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ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA
DIPARTIMENTO DI
SCIENZE E TECNOLOGIE AGRO-ALIMENTARI

CAVA DI MONTE TONDO

RISULTATI SPERIMENTAZIONE e CONSIDERAZIONI OPERATIVE

RINATURALIZZAZIONE con trapianto di specie

Considerando complessivamente tutte le piante messe a dimora nelle diverse fasi di trapianto emerge una risposta variegata delle diverse specie:

Sopravvivenza complessiva (Fig.1):
Specie con ottima sopravvivenza: *Fraxinus ornus;*
con buona sopravvivenza *il Pistacia terebinthus;*
con una sopravvivenza intermedia: *Rhamnus alaternus, Rosa canina*;
con bassa sopravvivenza: *Quercus ilex;*
con una sopravvivenza fallimentare: *Quercus pubescens e Juniperus communis*.

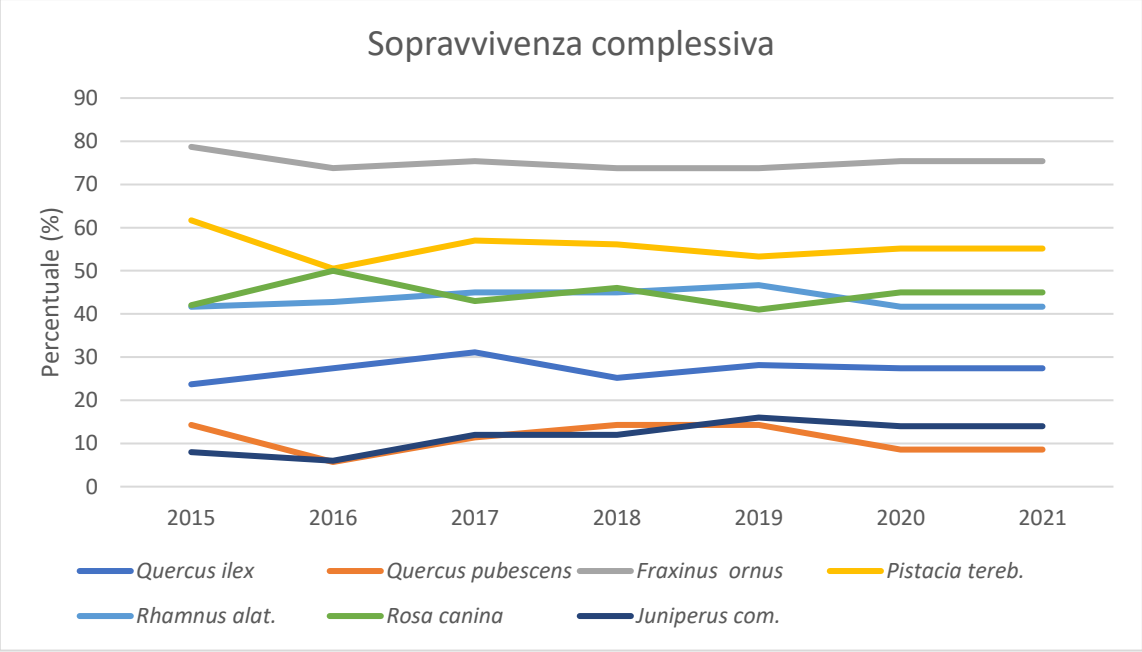

Fig. 1 Andamento della Sopravvivenza complessiva dei trapianti

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- Sviluppo complessivo (Fig.2):
  Specie con buon sviluppo: *Fraxinus ornus, Rhamnus alaternus* e *Rosa canina*;
  con sviluppo intermedio: *Quercus ilex* e *Juniperus communis*;
  con sviluppo limitato: *Pistacia terebinthus e Quercus pubescens*.

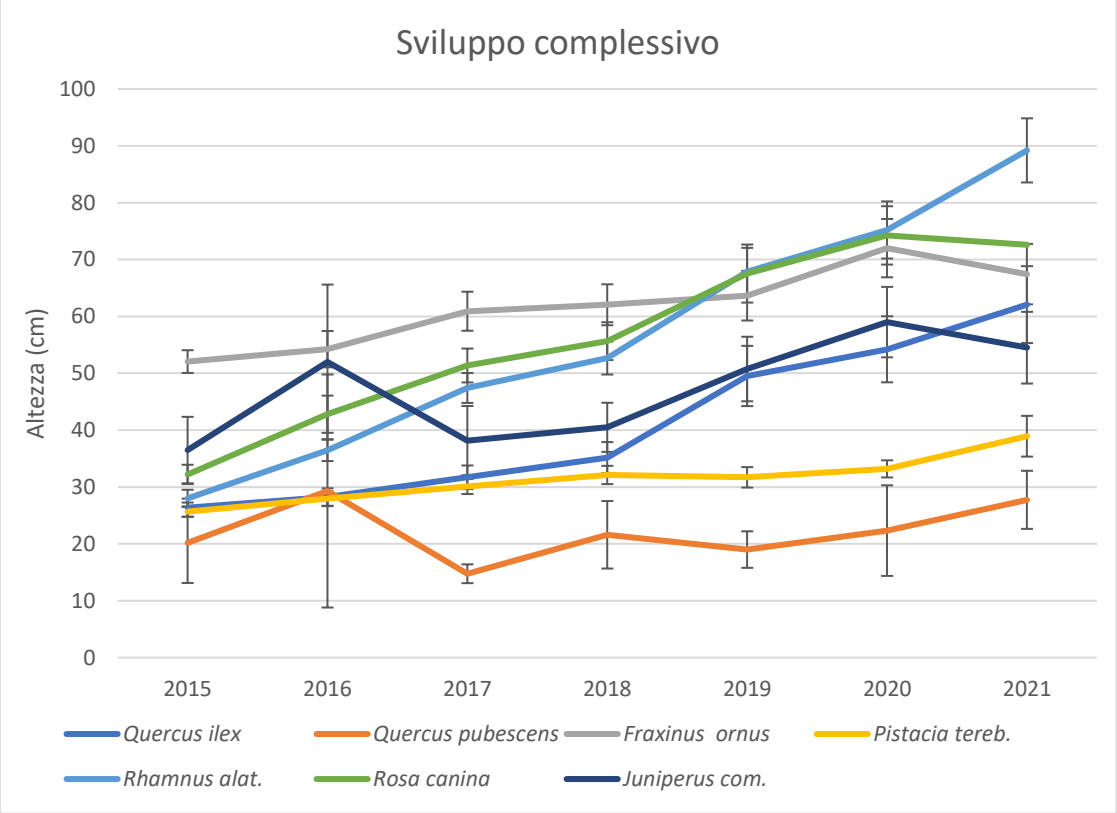

Fig. 2 Andamento complessivo dell'Altezza delle piante delle specie messe a dimora

Impianto

La risposta delle specie e delle singole piante è stata molto variabile in funzione delle diverse condizioni stazionali presenti.

Epoca di trapianto

L'epoca più corretta è risultata essere l'autunno per tutte le specie fatta eccezione per il *Quercus ilex* ed il *Rhamnus alaternus* che hanno attecchito meglio con un impianto a fine inverno.

Spessore dello sterile

La distribuzione dello sterile sul gradone è stata operata secondo le indicazioni progettuali a formare un piano inclinato raccordato a monte con la scarpata minerale gessosa a formare un

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piano inclinato verso il ciglio del gradone. In queste condizioni diverse sono le profondità di sterile presenti sul gradone.
La risposta delle piante è stata fortemente condizionata dallo spessore dello sterile presente: una disponibilità di almeno 50 cm risulta essere la condizione ottimale. Questa condizione è ritrovabile nelle posizioni intermedie del piano inclinato ricreato sul gradone dove si sono osservato le migliori risposte delle piante trapiantate.

Concimazioni all'impianto

All'inizio della sperimentazione era presente una buona risposta delle essenze erbacee sullo sterile riportato e modellato. Si è convenuto di mantenere questa risposta naturale associandola con un impianto di specie legnose. Su queste si è sperimentata una concimazione all'impianto all'interno della buca predisposta messa a confronto con un semplice trapianto.
La concimazione all'impianto non ha portato a forti differenze tra le due situazioni:
- alcune specie hanno evidenziato una crescita leggermente superiore (*Fraxinus ornus, Pistacia terebinthus*)
- altre hanno mostrato risposte similari (*Rosa canina, Quercus ilex*)
- una ha presentato una crescita leggermente inferiore (*Rhamnus alathernus)*.

Si è anche controllata la risposta della vegetazione erbacea rinaturata alla concimazione di impianto delle essenze legnose (Fig.3).

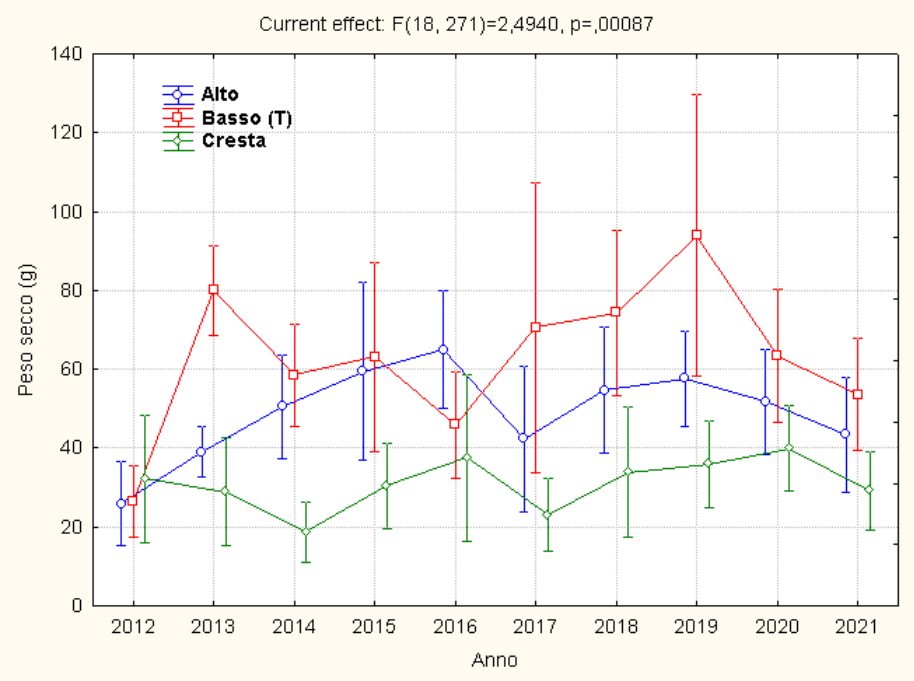

Fig.3 Andamento della Sostanza secca della copertura erbacea nei tre gradoni negli anni

A questo riguardo si sono confrontate 3 diverse situazioni:
- basso: gradone con sterile trapiantato
- alto: gradone con sterile a libera evoluzione
- cresta: cresta del fronte di scavo senza sterile.

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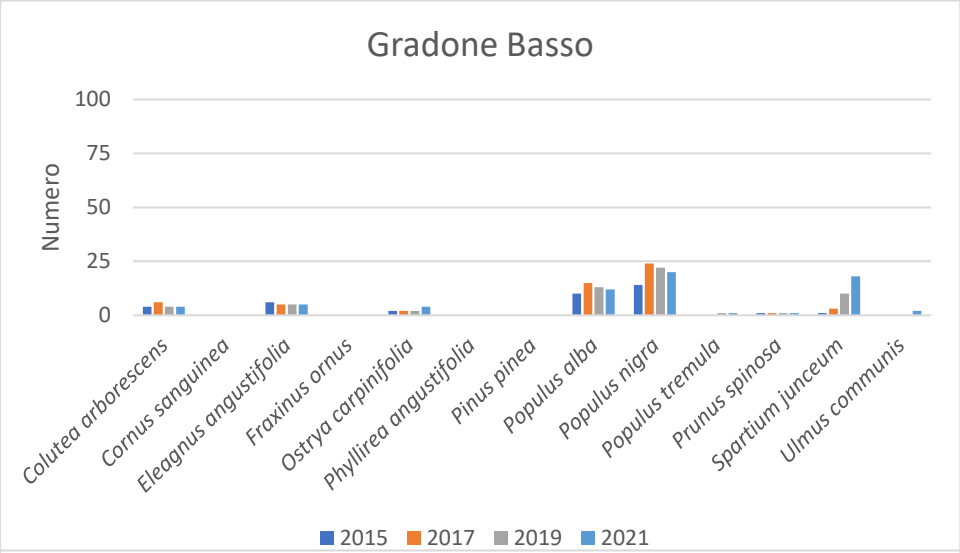
I dati decennali evidenziano una risposta della vegetazione erbacea alla presenza dello sterile (Alto -Basso vs Cresta), mentre per la concimazione localizzata si è osservato un effetto significativo solo nel primo anno (Basso > Alto), effetto che poi si è attenuato negli anni pur rimanendo il concimato leggermente superiore rispetto al rinaturato.

RINATURAZIONE: Ricolonizzazione naturale

A partire dal 2015 è iniziata l'osservazione del processo di affermazione di specie diffusesi naturalmente sui gradoni in osservazione. In particolare, sono state identificate negli anni 13 specie diverse, presenti in numero e posizione differenziate nei due gradoni a confronto: Basso – Rinaturalizzato, Alto – Rinaturato.
Il fenomeno si è presentato fin dall'inizio differenziato tra i due gradoni. Il gradone Alto ha sempre manifestato presenze naturali maggiori che negli anni sono decisamente aumentate, fenomeno sicuramente correlato alle minori distanze con il limite del bosco e con la vegetazione circostante.
Le presenze più frequenti sono risultate essere però simili nelle due condizioni: *Spartium junceum* (ginestra), *Populus alba* (pioppo bianco), *Populus nigra* (pioppo nero) ed *Eleagnus angustifolia* (olivello di Boemia) sono risultate essere le specie predominanti anche se in percentuali diverse nelle due situazioni a confronto (Fig.4/5).



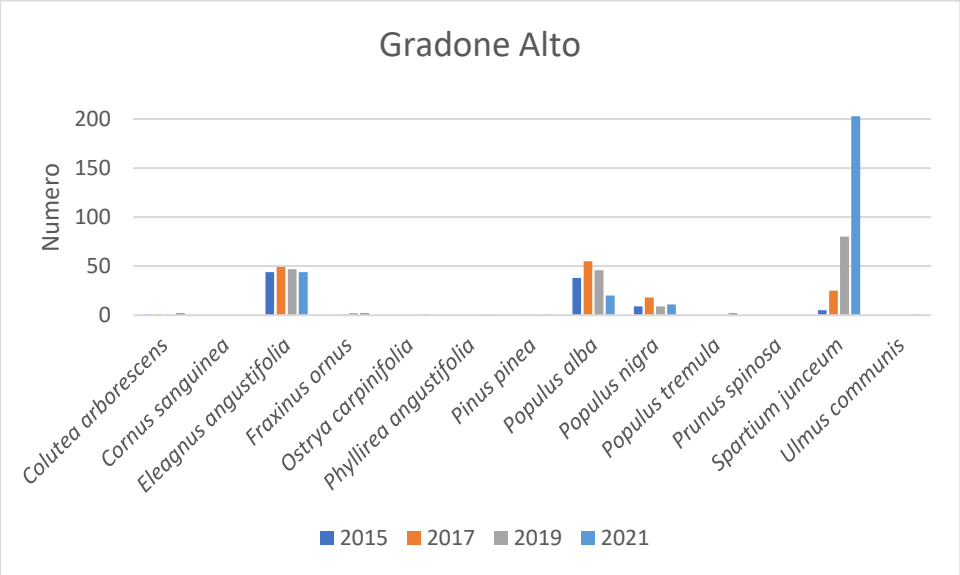


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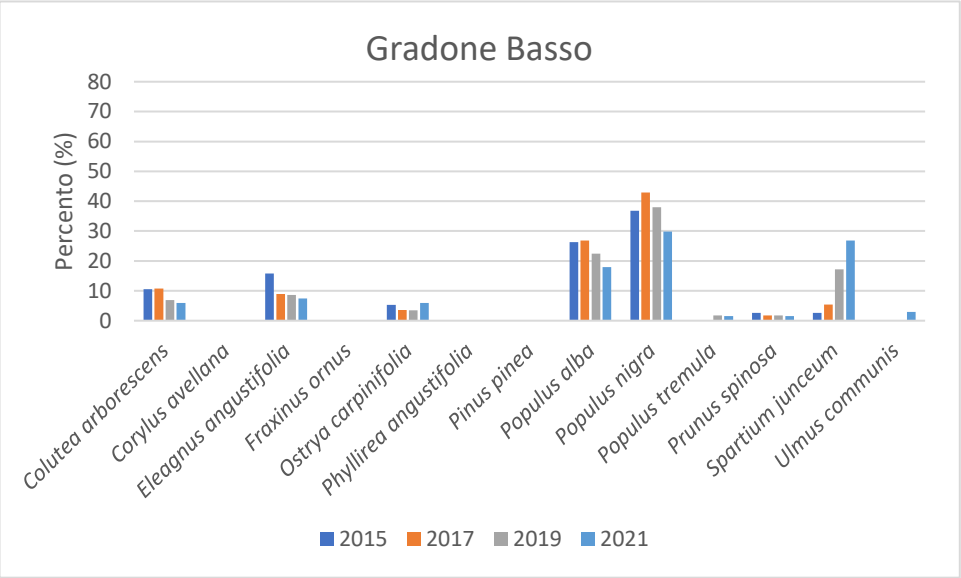
Fig.4 Presenze di specie rinaturate nei due diversi gradoni

Evidente la diversa composizione delle specie rinaturate:
- nel Gradone basso sono molto frequenti i pioppi, specie il nero, seguiti dalla ginestra e dall'olivello;
-nel gradone alto predominano la ginestra, l'olivello ed il pioppo bianco.
Molto interessante è però la dinamica del fenomeno: in entrambe le situazioni si sta osservando una crescita esponenziale di piante di ginestra associata ad una stasi o diminuzione nel numero delle altre specie.



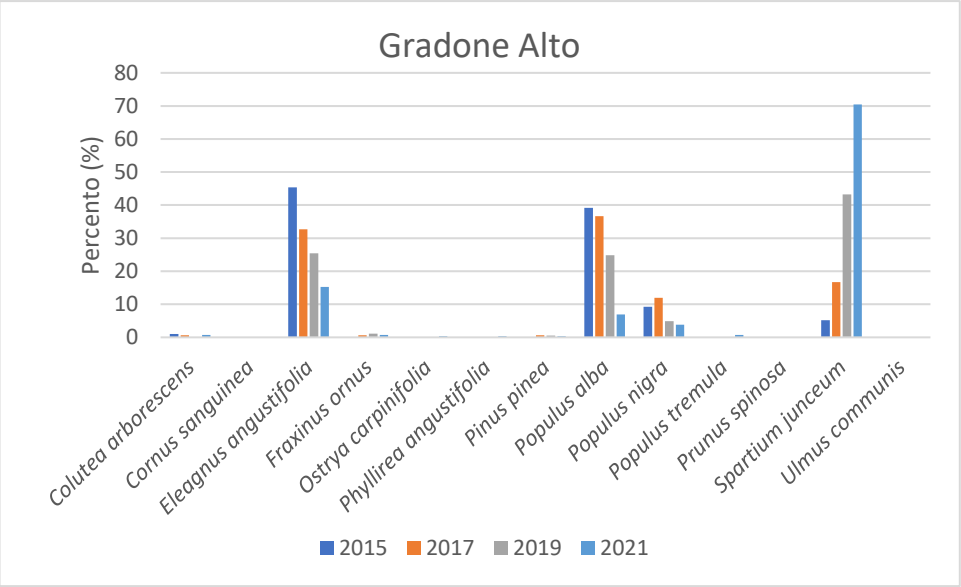


Fig.5 Percentuale della presenza di specie rinaturate nei due diversi gradoni

In termini percentuali questo fenomeno è ancora più evidente.

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Lo sviluppo di queste specie e piante rinaturate non sembra essere in alcun modo influenzato da trattamenti artificiali (Fig.6).
Da sottolineare come la rinaturazione di un ambito disturbato può favorire la diffusione di essenze aliene, in questo caso rappresentate dall'olivello di Boemia.

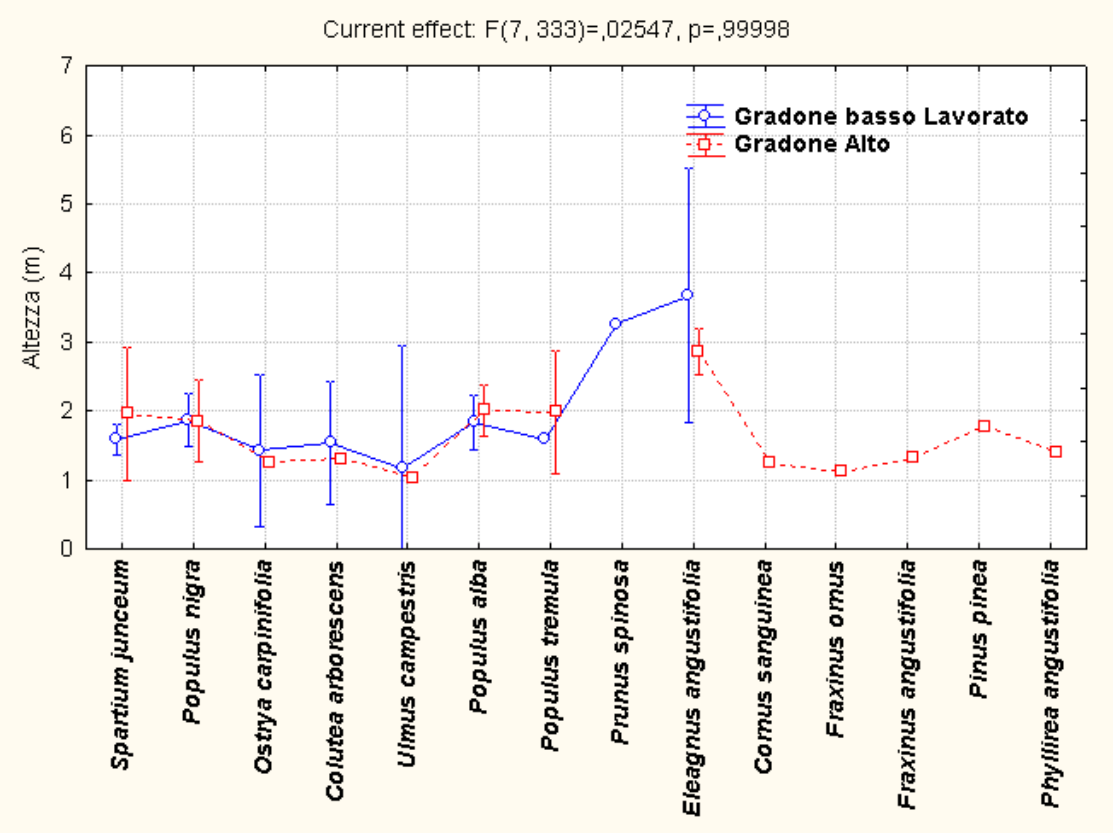

Fig.6 Sviluppo delle specie rinaturate nei due diversi gradoni

Infestazione da Vitalba su piante rinaturate

Nel tempo si è anche osservata una progressiva diffusione della *Clematis vitalba* una liana tipica dei nostri ambienti disturbati, molto esigente in termini di luce, pianta in grado di infestare l'area e poi arrampicarsi sulle piante legnose e crescere al di sopra di esse compromettendone lo sviluppo e, nel tempo, anche la sopravvivenza.
Analizzando le piante nei due diversi gradoni si osservano percentuali di infestazione molto elevate con valori che, per le specie più diffuse, arrivano anche all'80-90% (Fig.7).
Da sottolineare una diversa percentuale di infestazione tra i due gradoni: il gradone basso presenza percentuali maggiori in tutte le specie più frequenti. Questo può essere legato sia alla maggiore manipolazione del gradone a seguito sia degli impianti che delle manutenzioni annuali eseguite sulla vegetazione messa a dimora, sia con una maggiore disponibilità di azoto legata alla concimazione di impianto effettuata, elemento che ne stimola la diffusione.

Pur in presenza di valori di infestazione così elevati non si sono ancora manifestati effetti diretti sulla crescita delle legnose anche perché l'infestazione rilevata è nelle sue fasi iniziali.

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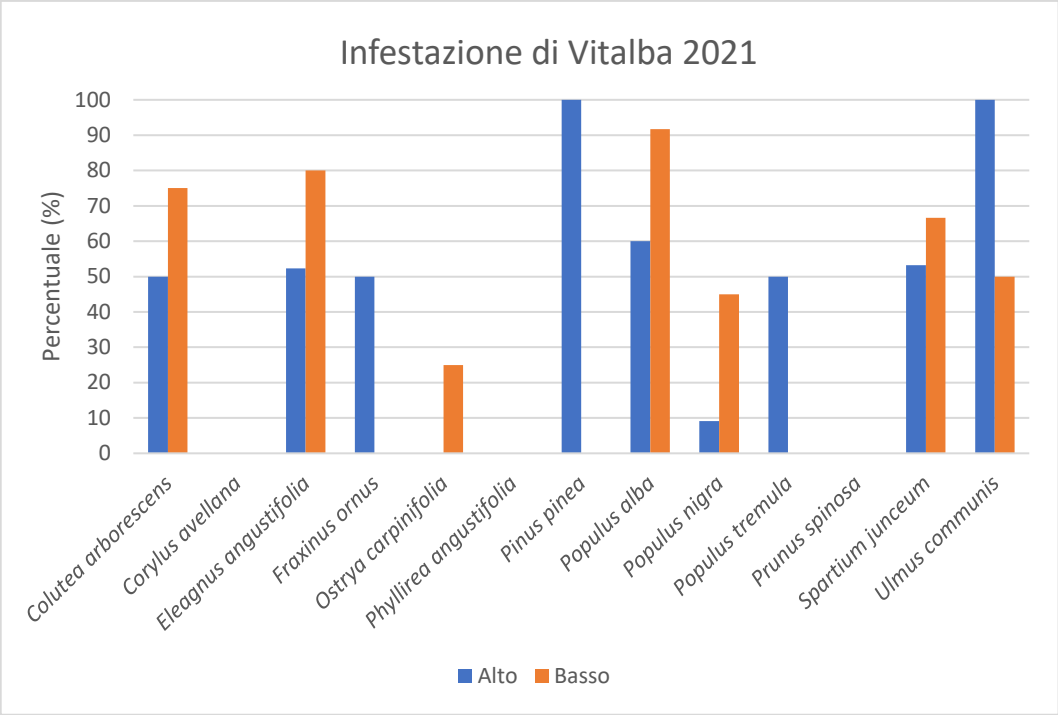

Fig.7 Percentuale piante infestate da vitalba nei due diversi gradoni

CONSIDERAZIONI OPERATIVE

Diverse sono le considerazioni che sono emerse in questi anni di sperimentazione.
La finalità dell'intervento di rivegetazione deve concentrarsi innanzitutto su uno sviluppo rapido ed efficace di una copertura vegetale legnosa che:
- limiti le problematiche paesaggistiche
- migliori le condizioni stazioni per favorire una evoluzione positiva
- favorisca una biodiversità e variabilità autoctona
- contrasti specie infestanti ed aliene.

Questi obiettivi possono essere raggiunti predisponendo innanzitutto un substrato non limitante l'attività biologica, favorendo:
- uno spessore adeguato dello sterile (minimo 50 cm)
- una conformazione che favorisca la conservazione in situ dell'acqua meteorica, attraverso la realizzazione di una contropendenza verso monte dello sterile, conformazione che limita anche eventuali fenomeni di rotolamento di detriti
- limiti l'erosione superficiale e la perdita di materiale fine verso valle.

Per favorire una risposta veloce della vegetazione si dovrà prevedere una leggera concimazione all'impianto, localizzata in corrispondenza delle piante al fine di evitare un eccesso di azoto che può favorire la diffusione della vitalba oltre che di altre specie.

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Nella rivegetazione si dovrà puntare sulle specie arboreo arbustive.
Nella scelta delle specie legnose si dovranno favorire specie a rapida crescita, copertura e diffusione, preferibilmente miglioratrici sia in termini chimici del substrato (leguminose) che in termini fisici micro ambientali, per generare fin da subito ambiti coperti ed ombreggiati che aiutino la sopravvivenza e lo sviluppo delle specie più esigenti e limitino le specie invasive come la vitalba.
Gli interventi dovranno necessariamente essere dilazionati nel tempo in due fasi distinte:
- fase di insediamento ed affermazione di specie rustiche, a crescita più rapida e miglioratrici: puntando sulle Leguminose come *Spartium junceum* e *Colutea arborescens* associate a essenze "rustiche" quali il *Rhamnus alaternus*, la *Rosa canina*, l'*Amelanchier ovalis*, *Phyllirea latifolia* e *Ligustrum vulgare* tra le arbustive e *Fraxinus ornus* e *Ostrya carpinifolia* tra le arboree.

- fase di insediamento di specie più esigenti quali le *Quercus ilex* che usufruendo di una copertura possono superare con maggiore facilità le fasi iniziali di adattamento. Si potrebbe tentare di inserire in questa fase anche la *Quercus pubescens*, pur se i risultati della sperimentazione non sono stati incoraggianti ed il *Pistacia terebinthus* negli ambiti più luminosi.

L'obiettivo è una veloce copertura del terreno associata ad un più lento miglioramento fisico e chimico del substrato che permetteranno di condizionare l'evoluzione successiva della copertura.

Maggiore attenzione dovrà essere esercitata al periodo di impianto della vegetazione: alcune specie che sembrano adattarsi alle condizioni estreme del fronte di cava, come il *Rhamnus* o il *Quercus ilex,* sono molto sensibili al trapianto alle basse temperature invernali e quindi sarà preferibile prevedere un loro impianto in primavera, mentre per le altre specie è preferibile un trapianto autunnale.

Si dovranno, infine, prevedere nei primi anni alcuni interventi di gestione periodici, biennali o triennali, al fine di contenere e limitare la diffusione sia di essenze aliene (Ailanto, Acero negundo) che di essenze infestanti (liane). L'affermazione di una densa copertura arboreo arbustiva favorirà il loro successivo controllo.

Bologna, 31.05.2022

Dott. Enrico Muzzi

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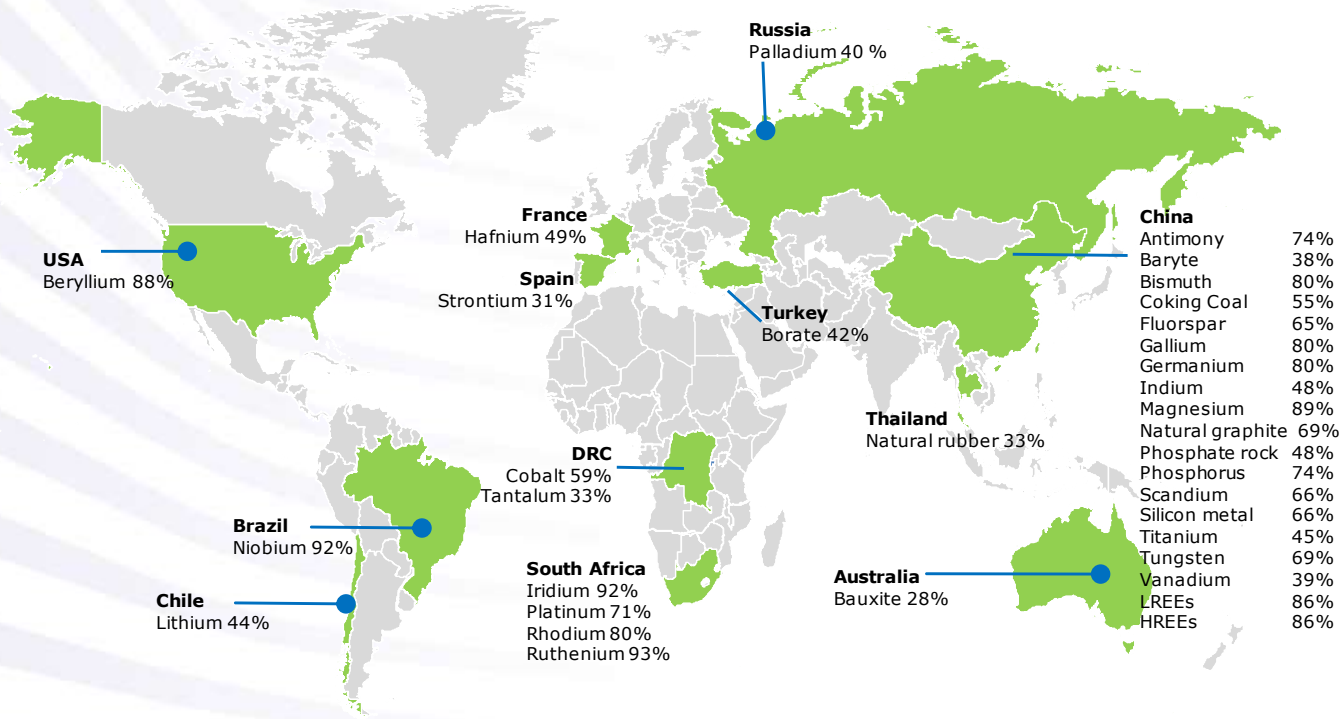
European Commission

Study on the EU's list of Critical Raw Materials (2020)

Final Report



Raw Materials

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Study on the EU's list of Critical Raw Materials (2020)

Final Report

31.01.2020

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EXECUTIVE SUMMARY

Context

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.

The EU Green Deal Communication[1] adopted on 11 December 2019 recognizes access to resources as a strategic security question to fulfil its ambition towards 2050 climate neutrality and increasing our climate ambition for 2030.

Secure and sustainable supply of both primary and secondary raw materials, in particular of critical raw materials, for key technologies and strategic sectors as renewable energy, e-mobility, digital, space and defence is one of the pre-requisites to achieve climate neutrality. The new Industrial Strategy for the EU[2] addresses the security and sustainability challenge and calls for an Action Plan on Critical Raw Materials and for industry-driven raw materials alliances.

This continues the work of the Commission to address the growing concern of securing valuable raw materials for the EU economy. Already in 2008, the European Commission launched the Raw Materials Initiative (RMI)[3]. 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. Critical raw materials are considered to be those that have high economic importance for the EU and a high supply risk.

The present study is the fourth technical assessment of critical raw materials for the EU, based on the methodology[4] developed by the European Commission in cooperation with the Ad hoc Working Group on Defining Critical Raw Materials (AHWG)[5] in 2017.

The first assessment (2011) identified 14 critical raw materials (CRMs) out of the 41 non-energy, non-agricultural candidate raw materials. In the 2014 exercise, 20 raw materials were identified as critical out of 54 candidates. In 2017, 27 CRMs were identified among 78 candidates.

Novelties of the 2020 assessment

The 2020 assessment covers a larger number of materials: 83 individual materials or 66 candidate raw materials comprising 63 individual and 3 grouped materials (ten individual heavy rare earth elements (REEs), five light REEs, and five platinum-group metals (PGMs)). Five new materials (arsenic, cadmium, strontium, zirconium and hydrogen) have been assessed.

[1] COM(2019) 640 final
[2] COM(2020) 102 final
[3] https://ec.europa.eu/growth/sectors/raw-materials/policy-strategy_en
[4] Methodology for establishing the EU List of Critical Raw Materials, 2017, ISBN 978-92-79-68051-9
[5] The AHWG on Defining Critical Raw Materials is a sub-group of the Raw Materials Supply Group expert group.

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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, tungsten, vanadium
Precious metals	gold, silver, and Platinum Group Metals (iridium, palladium, platinum, rhodium, ruthenium)
Rare earths	Heavy rare earths (dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium); Light rare earths (cerium, lanthanum, neodymium, praseodymium and samarium); and scandium
Other non-ferrous metals	aluminium, 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 and helium

For comparison, 41 candidate materials have been screened in 2011, 54 in 2014 and 61 in 2017.

Results

Of the 83 individual (66 candidate) raw materials assessed, the following 30 were identified as critical in this assessment:

2020 Critical Raw Materials (30)			
Antimony	Fluorspar	Magnesium	Silicon Metal
Baryte	Gallium	Natural Graphite	Tantalum
Bauxite	Germanium	Natural Rubber	Titanium
Beryllium	Hafnium	Niobium	Vanadium
Bismuth	HREEs	PGMs	Tungsten
Borates	Indium	Phosphate rock	Strontium
Cobalt	Lithium	Phosphorus	
Coking Coal	LREEs	Scandium	

The overall results of the 2020 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 and EI ≥ 2.8) of the graph. Blue dots represent the non-critical raw materials.

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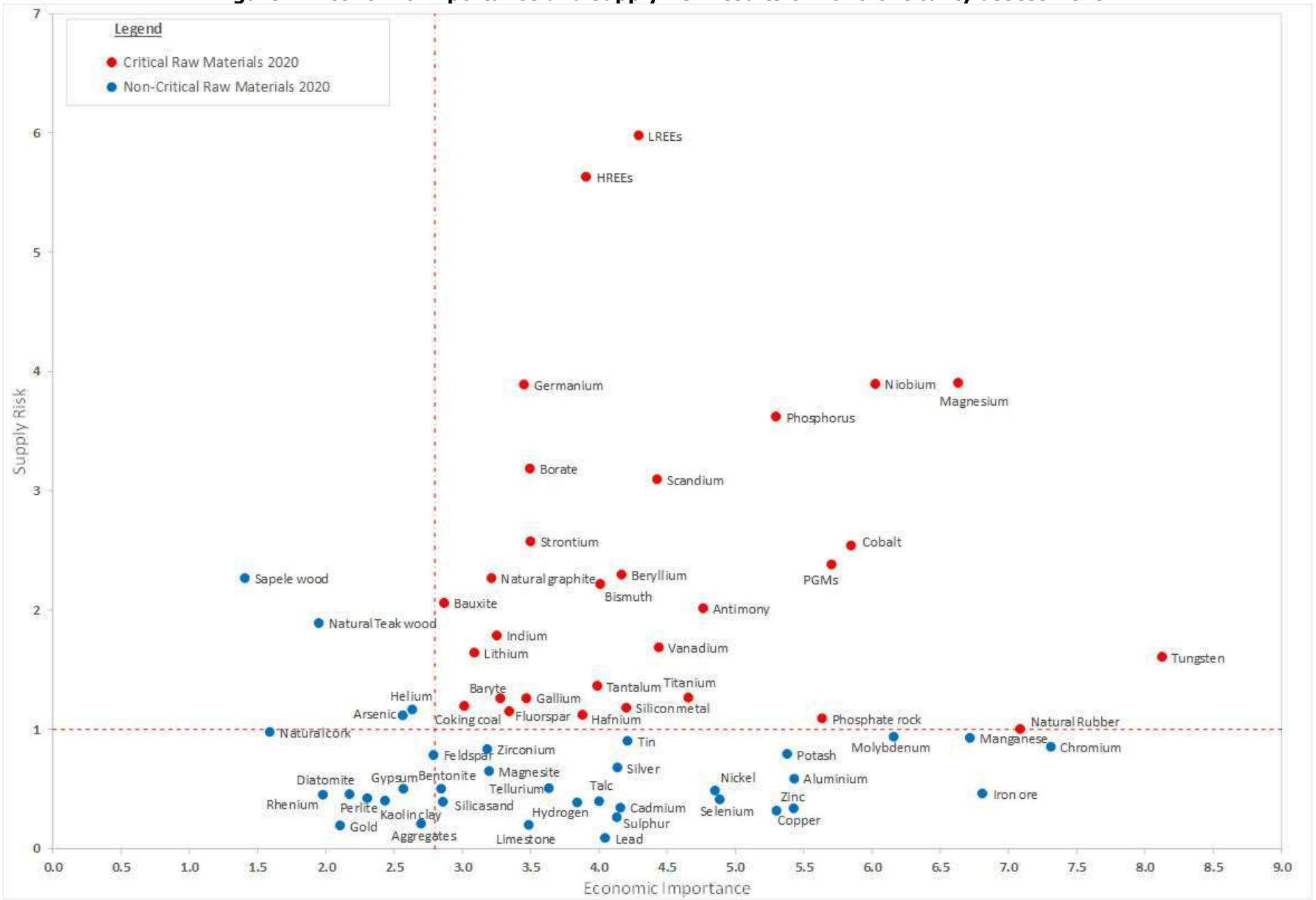
Figure A: Economic importance and supply risk results of 2020 criticality assessment



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The 2020 list confirms 26 of the 2017 CRMs. Three CRMs in the 2020 list were not considered as critical in the 2017 list: Bauxite, Lithium and Titanium. Conversely, Helium, critical in the 2017 CRM list, is no longer in 2020. Strontium is the only new candidate material that is in the 2020 list of CRMs.

2020 CRMs vs. 2017 CRMs			
Antimony	Germanium	PGMs	Bauxite
Baryte	Hafnium	Phosphate rock	Lithium
Beryllium	HREEs	Phosphorus	Titanium
Bismuth	LREEs	Scandium	
Borate	Indium	Silicon metal	
Cobalt	Magnesium	Tantalum	Strontium
Coking Coal	Natural Graphite	Tungsten	
Fluorspar	Natural Rubber	Vanadium	
Gallium	Niobium	~~*Helium*~~	

Legend:

Black: CRMs in 2020 and 2017
Red: CRMs in 2020, non-CRMs in 2017
Green: CRMs assessed in 2020 that were not assessed in 2017
~~*Strike:*~~ Non-CRMs in 2020 that were critical in 2017

The table below summarises the key changes in the 2020 CRMs list compared to the 2014 CRMs list. The 2020 assessment confirmed 19 CRMs from the 2014 list, whereas 8 of the non-critical materials in 2014 shifted to being critical in 2020.

2020 CRMs vs. 2014 CRMs			
Antimony	Indium	Baryte	Bismuth
Beryllium	Lithium	Bauxite	Phosphorus
Borate	Magnesium	Hafnium	Strontium
Cobalt	Natural Graphite	Natural Rubber	
Coking Coal	Niobium	Scandium	
Fluorspar	PGMs	Tantalum	
Gallium	Phosphate Rock	Titanium	
Germanium	Silicon Metal	Vanadium	
HREEs	Tungsten		
LREEs			

Legend

Black: CRMs in 2020 and 2014
Red: CRMs in 2020 that were not CRMs in 2014
Green: CRMs in 2020 that were not included in the assessment in 2014

The following tables present the major global supplier of the 2020 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.

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

Material		Stage[6]	Main global supplier	Share	Material		Stage	Main global supplier	Share
1	Antimony	E	China	74%	23	Magnesium	P	China	89%
2	Baryte	E	China	38%	24	Natural graphite	E	China	69%
3	Bauxite	E	Australia	28%	25	Natural rubber	E	Thailand	33%
4	Beryllium	E	USA	88%	26	Neodymium	E	China	86%
5	Bismuth	P	China	80%	27	Niobium	P	Brazil	92%
6	Borate	E	Turkey	42%	28	Palladium	P	Russia	40%
7	Cerium	E	China	86%	29	Phosphate rock	E	China	48%
8	Cobalt	E	Congo,DR	59%	30	Phosphorus	P	China	74%
9	Coking coal	E	China	55%	31	Platinum	P	S. Africa	71%
10	Dysprosium	E	China	86%	32	Praseodymium	E	China	86%
11	Erbium	E	China	86%	33	Rhodium	P	S. Africa	80%
12	Europium	E	China	86%	34	Ruthenium	P	S. Africa	93%
13	Fluorspar	E	China	65%	35	Samarium	E	China	86%
14	Gadolinium	E	China	86%	36	Scandium	P	China	66%
15	Gallium	P	China	80%	37	Silicon metal	P	China	66%
16	Germanium	P	China	80%	38	Tantalum	E	Congo,DR	33%
17	Hafnium	P	France	49%	39	Terbium	E	China	86%
18	Ho,Tm,Lu,Yb	E	China	86%	40	Titanium	P	China	45%
19	Indium	P	China	48%	41	Tungsten	P	China	69%
20	Iridium	P	S. Africa	92%	42	Vanadium	E	China	39%
21	Lanthanum	E	China	86%	43	Yttrium	E	China	86%
22	Lithium	P	Chile	44%	44	Strontium	E	Spain	31%

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

Table B: Major global supplier countries of CRMs – grouped materials (average)

Material	Stage	Main global supplier	Share
HREEs	E	China	86%
LREEs	E	China	86%
PGMs[7] (iridium, platinum, rhodium, ruthenium)	P	South Africa	75%
PGMs (palladium)	P	Russian Federation	40%

Figure B is the world map of the main global producers of the raw materials listed as critical for the EU in 2020.

[6] Stage refers to the life-cycle stage of the material that the criticality assessment was carried out on: extraction (E) or processing (P).

[7] 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.

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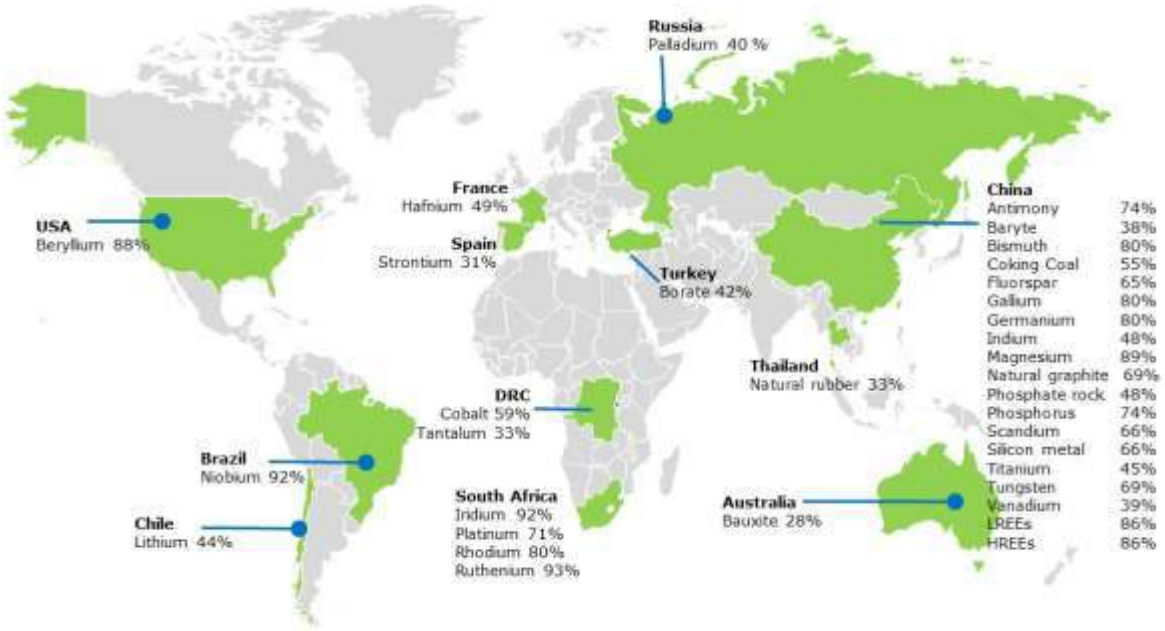
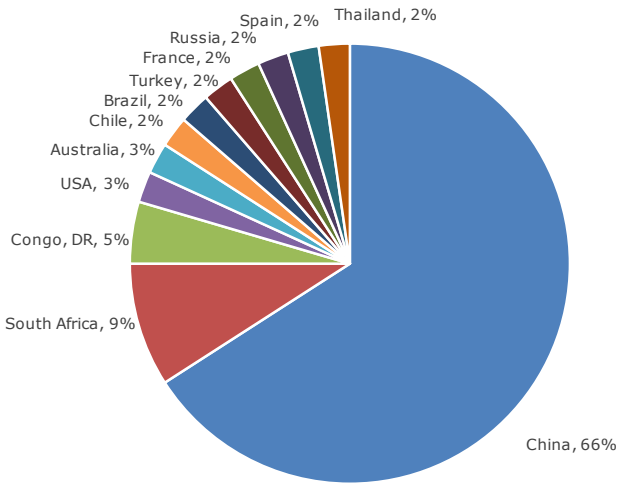
Figure B: Countries accounting for largest share of global supply of CRMs



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, the USA for beryllium and Brazil for niobium.

Figure C: Main Global supply countries of CRMs[8] (based on number of CRMs supplied, average 2012-2016)



In terms of the total number of CRMs, China is the major global supplier of 66% of the individual critical raw materials (Figure C). This includes all of the REEs and other critical raw materials such as magnesium, tungsten, antimony, gallium and germanium among others.

[8] The figure should not be interpreted in terms of tonnage of CRM that originate from these countries, but in terms of the number of CRMs, for which the country is the main global supplier or producer of the CRM.

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Figure D: EU producers of CRMs, in brackets shares of global supply, 2012-2016[9]

[9] JRC elaboration on multiple sources

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

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

	Material	Stage [10]	Main EU supplier	Share		Material	Stage	Main EU supplier	Share
1	Antimony	E	Turkey	62%	23	Magnesium	P	China	93%
2	Baryte	E	China	38%	24	Natural graphite	E	China	47%
3	Bauxite	E	Guinea	64%	25	Natural Rubber	E	Indonesia	31%
4	Beryllium	E	n/a	n/a	26	*Neodymium*	P	China	99%
5	Bismuth	P	China	49%	27	Niobium	P	Brazil	85%
6	Borate	E	Turkey	98%	28	*Palladium*	P	n/a	n/a
7	*Cerium*	P	China	99%	29	Phosphate rock	E	Morocco	24%
8	Cobalt	E	Congo,DR	68%	30	Phosphorus	P	Kazakhstan	71%
9	Coking coal	E	Australia	24%	31	*Platinum*	P	n/a	n/a
10	*Dysprosium*	P	China	98%	32	*Praseodymium*	P	China	99%
11	*Erbium*	P	China	98%	33	*Rhodium*	P	n/a	n/a
12	*Europium*	P	China	98%	34	*Ruthenium*	P	n/a	n/a
13	Fluorspar	E	Mexico	25%	35	*Samarium*	P	China	99%
14	*Gadolinium*	P	China	98%	36	Scandium	P	n/a	n/a
15	Gallium	P	Germany	35%	37	Silicon metal	P	Norway	30%
16	Germanium	P	Finland	51%	38	Tantalum	E	Congo,DR	36%
17	Hafnium	P	France	84%	39	*Terbium*	P	China	98%
18	Ho,Tm,Lu,Yb	P	China	98%	40	Titanium	P	n/a	n/a
19	Indium	P	France	28%	41	Tungsten	P	China	26%
20	*Iridium*	P	n/a	n/a	42	Vanadium	E	n/a	n/a
21	*Lanthanum*	P	China	99%	43	*Yttrium*	P	China	98%
22	Lithium	P	Chile	78%	44	Strontium	E	Spain	100 %

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

Table D: Major EU sourcing countries of CRMs – grouped materials (average)

Material	Stage	Main global supplier	Share
HREEs	P	China	98%
LREEs	P	China	99%
PGMs	P	n/a	n/a

Figure E is the world map of the main countries from which the EU is sourcing critical raw materials (EU sourcing).

[10] Stage refers to the life-cycle stage of the material that the criticality assessment was carried out on: extraction (E) or processing (P).

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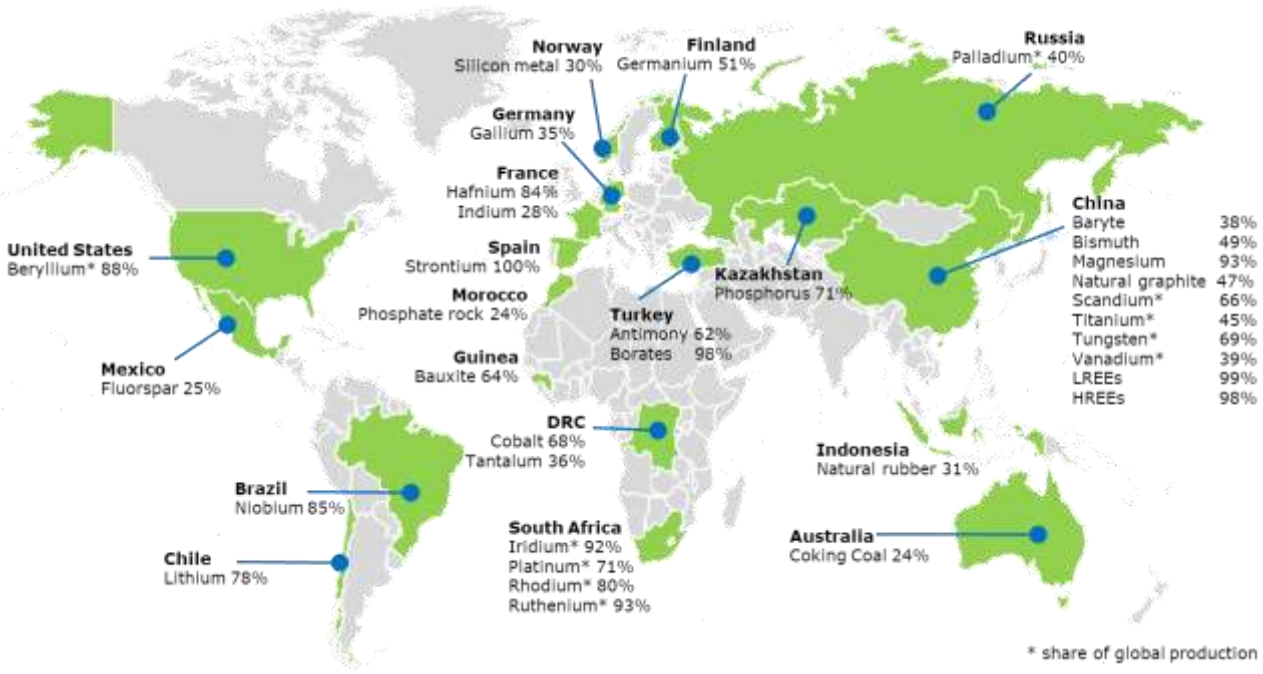
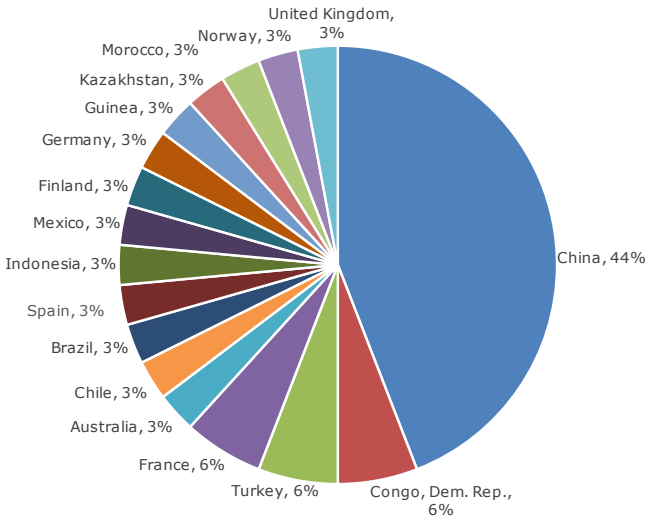
Figure E: Countries accounting for largest share of EU sourcing of CRMs



Despite China being the largest global supplier for the majority of the critical raw materials, the EU sourcing (i.e. domestic production plus imports) paints sometimes a different picture (Figure E). The picture of EU sourcing lacks specific data for the five PGMs, titanium and beryllium. Although China is certainly a major EU supplier (44% of materials, in number, as shown in Figure F), several other countries represent main shares of the EU supply for specific critical raw materials, such as Brazil (niobium), Chile (lithium) and Mexico (fluorspar).

Figure F: Main EU suppliers of CRMs[11] (based on number of CRMs supplied, average 2012-2016)



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.

[11] The figure should not be interpreted in terms of tonnage of CRM that originate from the countries, but in terms of the number of CRMs, for which the country is the main supplier for the EU.

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1. INTRODUCTION

1.1. CONTENT AND PURPOSE OF THIS REPORT

This joint GROW and JRC report 'Study on the review of the list of Critical Raw Materials' serves as the background document in support of the 2020 list of CRMs for the EU.

