=plus
342	Perpetua White Paper	2021	Perpetua White Paper on Antimony	Industry and other experts	https://perpetuaresources.com/wp-content/uploads/Antimony-White-Paper.pdf
343	Kaolin clay - applicatiions	2022	Combined values for kaolin and kaolinitic clay	Industry and other experts	
344	Niobium - Betatechnology	2023	Communication with an expert. Follow up of SCRREEN Valiadation workshops.	Industry and other experts	

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345	Tantalum - TaNb	2023	Communication with an expert. Follow up of SCRREEN Valiadation workshops.	Industry and other experts	
346	Tantalum - Imerys	2022	Communication with Grégoire Jean <gregoire.jean@imerys.com> . Follow up of SCRREEN Valiadation workshops.	Industry and other experts	
347	Tantalum combined	2023	combined refernces 4. WMD and 346. Imerys	Official data (EU, MS)	
348	Tantalum - 2020 calculation	2020	Previous assumption of 400t Ta for EU sourcing in 2020 calculations are still valid. Import data from COMEXT make no sense.	Industry and other experts	
349	Natural Teak	1999	acreage and yield data on teak, mixing both plantation teak and natural teak.	Official data (EU, MS)	https://www.fao.org/forestry/25865-06dd4a3ffc3583aae26be6c4cc5ef851a.pdf
350	Tellurium First Solar	2022	Internal communication with First Solar	Industry and other experts	
351	Tellurium First Solar Recycling	2011	Internal communication with First Solar	Industry and other experts	
352	USGS	2022	Titanium Statistics	Official data (EU, MS)	https://d9-wret.s3.us-west-2.amazonaws.com/assets/palladium/production/atoms/files/myb1-2019-titan-advrel.xlsx
353	Abuzriba et al.	2015	Substitution for Chromium and Nickel in Austenitic Stainless Steels	Scientific publications	https://www.researchgate.net/publication/300897258_Substitution_for_Chromium_and_Nickel_in_Austenitic_Stainless_Steels
354	Pierre-Jean Cunat	2020	Alloying elements in stainless steel and other chromium-containing alloys	Scientific publication	https://www.safefoodfactory.com/en/editorials/46-alloying-elements-stainless-steel-and-other-chromium-containing-alloys/
355	TTP Squared	2019	TTP Squared, Inc. Expert consultation	Industry and other experts	
356	Bushveld materials	2022	Information on the website of mining group Bushveld Materials	Commercial providers	About Vanadium – Bushveld Minerals
357	The Barytes Organisation	2022	Website of the 'The Barytes Organisation"	Commercial providers	https://barytes.org
358	Scienceviews	2003-2008	Website on various minerals	Non-commercial provided	Barite (scienceviews.com)
359	Sibelco	2022	Website of commercial Baryte producer Sibelco	Commercial providers	www.sibelco.com/materials/baryte
360	Barytes applications shares	2022	Estimate based on 179: in the US ~98% of the barytes are used for drilling fluids. In the EU 50% is used for plastics and paints and fillers.	Industry and other experts	
361	Gold - concentrates	2023	Communication with expert on average content of traded concenntrates	Industry and other experts	
362	Germanium -production EU	2022	Coorespondence with DERA	Industry and other experts	
363	Germanium - combined sources	2022	combining production 4. WMD and 362.for Germany and Belgium.	Industry and other experts	
364	Bismuth - combined	2023	combining production 4. WMD, 10. USGS and 333. jan Vermeylen for Belgium.		

ID	Short	Source Year	Reference	Source Type	DOI or URL
	sources				

Annex 13. Summary report of the stakeholders' validation workshops

Workshops preparation

In addition to bilateral exchanges during the data collection for the criticality assessment, a key aspect of the overall stakeholder consultation approach includes also the stakeholder data collection and validation workshops co-organised with the Horizon project SCRREEN2. These meetings were aimed to collect, review and validate the data used for the purpose of criticality calculations and information used in the factsheets. For selected materials, the workshops served also as a source of information for the Materials Systems Analyses (MSA). The stakeholder workshops also provided the opportunity to present the data sources used and contributions delivered by stakeholders as well as discuss any recommendations to improve results.