The present report is the result of intense cooperation with the Ad hoc Working Group on Defining Critical Raw Materials (AHWG[12]), consultants and key industry and scientific experts identified through the H2020 SCRREEN[13] project.

This report includes information on the criticality assessments carried out on the materials covered for this 2020 exercise. Further information is presented in the materials factsheets[14], for both critical and non-critical materials. These factsheets are provided as separate documents and are available in the EC's Raw Materials Information System (RMIS)[15].

The present report 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, international developments, quantitative assessment and related data, stakeholder consultations

1.2. OBJECTIVES OF THIS REPORT

This report presents the results of the assessment of the criticality of 83 raw materials for the EU based on the revised methodology developed by the European Commission (DG GROW and DG JRC)[16]. The report builds upon the work carried out in the previous assessments (2011[17], 2014[18] and 2017[19]). The report takes into account feedback gathered from the previous and 2020 exercises, and in doing so, establishes the basis for the updated list of critical raw materials for the EU.

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[12] 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

[13] http://scrreen.eu/the-project/

[14] The factsheets for critical and non-critical materials are provided as separate documents and are available through the RMIS. A total of 68 factsheets, corresponding to the 83 candidates (including both individual materials and groups) are included. The breakdown of the 68 factsheets are as follows:
- 64 individual material factsheets
- 1 individual factsheet for Aluminium (metal and bauxite)
- 1 individual factsheet for Phosphorus (phosphorus and phosphate rock)
- 1 grouped factsheet for the REEs (with sections dedicated to single elements)
- 1 grouped factsheet for the PGMs

[15] https://rmis.jrc.ec.europa.eu/

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

[17] 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.

[18] 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.

[19] 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.

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The operational objectives of this study were to:

- Assess the criticality of a selection of raw materials based on the EC criticality methodology.
- Analyse the production, key trends, trade flows and barriers of the raw materials with the aim to identify potential bottlenecks[20] and supply risks throughout the value chain. To the extent possible, data and projections are based on the reference period of the last 5 years in terms of data availability.
- Produce qualitative factsheets for all the raw materials assessed.
- Produce full datasets, calculation sheets and comprehensive list of data sources in an excel-compatible format.
- Continue to improve the quality and availability of data.
- Cooperate with both EU and non-EU experts (where relevant) to improve the findings of the study.
- Collaborate with the expert group 'Ad hoc Working Group on Defining Critical Raw Materials'[21] and with the SCRREEN[22] expert group.

In particular, the 2020 assessment incorporates the following aspects:

- Analysis of a wider range of raw materials (5 new candidates);
- Introduces a systematic two-stage supply chain assessment of the supply risk (mining/extracting and processing/refining stages);
- Updated factsheets for each of the materials assessed to include information on the supply chain, the criticality assessment and future trends;
- Optimise data quality and transparency, in respect to the hierarchy of data sources identified in the EC methodology, both in the assessments and factsheets; and
- Better coordination with parallel efforts to develop further Material System Analyses[23], as the priority data source for e.g. recycling data (EOL-RIR).

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

The assessment and the list of critical raw materials are intended to flag the supply risks of important materials for the EU economy. They contribute to securing the competitiveness of the EU industrial value chains starting with raw materials in line with the EU industrial policy. This should increase the overall competitiveness of the EU economy, in line with the Commission´s priorities. It should also help incentivise the European production of critical raw materials and facilitate the launching of new mining and recycling activities. The list is also being used to help prioritise needs and actions. For example, it serves as a supporting element when negotiating trade agreements, challenging trade distortion measures or promoting research and innovation actions.

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.

[20] 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.

[21] The consultants have provided scientific and technical support to the Commission throughout the course of the study, incorporated relevant comments and feedback, provided updates on the advancement of the work, and presented the findings of the assessment in the final report of the study on "Critical Raw Materials for the EU" and the publication of the new list of Critical Raw Materials.

[22] http://scrreen.eu/the-project/

[23] As part of a broader project, JRC and GROW are current delevoping or updating the MSA of 14 raw materials

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1.4. THE IMPORTANCE OF RAW MATERIALS IN EUROPE

In the last decade the growing challenge of securing access to metals and minerals needed for economic production has received increased attention from the public, economic actors and from politicians. Raw materials are not only essential for the production of a broad range of goods and services used in everyday life, but also for the development of emerging innovations, which are notably necessary for more eco-efficient technologies and globally competitive products.

The importance of metals and minerals to sustain businesses and the economy is particularly true for the EU, where about 30 million jobs[24] are directly reliant on access to raw materials.

The importance of critical raw materials for the EU:

- ***Industrial value chains*** *- non-energy raw materials are linked to all industries across all supply chain stages.*
- ***Strategic technologies*** *- technological progress and quality of life rely on access to a growing number of raw materials. For example, a smartphone might contain up to 50 different kinds of metals, all of which contribute to its small size, light weight and functionality.*
- ***Climate, energy and environment*** *– raw materials are closely linked to clean technologies essential to reach carbon neutrality targets by 2050. They are irreplaceable in solar panels, wind turbines, electric vehicles, and energy efficient lighting.*[25]

In Europe, the manufacturing industry (i.e. the production of end products and applications) and the refining industry (metallurgy, etc.) are often regarded as more important than the extractive industry (e.g. mining activities). Moreover, the value chain of raw materials is not fully and homogeneously covered by the European industry, with a pronounced imbalance between the upstream steps (extraction / harvesting) and the downstream steps (manufacturing and use). Nevertheless, the need for primary materials, such as ores and concentrates, and also for processed and refined materials is crucial for the wealth - even the survival - of the European industries and their associated jobs and economy.

Actually, very little extraction of non-energy raw materials occurs within European Member States, with e.g. the majority of ore and concentrates or refined materials or metals being sourced from non-European countries.

The following figure represents the main global producers of all candidate critical raw materials (in terms of number of raw materials, not in terms of tonnage). China clearly dominates, with 59% of the raw materials assessed[26] being mainly extracted in China. South Africa and USA are also the principal producer of the raw materials assessed.

[24] https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_pl
[25] https://ec.europa.eu/growth/sectors/raw-materials/specific-interest/critical_pl
[26] Figures are based on the assessment results of individual candidate materials, with the exclusion of sapele wood. Sapele wood was excluded from the analysis of primary global supply because it was not clear from available public EU trade data, which country(s) is the major global supplier. Several producing countries of sapele wood were identified such as Cameroon, Democratic Republic of Congo (Kinshasa), the Republic of Congo (Brazzaville), the Central African Republic, Ivory coast and Gabon, however without a clear indication of the overall shares coming from these producing countries.

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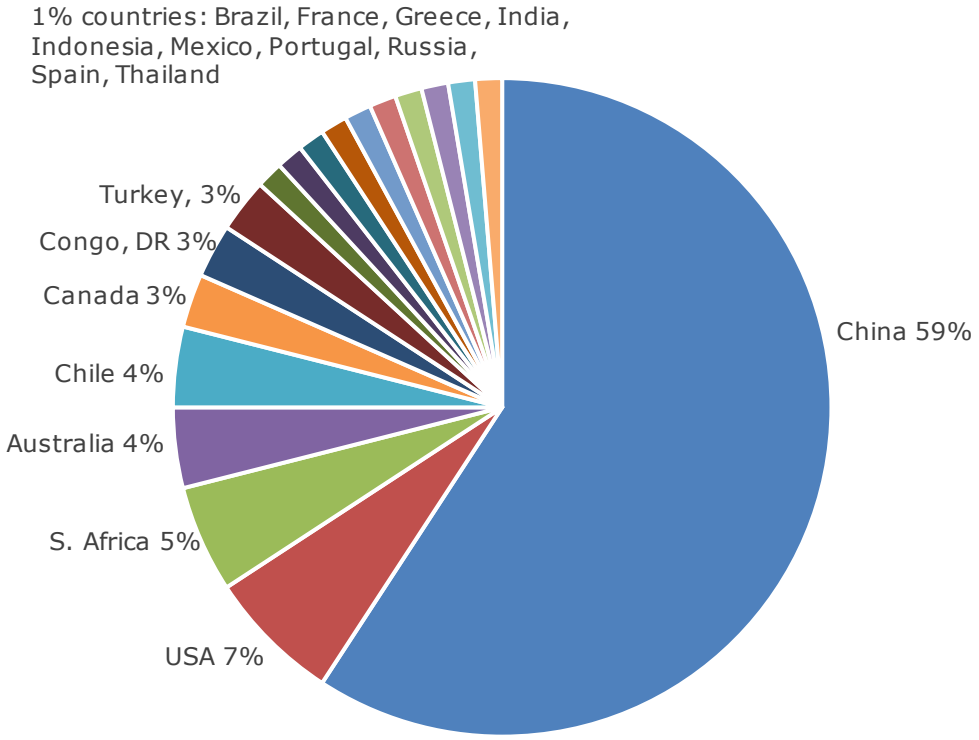
Figure 1: Main global suppliers of all candidate critical raw materials assessed, (based on number of raw materials supplied, average from 2012-2016)[27]



Global suppliers of all candidate critical raw materials (% based on number of raw materials supplied)

For many raw materials, the EU is absent from the upstream steps of the value chain, with no extraction of e.g. antimony, beryllium, bismuth, borates, molybdenum, niobium, PGMs, rare earths, tantalum, titanium, vanadium and zirconium. This may be due either to the absence of mineral deposits in the EU, or more often the limited knowledge of the availability of those materials in the EU, or to economic and societal factors that negatively affect exploration (for deposit discovery and characterisation, estimation of resources and reserves) or extraction, (closure of existing mines, reluctance to open new mines, etc.). The biotic materials natural rubber, sapele and natural teak wood come from tropical plants. Their production therefore also lies entirely outside the EU. To access these raw materials, the European Member States have no other choice than to import them, either unprocessed or refined, from other countries to feed their industries and markets.

The only few raw materials for which an EU Member State is the main global producer are hafnium (France), strontium (Spain), natural cork (Portugal) and perlite (Greece). For some raw materials such as e.g. aggregates, feldspar, gypsum, hafnium, indium, kaolin clay, limestone (high purity), magnesite, natural cork, perlite, silica sand, sulphur, the Member States produce enough primary materials to avoid significant extra-European

[27] Figures are based on the assessment results of 78 individual materials, rather than 80 due to the exclusion of sapele wood and limestone. Sapele wood was excluded from the analysis of primary global supply because it was not clear from available public EU trade data, which country(s) is the major global supplier. Several producing countries of sapele wood were identified such as Cameroon, Democratic Republic of Congo (Kinshasa), the Republic of Congo (Brazzaville), the Central African Republic, Ivory Coast and Gabon, however without a clear indication of the overall shares coming from these producing countries. Also Aggregates and Hydrogen are excluded because global production is not available.

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imports. However, this situation is fairly uncommon, with the EU being dependent on foreign imports for more than 80% of the raw materials needed for its industry and economy.

1.5. THE CHALLENGE OF CRITICAL RAW MATERIALS IN EUROPE

The dynamic technological changes and the rapid growth of emerging economies have led to an increasing, though sometimes volatile, demand for several metals and minerals. Securing access to a stable supply of such critical raw materials has become a major challenge for national and regional economies with limited indigenous natural resources, such as the EU economy, which is heavily dependent on imported supplies of many minerals and metals needed by industry.

Many of these materials are currently only extracted in a few countries, with China being the leading supplier as well as consumer of several important raw materials e.g. antimony, bismuth, magnesium, REEs, etc. This increases the risk of supply shortages and supply vulnerability along the value chain.

The likelihood of supply disruption is further increased by the fact that processing, smelting and refining of many metals are also concentrated in a small number of countries. On top of high concentration, some producing countries strictly control and limit the export of raw materials, intermediates and/or metals in order to safeguard them for their national industries, by imposing a number of export restriction measures that are often considered as distortive to free markets.

Supply restrictions can bring negative consequences to all the actors of the supply chain, as they have an influence on the supply conditions and price volatility. Mine production of minerals and metals often relies on large scale investment projects, which can take many years to implement, and, therefore, cannot react quickly to short term changes in demand, or are vulnerable to market manipulations by established suppliers trying to hamper emerging mining operations.

These factors together lead to a risk of supply shortages for various metals and minerals in the EU. The resources known to exist in the EU are not used well to provide adequate and timely supplies of these materials to meet domestic demand. The impact of raw materials supply disruption could therefore be loss of competitive economic activity in the EU and in some specific cases reduced availability of certain (strategic) final products.

1.6. ADDRESSING CRITICAL RAW MATERIAL CHALLENGES

The Raw Materials Initiative and the Identification of Critical Raw Materials

To address the growing concern of securing valuable raw materials for the EU economy, the European Commission launched the European Raw Materials Initiative[28] in 2008. It is an integrated strategy that establishes targeted measures to secure and improve access to raw materials for the EU:

- Fair and sustainable supply of raw materials from international markets;
- Fostering sustainable supply within the EU; and
- Boosting resource efficiency and promoting recycling.

For the successful implementation of EU policies in the field of raw materials, there is a need to know the key raw materials for the European economy, understand their stocks and flows and the market and to identify the supply bottlenecks.

One of the priority actions of the European Raw Materials Initiative was to establish a list of critical non-energy raw materials (CRMs) at EU level.

CRMs combine **a high economic importance** to the EU with **a high risk of supply disruptions**. In this context, the European Commission established an Ad Hoc Working

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

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Group on Defining Critical Raw Materials (AHWG) in 2009 as support and advisory group in identifying the non-energy raw materials considered as critical for the EU. The first report of this group, published in 2010, 'Critical raw materials for the EU', among its many valuable conclusions, suggested that the list of critical raw materials should be updated every three years. Accordingly, in its Communication 'Tackling the challenges in commodity markets and on raw materials' (COM(2011)25), the Commission committed to undertake a regular update of the list at least every three years. Regular revisions of the first assessment were carried out and resulted in the 2014 and 2017 list. The 2020 assessment addresses the fourth list of critical raw materials for the EU.

The methodology to identify CRMs

The identification of critical raw materials for the EU is based on the methodology developed and updated by the European Commission, in cooperation with the Ad hoc Working Group on Defining Critical Raw Materials (AHWG). Based on the methodology used in the assessments carried out in 2011 and 2014, the EC's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) established an internal Administrative Arrangement with the EC's DG Joint Research Centre (DG JRC) in 2015 to undertake a study on improving the assessment methodology used to define critical raw materials for the EU. This study resulted in a refined methodology for assessing the criticality of raw materials, which was applied in the 2017 and this 2020 assessment. The revised EC methodology introduced some targeted methodological improvements while keeping maximum possible comparability of the results with the previous assessments. The two main high-level components of criticality were retained:

- **Economic Importance (EI)** - calculated based on the importance of a given material in the EU for end-use applications and on the performance of its substitutes in these applications.
- **Supply Risk (SR)** - calculated based on factors that measure the risk of disruptions in supply of a given material (e.g. supply concentration, import reliance, governance performance measured by the World Governance Indicators, trade restrictions and agreements, existence and criticality of substitutes)

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2. CRITICALITY ASSESSMENT APPROACH

2.1 SCOPE & MATERIALS COVERED

The scope of this criticality assessment includes assessment of the 83 individual materials listed in Table 1. To facilitate coherence, all materials from previous assessments are included (with the exception of osmium[29]). This allows for the identification of any key materials that may move from the non-critical to critical status or vice versa.

Table 1: List of materials/groupings covered in the 2020 assessment

Legend:	
Green boxes =	Materials covered in 2014 but not in the 2011 assessments
Orange boxes =	Materials covered in 2017 but not in the 2014 assessments
Light blue boxes =	New materials covered in the 2020 assessment

Individual materials		
Aggregates	Germanium	Phosphate rock
Aluminium	Hafnium	Rhenium
Antimony	Helium	Scandium
Arsenic	Hydrogen	Selenium
Baryte	Indium	Sulphur
Bauxite	Iron Ore	Potash
Bentonite	Lead	Silica Sand
Beryllium	Limestone	Silicon Metal
Bismuth	Gold	Silver
Boron (Borates)	Gypsum	Strontium
Cadmium	Lithium	Talc
Chromium	Magnesite	Tantalum
Kaolin clay	Magnesium	Tellurium
Cobalt	Manganese	Tin
Coking coal	Molybdenum	Titanium
Copper	Natural Graphite	Tungsten
Diatomite	Nickel	Vanadium
Feldspar	Niobium	Zinc
Fluorspar	Perlite	Zirconium
Gallium	Phosphorus	
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	
Sapele wood	Natural Teak wood	

[29] 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 and 2020 exercises. Complementary information on osmium is provided in the PGMs factsheet.

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In addition to covering the same materials as previous assessments, the candidate materials assessed in the 2020 exercise also include five new materials[30] with the aim of widening the scope of the materials covered.

2.1.1 Bottleneck screening vs Double stage (changes 2017→ 2020)

The bottleneck screening in the 2017 exercise generated some discussion with stakeholders on which was the true bottleneck. In some cases (e.g. cobalt) some experts indicated the processing stage as the one with higher supplier concentration, whereas the numerical assessment pointed to the extraction stage as the one with the higher risk. For the 2020 exercise it was decided to systematically include a double-stage supply risk assessment for those materials where two clear stages could be identified and where an initial analysis revealed the likely existence of the necessary data; see Table 2. The bottleneck could then be more readily identified.

Table 2: List of materials covered by a double-stage supply risk assessment

2020 Raw materials assessed with double stage			
Antimony	Erbium	Lithium	Tin
Beryllium	Europium	Manganese	Titanium
Borate	Fluorspar	Molybdenum	Tungsten
Cerium	Gadolinium	Neodymium	Vanadium
Chromium	Ho, Tm, Lu, Yb	Nickel	Yttrium
Cobalt	Hydrogen	Praseodymium	Zinc
Coking Coal	Iron ore	Samarium	
Copper	Lanthanum	Silver	
Dysprosium	Lead	Terbium	

In accordance to the EC methodology, the stage with higher Supply Risk (SR) score has been used. For the remaining candidate materials, the assessment of the calculation risk was performed with the same approach and in the same stage in the supply chain as in 2017.

Annex 2 provides further information on the stage assessed and the rationale.

2.1.2 Time coverage

The reference period for data used in the assessments is the 5-year average for 2012-2016, where possible. Exceptions to this are clearly stated and justified in the individual factsheets.

[30] Arsenic, Cadmium, Hydrogen, Strontium, Zirconium

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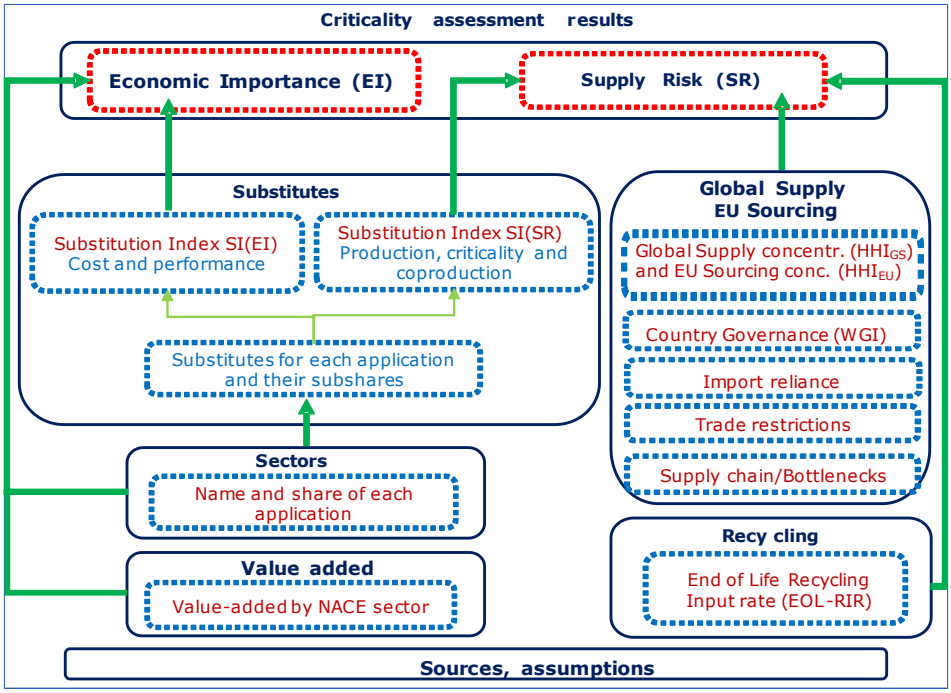
2.2 THE EC CRITICALITY METHODOLOGY

An overview of the EC's criticality methodology[31] is reported in Figure 2.

Two main parameters form the basis of the updated methodology: Economic Importance (EI) and Supply Risk (SR).

Figure 2: Overall structure of the criticality methodology[32]



The 2020 assessment applies consistently the EC criticality methodology, while ensuring comparability with the previous methodology used in 2011, 2014 and 2017.

There are several updates compared to the 2017 implementation of the revised methodology[33]:

- Identification of the bottlenecks for these two stages: systematic calculation of the supply risk for 36 candidate CRMs for both mining/extracting and processing/refining stages;
- More consistent application of the data source hierarchy in all calculations;
- Substantial improvement of End-of-Life Recycling Input Rate (EOL-RIR) results using higher quality EU based data (14 new Material System Analyses - MSA);

2.3 DATA COLLECTION AND SOURCES

The availability and quality of the data required to complete the criticality assessment are 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 assessments are provided in each of the material factsheets.

[31] Methodology for establishing the EU List of Critical Raw Materials, 2017, ISBN 978-92-79-68051-9
[32] Study on the review of the list of critical raw materials, 2017, ISBN 978-92-79-47937-3
[33] Further details in Methodology for establishing the EU List of Critical Raw Materials, 2017, ISBN 978-92-79-68051-9.

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The revised criticality methodology includes a data hierarchy that prioritises, first, official EU and Member States data over those from trade/industry associations and other special interest groups. Where possible, it also prioritises the use of data for Europe over datasets that relate to the whole world e.g. global data. In other words, European data shall receive priority over non-EU data. Data from organisations such as the United States Geological Survey (USGS) are used in the cases where no other comparable sources exist or where the alternatives are not of acceptable quality. Data from private sources (industry, trade associations, private data providers etc.) may also be considered in the absence of other data, under the condition that such data can be shared and published.

Regarding the overall availability and quality of the data sources, in general, there is good public data availability for global supply (e.g. from the World Mining Database and British Geological Survey). However, there are some materials that are more difficult to deal with because of material inconsistencies between world production and EU sourcing data. 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.

Table 3 presents the scoring matrix used based on the recommendations of the Commission to assess the quality of EU data on EU Supply Risk. The scoring matrix defines three main criteria using a scoring scale of 1 to 3 (from lowest to highest in terms of data quality). The overall score of the data quality used for the calculation of Supply Risk was characterised as: limited, satisfactory or very strong coverage based on the individual scores of the three main criteria. Sources used in the factsheets are provided at the end of each material or group factsheet. Additional details on the quality of the data sources are provided in the individual material factsheets and in the EC's Background Report on the Assessment of the Methodology on the list of Critical Raw Materials[34].

Table 3: Scoring matrix to evaluate quality of EU supply data

Criteria	Limited coverage	Satisfactory coverage	Very strong coverage
	1	2	3
Geographic coverage	Data is not available at EU level	Data is partly available at EU level	Data is available at EU level
Time coverage	Data available only for a few years	Data with no meaningful time series due to poor regularity of updates	Data available for time series and updated at regular intervals
Source type	Private/corporate data	Public source of data (except from several justified sources)	Public source

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. By involving all relevant industry stakeholders and members of the AHWG, the assessment results reflect the body of knowledge available throughout the EU on the topic of raw materials.

[34] JRC technical report (2017): Assessment of the methodology for establishing the EU list of Critical Raw Materials: «Background Report», ISBN 978-92-79-69612-1, available at the JRC Science Hub: https://ec.europa.eu/jrc

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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.

In addition to bilateral exchanges during the data collection for the criticality assessment, a key aspect of the overall stakeholder consultation approach includes the stakeholder data collection and validation workshops co-organised with the Horizon 2020 project SCRREEN. These workshops were aimed to collect and review 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.

The stakeholder data collection and validation workshops took place on 10, 11 and 12 September 2019. The aim of these stakeholder workshops was to discuss in detail the criticality calculations for each of the materials covered and to review and validate the data used in criticality assessments. 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 8 and includes details of the preparation and organisation of the workshops as well as the list of participants.

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3. CRITICALITY ASSESSMENT OUTCOME

3.1 CRITICALITY ASSESSMENT RESULTS

Table 4 summarises the criticality assessment results for the 83 individual candidate materials covered by the assessment.

Table 4 provides the scaled results of the Supply Risk (SR), Economic Importance (EI), Import Reliance (IR) and End-of-life Recycling Input Rate (EOL-RIR) for each of the candidate materials as well as the life cycle stage assessed. Results are rounded to one decimal point to enhance clarity. The table also indicates the supply data that was used (e.g. global supply and / or EU sourcing) in the calculations for Supply Risk. Annexes provide additional details of the assessment results, including substitution indexes and all other parameters.

Regarding the materials with negative import reliance, i.e. in case of net export, or IR=0, it should be noted that the SR is calculated based on EU sourcing only (except cases with inadequate quality data). Further details on negative import reliance results are provided (see section 3.4.2).

Table 4: Criticality assessment results (individual[35] materials, grouped materials)

Legend:

PGMs	Iridium, palladium, platinum, rhodium, ruthenium
LREEs	Cerium, lanthanum, neodymium, praseodymium and samarium
HREEs	Dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium
EOL-RIR	End-of-life Recycling Input Rate
Supply data used	Indicates whether the Supply Risk calculation uses EU sourcing (EU only), global supply only (GS) or both (GS + EU)[36]

Material	Stage	Supply Risk	EI	IR (%)	EoL-RIR (%)	SI_{SR}	SI_{EI}	Supply used in SR calc.
Aggregates	Extraction	0.2	2.7	1	8	0.93	0.97	EUS only
Aluminium	Processing	0.6	5.4	59	12	0.80	0.88	GS + EUS
Antimony	Extraction	2.0	4.8	100	28	0.92	0.94	GS + EUS
Arsenic	Processing	1.2	2.6	32	0	0.85	0.94	GS + EUS
Baryte	Extraction	1.3	3.3	70	1	0.95	0.96	GS + EUS
Bauxite	Extraction	2.1	2.9	87	0	0.99	1.00	GS + EUS
Bentonite	Extraction	0.5	2.8	15	19	0.99	0.99	GS + EUS
Beryllium	Extraction	2.3	4.2	0	0	0.99	0.99	GS only
Bismuth	Processing	2.2	4.0	50	0	0.96	0.94	GS + EUS
Borate	Extraction	3.2	3.5	100	1	1.00	1.00	GS + EUS
Cadmium	Processing	0.3	4.2	0	30	0.92	0.91	EUS only
Cerium	Processing	6.2	3.5	100	1	0.95	0.99	EUS only
Chromium	Processing	0.9	7.3	66	21	1.00	1.00	GS + EUS
Cobalt	Extraction	2.5	5.9	86	22	0.92	0.92	GS + EUS
Coking coal	Extraction	1.2	3.0	62	0	0.99	0.99	GS + EUS
Copper	Extraction	0.3	5.3	44	17	0.93	0.93	GS + EUS

[35] 80 rows, because *Ho, Tm, Lu, Yb are grouped*

[36] By default, both EU and global sources are used in the calculation. In case only either EU or global supply was used, data availability prevented to use both sourcing types.

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Material	Stage	Supply Risk	EI	IR (%)	EoL-RIR (%)	SI_{SR}	SI_{EI}	Supply used in SR calc.
Diatomite	Extraction	0.5	2.2	0	4	0.96	0.96	GS + EUS
Dysprosium	Processing	6.2	7.2	100	0	0.95	1.00	EUS only
Erbium	Processing	6.1	3.1	100	1	0.96	0.99	EUS only
Europium	Processing	3.7	3.3	100	38	0.79	0.95	EUS only
Feldspar	Extraction	0.8	2.8	34	8	0.99	0.99	GS + EUS
Fluorspar	Extraction	1.2	3.3	66	1	0.89	0.88	GS + EUS
Gadolinium	Processing	6.1	4.6	100	1	0.92	0.99	EUS only
Gallium	Processing	1.3	3.5	31	0	0.98	0.98	GS + EUS
Germanium	Processing	3.9	3.5	31	2	0.95	0.95	GS only
Gold	Extraction	0.2	2.1	n/a	29	0.98	0.99	GS only
Gypsum	Extraction	0.5	2.6	0	1	0.88	0.96	EUS only
Hafnium	Processing	1.1	3.9	0	0	0.91	0.96	GS only
Helium	Processing	1.2	2.6	89	1	0.94	0.96	GS + EUS
Ho, Tm, Lu, Yb	Processing	6.1	3.4	100	1	1.00	1.00	EUS only
Hydrogen	Extraction	0.4	3.8	0	0	1.00	1.00	GS + EUS
Indium	Processing	1.8	3.3	0	0	0.97	0.98	GS only
Iridium	Processing	3.2	4.2	100	14	0.91	0.95	GS only
Iron ore	Extraction	0.5	6.8	72	31	0.93	0.95	GS + EUS
Kaolin clay	Extraction	0.4	2.4	20	1	0.96	0.97	GS + EUS
Lanthanum	Processing	6.0	1.5	100	1	0.89	0.97	EUS only
Lead	Extraction	0.1	4.0	15	75	0.96	0.96	GS + EUS
Limestone	Extraction	0.2	3.5	5	19	0.90	0.98	GS + EUS
Lithium	Processing	1.6	3.1	100	0	0.93	0.93	GS + EUS
Magnesite	Extraction	0.6	3.2	0	2	0.98	0.99	GS + EUS
Magnesium	Processing	3.9	6.6	100	13	0.93	0.94	GS + EUS
Manganese	Extraction	0.9	6.7	90	8	1.00	1.00	GS + EUS
Molybdenum	Extraction	0.9	6.2	100	30	1.00	1.00	GS + EUS
Natural cork	Extraction	1.0	1.6	0	8	0.91	0.91	GS + EUS
Natural graphite	Extraction	2.3	3.2	98	3	0.99	0.99	GS + EUS
Natural Rubber	Extraction	1.0	7.1	100	1	0.99	0.99	GS + EUS
Natural Teak wood	Extraction	1.9	2.0	100	0	0.90	0.90	GS + EUS
Neodymium	Processing	6.1	4.8	100	1	0.93	0.98	EUS only
Nickel	Extraction	0.5	4.9	28	17	0.83	0.90	GS + EUS
Niobium	Processing	3.9	6.0	100	0	0.97	0.98	GS + EUS
Palladium	Processing	1.3	7.0	93	28	0.92	0.98	GS only
Perlite	Extraction	0.4	2.3	0	42	0.88	0.92	GS only
Phosphate rock	Extraction	1.1	5.6	84	17	1.00	1.00	GS + EUS
Phosphorus	Processing	3.5	5.3	100	0	1.00	1.00	GS + EUS
Platinum	Processing	1.8	5.9	98	25	0.85	0.98	GS only
Potash	Extraction	0.8	5.4	27	0	1.00	1.00	GS + EUS
Praseodymium	Processing	5.5	4.3	100	10	0.93	0.97	EUS only
Rhenium	Processing	0.5	2.0	22	50	0.98	1.00	GS only
Rhodium	Processing	2.1	7.4	100	28	0.99	0.99	GS only
Ruthenium	Processing	3.4	4.1	100	11	0.92	0.96	GS only
Samarium	Processing	6.1	7.3	100	1	0.98	0.98	EUS only
Sapele wood	Extraction	2.3	1.4	100	0	0.94	0.94	EUS only
Scandium	Processing	3.1	4.4	100	0	1.00	0.95	GS only
Selenium	Processing	0.4	4.9	9	1	0.90	0.95	GS + EUS
Silica sand	Extraction	0.4	2.9	0	18	0.97	0.97	GS + EUS
Silicon metal	Processing	1.2	4.2	63	0	0.99	0.99	GS + EUS
Silver	Extraction	0.7	4.1	40	19	0.95	0.97	GS + EUS

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Material	Stage	Supply Risk	EI	IR (%)	EoL-RIR (%)	SI_{SR}	SI_{EI}	Supply used in SR calc.
Strontium	Extraction	2.6	3.5	0	0	0.93	0.90	EUS only
Sulphur	Processing	0.3	4.1	0	5	0.99	0.99	EUS only
Talc	Extraction	0.4	4.0	13	16	0.98	0.99	GS + EUS
Tantalum	Extraction	1.4	4.0	99	0	0.95	0.96	GS only
Tellurium	Processing	0.5	3.6	0	1	0.86	0.93	EUS only
Terbium	Processing	5.5	4.1	100	6	0.79	0.95	EUS only
Tin	Extraction	0.9	4.2	0	31	0.90	0.91	GS only
Titanium	Processing	1.3	4.7	100	19	0.92	0.96	GS only
Tungsten	Processing	1.6	8.1	n/a	42	0.95	0.98	GS only
Vanadium	Extraction	1.7	4.4	n/a	2	0.98	0.99	GS only
Yttrium	Processing	4.2	3.5	100	31	0.98	0.99	EUS only
Zinc	Extraction	0.3	5.4	60	31	0.93	0.96	GS + EUS
Zirconium	Extraction	0.8	3.2	100	12	0.96	0.97	GS + EUS

Group averages	Stage	Supply Risk	EI	IR (%)	EOL-RIR (%)	SI_{SR}	SI_{EI}	Supply used in SR calc.
LREEs	Processing	6.0	4.3	100	3	0.94	0.98	EUS only
HREEs	Processing	5.6	3.9	100	8	0.94	0.99	
PGMs	Processing	2.4	5.7	98	21	0.92	0.97	GS only

Figure 3 presents the individual results for the grouped materials. The grey dots in Figure 3 represents the average scores for the platinum group metals (PGMs), the light green dot indicates the average result for the light rare earth metals (LREEs) and the dark green dot presents the heavy rare earth metals (HREEs).

Figure 3: SR and EI for individual materials grouped as PGMs, LREEs and HREEs

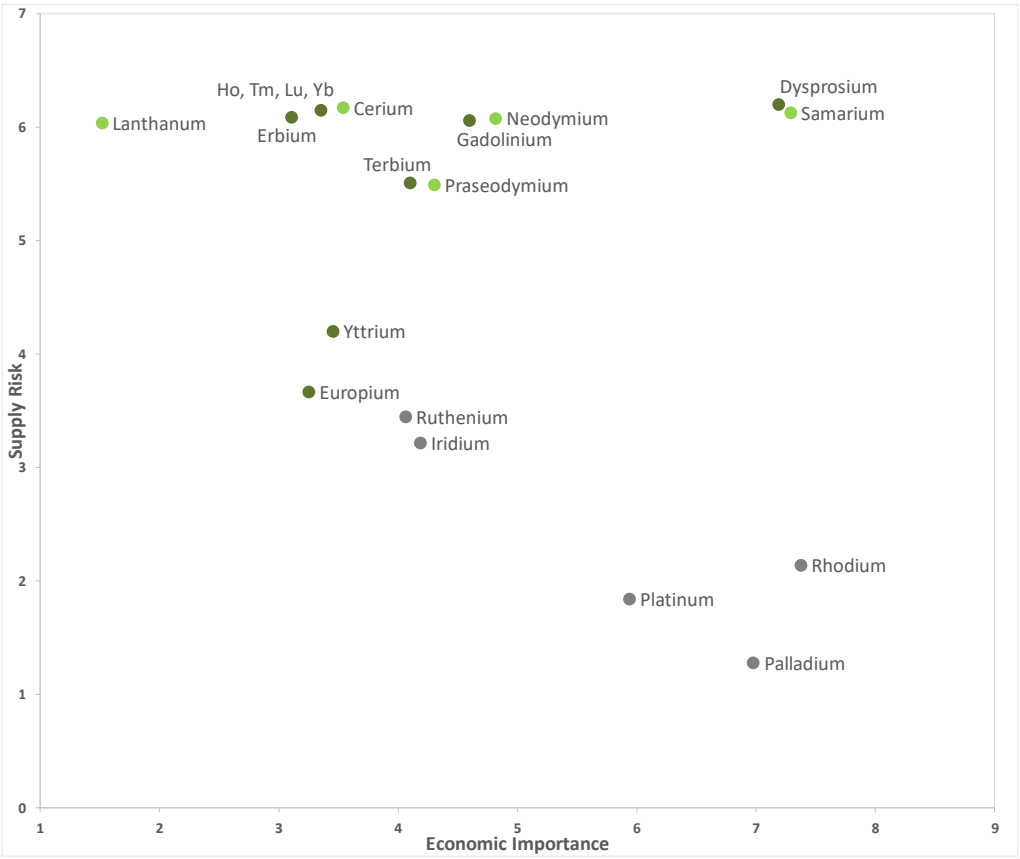

Figure 4 presents the Supply Risk and Economic Importance results for all the individual raw materials. Figure 5 presents the individual results for all non-grouped materials, as well as the average SR and EI scores for the PGMs, LREEs and HREEs groups.

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Figure 4: SR and EI results, individual materials and grouped materials

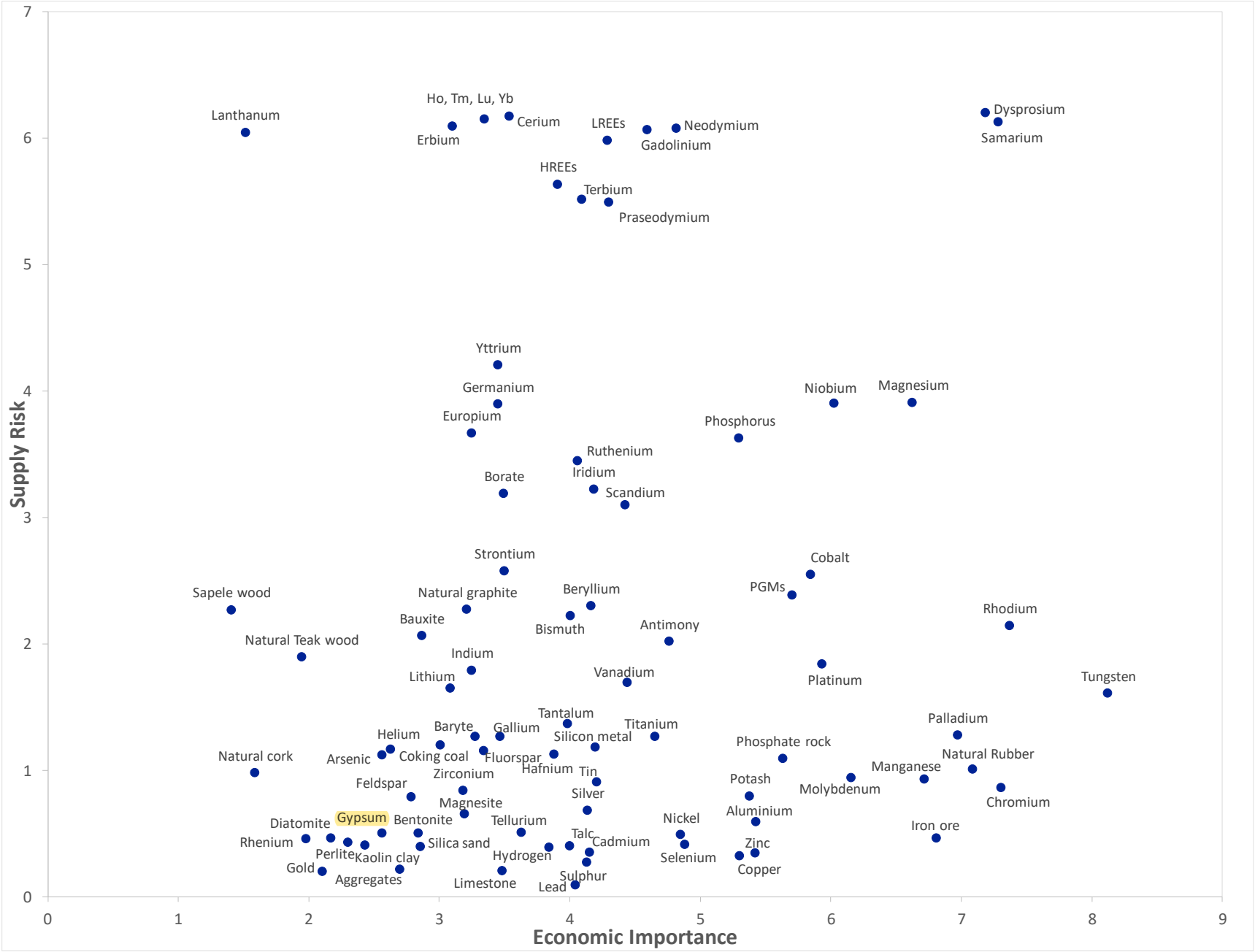

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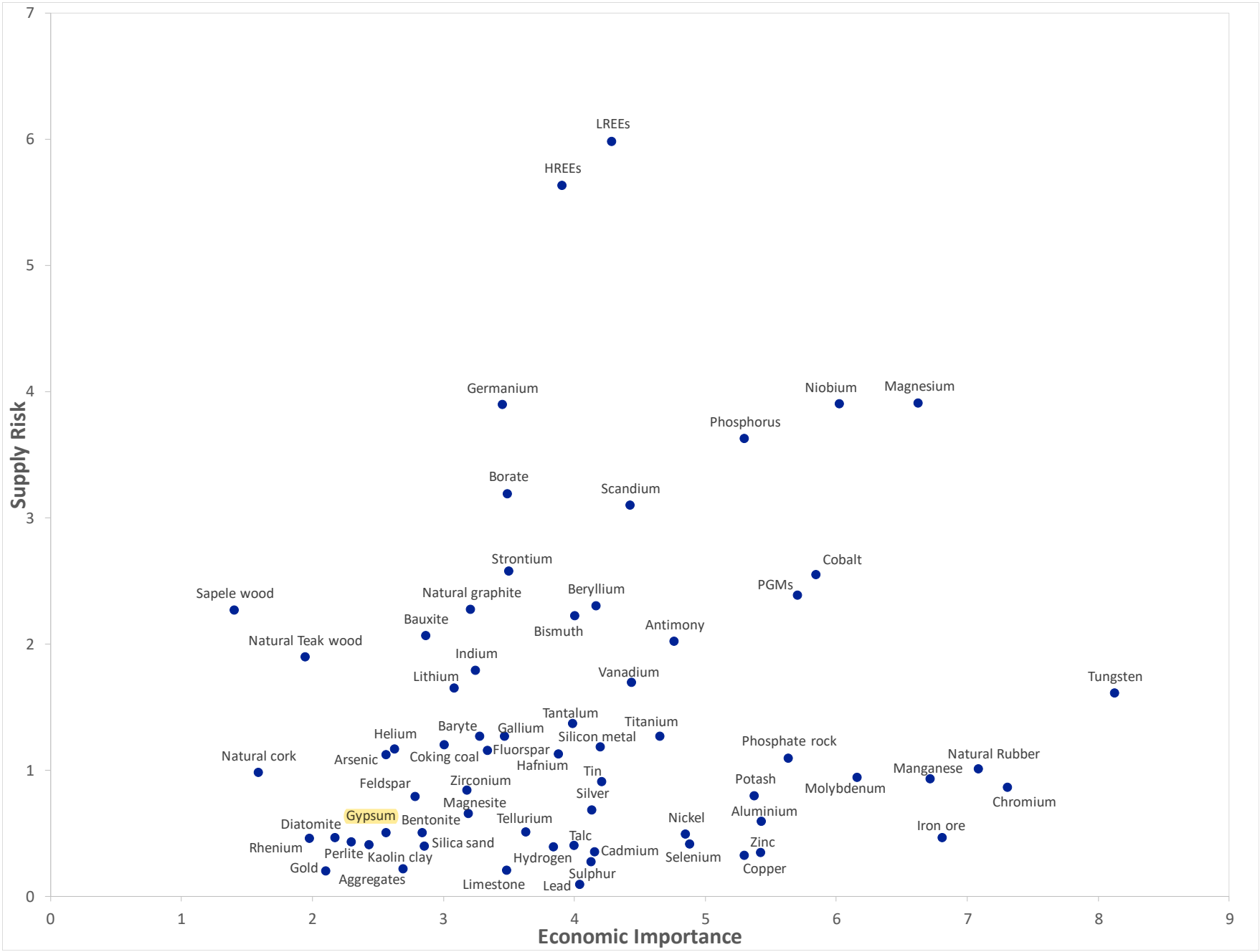
Figure 5: SR and EI results for individual non-grouped and grouped materials (HREEs, LREEs and PGMs)



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3.2 2020 LIST OF CRITICAL RAW MATERIALS FOR THE EU (CRMs)

Of the 83 candidate raw materials assessed, the following 30 raw materials or groups of raw materials are identified as critical.

Table 5: 2020 Critical raw materials for the EU

2020 Critical Raw Materials (30)			
Antimony	Fluorspar	Magnesium	Silicon Metal
Baryte	Gallium	Natural Graphite	Tantalum
Bauxite	Germanium	Natural Rubber	Titanium
Beryllium	Hafnium	Niobium	Tungsten
Bismuth	HREEs	PGMs	Vanadium
Borates	Indium	Phosphate rock	Strontium
Cobalt	Lithium	Phosphorus	
Coking Coal	LREEs	Scandium	

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.

Figure 6 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.

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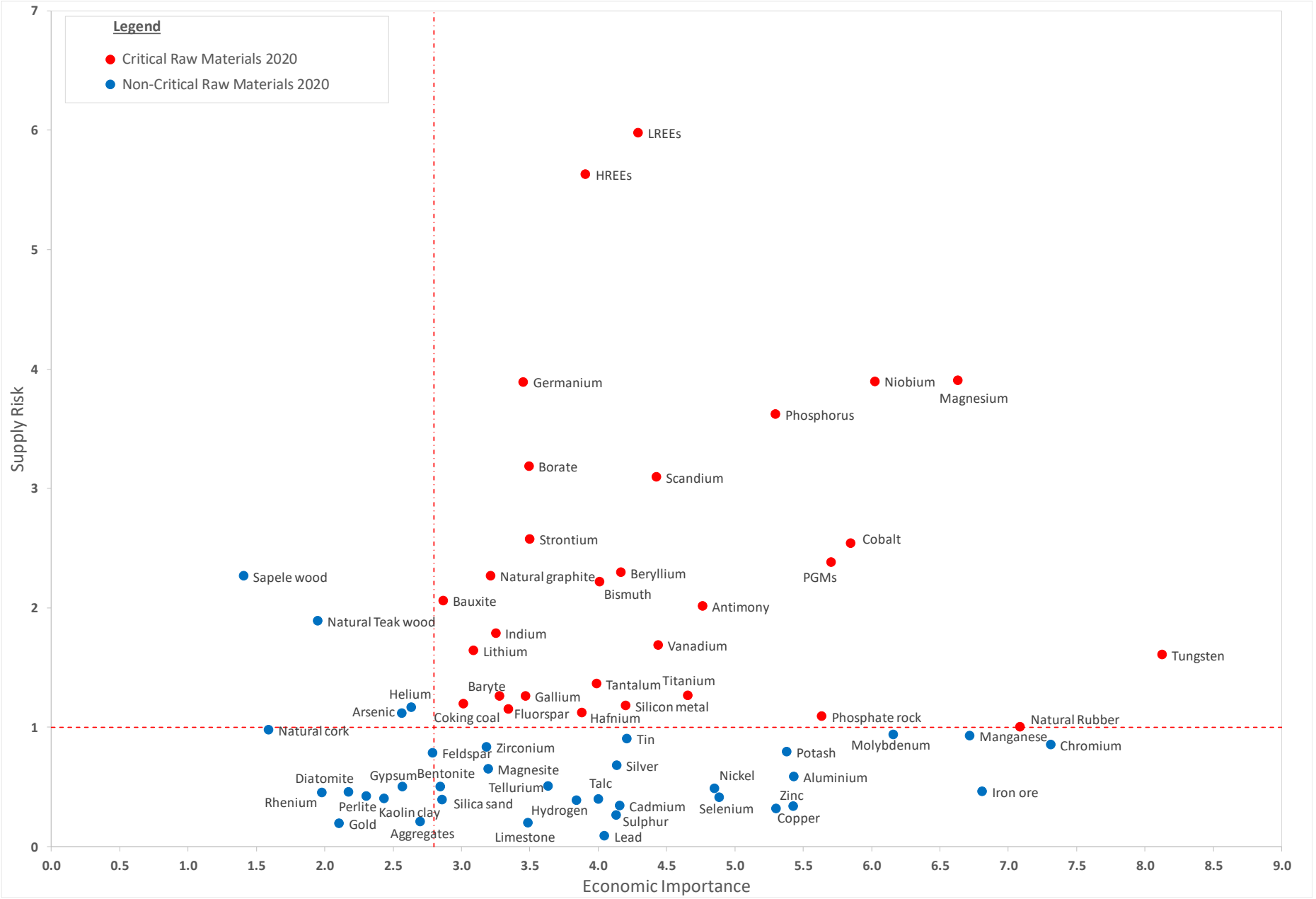
Figure 6: Criticality assessment results (individual materials and groups)



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3.3 COMPARISON WITH THE RESULTS OF PREVIOUS ASSESSMENTS

A good level of backwards compatibility and consistency with the previous criticality assessments remains a high priority for the EC. Table 6 highlights the key changes of the 2020 list in comparison to 2017. The changes in SR and EI are illustrated in Figure 7.

The 2020 CRMs list includes 26 of the CRMs identified in 2017. Only one CRM from 2017 shifted out of the list: helium. Compared to the 2017 CRM list, 3 additional raw materials are identified as critical and enter the 2020 CRMs list: bauxite, lithium, titanium. One of the 5 new candidates is in the 2020 list: strontium.

Table 6: Key changes to the 2020 list of CRMs compared to the 2017 CRMs list

2020 CRMs vs. 2017 CRMs		
Antimony	LREEs	Tungsten
Baryte	Indium	Vanadium
Beryllium	Magnesium	
Bismuth	Natural Graphite	Bauxite
Borate	Natural Rubber	Lithium
Cobalt	Niobium	Titanium
Coking Coal	PGMs	
Fluorspar	Phosphate rock	Strontium
Gallium	Phosphorus	
Germanium	Scandium	~~Helium~~
Hafnium	Silicon metal	
HREEs	Tantalum	

Legend:

Black: CRMs in 2020 and 2017

Red: CRMs in 2020, non-CRMs in 2017

Green: CRMs assessed in 2020, not assessed in 2017

~~Strike out:~~ Non-CRMs in 2020, critical in 2017

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 and 2020 assessments

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

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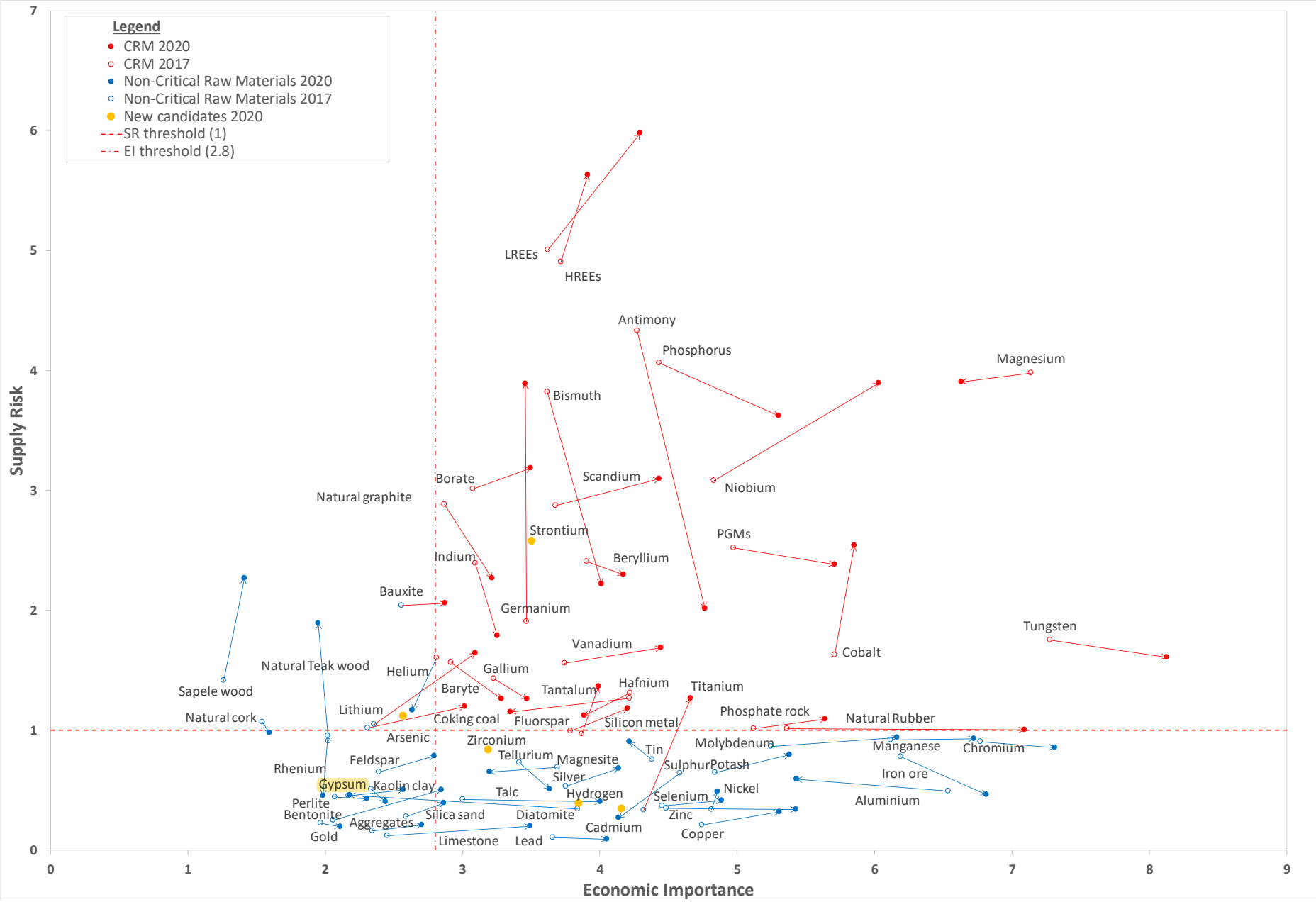
Figure 7: 2020 Criticality assessment results compared to the 2017 assessment



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3.4 KEY FINDINGS OF THE CRITICALITY ASSESSMENTS

This section highlights the key findings of the criticality assessment results, with emphasis on changes since 2017, newly assessed candidate CRMs and battery raw materials. Additional details are provided in the Annexes and in the individual material factsheets.

3.4.1 Summary of main results

A general decrease of supply risk and general increase of the economic importance have been observed, though with exceptions. Regarding the economic importance increase, this is mainly due to two reasons: i) there were sectors that grew in comparison with the previous assessment and had a higher value-added; ii) the final result is influenced by a scaling step, as the value-added of the largest manufacturing sector is now lower, corresponding to 27 Member States.

For some of the assessed materials, the criticality assessment highlights changes in the criticality in respect to 2017:

Raw material	Changes in SR and EI from 2017 to 2020	Reason for the change
Antimony	SR: 4.3 to 2.0	In the 2020 assessment the refining stage included also antimony oxides. This resulted in a lower supply risk at the refining stage, since global production was less concentrated and there is also production in the EU. Therefore, in 2020 the mine stage presented higher SR, because the EU has no production; hence is 100% reliant on import.
	EI: 4.3 to 4.7	Difference is due to changes in the value-added of NACE Rev. 2 sectors.
Bauxite	SR: 2.0 to 2.1	No significant change
	EI: 2.6 to 2.9	Difference is due to changes in the value-added of NACE Rev. 2 sectors.
Coking coal	SR: 1.0 to 1.2	Different consideration of the available substitutes in 2020. In particular, the use of Pulverized coal for injection (PCI) as a substitute has been removed from the calculation formula, as it is a widely applied technique by the EU steel industry, which has already reached its technical limits. In addition, an error in the calculation formulas of the EU supply risk component resulted in lower supply risk in the previous assessment by a value of 0.1.
	EI: 2.3 to 3.0	Introduction in the 2020 calculation of the NACE 2 sector C20 and a lower share allocated to the C24 sector.
Germanium	SR:1.9 to 3.9	Compared to 2017 in 2020 assessment only global supply of germanium was used in the calculations, since there was a lack of up-to-

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		date and reliable data for EU sourcing of other Ge products. The global supply of germanium is highly concentrated in China.
	EI: no change	No change
Helium	SR: 1.6 to 1.2	Both global supply and EU sourcing became less concentrated.
	EI: 2.8 to 2.6	Sectors distribution changed to better represent EU applications.
Titanium	SR: 0.3 to 1.2	The critical stage in 2020 assessment is the metal stage, which was not studied in 2017 (titanium sponge, essential in high-tech applications).
	EI: 4.3 to 4.7	Changes in the value-added of NACE Rev. 2 sectors.
Tungsten	SR: 1.8 to 1.6	In 2020 the refining stage was considered to be the most critical. Supply risk was calculated taking into account the distribution of smelters worldwide.
	EI: 7.3 to 8.1	Changes in the value-added of NACE Rev. 2 sectors.