The first data collection and validation stakeholders' workshop took place from 31 May to 3 June 2022 in Brussels. The aim of these stakeholder workshops was to discuss the value chains of the screened materials, and particular the EU dimension and to collect the maximum of information and data. Experts were also asked to contribute to relevant sections of the factsheets.

The second validation stakeholders' workshop took place from 20 to 23 September 2022 in Brussels. The aim of this workshop was to review and discuss the data selected by Grow experts and to validate them for the criticality assessments. Experts were also asked to contribute to relevant sections of the factsheets. It also aimed at discussing hypothesis and data for the undergoing MSA exercise on 30 materials.

A balance between the involvement of relevant stakeholders and methodological rigour is essential. The affirmation of a majority of stakeholder groups is essential to ensure that the results of the criticality assessments in particular, and the study as a whole, have the desired impact on EU business and policy making. The workshops however did not serve to discuss the methodology.

Prior to the workshops, several background documents have been submitted to participants by the consultants. This was to allow the opportunity for participants to familiarise themselves with the study and methodology used, as well as come prepared with any questions discussed during the introduction plenary session of the workshop.

Several follow-up actions were carried out after the SCRREEN2 workshops. E-mails were sent out to all participants thanking them for their interest, time and contributions as well as indicating any relevant follow-up actions e.g. deadlines for input, clarifications on specific input provided, etc. Follow-up with individual stakeholders who indicated willingness and capability to contribute relevant data and input for specific criticality assessments. Participants were reminded during the introduction session and throughout the day of the workshop that any of the data provided should be publishable and able to be sourced and cited. In other words, any (confidential) data provided that cannot be sourced or published could not have been accepted for the assessment.

I. First stakeholders' data collection and validation workshop on 31 May 5- 3 June 2022

The background documents sent to confirmed participants include:

Detailed agenda of the workshop(s):

- Details on the conference centre location and key contact information
- Rules of the day specifying the main aims of the workshop in terms of what is expected from participants
- Timetable and agenda of the day, including when the parallel discussions will take place for each material
- List of expected participants (both present and through teleconference)

Protected detailed calculation files: sent to the relevant stakeholder participants based on the materials attribution list described above.

List of questions per material prepared by SCRREEN (background documents).

Non-disclosure agreement (NDA): the NDA on information discussed during the workshops and related background documents was sent to all stakeholders who indicated their participation through teleconference. These participants were informed that their participation is dependent on timely reception of a signed NDA e.g. before the workshop. NDAs were distributed for signature at the start of each workshop for participants who are physically present.

The following table provides details on the agenda with materials covered during the stakeholder data collection workshop that was held from 31 May to 3 June 2022.