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: 1.6 to 2.5	A different approach was applied in the 2020 assessment in order to reflect more accurately the market in the extraction and processing stages. In particular, the trade of intermediate cobalt products requiring further refining was allocated to the extraction stage, whereas in the 2017 assessment they were considered as part of the processing (refining) stage.
	EI: 5.7 to 5.8	No significant changes are observed for the EI. Even with a change in the sectors distribution which better represents the EU applications.
Lithium	SR: 1.0 to 1.6	In 2020 the stage with the higher SR is the processing stage, which was not evaluated in the 2017 exercise.
	EI: 2.4 to 3.1	Changes in the value-added of NACE Rev. 2 sectors.
Manganese	SR: 0.9 to 0.9	Results are similar to the previous assessment

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	EI: 6.1 to 6.7	Results are similar to the previous assessment
Natural graphite	SR:2.9 to 2.3	The difference is due to a lower value of the EU supply risk in 2020. The EU sourcing became less concentrated.
	EI: 2.9 to 3.2	Changes in the value-added of NACE Rev. 2 sectors.

For the 5 new candidates:

Table 8: Criticality assessment results for new materials

Material	Stage assessed	Supply Risk	Economic Importance	Import Reliance (%)	EOL-RIR (%)
Arsenic	P	1.2	2.6	32	0
Cadmium	P	0.3	4.2	0	30
Hydrogen	E	0.4	3.8	0	0
Strontium	E	2.6	3.5	0	0
Zirconium	E	0.8	3.2	100	12

Raw material	Comment
Strontium	It is the only new candidate classified as critical, due to high supply concentration in Spain (only 1 company).
Arsenic	The supply risk is based on the global supply risk of arsenic in the form of diarsenic trioxide. Trade figures in Eurostat-Comext were not available in disaggregated form for diarsenic trioxide, thus the calculation for EU supply risk was not possible.
Cadmium	There is a very high recycling rate for cadmium.
Zirconium	Despite the very high import dependency, global supply and EU sourcing show relatively low concentration.
Hydrogen	There is a low supply risk as it is mostly produced from diversified sources of natural gas and synthetic gases.

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3.4.2 Summary of other criticality assessment results

Stages assessed

Table 9 lists the stage with higher SR for each of the critical raw materials The CRMs were assessed at the extraction stage (14) and at the processing stage (16).

Table 9: Stages assessed as critical for the 2020 critical raw materials

Mining/extraction (14)	Processing/refining (16)
Antimony	Bismuth
Baryte	Gallium
Bauxite	Germanium
Beryllium	Hafnium
Borate	HREEs
Cobalt	Indium
Coking Coal	Lithium
Fluorspar	LREEs
Natural Graphite	Magnesium
Natural Rubber	Niobium
Phosphate Rock	PGMs
Tantalum	Phosphorus
Strontium	Scandium
Vanadium	Silicon Metal
	Titanium
	Tungsten

Analysis of individual materials, Global suppliers and EU sourcing

Table 10 presents the results for the 2020 CRMs as individual materials, i.e. not including the groups HREEs (10 materials), LREEs (5 materials) and PGMs (5 materials).

Table 11 presents the averaged figures on global primary supply for the 3 material groups: HREEs, LREEs, and PGMs. It should be noted, however, that in Table 11 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.

Table 10: Global supply of the CRMs, individual materials

	Material	Stage [37]	Main global supplier	Share		Material	Stage	Main global supplier	Share
1	Antimony	E	China	74%	23	Magnesium	P	China	89%
2	Baryte	E	China	38%	24	Natural graphite	E	China	69%
3	Bauxite	E	Australia	28%	25	Natural rubber	E	Thailand	33%
4	Beryllium	E	USA	88%	26	Neodymium	E	China	86%
5	Bismuth	P	China	80%	27	Niobium	P	Brazil	92%
6	Borate	E	Turkey	42%	28	Palladium	P	Russia	40%
7	Cerium	E	China	86%	29	Phosphate rock	E	China	48%
8	Cobalt	E	Congo,DR	59%	30	Phosphorus	P	China	74%

[37] Stage refers to the life-cycle stage of the material that the criticality assessment was carried out on: extraction (E) or processing (P).

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Material		Stage [37]	Main global supplier	Share	Material		Stage	Main global supplier	Share
9	Coking coal	E	China	55%	31	Platinum	P	S. Africa	71%
10	Dysprosium	E	China	86%	32	Praseodymium	E	China	86%
11	Erbium	E	China	86%	33	Rhodium	P	S. Africa	80%
12	Europium	E	China	86%	34	Ruthenium	P	S. Africa	93%
13	Fluorspar	E	China	65%	35	Samarium	E	China	86%
14	Gadolinium	E	China	86%	36	Scandium	P	China	66%
15	Gallium	P	China	80%	37	Silicon metal	P	China	66%
16	Germanium	P	China	80%	38	Tantalum	E	Congo,DR	33%
17	Hafnium	P	France	49%	39	Terbium	E	China	86%
18	Ho,Tm,Lu,Yb	E	China	86%	40	Titanium	P	China	45%
19	Indium	P	China	48%	41	Tungsten	P	China	69%
20	Iridium	P	S. Africa	92%	42	Vanadium	E	China	39%
21	Lanthanum	E	China	86%	43	Yttrium	E	China	86%
22	Lithium	P	Chile	44%	44	Strontium	E	Spain	31%

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

*Global supply calculation based on production capacity.

Table 11: Global supply of grouped CRMs, arithmetic average

Global supply or production capacity of the CRMs – grouped materials (average)			
Material	Stage	Main global supplier	Share
HREEs	E	China	86%
LREEs	E	China	86%
PGMs[38] (iridium, platinum, rhodium, ruthenium)	P	South Africa	75%
PGMs (palladium)	P	Russian Federation	40%

The analysis of the global supply results 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 (Figure 8[39]). This includes all of the REEs and other critical raw materials including magnesium, tungsten, antimony, gallium and germanium, among others. In addition to China, several other countries are also important global suppliers of specific materials. For instance, Russia and South Africa are the largest global suppliers of platinum group metals, the USA of beryllium and Brazil for niobium.

Furthermore, 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 (Figure 9[40]). The analysis of the EU sourcing excludes the five PGMs, titanium and beryllium due to little or no EU sourcing activity. Although China is the major EU supplier, several other countries represent main shares of the EU supply for specific critical raw materials, such as the Brazil (niobium), Chile (lithium) and Mexico (fluorspar).

[38] 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.
[39] The figure should not be interpreted in terms of tonnage of CRM that originate from these countries, but in terms of the number of CRMs, for which the country is the main global supplier or producer of the CRM.
[40] The figure should not be interpreted in terms of tonnage of CRM that originate from the countries, but in terms of the number of CRMs, for which the country is the main supplier for the EU.

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Figure 8: Main global suppliers of CRMs (based on number of CRMs supplied), average from 2012-2016

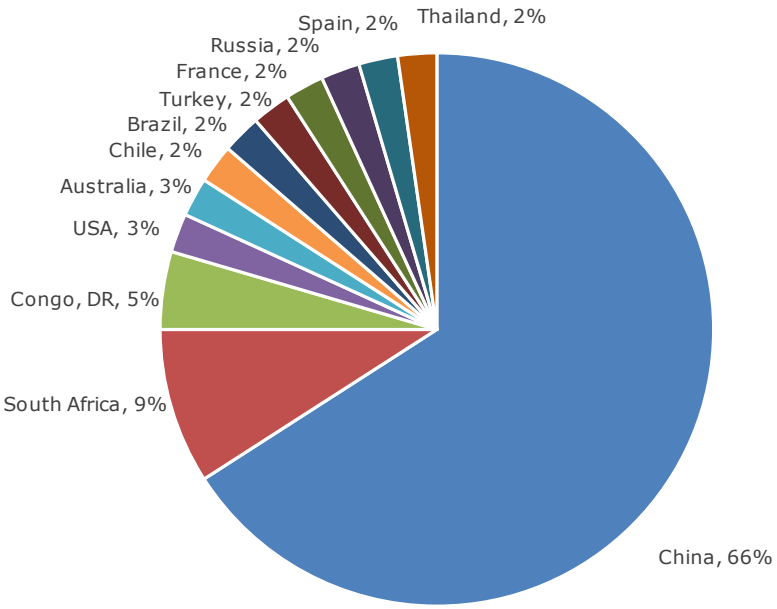
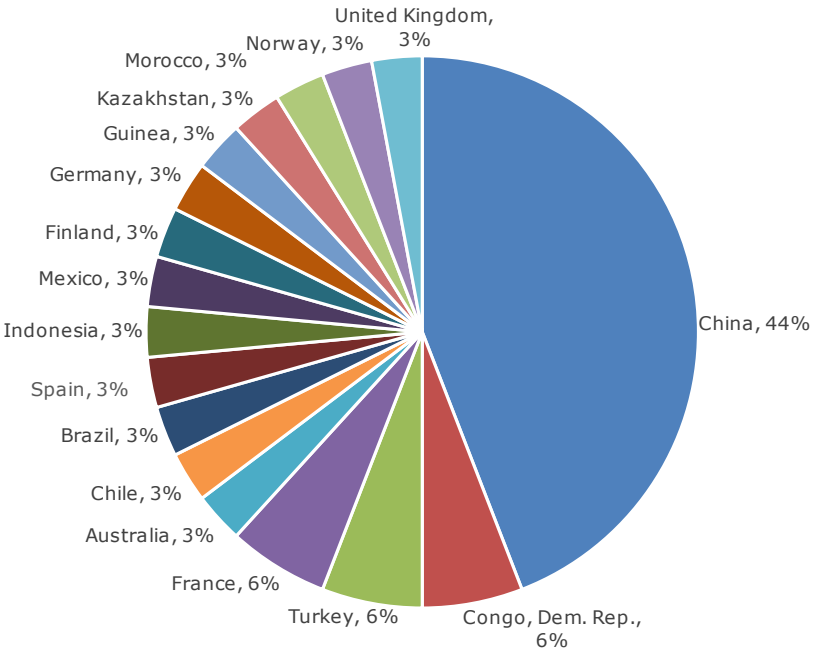


Figure 9: Main EU sourcing countries of CRMs (based on number of CRMs supplied), average from 2012- 2016 (REEs 2016-2018).



Another significant confirmation is that for certain CRMs, despite China being the largest global supplier, other countries represent the main source for the EU; see Table 12.

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Table 12: CRMs with China as the largest global supplier but not as largest EU supplier

CRM	Main EU supplier	Share of EU sourcing
Antimony	Turkey	62%
Coking coal	Australia	24%
Fluorspar	Mexico	25%
Gallium	Germany	35%
Germanium	Finland	51%
Indium	France	28%
Phosphate rock	Morocco	24%
Phosphorus	Kazakhstan	72%
Silicon metal	Norway	30%

Analysis of Supply risk results (global SR vs EU sourcing)

The revised methodology made available two measures of the SR, which are certainly useful for a more comprehensive evaluation of the current situation.

In the initial criticality methodology, the SR was estimated based on the mix of global supplier countries only. The revised methodology used an updated Supply Risk formula, which incorporates both global supply and EU sourcing. EU sourcing refers to the actual sources of the supply to the EU Member States.

In the revised methodology, the actual supply to the EU (EU sourcing) is used in combination with the global supply in order to calculate a more representative measure of the risk. The revised 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:

Due to concerns over sufficiently available high-quality data, the revised methodology recommends that in the case of 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.

The guidelines for applying the revised SR formula based on both global supply and EU sourcing are summarised as follows:

- Use of both global supply and EU sourcing data, which is the preferred method when the data quality is of sufficient high quality for both indicators;
- Use of global supply data only when the data on EU sourcing is of inadequate quality or not available;
- Use of EU sourcing data only, which is to be used only in specific cases when it is correct to assume that import dependency is negative or at zero percent.

Figure 10 presents a graphical comparison of the difference in SR scores based on the supply data used in the SR calculation. Table 15 in Annex 3 provides the detailed SR figures for each of the materials assessed. Analysis of the different possible SR results indicates that the SR score, when based on global supply only is in general higher compared to EU sourcing data only. It is noted that is not always possible to calculate both global supply and EU sourcing.

The systematic double-stage assessment made available 4 measures of the supply risk, for a limited number of candidate CRMs, as reported in Figure 11.

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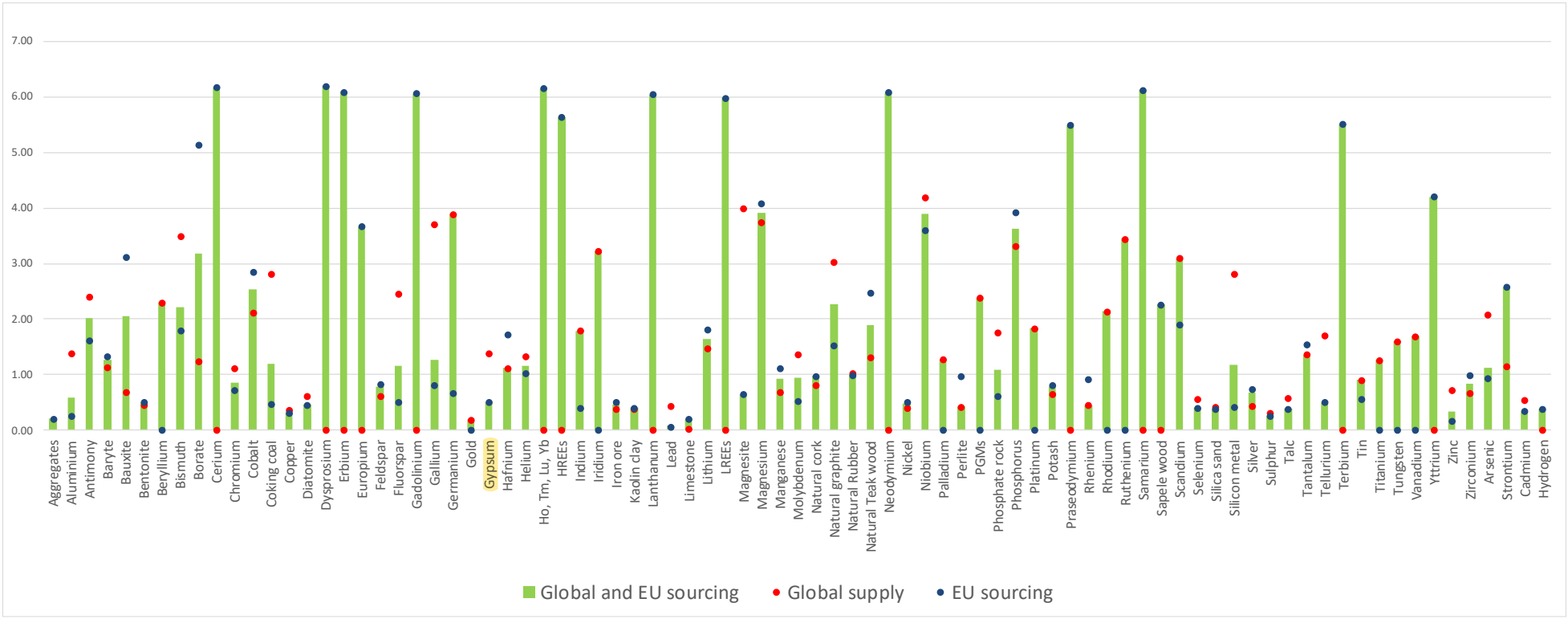
Figure 10: Comparison of SR results based on scope of supply data used[41]



[41] Global supply data and/'or EU sourcing supply data i.e. refers to actual sourcing (imports) of the material into the EU

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Figure 11: Comparison of SR results based on scope of supply data used (double stage)

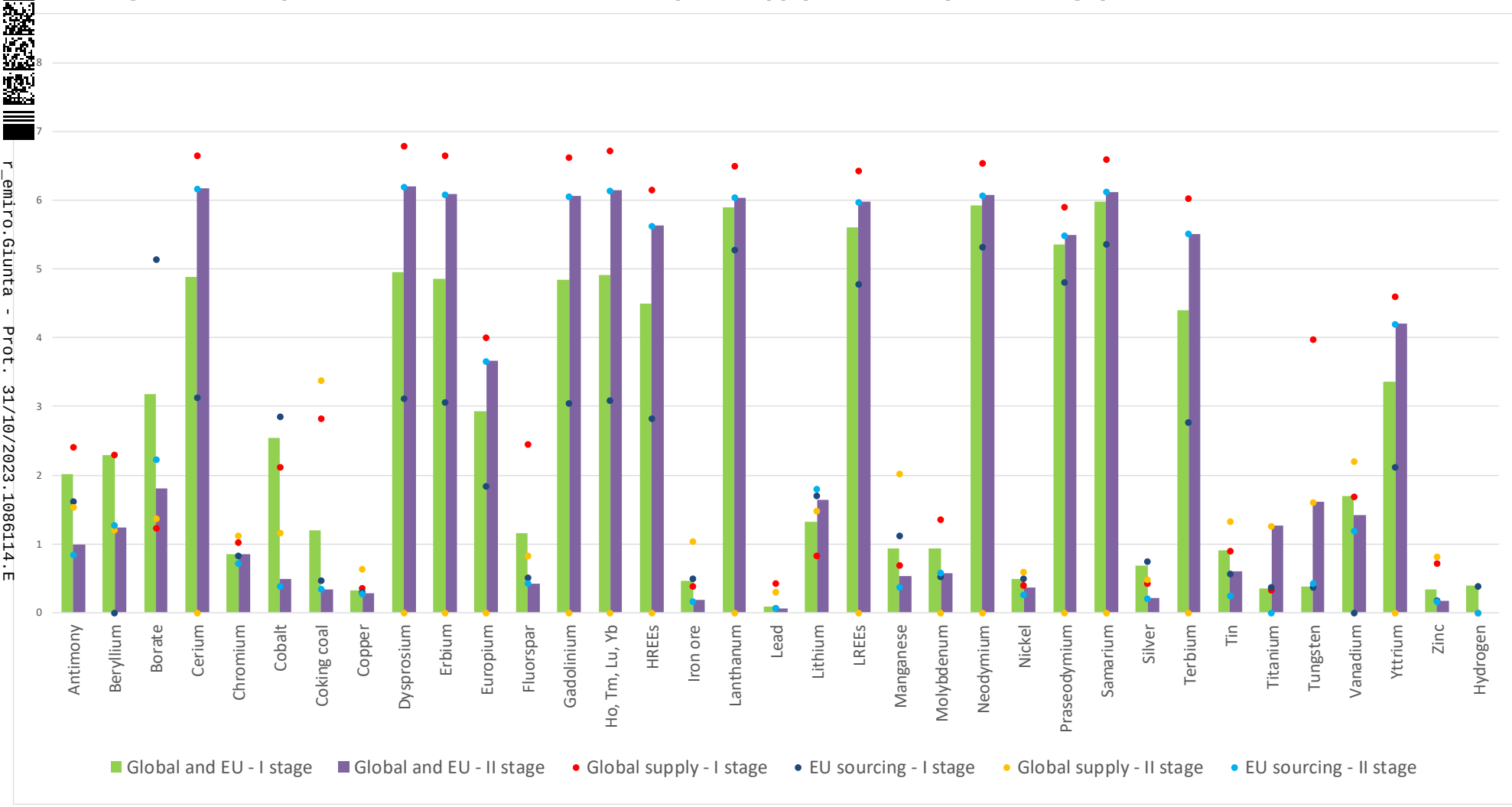

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Figure 12: End of life recycling input rate (EOL-RIR)

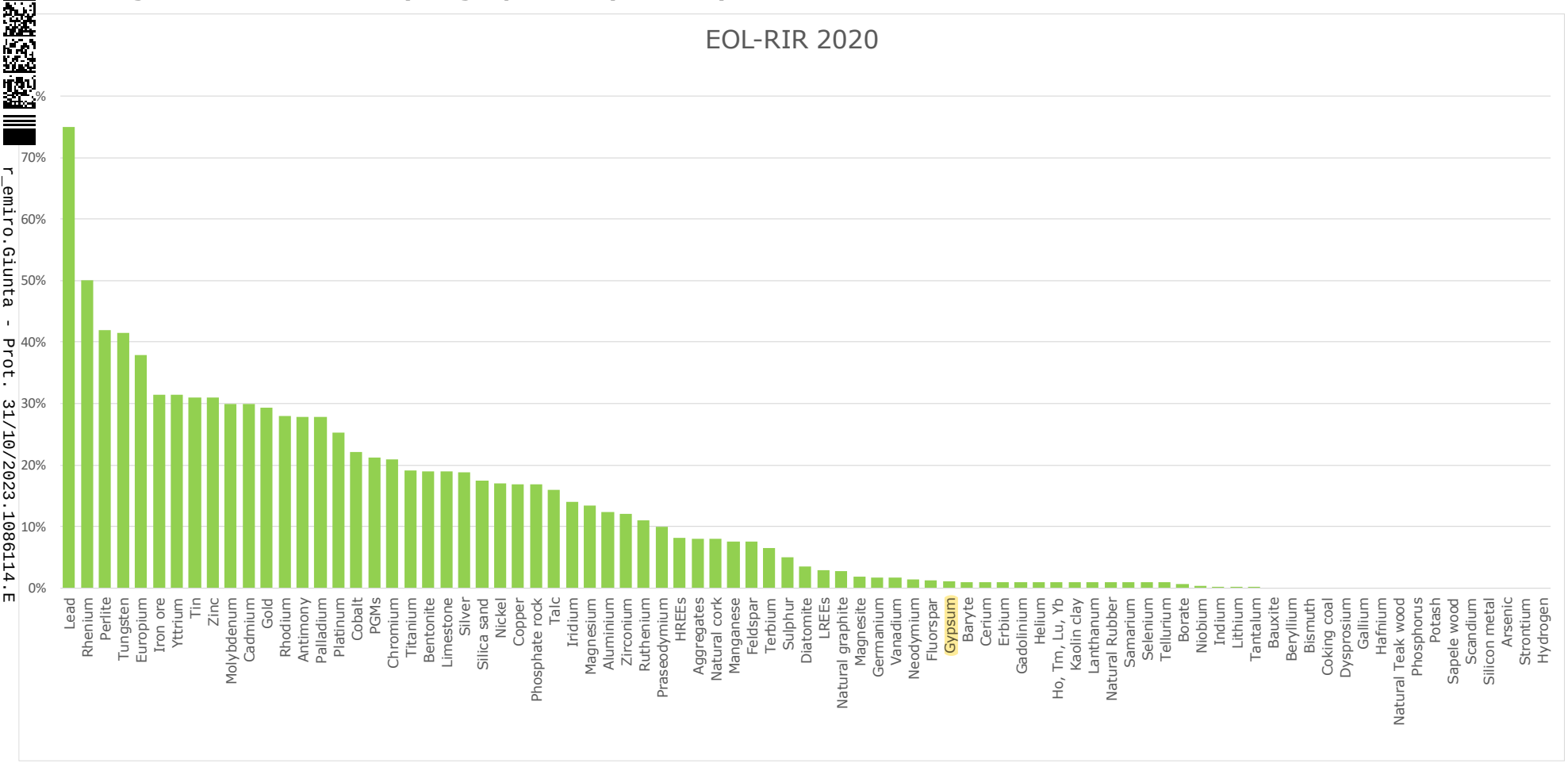

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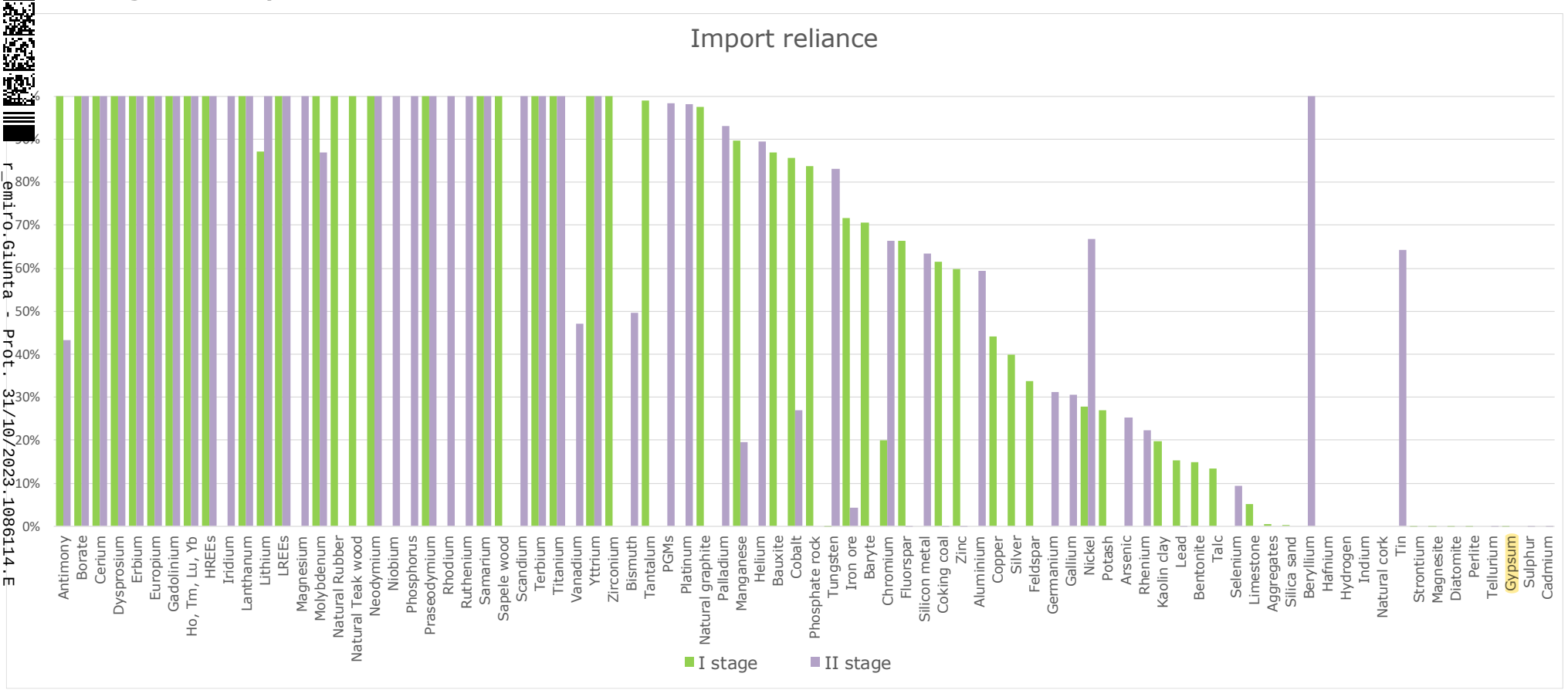
Figure 13: Import reliance



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End-of-Life (EOL)-recycling input rate results

Figure 12 presents the full set of EOL-RIR. EOL-RIR is the selected recycling indicator used as a risk reducing filter 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 or inadequate quality / representativeness is a well known problem. Synergies were identified and substantial improvements of End-of-Life Recycling Input Rate (EOL-RIR) results, using higher quality EU based data, were made possible thanks to 14 new Material System Analyses (MSAs) that were run in parallel to the criticality assessment.

Import reliance results for specific materials

Figure 13 presents 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 (see Table 13). As stipulated in the revised 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.

Table 13: Materials with negative or zero Import reliance

Material	Stage	Actual import reliance result
Cadmium	P	-178
Diatomite	E	-1
Gypsum	E	-25
Hydrogen	E	0
Magnesite	E	0
Natural cork	E	0
Silica sand	E	0
Strontium	E	0
Sulphur	P	-35
Tellurium	P	-14
Tin	E	0
Coking coal	P*	-3
Copper	P*	0
Fluorspar	P*	-19
Lead	P*	-1
Silver	P*	0
Tungsten	E*	-397
Zinc	P*	-2

* Second stage not used to define the criticality

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3.5 LIMITATIONS OF THE CRITICALITY ASSESSMENTS

Even though it is based on the most robust and comprehensive data available, a criticality assessment remains a screening exercise. This is more a call for attention than an in-depth analysis that would allow for stronger conclusions. Thus, limitations of the criticality assessment are important to take into account when interpreting the results. Key limitations can help to understand the robustness of the 2020 assessment results and the comparability of the results across the four assessments.

3.5.1 Robustness of the results

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 EU market shares**: For several materials EU market 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; however, 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 2017 exercise, also, the 2020 assessment integrates data on EU sourcing (when available and of high 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. Previous assessments considered the global supplier mix only 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 the REEs and PGMs for example) 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 reliable global supply data was used or stakeholders were consulted to validate or provide additional inputs to develop possible justified assumptions and hypothesis, where relevant.
- **Data on substitution and shares of material applications**: 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 industry experts to further develop acceptable assumptions and hypotheses for potential substitutes and sub-shares.
- **Data on End-of-life Recycling Input Rates (EOL-RIR):** The role of recycling as a risk-reducing filter of Supply Risk 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, but also to use data published in the report 'Recycling Rates of Metals' by the International Resource Panel of the United Nations Environment Programme (UNEP) to maintain the highest possible comparability with previous EC criticality reports. In the cases where MSA and UNEP data were not available, data or assumptions were used based on information provided in other sources e.g. sectorial reports, expert judgement and stakeholder inputs. Therefore, the SR result of the materials which use an EOL-RIR figure that does not stem from the preferred reference studies 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.

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3.6 RECOMMENDATIONS FOR FUTURE ASSESSMENTS

In the Communication on raw materials of 2011[42], 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.

The recommendations provided address both recommendations for improving the quality of the data used and recommendations for improving the reliability of future exercises.

Regarding recommendations to improve the quality of the data, although the revised methodology advises the use of high-quality EU based data, certain limitations and uncertainties with data sources were identified that could be further improved in future exercises. This underlines the importance of continuing to work closely with industry experts, members of the AHWG, important data providers such as Eurostat and other EC services, as well as Member State authorities to further improve the quality and reporting of European data. The following points could also be considered to increase the quality of the required data:

- Maintaining the importance of the transparency, objectivity and quality of the data used – as is recommended in the revised methodology, priority should be given to official and publicly available data over other sources such as private data that cannot be publicly accessed or unofficial / unpublished data. In addition, future exercises should continue to strive to maximise the contributions from all stakeholders and experts to ensure transparency as well as robustness of the data used and results derived. Continuous consultation with industry stakeholders is of crucial importance as they can provide important insights and feedback that are not necessarily available through existing data sources. With this in mind, adequate time should be allowed for the stakeholder consultations and for addressing inputs. This entails not only a period dedicated for the review of the criticality assessment calculations and the material factsheets but also to allow for exchanges with stakeholders and experts regarding contributions and other feedback.

- Working more closely with organisations that publish or provide publicly available EU-based data e.g. Eurostat, OECD, National statistics departments, geological surveys, ministries, trade organisations and others – this is important to further improve the quality and availability of EU production and trade statistics used in the criticality assessments. Regular discussions with these official data providers, for example, would be helpful to identify specific areas e.g. certain Member States, sectors, topics, specific data reporting challenges where greater efforts may be needed to improve and interpret the data reported.

- Finally, it is also essential to maintain the availability of detailed and coherent metadata information from EC public databases as well as the development of explanatory notes related to nomenclatures, which can provide important information in order to accurately interpret the data reported.

In view of future assessments, some recommendations for potential methodological improvements are summarised in Table 14.

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

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

Topics	Conclusions and recommendations
Materials and scope definitions	**Conclusions:** Additional efforts can be made to further develop harmonised definitions and to more clearly define the scope of some of the assessments. **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. As with most other analyses of this type, the revised EU methodology focuses on risk related to the first steps in the raw material's life cycle, such as extraction/harvesting, or related to a bottleneck further down the value chain, e.g. influencing potentially the refining steps. These studies generally do not consider the steps in which the refined material is used in a multitude of applications (except in the links in the economic importance). In the 2020 assessment, the first two life cycle stages were more systematic assessed. This reduced the risk of missing the stage with more supply risk in the material's life cycle. But, some raw materials may include an intermediate stage between mining and refining stages that may also be important for the assessment. **Recommendations:** Systematic assessment of both extraction and refining stages should continue in the next assessments. The factsheets should contain a more in-depth investigation of the materials across their life cycle and their supply chains, including for aspects such as future outlook, pricing and other key trends.
End-of-life Recycling Input Rates (EOL-RIR)	**Conclusions:** While the 2017 revised methodology provides guidelines and data sources than can be used for the EOL-RIR, the available data for all of the materials assessed is of varying quality. Material System Analyses (MSA) serve as a good basis for data gathering for EOL-RIR, however certain elements could be further improved. For example, these studies do not cover all materials in the 2020 criticality assessment and certain data are not reliable and/or up-to-date. In addition, the EOL-RIR used in EC methodology only considers the recycling of primary supply of the raw materials and does not take into account potential Supply Risk associated with secondary raw materials. Imports of "wastes and scraps" are not considered as part of the Supply Risk parameter. **Recommendations:** Further expansion of MSA studies and updates are needed. The factsheets may provide further information not captured in the EOL-RIR, nor in the CRM assessment, which may include: different recycling indicators reported in the literature and information on imports of wastes and scraps.
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. An example would be the use of a certain metal in a turbine, which could be a

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Topics	Conclusions and recommendations
	metal product or a piece of machinery. Evidence could also indicate that the material's end-use is in the production and distribution of energy. **Recommendations:** The selection of applications and associated sectors has a significant influence on the Economic Importance values. Therefore, future methodological improvements could offer additional guidance on the approach to be used. Clear guidance on how to deal with the evolution of volumes and values across the value chain would be helpful. Further modelling of selected key value chains and MSAs would also help, with stronger links being made between such studies and the CRM assessments.
Data Gaps	**Conclusions:** Official European statistics are prioritised over other sources of data, however on several occasions these databases have gaps that didn´t allow proper use of these data sources. **Recommendations:** In future assessments it could be useful to involve e.g. Eurostat directly in these assessments and/or provide feedback from such assessments. This may help to resolve some data gaps and to highlight data needs for the future.

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ABBREVIATIONS AND GLOSSARY

General abbreviations

AHWG	Ad-Hoc Working Group on Defining Critical Raw Materials
BGS	British Geological Survey
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
FAO	Food and Agriculture Organization of the United Nations
FTA	Free Trade Agreements
GDP	Gross Domestic Product
GVA	Gross Value Added
HHI	Herfindahl-Hirschman-Index
HREE	Heavy rare earth element
IR	Import Reliance
JRC	European Commission's 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
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
USGS	US Geological Survey
VAT	Value added tax
WGI	World Governance Index
WMD	World Mining Data
WTO	World Trade Organisation

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SPECIFIC ABBREVIATIONS FOR THE MATERIALS COVERED

Agr	Aggregates	Mn	Manganese
Al	Aluminium	Mo	Molybdenum
Sb	Antimony	NC	Natural cork
Brt	Baryte	Gr	Natural graphite
Bx	Bauxite	Nr	Natural Rubber
Bn	Bentonite	Nt	Natural Teak wood
Be	Beryllium	Nd	Neodymium
Bi	Bismuth	Ni	Nickel
Bo	Borate	Nb	Niobium
Ce	Cerium	Pd	Palladium
Cr	Chromium	Pe	Perlite
Co	Cobalt	P	Phosphorus
Cc	Coking coal	Phs	Phosphate rock
Cu	Copper	Pl	Platinum
Di	Diatomite	Po	Potash
Dy	Dysprosium	Pr	Praseodymium
Er	Erbium	Re	Rhenium
Eu	Europium	Rh	Rhodium
Fsp	Feldspar	Ru	Ruthenium
Fl	Fluorspar	Sm	Samarium
Gd	Gadolinium	Sw	Sapele wood
Ga	Gallium	Sc	Scandium
Ge	Germanium	Se	Selenium
Au	Gold	Sl	Silica sand
Gp	Gypsum	Si	Silicon metal
Hf	Hafnium	Ag	Silver
He	Helium	S	Sulphur
Ho	Holmium	Tc	Talc
In	Indium	Ta	Tantalum
Ir	Iridium	Te	Tellurium
Fe	Iron ore	Tb	Terbium
Kc	Kaolin clay	Tm	Thulium
La	Lanthanum	Sn	Tin
Pb	Lead	Ti	Titanium
Ls	Limestone	W	Tungsten
Li	Lithium	V	Vanadium
Lu	Lutetium	Yb	Ytterbium
Mgs	Magnesite	Y	Yttrium
Mg	Magnesium	Zn	Zinc

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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 revised EC methodology to measure the criticality of a raw material. In the EC methodology[43], 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 revised EC methodology for updating the list of critical raw materials for the EU[43]. 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

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

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Term	Definition in the context of this report
	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 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.
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.
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.

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Term	Definition in the context of this report
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.
Substitution	In the revised 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 revised EC methodology.
Supply Risk (SR)	One of the two main assessment parameters (along with Economic Importance) of the revised 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.

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ANNEXES

Annex 1. Overview of international criticality methodologies and assessments

Criticality is not an absolute concept and the methodologies for the assessment of Critical Raw Materials have to implicitly answer the question "**critical to whom?**". There is no generic and standardized approach to conduct a criticality assessment. Moreover, criticality is usually considered to be a relative concept in the sense that one material is more or less critical than another.

Criticality assessments are conducted at different levels: for a specific product[44], technology[45], company[46], country or region[47], or even at a global level[48]. The criticality of a raw material can be considered in the short term (e.g. a few years) or in the long term (a few decades).

Given the different scopes and objectives, a variety of indicators can be used for the assessment. Therefore, comparability is usually not possible between results from different methodologies.

The **International Round Table on Materials Criticality (IRTC)[49]** was partly established to discuss criticality in the context of industry, including the relationship/harmonization of criticality methods. The Round Table consists of international experts, including some criticality method developers, with a focus on relevant stakeholders such as industry representatives.

The **IRTC** published a **review of methodologies[50]** for criticality assessment. A first step of the review was the identification of differences in the goal and scope of the methods, their spatial boundary and time horizons. Secondly, the review analysed the other features of the methodologies: criticality dimensions, factors, indicators, data sources, methodological choices (for instance, use of thresholds, aggregation methods), foreseen application and intended audience.

Goal and scope of criticality assessment

Concerning the goal and scope phase, methodologies stemmed from different perceptions of "**what is at risk**". For instance, the first criticality assessments were governmental reports (in the US and UK) referring to raw materials used for national security and defence, and thus considered as "strategic"[51]. Lately, countries with high level of industrialisation and high import dependency for materials started to identify potential supply risk of materials that are important to **sustain contemporary lifestyles**, and for the development of national and regional economies. Some studies address **specific industrial sectors**, and identify potential bottlenecks for their deployment. This is the case of low-carbon energy

[44] E.g.: Bach et al. (2016) Integrated method to assess resource efficiency – ESSENZ. J. Clean. Prod. 137, 118–130.; Gemechu et al. (2017) Geopolitical-related supply risk assessment as a complement to environmental impact assessment: the case of electric vehicles. Int. J. Life Cycle Assess.; Graedel and Nuss, (2014) Employing Considerations of Criticality in Product Design. Jom 66, 2360–2366.

[45] E.g.: Bauer et al. (2010) US Department of Energy: Critical Materials Strategy; Helbig et al. (2018) Supply risks associated with lithium-ion battery materials. J. Clean. Prod. 172, 274–286 ; Moss et al. (2013). Critical Metals in the Path towards the Decarbonisation of the EU Energy Sector.

[46] Duclos et al. (2010) Design in an era of constrained resources. Mech. Eng. 36–40.

[47] E.g. European Commission, 2017a. Methodology for establishing the EU list of Critical Raw Materials ; Graedel et al. (2015). Criticality of metals and metalloids. Proc. Natl. Acad. Sci. 112, 4257–4262. Etc.

[48] E.g.: Graedel et al. (2015) Criticality of metals and metalloids. Proc. Natl. Acad. Sci. 112, 4257–4262. Morley & Eatherley (2008). Material Security - Ensuring Resource Availability for the UK Economy.

[49] https://irtc.info/about-irtc/

[50] Schrijvers et al. (2019) A review of methods and data to determine raw material criticality. Resources, Conservation & Recycling.

[51] NRC, 2008. Minerals, Critical Minerals, and the U.S. Economy. ; Morley, N., Eatherley, D., 2008. Material Security - Ensuring Resource Availability for the UK Economy.

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technologies. Geographical scope can be national or regional, but sometimes this is not clearly specified.

Time horizon is usually limited to the present status quo, but few studies make future projections[52].

Three **main objectives** of the criticality studies can be distinguished:

i) **raise the attention** of decision makers in industry and governments regarding raw materials supply and demand dynamics;

ii) provide information on **mitigation measures** (diversifying supply, increase recycling, launching new mining projects, etc.)

iii) perform a **pre-screening** to support prioritization of in-depth analysis.

The **set of materials** under investigation in the criticality studies also varies among different methodologies. Figure 14 provides an overview of the frequency with which materials are included in a selection of criticality assessment studies reviewed in Schrijvers et al. 2019.

Selection of indicators and data sources

Criticality assessments usually combine two main **dimensions** to evaluate materials: supply risk/disruption and vulnerability. These dimensions are characterized through various **indicators**. Diversity of supply, political stability, depletion and recyclability are the most frequently aspects included in the assessment of supply risk. Vulnerability can be assessed with a variety of indicators, which most frequently include substitutability, demand growth and price volatility.

Data availability is crucial for any assessment and strongly influences the study outcomes. A wide range of data sources can be used, but geological surveys are the major data providers, together with World Bank, which produces the Worldwide Governance Indicators, that is used by most of the studies. Scientific literature and industry reports are also relevant sources of information, as well as other international organizations report (e.g. UNEP). Data quality can vary from one material to another, as more information is usually available for bulk materials while minor metals, for instance, are more difficult to obtain. Moreover, important data gaps are usually affecting by-products and intermediate products.

The review highlights the importance of a clear **definition of goal and scope** of the study and the understanding of cause-effect mechanisms that link risk factors to indicators. Communication of CRM should also be more transparent regarding the methodological choices and the underlying uncertainty.

[52] E.g. KIRAM, KITECH (2014). The current activity of Korea for the rare metals future. ; Coulomb et al. (2015). Critical Minerals Today and in 2030: AN ANALYSIS FOR OECD COUNTRIES. OECD Environ. Work. Pap. 0_1,3-5,8-49.

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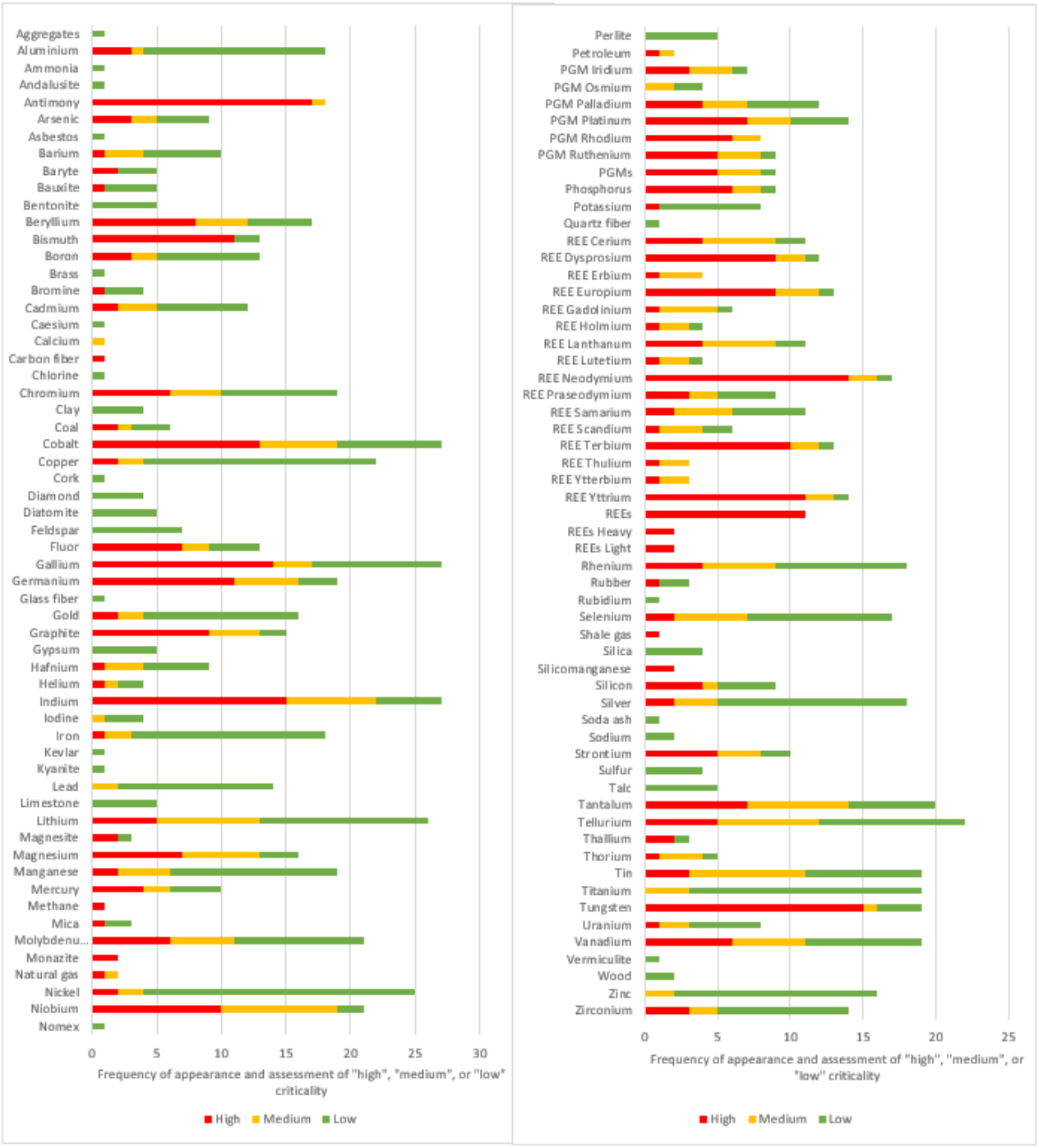

Figure 14: Frequency of appearance in criticality assessments and criticality determination (high, medium, or low) of materials[53] (Schrijvers et al., 2019).

[53] Included methods : NRC, Yale (global and country risk, only the supply risk axis), NSTC (2016 and 2018), EU (2011, 2014, and 2017), Helbig (2016 and 2018), Augsburg, KIRAM/KITECH, NEDO, BRGM, Werner, General Electric, iCIRCE, NIES, GeoPolRisk, SCARCE, Oakdene Hollins, Thomason, Rosenau-Tornow, Öko-Institut, Roelich, SDU, China, BGS (2011, 2012, and 2015), OECD, US DOE (both short term and medium term for 2010 and 2011), Moss (2011 and 2013). Excluded methods are BIRD, VDI and UBA (no results), Granta Design, ESSENZ and EBP/Empa (unaggregated results and/or company-specific), Angerer (no materials identified as critical). Multi-stage analyses and multiple forms of the same material are merged (only bottleneck is included), to avoid double counting of appearances. See SI-B for details on material inclusion and evaluation of methods.

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Annex 2. Stages assessed and rationale (only candidate CRMs with single stage screening)

	Stage assessed		Overview of rationales		Detailed rationales for stage assessed	
Material	Extraction	Processing	Data quality / (un)availability	Known bottleneck	Data quality / (un)availability on EU and global supply	Known bottleneck / expert feedback
Aggregates	X		X		Yes	Global supply data was available at both stages (extraction and refining). However, there is no strong evidence for significant refining production in the EU, therefore the extraction stage was selected for the criticality assessment.
Bauxite	X	See rationale under aluminium	X	X	Yes	The criticality of aluminium is assessed for two different life cycle stages, the extraction and processing stage (see Al criticality assessment). Data on global and EU supply was available and used in the assessment. It is important to assess the extraction stage, as the import reliance in Europe is substantial.
Aluminium	See rationale under bauxite	X	X	X	Yes	The criticality of aluminium is assessed for two different life cycle stages, the extraction and refining (see bauxite criticality assessment). Data on global and EU supply was available and used in the assessment. It is important to assess the refining stage, due to the importance of Aluminium in the European manufacturing sector and the competing demand from other global regions/ countries.
Arsenic		X	X	X	Yes	Arsenic is a by-product of copper, zinc, etc
Baryte	X		X	N/A	Global supply data was available at the extraction stage only, therefore this stage was selected for the criticality assessment.	N/A
Bentonite	X		X	X	Yes	Global and EU supply data was available at the extraction stage. Further, there was no robust evidence indicating a bottleneck at the refining stage, therefore the extraction stage was selected. Europe is a major producer of bentonite hence the sector is important for the EU economy.
Bismuth		X	X	N/A	Global supply data was available at the refining stage only, therefore this stage was selected for the criticality assessment.	N/A
Cadmium		X	X	X	Yes	Cadmium is a by-product of zinc

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	Stage assessed		Overview of rationales		Detailed rationales for stage assessed	
Material	Extraction	Processing	Data quality / (un)availability	Known bottleneck	Data quality / (un)availability on EU and global supply	Known bottleneck / expert feedback
Diatomite	X		X	X	Global supply data was available at the extraction stage only.	Global supply data was available at the extraction stage only. Further, there is no strong evidence indicating a bottleneck at the refining stage, therefore the extraction stage was selected for the criticality assessment.
Feldspar	X		X	X	Global supply data was available at the extraction stage only.	Global supply data was available at the extraction stage only. Further, there is no strong evidence indicating that there is a bottleneck at the refining stage, therefore the extraction stage was selected for the criticality assessment.
Gallium		X	X	N/A	Global supply data was available at the refining stage only, therefore this stage was selected for the criticality assessment.	N/A
Germanium		X	N/A	X	N/A	Ge is a by-product extracted from Zn ores and there are no Ge ores imports to the EU. Therefore, the processing stage was selected for the criticality assessment as it is assumed the processing stage has the highest supply risk i.e. bottleneck
Gold	X		X		Global supply data was available at the extraction stage only, therefore was selected for the criticality assessment.	N/A
Gypsum	X		X	X	Global and EU supply data was available at the extraction stage only.	Global and EU supply data was available at the extraction stage only. The rationale for the selection of the bottleneck is that for most industrial minerals the extraction stage is the bottleneck, as they are produced and sold in this form to product manufacturers.
Hafnium	-	X	N/A	X	N/A	Hafnium is only obtained as a by-product during the processing of other minerals e.g. zirconium. Therefore, data at the extraction (mine) level cannot exist. As such, the processing stage was selected as the bottleneck for the criticality assessment as the data used represents materials obtained after processing.
Helium		X	X	N/A	Global supply data was available at the refining stage only, therefore the processing stage was selected for the criticality assessment.	N/A
Hydrogen			X	N/A	EU sourcing only	N/A

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	Stage assessed		Overview of rationales		Detailed rationales for stage assessed	
Material	Extraction	Processing	Data quality / (un)availability	Known bottleneck	Data quality / (un)availability on EU and global supply	Known bottleneck / expert feedback
Indium		X	X	N/A	Global supply data was available at the refining stage only, therefore the processing stage was selected for the criticality assessment.	N/A
Iridium		X	N/A	X	N/A	Almost all iridium derived from primary source materials (i.e. mine production) is traded in the form of refined metal produced from integrated mining/metallurgical operations. There is only very limited international trade in iridium ores and concentrates, therefore the processing stage was selected for the criticality assessment.
Kaolin clay	X		X	X	Global and EU supply data was available at the extraction stage.	Global supply data was available at the extraction stage only. Further, there is no evidence indicating a bottleneck at the refining stage, therefore the extraction stage was selected for the criticality assessment.
Limestone	X		X	X	Global supply data for high grade limestone are not readily available.	Global supply data for high grade limestone are not readily available. Therefore, based on feedback from experts and data availability and quality, the extraction stage was selected for the criticality assessment, nevertheless data availability is very limited to undertake a detailed assessment.
Magnesite	X		X	N/A	Global supply data was available at the extraction stage only, therefore the extraction stage was selected for the criticality assessment.	N/A
Magnesium		X	X	X	X	There is no production of dolomite (extraction step of magnesium value chain) or refined magnesium (processing step) in the EU, however the refined materials are significantly imported to the EU, therefore indicating that that the processing step represents the highest supply risk. As such, the processing stage was selected for the criticality assessment. It is important to assess the refining stage of magnesium, due to the importance of magnesium metal in the European manufacturing sector and the competing demand from other global regions/ countries.

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	Stage assessed		Overview of rationales		Detailed rationales for stage assessed	
Material	Extraction	Processing	Data quality / (un)availability	Known bottleneck	Data quality / (un)availability on EU and global supply	Known bottleneck / expert feedback
Natural cork	X		X	X	Global supply data was available at the extraction stage only.	Global supply data was available at the extraction stage only. Further, there is no strong evidence for significant refining production in the EU, therefore the extraction stage was selected for the criticality assessment.
Natural graphite	X		X	N/A	Global supply data was available at the extraction stage only, therefore the extraction stage was selected for the criticality assessment.	N/A
Natural Rubber	X		X	X	Global supply data was available at the extraction stage only.	Global supply data was available at the extraction stage only. Further, there is no strong evidence for significant refining production in the EU, therefore the extraction stage was selected for the criticality assessment.
Natural Teak wood	X		X	X	Yes	Global supply data was available at both stages (extraction and refining). However, there is no strong evidence for significant refining production in the EU, therefore the extraction stage was selected for the criticality assessment.
Niobium		X	N/A	X	N/A	The processing stage was selected for the criticality assessment based on feedback received from experts indicating that the processing stage (e.g. ferroniobium) represents the most important bottleneck for the EU.
Palladium		X	N/A	X	N/A	Almost all palladium derived from primary source materials (i.e. mine production) is traded in the form of refined metal produced from integrated mining/metallurgical operations. There is only very limited international trade in palladium ores and concentrates. Therefore, the processing stage was selected for the criticality assessment.
Perlite	X		X	X	Global and EU supply data was available at the extraction stage only.	Global and EU supply data was available at the extraction stage only. Similarly to other industrial minerals, the extraction stages is mainly the bottleneck. Europe is a major producer of perlite therefore the extraction stage is of major importance to the EU.
Phosphate rock	X		X	X	Global and EU supply data was available at the extraction stage.	To highlight the difference between an extracted product and a refined product, both phosphate rock and phosphorus (P4) are assessed
Phosphorus		X	X	X	Global and EU supply data was available at the processing stage.	To highlight the difference between an extracted product and a refined product, both phosphate rock and phosphorus (P4) are assessed

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	Stage assessed		Overview of rationales		Detailed rationales for stage assessed	
Material	Extraction	Processing	Data quality / (un)availability	Known bottleneck	Data quality / (un)availability on EU and global supply	Known bottleneck / expert feedback
Platinum		X	N/A	X	N/A	Almost all platinum derived from primary source materials (i.e. mine production) is traded in the form of refined metal produced from integrated mining/metallurgical operations. There is only very limited international trade in platinum ores and concentrates. Therefore, the processing stage was selected for the criticality assessment.
Potash	X		X	X	Global supply data was available at the extraction stage only.	Global supply data was available at the extraction stage only. Limitations with data availability is the primary reason for the selection of the extraction stage instead of the refining stage to undertake the assessment.
Rhenium		X	X	X	Global supply data was available at the refining stage only, therefore the processing stage was selected for the criticality assessment.	N/A
Rhodium		X	N/A	X	N/A	Almost all rhodium derived from primary source materials (i.e. mine production) is traded in the form of refined metal produced from integrated mining/metallurgical operations. There is only very limited international trade in rhodium ores and concentrates. Therefore, the processing stage was selected for the criticality assessment.
Ruthenium		X	N/A	X	N/A	Almost all ruthenium derived from primary source materials (i.e. mine production) is traded in the form of refined metal produced from integrated mining/metallurgical operations. There is only very limited international trade in ruthenium ores and concentrates. Therefore, the processing stage was selected for the criticality assessment.
Sapele wood	X		X	X	Yes	Global supply data was available at both stages (extraction and refining). However, there is no strong evidence for significant refining production in the EU, therefore the extraction stage was selected for the criticality assessment.
Scandium		X	X	N/A	Global supply data was available at the refining stage only, therefore the extraction stage was selected for the criticality assessment.	N/A
Selenium		X	X	X	Global and EU supply data was available at the processing stage only.	Global and EU supply data was available at the processing stage only, therefore the processing stage was selected for the criticality assessment. Selenium is a by-product recovered during the refining of copper, therefore it is only the processing stage that is relevant for the assessment.

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	Stage assessed		Overview of rationales		Detailed rationales for stage assessed	
Material	Extraction	Processing	Data quality / (un)availability	Known bottleneck	Data quality / (un)availability on EU and global supply	Known bottleneck / expert feedback
Silica sand	X		X	N/A	Global supply data was available at the extraction stage only, therefore the extraction stage was selected for the criticality assessment.	N/A
Silicon metal		X	X	X	Global supply data was available at the refining stage only. Therefore the processing stage was selected for the criticality assessment.	Global supply data was available at the refining stage only. In addition, expert feedback indicated that there is no significant bottleneck at the extraction stage. Therefore, the processing stage was selected for the criticality assessment based on expert feedback and data availability.
Strontium	X		X	X	Yes	Limited data on metal stage
Sulphur		X	X	X	Global supply data was available at the refining stage only.	Global supply data was available at the refining stage only. Therefore the processing stage was selected for the criticality assessment.
Talc	X		X	X	Global supply data was available at the extraction stage only.	Global supply data was available at the extraction stage only. Further, there is no strong evidence indicating a bottleneck at the refining stage, therefore the extraction stage was selected for the criticality assessment.
Tantalum	X		X	X	Global supply data was available at the extraction stage only.	Global supply data was available at the extraction stage only. Further, there is no strong evidence indicating a bottleneck at the refining stage, therefore the extraction stage was selected for the criticality assessment.
Tellurium		X	X	X	Global and EU supply data was available at the processing stage only.	Global and EU supply data was available at the processing stage only, therefore the processing stage was selected for the criticality assessment. Tellurium is mainly produced as a by-product of copper refining, therefore the processing stage is only relevant for this assessment.
Zirconium	X		X	X	Yes	Limited data on metal stage

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Annex 3. Additional details on the criticality assessment results

The following additional criticality assessment results are provided:

- Comparison of Supply Risk results using different supply data (Table 15)
- Comparison of the results of previous assessments (Table 16)
- Individual and average EI and SR results of the grouped materials – HREEs, LREEs and PGMs (Table 17)

Table 15 presents the results of the Supply Risk calculation when using different Supply Risk data, which is based either on global supply or EU sourcing data only, or based on both global supply and EU sourcing depending on the availability and quality of the data for a given material, according to 2 stages when available.

Legend

PGMs	Iridium, palladium, platinum, rhodium, ruthenium
LREEs	Cerium, lanthanum, neodymium, praseodymium and samarium
HREEs	Dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium, yttrium

Table 15: Comparison of SR results based on scope of supply data used

	Supply Risk parameters							
	I stage				II stage			
Material	GS	EUS	GS+EUS	IR	GS	EUS	GS+EUS	IR
Aggregates	n/a	0.21	0.21	1%				
Aluminium					1.38	0.25	0.59	59%
Antimony	2.41	1.62	2.01	100%	1.54	0.84	0.99	43%
Arsenic					1.73	1.11	1.19	32%
Baryte	1.13	1.33	1.26	70%				
Bauxite	0.68	3.12	2.06	87%				
Bentonite	0.46	0.50	0.50	15%				
Beryllium	2.29	0.00	2.29	0%	1.20	1.28	1.24	100%
Bismuth					3.48	1.80	2.22	50%
Borate	1.23	5.14	3.19	100%	1.37	2.23	1.80	100%
Cadmium					0.54	0.34	0.34	-178%
Cerium	6.65	3.13	4.89	100%	n/a	6.17	6.17	100%
Chromium	1.03	0.83	0.85	20%	1.12	0.72	0.86	66%
Cobalt	2.12	2.85	2.54	86%	1.16	0.39	0.49	27%
Coking coal	2.82	0.47	1.19	62%	3.38	0.34	0.34	-3%
Copper	0.36	0.31	0.32	44%	0.64	0.27	0.27	0%
Diatomite	0.62	0.46	0.46	-1%				
Dysprosium	6.79	3.12	4.95	100%	n/a	6.20	6.20	100%
Erbium	6.66	3.06	4.86	100%	n/a	6.09	6.09	100%
Europium	4.01	1.84	2.92	100%	n/a	3.66	3.66	100%
Feldspar	0.61	0.82	0.78	34%				
Fluorspar	2.45	0.51	1.15	66%	0.82	0.42	0.42	-19%
Gadolinium	6.63	3.05	4.84	100%	n/a	6.06	6.06	100%
Gallium					3.71	0.82	1.26	31%
Germanium					3.89	0.66	3.89	31%
Gold	0.19	0.00	0.19	n/a				
Gypsum	1.39	0.50	0.50	-25%				
Hafnium					1.12	1.72	1.12	0%
Helium					1.33	1.03	1.16	89%
Ho, Tm, Lu, Yb	6.72	3.09	4.91	100%	n/a	6.15	6.15	100%
Hydrogen	0.00	0.39	0.39	0%				
Indium					1.79	0.40	1.79	0%
Iridium					3.22	0.00	3.22	100%

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	Supply Risk parameters							
	I stage				II stage			
Material	GS	EUS	GS+EUS	IR	GS	EUS	GS+EUS	IR
Iron ore	0.38	0.50	0.46	72%	1.04	0.17	0.19	4%
Kaolin clay	0.37	0.40	0.40	20%				
Lanthanum	6.50	5.29	5.89	100%	n/a	6.04	6.04	100%
Lead	0.43	0.06	0.09	15%	0.30	0.06	0.06	-1%
Limestone	0.02	0.20	0.20	5%				
Lithium	0.83	1.71	1.33	87%	1.48	1.81	1.64	100%
Magnesite	4.00	0.65	0.65	0%				
Magnesium					3.73	4.08	3.91	100%
Manganese	0.69	1.12	0.93	90%	2.01	0.37	0.53	20%
Molybdenum	1.36	0.52	0.94	100%	n/a	0.58	0.58	87%
Natural cork	0.82	0.98	0.98	0%				
Natural graphite	3.03	1.53	2.27	98%				
Natural Rubber	1.02	0.98	1.00	100%				
Natural Teak wood	1.31	2.47	1.89	100%				
Neodymium	6.54	5.32	5.93	100%	n/a	6.07	6.07	100%
Nickel	0.39	0.50	0.49	28%	0.59	0.26	0.37	67%
Niobium					4.19	3.60	3.90	100%
Palladium					1.27	0.00	1.27	93%
Perlite	0.42	0.97	0.42	-2%				
Phosphate rock	1.76	0.61	1.09	84%				
Phosphorus					3.32	3.78	3.55	100%
Platinum					1.84	0.00	1.84	98%
Potash	0.65	0.82	0.79	27%				
Praseodymium	5.91	4.81	5.36	100%	n/a	5.49	5.49	100%
Rhenium					0.45	0.91	0.45	22%
Rhodium					2.14	n/a	2.14	100%
Ruthenium					3.44	0.00	3.44	100%
Samarium	6.59	5.36	5.98	100%	n/a	6.12	6.12	100%
Sapele wood	0.00	2.27	2.27	100%				
Scandium					3.09	1.90	3.09	100%
Selenium					0.56	0.40	0.41	9%
Silica sand	0.41	0.39	0.39	0%				
Silicon metal					2.81	0.42	1.18	63%
Silver	0.43	0.74	0.68	40%	0.48	0.21	0.21	0%
Strontium	1.14	2.57	2.57	0%				
Sulphur					0.31	0.27	0.27	-35%
Talc	0.57	0.39	0.40	13%				
Tantalum	1.36	1.55	1.36	99%				
Tellurium					1.70	0.51	0.51	-14%
Terbium	6.02	2.77	4.40	100%	n/a	5.51	5.51	100%
Tin	0.90	0.57	0.90	0%	1.32	0.25	0.60	64%
Titanium	0.33	0.37	0.35	100%	1.26	0.00	1.26	100%
Tungsten	3.97	0.37	0.37	-397%	1.61	n/a	1.61	n/a
Vanadium	1.69	n/a	1.69	n/a	2.20	1.19	1.42	47%
Yttrium	4.59	2.11	3.35	100%	n/a	4.20	4.20	100%
Zinc	0.72	0.18	0.34	60%	0.82	0.17	0.17	-2%
Zirconium	0.68	0.99	0.83	100%				

Table 16 compares the results of the 2017 and previous assessments[54].

[54] 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.

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Legend	
Critical	Identified as a critical raw material
Non-critical	Identified as a non-critical raw material
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 World Governance indicators

Table 16: Comparison of 2020 results and previous assessments*

Criticality studies	2011		2014		2017		2020	
Material	SR*	EI	SR*	EI	SR	EI	SR	EI
Aggregates	-	-	-	-	0.2	2.3	0.2	2.7
Aluminium	0.2	8.9	0.4	7.6	0.5	6.5	0.6	5.4
Antimony	2.6	5.8	2.5	7.1	4.3	4.3	2.0	4.8
Arsenic	-	-	-	-	-	-	1.2	2.6
Baryte	1.7	3.7	1.7	2.8	1.6	2.9	1.3	3.3
Bauxite	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
Beryllium	1.3	6.2	1.5	6.7	2.4	3.9	2.3	4.2
Bismuth	-	-	-	-	3.8	3.6	2.2	4.0
Borate	0.6	5	1	5.7	3	3.1	3.2	3.5
Cadmium	-	-	-	-	-	-	0.3	4.2
Chromium	0.8	9.9	1	8.9	0.9	6.8	0.9	7.3
Cobalt	1.1	7.2	1.6	6.7	1.6	5.7	2.5	5.9
Coking coal	-	-	1.2	9	1	2.3	1.2	3.0
Copper	0.2	5.7	0.2	5.8	0.2	4.7	0.3	5.3
Diatomite	0.3	3.7	0.2	3	0.3	3.8	0.5	2.2
Feldspar	0.2	5.2	0.4	4.8	0.6	2.4	0.8	2.8
Fluorspar	1.6	7.5	1.7	7.2	1.3	4.2	1.2	3.3
Gallium	2.5	6.5	1.8	6.3	1.4	3.2	1.3	3.5
Germanium	2.7	6.3	1.9	5.5	1.9	3.5	3.9	3.5
Gold	-	-	0.2	3.8	0.2	2	0.2	2.1
Gypsum	0.4	5	0.5	5.5	0.5	2.2	0.5	2.6
Hafnium	-	-	0.4	7.8	1.3	4.2	1.1	3.9
Helium	-	-	-	-	1.6	2.8	1.2	2.6
HREEs	4.9	5.8	4.7	5.4	4.9	3.7	5.6	3.9
Hydrogen	-	-	-	-	-	-	0.4	3.8

* 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.

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Indium	2	6.7	1.8	5.6	2.4	3.1	1.8	3.3
Iron ore	0.4	8.1	0.5	7.4	0.8	6.2	0.5	6.8
Kaolin clay	0.3	4.4	0.3	4.8	0.5	2.3	0.4	2.4
Lead	-	-	-	-	0.1	3.7	0.1	4.0
Limestone	0.7	6	0.4	5.8	0.1	2.5	0.2	3.5
Lithium	0.7	5.6	0.6	5.5	1	2.4	1.6	3.1
LREEs	4.9	5.8	3.1	5.2	5	3.6	6.0	4.3
Magnesite	0.9	8.9	2.2	8.3	0.7	3.7	0.6	3.2
Magnesium	2.6	6.5	2.5	5.5	4	7.1	3.9	6.6
Manganese	0.5	9.8	0.4	7.8	0.9	6.1	0.9	6.7
Molybdenum	0.5	8.9	0.9	5.9	0.9	5.2	0.9	6.2
Natural cork	-	-	-	-	1.1	1.5	1.0	1.6
Natural graphite	1.3	8.7	2.2	7.4	2.9	2.9	2.3	3.2
Natural Rubber	-	-	0.9	7.7	1	5.4	1.0	7.1
Natural Teak wood	-	-	-	-	0.9	2	1.9	2.0
Nickel	0.3	9.5	0.2	8.8	0.3	4.8	0.5	4.9
Niobium	2.8	9	2.5	5.9	3.1	4.8	3.9	6.0
Perlite	0.3	4.2	0.3	4.6	0.4	2.1	0.4	2.3
PGMs	3.6	6.7	1.2	6.6	2.5	5	2.4	5.7
Phosphate rock	-	-	1.1	5.8	1	5.1	1.1	5.6
Phosphorus	-	-	-	-	4.1	4.4	3.5	5.3
Potash	-	-	0.2	8.6	0.6	4.8	0.8	5.4
Rhenium	0.8	7.7	0.9	4.5	1	2	0.5	2.0
Sapele wood	-	-	-	-	1.4	1.3	2.3	1.4
Scandium	4.9	5.8	1.1	3.8	2.9	3.7	3.1	4.4
Selenium	-	-	0.2	6.9	0.4	4.5	0.4	4.9
Silica sand	0.2	5.8	0.3	5.8	0.3	2.6	0.4	2.9
Silicon metal	-	-	1.6	7.1	1	3.8	1.2	4.2
Silver	0.3	5.1	0.7	4.8	0.5	3.8	0.7	4.1
Strontium	-	-	-	-	-	-	2.6	3.5
Sulphur	-	-	-	-	0.6	4.6	0.3	4.1
Talc	0.3	4	0.3	5.1	0.4	3	0.4	4.0
Tantalum	1.1	7.4	0.6	7.4	1	3.9	1.4	4.0
Tellurium	0.6	7.9	0.2	6	0.7	3.4	0.5	3.6
Tin	-	-	0.9	6.7	0.8	4.4	0.9	4.2
Titanium	0.1	5.4	0.1	5.5	0.3	4.3	1.3	4.7
Tungsten	1.8	8.8	2	9.1	1.8	7.3	1.6	8.1
Vanadium	0.7	9.7	0.8	9.1	1.6	3.7	1.7	4.4
Zinc	0.4	9.4	0.5	8.7	0.3	4.5	0.3	5.4
Zirconium	-	-	-	-	-	-	0.8	3.2

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The average and individual EI and SR scores for each of the individual materials categorised in groups are presented in Table 17 to provide additional information to consider when analysing the results. The SR and EI averages for the PGMs, HREEs and LREEs groups should be considered very carefully because they were not assessed separately in early assessments. PGMs and REEs were treated as single groups in 2011 assessment, and accordingly PGMs, HREEs and LREEs were treated as single groups in 2014. The average results of the five materials that are part of the PGMs group, 10 materials of HREEs group and 5 materials of LREEs group, are presented to allow backwards comparability.

Table 17: Individual and average EI and SR scores for material groups – LREEs, HREEs and PGMs

Materials	Supply Risk	Economic Importance	Import reliance (%)	EOL-RIR (%)	Supply data in SR
Cerium	6.2	3.5	100	1	EU sourcing
Lanthanum	6.0	1.5	100	1	
Neodymium	6.1	4.8	100	1	
Praseodymium	5.5	4.3	100	10	
Samarium	6.1	7.3	100	1	
Dysprosium	6.2	7.2	100	0	EU sourcing
Erbium	6.1	3.1	100	1	
Europium	3.7	3.3	100	38	
Gadolinium	6.1	4.6	100	1	
Ho, Tm, Lu, Yb	6.1	3.4	100	1	
Terbium	5.5	4.1	100	6	
Yttrium	4.2	3.5	100	31	
Iridium	3.2	4.2	100	14	Global supply only
Palladium	1.3	7.0	93	28	
Platinum	1.8	5.9	98	25	
Rhodium	2.1	7.4	100	28	
Ruthenium	3.4	4.1	100	11	
Group averages	Supply Risk	Economic Importance	Import reliance (%)	EOL-RIR (%)	Supply data in SR
LREEs	6.0	4.3	100	3	EU sourcing
HREEs	5.6	3.9	100	8	
PGMs	2.4	5.7	98	21	Global supply only

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Annex 4. Substitution indexes

Material	SI (EI)	SI (SR)	Material	SI (EI)	SI (SR)
Aggregates	0.93	0.97	Magnesium	0.93	0.94
Aluminium	0.80	0.88	Manganese	1.00	1.00
Antimony	0.92	0.94	Molybdenum	1.00	1.00
Arsenic	0.85	0.94	Natural cork	0.91	0.91
Baryte	0.95	0.96	Natural graphite	0.99	0.99
Bauxite	0.99	1.00	Natural Rubber	0.99	0.99
Bentonite	0.99	0.99	Natural Teak wood	0.90	0.90
Beryllium	0.99	0.99	Neodymium	0.93	0.98
Bismuth	0.96	0.94	Nickel	0.83	0.90
Borate	1.00	1.00	Niobium	0.97	0.98
Cadmium	0.92	0.91	Palladium	0.92	0.98
Cerium	0.95	0.99	Perlite	0.88	0.92
Chromium	1.00	1.00	Phosphate rock	1.00	1.00
Cobalt	0.92	0.92	Phosphorus	1.00	1.00
Coking coal	0.99	0.99	Platinum	0.85	0.98
Copper	0.93	0.93	Potash	1.00	1.00
Diatomite	0.96	0.96	Praseodymium	0.93	0.97
Dysprosium	0.95	1.00	Rhenium	0.98	1.00
Erbium	0.96	0.99	Rhodium	0.99	0.99
Europium	0.79	0.95	Ruthenium	0.92	0.96
Feldspar	0.99	0.99	Samarium	0.98	0.98
Fluorspar	0.89	0.88	Sapele wood	0.94	0.94
Gadolinium	0.92	0.99	Scandium	1.00	0.95
Gallium	0.98	0.98	Selenium	0.90	0.95
Germanium	0.95	0.95	Silica sand	0.97	0.97
Gold	0.98	0.99	Silicon metal	0.99	0.99
Gypsum	0.88	0.96	Silver	0.95	0.97
Hafnium	0.91	0.96	Strontium	0.93	0.90
Helium	0.94	0.96	Sulphur	0.99	0.99
Ho, Tm, Lu, Yb	1.00	1.00	Talc	0.98	0.99
Hydrogen	1.00	1.00	Tantalum	0.95	0.96
Indium	0.97	0.98	Tellurium	0.86	0.93
Iridium	0.91	0.95	Terbium	0.79	0.95
Iron ore	0.93	0.95	Tin	0.90	0.91
Kaolin clay	0.96	0.97	Titanium	0.92	0.96
Lanthanum	0.89	0.97	Tungsten	0.95	0.98
Lead	0.96	0.96	Vanadium	0.98	0.99
Limestone	0.90	0.98	Yttrium	0.98	0.99
Lithium	0.93	0.93	Zinc	0.93	0.96
Magnesite	0.98	0.99	Zirconium	0.96	0.97

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Annex 5. End uses, NACE2 sectors assignement

Material	Application	Share	NACE sector	VA
Aggregates	Construction	100%	C23 - Manufacture of other non-metallic mineral products	57,255
Aluminium	Construction	23%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Aluminium	Mobility (Transport and Automotive)	21%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Aluminium	Mobility (Transport and Automotive)	21%	C30 - Manufacture of other transport equipment	44,304
Aluminium	Packaging	17%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Aluminium	High Tech Engineering	12%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Aluminium	Consumer Durables	6%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Antimony	Flame retardants	43%	C20 - Manufacture of chemicals and chemical products	105,514
Antimony	Lead-acid batteries	32%	C27 - Manufacture of electrical equipment	80,745
Antimony	Lead alloys	14%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Antimony	Plastics (catalysts and stabilisers)	6%	C20 - Manufacture of chemicals and chemical products	105,514
Antimony	Glass and ceramics	5%	C23 - Manufacture of other non-metallic mineral products	57,255
Arsenic	Zinc production	71%	C24 - Manufacture of basic metals	55,426
Arsenic	Glassmaking	18%	C23 - Manufacture of other non-metallic mineral products	57,255
Arsenic	Chemicals	7%	C20 - Manufacture of chemicals and chemical products	105,514
Arsenic	Alloys	5%	C24 - Manufacture of basic metals	55,426
Arsenic	Electronics	0%	C26 - Manufacture of computer, electronic and optical products	65,703
Baryte	Weighting agent in oil and gas well drilling fluids or "muds"	60%	C23 - Manufacture of other non-metallic mineral products	57,255
Baryte	Filler in rubbers, plastics, paints & paper	30%	C22 - Manufacture of rubber and plastic products	75,980
Baryte	Chemical industry	10%	C20 - Manufacture of chemicals and chemical products	105,514
Bauxite	Refining to alumina	90%	C24 - Manufacture of basic metals	55,426

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Material	Application	Share	NACE sector	VA
Bauxite	Refractories	3%	C23 - Manufacture of other non-metallic mineral products	57,255
Bauxite	Cement	3%	C23 - Manufacture of other non-metallic mineral products	57,255
Bauxite	Abrasives	2%	C23 - Manufacture of other non-metallic mineral products	57,255
Bauxite	Chemicals	2%	C20 - Manufacture of chemicals and chemical products	105,514
Bentonite	Pet litter	34%	C23 - Manufacture of other non-metallic mineral products	57,255
Bentonite	Foundry molding sands	22%	C24 - Manufacture of basic metals	55,426
Bentonite	Civil engineering	13%	C23 - Manufacture of other non-metallic mineral products	57,255
Bentonite	Food and wine production	3%	C11 - Manufacture of beverages	32,505
Bentonite	Pelletizing of iron ore	8%	C24 - Manufacture of basic metals	55,426
Bentonite	Oil absorbents	8%	C20 - Manufacture of chemicals and chemical products	105,514
Bentonite	Paper	3%	C17 - Manufacture of paper and paper products	38,910
Bentonite	Specialties and drilling fluids	7%	B09 - Mining support service activities	3,400
Bentonite	Others	2%	C20 - Manufacture of chemicals and chemical products	105,514
Beryllium	Electronic and telecommunications equipments	42%	C26 - Manufacture of computer, electronic and optical products	65,703
Beryllium	Transport and Defence : Vehicle electronics	17%	C26 - Manufacture of computer, electronic and optical products	65,703
Beryllium	Transport and Defence : Auto components	17%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Beryllium	Transport and Defence : Aerospace components	10%	C30 - Manufacture of other transport equipment	44,304
Beryllium	Energy application	8%	C26 - Manufacture of computer, electronic and optical products	65,703
Beryllium	Industrial components : Moulds	3%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Beryllium	Industrial components : Metal	3%	C24 - Manufacture of basic metals	55,426
Beryllium	Others	0%	0	0
Bismuth	Chemicals	62%	C20 - Manufacture of chemicals and chemical products	105,514
Bismuth	Low-melting alloys	28%	C32 - Other manufacturing	39,160
Bismuth	Metallurgical additives	10%	C24 - Manufacture of basic metals	55,426
Borate	Glass	55%	C23 - Manufacture of other non-metallic mineral products	57,255

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Material	Application	Share	NACE sector	VA
Borate	Frits and Ceramics	17%	C23 - Manufacture of other non-metallic mineral products	57,255
Borate	Fertilisers	15%	C20 - Manufacture of chemicals and chemical products	105,514
Borate	Chemicals manufacture	4%	C20 - Manufacture of chemicals and chemical products	105,514
Borate	Construction materials (flame retardants, plasters, wood preservatives)	4%	C20 - Manufacture of chemicals and chemical products	105,514
Borate	Metals	4%	C24 - Manufacture of basic metals	55,426
Borate	Other	0%	0	0
Cadmium	Batteries	80%	C27 - Manufacture of electrical equipment	80,745
Cadmium	Pigments	11%	C20 - Manufacture of chemicals and chemical products	105,514
Cadmium	Coatings	7%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Cadmium	Stabilizers	2%	C20 - Manufacture of chemicals and chemical products	105,514
Cadmium	Others	0%	0	0
Cerium	Autocatalysts	35%	C20 - Manufacture of chemicals and chemical products	105,514
Cerium	Glass&Ceramics	33%	C23 - Manufacture of other non-metallic mineral products	57,255
Cerium	Polishing powders	11%	C26 - Manufacture of computer, electronic and optical products	65,703
Cerium	Fluid Cracking Catalysts	8%	C19 - Manufacture of coke and refined petroleum products	17,289
Cerium	Metal (excl. Batteries)	6%	C24 - Manufacture of basic metals	55,426
Cerium	Batteries	6%	C27 - Manufacture of electrical equipment	80,745
Cerium	Lighting	1%	C27 - Manufacture of electrical equipment	80,745
Chromium	Products made of Stainless Steel	74%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Chromium	Products made of Alloy Steel	19%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Chromium	Casting Molds	3%	C24 - Manufacture of basic metals	55,426
Chromium	Products made of chromium chemicals	3%	C20 - Manufacture of chemicals and chemical products	105,514
Chromium	Refractory bricks and mortars	1%	C23 - Manufacture of other non-metallic mineral products	57,255

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Material	Application	Share	NACE sector	VA
Chromium	Other uses	0%	0	0
Cobalt	Superalloys, hardfacing/HSS and other alloys	36%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Cobalt	Hard materials (carbides and diamond tools)	14%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Cobalt	Pigments and Inks	13%	C20 - Manufacture of chemicals and chemical products	105,514
Cobalt	Catalysts	12%	C20 - Manufacture of chemicals and chemical products	105,514
Cobalt	Tyre adhesives and paint dryers	11%	C20 - Manufacture of chemicals and chemical products	105,514
Cobalt	Magnets	7%	C27 - Manufacture of electrical equipment	80,745
Cobalt	Other – Biotech, Surface Treatment, etc	6%	C20 - Manufacture of chemicals and chemical products	105,514
Cobalt	Battery	3%	C27 - Manufacture of electrical equipment	80,745
Coking coal	Coke for steel production	82%	C24 - Manufacture of basic metals	55,426
Coking coal	Coke for other applications	9%	C23 - Manufacture of other non-metallic mineral products	57,255
Coking coal	Other uses (tar, benzole, electricity and heat)	8%	C20 - Manufacture of chemicals and chemical products	105,514
Copper	Automotive	6%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Copper	Digital appliances	14%	C26 - Manufacture of computer, electronic and optical products	65,703
Copper	Jewellery	5%	C32 - Other manufacturing	39,160
Copper	Ships, trucks and armored vehicles	10%	C20 - Manufacture of chemicals and chemical products	105,514
Copper	Subparts of interior	2%	C31 - Manufacture of furniture	26,171
Copper	Oxides and dopants	3%	C20 - Manufacture of chemicals and chemical products	105,514
Copper	Electrolytic refined copper	2%	C24 - Manufacture of basic metals	55,426
Copper	Components and household	22%	C27 - Manufacture of electrical equipment	80,745
Copper	Tubes, plates, wire	21%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Copper	Machinery	15%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Diatomite	Food industry	48%	C11 - Manufacture of beverages	32,505

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Material	Application	Share	NACE sector	VA
Diatomite	Pellettizing iron ore	23%	C23 - Manufacture of other non-metallic mineral products	57,255
Diatomite	Activated raw granules	13%	C23 - Manufacture of other non-metallic mineral products	57,255
Diatomite	Pet litter	7%	C23 - Manufacture of other non-metallic mineral products	57,255
Diatomite	Civil engineering	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Diatomite	Drilling fluids	2%	B09 - Mining support service activities	3,400
Diatomite	Foundry molding sands	1%	C24 - Manufacture of basic metals	55,426
Dysprosium	Magnets	100%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Erbium	Glass - Optical applications	74%	C23 - Manufacture of other non-metallic mineral products	57,255
Erbium	Lighting	26%	C27 - Manufacture of electrical equipment	80,745
Europium	Lighting	100%	C27 - Manufacture of electrical equipment	80,745
Feldspar	Ceramics (tiles, sanitaryware, tableware, glazes)	45%	C23 - Manufacture of other non-metallic mineral products	57,255
Feldspar	Glass (container, float, fiberglass, specialties)	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Feldspar	Constructions, brick, tiles	46%	C23 - Manufacture of other non-metallic mineral products	57,255
Feldspar	Others	3%	0	0
Fluorspar	Steel and iron making	36%	C24 - Manufacture of basic metals	55,426
Fluorspar	Refrigeration and air conditioning	9%	C27 - Manufacture of electrical equipment	80,745
Fluorspar	Refrigeration and air conditioning	9%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Fluorspar	Aluminium making and other metallurgy	15%	C24 - Manufacture of basic metals	55,426
Fluorspar	Solid fluoropolymers for cookware coating and cable insulation	11%	C27 - Manufacture of electrical equipment	80,745
Fluorspar	Fluorochemicals	10%	C20 - Manufacture of chemicals and chemical products	105,514
Fluorspar	UF6 in nuclear uranium fuel	6%	C24 - Manufacture of basic metals	55,426
Fluorspar	HF in alkylation process for oil refining	3%	C19 - Manufacture of coke and refined petroleum products	17,289
Gadolinium	Magnets	38%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Gadolinium	Metal (excl. Batteries)	30%	C24 - Manufacture of basic metals	55,426

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Material	Application	Share	NACE sector	VA
Gadolinium	Lighting	25%	C27 - Manufacture of electrical equipment	80,745
Gadolinium	Magnetic Resonance Imaging - MRI	8%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	80,180
Gadolinium	Other	0%	0	0
Gallium	Integrated circuits	70%	C26 - Manufacture of computer, electronic and optical products	65,703
Gallium	Lighting	25%	C27 - Manufacture of electrical equipment	80,745
Gallium	CIGS solar cells	5%	C26 - Manufacture of computer, electronic and optical products	65,703
Germanium	Infrared optics	47%	C26 - Manufacture of computer, electronic and optical products	65,703
Germanium	Optical fibres	40%	C27 - Manufacture of electrical equipment	80,745
Germanium	Satellite solar cells	13%	C26 - Manufacture of computer, electronic and optical products	65,703
Germanium	Others	0%	0	0
Gold	Jewellery	86%	C32 - Other manufacturing	39,160
Gold	Electronics	11%	C26 - Manufacture of computer, electronic and optical products	65,703
Gold	Other industrial applications	2%	C32 - Other manufacturing	39,160
Gold	Dental	1%	C32 - Other manufacturing	39,160
Gypsum	Plasterboard and Wallboard	51%	C23 - Manufacture of other non-metallic mineral products	57,255
Gypsum	Building plaster	26%	C23 - Manufacture of other non-metallic mineral products	57,255
Gypsum	Cement production	17%	C23 - Manufacture of other non-metallic mineral products	57,255
Gypsum	Agriculture	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Hafnium	Superalloy	61%	C24 - Manufacture of basic metals	55,426
Hafnium	Catalyst precursor	7%	C20 - Manufacture of chemicals and chemical products	105,514
Hafnium	Plasma cutting tips	15%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Hafnium	Nuclear control rod	11%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Hafnium	Oxide for Optical	3%	C26 - Manufacture of computer, electronic and optical products	65,703
Hafnium	Semiconductors	3%	C26 - Manufacture of computer, electronic and optical products	65,703

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Material	Application	Share	NACE sector	VA
Hafnium	Others	0%	0	0
Helium	Controlled atmospheres	23%	C24 - Manufacture of basic metals	55,426
Helium	Cryogenics	22%	C32 - Other manufacturing	39,160
Helium	Balloons	14%	C32 - Other manufacturing	39,160
Helium	Pressurisation and purging	9%	C32 - Other manufacturing	39,160
Helium	Analysis	9%	C32 - Other manufacturing	39,160
Helium	Welding	8%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Helium	Semiconductors, optic fibres	8%	C26 - Manufacture of computer, electronic and optical products	65,703
Helium	Leak detection	7%	C33 - Repair and installation of machinery and equipment	52,332
Ho, Tm, Lu, Yb	Glass - Optical applications	100%	C26 - Manufacture of computer, electronic and optical products	65,703
Hydrogen	Ammonia production	50%	C20 - Manufacture of chemicals and chemical products	105,514
Hydrogen	Refineries	30%	C19 - Manufacture of coke and refined petroleum products	17,289
Hydrogen	Methanol production	13%	C20 - Manufacture of chemicals and chemical products	105,514
Hydrogen	Metal processing	6%	C24 - Manufacture of basic metals	55,426
Hydrogen	Others	1%	C32 - Other manufacturing	39,160
Indium	Flat panel displays	60%	C26 - Manufacture of computer, electronic and optical products	65,703
Indium	Solders	11%	C26 - Manufacture of computer, electronic and optical products	65,703
Indium	PV cells	9%	C26 - Manufacture of computer, electronic and optical products	65,703
Indium	Thermal interface material	7%	C26 - Manufacture of computer, electronic and optical products	65,703
Indium	Batteries	5%	C27 - Manufacture of electrical equipment	80,745
Indium	Alloys/compounds	4%	C24 - Manufacture of basic metals	55,426
Indium	Semiconductors & LEDs	3%	C26 - Manufacture of computer, electronic and optical products	65,703
Indium	Other	0%	0	0
Iridium	Electrochemical	48%	C20 - Manufacture of chemicals and chemical products	105,514
Iridium	Other	0%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603

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Material	Application	Share	NACE sector	VA
Iridium	Electronics	39%	C26 - Manufacture of computer, electronic and optical products	65,703
Iridium	Chemical	13%	C20 - Manufacture of chemicals and chemical products	105,514
Iron ore	Steel in Construction	35%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Iron ore	Steel in Automotive	20%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Iron ore	Steel in Mechanical engineering	15%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Iron ore	Steel in Metalware	14%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Iron ore	Steel in Tubes	11%	C24 - Manufacture of basic metals	55,426
Iron ore	Steel in Domestic appliances	2%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Iron ore	Steel in Other transport	2%	C30 - Manufacture of other transport equipment	44,304
Iron ore	Other	0%	0	0
Kaolin clay	Ceramics	47%	C23 - Manufacture of other non-metallic mineral products	57,255
Kaolin clay	Paper	29%	C17 - Manufacture of paper and paper products	38,910
Kaolin clay	Fiberglass	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Kaolin clay	Refractories	5%	C23 - Manufacture of other non-metallic mineral products	57,255
Kaolin clay	Catalysts	4%	C19 - Manufacture of coke and refined petroleum products	17,289
Kaolin clay	Others	4%	0	0
Kaolin clay	Paints and adhesives	4%	C20 - Manufacture of chemicals and chemical products	105,514
Kaolin clay	Rubber and plastics	1%	C22 - Manufacture of rubber and plastic products	75,980
Kaolin clay	Cement	1%	C23 - Manufacture of other non-metallic mineral products	57,255
Lanthanum	Fluid Cracking Catalysts	67%	C19 - Manufacture of coke and refined petroleum products	17,289
Lanthanum	Glass&Ceramics	13%	C23 - Manufacture of other non-metallic mineral products	57,255
Lanthanum	Batteries	10%	C27 - Manufacture of electrical equipment	80,745
Lanthanum	Polishing powders	5%	C26 - Manufacture of	65,703

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Material	Application	Share	NACE sector	VA
			computer, electronic and optical products	
Lanthanum	Metal (excl.Batteries)	3%	C24 - Manufacture of basic metals	55,426
Lanthanum	Lighting	2%	C27 - Manufacture of electrical equipment	80,745
Lead	Batteries	84%	C27 - Manufacture of electrical equipment	80,745
Lead	Rolled and extruded products	6%	C24 - Manufacture of basic metals	55,426
Lead	Lead compounds	4%	C20 - Manufacture of chemicals and chemical products	105,514
Lead	Shot/ammunition	4%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Lead	Cable sheathing	1%	C27 - Manufacture of electrical equipment	80,745
Lead	Alloys and solders	1%	C24 - Manufacture of basic metals	55,426
Limestone	Cement & concrete, plaster & mortar, roadworks	31%	C23 - Manufacture of other non-metallic mineral products	57,255
Limestone	Manufacture of basic metals	8%	C24 - Manufacture of basic metals	55,426
Limestone	Paper, plastics and rubber	31%	C20 - Manufacture of chemicals and chemical products	105,514
Limestone	Agriculture	5%	C20 - Manufacture of chemicals and chemical products	105,514
Limestone	Others (Glass & ceramics,chemicals, water treatment)	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Limestone	Paint, coating, adhesives	6%	C20 - Manufacture of chemicals and chemical products	105,514
Limestone	Flue Gas Desulfurisation	9%	E39 - Remediation activities and other waste management services	1,301
Limestone	Feed	4%	C10 - Manufacture of food products	155,880
Lithium	Glass and ceramics	66%	C23 - Manufacture of other non-metallic mineral products	57,255
Lithium	Lubricating greases	9%	C20 - Manufacture of chemicals and chemical products	105,514
Lithium	Cement production	9%	C23 - Manufacture of other non-metallic mineral products	57,255
Lithium	Steel casting	5%	C24 - Manufacture of basic metals	55,426
Lithium	Pharmaceutical products	4%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	80,180
Lithium	Rubber and plastics production	4%	C22 - Manufacture of rubber and plastic products	75,980
Lithium	Al-Li alloys	2%	C25 - Manufacture of fabricated metal products,	148,351

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Material	Application	Share	NACE sector	VA
			except machinery and equipment	
Lithium	Batteries and products containing batteries	1%	C27 - Manufacture of electrical equipment	80,745
Magnesite	Steel making	57%	C24 - Manufacture of basic metals	55,426
Magnesite	Paper industry	12%	C17 - Manufacture of paper and paper products	38,910
Magnesite	Cement making	9%	C23 - Manufacture of other non-metallic mineral products	57,255
Magnesite	Agriculture (1 of 2)	7%	C20 - Manufacture of chemicals and chemical products	105,514
Magnesite	Agriculture (2 of 2)	7%	C10 - Manufacture of food products	155,880
Magnesite	Ceramics	5%	C23 - Manufacture of other non-metallic mineral products	57,255
Magnesite	Glass making	3%	C23 - Manufacture of other non-metallic mineral products	57,255
Magnesite	Others	0%	0	0
Magnesium	Transportation (Automotive)	50%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Magnesium	Packaging	21%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Magnesium	Desulfurisation agent	12%	C24 - Manufacture of basic metals	55,426
Magnesium	Construction	13%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Magnesium	Transportation (Air, Marine, Train)	4%	C30 - Manufacture of other transport equipment	44,304
Magnesium	Other applications	0%	0	0
Manganese	Steel (construction)	25%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Manganese	Steel (automotive)	14%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Manganese	Steel (mechanical engineering)	13%	C24 - Manufacture of basic metals	55,426
Manganese	Steel (structural steelworks)	11%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Manganese	Steel (tubes)	10%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351

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Material	Application	Share	NACE sector	VA
Manganese	Steel (metalware)	10%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Manganese	Non-steel alloys	6%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Manganese	Chemical manufacture	5%	C20 - Manufacture of chemicals and chemical products	105,514
Manganese	Steel (domestic appliances)	4%	C27 - Manufacture of electrical equipment	80,745
Manganese	Batteries (cathodes)	2%	C27 - Manufacture of electrical equipment	80,745
Molybdenum	Engineering steels	40%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Molybdenum	Stainless steels	23%	C19 - Manufacture of coke and refined petroleum products	17,289
Molybdenum	Chemicals	13%	C20 - Manufacture of chemicals and chemical products	105,514
Molybdenum	Foundries	8%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Molybdenum	Tool steels	8%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Molybdenum	Mo-Metals	6%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Molybdenum	Nickel alloys	2%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Natural cork	Wine corks	70%	C11 - Manufacture of beverages	32,505
Natural cork	Insulation, building materials	20%	C16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	27,967
Natural cork	General furniture	5%	C31 - Manufacture of furniture	26,171
Natural cork	Leisure	2%	C32 - Other manufacturing	39,160
Natural cork	Gaskets, expansion	1%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Natural cork	Gaskets, expansion	1%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Natural cork	Gaskets, expansion	1%	C30 - Manufacture of other transport equipment	44,304
Natural graphite	Refractories for steelmaking	53%	C24 - Manufacture of basic metals	55,426
Natural graphite	Foundries	15%	C23 - Manufacture of other non-metallic mineral products	57,255

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Material	Application	Share	NACE sector	VA
Natural graphite	Graphite shapes	2%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Natural graphite	Batteries	9%	C27 - Manufacture of electrical equipment	80,745
Natural graphite	Lubricants	6%	C20 - Manufacture of chemicals and chemical products	105,514
Natural graphite	Recarburising	5%	C24 - Manufacture of basic metals	55,426
Natural graphite	Pencils	5%	C23 - Manufacture of other non-metallic mineral products	57,255
Natural graphite	Friction products	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Natural Rubber	Automotive	75%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Natural Rubber	Other transport equipment	14%	C30 - Manufacture of other transport equipment	44,304
Natural Rubber	Machinery and offshore	6%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Natural Rubber	Furniture	2%	C31 - Manufacture of furniture	26,171
Natural Rubber	Packaging	1%	C22 - Manufacture of rubber and plastic products	75,980
Natural Rubber	Household appliances	1%	C27 - Manufacture of electrical equipment	80,745
Natural Rubber	Sportswear	1%	C32 - Other manufacturing	39,160
Natural Teak wood	Yachts, sailing boats	90%	C30 - Manufacture of other transport equipment	44,304
Natural Teak wood	High end furniture	10%	C31 - Manufacture of furniture	26,171
Neodymium	Magnets	41%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Neodymium	Batteries	14%	C27 - Manufacture of electrical equipment	80,745
Neodymium	Metal (excl. Batteries)	13%	C24 - Manufacture of basic metals	55,426
Neodymium	Ceramics	12%	C23 - Manufacture of other non-metallic mineral products	57,255
Neodymium	Glass	9%	C23 - Manufacture of other non-metallic mineral products	57,255
Neodymium	Catalysts	7%	C20 - Manufacture of chemicals and chemical products	105,514
Neodymium	Lasers	3%	C26 - Manufacture of computer, electronic and optical products	65,703
Neodymium	Other	0%	0	0
Nickel	Engineering (Steel)	39%	C28 - Manufacture of machinery and equipment n.e.c.	182,589

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Material	Application	Share	NACE sector	VA
Nickel	Metal goods (Steel)	21%	C24 - Manufacture of basic metals	55,426
Nickel	Transport (Steel)	19%	C30 - Manufacture of other transport equipment	44,304
Nickel	Electrical and Electronics (Steel)	11%	C27 - Manufacture of electrical equipment	80,745
Nickel	Building and construction (Steel)	10%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Niobium	Automotive (Steel)	23%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Niobium	Construction (Steel)	45%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Niobium	Stainless Steel	10%	C24 - Manufacture of basic metals	55,426
Niobium	Oil & Gas	17%	C24 - Manufacture of basic metals	55,426
Niobium	Special Steel	3%	C30 - Manufacture of other transport equipment	44,304
Palladium	Autocatalyst	87%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Palladium	Electronics	4%	C26 - Manufacture of computer, electronic and optical products	65,703
Palladium	Chemical	4%	C20 - Manufacture of chemicals and chemical products	105,514
Palladium	Dental	2%	C32 - Other manufacturing	39,160
Palladium	Jewellery	2%	C32 - Other manufacturing	39,160
Palladium	Other	0%	0	0
Palladium	Investment	0%	0	0
Perlite	Building construction products	59%	C23 - Manufacture of other non-metallic mineral products	57,255
Perlite	Filter aid	24%	C11 - Manufacture of beverages	32,505
Perlite	Horticultural aggregate	11%	C23 - Manufacture of other non-metallic mineral products	57,255
Perlite	Fillers	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Phosphate rock	Mineral fertilizer	86%	C20 - Manufacture of chemicals and chemical products	105,514
Phosphate rock	Animal feed	10%	C10 - Manufacture of food products	155,880
Phosphate rock	Detergents, chemicals, food additives	4%	C20 - Manufacture of chemicals and chemical products	105,514
Phosphorus	Chemicals	90%	C20 - Manufacture of chemicals and chemical products	105,514

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Material	Application	Share	NACE sector	VA
Phosphorus	Metals	1%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Phosphorus	Electronics	5%	C26 - Manufacture of computer, electronic and optical products	65,703
Phosphorus	Agrochemicals	4%	C20 - Manufacture of chemicals and chemical products	105,514
Platinum	Autocatalyst	77%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Platinum	Jewellery	10%	C32 - Other manufacturing	39,160
Platinum	Chemical	6%	C20 - Manufacture of chemicals and chemical products	105,514
Platinum	Other	0%	0	0
Platinum	Medical and Biomedical	4%	C32 - Other manufacturing	39,160
Platinum	Investment	0%	0	0
Platinum	Petroleum	2%	C19 - Manufacture of coke and refined petroleum products	17,289
Platinum	Electronics	1%	C26 - Manufacture of computer, electronic and optical products	65,703
Platinum	Glass	1%	C23 - Manufacture of other non-metallic mineral products	57,255
Potash	Fertiliser	92%	C20 - Manufacture of chemicals and chemical products	105,514
Potash	Chemical manufacture	8%	C20 - Manufacture of chemicals and chemical products	105,514
Praseodymium	Magnets	27%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Praseodymium	Ceramics	17%	C23 - Manufacture of other non-metallic mineral products	57,255
Praseodymium	Batteries	13%	C27 - Manufacture of electrical equipment	80,745
Praseodymium	Metal (excl. Batteries)	12%	C24 - Manufacture of basic metals	55,426
Praseodymium	Catalysts	11%	C20 - Manufacture of chemicals and chemical products	105,514
Praseodymium	Polishing powders	11%	C26 - Manufacture of computer, electronic and optical products	65,703
Praseodymium	Glass	9%	C23 - Manufacture of other non-metallic mineral products	57,255
Praseodymium	Other	0%	0	0
Rhenium	Aerospace	83%	C30 - Manufacture of other transport equipment	44,304
Rhenium	Catalysts in petroleum industry	17%	C19 - Manufacture of coke and refined petroleum products	17,289

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Material	Application	Share	NACE sector	VA
Rhenium	Others	0%	0	0
Rhodium	Autocatalyst	84%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Rhodium	Glass	10%	C23 - Manufacture of other non-metallic mineral products	57,255
Rhodium	Chemical	6%	C20 - Manufacture of chemicals and chemical products	105,514
Rhodium	Other	0%	0	0
Rhodium	Electronics	0%	C26 - Manufacture of computer, electronic and optical products	65,703
Ruthenium	Chemical	30%	C20 - Manufacture of chemicals and chemical products	105,514
Ruthenium	Electronics	48%	C26 - Manufacture of computer, electronic and optical products	65,703
Ruthenium	Electrochemical	22%	C20 - Manufacture of chemicals and chemical products	105,514
Ruthenium	Other	0%	0	0
Samarium	Magnets	97%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Samarium	Medical and optical applications	3%	C26 - Manufacture of computer, electronic and optical products	65,703
Sapele wood	Construction material	80%	C16 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	27,967
Sapele wood	Furniture	10%	C31 - Manufacture of furniture	26,171
Sapele wood	Boats	10%	C30 - Manufacture of other transport equipment	44,304
Scandium	Solid Oxide Fuel Cells (SOFCs)	91%	C27 - Manufacture of electrical equipment	80,745
Scandium	Al-Sc alloys	9%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Scandium	Others	0%	0	0
Selenium	Metallurgy	40%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Selenium	Glass manufacturing	25%	C23 - Manufacture of other non-metallic mineral products	57,255
Selenium	Electronics	10%	C26 - Manufacture of computer, electronic and optical products	65,703
Selenium	Pigments	10%	C20 - Manufacture of chemicals and chemical products	105,514
Selenium	Agricultural/ biological products	10%	C20 - Manufacture of chemicals and chemical	105,514

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Material	Application	Share	NACE sector	VA
			products	
Selenium	Other Applications	5%	C20 - Manufacture of chemicals and chemical products	105,514
Silica sand	Construction and Soil	37%	C23 - Manufacture of other non-metallic mineral products	57,255
Silica sand	Glass	31%	C23 - Manufacture of other non-metallic mineral products	57,255
Silica sand	Others	16%	C23 - Manufacture of other non-metallic mineral products	57,255
Silica sand	Foundry	13%	C24 - Manufacture of basic metals	55,426
Silica sand	Filler, extender and sealant	3%	C22 - Manufacture of rubber and plastic products	75,980
Silica sand	Oil field	0%	B06 - Extraction of crude petroleum and natural gas	19,750
Silicon metal	Chemical applications	54%	C20 - Manufacture of chemicals and chemical products	105,514
Silicon metal	Aluminium alloys	38%	C24 - Manufacture of basic metals	55,426
Silicon metal	Solar applications	6%	C26 - Manufacture of computer, electronic and optical products	65,703
Silicon metal	Electronic applications	2%	C26 - Manufacture of computer, electronic and optical products	65,703
Silver	Jewelery, Silverware, recreative products	31%	C32 - Other manufacturing	39,160
Silver	Paints, oxides, photograph	18%	C20 - Manufacture of chemicals and chemical products	105,514
Silver	Automotive	8%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Silver	Batteries	7%	C27 - Manufacture of electrical equipment	80,745
Silver	Industrial machinery	7%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Silver	Other transport equipment	7%	C30 - Manufacture of other transport equipment	44,304
Silver	Electronic parts	6%	C26 - Manufacture of computer, electronic and optical products	65,703
Silver	Glass	6%	C23 - Manufacture of other non-metallic mineral products	57,255
Silver	Parts like bearings	6%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Silver	Medicine	4%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	80,180
Strontium	Drilling fluids	70%	C23 - Manufacture of other non-metallic mineral products	57,255

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Material	Application	Share	NACE sector	VA
Strontium	Pyrotechnics and signals	9%	C20 - Manufacture of chemicals and chemical products	105,514
Strontium	Magnets	9%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Strontium	Master alloys	3%	C24 - Manufacture of basic metals	55,426
Strontium	Pigments and fillers	3%	C20 - Manufacture of chemicals and chemical products	105,514
Strontium	Zinc production	3%	C24 - Manufacture of basic metals	55,426
Strontium	Glass	3%	C23 - Manufacture of other non-metallic mineral products	57,255
Sulphur	Chemical applications	71%	C20 - Manufacture of chemicals and chemical products	105,514
Sulphur	Petroleum refining	24%	C19 - Manufacture of coke and refined petroleum products	17,289
Sulphur	Metallurgy	4%	C24 - Manufacture of basic metals	55,426
Sulphur	Paper production	1%	C17 - Manufacture of paper and paper products	38,910
Talc	Polymer for car industry	34%	C22 - Manufacture of rubber and plastic products	75,980
Talc	Paper	21%	C17 - Manufacture of paper and paper products	38,910
Talc	Paint and Coatings	18%	C20 - Manufacture of chemicals and chemical products	105,514
Talc	Feed	8%	C10 - Manufacture of food products	155,880
Talc	Building material	7%	C23 - Manufacture of other non-metallic mineral products	57,255
Talc	Fertilizers	4%	C20 - Manufacture of chemicals and chemical products	105,514
Talc	Others	4%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	80,180
Talc	Rubber	2%	C22 - Manufacture of rubber and plastic products	75,980
Talc	Cosmetics	1%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	80,180
Talc	Pharmaceuticals	1%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	80,180
Tantalum	Capacitors	40%	C26 - Manufacture of computer, electronic and optical products	65,703
Tantalum	Sputtering targets	20%	C26 - Manufacture of computer, electronic and optical products	65,703
Tantalum	Superalloys	14%	C30 - Manufacture of other transport equipment	44,304

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Material	Application	Share	NACE sector	VA
Tantalum	Chemicals	12%	C20 - Manufacture of chemicals and chemical products	105,514
Tantalum	Carbides	10%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Tantalum	Mill products	4%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Tellurium	Solar power	40%	C26 - Manufacture of computer, electronic and optical products	65,703
Tellurium	Thermo-electric devices	30%	C26 - Manufacture of computer, electronic and optical products	65,703
Tellurium	Metallurgy	15%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Tellurium	Chemical manufacture	10%	C20 - Manufacture of chemicals and chemical products	105,514
Tellurium	Rubber vulcanising	5%	C22 - Manufacture of rubber and plastic products	75,980
Terbium	Lighting	68%	C27 - Manufacture of electrical equipment	80,745
Terbium	Magnets	32%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Tin	Solders	47%	C26 - Manufacture of computer, electronic and optical products	65,703
Tin	Chemicals	18%	C20 - Manufacture of chemicals and chemical products	105,514
Tin	Tinplate	13%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Tin	Others	10%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Tin	Lead acid batteries	6%	C27 - Manufacture of electrical equipment	80,745
Tin	Copper alloys	6%	C24 - Manufacture of basic metals	55,426
Titanium	Paints	54%	C20 - Manufacture of chemicals and chemical products	105,514
Titanium	Polymers	24%	C22 - Manufacture of rubber and plastic products	75,980
Titanium	Aerospace	8%	C30 - Manufacture of other transport equipment	44,304
Titanium	Medical equipment	6%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Titanium	Automotive	3%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603

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Material	Application	Share	NACE sector	VA
Titanium	Hand held objects	2%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Titanium	Alloys	2%	C24 - Manufacture of basic metals	55,426
Titanium	Various	1%	C21 - Manufacture of basic pharmaceutical products and pharmaceutical preparations	80,180
Tungsten	Mill and cutting tools	33%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Tungsten	Mining and construction tools	23%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Tungsten	Other wear tools	18%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Tungsten	Catalysts and pigments	8%	C20 - Manufacture of chemicals and chemical products	105,514
Tungsten	Lighting and electronic uses	6%	C26 - Manufacture of computer, electronic and optical products	65,703
Tungsten	High speed steels applications	6%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Tungsten	Aeronautics and energy uses	5%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Tungsten	others	0%	0	0
Vanadium	High-strength low-alloy steels (HSLA)	60%	C24 - Manufacture of basic metals	55,426
Vanadium	Special steel	30%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Vanadium	Super alloys for high-end uses	3%	C29 - Manufacture of motor vehicles, trailers and semi-trailers	160,603
Vanadium	Chemicals	3%	C20 - Manufacture of chemicals and chemical products	105,514
Vanadium	Cast Iron for rigid structures	2%	C30 - Manufacture of other transport equipment	44,304
Vanadium	Stainless steel	1%	C28 - Manufacture of machinery and equipment n.e.c.	182,589
Vanadium	Energy storage	1%	C27 - Manufacture of electrical equipment	80,745
Yttrium	Lighting	50%	C27 - Manufacture of electrical equipment	80,745
Yttrium	Ceramics	38%	C23 - Manufacture of other non-metallic mineral products	57,255
Yttrium	Alloys	8%	C24 - Manufacture of basic metals	55,426
Yttrium	Glass	4%	C23 - Manufacture of other non-metallic mineral products	57,255
Yttrium	Others	0%	0	0

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Material	Application	Share	NACE sector	VA
Zinc	Galvanising	52%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Zinc	Zinc alloys	17%	C24 - Manufacture of basic metals	55,426
Zinc	Brass and bronze	15%	C24 - Manufacture of basic metals	55,426
Zinc	Zinc compounds (incl. dust and powder)	10%	C20 - Manufacture of chemicals and chemical products	105,514
Zinc	Zinc semi-manufactures	6%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351
Zirconium	Ceramics	43%	C23 - Manufacture of other non-metallic mineral products	57,255
Zirconium	Refractories	15%	C23 - Manufacture of other non-metallic mineral products	57,255
Zirconium	Foundry	15%	C24 - Manufacture of basic metals	55,426
Zirconium	Chemicals	12%	C20 - Manufacture of chemicals and chemical products	105,514
Zirconium	Others	10%	C26 - Manufacture of computer, electronic and optical products	65,703
Zirconium	Pigments	3%	C20 - Manufacture of chemicals and chemical products	105,514
Zirconium	Superalloys, Nuclear	2%	C24 - Manufacture of basic metals	55,426

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Annex 6. Global supply, trade-related varialble and WGI (2 stages).