Agenda of the first stakeholders' workshop

Tuesday 31/05/2022					
13:30	Registration				
14:00	European Commission and SCRREEN				
Background and guidance for the workshop					
15:30	Tellurium	15:30	Hydrogen	15:30	Natural Teak Wood
16:00	Selenium	16:00	Baryte	16:00	Sapele Wood
16:30	Tungsten	16:45	Vanadium	16:30	Roundwood
17:00	Germanium			17:00	Natural Rubber
17:30	end of the day				
Wednesday 01/06/2022					
09:30	Registration				
10:00	Boron/Borates	10:00	Bauxite/Aluminium	10:00	Aggregates
10:30	Lithium			10:30	Fluorspar
		11:00	Silver	11:00	Kaolin Clay
11:30	Cobalt	11:30	Potash	11:30	Feldspar
		12:00	Gold	12:00	Silica Sand
12:30					
14:00	Scandium	14:00	Limestone	14:00	Phosphorus/Phosphate
14:30	Magnesite	14:30	Bentonite		
15:00	Magnesium	15:00	Talc		
15:30	STRONTIUM	15:30	Perlite	15:30	Titanium
16:00	Sulphur	16:00	Cadmium	16:00	Chromium
16:30	Bismuth	16:30	Gypsum	16:30	Iron Ore
17:00	end of the day				
Thursday 02/06/2022					
09:30	Registration				
10:00	Light Rare Earth	10:00	Helium	10:00	Indium
		10:30	Noble gases: neon,	10:30	Rhenium
				11:00	Molybdenum
11:30	Heavy Rare Earth	11:30		11:30	Zinc (Zn)
		12:00	Silicon metal	12:00	Lead
12:30					
14:00	Palladium	14:00	Copper	14:00	Coking Coal
14:30	Platinum			14:30	Diatomite
15:00	Rhodium	15:00	Zirconium	15:00	Natural Cork
15:30	Ruthenium + Iridium	15:30	Hafnium	15:30	Niobium
16:00	Beryllium			16:00	Tantalum
16:30	end of the day				
Friday 03/06/2022					
09:30	Registration				
10:00	Nickel	10:00	Gallium	10:00	
10:30		10:30	Antimony	10:30	
11:00	Manganese	11:00	Arsenic	11:00	
11:30		11:30	Tin (Sn)	11:30	
12:00	Natural Graphite	12:00		12:00	
12:30	end of the meeting				

The list of SCRREEN and DG GROW appointed experts attending the workshop is provided below.

Attendance list

Last Name	First Name	Company	Country
Aguilar-Hernandez	Glenn	CML, Leiden University	Netherlands
Anastasatou	Marianthi	Hellenic Survey of Geology and Mineral Exploration; National and Kapodistrian University of Athens	Greece
Aranda Alentorn	José Miguel	TECNICI SL	Spain
Arvanitidis	Nikolaos	Geological Survey of Sweden	Sweden
Bahremandi	Neda	REIA	Belgium
Barakos	George	Curtin University	Australia
Baranzelli	Claudia	-	Italy
Baron	Yifaat	Oeko-Institut e.V	Germany
Bastein	Ton	TNO	Netherlands
Blengini	Gian Andrea	Politecnico di Torino	Italy
Bonenkamp	Noortje	TNO	Netherlands
Bourg	Stéphane	CEA	France
Brown	Stewart	Johnson Matthey	United Kingdom
Bruno	Jens	CANTERAS INDUSTRIALES,S.L.	Spain
Buenger	Thomas	First Tin PLc	United Kingdom
Castresana-Pelayo	Jose Maria	Maxamcorp-International, s.l.	Spain
Cavezza	Francesca	European Aluminium	Belgium
Chavasse	Roland	International Lithium Association	United Kingdom
Chrétien	Anaëlle	In Extenso Innovation Croissance	France
Ciacci	Luca	University of Bologna	Italy
Cinaralp	Fazilet	ETRMA	Belgium
Corti	Fabrizio	Imerys Graphite and Carbon	Switzerland
Demange	Clara	LGI	France
Devauze	Chloe	In Extenso Innovation Croissance (IEIC)	France
Di Girolamo	Giovanni	ENEA	Italy
Dietrich	Anna	Öko-Institut	Germany
Dondi	Michele	CNR-ISTEC	Italy
Eilu	Pasi	Geological Survey of Finland	Finland
Eriksen	Dag Øistein	Primus.inter.pares AS	Norway
Eynard	Umberto	JRC	Italy
Fairlie	Tom	Cobalt Institute	United Kingdom
Forriere	Barbara	RENAULT	France
Frias Gomez	Carlos	Riotinto Proyectos y Desarrollos, S.L.	Spain
Galloux	Foulques	LGI	France
Garbarino	Elena	European Defence Agency	Belgium
Gautneb	Håvard	Geological survey of Norway	Norway
Georgitzikis	Konstantinos	JRC	Italy
Ghattas	Haifa	Euroalliages	Belgium
Gilles	Mik	International Cadmium Association	Belgium
Grund	Sabina	International Zinc Association (IZA)	Germany
Gutiérrez	Vicente	CONFEDEM	Spain