	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Aluminium					China	52%	5.83	1.10
Aluminium					Russian Federation	6%	6.20	1.10
Aluminium					Other Non Eu Countries	6%	0.00	1.00
Aluminium					Canada	5%	2.26	1.00
Aluminium					United Arab Emirates	4%	3.94	1.00
Aluminium					India	4%	5.45	1.00
Aluminium					Australia	3%	2.36	1.00
Aluminium					United States	3%	2.92	1.00
Aluminium					Norway	2%	2.03	1.00
Aluminium					Brazil	2%	5.08	1.00
Aluminium					Bahrain	2%	5.15	1.00
Aluminium					Iceland	1%	2.52	1.00
Aluminium					South Africa	1%	4.65	1.00
Aluminium					Saudi Arabia	1%	5.51	1.00
Aluminium					Qatar	1%	4.03	1.00
Aluminium					Mozambique	1%	5.93	1.00
Aluminium					Germany	1%	2.47	0.80
Aluminium					Argentina	1%	5.47	1.00
Aluminium					France	1%	3.11	0.80
Aluminium					Spain	1%	3.62	0.80
Aluminium					Romania	<1%	4.70	0.80
Aluminium					Greece	<1%	4.60	0.80
Aluminium					Slovakia	<1%	3.79	0.80
Aluminium					Sweden	<1%	2.05	0.80
Aluminium					Slovenia	<1%	3.50	0.80
Aluminium					Italy	<1%	4.17	0.80
Aluminium					Netherlands	<1%	2.19	0.80
Antimony	China	74%	5.83	1.10	China	59%	5.83	1.10
Antimony	Tajikistan	8%	6.88	1.00	Belgium	12%	2.81	0.80
Antimony	Russian Federation	4%	6.20	1.00	France	4%	3.11	0.80
Antimony	Myanmar	3%	6.95	1.00	Vietnam	3%	5.75	1.00
Antimony	Bolivia	3%	5.97	1.10	Bolivia	3%	5.97	1.10
Antimony	Australia	2%	2.36	1.00	Thailand	3%	5.50	1.00
Antimony	Turkey	2%	5.34	1.00	Japan	2%	2.77	1.00
Antimony	South Africa	1%	4.65	1.00	Other Non Eu Countries	2%	0.00	1.00
Antimony	Kyrgyz Republic	1%	6.30	1.00	India	2%	5.45	1.00
Antimony	Kazakhstan	1%	5.90	1.00	Myanmar	1%	6.95	1.00
Antimony	Iran, Islamic Rep.	<1%	6.65	1.00	Germany	1%	2.47	0.80
Antimony	Lao Pdr	<1%	6.25	1.00	United States	1%	2.92	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Antimony	Vietnam	<1%	5.75	1.00	Korea, Rep.	1%	3.74	1.00
Antimony	Morocco	<1%	5.48	1.00	Spain	1%	3.62	0.80
Antimony	Thailand	<1%	5.50	1.00	Netherlands	1%	2.19	0.80
Antimony	Pakistan	<1%	6.78	1.00	Other Eu Countries	1%	0.00	0.80
Antimony	Peru	<1%	5.30	1.00	Mexico	1%	5.33	1.00
Antimony	Mexico	<1%	5.33	1.00	United Kingdom	1%	2.60	0.80
Antimony	Guatemala	<1%	6.00	1.00	Tajikistan	1%	6.88	1.00
Antimony	Canada	<1%	2.26	1.00				
Antimony	Ecuador	<1%	5.99	1.00				
Antimony	Honduras	<1%	6.06	1.00				
Arsenic					China	57%	5.83	1.00
Arsenic					Peru	13%	5.30	1.00
Arsenic					Morocco	17%	5.48	1.10
Arsenic					Namibia	5%	4.44	1.00
Arsenic					Russian Federation	3%	6.20	1.00
Arsenic					Belgium	2%	2.81	0.80
Arsenic					Iran, Islamic Rep.	<1%	6.65	1.00
Arsenic					Philippines	<1%	5.49	1.00
Arsenic					Bolivia	<1%	5.97	1.00
Arsenic					Japan	<1%	2.77	1.00
Baryte	China	38%	5.83	1.10				
Baryte	India	12%	5.45	1.00				
Baryte	Morocco	10%	5.48	1.00				
Baryte	Iran, Islamic Rep.	8%	6.65	1.00				
Baryte	Kazakhstan	7%	5.90	1.00				
Baryte	Turkey	6%	5.34	1.00				
Baryte	United States	6%	2.92	1.00				
Baryte	Other Non Eu Countries	3%	0.00	1.00				
Baryte	Russian Federation	2%	6.20	1.00				
Baryte	Mexico	2%	5.33	1.00				
Baryte	Thailand	1%	5.50	1.00				
Baryte	Pakistan	1%	6.78	1.00				
Baryte	Vietnam	1%	5.75	1.00				
Baryte	Other Eu Countries	1%	0.00	0.80				
Baryte	Germany	1%	2.47	0.80				
Baryte	Peru	1%	5.30	1.00				
Bauxite	Australia	28%	2.36	1.00				
Bauxite	China	20%	5.83	1.20				
Bauxite	Brazil	13%	5.08	1.00				
Bauxite	India	8%	5.45	1.10				
Bauxite	Guinea	8%	6.72	1.10				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Bauxite	Indonesia	7%	5.47	1.10				
Bauxite	Jamaica	3%	4.85	1.00				
Bauxite	Malaysia	3%	4.39	1.00				
Bauxite	Other Non Eu countries	3%	0.00	1.00				
Bauxite	Russian Federation	2%	6.20	1.00				
Bauxite	Kazakhstan	2%	5.90	1.00				
Bauxite	Saudi Arabia	1%	5.51	1.00				
Bauxite	Suriname	1%	5.16	1.00				
Bauxite	Greece	1%	4.60	0.80				
Bauxite	Guyana	1%	5.56	1.00				
Bauxite	Venezuela, Rb	1%	7.30	1.00				
Bauxite	France	<1%	3.11	0.80				
Bauxite	Hungary	<1%	4.06	0.80				
Bauxite	Croatia	<1%	4.27	0.80				
Bentonite	United States	26%	2.92	1.00				
Bentonite	China	21%	5.83	1.00				
Bentonite	Turkey	9%	5.34	1.00				
Bentonite	India	8%	5.45	1.00				
Bentonite	Greece	6%	4.60	0.80				
Bentonite	Other non EU countries	6%	0.00	1.00				
Bentonite	Russian federation	4%	6.20	1.00				
Bentonite	Mexico	3%	5.33	1.00				
Bentonite	Japan	3%	2.77	1.00				
Bentonite	Iran, Islamic Rep.	2%	6.65	1.00				
Bentonite	Other EU countries	2%	0.00	0.80				
Bentonite	Germany	2%	2.47	0.80				
Bentonite	Brazil	2%	5.08	1.00				
Bentonite	Czech Republic	2%	3.47	0.80				
Bentonite	Ukraine	1%	6.23	1.00				
Bentonite	Argentina	1%	5.47	1.00				
Bentonite	Slovakia	1%	3.79	0.80				
Beryllium	United States	88%	2.92	1.00	United States	50%	2.92	1.00
Beryllium	China	8%	5.83	1.00	Kazakhstan	25%	5.90	1.00
Beryllium	Madagascar	2%	6.26	1.00	Japan	17%	2.77	1.00
Beryllium	Mozambique	1%	5.93	1.00	China	8%	5.83	1.00
Beryllium	Other Non Eu Countries	<1%	0.00	1.00				
Bismuth					China	80%	5.83	1.00
Bismuth					Belgium	5%	2.81	0.80
Bismuth					Lao Pdr	4%	6.25	1.00
Bismuth					Mexico	4%	5.33	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Bismuth					Japan	3%	2.77	1.00
Bismuth					Korea, Rep.	2%	3.74	1.00
Bismuth					Peru	1%	5.30	1.00
Bismuth					Kazakhstan	1%	5.90	1.00
Bismuth					Bolivia	<1%	5.97	1.00
Bismuth					Other non EU countries	<1%	0.00	1.00
Borate	Turkey	42%	5.34	1.00	United States	67%	2.92	1.00
Borate	United States	24%	2.92	1.00	Chile	10%	3.11	1.00
Borate	Chile	11%	3.11	1.00	Russian Federation	8%	6.20	1.00
Borate	Argentina	7%	5.47	1.10	Malaysia	4%	4.39	1.00
Borate	Peru	5%	5.30	1.00	Peru	4%	5.30	1.00
Borate	China	4%	5.83	1.00	Argentina	3%	5.47	1.10
Borate	Bolivia	3%	5.97	1.10	Bolivia	2%	5.97	1.10
Borate	Russian Federation	2%	6.20	1.00	Other Non EU countries	2%	0.00	1.00
Borate	Kazakhstan	1%	5.90	1.00	China	1%	5.83	1.00
Borate	Iran, Islamic Rep.	<1%	6.65	1.00	Turkey	1%	5.34	1.00
Cadmium					China	33%	5.83	1.00
Cadmium					Korea, Rep.	17%	3.74	1.00
Cadmium					Japan	8%	2.77	1.00
Cadmium					Kazakhstan	7%	5.90	1.00
Cadmium					Canada	6%	2.26	1.00
Cadmium					Mexico	6%	5.33	1.00
Cadmium					Russian Federation	4%	6.20	1.00
Cadmium					Peru	3%	5.30	1.00
Cadmium					Netherlands	2%	2.19	0.80
Cadmium					United States	2%	2.92	1.00
Cadmium					Germany	2%	2.47	0.80
Cadmium					Poland	2%	3.60	0.80
Cadmium					Bulgaria	2%	4.73	0.80
Cadmium					Uzbekistan	1%	6.98	1.00
Cadmium					Norway	1%	2.03	1.00
Cadmium					Brazil	1%	5.08	1.00
Cadmium					Korea, Dem. Rep.	1%	7.74	1.00
Cadmium					India	1%	5.45	1.00
Cadmium					Argentina	<1%	5.47	1.00
Cadmium					Armenia	<1%	5.41	1.00
Cerium	China	86%	5.83	1.59				
Cerium	Australia	6%	2.36	1.00				
Cerium	United States	2%	2.92	1.00				
Cerium	Russian Federation	2%	6.20	1.00				
Cerium	India	1%	5.45	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Cerium	Brazil	1%	5.08	1.00				
Cerium	Thailand	1%	5.50	1.00				
Cerium	Malaysia	1%	4.39	1.00				
Cerium	Vietnam	<1%	5.75	1.00				
Chromium	South Africa	46%	4.65	1.00	China	37%	5.83	1.10
Chromium	Kazakhstan	16%	5.90	1.00	South Africa	28%	4.65	1.00
Chromium	Turkey	13%	5.34	1.00	Kazakhstan	14%	5.90	1.00
Chromium	India	10%	5.45	1.20	India	9%	5.45	1.00
Chromium	Finland	4%	1.98	0.80	Other Non EU Countries	4%	0.00	1.00
Chromium	Albania	2%	5.16	1.00	Finland	4%	1.98	0.80
Chromium	Oman	2%	4.70	1.00	Russian Federation	4%	6.20	1.00
Chromium	Russian Federation	2%	6.20	1.00	Other EU countries	1%	0.00	0.80
Chromium	Brazil	2%	5.08	1.00				
Chromium	Iran, Islamic Rep.	1%	6.65	1.00				
Chromium	Zimbabwe	1%	7.17	1.01				
Chromium	Madagascar	<1%	6.26	1.00				
Chromium	Australia	<1%	2.36	1.00				
Chromium	Pakistan	<1%	6.78	1.00				
Chromium	Papua New Guinea	<1%	5.94	1.00				
Chromium	China	<1%	5.83	1.10				
Chromium	Philippines	<1%	5.49	1.00				
Chromium	Sudan	<1%	7.70	1.00				
Chromium	Cuba	<1%	5.87	1.00				
Chromium	Afghanistan	<1%	7.53	1.00				
Chromium	Vietnam	<1%	5.75	1.00				
Chromium	Kosovo	<1%	5.64	1.00				
Chromium	Greece	<1%	4.60	0.80				
Cobalt	Congo, Dem. Rep.	59%	7.60	1.10	China	49%	5.83	1.10
Cobalt	China	7%	5.83	1.10	Finland	12%	1.98	0.80
Cobalt	Canada	5%	2.26	1.00	Canada	6%	2.26	1.00
Cobalt	Australia	4%	2.36	1.00	Australia	5%	2.36	1.00
Cobalt	Zambia	4%	5.40	1.10	Zambia	5%	5.40	1.00
Cobalt	French Guiana	3%	3.23	1.00	Japan	4%	2.77	1.00
Cobalt	Cuba	3%	5.87	1.00	Norway	4%	2.03	1.00
Cobalt	Philippines	2%	5.49	1.00	Madagascar	3%	6.26	1.00
Cobalt	Madagascar	2%	6.26	1.00	Russian Federation	3%	6.20	1.00
Cobalt	Brazil	2%	5.08	1.00	Congo, Dem. Rep.	3%	7.60	1.10
Cobalt	Russian Federation	2%	6.20	1.00	Morocco	2%	5.48	1.00
Cobalt	Finland	1%	1.98	0.80	Belgium	2%	2.81	0.80
Cobalt	Indonesia	1%	5.47	1.10	Brazil	1%	5.08	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Cobalt	Papua New Guinea	1%	5.94	1.00	South Africa	1%	4.65	1.00
Cobalt	Morocco	1%	5.48	1.00	Uganda	1%	5.99	1.00
Cobalt	South Africa	1%	4.65	1.00	Mexico	<1%	5.33	1.00
Cobalt	United States	<1%	2.92	1.00	India	<1%	5.45	1.00
Cobalt	Zimbabwe	<1%	7.17	1.00	France	<1%	3.11	0.80
Cobalt	Botswana	<1%	3.89	1.00				
Cobalt	Vietnam	<1%	5.75	1.00				
Cobalt	Uganda	<1%	5.99	1.00				
Coking coal	China	55%	5.83	1.55	China	69%	5.83	1.20
Coking coal	Australia	16%	2.36	1.00	Russian Federation	7%	6.20	1.10
Coking coal	Russian Federation	7%	6.20	1.00	Japan	5%	2.77	1.00
Coking coal	United States	6%	2.92	1.00	India	3%	5.45	1.00
Coking coal	India	5%	5.45	1.00	Other Non Eu Countries	3%	0.00	1.00
Coking coal	Canada	3%	2.26	1.00	United States	3%	2.92	1.00
Coking coal	Other Non Eu Countries	2%	0.00	1.00	Korea, Rep.	2%	3.74	1.00
Coking coal	Kazakhstan	1%	5.90	1.00	Poland	1%	3.60	0.80
Coking coal	Ukraine	1%	6.23	1.00	Germany	1%	2.47	0.80
Coking coal	Poland	1%	3.60	0.80	Taiwan, China	1%	3.27	1.00
Coking coal	Mongolia	1%	5.18	1.10	France	<1%	3.11	0.80
Coking coal	Czech Republic	<1%	3.47	0.80	United Kingdom	<1%	2.60	1.00
Coking coal	Germany	<1%	2.47	0.80	Australia	<1%	2.36	1.00
Coking coal					Italy	<1%	4.17	0.80
Coking coal					Czech Republic	<1%	3.47	0.80
Coking coal					Netherlands	<1%	2.19	0.80
Coking coal					Spain	<1%	3.62	0.80
Coking coal					Slovakia	<1%	3.79	0.80
Coking coal					Belgium	<1%	2.81	0.80
Coking coal					Austria	<1%	2.50	0.80
Coking coal					Sweden	<1%	2.05	0.80
Coking coal					Hungary	<1%	4.06	0.80
Coking coal					Finland	<1%	1.98	0.80
Coking coal					Bosnia And Herzegovina	<1%	5.44	1.00
Coking coal					Vietnam	<1%	5.75	1.00
Coking coal					Indonesia	<1%	5.47	1.00
Coking coal					Pakistan	<1%	6.78	1.00
Copper	Chile	30%	3.11	1.00	China	33%	5.83	1.10
Copper	China	9%	5.83	1.10	Chile	12%	3.11	1.00
Copper	Peru	9%	5.30	1.00	Japan	7%	2.77	1.00
Copper	United States	7%	2.92	1.00	United States	5%	2.92	1.00
Copper	Australia	5%	2.36	1.00	Russian federation	4%	6.20	1.10
Copper	Congo, Dem.	5%	7.60	1.10	India	3%	5.45	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
	Rep.							
Copper	Other Non Eu Countries	4%	0.00	1.00	Congo, Dem. Rep.	3%	7.60	1.10
Copper	Zambia	4%	5.40	1.00	Germany	3%	2.47	0.80
Copper	Russian federation	4%	6.20	1.00	Korea, Rep.	3%	3.74	1.00
Copper	Canada	4%	2.26	1.00	Poland	3%	3.60	0.80
Copper	Mexico	3%	5.33	1.00	Other Non Eu Countries	2%	0.00	1.00
Copper	Indonesia	3%	5.47	1.20	Zambia	2%	5.40	1.00
Copper	Kazakhstan	2%	5.90	1.00	Australia	2%	2.36	1.00
Copper	Poland	2%	3.60	0.80	Mexico	2%	5.33	1.00
Copper	Brazil	2%	5.08	1.00	Spain	2%	3.62	0.80
Copper	Mongolia	1%	5.18	1.20	Belgium	2%	2.81	0.80
Copper	Iran, Islamic Rep.	1%	6.65	1.00	Kazakhstan	2%	5.90	1.00
Copper	Lao Pdr	1%	6.25	1.00	Peru	2%	5.30	1.00
Copper	Other Eu Countries	1%	0.00	0.80	Canada	1%	2.26	1.00
Copper	Spain	1%	3.62	0.80	Bulgaria	1%	4.73	0.80
Copper	Bulgaria	1%	4.73	0.80	Brazil	1%	5.08	1.00
Copper	Turkey	1%	5.34	1.00	Indonesia	1%	5.47	1.00
Copper	Uzbekistan	1%	6.98	1.00	Sweden	1%	2.05	0.80
Copper	Argentina	1%	5.47	1.10	Iran, Islamic Rep.	1%	6.65	1.00
Copper					Philippines	1%	5.49	1.00
Copper					Finland	1%	1.98	0.80
Copper					Other Eu Countries	<1%	0.00	0.80
Diatomite	United States	35%	2.92	1.00				
Diatomite	China	19%	5.83	1.00				
Diatomite	Argentina	10%	5.47	1.00				
Diatomite	Denmark	5%	2.11	0.80				
Diatomite	Peru	5%	5.30	1.00				
Diatomite	Japan	4%	2.77	1.00				
Diatomite	Mexico	4%	5.33	1.00				
Diatomite	France	4%	3.11	0.80				
Diatomite	Turkey	3%	5.34	1.00				
Diatomite	Other non EU countries	3%	0.00	1.00				
Diatomite	Spain	2%	3.62	0.80				
Diatomite	Czech Republic	1%	3.47	0.80				
Diatomite	Korea, Rep.	1%	3.74	1.00				
Diatomite	Chile	1%	3.11	1.00				
Diatomite	Armenia	1%	5.41	1.00				
Diatomite	Other EU countries	<1%	0.00	0.80				
Dysprosium	China	86%	5.83	1.59				
Dysprosium	Australia	6%	2.36	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Dysprosium	United States	2%	2.92	1.00				
Dysprosium	Russian Federation	2%	6.20	1.00				
Dysprosium	India	1%	5.45	1.00				
Dysprosium	Brazil	1%	5.08	1.00				
Dysprosium	Thailand	1%	5.50	1.00				
Dysprosium	Malaysia	1%	4.39	1.00				
Dysprosium	Vietnam	<1%	5.75	1.00				
Erbium	China	86%	5.83	1.59				
Erbium	Australia	6%	2.36	1.00				
Erbium	United States	2%	2.92	1.00				
Erbium	Russian Federation	2%	6.20	1.00				
Erbium	India	1%	5.45	1.00				
Erbium	Brazil	1%	5.08	1.00				
Erbium	Thailand	1%	5.50	1.00				
Erbium	Malaysia	1%	4.39	1.00				
Erbium	Vietnam	<1%	5.75	1.00				
Europium	China	86%	5.83	1.59				
Europium	Australia	6%	2.36	1.00				
Europium	United States	2%	2.92	1.00				
Europium	Russian Federation	2%	6.20	1.00				
Europium	India	1%	5.45	1.00				
Europium	Brazil	1%	5.08	1.00				
Europium	Thailand	1%	5.50	1.00				
Europium	Malaysia	1%	4.39	1.00				
Europium	Vietnam	<1%	5.75	1.00				
Feldspar	Turkey	31%	5.34	1.00				
Feldspar	China	10%	5.83	1.00				
Feldspar	Italy	8%	4.17	0.80				
Feldspar	India	5%	5.45	1.00				
Feldspar	Indonesia	5%	5.47	1.00				
Feldspar	Thailand	5%	5.50	1.00				
Feldspar	Iran, Islamic Rep.	4%	6.65	1.00				
Feldspar	Canada	2%	2.26	1.00				
Feldspar	Other Non Eu Countries	2%	0.00	1.00				
Feldspar	France	2%	3.11	0.80				
Feldspar	Spain	2%	3.62	0.80				
Feldspar	United States	2%	2.92	1.00				
Feldspar	Poland	2%	3.60	0.80				
Feldspar	Russian Federation	2%	6.20	1.00				
Feldspar	Korea, Rep.	2%	3.74	1.00				
Feldspar	Czech Republic	2%	3.47	0.80				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Feldspar	Brazil	1%	5.08	1.00				
Feldspar	Malaysia	1%	4.39	1.00				
Feldspar	Germany	1%	2.47	0.80				
Feldspar	Norway	1%	2.03	1.00				
Feldspar	Other Eu Countries	1%	0.00	0.80				
Feldspar	Argentina	1%	5.47	1.00				
Feldspar	Algeria	1%	6.43	1.00				
Feldspar	Ecuador	1%	5.99	1.00				
Feldspar	Egypt, Arab Rep.	1%	6.48	1.00				
Feldspar	Mexico	1%	5.33	1.00				
Feldspar	Japan	1%	2.77	1.00				
Feldspar	Vietnam	1%	5.75	1.00				
Feldspar	Saudi Arabia	1%	5.51	1.00				
Feldspar	South Africa	<1%	4.65	1.00				
Fluorspar	China	65%	5.83	1.10	China	34%	5.83	1.10
Fluorspar	Mexico	15%	5.33	1.00	Mexico	16%	5.33	1.00
Fluorspar	Mongolia	5%	5.18	1.10	Singapore	8%	2.37	1.00
Fluorspar	South Africa	3%	4.65	1.00	Italy	7%	4.17	0.80
Fluorspar	Spain	2%	3.62	0.80	Germany	6%	2.47	0.80
Fluorspar	Vietnam	2%	5.75	1.00	Other Non Eu Countries	5%	0.00	1.00
Fluorspar	Bulgaria	1%	4.73	0.80	Japan	3%	2.77	1.00
Fluorspar	Morocco	1%	5.48	1.00	Australia	3%	2.36	1.00
Fluorspar	Kenya	1%	6.03	1.10	Spain	2%	3.62	0.80
Fluorspar	Iran, Islamic Rep.	1%	6.65	1.00	India	2%	5.45	1.00
Fluorspar	Germany	1%	2.47	0.80	Canada	2%	2.26	1.00
Fluorspar	Namibia	1%	4.44	1.00	Tunisia	2%	5.40	1.00
Fluorspar	Russian Federation	1%	6.20	1.00	Other Eu Countries	2%	0.00	0.80
Fluorspar	Argentina	1%	5.47	1.00	United Arab Emirates	2%	3.94	1.00
Fluorspar	Brazil	<1%	5.08	1.00	Sweden	1%	2.05	0.80
Fluorspar	United Kingdom	<1%	2.60	1.00	Norway	1%	2.03	1.00
Fluorspar	Thailand	<1%	5.50	1.00	Lithuania	1%	3.50	0.80
Fluorspar	Pakistan	<1%	6.78	1.00	France	1%	3.11	0.80
Fluorspar	Turkey	<1%	5.34	1.00	United States	1%	2.92	1.00
Fluorspar	Korea, Dem. Rep.	<1%	7.74	1.00				
Fluorspar	Afghanistan	<1%	7.53	1.00				
Fluorspar	India	<1%	5.45	1.00				
Fluorspar	Egypt, Arab Rep.	<1%	6.48	1.00				
Fluorspar	Sudan	<1%	7.70	1.00				
Gadolinium	China	86%	5.83	1.59				
Gadolinium	Australia	6%	2.36	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Gadolinium	United States	2%	2.92	1.00				
Gadolinium	Russian Federation	2%	6.20	1.00				
Gadolinium	India	1%	5.45	1.00				
Gadolinium	Brazil	1%	5.08	1.00				
Gadolinium	Thailand	1%	5.50	1.00				
Gadolinium	Malaysia	1%	4.39	1.00				
Gadolinium	Vietnam	<1%	5.75	1.00				
Gallium					China	80%	5.83	1.00
Gallium					Germany	8%	2.47	0.80
Gallium					Ukraine	5%	6.23	1.00
Gallium					Japan	3%	2.77	1.00
Gallium					Russian Federation	2%	6.20	1.00
Gallium					Kazakhstan	1%	5.90	1.00
Gallium					Hungary	1%	4.06	0.80
Germanium					China	80%	5.83	1.10
Germanium					Finland	10%	1.98	0.80
Germanium					Russian Federation	5%	6.20	1.00
Germanium					United States	2%	2.92	1.00
Germanium					Japan	2%	2.77	1.00
Germanium					Ukraine	1%	6.23	1.00
Gold	China	14%	5.83	1.10				
Gold	Other Non Eu Countries	10%	0.00	1.00				
Gold	Australia	8%	2.36	1.00				
Gold	Russian Federation	8%	6.20	1.00				
Gold	United States	7%	2.92	1.00				
Gold	Peru	6%	5.30	1.00				
Gold	South Africa	5%	4.65	1.00				
Gold	Canada	4%	2.26	1.00				
Gold	Mexico	4%	5.33	1.00				
Gold	Ghana	3%	4.94	1.00				
Gold	Indonesia	3%	5.47	1.10				
Gold	Brazil	3%	5.08	1.00				
Gold	Uzbekistan	3%	6.98	1.00				
Gold	Papua New Guinea	2%	5.94	1.00				
Gold	Sudan	2%	7.70	1.00				
Gold	Argentina	2%	5.47	1.00				
Gold	Tanzania	2%	5.74	1.00				
Gold	Colombia	2%	5.39	1.00				
Gold	Mali	2%	6.39	1.00				
Gold	Kazakhstan	1%	5.90	1.00				
Gold	Chile	1%	3.11	1.00				
Gold	Burkina Faso	1%	5.74	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Gold	Philippines	1%	5.49	1.00				
Gold	Congo, Dem. Rep.	1%	7.60	1.00				
Gold	Turkey	1%	5.34	1.00				
Gold	Dominican Republic	1%	5.40	1.00				
Gold	Other Eu Countries	1%	0.00	0.80				
Gold	Zimbabwe	1%	7.17	1.10				
Gold	Guinea	1%	6.72	1.00				
Gold	Mongolia	1%	5.18	1.00				
Gypsum	China	49%	5.83	1.00				
Gypsum	United States	6%	2.92	1.00				
Gypsum	Iran, Islamic Rep.	6%	6.65	1.00				
Gypsum	Other non EU countries	5%	0.00	1.00				
Gypsum	Thailand	5%	5.50	1.00				
Gypsum	Iraq	4%	7.35	1.00				
Gypsum	Turkey	3%	5.34	1.00				
Gypsum	Mexico	3%	5.33	1.00				
Gypsum	Spain	3%	3.62	0.80				
Gypsum	Russian Federation	2%	6.20	1.00				
Gypsum	Oman	1%	4.70	1.00				
Gypsum	Australia	1%	2.36	1.00				
Gypsum	Brazil	1%	5.08	1.00				
Gypsum	Germany	1%	2.47	0.80				
Gypsum	India	1%	5.45	1.00				
Gypsum	Italy	1%	4.17	0.80				
Gypsum	France	1%	3.11	0.80				
Gypsum	Other EU countries	1%	0.00	0.80				
Gypsum	Saudi Arabia	1%	5.51	1.00				
Gypsum	Canada	1%	2.26	1.00				
Gypsum	Algeria	1%	6.43	1.00				
Gypsum	Ukraine	1%	6.23	1.00				
Gypsum	Argentina	1%	5.47	1.00				
Gypsum	Pakistan	1%	6.78	1.00				
Gypsum	Poland	<1%	3.60	0.80				
Gypsum	United Kingdom	<1%	2.60	1.00				
Gypsum	Chile	<1%	3.11	1.00				
Gypsum	Romania	<1%	4.70	0.80				
Gypsum	Egypt, Arab Rep.	<1%	6.48	1.00				
Gypsum	Austria	<1%	2.50	0.80				
Hafnium					France	49%	3.11	0.80
Hafnium					United States	44%	2.92	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Hafnium					Russian Federation	3%	6.20	1.10
Hafnium					China	3%	5.83	1.00
Hafnium					Ukraine	1%	6.23	1.00
Helium					United States	63%	2.92	1.00
Helium					Qatar	17%	4.03	1.00
Helium					Algeria	13%	6.43	1.00
Helium					Russian Federation	3%	6.20	1.00
Helium					Australia	2%	2.36	1.00
Helium					Poland	2%	3.60	0.80
Helium					Canada	<1%	2.26	1.00
Helium					China	<1%	5.83	1.00
Helium					India	<1%	5.45	1.00
Helium					Ukraine	<1%	6.23	1.00
Helium					Germany	<1%	2.47	0.80
Ho, Tm, Lu, Yb	China	86%	5.83	1.59	China	97%	5.83	1.67
Ho, Tm, Lu, Yb	Australia	6%	2.36	1.00	Japan	2%	2.77	1.00
Ho, Tm, Lu, Yb	United States	2%	2.92	1.00	Estonia	1%	3.07	0.80
Ho, Tm, Lu, Yb	Russian Federation	2%	6.20	1.00	United Kingdom	1%	2.60	1.00
Ho, Tm, Lu, Yb	India	1%	5.45	1.00				
Ho, Tm, Lu, Yb	Brazil	1%	5.08	1.00				
Ho, Tm, Lu, Yb	Thailand	1%	5.50	1.00				
Ho, Tm, Lu, Yb	Malaysia	1%	4.39	1.00				
Ho, Tm, Lu, Yb	Vietnam	<1%	5.75	1.00				
Indium					China	48%	5.83	1.19
Indium					Korea, Rep.	21%	3.74	1.00
Indium					Japan	8%	2.77	1.00
Indium					Canada	8%	2.26	1.00
Indium					Russian Federation	4%	6.20	1.00
Indium					France	4%	3.11	0.80
Indium					Belgium	3%	2.81	0.80
Indium					Germany	1%	2.47	0.80
Indium					Peru	1%	5.30	1.00
Indium					Brazil	1%	5.08	1.00
Indium					Italy	1%	4.17	0.80
Indium					Netherlands	<1%	2.19	0.80
Iridium					South Africa	92%	4.65	1.00
Iridium					Zimbabwe	5%	7.17	1.00
Iridium					Canada	2%	2.26	1.00
Iridium					Russian Federation	1%	6.20	1.10
Iron ore	Australia	35%	2.36	1.00	China	49%	5.83	1.10
Iron ore	Brazil	18%	5.08	1.00	Japan	7%	2.77	1.00
Iron ore	China	10%	5.83	1.10	India	5%	5.45	1.10

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Iron ore	India	8%	5.45	1.20	United States	5%	2.92	1.00
Iron ore	Russian Federation	5%	6.20	1.00	Other Non Eu Countries	5%	0.00	1.00
Iron ore	Other non EU Countries	5%	0.00	1.00	Russian Federation	4%	6.20	1.00
Iron ore	South Africa	4%	4.65	1.00	Korea, Rep.	4%	3.74	1.00
Iron ore	Ukraine	3%	6.23	1.00	Other Eu Countries	3%	0.00	0.80
Iron ore	United States	2%	2.92	1.00	Germany	3%	2.47	0.80
Iron ore	Iran, Islamic Rep.	2%	6.65	1.00	Turkey	2%	5.34	1.00
Iron ore	Kazakhstan	2%	5.90	1.00	Brazil	2%	5.08	1.00
Iron ore	Canada	2%	2.26	1.00	Ukraine	2%	6.23	1.00
Iron ore	Sweden	2%	2.05	0.80	Italy	1%	4.17	0.80
Iron ore	Mexico	1%	5.33	1.00	Taiwan, China	1%	3.27	1.00
Iron ore	Chile	1%	3.11	1.00	Mexico	1%	5.33	1.00
Iron ore	Other EU Countries	<1%	0.00	0.80	Iran, Islamic Rep.	1%	6.65	1.00
Iron ore					France	1%	3.11	0.80
Iron ore					Spain	1%	3.62	0.80
Iron ore					Canada	1%	2.26	1.00
Iron ore					United Kingdom	1%	2.60	1.00
Iron ore					Poland	1%	3.60	0.80
Kaolin clay	China	15%	5.83	1.00				
Kaolin clay	Ukraine	12%	6.23	1.00				
Kaolin clay	United States	12%	2.92	1.00				
Kaolin clay	Germany	10%	2.47	0.80				
Kaolin clay	India	9%	5.45	1.00				
Kaolin clay	Czech Republic	7%	3.47	0.80				
Kaolin clay	Turkey	5%	5.34	1.00				
Kaolin clay	Brazil	4%	5.08	1.00				
Kaolin clay	United Kingdom	3%	2.60	1.00				
Kaolin clay	Other Non Eu Countries	2%	0.00	1.00				
Kaolin clay	Iran, Islamic Rep.	2%	6.65	1.00				
Kaolin clay	Indonesia	2%	5.47	1.00				
Kaolin clay	Malaysia	2%	4.39	1.00				
Kaolin clay	Italy	2%	4.17	0.80				
Kaolin clay	Vietnam	1%	5.75	1.00				
Kaolin clay	Spain	1%	3.62	0.80				
Kaolin clay	France	1%	3.11	0.80				
Kaolin clay	Portugal	1%	3.34	0.80				
Kaolin clay	Mexico	1%	5.33	1.00				
Kaolin clay	Poland	1%	3.60	0.80				
Kaolin clay	Korea, Rep.	1%	3.74	1.00				
Kaolin clay	Thailand	1%	5.50	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Kaolin clay	Bulgaria	1%	4.73	0.80				
Kaolin clay	Belgium	1%	2.81	0.80				
Kaolin clay	Egypt, Arab Rep.	1%	6.48	1.00				
Kaolin clay	Russian Federation	<1%	6.20	1.00				
Kaolin clay	Australia	<1%	2.36	1.00				
Kaolin clay	Other Eu Countries	<1%	0.00	0.80				
Kaolin clay	Serbia	<1%	5.05	1.00				
Kaolin clay	Uzbekistan	<1%	6.98	1.00				
Lanthanum	China	86%	5.83	1.59				
Lanthanum	Australia	6%	2.36	1.00				
Lanthanum	United States	2%	2.92	1.00				
Lanthanum	Russian Federation	2%	6.20	1.00				
Lanthanum	India	1%	5.45	1.00				
Lanthanum	Brazil	1%	5.08	1.00				
Lanthanum	Thailand	1%	5.50	1.00				
Lanthanum	Malaysia	1%	4.39	1.00				
Lanthanum	Vietnam	<1%	5.75	1.00				
Lead	China	49%	5.83	1.20	China	43%	5.83	1.10
Lead	Australia	12%	2.36	1.00	United States	10%	2.92	1.00
Lead	Other Non Eu Countries	8%	0.00	1.00	Other Non Eu Countries	8%	0.00	1.00
Lead	United States	7%	2.92	1.00	Korea, Rep.	6%	3.74	1.00
Lead	Peru	6%	5.30	1.00	India	4%	5.45	1.00
Lead	Mexico	5%	5.33	1.00	Other Eu Countries	4%	0.00	0.80
Lead	Russian Federation	3%	6.20	1.00	Germany	4%	2.47	0.80
Lead	India	2%	5.45	1.00	Mexico	3%	5.33	1.00
Lead	Bolivia	2%	5.97	1.00	United Kingdom	3%	2.60	1.00
Lead	Poland	2%	3.60	0.80	Canada	3%	2.26	1.00
Lead	Other Eu Countries	2%	0.00	0.80	Japan	2%	2.77	1.00
Lead	Sweden	1%	2.05	0.80	Australia	2%	2.36	1.00
Lead	Turkey	1%	5.34	1.00	Italy	2%	4.17	0.80
Lead					Brazil	2%	5.08	1.00
Lead					Spain	2%	3.62	0.80
Lead					Poland	1%	3.60	0.80
Lead					Belgium	1%	2.81	0.80
Lead					Kazakhstan	1%	5.90	1.00
Lead					Russian Federation	1%	6.20	1.00
Limestone	Other Non Eu Countries	72%	0.00	1.00				
Limestone	Other EU countries	5%	0.00	0.80				
Limestone	France	5%	3.11	0.80				

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Limestone	Italy	5%	4.17	0.80				
Limestone	Germany	5%	2.47	0.80				
Limestone	Austria	4%	2.50	0.80				
Limestone	Poland	1%	3.60	0.80				
Limestone	Spain	1%	3.62	0.80				
Limestone	Denmark	1%	2.11	0.80				
Limestone	Greece	1%	4.60	0.80				
Lithium	Chile	38%	3.11	1.00	Chile	44%	3.11	1.00
Lithium	Australia	36%	2.36	1.00	China	39%	5.83	1.00
Lithium	Argentina	12%	5.47	1.10	Argentina	13%	5.47	1.00
Lithium	China	7%	5.83	1.00	United States	3%	2.92	1.00
Lithium	United States	3%	2.92	1.00	Brazil	<1%	5.08	1.00
Lithium	Zimbabwe	2%	7.17	1.00	Others	<1%	0.00	1.00
Lithium	Brazil	1%	5.08	1.00				
Lithium	Portugal	<1%	3.34	0.80				
Lithium	Bolivia	<1%	5.97	1.00				
Magnesite	China	66%	5.83	1.61				
Magnesite	Turkey	11%	5.34	1.00				
Magnesite	Russian Federation	5%	6.20	1.00				
Magnesite	Slovakia	3%	3.79	0.80				
Magnesite	Austria	3%	2.50	0.80				
Magnesite	Brazil	2%	5.08	1.00				
Magnesite	Spain	2%	3.62	0.80				
Magnesite	Australia	2%	2.36	1.00				
Magnesite	Greece	1%	4.60	0.80				
Magnesite	India	1%	5.45	1.00				
Magnesite	Korea, Dem. Rep.	1%	7.74	1.00				
Magnesite	Iran, Islamic Rep.	1%	6.65	1.00				
Magnesite	Other non EU countries	1%	0.00	1.00				
Magnesite	Canada	1%	2.26	1.00				
Magnesite	Mexico	<1%	5.33	1.00				
Magnesite	Poland	<1%	3.60	0.80				
Magnesite	Other EU countries	<1%	0.00	0.80				
Magnesium					China	89%	5.83	1.00
Magnesium					United States	4%	2.92	1.00
Magnesium					Israel	3%	3.83	1.00
Magnesium					Brazil	2%	5.08	1.00
Magnesium					Russian Federation	1%	6.20	1.00
Magnesium					Turkey	1%	5.34	0.00
Magnesium					Malaysia	<1%	4.39	1.00
Magnesium					Korea, Rep.	<1%	3.74	1.00
Magnesium					Kazakhstan	<1%	5.90	1.00

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Magnesium					Ukraine	<1%	6.23	1.00
Magnesium					India	<1%	5.45	1.00
Magnesium					Iran, Islamic Rep.	<1%	6.65	1.00
Manganese	South Africa	28%	4.65	1.00	China	57%	5.83	1.10
Manganese	China	17%	5.83	1.10	India	12%	5.45	1.00
Manganese	Australia	17%	2.36	1.00	South Africa	5%	4.65	1.00
Manganese	Gabon	10%	5.97	1.10	Ukraine	5%	6.23	1.00
Manganese	Brazil	7%	5.08	1.00	Norway	3%	2.03	1.00
Manganese	India	5%	5.45	1.00	Korea, Rep.	3%	3.74	1.00
Manganese	Ghana	3%	4.94	1.00	Japan	3%	2.77	1.00
Manganese	Ukraine	3%	6.23	1.00	Russian Federation	2%	6.20	1.10
Manganese	Kazakhstan	3%	5.90	1.00	Brazil	2%	5.08	1.00
Manganese	Malaysia	2%	4.39	1.00	Australia	1%	2.36	1.00
Manganese	Other Non Eu Countries	2%	0.00	1.00	Spain	1%	3.62	0.80
Manganese	Mexico	1%	5.33	1.00	Georgia	1%	4.47	1.00
Manganese	Côte D'Ivoire	1%	6.21	1.00	Mexico	1%	5.33	1.00
Manganese	Myanmar	1%	6.95	1.00	France	1%	3.11	0.80
Manganese	Other Eu Countries	<1%	0.00	0.80	Other Non Eu Countries	1%	0.00	1.00
Manganese					Kazakhstan	1%	5.90	1.00
Manganese					United States	1%	2.92	1.00
Manganese					Other Eu Countries	<1%	0.00	0.80
Molybdenum	China	47%	5.83	1.36				
Molybdenum	Chile	17%	3.11	1.00				
Molybdenum	United States	16%	2.92	1.00				
Molybdenum	Peru	7%	5.30	1.00				
Molybdenum	Mexico	4%	5.33	1.00				
Molybdenum	Canada	2%	2.26	1.00				
Molybdenum	Armenia	2%	5.41	1.00				
Molybdenum	Other Non Eu Countries	2%	0.00	1.00				
Molybdenum	Russian Federation	1%	6.20	1.10				
Molybdenum	Iran, Islamic Rep.	1%	6.65	1.00				
Natural cork	Portugal	50%	3.34	0.80				
Natural cork	Spain	31%	3.62	0.80				
Natural cork	Morocco	6%	5.48	1.00				
Natural cork	Algeria	5%	6.43	1.00				
Natural cork	Tunisia	3%	5.40	1.00				
Natural cork	Italy	3%	4.17	0.80				
Natural cork	France	3%	3.11	0.80				
Natural graphite	China	69%	5.83	1.10				
Natural graphite	India	12%	5.45	1.00				
Natural graphite	Brazil	8%	5.08	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Natural graphite	Korea, Dem. Rep.	3%	7.74	1.00				
Natural graphite	Canada	2%	2.26	1.00				
Natural graphite	Russian Federation	1%	6.20	1.00				
Natural graphite	Turkey	1%	5.34	1.00				
Natural graphite	Mexico	1%	5.33	1.00				
Natural graphite	Ukraine	1%	6.23	1.00				
Natural graphite	Norway	1%	2.03	1.00				
Natural graphite	Zimbabwe	1%	7.17	1.00				
Natural graphite	Madagascar	1%	6.26	1.00				
Natural graphite	Sri Lanka	<1%	5.36	1.00				
Natural graphite	Romania	<1%	4.70	0.80				
Natural graphite	Argentina	<1%	5.47	1.00				
Natural graphite	Germany	<1%	2.47	0.80				
Natural graphite	Austria	<1%	2.50	0.80				
Natural graphite	Sweden	<1%	2.05	0.80				
Natural graphite	Korea, Rep.	<1%	3.74	1.00				
Natural Rubber	Thailand	33%	5.50	1.00				
Natural Rubber	Indonesia	24%	5.47	1.00				
Natural Rubber	Vietnam	7%	5.75	1.00				
Natural Rubber	India	7%	5.45	1.00				
Natural Rubber	China	6%	5.83	1.00				
Natural Rubber	Malaysia	6%	4.39	1.00				
Natural Rubber	Philippines	3%	5.49	1.00				
Natural Rubber	Guatemala	3%	6.00	1.00				
Natural Rubber	Côte D'Ivoire	3%	6.21	1.00				
Natural Rubber	Other non EU countries	2%	0.00	1.00				
Natural Rubber	Myanmar	1%	6.95	1.00				
Natural Rubber	Brazil	1%	5.08	1.00				
Natural Rubber	Nigeria	1%	6.83	1.00				
Natural Rubber	Sri Lanka	1%	5.36	1.00				
Natural Rubber	Liberia	1%	6.29	1.00				
Natural Teak wood	India	40%	5.45	1.00				
Natural Teak wood	Indonesia	30%	5.47	1.00				
Natural Teak wood	Myanmar	9%	6.95	1.00				
Natural Teak wood	Ghana	5%	4.94	1.00				
Natural Teak wood	Nigeria	4%	6.83	1.00				
Natural Teak wood	Other Non Eu Countries	3%	0.00	1.00				
Natural Teak wood	Thailand	3%	5.50	1.00				
Natural Teak wood	Bangladesh	2%	6.41	1.00				
Natural Teak	Brazil	2%	5.08	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
wood								
Natural Teak wood	Panama	1%	4.79	1.00				
Natural Teak wood	Côte D'Ivoire	1%	6.21	1.00				
Neodymium	China	86%	5.83	1.59				
Neodymium	Australia	6%	2.36	1.00				
Neodymium	United States	2%	2.92	1.00				
Neodymium	Russian Federation	2%	6.20	1.00				
Neodymium	India	1%	5.45	1.00				
Neodymium	Brazil	1%	5.08	1.00				
Neodymium	Thailand	1%	5.50	1.00				
Neodymium	Malaysia	1%	4.39	1.00				
Neodymium	Vietnam	<1%	5.75	1.00				
Nickel	Indonesia	18%	5.47	1.18	China	29%	5.83	1.29
Nickel	Philippines	17%	5.49	1.00	Russian Federation	12%	6.20	1.00
Nickel	Australia	11%	2.36	1.00	Japan	10%	2.77	1.00
Nickel	Russian Federation	11%	6.20	1.00	Canada	8%	2.26	1.00
Nickel	Canada	10%	2.26	1.00	Australia	7%	2.36	1.00
Nickel	Other non EU	9%	0.00	1.00	Other non EU	6%	0.00	1.00
Nickel	French Guiana	8%	3.23	1.00	Norway	5%	2.03	1.10
Nickel	China	4%	5.83	1.10	Brazil	4%	5.08	1.00
Nickel	Brazil	4%	5.08	1.00	French Guiana	3%	3.23	1.00
Nickel	Cuba	2%	5.87	1.00	Finland	3%	1.98	0.80
Nickel	South Africa	2%	4.65	1.00	Colombia	2%	5.39	1.00
Nickel	Colombia	2%	5.39	1.00	Indonesia	2%	5.47	1.00
Nickel	Greece	1%	4.60	0.80	United Kingdom	2%	2.60	0.80
Nickel	Finland	1%	1.98	0.80	South Africa	2%	4.65	1.00
Nickel	Spain	<1%	3.62	0.80	Korea, Rep.	2%	3.74	1.00
Nickel	Poland	<1%	3.60	0.80	Madagascar	2%	6.26	1.00
Nickel					Greece	1%	4.60	0.80
Nickel					France	1%	3.11	0.80
Nickel					Poland	<1%	3.60	0.80
Nickel					Austria	<1%	2.50	0.80
Niobium					Brazil	92%	5.08	1.00
Niobium					Canada	8%	2.26	1.00
Niobium					Russian Federation	<1%	6.20	1.00
Palladium					Russian Federation	40%	6.20	1.10
Palladium					South Africa	37%	4.65	1.00
Palladium					Canada	10%	2.26	1.00
Palladium					United States	6%	2.92	1.00
Palladium					Zimbabwe	5%	7.17	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Palladium					Botswana	<1%	3.89	1.00
Palladium					Finland	<1%	1.98	0.80
Palladium					China	<1%	5.83	1.00
Palladium					Australia	<1%	2.36	1.00
Palladium					Poland	<1%	3.60	0.80
Palladium					Serbia	<1%	5.05	1.00
Perlite	Greece	22%	4.60	0.80				
Perlite	Turkey	22%	5.34	1.00				
Perlite	China	17%	5.83	1.00				
Perlite	Iran, Islamic Rep.	14%	6.65	1.00				
Perlite	United States	11%	2.92	1.00				
Perlite	Japan	5%	2.77	1.00				
Perlite	Hungary	2%	4.06	0.80				
Perlite	Italy	1%	4.17	0.80				
Perlite	Russian Federation	1%	6.20	1.00				
Perlite	Thailand	1%	5.50	1.00				
Perlite	Argentina	1%	5.47	1.00				
Perlite	Mexico	1%	5.33	1.00				
Perlite	Slovakia	<1%	3.79	0.80				
Perlite	Ukraine	<1%	6.23	1.00				
Perlite	Philippines	<1%	5.49	1.00				
Perlite	Armenia	<1%	5.41	1.00				
Perlite	Bulgaria	<1%	4.73	0.80				
Perlite	New Zealand	<1%	1.93	1.00				
Perlite	Chile	<1%	3.11	1.00				
Perlite	Australia	<1%	2.36	1.00				
Perlite	South Africa	<1%	4.65	1.00				
Phosphate rock	China	48%	5.83	1.47				
Phosphate rock	Morocco	11%	5.48	1.10				
Phosphate rock	United States	10%	2.92	1.00				
Phosphate rock	Russian Federation	6%	6.20	1.00				
Phosphate rock	Peru	6%	5.30	1.00				
Phosphate rock	Brazil	3%	5.08	1.00				
Phosphate rock	Jordan	3%	5.16	1.00				
Phosphate rock	Egypt, Arab Rep.	2%	6.48	1.02				
Phosphate rock	Other non-EU countries	2%	0.00	1.00				
Phosphate rock	Israel	1%	3.83	1.00				
Phosphate rock	Tunisia	1%	5.40	1.00				
Phosphate rock	Vietnam	1%	5.75	1.10				
Phosphate rock	South Africa	1%	4.65	1.00				
Phosphate rock	Mexico	1%	5.33	1.00				
Phosphate rock	Saudi Arabia	1%	5.51	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Phosphate rock	Senegal	1%	5.21	1.00				
Phosphate rock	Algeria	1%	6.43	1.00				
Phosphate rock	Togo	1%	6.34	1.00				
Phosphate rock	Australia	1%	2.36	1.00				
Phosphate rock	Kazakhstan	1%	5.90	1.00				
Phosphate rock	India	<1%	5.45	1.00				
Phosphate rock	Finland	<1%	1.98	0.80				
Phosphorus					China	74%	5.83	1.00
Phosphorus					Kazakhstan	9%	5.90	1.00
Phosphorus					Vietnam	9%	5.75	1.00
Phosphorus					United States	8%	2.92	1.00
Platinum					South Africa	71%	4.65	1.00
Platinum					Russian Federation	13%	6.20	1.10
Platinum					Zimbabwe	7%	7.17	1.10
Platinum					Canada	5%	2.26	1.00
Platinum					United States	2%	2.92	1.00
Platinum					China	1%	5.83	1.00
Platinum					Colombia	1%	5.39	1.00
Platinum					Finland	1%	1.98	0.80
Platinum					Botswana	<1%	3.89	1.00
Platinum					Australia	<1%	2.36	1.00
Platinum					Poland	<1%	3.60	0.80
Platinum					Serbia	<1%	5.05	1.00
Potash	Canada	28%	2.26	1.00				
Potash	Russian Federation	17%	6.20	1.00				
Potash	Belarus	15%	6.18	1.10				
Potash	China	13%	5.83	1.10				
Potash	Germany	8%	2.47	0.80				
Potash	Israel	5%	3.83	1.00				
Potash	Other Non Eu Countries	4%	0.00	1.00				
Potash	Jordan	3%	5.16	1.00				
Potash	Chile	3%	3.11	1.00				
Potash	United States	2%	2.92	1.00				
Potash	Spain	2%	3.62	0.80				
Praseodymium	China	86%	5.83	1.59				
Praseodymium	Australia	6%	2.36	1.00				
Praseodymium	United States	2%	2.92	1.00				
Praseodymium	Russian Federation	2%	6.20	1.00				
Praseodymium	India	1%	5.45	1.00				
Praseodymium	Brazil	1%	5.08	1.00				
Praseodymium	Thailand	1%	5.50	1.00				
Praseodymium	Malaysia	1%	4.39	1.00				
Praseodymium	Vietnam	<1%	5.75	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Rhenium					Chile	48%	3.11	1.00
Rhenium					United States	18%	2.92	1.00
Rhenium					Poland	12%	3.60	0.80
Rhenium					Korea, Rep.	7%	3.74	1.00
Rhenium					China	5%	5.83	1.00
Rhenium					Japan	5%	2.77	1.00
Rhenium					Other non Eu countries	5%	0.00	1.00
Rhodium					South Africa	80%	4.65	1.00
Rhodium					Russia	12%	0.00	1.10
Rhodium					Zimbabwe	5%	7.17	1.10
Rhodium					Canada	2%	2.26	1.00
Rhodium					United States	1%	2.92	1.00
Ruthenium					South Africa	93%	4.65	1.10
Ruthenium					Zimbabwe	4%	7.17	1.00
Ruthenium					Canada	2%	2.26	1.00
Ruthenium					Russia	1%	0.00	1.00
Ruthenium					Other Non Eu Countries	<1%	0.00	1.00
Ruthenium					United States	<1%	2.92	1.00
Samarium	China	86%	5.83	1.59				
Samarium	Australia	6%	2.36	1.00				
Samarium	United States	2%	2.92	1.00				
Samarium	Russian Federation	2%	6.20	1.00				
Samarium	India	1%	5.45	1.00				
Samarium	Brazil	1%	5.08	1.00				
Samarium	Thailand	1%	5.50	1.00				
Samarium	Malaysia	1%	4.39	1.00				
Samarium	Vietnam	<1%	5.75	1.00				
Sapele wood	Other Non Eu Countries	100%	0.00	1.00				
Scandium					China	66%	5.83	1.10
Scandium					Russian Federation	26%	6.20	1.00
Scandium					Ukraine	7%	6.23	1.00
Scandium					Kazakhstan	1%	5.90	1.00
Selenium					China	23%	5.83	1.00
Selenium					Japan	23%	2.77	1.00
Selenium					Germany	20%	2.47	0.80
Selenium					Belgium	6%	2.81	0.80
Selenium					Russian Federation	5%	6.20	1.00
Selenium					Canada	5%	2.26	1.00
Selenium					Mexico	3%	5.33	1.00
Selenium					Finland	3%	1.98	0.80
Selenium					Poland	3%	3.60	0.80
Selenium					Other non EU	2%	0.00	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
					countries			
Selenium					Philippines	2%	5.49	1.00
Selenium					Kazakhstan	2%	5.90	1.00
Selenium					Peru	1%	5.30	1.00
Selenium					Sweden	1%	2.05	0.80
Silica sand	United States	38%	2.92	1.00				
Silica sand	Netherlands	17%	2.19	0.80				
Silica sand	Turkey	5%	5.34	1.00				
Silica sand	Italy	4%	4.17	0.80				
Silica sand	Other Non Eu Countries	4%	0.00	1.00				
Silica sand	Malaysia	3%	4.39	1.00				
Silica sand	France	3%	3.11	0.80				
Silica sand	India	3%	5.45	1.00				
Silica sand	Germany	2%	2.47	0.80				
Silica sand	Bulgaria	2%	4.73	0.80				
Silica sand	Brazil	2%	5.08	1.00				
Silica sand	Spain	2%	3.62	0.80				
Silica sand	Poland	2%	3.60	0.80				
Silica sand	Korea, Rep.	1%	3.74	1.00				
Silica sand	Belgium	1%	2.81	0.80				
Silica sand	United Kingdom	1%	2.60	1.00				
Silica sand	Other Eu Countries	1%	0.00	0.80				
Silica sand	Australia	1%	2.36	1.00				
Silica sand	Japan	1%	2.77	1.00				
Silica sand	Mexico	1%	5.33	1.00				
Silica sand	Canada	1%	2.26	1.00				
Silica sand	New Zealand	1%	1.93	1.00				
Silica sand	South Africa	1%	4.65	1.00				
Silica sand	Iran, Islamic Rep.	1%	6.65	1.00				
Silica sand	Moldova	1%	5.54	1.00				
Silica sand	Latvia	<1%	3.73	0.80				
Silica sand	Argentina	<1%	5.47	1.00				
Silica sand	Austria	<1%	2.50	0.80				
Silica sand	Czech Republic	<1%	3.47	0.80				
Silicon metal					China	66%	5.83	1.10
Silicon metal					United States	8%	2.92	1.00
Silicon metal					Brazil	7%	5.08	1.00
Silicon metal					Norway	6%	2.03	1.00
Silicon metal					France	4%	3.11	0.80
Silicon metal					South Africa	2%	4.65	1.00
Silicon metal					Australia	2%	2.36	1.00
Silicon metal					Russian Federation	2%	6.20	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Silicon metal					Germany	1%	2.47	0.80
Silicon metal					Spain	1%	3.62	0.80
Silicon metal					Canada	1%	2.26	1.00
Silver	Mexico	21%	5.33	1.00	China	22%	5.83	1.08
Silver	Peru	14%	5.30	1.00	United States	20%	2.92	1.00
Silver	China	13%	5.83	1.10	India	16%	5.45	1.10
Silver	Australia	6%	2.36	1.00	Japan	9%	2.77	1.00
Silver	Russian Federation	5%	6.20	1.00	Germany	3%	2.47	0.80
Silver	Chile	5%	3.11	1.00	Other Non Eu Countries	3%	0.00	1.00
Silver	Poland	5%	3.60	0.80	Canada	3%	2.26	1.00
Silver	Bolivia	5%	5.97	1.10	Thailand	3%	5.50	1.00
Silver	United States	4%	2.92	1.00	Italy	3%	4.17	0.80
Silver	Kazakhstan	4%	5.90	1.00	Russian Federation	2%	6.20	1.00
Silver	Argentina	3%	5.47	1.00	Korea, Rep.	2%	3.74	1.00
Silver	Guatemala	2%	6.00	1.00	United Kingdom	2%	2.60	1.00
Silver	Canada	2%	2.26	1.00	Mexico	2%	5.33	1.00
Silver	Sweden	2%	2.05	0.80	Australia	1%	2.36	1.00
Silver	India	1%	5.45	1.00	France	1%	3.11	0.80
Silver	Other Non Eu Countries	1%	0.00	1.00	Taiwan, China	1%	3.27	1.00
Silver	Turkey	1%	5.34	1.00	Belgium	1%	2.81	0.80
Silver	Morocco	1%	5.48	1.00	Brazil	1%	5.08	1.00
Silver	Indonesia	1%	5.47	1.01	Austria	1%	2.50	0.80
Silver	Other Eu Countries	<1%	0.00	0.80	Indonesia	1%	5.47	1.01
Silver	Dominican Republic	<1%	5.40	1.00	Turkey	1%	5.34	1.00
Silver	Papua New Guinea	<1%	5.94	1.00	Hong Kong Sar, China	1%	2.56	1.00
Silver	South Africa	<1%	4.65	1.00	Spain	<1%	3.62	0.80
Silver	Bulgaria	<1%	4.73	0.80	Bulgaria	<1%	4.73	0.80
Silver	Korea, Dem. Rep.	<1%	7.74	1.00	Czech Republic	<1%	3.47	0.80
Silver	Mongolia	<1%	5.18	1.00	Netherlands	<1%	2.19	0.80
Silver	Honduras	<1%	6.06	1.00	Poland	<1%	3.60	0.80
Silver	Iran, Islamic Rep.	<1%	6.65	1.00	Other Eu Countries	<1%	0.00	0.80
Silver	Lao Pdr	<1%	6.25	1.00	Greece	<1%	4.60	0.80
Silver	Portugal	<1%	3.34	0.80	Sweden	<1%	2.05	0.80
Strontium	Spain	31%	3.62	0.80				
Strontium	Iran, Islamic Rep.	30%	6.65	1.00				
Strontium	China	19%	5.83	1.00				
Strontium	Mexico	17%	5.33	1.00				
Strontium	Argentina	2%	5.47	1.00				
Sulphur					China	15%	5.83	1.00
Sulphur					United States	14%	2.92	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Sulphur					Russian Federation	10%	6.20	1.00
Sulphur					Canada	8%	2.26	1.00
Sulphur					Saudi Arabia	6%	5.51	1.00
Sulphur					Japan	5%	2.77	1.00
Sulphur					United Arab Emirates	5%	3.94	1.00
Sulphur					Kazakhstan	4%	5.90	1.00
Sulphur					India	4%	5.45	1.00
Sulphur					Other Non Eu Countries	4%	0.00	1.00
Sulphur					Qatar	3%	4.03	1.00
Sulphur					Iran, Islamic Rep.	3%	6.65	1.00
Sulphur					Korea, Rep.	3%	3.74	1.00
Sulphur					Chile	3%	3.11	1.00
Sulphur					Mexico	1%	5.33	1.00
Sulphur					Australia	1%	2.36	1.00
Sulphur					Finland	1%	1.98	0.80
Sulphur					Kuwait	1%	5.24	1.00
Sulphur					Venezuela, Rb	1%	7.30	1.00
Sulphur					Poland	1%	3.60	0.80
Sulphur					Italy	1%	4.17	0.80
Sulphur					Germany	1%	2.47	0.80
Sulphur					Spain	1%	3.62	0.80
Sulphur					Peru	1%	5.30	1.00
Sulphur					Brazil	1%	5.08	1.00
Sulphur					Indonesia	1%	5.47	1.00
Sulphur					Philippines	1%	5.49	1.00
Sulphur					Bulgaria	1%	4.73	0.80
Sulphur					France	1%	3.11	0.80
Sulphur					Other Eu Countries	<1%	0.00	0.80
Talc	China	26%	5.83	1.25				
Talc	India	13%	5.45	1.00				
Talc	Brazil	8%	5.08	1.00				
Talc	United states	8%	2.92	1.00				
Talc	Korea, Rep.	8%	3.74	1.00				
Talc	Mexico	6%	5.33	1.00				
Talc	Japan	5%	2.77	1.00				
Talc	France	5%	3.11	0.80				
Talc	Finland	5%	1.98	0.80				
Talc	Other Non Eu Countries	4%	0.00	1.00				
Talc	Canada	2%	2.26	1.00				
Talc	Italy	2%	4.17	0.80				
Talc	Turkey	2%	5.34	1.00				
Talc	Russian	2%	6.20	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
	Federation							
Talc	Austria	2%	2.50	0.80				
Talc	Australia	1%	2.36	1.00				
Talc	Iran, Islamic Rep.	1%	6.65	1.00				
Talc	Other Eu Countries	<1%	0.00	0.80				
Tantalum	Congo, Dem. Rep.	33%	7.60	1.00				
Tantalum	Rwanda	28%	5.17	1.10				
Tantalum	Brazil	9%	5.08	1.00				
Tantalum	China	6%	5.83	1.20				
Tantalum	Ethiopia	6%	6.52	1.00				
Tantalum	Nigeria	5%	6.83	1.00				
Tantalum	Mozambique	5%	5.93	1.00				
Tantalum	Russian Federation	3%	6.20	1.00				
Tantalum	Burundi	2%	7.00	1.10				
Tantalum	Malaysia	1%	4.39	1.00				
Tantalum	Australia	1%	2.36	1.00				
Tantalum	Canada	1%	2.26	1.00				
Tantalum	Bolivia	<1%	5.97	1.00				
Tantalum	France	<1%	3.11	0.80				
Tellurium					China	54%	5.83	1.00
Tellurium					United States	14%	2.92	1.00
Tellurium					Japan	10%	2.77	1.00
Tellurium					Russian Federation	9%	6.20	1.00
Tellurium					Sweden	7%	2.05	0.80
Tellurium					Canada	3%	2.26	1.00
Tellurium					Peru	2%	5.30	1.00
Tellurium					Bulgaria	1%	4.73	0.80
Terbium	China	86%	5.83	1.59				
Terbium	Australia	6%	2.36	1.00				
Terbium	United States	2%	2.92	1.00				
Terbium	Russian Federation	2%	6.20	1.00				
Terbium	India	1%	5.45	1.00				
Terbium	Brazil	1%	5.08	1.00				
Terbium	Thailand	1%	5.50	1.00				
Terbium	Malaysia	1%	4.39	1.00				
Terbium	Vietnam	<1%	5.75	1.00				
Tin	China	35%	5.83	1.29	China	47%	5.83	1.42
Tin	Indonesia	27%	5.47	1.00	Indonesia	19%	5.47	1.00
Tin	Myanmar	10%	6.95	1.00	Malaysia	9%	4.39	1.00
Tin	Peru	7%	5.30	1.00	Peru	6%	5.30	1.00
Tin	Bolivia	6%	5.97	1.10	Thailand	5%	5.50	1.00
Tin	Brazil	6%	5.08	1.00	Brazil	4%	5.08	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Tin	Australia	2%	2.36	1.00	Bolivia	4%	5.97	1.00
Tin	Congo, Dem. Rep.	2%	7.60	1.00	Belgium	3%	2.81	0.80
Tin	Vietnam	1%	5.75	1.20	Other Non Eu Countries	1%	0.00	1.00
Tin	Other Non Eu Countries	1%	0.00	1.00	Vietnam	1%	5.75	1.10
Tin	Malaysia	1%	4.39	1.00	Poland	1%	3.60	0.80
Tin	Rwanda	1%	5.17	1.10				
Tin	Other Eu Countries	<1%	0.00	0.80				
Titanium	Canada	19%	2.26	1.00	China	45%	5.83	1.00
Titanium	China	15%	5.83	1.10	Russian Federation	22%	6.20	1.00
Titanium	Australia	13%	2.36	1.00	Japan	22%	2.77	1.00
Titanium	South Africa	12%	4.65	1.00	Kazakhstan	7%	5.90	1.00
Titanium	Mozambique	6%	5.93	1.00	Ukraine	4%	6.23	1.00
Titanium	Norway	6%	2.03	1.00	India	<1%	5.45	1.00
Titanium	Ukraine	6%	6.23	1.00	Other Non Eu Countries	<1%	0.00	1.00
Titanium	India	6%	5.45	1.10				
Titanium	Vietnam	5%	5.75	1.20				
Titanium	Madagascar	3%	6.26	1.00				
Titanium	Kenya	2%	6.03	1.00				
Titanium	Korea, Dem. Rep.	2%	7.74	1.00				
Titanium	Senegal	2%	5.21	1.00				
Titanium	United States	1%	2.92	1.00				
Titanium	Sierra Leone	1%	6.17	1.10				
Titanium	Russian Federation	1%	6.20	1.00				
Titanium	Brazil	1%	5.08	1.00				
Titanium	Sri Lanka	<1%	5.36	1.00				
Titanium	Malaysia	<1%	4.39	1.00				
Titanium	Kazakhstan	<1%	5.90	1.00				
Tungsten	China	82%	5.83	1.78	China	69%	5.83	1.00
Tungsten	Russian Federation	4%	6.20	1.10	Vietnam	7%	5.75	1.00
Tungsten	Vietnam	4%	5.75	1.20	United States	6%	2.92	1.00
Tungsten	Canada	2%	2.26	1.00	Russian federation	6%	6.20	1.00
Tungsten	Bolivia	1%	5.97	1.00	Brazil	4%	5.08	1.00
Tungsten	Rwanda	1%	5.17	1.10	Austria	1%	2.50	0.80
Tungsten	Austria	1%	2.50	0.80	Germany	1%	2.47	0.80
Tungsten	Portugal	1%	3.34	0.80	India	1%	5.45	1.00
Tungsten	Spain	1%	3.62	0.80	Japan	1%	2.77	1.00
Tungsten	Mongolia	1%	5.18	1.00	Uzbekistan	1%	6.98	1.00
Tungsten	Brazil	1%	5.08	1.00	Korea, Rep.	1%	3.74	1.00
Tungsten	United Kingdom	1%	2.60	1.00				
Tungsten	Australia	<1%	2.36	1.00				