Last Name	First Name	Company	Country
Hagelüken	Christian	Umicore	Germany
Hajonides	Thomas	TNO	Netherlands
Helbig	Christoph	Universität Bayreuth	Germany
Hool	Alessandra	ESM Foundation	Switzerland
Husen	Peter	Vanitec	Germany
Ighilahriz	Mariane	4M Consulting	France
Joosu	Lauri	Geological Survey of Estonia	Estonia
Karhu	Marjaana	VTT Technical Research Centre of Finland	Finland
Knudson	Theodore	Materion Corporation	United States
Koehle	Julian	International Platinum Group Metals Association	Germany
Komnitsas	Kostas	Technical University of Crete	Greece
Koukouzas	Nikolaos	CERTH/CPERI	Greece
Kulczycka	Joanna	Mineral and Energy Economy Research Institute	Poland
Lapkovskis	Vjaceslavs	Riga Technical University	Latvia
Mancheri	Nabeel	REIA	Belgium
Martin	Joffrey	In Extenso Innovation	France
Marx	Henrik	Heraeus Metals Germany	Germany
Maury	Thibaut	Joint Research Center	Italy
Mavrogonatos	Konstantinos	Hellenic Survey of Geology and Mineral Exploration (HSGME); National and Kapodistrian University of Athens (NKUA)	Greece
Mayoral Fernandez	Gonzalo Roberto	OMNIS MINERÍA, S.L.U.	Spain
Mertas	Bartosz	Institute for Chemical Processing of Coal	Poland
Mikolajczak	Claire	Indium Corporation	Italy
Mistry	Mark	Nickel Institute	Germany
Mählmann	Peter	TROPAG Oscar H. Ritter Nachf. GmbH / member of BeST - Beryllium Science&Technology Assciation	Germany
Nair	Lekshmi	International Rubber Study Group	Singapore
Nättorp	Anders	FHNW	Switzerland
Papavasileiou	Konstantinos	NATIONAL AND KAPODISTRIAN UNIVERSITY OF ATHENS	Greece
Papavasileiou	Konstantinos	National and Kapodistrian University ofAthens	Greece
Patil	Ajay	Swiss Federal Institute of Technology at Lausanne and REMRETEch GmbH	Switzerland
Pereira	Bruno	Sinergeo	Portugal
Perumalsamy	Navaraj	ANNAI FATHIMA COLLEGE OF ARTS AND SCIENCE	India
Puzone	Massimo	Enea	Italy
Quijano	Laura	EuroGeoSurveys	Belgium
Regueiro	Manuel	CSIC	Spain
Renier	Angélique	NGK BERYLCO FRANCE	France
Rietveld	Elmer	TNO	Netherlands
Rodero Manso	Ines	EUROALLIAGES	Belgium
Salazar Merino	Pablo	CBMM Europe	Netherlands
Schofield	Emma	Johnson Matthey	United Kingdom
Shtiza	Aurela	IMA-Europe	Belgium

Last Name	First Name	Company	Country
Slupek	Kamila	Eurometaux	Belgium
Smolnik	Grzegorz	Silesian University of Technology, Gliwice	Poland
Straže	Aleŝ	University of Ljubljana, Biotechnical Faculty	Slovenia
Tauber	Martin	International Magnesium Association	Belgium
Teran	Klemen	Geological Survey of Slovenia	Slovenia
Tercero	Luis	Fraunhofer ISI	Germany
Thornton	Christopher	European Sustainable Phosphorus Platform	France
Van Leeuwen	Martin	International Zinc Association	Belgium
Videlo	Mathilde	LGI Sustainable Innovation	France
Videlo	Mathilde	LGI	France
Vinck	Nadia	Euroalliages	Belgium
Whittlesey	Sam	LGI Sustainable Innovation	France
Winbow	Howard	IZA	Belgium
Wittmer	Dominic	Dominic Wittmer (Freelancer)	Germany
de Asís	Pilar	Magnesitas Navarras	Spain