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Tungsten	Myanmar	<1%	6.95	1.00				
Tungsten	Uzbekistan	<1%	6.98	1.00				
Tungsten	Peru	<1%	5.30	1.00				
Tungsten	Korea, Dem. Rep.	<1%	7.74	1.00				
Tungsten	Burundi	<1%	7.00	1.00				
Tungsten	Thailand	<1%	5.50	1.00				
Tungsten	Congo, Dem. Rep.	<1%	7.60	1.00				
Tungsten	Kyrgyz Republic	<1%	6.30	1.00				
Tungsten	Uganda	<1%	5.99	1.00				
Tungsten	Korea, Rep.	<1%	3.74	1.00				
Vanadium	China	39%	5.83	1.00	China	57%	5.83	1.10
Vanadium	South Africa	31%	4.65	1.00	South Africa	13%	4.65	1.00
Vanadium	Russian Federation	25%	6.20	1.00	Russian Federation	9%	6.20	1.00
Vanadium	Brazil	3%	5.08	1.00	United States	5%	2.92	1.00
Vanadium	Kazakhstan	1%	5.90	1.00	Brazil	3%	5.08	1.00
Vanadium	United States	<1%	2.92	1.00	Japan	2%	2.77	1.00
Vanadium	Australia	<1%	2.36	1.00	Korea, Rep.	1%	3.74	1.00
Vanadium					Taiwan, China	0%	3.27	1.00
Vanadium					India	1%	5.45	1.00
Vanadium					Austria	8%	2.50	0.80
Vanadium					Germany	0%	2.47	0.80
Vanadium					Other Non Eu Countries	0%	0.00	1.00
Yttrium	China	86%	5.83	1.59				
Yttrium	Australia	6%	2.36	1.00				
Yttrium	United States	2%	2.92	1.00				
Yttrium	Russian Federation	2%	6.20	1.00				
Yttrium	India	1%	5.45	1.00				
Yttrium	Brazil	1%	5.08	1.00				
Yttrium	Thailand	1%	5.50	1.00				
Yttrium	Malaysia	1%	4.39	1.00				
Yttrium	Vietnam	<1%	5.75	1.00				
Zinc	China	37%	5.83	1.20	China	42%	5.83	1.10
Zinc	Australia	11%	2.36	1.00	Korea, Dem. Rep.	7%	7.74	1.00
Zinc	Peru	10%	5.30	1.00	India	5%	5.45	1.00
Zinc	United States	6%	2.92	1.00	Canada	5%	2.26	1.00
Zinc	India	6%	5.45	1.00	Japan	4%	2.77	1.00
Zinc	Mexico	5%	5.33	1.00	Spain	4%	3.62	0.80
Zinc	Other Non Eu Countries	4%	0.00	1.00	Australia	4%	2.36	1.00
Zinc	Bolivia	3%	5.97	1.00	Peru	3%	5.30	1.00
Zinc	Canada	3%	2.26	1.00	Other Non Eu Countries	2%	0.00	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Zinc	Kazakhstan	3%	5.90	1.00	Mexico	2%	5.33	1.00
Zinc	Ireland	2%	2.58	0.80	Kazakhstan	2%	5.90	1.00
Zinc	Other Eu Countries	2%	0.00	0.80	Finland	2%	1.98	0.80
Zinc	Sweden	2%	2.05	0.80	Netherlands	2%	2.19	0.80
Zinc	Russian Federation	2%	6.20	1.00	Brazil	2%	5.08	1.00
Zinc	Turkey	1%	5.34	1.00	Belgium	2%	2.81	0.80
Zinc	Namibia	1%	4.44	1.00	Russian Federation	2%	6.20	1.00
Zinc	Brazil	1%	5.08	1.00	Other Eu Countries	1%	0.00	0.80
Zinc	Iran, Islamic Rep.	1%	6.65	1.00	United States	1%	2.92	1.00
Zinc					Germany	1%	2.47	0.80
Zinc					France	1%	3.11	0.80
Zinc					Norway	1%	2.03	1.00
Zinc					Poland	1%	3.60	0.80
Zinc					Iran, Islamic Rep.	1%	6.65	1.00
Zirconium	Australia	42%	2.36	1.00				
Zirconium	South Africa	25%	4.65	1.00				
Zirconium	China	10%	5.83	1.10				
Zirconium	United States	5%	2.92	1.00				
Zirconium	Mozambique	4%	5.93	1.00				
Zirconium	Indonesia	3%	5.47	1.03				
Zirconium	Ukraine	2%	6.23	1.00				
Zirconium	Brazil	2%	5.08	1.00				
Zirconium	Madagascar	2%	6.26	1.00				
Zirconium	Senegal	2%	5.21	1.00				
Zirconium	India	1%	5.45	1.00				
Zirconium	Vietnam	1%	5.75	1.10				
Zirconium	Kenya	1%	6.03	1.00				
Zirconium	Russian federation	1%	6.20	1.00				
Zirconium	Sierra Leone	<1%	6.17	1.00				
Zirconium	Sri Lanka	<1%	5.36	1.00				
Zirconium	Nigeria	<1%	6.83	1.00				
Zirconium	Turkey	<1%	5.34	1.00				
Zirconium	Malaysia	<1%	4.39	1.00				

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Annex 7. EU Sourcing, trade-related variable and WGI (2 stages).

	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Aggregates	Germany	22%	2.47	0.80				
Aggregates	France	15%	3.11	0.80				
Aggregates	Poland	11%	3.60	0.80				
Aggregates	Other EU countries	9%	0.00	0.80				
Aggregates	Italy	8%	4.17	0.80				
Aggregates	Spain	5%	3.62	0.80				
Aggregates	Austria	5%	2.50	0.80				
Aggregates	Romania	4%	4.70	0.80				
Aggregates	Finland	4%	1.98	0.80				
Aggregates	Sweden	4%	2.05	0.80				
Aggregates	Belgium	3%	2.81	0.80				
Aggregates	Netherlands	3%	2.19	0.80				
Aggregates	Czech Republic	3%	3.47	0.80				
Aggregates	Hungary	2%	4.06	0.80				
Aggregates	Denmark	2%	2.11	0.80				
Aggregates	Greece	1%	4.60	0.80				
Aggregates	United Kingdom	<1%	2.60	1.00				
Aluminium					Russian Federation	17%	6.20	1.10
Aluminium					Other Non Eu Countries	15%	0.00	1.00
Aluminium					Germany	10%	2.47	0.80
Aluminium					Mozambique	9%	5.93	1.00
Aluminium					France	7%	3.11	0.80
Aluminium					Spain	6%	3.62	0.80
Aluminium					Iceland	6%	2.52	1.00
Aluminium					Norway	6%	2.03	1.00
Aluminium					Romania	5%	4.70	0.80
Aluminium					Greece	3%	4.60	0.80
Aluminium					Slovakia	3%	3.79	0.80
Aluminium					United Arab Emirates	3%	3.94	1.00
Aluminium					Sweden	2%	2.05	0.80
Aluminium					Canada	2%	2.26	1.00
Aluminium					United Kingdom	2%	2.60	1.00
Aluminium					Slovenia	2%	3.50	0.80
Aluminium					Italy	1%	4.17	0.80
Aluminium					Netherlands	1%	2.19	0.80
Antimony	Turkey	62%	5.34	1.00	China	40%	5.83	1.10
Antimony	Bolivia	20%	5.97	1.10	Belgium	29%	2.81	0.80
Antimony	Guatemala	7%	6.00	1.00	France	11%	3.11	0.80
Antimony	Switzerland	5%	2.03	1.00	Germany	3%	2.47	0.80
Antimony	Kosovo	2%	5.64	1.00	Other Non Eu Countries	3%	0.00	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Antimony	China	2%	5.83	1.10	Korea, Rep.	3%	3.74	1.00
Antimony	Other Non Eu Countries	1%	0.00	1.00	Spain	3%	3.62	0.80
Antimony					Netherlands	2%	2.19	0.80
Antimony					Other Eu Countries	2%	0.00	0.80
Antimony					Bolivia	1%	5.97	1.10
Antimony					United Kingdom	1%	2.60	0.80
Antimony					Vietnam	1%	5.75	1.00
Antimony					Turkey	<1%	5.34	1.00
Antimony					United States	<1%	2.92	1.00
Antimony					India	<1%	5.45	1.00
Antimony					Hong Kong Sar, China	<1%	2.56	1.00
Antimony					Norway	<1%	2.03	1.00
Antimony					Japan	<1%	2.77	1.00
Antimony					Switzerland	<1%	2.03	1.00
Arsenic					Belgium	67%	2.81	0.80
Arsenic					China	29%	5.83	1.00
Arsenic					Japan	2%	2.77	1.00
Arsenic					Hong Kong	1%	2.56	1.00
Arsenic					United Kingdom	1%	2.60	0.80
Arsenic					Other Non EU	<1%	0.00	1.00
Baryte	China	38%	5.83	1.10				
Baryte	Morocco	28%	5.48	1.00				
Baryte	Other Eu Countries	15%	0.00	0.80				
Baryte	Germany	10%	2.47	0.80				
Baryte	Turkey	6%	5.34	1.00				
Baryte	Norway	1%	2.03	1.00				
Baryte	Tunisia	1%	5.40	1.00				
Baryte	Other Non Eu Countries	1%	0.00	1.00				
Bauxite	Guinea	64%	6.72	1.10				
Bauxite	Greece	12%	4.60	0.80				
Bauxite	Brazil	10%	5.08	1.00				
Bauxite	Sierra Leone	7%	6.17	1.00				
Bauxite	Other Non Eu Countries	2%	0.00	1.00				
Bauxite	Ghana	1%	4.94	1.00				
Bauxite	China	1%	5.83	1.00				
Bauxite	Guyana	1%	5.56	1.00				
Bauxite	Turkey	1%	5.34	1.00				
Bauxite	France	1%	3.11	0.80				
Bauxite	Hungary	<1%	4.06	0.80				
Bauxite	Croatia	<1%	4.27	0.80				
Bentonite	Greece	36%	4.60	0.80				
Bentonite	Germany	13%	2.47	0.80				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Bentonite	Czech Republic	10%	3.47	0.80				
Bentonite	TURKEY	8%	5.34	1.00				
Bentonite	Slovakia	7%	3.79	0.80				
Bentonite	Cyprus	5%	3.36	0.80				
Bentonite	INDIA	5%	5.45	1.00				
Bentonite	Spain	3%	3.62	0.80				
Bentonite	MOROCCO	3%	5.48	1.00				
Bentonite	Bulgaria	2%	4.73	0.80				
Bentonite	Italy	1%	4.17	0.80				
Bentonite	UNITED KINGDOM	1%	2.60	1.00				
Bentonite	UNITED STATES	1%	2.92	1.00				
Bentonite	France	1%	3.11	0.80				
Bentonite	CANADA	1%	2.26	1.00				
Bentonite	Romania	1%	4.70	0.80				
Bentonite	CHINA	1%	5.83	1.00				
Bentonite	other non EU countries	1%	0.00	1.00				
Bentonite	Egypt, Arab Rep.	<1%	6.48	1.00				
Bentonite	Hungary	<1%	4.06	0.80				
Bentonite	GEORGIA	<1%	4.47	1.00				
Bentonite	Poland	<1%	3.60	0.80				
Bentonite	Slovenia	<1%	3.50	0.80				
Beryllium					United States	55%	2.92	1.00
Beryllium					Kazakhstan	23%	5.90	1.00
Beryllium					Japan	17%	2.77	1.00
Beryllium					China	5%	5.83	1.00
Bismuth					China	49%	5.83	1.00
Bismuth					Belgium	47%	2.81	0.80
Bismuth					Other Non Eu Countries	1%	5.30	0.00
Bismuth					Peru	1%	2.26	1.00
Bismuth					Canada	1%	2.77	1.00
Bismuth					Japan	<1%	3.74	1.00
Bismuth					Korea, Rep.	<1%	2.92	1.00
Bismuth					United States	<1%	4.73	1.00
Borate	Turkey	98%	5.34	1.00	Turkey	60%	5.34	1.00
Borate	Argentina	1%	5.47	1.10	United States	35%	2.92	1.00
Borate	Norway	<1%	2.03	1.00	Other Non Eu Countries	2%	0.00	1.00
Borate	Bolivia	<1%	5.97	1.10	Chile	1%	3.11	1.00
Borate	Peru	<1%	5.30	1.00	Peru	1%	5.30	1.00
Borate	Chile	<1%	3.11	1.00	Russian Federation	1%	6.20	1.00
Borate	Other Non Eu Countries	<1%	0.00	1.00	Bolivia	1%	5.97	1.00
Cadmium					Netherlands	30%	2.19	0.80

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Cadmium					Germany	24%	2.47	0.80
Cadmium					Poland	21%	3.60	0.80
Cadmium					Bulgaria	19%	4.73	0.80
Cadmium					Russian Federation	4%	6.20	1.00
Cadmium					China	2%	5.83	1.00
Cadmium					Other Non Eu Countries	<1%	0.00	1.00
Cerium	Russian Federation	64%	6.20	1.10	China	99%	5.83	1.10
Cerium	China	26%	5.83	1.00	United Kingdom	1%	2.60	1.00
Cerium	United Kingdom	6%	2.60	1.00	Other non EU Countries	<1%	0.00	1.00
Cerium	Other non EU countries	2%	0.00	1.00	Vietnam	<1%	5.75	1.00
Cerium	Japan	2%	2.77	1.00				
Chromium	Finland	77%	1.98	0.80	South Africa	41%	4.65	1.00
Chromium	South Africa	14%	4.65	1.00	Finland	25%	1.98	0.80
Chromium	Other Non EU Countries	4%	0.00	1.00	Other Non Eu Countries	10%	0.00	1.00
Chromium	Turkey	4%	5.34	1.00	Other Eu countries	5%	0.00	0.80
Chromium	India	<1%	5.45	1.20	Russian Federation	5%	6.20	1.00
Chromium	Albania	<1%	5.16	1.00	Zimbabwe	5%	7.17	1.00
Chromium	Pakistan	<1%	6.78	1.00	Kazakhstan	3%	5.90	1.00
Chromium	Greece	<1%	4.60	0.80	Turkey	3%	5.34	1.00
Chromium					India	2%	5.45	1.00
Chromium					Albania	2%	5.16	1.00
Chromium					Oman	<1%	4.70	1.00
Chromium					China	<1%	5.83	1.10
Cobalt	Congo, Dem. Rep.	68%	7.60	1.10	Finland	54%	1.98	0.80
Cobalt	Finland	14%	1.98	0.80	Belgium	7%	2.81	0.80
Cobalt	French Guiana	5%	3.23	1.00	Norway	7%	2.03	1.00
Cobalt	Russian Federation	5%	6.20	1.00	United States	7%	2.92	1.00
Cobalt	Canada	5%	2.26	1.10	Zambia	4%	5.40	1.00
Cobalt	Other Non Eu Countries	2%	0.00	1.00	Madagascar	4%	6.26	1.00
Cobalt	Australia	1%	2.36	1.00	China	4%	5.83	1.00
Cobalt	South Africa	<1%	4.65	1.00	United Kingdom	3%	2.60	1.00
Cobalt					Russian Federation	2%	6.20	1.10
Cobalt					Congo, Dem. Rep.	2%	7.60	1.00
Cobalt					France	1%	3.11	0.80
Cobalt					Japan	1%	2.77	1.00
Cobalt					Uganda	1%	5.99	1.00
Cobalt					Congo, Rep.	1%	6.73	1.00
Cobalt					Brazil	1%	5.08	1.00
Cobalt					South Africa	1%	4.65	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Cobalt					Morocco	<1%	5.48	1.00
Cobalt					Other non EU	<1%	0.00	1.00
Cobalt					Qatar	<1%	4.03	1.00
Cobalt	United Kingdom	<1%	2.60	1.00				
Coking coal	Australia	24%	2.36	1.00	Poland	24%	3.60	0.80
Coking coal	Poland	23%	3.60	0.80	Germany	23%	2.47	0.80
Coking coal	United States	21%	2.92	1.00	France	9%	3.11	0.80
Coking coal	Czech Republic	8%	3.47	0.80	Italy	6%	4.17	0.80
Coking coal	Germany	8%	2.47	0.80	Czech Republic	6%	3.47	0.80
Coking coal	Russian Federation	7%	6.20	1.00	Netherlands	5%	2.19	0.80
Coking coal	Canada	5%	2.26	1.00	Spain	4%	3.62	0.80
Coking coal	Other Non Eu Countries	3%	0.00	1.00	Slovakia	4%	3.79	0.80
Coking coal	Mozambique	1%	5.93	1.00	Belgium	4%	2.81	0.80
Coking coal	Colombia	1%	5.39	1.00	Austria	3%	2.50	0.80
Coking coal	Ukraine	1%	6.23	1.00	Sweden	3%	2.05	0.80
Coking coal	Kazakhstan	<1%	5.90	1.00	Hungary	3%	4.06	0.80
Coking coal					Finland	2%	1.98	0.80
Coking coal					Russian Federation	1%	6.20	1.10
Coking coal					China	<1%	5.83	1.20
Coking coal					Ukraine	<1%	6.23	1.00
Coking coal					Colombia	<1%	5.39	1.00
Coking coal					United Kingdom	<1%	2.60	1.00
Coking coal					Australia	<1%	2.36	1.00
Coking coal					United States	<1%	2.92	1.00
Coking coal					Bosnia And Herzegovina	<1%	5.44	1.00
Coking coal					Chile	<1%	3.11	1.00
Coking coal					Canada	<1%	2.26	1.00
Coking coal					India	<1%	5.45	1.00
Coking coal					Other Non Eu Countries	<1%	0.00	1.00
Coking coal					Japan	<1%	2.77	1.00
Copper	Poland	27%	3.60	0.80	Germany	22%	2.47	0.80
Copper	Chile	13%	3.11	1.00	Poland	19%	3.60	0.80
Copper	Peru	10%	5.30	1.00	Spain	13%	3.62	0.80
Copper	Other Eu Countries	8%	0.00	0.80	Belgium	13%	2.81	0.80
Copper	Spain	8%	3.62	0.80	Bulgaria	7%	4.73	0.80
Copper	Bulgaria	7%	4.73	0.80	Russian Federation	7%	6.20	1.10
Copper	Brazil	7%	5.08	1.00	Sweden	7%	2.05	0.80
Copper	Argentina	4%	5.47	1.10	Finland	5%	1.98	0.80
Copper	Canada	3%	2.26	1.00	Other Eu Countries	4%	0.00	0.80
Copper	United States	3%	2.92	1.00	Kazakhstan	1%	5.90	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Copper	Georgia	2%	4.47	1.00	United Kingdom	1%	2.60	0.80
Copper	Indonesia	2%	5.47	1.20	Serbia	1%	5.05	1.00
Copper	Other Non Eu Countries	1%	0.00	1.00	South Africa	<1%	4.65	1.00
Copper	Turkey	1%	5.34	1.00	Norway	<1%	2.03	1.00
Copper	Australia	1%	2.36	1.00	Mexico	<1%	5.33	1.00
Copper	Morocco	1%	5.48	1.00	Other Non Eu countries	<1%	0.00	1.00
Copper	Macedonia, Fyr	1%	5.07	1.00	China	<1%	5.83	1.10
Copper	Armenia	1%	5.41	1.00	Brazil	<1%	5.08	1.00
Copper	Papua New Guinea	<1%	5.94	1.00				
Copper	Mexico	<1%	5.33	1.00				
Copper	Colombia	<1%	5.39	1.00				
Diatomite	Denmark	35%	2.11	0.80				
Diatomite	France	26%	3.11	0.80				
Diatomite	Spain	16%	3.62	0.80				
Diatomite	Czech Republic	10%	3.47	0.80				
Diatomite	UNITED STATES	7%	2.92	1.00				
Diatomite	TURKEY	3%	5.34	1.00				
Diatomite	MEXICO	2%	5.33	1.00				
Diatomite	RUSSIAN FEDERATION	1%	6.20	1.00				
Diatomite	Other non EU countries	<1%	0.00	1.00				
Diatomite	CHINA	<1%	5.83	1.00				
Diatomite	ARMENIA	<1%	5.41	1.00				
Diatomite	Poland	<1%	3.60	0.80				
Diatomite	UNITED KINGDOM	<1%	2.60	1.00				
Dysprosium	China	68%	5.83	1.10	China	98%	5.83	1.10
Dysprosium	Japan	18%	2.77	1.00	Other non EU Countries	1%	0.00	1.00
Dysprosium	United kingdom	6%	2.60	1.00	United Kingdom	1%	2.60	1.00
Dysprosium	Russian Federation	5%	6.20	1.00				
Dysprosium	Other non EU countries	2%	0.00	1.00				
Erbium	China	69%	5.83	1.10	China	98%	5.83	1.10
Erbium	Japan	18%	2.77	1.00	Other non EU Countries	1%	0.00	1.00
Erbium	United Kingdom	6%	2.60	1.00	United Kingdom	1%	2.60	1.00
Erbium	Russian Federation	5%	6.20	1.00				
Erbium	Other non EU countries	2%	0.00	1.00				
Europium	China	69%	5.83	1.10	China	98%	5.83	1.10
Europium	Japan	18%	2.77	1.00	Other non EU Countries	1%	0.00	1.00
Europium	United	6%	2.60	1.00	United Kingdom	1%	2.60	1.00

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Material	Country	Share	WGI	t	Country	Share	WGI	t
	Kingdom							
Europium	Russian Federation	5%	6.20	1.00				
Europium	Other non EU countries	2%	0.00	1.00				
Feldspar	Turkey	32%	5.34	1.00				
Feldspar	Italy	29%	4.17	0.80				
Feldspar	France	7%	3.11	0.80				
Feldspar	Spain	7%	3.62	0.80				
Feldspar	Poland	7%	3.60	0.80				
Feldspar	Czech Republic	6%	3.47	0.80				
Feldspar	Germany	4%	2.47	0.80				
Feldspar	Norway	2%	2.03	1.00				
Feldspar	Portugal	1%	3.34	0.80				
Feldspar	Bulgaria	1%	4.73	0.80				
Feldspar	Finland	1%	1.98	0.80				
Feldspar	Austria	<1%	2.50	0.80				
Feldspar	Sweden	<1%	2.05	0.80				
Feldspar	Other Eu Countries	<1%	0.00	0.80				
Feldspar	Canada	<1%	2.26	1.00				
Feldspar	Russian Federation	<1%	6.20	1.00				
Feldspar	Macedonia, Fyr	<1%	5.07	1.00				
Feldspar	Morocco	<1%	5.48	1.00				
Feldspar	Other Non Eu Countries	<1%	0.00	1.00				
Fluorspar	Mexico	25%	5.33	1.00	Germany	42%	2.47	0.80
Fluorspar	Spain	14%	3.62	0.80	Italy	15%	4.17	0.80
Fluorspar	South Africa	12%	4.65	1.00	Spain	12%	3.62	0.80
Fluorspar	Bulgaria	10%	4.73	0.80	France	8%	3.11	0.80
Fluorspar	China	8%	5.83	1.10	Norway	3%	2.03	1.00
Fluorspar	Germany	6%	2.47	0.80	Lithuania	3%	3.50	0.80
Fluorspar	United Kingdom	6%	2.60	1.00	Mexico	2%	5.33	1.00
Fluorspar	Kenya	6%	6.03	1.00	United Kingdom	2%	2.60	0.80
Fluorspar	Namibia	5%	4.44	1.00	Sweden	2%	2.05	0.80
Fluorspar	Morocco	4%	5.48	1.00	Netherlands	1%	2.19	0.80
Fluorspar	Vietnam	2%	5.75	1.00	Belgium	1%	2.81	0.80
Fluorspar	Mongolia	1%	5.18	1.10	Hungary	1%	4.06	0.80
Fluorspar	Pakistan	<1%	6.78	1.00	Tunisia	1%	5.40	1.00
Fluorspar	Egypt, Arab Rep.	<1%	6.48	1.00	Czech Republic	1%	3.47	0.80
Fluorspar	Canada	<1%	2.26	1.00	Other Eu Countries	1%	0.00	0.80
Fluorspar	Brazil	<1%	5.08	1.00	Canada	1%	2.26	1.00
Fluorspar	Russian Federation	<1%	6.20	1.00	United States	1%	2.92	1.00
Fluorspar	United States	<1%	2.92	1.00	Other Non Eu Countries	1%	0.00	1.00

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Fluorspar	Norway	<1%	2.03	1.00	Singapore	<1%	2.37	1.00
Fluorspar	India	<1%	5.45	1.00	Japan	<1%	2.77	1.00
Fluorspar	Argentina	<1%	5.47	1.00	Iceland	<1%	2.52	1.00
Fluorspar	Turkey	<1%	5.34	1.00	China	<1%	5.83	1.10
Fluorspar	Other Non Eu Countries	<1%	0.00	1.00	Belarus	<1%	6.18	1.00
Fluorspar	Japan	<1%	2.77	1.00	Mozambique	<1%	5.93	1.00
Fluorspar	Switzerland	<1%	2.03	1.00	Taiwan, China	<1%	3.27	1.00
Fluorspar	Iran, Islamic Rep.	<1%	6.65	1.00				
Gadolinium	China	69%	5.83	1.10	China	98%	5.83	1.10
Gadolinium	Japan	18%	2.77	1.00	Other non EU Countries	1%	0.00	1.00
Gadolinium	United Kingdom	6%	2.60	1.00	United Kingdom	1%	2.60	1.00
Gadolinium	Russian Federation	5%	6.20	1.00				
Gadolinium	Other non EU countries	2%	0.00	1.00				
Gallium					Germany	35%	2.47	0.80
Gallium					United Kingdom	28%	2.60	0.80
Gallium					China	27%	5.83	1.00
Gallium					United States	4%	2.92	1.00
Gallium					Hungary	2%	4.06	0.80
Gallium					Japan	1%	2.77	1.00
Gallium					Korea, Rep.	1%	3.74	1.00
Gallium					Taiwan, China	1%	3.27	1.00
Gallium					Hong Kong Sar, China	1%	2.56	1.00
Gallium					Canada	<1%	2.26	1.00
Gallium					Russian Federation	<1%	6.20	1.00
Gallium					Switzerland	<1%	2.03	1.00
Gallium					Singapore	<1%	2.37	1.00
Gallium					India	<1%	5.45	1.00
Germanium					Finland	51%	1.98	0.80
Germanium					China	17%	5.83	1.10
Germanium					United Kingdom	11%	2.60	0.80
Germanium					Russian Federation	10%	6.20	1.00
Germanium					United States	10%	2.92	1.00
Germanium					Taiwan, China	1%	3.27	1.00
Germanium					Japan	<1%	2.77	1.00
Germanium					Canada	<1%	2.26	1.00
Germanium					Other Non Eu countries	<1%	0.00	1.00
Gypsum	Spain	36%	3.62	0.80				
Gypsum	Germany	15%	2.47	0.80				
Gypsum	Italy	13%	4.17	0.80				
Gypsum	France	11%	3.11	0.80				

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Gypsum	Poland	6%	3.60	0.80				
Gypsum	Romania	4%	4.70	0.80				
Gypsum	Austria	3%	2.50	0.80				
Gypsum	Greece	3%	4.60	0.80				
Gypsum	Other EU countries	2%	0.00	0.80				
Gypsum	Portugal	1%	3.34	0.80				
Gypsum	Latvia	1%	3.73	0.80				
Gypsum	Ireland	1%	2.58	0.80				
Gypsum	Croatia	1%	4.27	0.80				
Gypsum	Bulgaria	<1%	4.73	0.80				
Gypsum	Morocco	<1%	5.48	1.00				
Gypsum	Norway	<1%	2.03	1.00				
Gypsum	Bosnia And Herzegovina	<1%	5.44	1.00				
Gypsum	Ukraine	<1%	6.23	1.00				
Gypsum	Thailand	<1%	5.50	1.00				
Gypsum	N. Macedonia	<1%	0.00	1.00				
Gypsum	Vietnam	<1%	5.75	1.00				
Gypsum	Tunisia	<1%	5.40	1.00				
Gypsum	United States	<1%	2.92	1.00				
Gypsum	China	<1%	5.83	1.00				
Gypsum	Turkey	<1%	5.34	1.00				
Gypsum	Egypt, Arab Rep.	<1%	6.48	1.00				
Gypsum	United Kingdom	<1%	2.60	1.00				
Gypsum	Other non EU countries	<1%	0.00	1.00				
Hafnium					France	84%	3.11	0.80
Hafnium					United States	5%	2.92	1.00
Hafnium					United Kingdom	4%	2.60	1.00
Hafnium					Russian Federation	2%	6.20	1.10
Hafnium					China	2%	5.83	1.00
Hafnium					Ukraine	1%	6.23	1.00
Hafnium					Canada	<1%	2.26	1.00
Hafnium					Turkey	<1%	5.34	1.00
Hafnium					Taiwan, China	<1%	3.27	1.00
Hafnium					Switzerland	<1%	2.03	1.00
Helium					United States	34%	2.92	1.00
Helium					Algeria	31%	6.43	1.00
Helium					Qatar	15%	4.03	1.00
Helium					Poland	8%	3.60	0.80
Helium					Russian Federation	3%	6.20	1.00
Helium					United Kingdom	3%	2.60	0.80
Helium					United Arab Emirates	3%	3.94	1.00

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Helium					China	1%	5.83	1.00
Helium					Other Non EU Countries	1%	0.00	1.00
Helium					Germany	<1%	2.47	0.80
Ho, Tm, Lu, Yb	China	69%	5.83	1.10	China	98%	5.83	1.10
Ho, Tm, Lu, Yb	Japan	18%	2.77	1.00	Other non EU Countries	1%	0.00	1.00
Ho, Tm, Lu, Yb	United Kingdom	6%	2.60	1.00	United Kingdom	1%	2.60	1.00
Ho, Tm, Lu, Yb	Russian Federation	5%	6.20	1.00				
Ho, Tm, Lu, Yb	Other non EU countries	2%	0.00	1.00				
Hydrogen	Germany	27%	2.47	0.80				
Hydrogen	Netherlands	20%	2.19	0.80				
Hydrogen	Spain	16%	3.62	0.80				
Hydrogen	Belgium	12%	2.81	0.80				
Hydrogen	Italy	12%	4.17	0.80				
Hydrogen	France	8%	3.11	0.80				
Hydrogen	United Kingdom	3%	2.60	1.00				
Hydrogen	Other Eu Countries	2%	0.00	0.80				
Indium					France	28%	3.11	0.80
Indium					Belgium	23%	2.81	0.80
Indium					United Kingdom	12%	2.60	0.80
Indium					Germany	10%	2.47	0.80
Indium					China	6%	5.83	1.10
Indium					United States	5%	2.92	1.00
Indium					Italy	5%	4.17	0.80
Indium					Taiwan, China	4%	3.27	1.00
Indium					Japan	3%	2.77	1.00
Indium					Netherlands	2%	2.19	0.80
Indium					Korea, Rep.	1%	3.74	1.00
Indium					Hong Kong Sar, China	1%	2.56	1.00
Indium					Russian Federation	1%	6.20	1.00
Indium					Canada	<1%	2.26	1.00
Indium					Liechtenstein	<1%	2.32	1.00
Indium					Switzerland	<1%	2.03	1.00
Indium					Malaysia	<1%	4.39	1.00
Indium					India	<1%	5.45	1.00
Iron ore	Brazil	33%	5.08	1.00	Other Eu Countries	31%	0.00	0.80
Iron ore	Sweden	24%	2.05	0.80	Germany	26%	2.47	0.80
Iron ore	Ukraine	11%	6.23	1.00	Italy	15%	4.17	0.80
Iron ore	Canada	11%	2.26	1.00	France	9%	3.11	0.80
Iron ore	Other Non Eu Countries	5%	0.00	1.00	Spain	9%	3.62	0.80
Iron ore	Russian	5%	6.20	1.00	Poland	5%	3.60	0.80

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Material	Country	Share	WGI	t	Country	Share	WGI	t
	Federation							
Iron ore	South Africa	3%	4.65	1.00	Russian Federation	2%	6.20	1.00
Iron ore	Mauritania	2%	6.42	1.00	Ukraine	2%	6.23	1.00
Iron ore	Other Eu Countries	2%	0.00	0.80	Brazil	<1%	5.08	1.00
Iron ore	Norway	2%	2.03	1.00	United Kingdom	<1%	2.60	1.00
Iron ore	Liberia	2%	6.29	1.00	Switzerland	<1%	2.03	1.00
Iron ore					Other Non Eu Countries	<1%	0.00	1.00
Iron ore					China	<1%	5.83	1.10
Iron ore					Serbia	<1%	5.05	1.00
Iron ore					Belarus	<1%	6.18	1.00
Iron ore					Turkey	<1%	5.34	1.00
Iron ore					India	<1%	5.45	1.10
Iron ore					Norway	<1%	2.03	1.00
Iron ore					Oman	<1%	4.70	1.00
Kaolin clay	Germany	31%	2.47	0.80				
Kaolin clay	Czech Republic	21%	3.47	0.80				
Kaolin clay	Ukraine	10%	6.23	1.00				
Kaolin clay	Brazil	6%	5.08	1.00				
Kaolin clay	Italy	5%	4.17	0.80				
Kaolin clay	United Kingdom	5%	2.60	1.00				
Kaolin clay	Spain	4%	3.62	0.80				
Kaolin clay	France	4%	3.11	0.80				
Kaolin clay	United States	4%	2.92	1.00				
Kaolin clay	Portugal	3%	3.34	0.80				
Kaolin clay	Poland	3%	3.60	0.80				
Kaolin clay	Bulgaria	2%	4.73	0.80				
Kaolin clay	Belgium	2%	2.81	0.80				
Kaolin clay	Other Non Eu Countries	1%	0.00	1.00				
Kaolin clay	Romania	<1%	4.70	0.80				
Kaolin clay	Hungary	<1%	4.06	0.80				
Kaolin clay	Turkey	<1%	5.34	1.00				
Kaolin clay	Morocco	<1%	5.48	1.00				
Kaolin clay	Austria	<1%	2.50	0.80				
Kaolin clay	Serbia	<1%	5.05	1.00				
Kaolin clay	Slovakia	<1%	3.79	0.80				
Kaolin clay	China	<1%	5.83	1.00				
Lanthanum	China	93%	5.83	1.10	China	99%	5.83	1.10
Lanthanum	Other non EU countries	4%	0.00	1.00	United Kingdom	1%	2.60	1.00
Lanthanum	United Kingdom	3%	2.60	1.00	Other non EU Countries	<1%	0.00	1.00
Lanthanum					Vietnam	<1%	5.75	1.00
Lead	Poland	18%	3.60	0.80	Other Eu Countries	27%	0.00	0.80

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Lead	Sweden	16%	2.05	0.80	Germany	25%	2.47	0.80
Lead	Other Eu Countries	9%	0.00	0.80	Italy	12%	4.17	0.80
Lead	Ireland	8%	2.58	0.80	Spain	11%	3.62	0.80
Lead	Peru	7%	5.30	1.00	Poland	10%	3.60	0.80
Lead	Macedonia, Fyr	7%	5.07	1.00	Belgium	9%	2.81	0.80
Lead	Australia	7%	2.36	1.00	United Kingdom	3%	2.60	1.00
Lead	United States	6%	2.92	1.00	Russian Federation	1%	6.20	1.00
Lead	Mexico	6%	5.33	1.00	Kazakhstan	1%	5.90	1.00
Lead	Argentina	3%	5.47	1.00	Korea, Rep.	1%	3.74	1.00
Lead	Morocco	3%	5.48	1.00	Lebanon	<1%	6.25	1.00
Lead	Turkey	2%	5.34	1.00	Other Non Eu Countries	<1%	0.00	1.00
Lead	Bolivia	2%	5.97	1.00	Ukraine	<1%	6.23	1.00
Lead	Other Non Eu Countries	2%	0.00	1.00	Israel	<1%	3.83	1.00
Lead	Serbia	2%	5.05	1.00	Morocco	<1%	5.48	1.00
Lead	Chile	1%	3.11	1.00	Belarus	<1%	6.18	1.00
Lead	Bosnia And Herzegovina	1%	5.44	1.00				
Lead	Kosovo	<1%	5.64	1.00				
Limestone	Other EU countries	17%	0.00	0.80				
Limestone	France	16%	3.11	0.80				
Limestone	Italy	16%	4.17	0.80				
Limestone	Germany	15%	2.47	0.80				
Limestone	Austria	14%	2.50	0.80				
Limestone	Norway	6%	2.03	1.00				
Limestone	Poland	4%	3.60	0.80				
Limestone	Spain	3%	3.62	0.80				
Limestone	Denmark	3%	2.11	0.80				
Limestone	Greece	2%	4.60	0.80				
Limestone	Turkey	2%	5.34	1.00				
Limestone	Other non-EU countries	<1%	0.00	1.00				
Lithium	Australia	87%	2.36	1.00	Chile	78%	3.11	1.00
Lithium	Portugal	13%	3.34	0.80	United States	8%	2.92	1.00
Lithium					Russian Federation	4%	6.20	1.00
Lithium					China	3%	5.83	1.00
Lithium					United Kingdom	3%	2.60	1.00
Lithium					Argentina	3%	5.47	1.10
Lithium					Mexico	<1%	5.33	1.00
Lithium					India	<1%	5.45	1.00
Lithium					Switzerland	<1%	2.03	1.00
Lithium					Canada	<1%	2.26	1.00
Lithium					Australia	<1%	2.36	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Lithium					Norway	<1%	2.03	1.00
Lithium					Japan	<1%	2.77	1.00
Lithium					Indonesia	<1%	5.47	1.00
Lithium					Lebanon	<1%	6.25	1.00
Lithium					Israel	<1%	3.83	1.00
Lithium					Syrian Arab Republic	<1%	7.96	1.00
Lithium					Korea, Rep.	<1%	3.74	1.00
Magnesite	Slovakia	32%	3.79	0.80				
Magnesite	Austria	26%	2.50	0.80				
Magnesite	Spain	22%	3.62	0.80				
Magnesite	Greece	14%	4.60	0.80				
Magnesite	Poland	3%	3.60	0.80				
Magnesite	Finland	1%	1.98	0.80				
Magnesite	Other non eu countries	<1%	0.00	1.00				
Magnesium					China	93%	5.83	1.00
Magnesium					United Kingdom	2%	2.60	1.00
Magnesium					Israel	2%	3.83	1.00
Magnesium					Serbia	2%	5.05	1.00
Magnesium					Russian Federation	1%	6.20	1.00
Magnesium					Other Non EU Countries	1%	0.00	1.00
Magnesium					Other EU countries	<1%	0.00	0.80
Manganese	South Africa	33%	4.65	1.00	Norway	19%	2.03	1.00
Manganese	Gabon	26%	5.97	1.10	Spain	15%	3.62	0.80
Manganese	Brazil	22%	5.08	1.00	South Africa	15%	4.65	1.00
Manganese	Bulgaria	5%	4.73	0.80	France	13%	3.11	0.80
Manganese	Hungary	3%	4.06	0.80	India	11%	5.45	1.00
Manganese	Ukraine	2%	6.23	1.00	Ukraine	8%	6.23	1.00
Manganese	Other Non Eu Countries	2%	0.00	1.00	Other countries, NES	6%	0.00	1.00
Manganese	Australia	2%	2.36	1.00	Slovakia	3%	3.79	0.80
Manganese	Ghana	2%	4.94	1.00	Korea, Rep.	2%	3.74	1.00
Manganese	Argentina	1%	5.47	1.00	Other Non Eu Countries	2%	0.00	1.00
Manganese	Other countries, NES	1%	0.00	1.00	Italy	1%	4.17	0.80
Manganese	Romania	1%	4.70	0.80	Georgia	1%	4.47	1.00
Manganese	Mexico	1%	5.33	1.00	Romania	1%	4.70	0.80
Manganese					Russian Federation	1%	6.20	1.10
Manganese					Brazil	1%	5.08	1.00
Manganese					Venezuela, Rb	<1%	7.30	1.00
Manganese					Gabon	<1%	5.97	1.00
Manganese					Poland	<1%	3.60	0.80
Molybdenum	United States	47%	2.92	1.00	Chile	35%	3.11	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Molybdenum	Other Non EU Countries	23%	0.00	1.00	United Kingdom	26%	2.60	1.00
Molybdenum	Chile	14%	3.11	1.00	United States	17%	2.92	1.00
Molybdenum	Canada	7%	2.26	1.00	Other Non Eu Countries	17%	0.00	1.00
Molybdenum	Peru	7%	5.30	1.00	Korea, Rep.	10%	3.74	1.00
Molybdenum	Mexico	2%	5.33	1.00	Armenia	10%	5.41	1.00
Molybdenum					Russian Federation	9%	6.20	1.10
Molybdenum					Mexico	7%	5.33	1.00
Molybdenum					Iran, Islamic Rep.	4%	6.65	1.00
Molybdenum					China	2%	5.83	1.10
Molybdenum					Thailand	1%	5.50	1.00
Natural cork					Congo, Dem. Rep.	100%	7.60	1.00
Natural cork	Portugal	55%	3.34	0.80				
Natural cork	Spain	34%	3.62	0.80				
Natural cork	Italy	3%	4.17	0.80				
Natural cork	Morocco	3%	5.48	1.00				
Natural cork	France	3%	3.11	0.80				
Natural cork	Tunisia	1%	5.40	1.00				
Natural cork	China	<1%	5.83	1.00				
Natural graphite	China	47%	5.83	1.10				
Natural graphite	Brazil	12%	5.08	1.00				
Natural graphite	Norway	8%	2.03	1.00				
Natural graphite	Other Non Eu Countries	8%	0.00	1.00				
Natural graphite	Zimbabwe	7%	7.17	1.00				
Natural graphite	Ukraine	4%	6.23	1.00				
Natural graphite	Belarus	4%	6.18	1.00				
Natural graphite	Madagascar	2%	6.26	1.00				
Natural graphite	Russian Federation	2%	6.20	1.00				
Natural graphite	Canada	2%	2.26	1.00				
Natural graphite	Romania	2%	4.70	0.80				
Natural graphite	Sri Lanka	1%	5.36	1.00				
Natural graphite	United States	1%	2.92	1.00				
Natural graphite	Germany	<1%	2.47	0.80				
Natural graphite	Austria	<1%	2.50	0.80				
Natural graphite	Sweden	<1%	2.05	0.80				
Natural Rubber	Indonesia	31%	5.47	1.00				
Natural Rubber	Thailand	18%	5.50	1.00				
Natural Rubber	Malaysia	16%	4.39	1.00				
Natural Rubber	Côte D'Ivoire	15%	6.21	1.00				
Natural Rubber	Vietnam	7%	5.75	1.00				
Natural Rubber	Cameroon	3%	6.59	1.00				
Natural Rubber	Nigeria	2%	6.83	1.00				

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Natural Rubber	Other non Eu countries	2%	0.00	1.00				
Natural Rubber	Gabon	1%	5.97	1.00				
Natural Rubber	Liberia	1%	6.29	1.00				
Natural Rubber	Ghana	1%	4.94	1.00				
Natural Rubber	Guinea	1%	6.72	1.00				
Natural Rubber	United Kingdom	1%	2.60	1.00				
Natural Teak wood	Myanmar	61%	6.95	1.00				
Natural Teak wood	Malaysia	13%	4.39	1.00				
Natural Teak wood	Indonesia	5%	5.47	1.00				
Natural Teak wood	Cameroon	5%	6.59	1.00				
Natural Teak wood	Congo, Rep.	4%	6.73	1.00				
Natural Teak wood	Congo, Dem. Rep.	4%	7.60	1.00				
Natural Teak wood	Brazil	2%	5.08	1.00				
Natural Teak wood	Ghana	2%	4.94	1.00				
Natural Teak wood	Côte D'Ivoire	2%	6.21	1.00				
Natural Teak wood	Other Non Eu Countries	1%	0.00	1.00				
Natural Teak wood	India	<1%	5.45	1.00				
Natural Teak wood	China	<1%	5.83	1.00				
Natural Teak wood	United States	<1%	2.92	1.00				
Neodymium	China	93%	5.83	1.10	China	99%	5.83	1.10
Neodymium	Other non EU countries	4%	0.00	1.00	United Kingdom	1%	2.60	1.00
Neodymium	United Kingdom	3%	2.60	1.00	Other non EU Countries	<1%	0.00	1.00
Neodymium					Vietnam	<1%	5.75	1.00
Nickel	South Africa	28%	4.65	1.00	Russian Federation	17%	6.20	1.10
Nickel	Greece	20%	4.60	0.80	Finland	14%	1.98	0.80
Nickel	Finland	18%	1.98	0.80	Other non EU	11%	0.00	1.00
Nickel	Canada	14%	2.26	1.00	United Kingdom	10%	2.60	0.80
Nickel	Brazil	8%	5.08	1.00	Russian Federation	9%	6.20	1.00
Nickel	Spain	6%	3.62	0.80	Norway	9%	2.03	1.00
Nickel	United States	2%	2.92	1.00	Greece	4%	4.60	0.80
Nickel	Norway	1%	2.03	1.00	Australia	4%	2.36	1.00
Nickel	Poland	1%	3.60	0.80	Ukraine	4%	6.23	1.00
Nickel	Other non EU	<1%	0.00	1.00	Canada	4%	2.26	1.00
Nickel	Indonesia	<1%	5.47	1.10	Brazil	3%	5.08	1.00
Nickel					Madagascar	3%	6.26	1.00
Nickel					French Guiana	2%	3.23	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Nickel					France	2%	3.11	0.80
Nickel					Macedonia, Fyr	2%	5.07	1.00
Nickel					Poland	<1%	3.60	0.80
Nickel					Austria	<1%	2.50	0.80
Niobium					Brazil	85%	5.08	1.00
Niobium					Canada	13%	2.26	1.00
Niobium					United Kingdom	1%	2.60	1.00
Niobium					Switzerland	<1%	2.03	1.00
Niobium					Belize	<1%	5.31	1.00
Niobium					Russian Federation	<1%	6.20	1.00
Niobium					United Arab Emirates	<1%	3.94	1.00
Niobium					South Africa	<1%	4.65	1.00
Niobium					Norway	<1%	2.03	1.00
Niobium					United States	<1%	2.92	1.00
Niobium					Turkey	<1%	5.34	1.00
Niobium					Japan	<1%	2.77	1.00
Niobium					Serbia	<1%	5.05	1.00
Perlite	Greece	68%	4.60	0.80				
Perlite	Turkey	13%	5.34	1.00				
Perlite	Hungary	5%	4.06	0.80				
Perlite	South Africa	5%	4.65	1.00				
Perlite	Italy	4%	4.17	0.80				
Perlite	Slovakia	2%	3.79	0.80				
Perlite	Other Non Eu Countries	1%	0.00	1.00				
Perlite	China	<1%	5.83	1.00				
Perlite	Mozambique	<1%	5.93	1.00				
Perlite	United States	<1%	2.92	1.00				
Perlite	Bulgaria	<1%	4.73	0.80				
Perlite	Switzerland	<1%	2.03	1.00				
Perlite	Australia	<1%	2.36	1.00				
Perlite	Uzbekistan	<1%	6.98	1.00				
Perlite	Russian Federation	<1%	6.20	1.00				
Perlite	Hong Kong Sar, China	<1%	2.56	1.00				
Perlite	Ukraine	<1%	6.23	1.00				
Perlite	Canada	<1%	2.26	1.00				
Perlite	Syrian Arab Republic	<1%	7.96	1.00				
Perlite	Iran, Islamic Rep.	<1%	6.65	1.00				
Perlite	Macedonia, Fyr	<1%	5.07	1.00				
Perlite	Israel	<1%	3.83	1.00				
Perlite	Serbia	<1%	5.05	1.00				
Perlite	Japan	<1%	2.77	1.00				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Perlite	Moldova	<1%	5.54	1.00				
Perlite	Tunisia	<1%	5.40	1.00				
Perlite	Pakistan	<1%	6.78	1.00				
Perlite	Norway	<1%	2.03	1.00				
Perlite	Korea, Rep.	<1%	3.74	1.00				
Perlite	Kuwait	<1%	5.24	1.00				
Perlite	Other Eu Countries	<1%	0.00	0.80				
Perlite	Sri Lanka	<1%	5.36	1.00				
Phosphate rock	Morocco	24%	5.48	1.00				
Phosphate rock	Russian Federation	20%	6.20	1.00				
Phosphate rock	Finland	16%	1.98	0.80				
Phosphate rock	Algeria	11%	6.43	1.00				
Phosphate rock	Israel	7%	3.83	1.00				
Phosphate rock	Syrian Arab Republic	6%	7.96	1.00				
Phosphate rock	Senegal	4%	5.21	1.00				
Phosphate rock	Egypt, Arab Rep.	4%	6.48	1.04				
Phosphate rock	South Africa	3%	4.65	1.00				
Phosphate rock	Jordan	3%	5.16	1.00				
Phosphate rock	Togo	2%	6.34	1.00				
Phosphate rock	Other non-EU countries	1%	0.00	1.00				
Phosphate rock	Mozambique	1%	5.93	1.00				
Phosphorus					Kazakhstan	71%	5.90	1.20
Phosphorus					Vietnam	18%	5.75	1.00
Phosphorus					China	9%	5.83	1.20
Phosphorus					Other Non Eu Countries	3%	0.00	1.00
Potash	Germany	57%	2.47	0.80				
Potash	Spain	12%	3.62	0.80				
Potash	Russian Federation	11%	6.20	1.00				
Potash	Belarus	9%	6.18	1.10				
Potash	United Kingdom	4%	2.60	1.00				
Potash	Chile	3%	3.11	1.00				
Potash	Canada	2%	2.26	1.00				
Potash	Israel	2%	3.83	1.00				
Potash	Other Non Eu Countries	1%	0.00	1.00				
Praseodymium	China	93%	5.83	1.10	China	99%	5.83	1.10
Praseodymium	Other non EU countries	4%	0.00	1.00	United Kingdom	1%	2.60	1.00
Praseodymium	United Kingdom	3%	2.60	1.00	Other non EU Countries	<1%	0.00	1.00
Praseodymium					Vietnam	<1%	5.75	1.00
Rhenium					Poland	78%	3.60	0.80
Rhenium					Korea, Rep.	7%	3.74	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Rhenium					Uzbekistan	7%	6.98	1.00
Rhenium					Iran, Islamic Rep.	7%	6.65	1.00
Samarium	China	93%	5.83	1.10	China	99%	5.83	1.10
Samarium	Other non EU countries	4%	0.00	1.00	United Kingdom	1%	2.60	1.00
Samarium	United Kingdom	3%	2.60	1.00	Other non EU Countries	<1%	0.00	1.00
Samarium					Vietnam	<1%	5.75	1.00
Sapele wood					Congo, Dem. Rep.	<1%	7.60	1.00
Sapele wood	Cameroon	55%	6.59	1.00				
Sapele wood	Congo, Rep.	18%	6.73	1.00				
Sapele wood	Congo, Dem. Rep.	13%	7.60	1.00				
Sapele wood	Malaysia	9%	4.39	1.00				
Sapele wood	Other Non Eu Countries	4%	0.00	1.00				
Sapele wood	Gabon	1%	5.97	1.00				
Scandium					United Kingdom	98%	2.60	0.80
Scandium					Russian Federation	1%	6.20	1.00
Scandium					Kazakhstan	<1%	5.90	1.00
Scandium					Hong Kong Sar, China	<1%	2.56	1.00
Scandium					United States	<1%	2.92	1.00
Selenium					Germany	42%	2.47	0.80
Selenium					Belgium	12%	2.81	0.80
Selenium					Other Non Eu Countries	11%	0.00	1.00
Selenium					Russian Federation	6%	6.20	1.00
Selenium					Finland	6%	1.98	0.80
Selenium					Poland	5%	3.60	0.80
Selenium					United Kingdom	4%	2.60	1.00
Selenium					Taiwan, China	4%	3.27	1.00
Selenium					China	3%	5.83	1.00
Selenium					Japan	3%	2.77	1.00
Selenium					Sweden	2%	2.05	0.80
Selenium					Norway	2%	2.03	1.00
Silica sand	Netherlands	47%	2.19	0.80				
Silica sand	Italy	12%	4.17	0.80				
Silica sand	France	8%	3.11	0.80				
Silica sand	Germany	6%	2.47	0.80				
Silica sand	Bulgaria	6%	4.73	0.80				
Silica sand	Spain	5%	3.62	0.80				
Silica sand	Poland	4%	3.60	0.80				
Silica sand	Belgium	3%	2.81	0.80				
Silica sand	Latvia	1%	3.73	0.80				
Silica sand	Austria	1%	2.50	0.80				

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Material	Country	Share	WGI	t	Country	Share	WGI	t
Silica sand	Czech Republic	1%	3.47	0.80				
Silica sand	Denmark	1%	2.11	0.80				
Silica sand	Sweden	1%	2.05	0.80				
Silica sand	Romania	1%	4.70	0.80				
Silica sand	Slovakia	<1%	3.79	0.80				
Silica sand	Tunisia	<1%	5.40	1.00				
Silica sand	Egypt, Arab Rep.	<1%	6.48	1.00				
Silica sand	Slovenia	<1%	3.50	0.80				
Silica sand	United Kingdom	<1%	2.60	1.00				
Silica sand	Croatia	<1%	4.27	0.80				
Silica sand	Other Non Eu Countries	<1%	0.00	1.00				
Silica sand	Hungary	<1%	4.06	0.80				
Silica sand	Greece	<1%	4.60	0.80				
Silica sand	Lithuania	<1%	3.50	0.80				
Silica sand	Serbia	<1%	5.05	1.00				
Silica sand	Portugal	<1%	3.34	0.80				
Silica sand	Estonia	<1%	3.07	0.80				
Silica sand	Ireland	<1%	2.58	0.80				
Silicon metal					Norway	30%	2.03	1.00
Silicon metal					France	20%	3.11	0.80
Silicon metal					China	11%	5.83	1.10
Silicon metal					Brazil	7%	5.08	1.00
Silicon metal					Germany	6%	2.47	0.80
Silicon metal					Spain	6%	3.62	0.80
Silicon metal					Other Non Eu Countries	5%	0.00	1.00
Silicon metal					Russian Federation	4%	6.20	1.00
Silicon metal					Bosnia And Herzegovina	3%	5.44	1.00
Silicon metal					Australia	3%	2.36	1.00
Silicon metal					United Kingdom	2%	2.60	1.00
Silicon metal					Iceland	1%	2.52	1.00
Silicon metal					United States	1%	2.92	1.00
Silicon metal					Thailand	1%	5.50	1.00
Silver	Mexico	27%	5.33	1.00	Germany	22%	2.47	0.80
Silver	Peru	27%	5.30	1.00	Italy	16%	4.17	0.80
Silver	Poland	15%	3.60	0.80	France	9%	3.11	0.80
Silver	Argentina	13%	5.47	1.00	Belgium	8%	2.81	0.80
Silver	Sweden	5%	2.05	0.80	United States	7%	2.92	1.00
Silver	Canada	3%	2.26	1.00	Switzerland	6%	2.03	1.00
Silver	United States	2%	2.92	1.00	United Kingdom	6%	2.60	1.00
Silver	Bolivia	2%	5.97	1.10	Austria	5%	2.50	0.80
Silver	Morocco	1%	5.48	1.00	Japan	4%	2.77	1.00
Silver	Norway	1%	2.03	1.00	Argentina	2%	5.47	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Silver	South Africa	1%	4.65	1.00	Spain	1%	3.62	0.80
Silver	Panama	1%	4.79	1.00	Turkey	1%	5.34	1.00
Silver	Bulgaria	1%	4.73	0.80	Bulgaria	1%	4.73	0.80
Silver	Portugal	<1%	3.34	0.80	Other Non Eu Countries	1%	0.00	1.00
Silver	Greece	<1%	4.60	0.80	Czech Republic	1%	3.47	0.80
Silver	Spain	<1%	3.62	0.80	Netherlands	1%	2.19	0.80
Silver	Romania	<1%	4.70	0.80	Morocco	1%	5.48	1.00
Silver	Finland	<1%	1.98	0.80	Poland	1%	3.60	0.80
Silver	Ireland	<1%	2.58	0.80	Brazil	1%	5.08	1.00
Silver	Tajikistan	<1%	6.88	1.00	Canada	1%	2.26	1.00
Silver	Other Non Eu Countries	<1%	0.00	1.00	Norway	1%	2.03	1.00
Silver	Slovakia	<1%	3.79	0.80	Other Eu Countries	1%	0.00	0.80
Silver					China	1%	5.83	1.00
Silver					Greece	<1%	4.60	0.80
Silver					Sweden	<1%	2.05	0.80
Silver					Korea, Rep.	<1%	3.74	1.00
Silver					Bolivia	<1%	5.97	1.00
Silver					Peru	<1%	5.30	1.00
Strontium	Spain	100%	3.62	0.80				
Strontium	China	<1%	5.83	1.00				
Strontium	Japan	<1%	2.77	1.00				
Strontium	Other Non-EU countries	<1%	0.00	1.00				
Strontium	Mexico	<1%	5.33	1.00				
Strontium	Canada	<1%	2.26	1.00				
Sulphur					Finland	16%	1.98	0.80
Sulphur					Poland	14%	3.60	0.80
Sulphur					Italy	14%	4.17	0.80
Sulphur					Other Eu Countries	14%	0.00	0.80
Sulphur					Germany	13%	2.47	0.80
Sulphur					Spain	12%	3.62	0.80
Sulphur					Bulgaria	8%	4.73	0.80
Sulphur					Kazakhstan	3%	5.90	1.00
Sulphur					Russian Federation	3%	6.20	1.00
Sulphur					Other Non Eu Countries	1%	0.00	1.00
Sulphur					Turkey	<1%	5.34	1.00
Sulphur					Serbia	<1%	5.05	1.00
Sulphur					Norway	<1%	2.03	1.00
Talc	France	28%	3.11	0.80				
Talc	Finland	28%	1.98	0.80				
Talc	Italy	12%	4.17	0.80				
Talc	Austria	10%	2.50	0.80				

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Talc	Pakistan	10%	6.78	1.00				
Talc	China	4%	5.83	1.10				
Talc	Australia	3%	2.36	1.00				
Talc	Other Eu Countries	1%	0.00	0.80				
Talc	India	1%	5.45	1.00				
Talc	Egypt, Arab Rep.	1%	6.48	1.00				
Talc	Other Non Eu Countries	1%	0.00	1.00				
Talc	United States	1%	2.92	1.00				
Talc	Korea, Rep.	<1%	3.74	1.00				
Talc	Norway	<1%	2.03	1.00				
Talc	Korea, Dem. Rep.	<1%	7.74	1.00				
Tantalum	Congo, Dem. Rep.	36%	7.60	1.00				
Tantalum	Rwanda	30%	5.17	1.10				
Tantalum	Brazil	13%	5.08	1.00				
Tantalum	Ethiopia	6%	6.52	1.00				
Tantalum	Nigeria	5%	6.83	1.00				
Tantalum	Mozambique	5%	5.93	1.00				
Tantalum	Burundi	3%	7.00	1.10				
Tantalum	Australia	2%	2.36	1.00				
Tantalum	France	1%	3.11	0.80				
Tellurium					Other non EU countries	42%	0.00	1.00
Tellurium					Ukraine	28%	6.23	1.00
Tellurium					Sweden	9%	2.05	0.80
Tellurium					China	7%	5.83	1.00
Tellurium					Russian Federation	5%	6.20	1.00
Tellurium					Canada	2%	2.26	1.00
Tellurium					Hong Kong Sar, China	2%	2.56	1.00
Tellurium					United Kingdom	2%	2.60	1.00
Tellurium					Bulgaria	1%	4.73	0.80
Tellurium					Peru	1%	5.30	1.00
Tellurium					Japan	1%	2.77	1.00
Tellurium					Philippines	<1%	5.49	1.00
Terbium	China	69%	5.83	1.10	China	98%	5.83	1.10
Terbium	Japan	18%	2.77	1.00	Other non EU Countries	1%	0.00	1.00
Terbium	United Kingdom	6%	2.60	1.00	United Kingdom	1%	2.60	1.00
Terbium	Russian Federation	5%	6.20	1.00				
Terbium	Other non EU countries	2%	0.00	1.00				
Tin	United States	44%	2.92	1.00	Belgium	26%	2.81	0.80
Tin	Portugal	33%	3.34	0.80	United Kingdom	15%	2.60	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Tin	Spain	8%	3.62	0.80	Peru	14%	5.30	1.00
Tin	Thailand	7%	5.50	1.00	Other Non Eu Countries	14%	0.00	1.00
Tin	Hong Kong Sar, China	2%	2.56	1.00	Malaysia	10%	4.39	1.00
Tin	United Arab Emirates	1%	3.94	1.00	Thailand	6%	5.50	1.00
Tin	Other Non Eu Countries	1%	0.00	1.00	Poland	6%	3.60	0.80
Tin	United Kingdom	1%	2.60	1.00	Singapore	4%	2.37	1.00
Tin	Tanzania	1%	5.74	1.00	China	3%	5.83	1.10
Tin	Japan	1%	2.77	1.00	Brazil	3%	5.08	1.00
Tin	China	1%	5.83	1.10	Spain	<1%	3.62	0.80
Tin	Other Eu Countries	<1%	0.00	0.80				
Titanium	Norway	25%	2.03	1.00				
Titanium	South Africa	18%	4.65	1.00				
Titanium	Canada	16%	2.26	1.00				
Titanium	Australia	11%	2.36	1.00				
Titanium	Mozambique	9%	5.93	1.00				
Titanium	India	7%	5.45	1.10				
Titanium	Ukraine	5%	6.23	1.00				
Titanium	Sierra Leone	3%	6.17	1.10				
Titanium	Brazil	3%	5.08	1.00				
Titanium	Kenya	1%	6.03	1.00				
Titanium	China	1%	5.83	1.10				
Titanium	Egypt, Arab Rep.	<1%	6.48	1.00				
Titanium	United States	<1%	2.92	1.00				
Titanium	Vietnam	<1%	5.75	1.20				
Titanium	Other Non Eu Countries	<1%	0.00	1.00				
Titanium	Russian Federation	<1%	6.20	1.00				
Titanium	Georgia	<1%	4.47	1.00				
Titanium	Senegal	<1%	5.21	1.00				
Titanium	Sri Lanka	<1%	5.36	1.00				
Titanium	Turkey	<1%	5.34	1.00				
Tungsten	Austria	35%	2.50	0.80				
Tungsten	Portugal	27%	3.34	0.80				
Tungsten	Spain	27%	3.62	0.80				
Vanadium					Austria	52%	2.50	0.80
Vanadium					Russian Federation	32%	6.20	1.00
Vanadium					China	6%	5.83	1.10
Vanadium					South Africa	5%	4.65	1.00
Vanadium					Brazil	1%	5.08	1.00
Vanadium					Germany	1%	2.47	0.80
Vanadium					Taiwan, China	1%	3.27	1.00

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	I stage				II stage			
Material	Country	Share	WGI	t	Country	Share	WGI	t
Vanadium					Thailand	1%	5.50	1.00
Vanadium					United States	<1%	2.92	1.00
Vanadium					other non eu countries	<1%	0.00	1.00
Yttrium	China	69%	5.83	1.10	China	98%	5.83	1.10
Yttrium	Japan	18%	2.77	1.00	Other non EU Countries	1%	0.00	1.00
Yttrium	United Kingdom	6%	2.60	1.00	United Kingdom	1%	2.60	1.00
Yttrium	Russian Federation	5%	6.20	1.00				
Yttrium	Other non EU countries	2%	0.00	1.00				
Zinc	Australia	17%	2.36	1.00	Spain	21%	3.62	0.80
Zinc	Ireland	13%	2.58	0.80	Finland	13%	1.98	0.80
Zinc	Peru	13%	5.30	1.00	Netherlands	12%	2.19	0.80
Zinc	Other Eu Countries	12%	0.00	0.80	Belgium	11%	2.81	0.80
Zinc	Sweden	11%	2.05	0.80	Other Eu Countries	9%	0.00	0.80
Zinc	United States	9%	2.92	1.00	Germany	7%	2.47	0.80
Zinc	Bolivia	5%	5.97	1.00	France	7%	3.11	0.80
Zinc	Turkey	3%	5.34	1.00	Poland	7%	3.60	0.80
Zinc	Mexico	3%	5.33	1.00	Peru	3%	5.30	1.00
Zinc	Canada	3%	2.26	1.00	Norway	3%	2.03	1.00
Zinc	Other Non Eu Countries	3%	0.00	1.00	Namibia	3%	4.44	1.00
Zinc	Macedonia, Fyr	2%	5.07	1.00	United Kingdom	1%	2.60	1.00
Zinc	Chile	2%	3.11	1.00	Mexico	1%	5.33	1.00
Zinc	Namibia	1%	4.44	1.00	Other Non Eu Countries	1%	0.00	1.00
Zinc	Morocco	1%	5.48	1.00	Kazakhstan	1%	5.90	1.00
Zinc	Burkina Faso	1%	5.74	1.00	Brazil	<1%	5.08	1.00
Zinc	Serbia	1%	5.05	1.00	India	<1%	5.45	1.00
Zinc	Honduras	1%	6.06	1.00				
Zirconium	South Africa	43%	4.65	1.00				
Zirconium	Australia	31%	2.36	1.00				
Zirconium	Mozambique	9%	5.93	1.00				
Zirconium	Senegal	6%	5.21	1.00				
Zirconium	Ukraine	4%	6.23	1.00				
Zirconium	Kenya	3%	6.03	1.00				
Zirconium	Other non EU countries	2%	0.00	1.00				
Zirconium	Madagascar	1%	6.26	1.00				
Zirconium	United States	1%	2.92	1.00				

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Annex 8. Worked example of assessment calculation

For the purpose of illustration, step-by-step criticality assessment calculations for Cobalt are shown here. Emphasis is given on the double stage assessment.

Economic importance (EI)

Raw material end-use applications are assigned to the EU's manufacturing sectors at NACE Rev.2 (2 digit level). The weighted sum of application share of by manufacturing sector and Gross Value-Added (GVA) is calculated:

Table 18: Weighted sum of application share by manufacturing sector and GVA

Application	Share	2-digit NACE sector	NACE sector GVA (M€)	Contribution to EI (Share x sector GVA)
Source: Cobalt Institute		Source: ESTAT		JRC elaboration*
Superalloys, hardfacing/HSS and other alloys	36%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351	53,407
Hard materials (carbides and diamond tools)	14%	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351	20,324
Pigments and Inks	13%	C20 - Manufacture of chemicals and chemical products	105,514	13,717
Catalysts	12%	C20 - Manufacture of chemicals and chemical products	105,514	12,556
Tyre adhesives and paint dryers	11%	C20 - Manufacture of chemicals and chemical products	105,514	11,290
Magnets	7%	C27 - Manufacture of electrical equipment	80,745	5,329
Battery	3%	C27 - Manufacture of electrical equipment	80,745	2,180
Other – Biotech, Surface Treatment, etc	6%	C20 - Manufacture of chemicals and chemical products 0	105,514	5,803
Total				**124,606**

**Selecting the correspondence between applications and NACE 2 sectors is done by JRC and validated during stakeholders consultation*

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The sum of "contribution to EI" is ponderated using the Substitute Index for Economic Importance – SI(EI)[55] linked to substitute cost and technical performance:

$$SI(EI)_{Cobalt} = 0.92$$

$$\textbf{EI (unscaled)}_{\textbf{Cobalt}} = 124{,}606 \times 0.92 = \textbf{114,733}$$

The result is scaled by dividing the calculated EI score by the highest value of the manufacturing sector NACE Rev.2 at the 2-digit level and multiplied by 10, in order to obtain the value in the scale between 0-10:

$$\textbf{EI (scaled)}_{\textbf{Cobalt}} = 114{,}733 / 196{,}055 \times 10 = \textbf{5.85}$$

Supply risk (SR)

Production data for cobalt, both extraction and processing stage, are given below. To move from fractional shares to a supply risk score, which is based on the Herfindahl-Hirschmann-Index (HHI), the square of the shares is needed. In the calculation of supply risk, the square of the shares are first multiplied by the scaled World governance Index (WGI), leading to a "contribution to HHI_{WGI}". This calculation is performed for both the global supply (GS) and the EU supply (EU) and for the two stages, separately.

A trade variable (t), representing export taxes, export quotas and export prohibitions is used to adjust the HHI_{WGI} into $HHI_{WGI\text{-}t}$

Table 19: Stage I (ores and intermediates). Concentration risk for global supply: Global Supply Risk – $(HHI_{WGI\text{-}t})_{GS}$

Country	Share of production	WGI_{scaled}	Contribution to $(HHI_{WGI})_{GS}$	T (trade variable)*	Contribution to $(HHI_{WGI\text{-}t})_{GS}$
Source: WMD		Source: WorldBank	JRC elaboration		
DR Congo	58.7%	7.60	2.62	1.10	2.88
China	7%	5.83	0.03	1.10	0.03
Canada	5%	2.26	0.01	1.00	0.01
Australia	4%	2.36	<0.01	1.00	<0.01
Zambia	4%	5.40	0.01	1.10	0.01
French Guiana	3%	3.23	<0.01	1.00	<0.01
Cuba	3%	5.87	<0.01	1.00	<0.01
Philippines	2%	5.49	<0.01	1.00	<0.01

[55] JRC elaboration o multiple sources – see Factsheet for list of references

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Country	Share of production	WGI_{scaled}	Contribution to $(HHI_{WGI})_{GS}$	T (trade variable)*	Contribution to $(HHI_{WGI-t})_{GS}$
Madagascar	2%	6.26	<0.01	1.00	<0.01
Brazil	2%	5.08	<0.01	1.00	<0.01
Russia	2%	6.20	<0.01	1.00	<0.01
Finland	1%	1.98	<0.01	0.80	<0.01
Indonesia	1%	5.47	<0.01	1.10	<0.01
Papua New Guinea	1%	5.94	<0.01	1.00	<0.01
Morocco	1%	5.48	<0.01	1.00	<0.01
South Africa	1%	4.65	<0.01	1.00	<0.01
United States	<0%	2.92	<0.01	1.00	<0.01
Zimbabwe	<0%	7.17	<0.01	1.00	<0.01
Botswana	<0%	3.89	<0.01	1.00	<0.01
Vietnam	<0%	5.75	<0.01	1.00	<0.01
Uganda	<0%	5.99	<0.01	1.00	<0.01
			2.68		**2.95**

**based on OECD database of export restrictions and European Commission database on trade agreements*

Table 20: Stage I (ores and intermediates). Concentration risk for EU supply: EU Supply Risk – $(HHI_{WGI-t})_{EU}$

Country	Share of production	WGI_{scaled}	Contribution to $(HHI_{WGI})_{EU}$	T (trade variable)*	Contribution to $(HHI_{WGI-t})_{EU}$
Source: WMD, Eurostat Comext, Roskill		Source: WorldBank	JRC elaboration		
DR Congo	68%	7.60	3.55	1.10	3.90
Finland	14%	1.98	0.04	0.80	0.03
Canada	5%	2.26	0.01	1.00	0.01
Russia	5%	6.20	0.02	1.00	0.02
French Guiana	5%	3.23	0.01	1.00	0.01
South Africa	0%	4.65	<0.01	1.00	<0.01
Australia	1%	2.36	<0.01	1.00	<0.01

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Other non EU countries	2%	0.00	0.00	1.00	0.00
			3.62		**3.97**

**based on OECD database of export restrictions and European Commission database on trade agreements*

Table 21: Stage II (metal). Concentration risk for global supply: Global Supply Risk – $(HHI_{WGI-t})_{GS}$

Country	Share of production	WGI_{scaled}	Contribution to $(HHI_{WGI})_{GS}$	T (trade variable)*	Contribution to $(HHI_{WGI-t})_{GS}$
Source: USGS, Cobalt Market Review		Source: WorldBank	JRC elaboration		
China	49%	5.83	1.40	1.10	5.83
Finland	12%	1.98	0.03	0.80	0.02
Canada	6%	2.26	0.01	1.00	0.01
Australia	5%	2.36	0.01	1.00	0.01
Zambia	5%	5.40	0.01	1.00	0.01
Japan	4%	2.77	<0.01	1.00	<0.01
Norway	4%	2.03	<0.01	1.00	<0.01
Madagascar	3%	6.26	<0.01	1.00	<0.01
Russian Federation	3%	6.20	<0.01	1.00	<0.01
Congo, Dem. Rep.	3%	7.60	<0.01	1.10	0.01
Morocco	2%	5.48	<0.01	1.00	<0.01
Belgium	2%	2.81	<0.01	0.80	<0.01
Brazil	1%	5.08	<0.01	1.00	<0.01
South Africa	1%	4.65	<0.01	1.00	<0.01
Uganda	1%	5.99	<0.01	1.00	<0.01
Mexico	<1%	5.33	<0.01	1.00	<0.01
India	<1%	5.45	<0.01	1.00	<0.01
France	<1%	3.11	<0.01	0.80	<0.01
			1.48		**1.61**

**based on OECD database of export restrictions and European Commission database on trade agreements*

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Table 22: Stage II (ores and intermediates). Concentration risk for EU supply: EU Supply Risk – $(HHI_{WGI-t})_{EU}$

Country	Share of production	WGI_{scaled}	Contribution to $(HHI_{WGI})_{EU}$	T (trade variable)*	Contribution to $(HHI_{WGI-t})_{EU}$
Source: Eurostat Comext, USGS, Cobalt Market Review		Source: WorldBank	JRC elaboration		
Finland	54%	1.98	0.58	0.80	0.46
Belgium	7%	2.81	0.01	0.80	0.01
Norway	7%	2.03	0.01	1.00	0.01
United States	7%	2.92	0.01	1.00	0.01
Zambia	4%	5.40	0.01	1.00	0.01
Madagascar	4%	6.26	0.01	1.00	0.01
China	4%	5.83	0.01	1.00	0.01
UK	3%	2.60	<0.01	1.00	<0.01
Russia	2%	6.20	<0.01	1.10	<0.01
DR Congo	2%	7.60	<0.01	1.00	<0.01
France	1%	3.11	<0.01	0.80	<0.01
Japan	1%	2.77	<0.01	1.00	<0.01
Uganda	1%	5.99	<0.01	1.00	<0.01
Congo, Rep.	1%	6.73	<0.01	1.00	<0.01
Brazil	1%	5.08	<0.01	1.00	<0.01
South Africa	1%	4.65	<0.01	1.00	<0.01
Morocco	<1%	5.48	<0.01	1.00	<0.01
Qatar	<1%	4.03	<0.01	1.00	<0.01
Other non EU countries	<1%	0.00	0.00	1.00	0.00
			0.65		**0.54**

**based on OECD database of export restrictions and European Commission database on trade agreements*

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The following formula is used to calculate SR:

$$SR = \left[\left(HHI_{WGI,t}\right)_{GS} \cdot \frac{IR}{2} + \left(HHI_{WGI,t}\right)_{EU} \cdot \left(1 - \frac{IR}{2}\right)\right] \cdot (1 - EoL_{RIR}) \cdot SI_{SR}$$

Import reliance (IR) is based on EU import, export (Eurostat Comext) and domestic production (WMD, USGS, Cobalt Market Review) and for cobalt is:

$$IR_{I\ stage} = 86\%$$
$$IR_{II\ stage} = 27\%$$

The weighted sum of HHI for GS and EU is then ponderated using the **Substitute Index for Supply Risk – SI(SR)** and the **End-of-life Recycling Input Rate (EoL-RIR)**[56]:

$$SI(SR)_{Cobalt} = 0.92$$
$$EoL\text{-}RIR_{Cobalt} = 22\%$$

SR results for the first and second stages of cobalt:

$$SR_{Cobalt,\ ores\ and\ intermediates} = \left[2.95 \cdot \frac{0.86}{2} + 3.97 \cdot \left(1 - \frac{0.86}{2}\right)\right] \cdot (1 - 0.22) \cdot 0.92 = \mathbf{2.5}$$

$$SR_{Cobalt,\ metal} = \left[1.61 \cdot \frac{0.27}{2} + 0.54 \cdot \left(1 - \frac{0.27}{2}\right)\right] \cdot (1 - 0.22) \cdot 0.92 = \mathbf{0.5}$$

The thresholds for the criticality assessment are set at 2.8 for economic importance and 1 for supply risk. Therefore cobalt is assessed as critical for the first stage due to both economic importance and supply risk exceed the thresholds, while the second stage results as no critical. If at least one stage exceed the two thresholds, the candidate raw material is assessed as critical.

Table 23: EI and SR results for cobalt

I stage (ores and intermediates)	II stage (metal)
EI = 5.9	EI = 5.9
SR = 2.5	SR = 0.5

[56] JRC elaboration of multiple sources – see Factsheet for list of references

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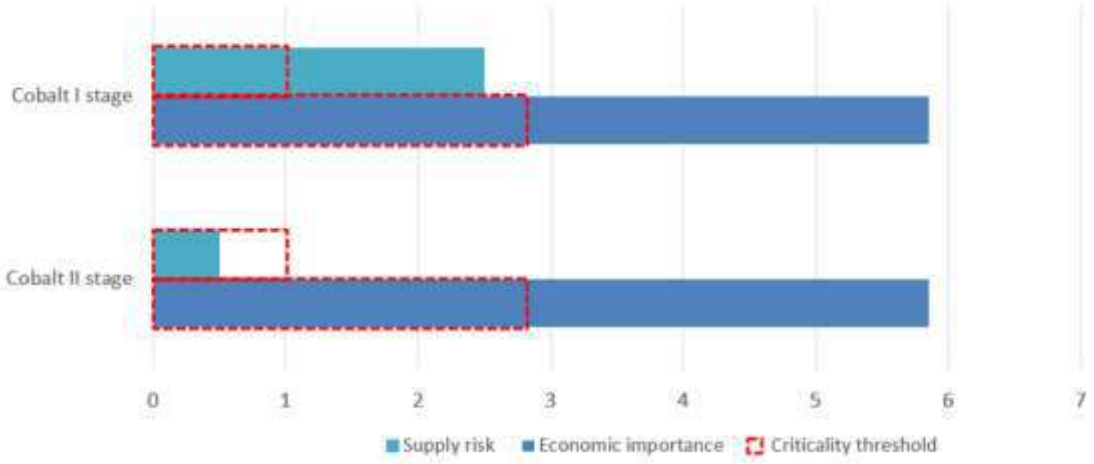
Figure 15: EI and SR results for cobalt



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Annex 9. Summary report of the stakeholder validation workshops

Workshop 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 H2020 project SCRREEN. These meetings were aimed to review 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 discuss any recommendations to improve results.

Three stakeholder data collection and validation workshops took place on 10, 11 and 12 September 2019 at the Hotel Thon in Brussels. The aim of these stakeholder workshops was not to discuss the revised criticality methodology, which had been validated by the AHWG and the Commission, but to discuss in detail the criticality calculations for each of the materials covered during each workshop and to review and validate the data used in criticality assessments. Experts were also asked to contribute to relevant sections of the factsheets.

A balance between the involvement of relevant stakeholders and methodological rigour is essential. For example, in order to maintain objective and transparent results, the workshops should not allow for extensive participation, or even decision making of particular stakeholders regarding the project itself. On the other hand, 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

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.

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.

A 1-page summary summarising the content of the excel calculation files.

Draft factsheets

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.

Final workshop organisation

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Table 24 provides details on the materials that were covered during the stakeholder validation workshops that were held on 11-12-13September 2019.

Table 24: Organisation of the stakeholder workshops

Workshop I: 10 September 2019					
9:30	Registrations				
10:00	Welcome by the European Commission and SCRREEN				
	Background and guidance for the workshop				
11:00	Zinc	11:00	Germanium	11:00	Potash
11:30	Sulphur	11:30	Tellurium	11:30	Bauxite
12:00	Vanadium (45min)	12:00	Fluorspar	12:00	Aluminum
12:45	Copper	12:30	Bismuth (45min)	12:30	Aggregates
13:15	LUNCH BREAK				
14:00	Light Rare Earth	14:00	Feldspar	14:00	Baryte (45min)
14:30		14:30	Gypsum	14:45	Natural Rubber (45min)
15:00		15:00	Diatomite		
15:30	Heavy Rare Earth	15:30	Rhenium	15:30	Natural Teak Wood
16:00		16:00	Molybdenum	16:00	Natural Cork
16:30		16:30	Lead	16:30	Sapele Wood
17:00	Wrap up				

Workshop II: 11 September 2019					
9:30	Registrations				
10:00	Welcome by the European Commission and SCRREEN				
	Background and guidance for the workshop				
11:00	Lithium	11:00	Magnesite	11:00	Coking Coal
11:30		11:30	Magnesium	11:30	Kaolin Clay
12:00	Cobalt	12:00	Perlite	12:00	Boron/Borates
12:30		12:30	Limestone	12:30	Selenium
13:00	LUNCH BREAK				
14:00	Nickel	14:00	Beryllium	14:00	Helium (45min)
14:30		14:30	Bentonite	14:45	Hafnium (45min)
15:00	Manganese	15:00	Gallium		
15:30		15:30	Titanium	15:30	Antimony
16:00	Natural Graphite	16:00	Talc	16:00	Gold
16:30		16:30	Silica Sand	16:30	ARSENIC
17:00	Wrap up				

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Workshop III: 12 September 2019					
9:30	Registrations				
10:00	Welcome by the European Commission and SCRREEN				
	Background and guidance for the workshop				
11:00	Tin	11:00	Chromium	11:00	Indium
11:30	Palladium	11:30	Phosphate Rock	11:30	Silver
12:00	Ruthenium + Iridium	12:00	Phosphorus (45min)	12:00	Silicon metal
12:30	Platinum			12:30	Cadmium
13:00	LUNCH BREAK				
14:00	Rhodium	14:00	Tungsten	14:00	HYDROGEN
14:30	Scandium	14:30	Niobium	14:30	STRONTIUM
15:00	Iron Ore	15:00	Tantalum (45min)	15:00	ZIRCONIUM
15:45	Wrap up				

Follow-up of the validation workshops

Several follow-up actions were carried out after the SCRREEN workshops:

- A summary of key discussion points raised by workshop attendees related to the overall work carried out on the criticality assessments.
- 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.
- 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.

The list of SCRREEN experts is displayed in Table 25.

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Table 25: Validation workshops attendance list

Family Name	First Name	Organisation	Country
Almeida Azevedo	Joao Paulo	Sinergeo, SAGHA, Lda.	Portugal
Anastasatou	Marianthi	National and Kapodistrian University of Athens	Greece
Areas Alonso	Antonio	MInas y Geologia	Spain
Arvanitidis	Nikolaos	Geological Survey of Sweden (SGU)	Sweden
Balomenos	Efthymios	NTUA / MYTILINEOS METALLURGY	Greece
Bhagwat	Mukund	Mukund Bhagwat Consultancy Comm V	Belgium
Bonoli	Alessandra	University of Bologna	Italy
Braconi	Aurelio	EUROFER	Belgium
Braibant	Caroline	International Antimony Association	Belgium
Branche	Nathalie	AMG Antimony	France
Brown	Teresa	British Geological Survey	United Kingdom
Carpantier	Jean-Francois	Universit Aix-Marseille	France
Carpels	Mark	Campine	Belgium
Castresana-Pelayo	Jose M.	MAXAM	Spain
Ceschini	Lorella	University of Bologna	Italy
Chanson	Claude	RECHARGE	Belgium
Chavasse	roland	Tantalum-Niobium International Study Centre (T.I.C.)	Belgium
Coles	George	Roskill Information Services Ltd	United Kingdom
Corti	Fabrizio	IMERYS GRAPHITE AND CARBON	Switzerland
Cristo	Nelson	ASSIMAGRA - Mineral Resources of Portugal	Portugal
de la Feld	Marco	ENCO srl	Italy
De Oliveira	Daniel P.	LNEG - Laboratorio Nacional Energia e Geologia	Portugal
Deschamps	Yves	Orano Mining	France
Di Girolamo	Giovanni	ENEA	Italy
Dodds	Chris	The University of Nottingham	United Kingdom
Dondi	Michele	CNR-ISTEC	Italy
Eilu	Pasi	Geological Survey of Finland	Finland
Eriksen	Dag Oistein	Primus.inter.pares AS	Norway
Ferrero	Anna Maria	University of Turin	Italy
Fontbote	Lluis	University of Geneva, Switzerland	Switzerland
Forrière	Barbara	RENAULT SA	France
Forsgren	Christer	Stena Recycling International	Sweden
Ganev	Iva	EUROALLIAGES	Belgium
Garcia-Balbuena	David	Terrafame Oy	Finland
Gauss	Roland	EIT RawMaterials GmbH	Germany
Gautneb	Havard	Geologial survey of Norway	Norway
Girardi	Francesca	IMA Europe	Belgium
Gloaguen	Eric	BRGM (French Geological Survey)	France
Gomez-Barreiro	Juan	Universidad de Salamanca	Spain
Goovaerts	Hilde	Campine	Belgium
Gutierrez Peinador	Vicente	CONFEDEM	Spain
Hagelueken	Christian	Umicore	Germany
Hebestreit	Corina	Euromines	Belgium

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Huxtable	Peter	Huxtable associates	United Kingdom
Jaouen	Frederic	CNRS	France
JULIENNE	DIDIER	JULIENNE RESOURCES	France
Kapyaho	Asji	Geological Survey of Finland	Finland
Kalvig	Per	GEUS	Denmark
Karas	Henryk	Advisory Mining Board; Ministry of Environment; Poland	Poland
Koehle	Julian	International Platinum Group Metals Association	Germany
Koukouzas	Nikolaos	CERTH	GREECE
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Lapkovskis	Vjaceslavs	Riga Technical University	Latvia
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Macedo	Gustavo	CBMM	The Netherlands
Maehlmann	Peter	TROPAG Oscar H. Ritter Nachf. GmbH	Germany
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Marchan	Carmen	Minsitry for Ecological Transition	Spain
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Mlynarczyk	Michal Stanislaw	Redstone Exploration Services Sp. z o.o.	Poland
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EIT RAW MATERIALS STRATEGIC AGENDA 2021-2027

The EIT – Making Innovation Happen

Berlin |15 March 2021

European Institute of Innovation and Technology (EIT)

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1 EXECUTIVE SUMMARY

EIT RawMaterials is a key European actor to advance Europe's transition into a sustainable economy. EIT RawMaterials has the overarching mandate to support securing the supply of critical and other strategically important raw materials to the European industry by driving innovation along the raw materials value chain. The activities of EIT RawMaterials contribute to maintaining and increasing Europe's competitiveness whilst securing and creating new jobs.

The COVID-19 crisis has increased the importance of supply security by causing major disruptions of entire international supply chains and putting at risk the competitiveness of key European industrial ecosystems. The establishment of a European Raw Materials Alliance (ERMA) driven by EIT RawMaterials will restore the resilience of European value chains through relocating critical supply chain steps into Europe.

EIT RawMaterials has evolved to an open, integrated, outward-looking and expanding partnership closely connected with the policy agenda of the European Commission and driven by a strategy to create industrial symbiosis through innovation across value chains. In 2021, EIT RawMaterials has left behind its ramp-up period and becomes a mature KIC with a strong partner base, excellent impact profile and solid pathway to financial sustainability. From the start- and scale-up phase (2015-2020) the KIC is now entering into a network- and service-focused organisation (2021-2027) with the ambitious aim to emerge as a stand-alone and profitable, fully-fledged professional service organisation (> 2027).

This fundamental shift, coupled with the critical mass and quality of our partner base, will enable the provision of the most important services to our current and future partners: the ability to generate intelligence, drive innovation across value chains and create societal and economic impact for Europe. This, together with our international reputation and vision, will shape EU policies for the needs of our sector and our partnership. At global scale, EIT RawMaterials is committed to contribute to and fully comply with the UN Sustainable Development Goals (UN SDGs) in any activities we do. Major UN SDGs EIT RawMaterials contributes to are #9, Industry, innovation and infrastructure; #11, Sustainable cities and communities; #12, Responsible production and consumption; and #13, Climate action.

Sustainable extraction, processing and use of raw materials today receives unprecedented industrial and political attention in Europe, illustrated clearly by the raw material dependency of the energy, mobility and manufacturing sectors. As the European spearhead in raw materials innovation and business, EIT RawMaterials is better positioned than ever before at all political levels, strongly contributing to the Green Deal, Industry Strategy, Circular Economy Action Plan, Digital Agenda and Higher Education Initiative for the European Union.

EIT RawMaterials builds on the world's largest network of excellent partners in raw materials and advanced materials – strong in large industry presence needed for innovation in the sector, and integrating start-ups and SMEs that play an important role as innovators, suppliers and customers to large industry actors. In its first five years of operation, EIT RawMaterials has had a significant impact on where innovation happens in the raw materials sector: while supporting critical innovation processes between universities, RTOs and large industry, we saw a rise of new start-ups and SMEs in the raw materials field, traditionally covered by consolidated large industry. A lack of start-ups was clearly identified by a study of McKinsey & Company

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and System IQ on behalf of EIT RawMaterials in 2016 and could be closed for the most important raw materials value chain steps – within only 5 years of existence. By closing the gap between small and large industries, EIT RawMaterials ensures that start-ups and SMEs get their ideas validated with the best players in Europe. This has already been demonstrated in many up-scaling projects where start-ups and large industry co-create innovative products and services, establishing new profitable growth opportunities. EIT-labelled education programmes additionally contribute to initiate disruptive innovation by further developing entrepreneurial skills and mindsets of students. This will be a game changer for established business models but also new, fast moving fields such as Circular Economy.

EIT RawMaterials will further boost its outreach activities by leading important industry alliances, including cross-KIC activities, by participating in existing H2020 and future Horizon Europe funding schemes and by continuing to develop strong synergies with DG Grow and other key actors at EU scale. EIT RawMaterials will raise additional external financing possibilities at national and regional levels through existing and new RIS Hubs, maintain and expand its partner base via strong regional footprints and proactively commercialise its value-adding services. EIT RawMaterials is excellently positioned to innovate through an ecosystem approach as highlighted in the new Industry Strategy for Europe. By providing a compelling offer of breakthrough concepts, for business, education, innovation and technology it will continuously extend its ability to reach out and influence external stakeholders, EIT RawMaterials is increasing the impact and range of services that can be offered to its partners.

EIT RawMaterials' partnership is the core strength and key success factor of the KIC. Even in difficult times with short term requirements on financial sustainability and additional challenges such as an unprecedented external shock caused by COVID-19, the core of the partnership is still supportive to the KIC, sharing their concerns for example through position papers. This is *the* true and winning key asset of EIT RawMaterials and must be naturally the key asset for any Community like a KIC.

EIT RawMaterials has the best possible base to start developing a fundamental change of its partnership, business and operational models. The vision and strategic objectives that were defined for the Community in the beginning – securing raw materials supply, designing materials solutions, closing materials loops – are still relevant for the future and in accordance with the latest EU policy papers. The strategic objectives are sharpened by defining clear goals and relating to the mission statement of the new strategic roadmap: "EIT RawMaterials will advance Europe's transition to sustainability by driving innovation along the raw materials value chain." Portfolio management and foresight guided by the vision, mission, strategic objectives and lighthouses will matter more in the future to stress EIT RawMaterials' support to EU policies and strategies and continue to position EIT RawMaterials as a well-known brand.

In 2020, EIT RawMaterials is entering a new phase, marked by reaching the top of the EIT funding curve, with EIT funding starting to decline in 2021, in line with the general initial EIT funding model and projections. The way to innovate will thus be a different one in the future: there will be less EIT funding, less co-funding and lower levels of individual membership fees available; the level of committed funding to projects will stay high and continuously be brought forward over the next 2-3 years. Taking into account these developments, EIT RawMaterials will redefine the membership strategy and its business model as such. EIT RawMaterials will remain open for new partners from across the raw materials value chain and from all over Europe including RIS countries and regions.

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The way to innovate will have to consider short- and mid-term challenges whilst keeping its fundamental mission to be a major contributor to the EU Green Deal, the Circular Economy Action Plan and the securing of raw materials supply through driving innovation. To upgrade the innovation model, EIT RawMaterials will actively engage with external funding actors for an increased amount of co-financing and adapt the organisation accordingly. This will also require a change of portfolio management and operational models – for example, going from large annual calls to smaller agile within-the-year calls. Ideally, this will be supported by higher flexibility coming from multi-annual grants and the elimination of the KCA model under Horizon Europe. Additional push by the EIT and the KICs at large is required to strive for simplification at all levels as also recently expressed by the ITRE Committee and in order to stay competitive against other funding sources.

EIT RawMaterials will further improve the way the organisation is supporting the partnership through HQ and CLC level activities in partner and project management and support, servicing, access to alternative financing, market intelligence and foresight, and other key areas. This will also require changes in the performance targets and systems on all organisational levels. EIT RawMaterials will further sharpen its portfolio of activities according to the new strategic roadmap as well as EU priorities and foresight. The newly revised Strategic Agenda 2021-2027 is fully aligned with the strategic priorities of Horizon Europe. EIT RawMaterials will prioritise and focus on activities that are mutually beneficial for the Community *and* the organisation as well as strive for a financially sustainable, professional service organisation.

2 STRATEGIC ANALYSIS OF THE SOCIETAL CHALLENGE

2.1 EIT RawMaterials: key European enabler of a green, circular economy

"We have to be very vigilant that today's dependency on fossil fuels like oil and gas is not replaced by dependency on lithium, cobalt, copper and other raw materials that we need for the green transition, where Europe is leading the way (Maroš Šefčovič, Vice-president of the European Commission)"

Metals and minerals are the fundamental building blocks of advanced materials, tools and machinery used to sustain all primary and secondary industry sectors and, ultimately, for the widespread implementation of carbon-neutral green energy technologies and the transition from the linear to the circular economy. Lithium, cobalt, 'scrap metal' and 'e-waste' are becoming part of the normal lexicon of young Europeans, but represent only the tip of the iceberg of the 'basket' of commodities needed to support this transition. Europe's mining and processing industries, although accounting for less than 3% of the world's production, directly employ over 1 million people generating a yearly turnover of around EUR 65 billion. The advanced

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materials industry comes with 10 million jobs in its value chains and contributes to more than EUR 650 billion annually to Europe's GDP (EC, RMIS, RM Scoreboard, 2018).

Over the first five years of its existence, EIT RawMaterials has developed a strong and diverse community of over 400 industry, research and academic partner institutions. While providing a stable and reliable platform for networking, innovation and education, EIT RawMaterials has succeeded in connecting very diverse market sectors into integrated value chains, thus highlighting market opportunities as well as Europe's vulnerability to disruptions of the supply chains brought about by natural, geopolitical and economic crises. This community has the credentials, drive and expertise to lead the implementation of the Green Deal in terms of raw materials supply, both from primary (mining) and secondary (recycling) sources, as well as the design and production of new advanced materials needed to achieve a carbon-neutral Europe. Over the next seven years, EIT RawMaterials will spearhead and coordinate activities that will support Europe's ambition to become the world leader in implementing the transition to the green, circular economy.

Figure 1: Raw Materials Value Chain

2.2 Societal Challenges

Raw and advanced materials are critically important for achieving the fundamental goals set in COP21 and in the 2030 *Agenda for Sustainable Development*: long-term mitigation (temperature rise below 2 °C) by enabling the development of alternative and sustainable energy and mobility technologies; reduction of vulnerability through the establishment of secure supply chains; and capacity building to safeguard the skills and infrastructures needed to guarantee the prosperity of European citizens.

Promoting education, innovation and business creation activities under consideration of the societal challenges tackled by EIT RawMaterials will remain a fundamental part of our strategy execution model. Two of the challenges faced by EIT RawMaterials were among the triggers for the establishment of the EIT – the need to develop and educate 'T-shaped' professionals for Industry 4.0, and the need for R&D investment beyond basic research and closing the gap between IP ownership and loss of know-how, innovation capacity and technology leadership. Consequently the three strategic objectives (SO) of EIT RawMaterials – securing raw materials supply; designing materials solutions; and closing materials loops – are connecting the societal challenges together with the industrial transformation needs that are specific to the European raw and advanced materials sector along the entire value chain:

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1. Dependency on imported raw and advanced materials, leading to vulnerability to external disruptions in supply chains (SO 1 - securing raw materials supply).
2. Low social acceptance of the raw and advanced materials extraction and production, leading to public perception that the sector is not compatible with the goals of the Green Deal (SO 1 - securing raw materials supply; and SO 3 - closing materials loops).
3. The design and production of advanced materials, components and products that enable the transition to a carbon-neutral Europe have increasingly moved to non-European countries, putting European innovation capacity at risk (SO 2 - designing materials solutions).
4. Need to transition from the 'brown energy' to the 'green energy', and from the linear economy to the circular economy to fulfil the aspirational goals of the Green Deal (SO 3 - closing materials loops; and SO 2 - designing materials solutions).

Moving towards Horizon Europe, EIT RawMaterials continues to address the Societal Challenges already identified within Horizon 2020: 'Climate action, environment, resource efficiency and raw materials', 'Secure, clean and efficient energy', and 'Smart, green and integrated transport'. Specific UN SDGs addressed include 'Quality Education', 'Industry, Innovation and Infrastructure', 'Responsible Consumption and Production' and 'Life on Land', 'Clean Water and Sanitation', 'Affordable and Clean Energy', 'Decent Work and Economic Growth' and 'Sustainable Cities and Communities'.

EIT RawMaterials 'Lighthouses' are large-scale and long-term innovation initiatives that address critical and specific raw materials challenges for Europe. Lighthouses are mission approaches to innovation and education challenges, directly providing an operational link between societal challenges and strategic objectives. The three EIT RawMaterials Lighthouses – Sustainable Discovery and Supply (Sustainability starts with Europe's resource potential); Sustainable Materials for Future Mobility (Innovation in electrification and lightweight design enabling energy transition); and Circular Societies (Closing material loops: a radical shift from linear to circular thinking) – guide activities across the KIC's education, innovation and business creation portfolios. For each Lighthouse, technological roadmaps have been developed, are kept up-to-date and are regularly discussed with the partners at different occasions (e.g. RM Expert Fora). Lighthouses thus serve as an important basis for the KIC's intelligence and knowledge base and add to the brand and visibility of EIT RawMaterials. They connect the partnership to large-scale, multidisciplinary EC initiatives such as the European Raw Materials Alliance, the European Battery Alliance, the New Industrial Strategy for a Green and Digital Europe, and the Circular Economy Action Plan.

2.3 The Context

Europe is highly dependent on importing raw and advanced materials to secure the global competitiveness of its manufacturing industries and to accelerate the transition to a resource-efficient, carbon-neutral and sustainable society. This dependency has increased over time and is undermining our ability to maintain the innovation leadership that has underpinned EU's economic prosperity and social harmony.

Europe is using 23% of the world's mine production for metals and minerals but only produces 2-3 % itself. (European Commission, 2017).

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An increasing number of raw materials with particularly high economic importance are exposed to a significant supply risk, which is why they are deemed to be critical. Once considered the backbone of the European economy, mining, production and processing have declined in the EU over the last decades.

Reliable and sustainable sources of the commodities needed to boost Europe's prosperity and world leadership in the green economy do abound within Europe. Much of the European continent remains under-explored in terms of greenfield geological resources, and most comprehensive exploration campaigns, especially in the Balkans and Eastern Europe, date back to the mid-fifties. Huge reserves remain to be found onshore, especially under thick sedimentary cover (e.g. north German basin) as well as offshore. In addition to greenfield deposits, Europe has a millennial legacy of sites impacted by mining and industrial activities. These countless 'brownfield' sites represent an untapped local resource potential for the transition to a green economy.