II. Second stakeholders' validation workshop on 20-23 September 2022

The background documents sent to confirmed participants include:

Detailed agenda of the workshop(s):

- Details on the conference centre location and key contact information
- Rules of the day specifying the main aims of the workshop in terms of what is expected from participants
- Timetable and agenda of the day, including when the parallel discussions will take place for each material
- List of expected participants (both present and through teleconference)

Protected detailed calculation files: sent to the relevant stakeholder participants based on the materials attribution list described above.

List of questions per material prepared by SCRREEN (background documents).

Background documents prepared by MSA group

Non-disclosure agreement (NDA): the NDA on information discussed during the workshops and related background documents was sent to all stakeholders who indicated their participation through teleconference. These participants were informed that their participation is dependent on timely reception of a signed NDA e.g. before the workshop. NDAs were distributed for signature at the start of each workshop for participants who are physically present.

The following table provides details on the agenda with materials covered during the stakeholder data collection workshop that was held on 20-23 September 2022.

Agenda of the second stakeholders' workshop (in orange, materials with MSA)

Tuesday20/09/2022 Afternoon

13:00 Registration

14:00 Welcome by the European Commission and SCRREEN

Background and guidance for the workshop

14:30 Tellurium	14:30 Kaolin Clay	14:30 Nickel
15:00 Selenium	15:00 Feldspar	15:15 Manganese
15:30 Tungsten	15:30 Aggregates	16:00 Natural Graphite
16:30 Germanium	16:30 Limestone	16:30 Natural Rubber
	17:00 Silica Sand	17:00 Roundwood

17:30 End of the day

Wednesday; 21/09/2022 Morning

09:30 Registration

10:00 Boron/Borates	10:00 Aluminium/Bauxite	10:00 Fluorspar
11:00 Lithium	11:00 Potash	11:00 Bentonite
11:45 Cobalt	11:30 Silver	11:30 Perlite
	12:00 Gold	12:00 Gypsum

12:30 Lunch

Wednesday; 21/09/2022 Afternoon

13:30 Registration

14:00 Magnesite	14:00 Rare Earth	14:00 Indium
15:00 Magnesium		15:00 Rhenium
		15:30 Molybdenum
16:00 Diatomite		16:00 Zinc (Zn)
16:30 Natural Cork		16:30 Lead
	17:00 Scandium	

17:30 end of the day

Thursday 22/09/2022 Morning

09:30 Registration

10:00 Silicon metal	10:00 Natural Teak Wood	10:00 Strontium
	10:30 Sapele Wood	
11:00 Tin	11:00 Bismuth	11:00 Helium
11:30 Cadmium	11:30 Sulphur	11:30 Noble gases: neon, krypton, xenon
	12:00 Talc	

12:30 Lunch

Thursday 22/09/2022 Afternoon

13:30 Registration

14:00 Palladium	14:00 Copper	14:00 Phosphorus/Phosphate Rock
Platinum	15:00 Niobium	15:00 Chromium
Rhodium		
16:00 Ruthenium + Iridium	16:00 Tantalum	16:00 Titanium
16:30 Beryllium	16:30 Zirconium	
	17:00 Hafnium	17:00 Iron Ore

17:30 end of the day

Friday 23/09/2022 Morning

9:30 Registration

10:00 Coking Coal	10:00 Gallium
11:00 Hydrogen	11:00 Antimony
11:30 Baryte	
12:00 Vanadium	12:00 Arsenic

12:30 end of the meeting

The list of SCRREEN and DG GROW appointed experts attending the workshop is provided below.

Attendance list

Last Name	First Name	Company	Country
Aguilar-Hernandez	Glenn	CML, Leiden University	Netherlands
Amwele	Martha	EIT RawMaterials	Germany
Anastasatou	Marianthi	Hellenic Survey of Geology and Mineral Exploration; National and Kapodistrian University of Athens	Greece
Andres	Tobias	Association of the German Potash and Salt Industry	Belgium
Arvanitidis	Nikolaos	Geological Survey of Sweden	Sweden
Barakos	George	Curtin University	Australia
Baranzelli	Claudia	-	Italy
Baron	Yifaat	Oeko-Institut e.V	Germany
Betz	Johannes	Oeko-Institut	Germany
Blagoeva	Darina	EC JRC	Netherlands
Blengini	Gian Andrea	Politecnico di Torino	Italy
Boixereu	Ester	IGME -CSIC	Spain
Bonoli	Alessandra	University of Bologna	Italy
Bourg	Stéphane	CEA	France
Bruggink	Maurits	Beryllium Science & Technology Association	Belgium
Bruno	Jens	CANTERAS INDUSTRIALES,S.L.	Spain
Bruno Díaz	Aina	Amphos 21 Consulting	Spain
Brusoni	Carolina	BASF	Belgium
Buchner	Marlene	Öko-Institut	Germany
Buenger	Thomas	First Tin PLc	United Kingdom
Bulach	Winfried	Oeko-Institut e.V.	Germany
Carrara	Samuel	Joint Research Centre	Netherlands
Castresana-Pelayo	Jose Maria	Maxamcorp-International, s.l.	Spain
Cavezza	Francesca	European Aluminium	Belgium
Chavasse	Roland	International Lithium Association	United Kingdom
Chrétien	Anaëlle	In Extenso Innovation Croissance	France
Ciacci	Luca	UNIBO	Italy
Cinaralp	Fazilet	ETRMA	Belgium
Coropciuc	Mirona	European Carbon and Graphite Association	Belgium
Corti	Fabrizio	Imerys Graphite and Carbon	Switzerland
Danino-Perraud	Raphael	Consultant	France
Daquino	Giuseppe Giovanni	European Defence Agency	Belgium
Delgado	Pedro	IGME	Spain
Demange	Clara	LGI	France
Devauze	Chloe	In Extenso Innovation Croissance (IEIC)	France
Di Girolamo	Giovanni	ENEA	Italy
Dittrich	Monika	ifeu	Germany
Dondi	Michele	CNR-ISTEC	Italy
Eichler	Stefan	Freiberger Compound Materials GmbH	Germany
Eilu	Pasi	Geological Survey of Finland	Finland
Eriksen	Dag	Primus.inter.pares AS	Norway

Last Name	First Name	Company	Country
Fairlie	Tom	Cobalt Institute	United Kingdom
Fontboté	Lluís	University of Geneva, Dept. Earth Sciences, Switzerland	Switzerland
Forte	Federica	ENEA	Italy
Garbarino	Elena	European Defence Agency	Belgium
Gautneb	Håvard	Geological survey of Norway	Norway
Gauß	Roland	EIT RawMaterials	Germany
Georgitzikis	Konstantinos	JRC	Italy
Ghattas	Haifa	Euroalliages	Belgium
Gilles	Michael	ICdA	Belgium
Godoy León	María Fernanda	Ghent University	Belgium
Green	Toby	BASF	United Kingdom
Grund	Sabina	International Zinc Association (IZA)	Germany
Gutiérrez	Vicente	CONFEDEM	Spain
Hagelüken	Christian	Umicore	Germany
Helbig	Christoph	Universität Bayreuth	Germany
Hermann	Ludwig	Proman Management GmbH	Austria
Hill	Darren	Innovate UK KTN	United Kingdom
Hool	Alessandra	ESM Foundation	Switzerland
Husen	Peter	Vanitec	Germany
Huxtable	Peter	Huxtable Associates	United Kingdom
Ighilahriz	Mariane	4M Consulting	France
Ignatova	Julia	NPM Silmet OU	Estonia
Jansen	Jeanette	Nedmag	Netherlands
Joosu	Lauri	Geological Survey of Estonia	Estonia
Kalvig	Per	GEUS / MiMa	Denmark
Karaś	Henryk	Cracow Technical Association	Poland
Karhu	Marjaana	VTT Technical Research Centre of Finland	Finland
Knudson	Theodore	Materion Corporation	United States
Koehle	Julian	International Platinum Group Metals Association	Germany
Kollias	Konstantinos	European Aluminium	Belgium
Koukouzas	Nikolaos	CERTH/CPERI	Greece
Kuby	Rolf	Euromines	Belgium
Kulczycka	Joanna	Mineral and Energy Economy Research Institute	Poland
Kyrkjeeide	Jorulf	TiZir Titanium & Iron AS	Norway
Ladenberger	Anna	Geological Survey of sweden	Sweden
Latunussa	Cynthia E. L.	JRC	Italy
Le Gleuher	Maïté	BRGM	France
Legay	Mathilde	LGI	France
Leroy	Christian	European Aluminium	Belgium
Limberger	Sonja	ifeu gGmbH	Germany
Llorens	Teresa	IGME	Spain
Luaces Frades	César	Federación de Áridos	Spain
Magrini	Chiara	indipendent	Italy

Last Name	First Name	Company	Country
Mancheri	Nabeel	REIA	Belgium
Martin	Joffrey	In Extenso Innovation	France
Marx	Henrik	Heraeus Metals Germany	Germany
Mavrogonatos	Constantinos	National and Kapodistrian Univ. of Athens/Hellenic Survey of Geology and Mineral Exploration	Greece
Mayoral Fernandez	Gonzalo Roberto	OMNIS MINERÍA, S.L.U.	Spain
Meese-Marktscheffel	Julia	H.C. Starck Tungsten GmbH	Germany
Meier	Michael	ORANO	France
Menad	Nour	BRGM	France
Mertas	Bartosz	Institute of Energy and Fuels Processing Technology (former Institute for Chemical Processing of Coal)	Poland
Mikolajczak	Claire	Indium Corporation	Italy
Millet	Patrice	European Commission	Belgium
Miretti	Ugo	HaDEA	Belgium
Mistry	Mark	Nickel Institute	Germany
Morris	Stephen	innovate UK KTN	United Kingdom
Mählmann	Peter	TROPAG Oscar H. Ritter Nachf. GmbH / member of BeST - Beryllium Science&Technology Assciation	Germany
Müller	Birgit	Freiberger Compound Materials GmbH	Germany
Nair	Lekshmi	International Rubber Study Group	Singapore
Navarro	Rafael	Spanish Geological Survey of Spain	Spain
Nazarenko	Zinaida	EPMF	Belgium
Neffati	Sheraz	International Chromium Development Association	France
Neumann	Bianca Derya	European Institute of Innovation and Technology RawMaterials	Germany
Noire	Marie-Helene	CEA	France
O'Brien	Jim	GAIN (Global Aggregates Information Network)	Ireland
Oleś	Adam	JSW	Poland
Patil	Ajay B.	Department of Chemistry, University of Jyvaskyla	Finland
Pawlowska	Adrianna	RHI Magnesita	Austria
Pearce	Jeremy	International Tin Association	United Kingdom
Peck	David	Delft University of Technology (TU Delft)	Netherlands
Pedro	Delgado	CN IGME-CSIC	Spain
Peres	Marta	Association Cluster Portugal Mineral Resources	Portugal
Perumalsamy	Navaraj	ANNAI FATHIMA COLLEGE OF ARTS AND SCIENCE	India
Puzone	Massimo	Enea	Italy
Radermacher	Dirk	ICDA - International Chromium Development Association	Germany
Reeves	Matthew	Innovate UK KTN	United Kingdom
Regueiro	Manuel	CSIC	Spain
Renier	Angélique	NGK BERYLCO FRANCE	France
Ricci	Carlo	University of Cagliari	Italy
Ricketts	Brian	EURACOAL aisbl	Belgium
Rietveld	Elmer	TNO	Netherlands

Last Name	First Name	Company	Country
Rodero Manso	Ines	EUROALLIAGES	Belgium
Roman-Ross	Gabriela	AMPHOS 21 Consulting	Spain
Ryan	Marge	Johnson Matthey	United Kingdom
Salazar	Pablo	CBMM	Netherlands
Salvio	Giuseppe	ENCO srl	Italy
Samouhos	Michail	National Technical University of Athens	Greece
Samy Iyyah Konar	Navaraj	Annai Fathima College and Yadava College , Madurai	India
Scheja	Oscar	Scandinavian Steel AB	Sweden
Schellhas	Isabell	K+S AG	Germany
Schmidt	Steffen	Wolfram Bergbau & Hütten AG	Austria
Schwela	Ulric	International Lithium Association	United Kingdom
Shtiza	Aurela	IMA-Europe	Belgium
Slupek	Kamila	Eurometaux	Belgium
Smolnik	Grzegorz	Silesian University of Technology, Gliwice	Poland
Spagni	Alessandro	ENEA	Italy
Suffys	Tristan	EUROGYPSUM	Belgium
Sánchez	Teresa	IGME	Spain
Tagliente	Maria Antonia	ENEA	Italy
Tauber	Martin	International Magnesium Association	United States
Tazi	Nacef	DG JRC	Italy
Teran	Klemen	Geological Survey of Slovenia	Slovenia
Tercero	Luis	Fraunhofer ISI	Germany
Thornton	Chris	ESPP European Sustainable Phosphorus Platform	France
Timón	Susana	IGME	Spain
Timón Sánchez	Susana Mª	CN IGME CSIC	Spain
Trevisan	Lucile	In Extenso Innovation Croissance	France
Turner	Matthew	Anglo American Platinum	United Kingdom
Van Der Laan	Henk	VIC Van der Laan International Consultancy BV	Netherlands
Van Leeuwen	Martin	International Zinc Association	Belgium
Vandenhoeck	Geert	Umicore - Electro-Optic Materials	Belgium
Vermeylen	Jan	Vital Materials Co., Ltd.	Germany
Videlo	Mathilde	LGI Sustainable Innovation	France
Vinck	Nadia	Euroalliages	Belgium
Väisänen	Ari	University of Jyväskylä	Finland
Winbow	Howard	IZA	Belgium
Wolff	Alexander	H.C. Starck Tungsten GmbH	Germany
Zeiler	Burghard	International Tungsten Industry Association	United Kingdom
de Asís	Pilar	Magnesitas Navarras	Spain
de Carolis	Roberta	ENEA	Italy
de Oliveira	Daniel	LNEG	Portugal

Annex 14. Key authors and contributors

GROW core team:

Milan Grohol
Constanze Veeh

Other Commission contributors:

Darina Blagoeva (JRC), Erwan Bourdon (GROW), Anna Walch (GROW)

External support:

DG GROW appointed experts from the EU expert database[40] to support the assessment. DG GROW has also concluded a Memorandum of Understanding with BRGM to support this assessment. Maïté le Gleuher and Alexis Plunder of BRGM contributed.

The following experts have contributed to the assessment in the role of an expert or a rapporteur, reviewing the work of other experts:

RAPPORTEURS	EXPERTS	
Chloé Devauze	Alessa Hool	Luca Ciacci
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[40] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/work-as-an-expert

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