Despite the existence of abundant resources, there are substantial bottlenecks (regulatory and financial) in the up- and mid-stream of traditional sectors (e.g., equipment manufacturing and aerospace and defence) as well as in the emerging strategic EU industrial value chains such as microelectronics, batteries, hydrogen technologies and clean vehicles. These hurdles need to be overcome to unlock local investment and financing, and there is an urgent need to maintain the skill base and professional workforce required to transition from the brown to the green economy. European industries must also maintain their innovative edge and leadership in recycling and advanced materials design to secure the prosperity of European citizens and the effective transition to the circular economy. This innovative edge requires a stable, secure, socially and environmentally responsible source and supply of raw materials and production of advanced materials, a strong skills base and supportive policies.

The unfolding global health crisis due to COVID-19 has highlighted our vulnerability to the disruption of raw and advanced materials supply chains. Once the medical emergency is over and the economic recovery is under way, it will become imperative to secure the supply of raw materials within Europe and to maintain a solid skills base for the processing, engineering and design of advanced materials. Under these conditions, the EU will be able to develop a new model of society that can thrive in a sustainable and socially equitable manner in the good times, and remain functional during the bad times brought about by health, environmental and political crises.

2.4 SWOT Analysis

EIT RawMaterials has evolved from an organization almost entirely focused on traditional thematic areas and on a portfolio driven by individual consortia to an open, integrated and outward-looking partnership closely aligned with the EC policy agenda, and whose strategy is driven by value chains through its three Lighthouses. This fundamental shift, coupled with the critical mass and quality of our partner base, will enable the provision of the most important services to our current and future partners: the ability to generate knowledge, intelligence and drive innovation in the sector across value chains, and the international standing and vision required to influence EU policies that will benefit the sector and therefore our partnership.

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Table 1: SWOT Analysis

Strengths	***Opportunities***
• Strong partnership across primary and secondary sectors, upstream and downstream along the respective value chains • Pool of talented and well-educated people • Driving the knowledge triangle (Education, Innovation, Research) across Europe by integrating business • Knowledge base and industrial infrastructure • Interdisciplinary approach across values chains • Strong presence in RIS regions and integration with high-quality education programmes (LLL, WSL, labelled programmes) • Strategic objectives and actions matching societal challenges and Sustainability Development Goals • Strong network and mechanisms to support entrepreneurs, start-ups and SMEs	• Further alignment with EC and development of stronger synergies with other EU raw materials strategies (e.g. RawMaterials Initiative; EIP on Raw Materials) • Achieve financial sustainability through European Raw Materials Alliance • Connecting cross-regional, -project, -partner and -KIC activities • Attracting investments in disruptive and game-changing technologies and innovation • Complementary equity funding for upscaling projects • Further develop organizational agility, speed, simplicity and excellence • Decided Marketing and Branding • Highlighted relevance of the sector in recent EU policies (Green Deal, New Industry strategy) and through recent events (COVID-19 pandemic) • Leadership in Circular Economy activities and synergies with the extended KIC community • Readiness for digitalization of educational activities • Additional financing for KIC Partners (e.g. EIC)
Weaknesses	***Threats***
• Uneven distribution of partners across value chains – some sections are under-represented, especially downstream the value chain (possible mitigation via ERMA and cross-KIC collaboration) • Low financial sustainability of education projects • Low impact of some activities in the early years of the KIC (mitigation measures taken) • Uneven distribution of budget and resources in the early years of the KIC (mitigation measures taken) • Limited resources relative to the range and diversity of activities across many sectors	• EU legislation, fiscal policies and trade conditions are not supportive of the sector, especially for primary production • Administrative process burden deteriorating competitiveness towards other funding sources • Lack of awareness/acceptance from the public • Distorted market conditions for raw and processed materials • Vulnerability to disruptions in the supply chains • Lack of investment due to capital-intensive nature of the sector and low commodity prices due to current economic/geopolitical environment • Continued loss of high-value materials production and processing to non-European countries • Sector not attractive to students and to the skilled workforce that is necessary to implement the Digital Transformation and Industry 4.0

2.5 Synergies

Our strategic priorities (Lighthouses) and objectives are fully aligned with the goals of the Green Deal, and strong synergies have been forged with the EC and other institutions to unite our partners under a common voice at the political level and tackle perhaps the main challenge faced by our sector in Europe: the unfavourable fiscal and trade policies, leading to lack of competitiveness under distorted market conditions.

'Trade policy also needs to ensure undistorted, fair trade and investment in raw materials that the EU economy needs for the green transition' (The Green Deal).

Our synergies and outreach activities recognize that incremental innovation is not sufficient to address current and future economic, environmental and social challenges. What is needed is radical behavioural

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change in individuals, governments and corporations. Therefore, EIT RawMaterials is stepping out of its original role as mere 'innovation enabler' to become a driver of policy change on behalf of its members.

Table 2: Elements of Green Deal addressed by EIT RawMaterials

Elements of the Green Deal	Goals	EIT RawMaterials strategic contribution and SDGs addressed
2.1.3 Mobilising industry for a clean and circular economy	Support and accelerate the transition to a circular economy. Introduce legal requirements to boost the market of secondary raw materials.	The **Lighthouse Circular Societies** supports activities that i) optimize the material chain for end-of-life products and optimize the recycling of minerals and metals; ii) increase the substitution of critical and toxic materials in products; and iii) improve the design of products for the circular economy. SDGs addressed: 9, 11, 12 (indirect: 4, 7, 8)
	Ensure the supply of sustainable raw materials by diversifying supply from both primary and secondary sources.	One of the primary goals of the **Lighthouse Sustainable Discovery and Supply** is to unlock the potential for a renewed raw materials sector in Europe, both form primary and secondary sources, as a driver for domestic raw material value chains. SDGs addressed: 11, 12 (indirect: 4, 6, 15)
2.1.2 Supplying clean, affordable and secure energy	Development of a power sector based largely on renewable sources like wind turbines and solar panels. Prioritisation of energy efficiency	EIT RawMaterials contribute with the **Lighthouse Sustainable Discovery and Supply** to increase the environmental, economic and societal sustainable exploration, extracting and processing of minerals and metals in Europe which are needed for a renewable energy sector. SDGs addressed: 7, 9, 12 (indirect: 4, 8, 11) The **Lighthouses Sustainable Materials for Future Mobility** deals with the development and implementation of energy efficiency technologies for all parts of the value chain of mineral resources, including advanced materials for energy-efficient technologies and renewable energy solutions. SDGs addressed: 7, 11,13 (indirect: 3, 4, 9, 12)
2.1.5 Accelerating the shift to sustainable and smart mobility	Ramp-up the production and deployment of sustainable alternative transport fuels	Minerals and metals play an important role for the increase of zero- and low-emission vehicles. The **Lighthouse Sustainable Materials for Future Mobility** has an active role in relevant industrial alliances to foster and strengthen the European minerals and metals sector. SDGs addressed: 7, 11,13 (indirect: 3, 4, 9, 12)
2.1.8 A zero-pollution ambition for a toxic-free environment	Restore the natural functions of ground and surface water; protect citizens and the environment against hazardous chemicals	EIT RawMaterials projects across the **three Lighthouses** are developing technologies to reduce waste water pollution in the mining, processing and production sector and to substitute hazardous chemicals and minerals in the production process. SDGs addressed: 6, 12, 15 (indirect: 4, 13)
2.1.1 Increasing the EU´s Climate ambition for 2030 and 2050 (zero CO_2 emissions in 2050)	Ensure an effective carbon pricing throughout the economy and a new carbon border adjustment.	EIT RawMaterials supports this goal across the **three Lighthouses.** Under new carbon pricing and carbon border adjustment mechanisms, the minerals and metals extracted in Europe will be more attractive to local industries and will provide the material and industry infrastructure needed for the transition to the green economy. This will strengthen the European minerals and metals sector and increase the investments in further environmentally sustainable innovations. SDGs addressed: 7, 13, 16 (indirect: 4, 8, 9, 11, 12)

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3 VISION, MISSION AND STRATEGIC OBJECTIVES

3.1 KIC's vision

EIT RawMaterials envisions to **develop raw and advanced materials into a major strength for Europe**. EIT RawMaterials sees a Europe that bases its industrial competitiveness on cost-efficient, sustainable and innovative use of raw materials from secure and traceable sources, and on highly-skilled people, entrepreneurs and innovative education systems.

In this vision, products, processes and services are designed to maximise the value of the materials used to implement a circular and sustainable economy. Improving the performance of existing material cycles and designing new ones for circularity will attract new investments, harness the innovation capacity of start-ups, SMEs and large industry for competitiveness, as well as attract the interest of talented, skilled, entrepreneurial people. Society will become more aware of its dependence on raw materials, and the sector will be perceived as innovative and attractive. This is why EIT RawMaterials applies a holistic and systemic approach in technology, entrepreneurship and talent development.

3.2 KIC's mission

The strength and complementarity of the EIT RawMaterials community will contribute to realising the ambitious vision for Europe. This is possible because the community creates and maintains knowledge, skills and technology across the entire raw materials value chain: from exploration, mining, processing and metallurgy of raw materials, to the design of tools and equipment, smart products and services, and end-of-life product management and recycling. Knowledge, skills and technology are applied across sectorial boundaries between primary and secondary industries. EIT RawMaterials therefore has a pivotal role in making Europe succeed under rapidly developing challenges, as articulated in our mission statement:

EIT RawMaterials' mission is to advance Europe's transition to sustainability by driving innovation along the raw material value chain.

Being part of the EU agenda and based on its expertise, the community identifies itself by four unique selling propositions:

1. We are the world's leading partnership on raw materials
2. We develop Europe's raw materials talent and technology
3. Our community proactively addresses cross value chain challenges
4. We foster investment cases securing raw materials supply and supporting a green transition

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3.3 KIC's strategic objectives

To fulfill its mission, EIT RawMaterials sets three strategic objectives: 1) Securing raw materials supply; 2) designing materials solutions; and 3) closing materials loops. These objectives are complementary and invite the cross- fertilisation by different actors and in different areas of expertise across the raw materials value chain. Innovative solutions to raw materials challenges emerge where the three strategic objectives interact, but also within each of the strategic objectives themselves. To build even stronger synergies in addressing global raw materials challenges, the strategic objectives are implemented through the EIT RawMaterials Lighthouses. The new European Raw Materials Alliance (ERMA) will enable EIT RawMaterials to maintain a healthy member base especially with industry, and to create a new platform for financial sustainability including educational activities. In parallel, we will actively participate to the implementation of the Higher Education Institutions (HEI) initiative that by increasing the entrepreneurial and innovation capacities of theses institutions and their interaction with the ecosystems of innovation should significantly contribute to the achievement of these strategic objectives.

Each strategic objective will be reached by a combination of the KIC's activity areas:

- **Learning and Education** including Wider Society Learning (WSL), Lifelong Learning (LL), MSc and PhD training, as well as increasing the innovation and entrepreneurship capacity of Higher Education Institutions
- **Acceleration** including Upscaling (UPS) and Start-up creation and growth
- **Matchmaking and Networking** in Europe and with third countries
- **Strategic co-operation** with business and civil society
- **Contribution to trade policy, EU Industrial Policy and policies related to circular economy**

During 2021-2027, EIT RawMaterials will continue to use EIT funding for these activities, but shall increasingly rely on other funding sources such as alternative European, national and regional funds, private equity and commercial services offered by EIT RawMaterials. Additional bridge financing opportunities will arise from important European facilities such as EIC, EIB/EIF, EBRD and others. EIT RawMaterials will capitalise on those incremental financing opportunities by driving the dealflow of high growth ventures.

EIT RawMaterials embeds the EIT's **Regional Innovation Scheme** into all activity areas and future calls supporting achieving the strategic objectives. The majority of RIS countries in different parts of Europe are well endowed with natural resources and EIT RawMaterials has a very well established presence in all of them. While there are countries where strong Partners are already very active, there remain places where EIT RawMaterials can create stronger and long lasting impact. This shall be achieved directly through the KAVA activities driven by established Partners and the RIS Hubs. The latter serve as the local one-stop-shop for different KAVA activities where the interaction between interested parties and Knowledge Triangle Integration happens. The RIS Hubs of EIT RawMaterials together with the **HEI Capacity Building Initiative** will be utilised by the KIC to further promote KTI. For example, investments into developing Lithium deposits in Eastern Europe will create a demand for skilled people, which will be met by education programmes created by KIC partner universities located in RIS countries. A new mine will also create demand for suppliers and technology providers, which is a good opportunity for new start-ups to emerge. EIT RawMaterials will facilitate the RIS regions' readiness for such projects with capacity building activities offered to current and future partners. It will take into account local specifics to achieve maximum impact.

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The strategic objectives as well as KIC procedures, activities and programmes maintain the purpose to achieve gender balance in full alignment with the prevailing EU legal and policy framework. With dedicated activities such as the Go Circular program focusing on digital skills and circular economy for young girls we address early learners to become interested and inspired of the raw materials sector.

3.3.1 Strategic Objective 1: Securing raw materials supply

The European industry is fundamentally dependent on raw materials extraction and processing, which today mostly takes place outside of Europe. The market dominance of Chinese companies on rare earth elements vital to digital, defence, chemical and space industries, or that of Democratic Republic of Congo on cobalt needed for Li-ion batteries in electric vehicles are perfect illustrations of this dependency. What is more, the sustainability of raw materials from non-European sources is to be questioned in many cases. Europe's global industrial leadership needs to be built on a solid supply of sustainably extracted and processed raw materials both from European and non-European sites – "Europe's strategic autonomy for raw materials must again be brought to the forefront" (Anna-Michelle Asimakopoulou on Euractiv, 2020).

The strategic objective supports the EIT's overarching Strategic Objective (1) on "strengthening sustainable innovation ecosystems across Europe". The objective will be reached through the following actions: First, EIT RawMaterials focuses on securing raw materials supply from within Europe by strengthening and shortening raw materials supply chains in Europe from mines and secondary sources, and enabling sustainable new extraction and processing of raw materials. Through the **acceleration of innovations** to the market and **upscaling of technologies** in mining, processing and geological knowledge, new resources will be identified and mines, processing plants and recovery facilities will be established and upgraded. New search models and advanced digitalization created in upscaling projects and by SMEs supported by EIT RawMaterials are expected to lead to **at least one major ore discovery in Europe** by 2027. EIT RawMaterials' strong foothold in RIS countries is a key success factor here. EIT RawMaterials will position itself strategically in the development of new mining projects, which will contribute to this overarching goal. The focus of these activities will be two-fold: supporting key investments in the countries where EIT RawMaterials already has a well-established presence and fostering the relationships with investors in the countries where this presence could be strengthened. The latter is particularly relevant for the Balkan Peninsula.

Second, EIT RawMaterials provides access to investment and business opportunities to start-ups developing exploration technologies and to junior mining companies. By **creating matches** between start-ups, junior companies, large companies and investors EIT RawMaterials will contribute to the European exploration spending and consequently opening of new mines. As an overall European target, EIT RawMaterials expects **exploration spending** to grow from 2% to 4% of global total by 2030 – to achieve this, EIT RawMaterials develops strategic collaboration in setting up new exploration funds (e.g. with EBRD). The digital solutions such as sensors and remote operation systems developed by the KIC partners and start-ups will continue to contribute significantly to the transformation towards fully autonomous and zero emission mines. The KIC is foreseen to be involved in **opening of at least one new mine in Europe by 2027**.

Third, the strategic objective requires increasing the social license to operate (SLO) for new mines, urban mines and processing plants. Gaining the SLO is a process between a range of stakeholders where the already proven EIT RawMaterials **Wider Society Learning** will be deployed. Through **strategic co-operation** with the EC and the member states, EIT RawMaterials will contribute to securing raw material supply chains

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from EU trade partners thereby creating a more level playing field for European sustainable sourcing. EIT RawMaterials will lead the development of new tools for **ethical sourcing and traceability** of raw materials, and **establish industry alliances** as a key mechanism towards sustainable and secure supply of raw materials. Development of sustainability certification standards will allow the producers to demonstrate that their product and sourcing have been done in a sustainable manner and gain extra margins.

Finally, the strategic objective requires a sound skills base. Through **EIT-labelled and other focused education** activities EIT RawMaterials will deliver entrepreneurial talent to industry and local innovation ecosystems, fully integrating the KT. This is particularly pertinent in increasing the attractiveness of exploration, mining and minerals processing towards students as well as entrepreneurs. In addition, current workforce in the sector will engage in upskilling within the KIC's **Lifelong Learning** courses for professionals.

3.3.2 Strategic Objective 2: Designing materials solutions

When new products are designed, decisions are made which have significant consequences from an environmental and raw materials perspective. According to the EU Circular Economy Action plan, up to 80% of the environmental impacts of a product are defined at the design stage, and to a large degree these impacts result from the choice and design of materials in products. The approach towards the design of solutions must address the whole life cycle in a systemic way, from raw materials supply to materials innovation, advanced materials, products, product-service systems, processes, design of products for circularity, new business models, new policy measures, new taxation approaches, and new education and awareness methodologies.

The strategic objective supports the EIT's overarching Strategic Objective (3) on "bringing new solutions to global challenges to the market". It will be reached through the following actions: First, by **accelerating and upscaling the design and production of advanced and engineered materials,** the KIC will counter the trend of advanced materials development moving from Europe to other regions. In particular Asian countries have become increasingly competitive in advanced materials development. By bringing **new start-ups producing advanced and engineered materials and digital process solutions** to the market, and by **supporting the innovation capacity** of the existing European SMEs and large industry on advanced and engineered materials, EIT RawMaterials directly contributes to new strategic and critical materials being identified and engineered, to investment attracted, and to manufacturing plants opened and upgraded.

As a contribution of EIT RawMaterials activities, a **significant increase** of advanced materials production for batteries, fuel cells, magnets and e-drives will be seen in Europe by 2027. Additionally, new lightweight steel and aluminium solutions as well as highly durable and corrosion resistant materials for the process industry are emerging, contributing to the circular economy and reduction of greenhouse gas emissions in a wide range of applications. Specifically, the KIC is foreseen to be involved in the market launch of **first generation solid state batteries** and development of **new steel and aluminium alloy compositions to be** developed by EIT RawMaterials. The KIC is expected to be involved in the establishment of the **first precursor cathode materials plant in Europe**, as well as in the establishment of **at least one battery cathode and anode materials** manufacturing plant. A significant reduction in the amount of **rare earth elements in magnets production** is expected by 2025 as a result of the KIC's activity. The RIS region with its strong academic tradition in material science is emerging as a hotspot for innovation in advanced materials.

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The KIC will continue to create a talent pipeline to offer the best talent available to the industry and local innovation ecosystems on advanced materials development related to batteries, fuel cells, magnets, e-drives, renewable energy, and lightweighting. Upskilling the workforce through **Lifelong Learning**, education of entrepreneurially-minded individuals aiming for the advanced materials sector, as well as **higher education labelled and non-labelled programmes** will contribute to this objective. EIT RawMaterials is excellently positioned to increase the innovation capacity of Higher Education Institutions (HEIs) and contribute to the development of entrepreneurs. Finally, the Wider Society Learning activity will support policy decisions on the establishment of facilities for advanced and engineered materials and supply chains.

3.3.3 Strategic Objective 3: Closing materials loops

Raw, processed and advanced materials, from primary and secondary sources, are the backbone of the economy, and a radical shift is required from linear to circular thinking. End-of-life products must be considered as a resource for another cycle, while losses and stocks of unused materials must be minimized and valorized along the value chain. The latter is in particular relevant for secondary sources in RIS countries due to the low degree of recovery of process residues and end-of-life products. In addition, the interactions between materials must be considered for the best circular solution from a systemic standpoint. Awareness of the benefits of closing material loops must be raised in society. The successful transition to the circular economy at the global scale depends on reliable and sustainable supply and management of raw materials. This strategic objective is closely linked to the EU Circular Economy Action Plan adopted 11 March 2020, in particular for its focus on circularity in industrial processes and to move towards a 'zero waste' goal. EIT RawMaterials supports DG ENV regarding the Environmental Technology Verification (ETV) Programme.

The strategic objective supports the EIT's overarching Strategic Objective (2) on "fostering innovation and entrepreneurship through better education". The objective will be reached through the following actions: First, the KIC contributes to the design for circular economy by developing new designs and methodologies for material flow analysis and life-cycle assessment, as well as improving resource efficiency. Here, **upscaling and acceleration** activities are closely tied to the creation of knowledge through the KIC's **knowledge and dissemination** activities. As a result, it is foreseen that at least 10% of European companies in the raw materials sector are using standards and methods developed by partners of EIT RawMaterials. For example, improved Life Cycle Inventory databases for raw materials and advanced materials related to e-mobility will be provided.

Second, also through the **acceleration, access-to-finance and upscaling activities**, EIT RawMaterials will significantly contribute to the end-of-waste paradigm of the EU. The KIC is particularly suited to undertaking this, as the sector contributes to more than 25% in volume of all waste generated in Europe (Eurostat 2019). The KIC will develop new methodologies to increase **the raw and advanced materials' recycling rates** and extend to other materials, and improve utilization of process residues through industrial symbiosis and closed loops. This will be particularly applied in RIS countries where not only secondary sources can be valorized, but also recycling rates are substantially lower, providing room for improvement. The KIC can build on the expertise of its partner network and transfer knowledge to RIS countries. Through the **Wider Society Learning** activities, the KIC will contribute to the take-back of consumer electronics and increased recovery from industrial secondary streams. As concrete targets, the KIC will contribute to **doubling the recovery of critical raw materials** from the current levels, and to **implementing Zero Liquid Discharge** in at least 50% of new processing plants of the raw materials sector. Finally, the KIC contributes to the launch of

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two new smelting solutions in the steel and non-ferrous industries, making it possible to significantly increase the intake of complex recycled materials and reduce waste.

Finally, to ensure that Europe retains the skills base for a prosperous circular economy (design for post-use, reuse, remanufacturing, recycling, recovery), the KIC sets an ambitious target: Students and professionals trained by EIT RawMaterials in the Lifelong Learning, MSc and PhD programmes are the **most capable of solving circular economy challenges** and contributing to the Green Deal.

4 IMPACT AND RESULTS

4.1 Impact

Humanity stands... before a great problem of finding new raw materials and new sources of energy that shall never become exhausted. In the meantime, we must not waste what we have, but must leave as much as possible for coming generations." (Svante Arrhenius, Chemistry Nobel Prize in 1903)

Raw materials are essential to the transition to a carbon-neutral circular economy and to the implementation of the UN Sustainable Development Goals (UN SDGs). When impact is measured in terms of value added and jobs, the raw materials sector (extraction and processing) contributes around 140 billion euros and 2.5 million jobs to the European economy, with processing accounting for over 80% of these figures. Overall, the downstream industries depending on raw materials supply create close to EUR 2.5 trillion of value added and 40 million jobs (EC, RMIS, RM Scoreboard, 2018).

Since its establishment, EIT RawMaterials has succeeded in generating positive impact exceeding the initial expectations, with the most notable achievements to date (including forecast for 2020):

- Over 30 000 graduates in raw materials courses, with more than 220 graduates from EIT-labelled programmes and over 40% female gender ratio;
- More than 150 innovations introduced to the market and around 1 000 pilot/demo plants and prototypes;
- Five innovation hubs established in the RIS region, with over 20% of total EIT funding directed to RIS countries;
- More than 200 start-ups supported, and more than 140 MEUR attracted by entities supported by EIT RawMaterials.

In line with the EIT RawMaterials vision, mission and strategic objectives, the partnership will enable the creation of new European and international networks and alliances, innovation and entrepreneurial activities across the entire raw and advanced materials value chain.

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Driven by its ambitious financial sustainability targets and determination to become a leading organization in the international arena, EIT RawMaterials will focus its efforts on securing the funding to support and expand its activities. Smart solutions based on improved knowledge, comprehensive data and advanced technologies will boost the European raw materials sector and thereby reduce import dependency, diversify supply and contribute to economic growth. Social engagement through education, capacity building e.g. in RIS regions, networking and liaising with all involved stakeholders and the wider public will play a pivotal role in raising awareness and increasing acceptance of and participation in a renewed raw materials sector in Europe.

This highly competent and integrated partnership will support the most promising and effective solutions, which will lead to:

- Implementation of a circular economy[1]
- Increase in resource efficiency[2]
- Reduction of environmental impacts[3]
- Increased security of supply of raw materials that serve societal needs[4]
- Diverse, highly skilled and versatile workforce that will maintain Europe's competitive advantage[5]

These positive impacts will strengthen the competitiveness of industries across Europe and contribute to increased employment and growth.[6]

The well-established activity areas (upscaling and business creation and support; matchmaking and networking; education) will be scaled up and fully aligned with the Strategic Objectives and the United Nations Sustainable Development Goals to generate value for the partners and positive societal impacts for the wider community:

- **Acceleration (Upscaling and Business Creation and Support).** Engage with start-ups, SMEs as well as large research and industry organizations through more agile mechanisms ('regular' KAVAs, Acceleration and Booster calls, SME-support calls, fast-track calls and Knowledge Creation and Dissemination calls) to support activities and actions that will lead to high core and impact KPIs while at the same time contributing to the KIC's financial sustainability.
- **Education.** Create systemic impact by strengthening the innovation capacity of local innovation ecosystems: 1) increase the innovation and entrepreneurship capacity of Higher Education Institutes (HEIs); 2) empower entrepreneurs to transform knowledge into societal value; and 3) provide highly-skilled talent to industry / value chain stakeholders.
- **Matchmaking and Networking.** Strong engagement with the EC (DG Grow, DG RTD and DG Environment), other EIT KICs, relevant PPPs (e.g., SPIRE) and other networks (e.g., Battery Alliance) to align with and influence policy and trade decisions. Strong engagement with funding agencies (EC – including EIC - as well as International, national, investors) to reach financial sustainability

[1] Addressing United Nations Sustainable Development Goals (SDG) 11 (Sustainable Cities and Communities) and 12 (Responsible Consumption and Production)
[2] SDGs 7 (Affordable and Clean Energy), 9 (Industry, Innovation and Infrastructure), 11 and 12
[3] SDGs 6 (Clean Water and Sanitation), 13 (Climate Action) and 15 (Life on Land);
[4] SDGs 7, 9, 11 and 12
[5] SDGs 4 (Quality Education) and 5 (Gender Equality)
[6] SDG 8 (Decent Work and Economic Growth)

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goals. Dissemination and marketing activities to raise the profile of EIT RawMaterials as the leading organization and service provider in the sector (InfoCenter, Expert Fora, EIT RawMaterials Summit).

This process, coupled with a more rigorous selection and revision of funded projects, will lead to a drastic reduction and consolidation of the project portfolio and an equally dramatic increase in the quality of the activities and impact generated. This will include the focus on generating impact in the RIS regions to build their capacity and increase the innovation levels of the recipient countries.

The EU Joint Research Centre will support EIT RawMaterials by benchmarking us against similar organizations within and outside of Europe in order to establish and monitor the societal and economic impact of the sector as well as the specific impact of EIT RawMaterials on the sector. The EIT RawMaterials Alumni Association and the newly-introduced legacy-tracking process will ensure that the impact of projects is duly recorded beyond the funding phase and disseminated through the most appropriate channels and using target-specific language. This 'evidence of track-record' will enhance the reputation and credibility of the KIC community, thus boosting its international standing and attractiveness of its value proposition as a business partner.

In keeping with the refinement of its strategic agenda and with changes in the EIT core KPIs, EIT RawMaterials has reviewed its impact KPIs and aligned them with its strategic objectives and overall societal impact (Table 3). The matching is somewhat deceptive because most indicators address more than one strategic objective. The 2027 targets will be updated annually (this applies to all tables and figures in the core document as well as annexes).

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Table 3: EIT RawMaterials Impact Targets

Indicator	Target	2021	2022	2023	2024	2025	2026	2027	Strategic Objectives
Create business for the raw materials sector and for the advanced materials sector in Europe	Investment attracted in primary resources and advanced materials development (e.g., new infrastructure at pilot/demo/industry-scale, new mine, exploration spending)	300.0 M€	450.0 M€	600 M€	750 M€	950 M€	1100 M€	1300 M€	1,2,3
Improve industrial competitiveness of the raw materials sector and advanced materials sector in Europe	Savings and increase in sales resulting from improved material and energy efficiency	12 M€	20 M€	30 M€	40 M€	60 M€	80 M€	100 M€	1,2,3
Enable infrastructure investments in Europe	Number of new pilot/demo plants, prototypes, or production units	450	500	535	572	607	642	677	1,2,3
Bring back advanced materials development to Europe	Number of new advanced materials developed	-	1	1	2	3	4	5	2
	Develop new or improved products with reduced toxic materials	40	50	54	58	62	66	70	2
Increase the raw and advanced materials' recycling rates and extend to other materials	Increase in percentage recovery and recycling of selected CRMs over current rates	-	1% increase	1% increase	2% increase	3% increase	4% increase	5% increase	3
Enhanced sustainability	% of new and existing processing plants with reduced discharge	5%	10%	15%	20%	30%	40%	50%	3
	Total number of european companies in the raw materials sector using sustainability standards and methods developed by partners of EIT RawMaterials	0%	0%	1%	1%	2%	3%	5%	3
Integrate and leverage the RM potential in the RIS region	Integration of the RIS region – % funding RIS participants in non-RIS projects	20%	20%	20%	20%	20%	20%	20%	1,2,3
Ensure stable RM workforce	Creating/maintaining/re-skilling jobs in the RM sector (including conversion from brown technologies)[1]	1,000	1,300	1,900	2,800	5,800	8,900	12,000	1,2,3
Improve gender balance in the RM sector	Women graduating from RM-related courses	35%	37%	40%	40%	45%	45%	50%	1,2,3
Carbon savings in the RM sector	Percentage of CO_2 emitted savings	-	2%	3%	5%	10%	15%	20%	1,2,3
CRM substitution/reduction	Number of substitution cases	50	70	75	80	85	90	100	2
Raw materials produced in Europe	Percentage increase of raw materials produced in Europe	-	-	1%	2%	3%	4%	5%	1
Advanced materials produced in Europe	Percentage increase of advanced materials produced in Europe	-	-	1%	2%	3%	4%	5%	2

Notes: Cumulative or average targets.
1: Primary sector: maintaining jobs and converting jobs from brown to green technologies. Recycling: mainly creating new jobs. Cumulative target of 12,000 jobs in 2027 based on JRC Raw Materials Scoreboard 2018 data (see https://rmis.jrc.ec.europa.eu/?page=scoreboard2018#/ind/7), considering number of jobs in metals extraction and processing (Total 1,049,640 jobs - 12,000 jobs is about 1% of the total).

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4.2 Results

Table 4: Annual KPI targets

Code	KPIs	2021	2022	2023	2024	2025	2026	2027	Total 2021-2027
EITHE01.1	#Designed/Tested Innovations	2	4	14	15	15	15	15	80
EITHE01.3 EITRIS	EIT RIS Designed/Tested Innovations				18%				14
EITHE01.4 EITRIS	#EIT RIS Countries – Designed/Tested Innovations	0	0	1	2	3	3	3	
EITHE02.1	#Marketed Innovations	71	44	29	30	30	30	30	264
EITHE02.2 EITRIS	EIT RIS Marketed Innovations				16%				41
EITHE02.3 EITRIS	#EIT RIS Countries – Marketed Innovations	5	4	3	3	3	3	3	
EITHE03.1	#Supported Start-ups/Scale-ups	75	50	50	50	50	50	50	375
EITHE03.2 EITRIS	EIT RIS Start-ups/Scale-ups Supported				30%				112
EITHE03.3 EITRIS	#EIT RIS Countries – KIC supported Start-ups/Scale-ups	8	8	8	8	8	7	7	
EITHE04.1	#Start-ups created of/for innovation	6	2	2	10	10	10	10	50
EITHE04.2 EITRIS	#EIT RIS Start-ups created of/for innovation				16%				8
EITHE04.3 EITRIS	#EIT RIS Countries – Start-ups created of/for innovation	1	0	0	1	1	1	1	
EITHE05.1	#Start-ups created of EIT labelled MSc/PhD programmes	3	4	7	8	10	12	13	57
EITHE05.2 EITRIS	#EIT RIS Start-ups created of EIT labelled MSc/PhD programmes				16%				9
EITHE05.3 EITRIS	#EIT RIS Countries – Start-ups created of EIT labelled MSc/PhD programmes	0	0	0	0	1	1	1	
EITHE06.1	Investment attracted by KIC supported Start-ups /Scale-ups	10	10	10	10	10	10	10	70
EITHE06.2 EITRIS	Investment attracted by KIC supported EIT RIS Start-ups/Scale-ups				15%				10.5
EITHE06.3 EITRIS	# EIT RIS Countries – Investment attracted by KIC supported EIT RIS Start-ups/Scale-ups	1	1	2	2	3	3	3	
EITHE07.1	#Graduates from EIT labelled MSc/PhD programmes	184	140	160	180	200	200	200	1,264
EITHE07.2 EITRIS	# EIT RIS Graduates from EIT labelled MSc/PhD programmes				16%				205
EITHE07.3	% of Graduates in same disciplines from partner HEIs	22%	22%	22%	22%	22%	22%	22%	
EITHE08.1	#Participants in (non-degree) education and training	5,835	4,327	3,903	3,370	3,370	3,370	3,370	27,545
EITHE08.2 EITRIS	# EIT RIS Participants with (non-degree) education and training				17%				4,650
EITHE09.1	# EIT labelled MSc/PhD students and graduates who joined Start-ups	4	6	9	11	14	17	18	79
EITHE09.2 EITRIS	# EIT RIS EIT labelled MSc/PhD students and graduates who joined Start-ups				15%				12
EITHE10.1	# Active KIC Partners	300	300	300	300	300	300	300	
EITHE10.2 EITRIS	# EIT RIS Active KIC Partners				38%				115
EITHE10.3 EITRIS	# EIT RIS Countries – Active KIC Partners	14	14	14	14	14	14	14	
EITHE11.1	FS revenues	8.6	10.2	12.5	16.4	21.3	27.9	44.0	140.9
EITHE11.2	% FS coefficient	12%	15%	18%	22%	29%	43%	80%	
EITHE12.1	% Co-funding rate	35%	28%	30%	31%	34%	39%	50%	
EITHE13.1	# KIC success stories	20	20	20	20	20	20	20	140
EITHE13.2 EITRIS	# EIT RIS Success stories				16%				22
EITHE13.3 EITRIS	# EIT RIS Countries – Success stories	2	3	3	4	4	3	3	
EITHE 16.1	# HEIs involved in EIT and KIC activities	75	75	75	75	75	75	75	
EITHE 16.2	# RIS HEIs				40%				30
EITHE 16.3	# HEIs involved in the new HEI Action	6	8	10	13	15	15	15	82
EITHE 16.4	# RIS HEIs				15%				12

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5 GOVERNANCE AND OPERATION MODEL

5.1 Partnership

5.1.1 The diversity and strength of the partnership across the whole value chain

The EIT RawMaterials partnership consists of the most relevant partners for addressing European raw materials challenges. EIT RawMaterials connects and integrates actors from all parts of the raw materials value chain and from different fields of application that would not necessarily collaborate otherwise. This unique collaborative environment is fertile ground for breakthrough innovations and radically new ways to address raw materials challenges. EIT RawMaterials comprises more than 130 Core and Associate Partners from leading businesses, universities and research institutes, and an additional 200 Project Partners contributing to specific tasks in KAVA projects. To secure the capacity building of modest and moderate innovation ecosystems, EIT RawMaterials also offers the RIS Task Partner category to partners from the RIS region, who otherwise would not be able to participate in the KIC's activities. EIT RawMaterials will also explore the benefits of adopting a new SME partner category to increase the inclusiveness of the KIC and to boost the growth of scale-ups in the raw materials sector. Such a category will provide an opportunity for growth companies to enjoy the full benefits of the KIC while offering a low threshold to join.

Core and Associate Partners are the strategic backbone of the EIT RawMaterials innovation ecosystem. Core partners participate actively in defining the strategy and priorities of the KIC on two main levels: 1) In the bi-annual General Assembly where the KIC's top decisions are made through voting, core partners have one vote each. 2) Core partners have strong representation in the CLC steering committees, thus supporting and guiding the CLC in its decision making. The chairs of the CLC steering committees come from core partner organisations, and also participate in the Strategic Management Team (SMT) of the KIC (see section 5.2 Governance for further details). An additional benefit of being a Core Partner is that the maximum amount of annual KAVA funding is less restricted than in other partner categories. Concomitantly Core Partners pay the highest membership fee in EIT RawMaterials.

Associate partners also participate in the CLC work through representation in the Steering Committees, and in the KIC's highest decision making in the General Assembly through one shared vote per each CLC (for details see eitrawmaterials.eu / Partners and the Internal Agreement). While paying a lower membership fee than Core Partners, Associate Partners have a stricter limit to the annual KAVA funding. Finally, the Core and Associate partners are supported in KAVA projects by Project Partners, who participate in 1-2 projects at a time with strict budget limitations and lower membership fee than Core and Associate Partners. Project Partners do not have a seat in the CLC Steering Committees, and have a single shared vote in the General Assembly.

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This well-balanced and diverse partnership of excellence enables EIT RawMaterials to achieve significant impact. Strong interaction of EIT RawMaterials with SMEs and start-ups additionally creates added value and forms a strong basis for innovation. While SMEs are often suppliers to large industry partners, start-ups provide entirely new business models to the sector (e.g. in Circular Economy). These stakeholders are thus a crucial part of the ecosystem and important to further grow and develop the partnership in an open and impactful way. EIT RawMaterials will further facilitate start-ups and SMEs to enter the partnership and apply for calls (e.g. through setting up a dedicated new membership category).

Industry

Approximately one-third of the partners are from different industry sectors and represent key steps of the value chain. Many world-leading companies are partners of EIT RawMaterials today, and this continues to be our priority to ensure maximum impact. EIT RawMaterials extends its industry reach by supporting the development of new industry alliances in relevant fields.

To guarantee strong engagement of SMEs and increase involvement and awareness of the RM industry across Europe, EIT RawMaterials has secured the support of over 20 regional and national clusters and networks, including industry associations and Chambers of Commerce. These contribute expertise, outreach and potential financial support to Co-location Centres (CLCs).

Research organisations (RTO)

EIT RawMaterials includes many of Europe's most renowned research institutes with broad competence and specialised expertise in related areas. This includes national Geological Surveys providing key expertise in primary and secondary mineral resources in Europe and vital links with policy makers. In addition, end-user connected RTOs are active in the whole value chain and provide strong networks with SMEs and start-ups. As innovative idea providers, RTOs thus generate innovative projects close to the market. The Technology Transfer Offices (TTOs) of RTOs and universities play a crucial role for EIT RawMaterials in their capacities as co-servicing partners in providing commercialisation services to the KIC partners.

Universities

University partners provide educational capacity, curricula and top-level academics to reach and exceed educational goals. University partners also contribute through research and entrepreneurial activities via their TTOs. Several of the partner universities have already taken remarkable initiatives to promote creative entrepreneurship, stimulate design-thinking innovation and foster cross-disciplinary collaborative environments for students, researchers and business. To ensure a strong integration of such business and entrepreneurial thinking into educational programmes is of key priority for EIT RawMaterials.

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5.1.2 Co-location Centres (CLCs), RIS Hubs and geographic coverage across Europe

As the RM sector and its associated challenges are strongly embedded in regional innovation ecosystems, it is very important for the partnership to reach pan-European coverage. Currently, there are core, associate and project partners from nearly all EU countries. The outreach activities and involvement of partners from other countries will enable the partnership to grow further. These activities will focus on RIS countries e.g. located in Eastern and South-Eastern Europe (ESEE) where projects will boost economic development and employment.

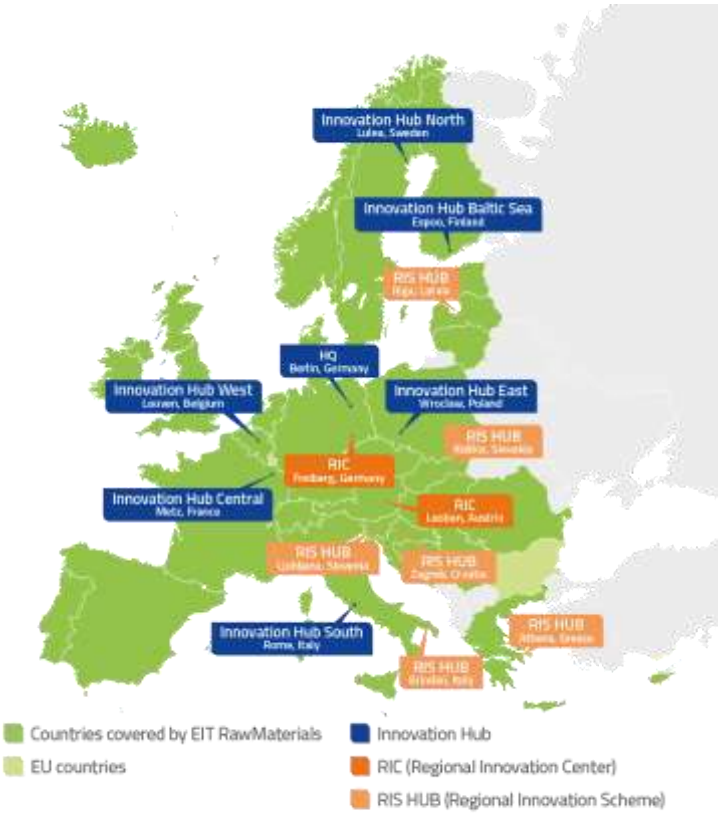

Figure 2: EIT RawMaterials presence in Europe

EIT RawMaterials strengthens its pan-European strategy by increasing the capacity building of higher education institutions through a leading role in the EIT's new HEI initiative and positioning the Initiative as the go-to capacity building instrument in the European innovation landscape. The goal is to create systemic impact in higher education by supporting HEIs to become more innovative and entrepreneurial – from teaching and learning to venture and business creation to strengthening the integration of HEIs in innovation ecosystems and their contribution to the realisation of the KIC societal impact pathways.

There are six Co-location Centres (CLCs) covering Europe in a geographically balanced way to offer physical proximity to the KIC partners (see Figure 2). Each CLC is transnational to stimulate networking and collaboration across Europe. CLCs work along all themes and complement one another with their fields of expertise and the innovation potential contributed by their partners.

EIT RawMaterials aims at extending its geographical reach into RIS countries and attract new partners by sharing knowledge, best practices and innovative technologies with the respective ecosystems. RIS Hubs are highly relevant for this purpose. This is why already six RIS Hubs were established (see Figure 2), making EIT RawMaterials excellently positioned in these regions.

In the period of 2021-2027, EIT RawMaterials will further strengthen its Partnership in the RIS countries. In previous years, partners from RIS countries were continuously stronger involved with many upgrading their status to Project Partners. Going forward that process is expected to continue in the following pathways:

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- Wider participation of representatives from countries and regions under represented in EIT RawMaterials today (e.g. Czech Republic, Bulgaria, Romania);
- Well established involvement and upgraded status of Partners from strategic RIS Regions (Western Balkans, Baltics);
- Networking and intake through RIS Hubs which act as local offices of the KIC and contact points.

Table 5: KIC partnership growth strategy

	2021	2022	2023	2024	2025	2026	2027
#CLCs[2]	6	6	6	6	6	6	6
#EIT RIS Hubs	6	7	8	9	10	10	10
# Number of partners[(a)] [3]	130	140	145	150	155	160	165
# Number of project partners[(b)] [4]	200	200	190	185	180	150	150
# Partners from EIT RIS countries[5]	100	110	120	130	140	140	130

Notes: The development of the partnership is assuming a new membership model to be implemented in the future, allowing an easier access for RIS partners and SMEs. The target numbers of CLCs and EIT RIS Hubs will be assessed against a possible further expansion. (a) Partners, which have an influence on a KIC's operations (members of associations, core partners, etc.). This includes all the KIC partnership categories as defined in chapter 5.1. (b) Activity partners, which are involved only in implementation of KICs activities. This includes all the KIC partnership categories as defined in chapter 5.1.
1: Average across years. 2: Consolidation of activities can lead to changes in composition accounting for optimal regional balance. 3: Continued growth of Core and Associate Partners will be supported through key strategic initiatives (especially ERMA and HEI). 4: Decrease due to portfolio consolidation and decreasing EIT funding. 5: Based on increase of # RIS Hubs and key strategic initiatives.

5.2 Governance

5.2.1 Legal structure

EIT RawMaterials is a service organisation for its partners. The administrative headquarters (HQ) and legal seats of EIT RawMaterials e.V. (German registered association) and EIT RawMaterials GmbH (German limited liability company) are based in Berlin, Germany. EIT RawMaterials e.V. is the partner association and sole shareholder of EIT RawMaterials GmbH. It makes strategic decisions for the KIC, such as approving annual Business Plans, updating strategy or the adoption of Lighthouse programmes. EIT RawMaterials GmbH is the KIC LE and as such legally responsible to the EIT reporting on the use of funds and impact achieved. This includes the application of monitoring and controlling measures as required by the EIT.

The legal setup of EIT RawMaterials includes the CLCs as limited liability companies in the form of the respective national legislation under the sole ownership of EIT RawMaterials GmbH.

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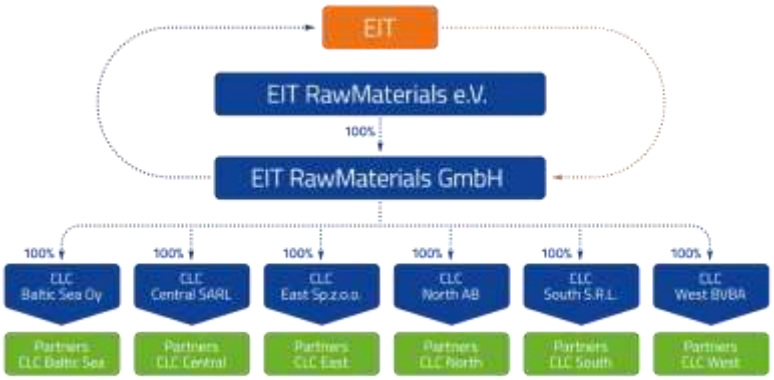

Figure 3: Legal structure

5.2.2 Governance structure, decision-making and advisory bodies

The community- and network-type of organisation of EIT RawMaterials requires an effective and transparent governance structure. The decision-making process between HQ and CLCs follows a lean, agile and cohesive approach reflecting both top-down as well as bottom-up approaches. The HQ ensures execution of the Strategic Agenda within the CLC legal entities (see Figure 4).

The governance model is shown in Figure 4. The decision-making bodies of EIT RawMaterials e.V. include the General Assembly and the Executive Board. The General Assembly is composed of the partners of EIT RawMaterials and defines the mission and strategy of the organisation. The Executive Board including its Chair is composed of top management representatives from core partners as well as external organisations with relevant network and experience. It is envisaged to achieve a balanced representation of partner and non-partner Board members (the number of independent Executive Board members will comprise at least 50% of the total from 2022, as per the requirements of the final Partnership Agreement). The Board serves as the steering board and among other tasks approves the annual business plan of EIT RawMaterials. The board members are nominated by a Nomination Committee with members from all CLCs and are elected by the General Assembly. In addition, members of the Executive Board have been selected to represent the diversity of the partners, balanced across the value chain and within the knowledge triangle.

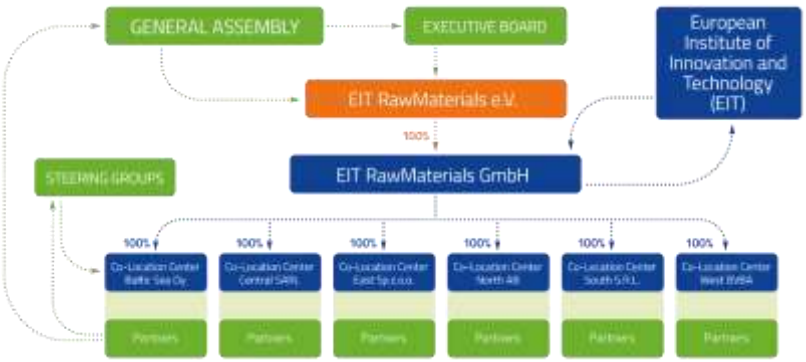

Figure 4: EIT RawMaterials governance model

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At EIT RawMaterials GmbH, the Managing Board is composed of the CEO and COO, both work together as a team. The Managing Board is responsible for the implementation of the current strategy and business plan as approved by the Executive Board. The CEO is the principal in the Managing Board with the final responsibility for the EIT and is accountable to the Executive Board. The COO reports to the CEO (see Figure 5 for other direct and dotted reporting lines). Both represent the KIC at the board meetings. The CEO is the Chairperson of the Strategic Management Team (SMT) and the COO is in the chair of the Operational Management Team (OMT). EIT RawMaterials GmbH is a diverse and gender-balanced organisation with 26 female and 19 male staff members (status: end q4/2020).

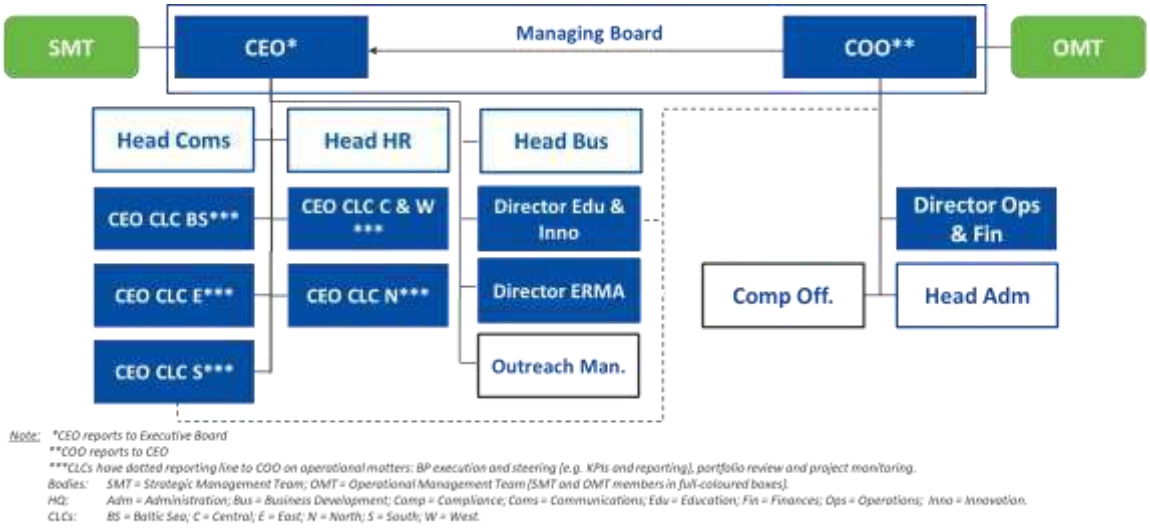

Figure 5: EIT RawMaterials operational structure

5.3 Budget

In line with EIT regulation recast article 17, EIT funding sources have been tentatively included in the 2021-2027 financial plan (see Table 6 below). Compared to the original EIT GB Decision 4/2015 on the "Principles on KICs' Financial Sustainability", which also served as a basis for the work of the Task Force Financial Sustainability in 2017, the maximum EIT funding rates for the years 2026 and 2027 have been decreased by 10% to 70% (before: 80%) and 50% (before: 60%), respectively. Together with the lower overall EIT funding, the new maximum ratios represent a severe challenge to the KIC's financial sustainability strategy.

The current EIT funding estimations for the years 2022-2027 do not yet include additional upside potential of up to 10m EUR p.a. that will derive from the new HEI for EIT RawMaterials as the KIC leading the initiative in 2021 (in total up to 400m EUR of the EIT's budget over 2021-2027 across the KICs). EIT RawMaterials is excellently positioned to secure high amounts of additional funding from both opportunities.

In Table 6, the partner contributions indicated include both (1) membership fees and (2) project co-funding:

(1) Membership fees are contributed by partners annually based on their partner category (Core, Associate, Partner). With the decrease in EIT funding, membership fees might decrease as well.

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This is why the KIC diversifies its revenue and at the same time optimise the partner offerings aside from EIT funding (e.g. services, additional funds, etc.; see next chapter for details).

(2) Project co-funding includes partners' in-kind contributions into KAVAs and all partner-sided contributions from Member States, associated or third countries and public authorities.

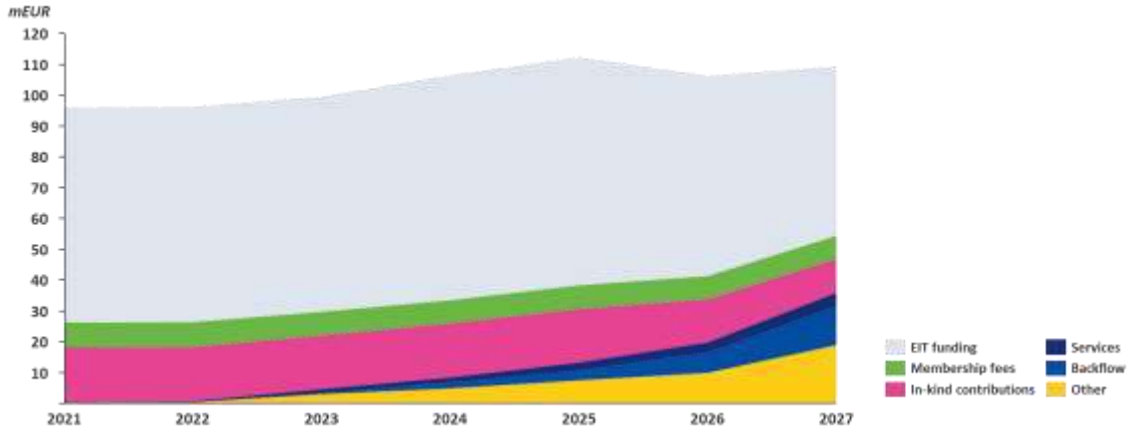
Third-party contributions in Table 6 include public funding attracted by the KIC organisation from other national, regional and international bodies. It also includes direct funding or brokerage fees the KIC obtains for funnelling projects into follow-up financing arising (e.g. ERMA). Third-party contributions include as well backflow from start-ups and up-scaling projects (which could become KIC LE investments, see Table 6) as well as revenues generated through services (e.g. hosting of events, sale of studies and consulting services, etc.). More background is provided in the next chapter on financial sustainability.

Table 6: Overview on the financing of KIC activities (MEUR)

KIC Financing (MEUR)	2021	2022	2023	2024	2025	2026	2027	Total:
EIT Grant	70.0	70.0	70.0	73.0	74.0	65.0	55.0	**477.0**
KIC LE investments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Partners membership fees	8.0	8.0	7.5	7.5	7.5	7.5	7.5	**53.5**
Other partners contributions	17.5	17.5	17.5	17.5	17.5	14.0	11.0	**112.5**
Third party contribution	0.8	1.0	5.0	8.9	13.8	20.4	36.5	**86.4**
Total Funding	**96.3**	**96.5**	**100.0**	**106.9**	**112.8**	**106.9**	**110.0**	**729.4**
% of EIT grant of the total budget	73%	73%	70%	68%	66%	61%	50%	**65%**

Disclaimer: It is pertinent to note that the Table above does not represent a commitment by the EIT to disburse the listed amount. *Note*: Assumptions subject pending to explanation provided to EIT in Cover Letter dated 15 March 2021.

Figure 6: planned allocation of funding / investments



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5.4 Financial Sustainability

EIT RawMaterials presents a comprehensive and competitive business model that secures the long-term financial sustainability and prosperity of the organisation. The business model relies on the overall added-value principle of EIT RawMaterials, which is to offer the highest quality of services. EIT RawMaterials builds on its strong partner base and network to deliver tangible value to partners and external collaborators.

EIT RawMaterials' business model is based on membership fees, services fees and success fees as well as securing additional large funding sources. EIT RawMaterials has been the most successful KIC in 2016-2018 when looking at the total amount of revenues created. Our ambitious target is to keep this leadership position through further diversifying and increasing our revenue streams while complementing and securing membership fees. This will ensure that the positive impact of EIT RawMaterials will endure beyond the initial EIT funding.

EIT RawMaterials has prioritised four Key Strategic Activity Areas with the ambitious goal to secure a leadership position in all value streams at European level. They result in the following revenue-generating Key Action Areas and Services, which fuel the main revenue streams of EIT RawMaterials.

5.4.1 Key Action Area 1: Intelligence services

EIT RawMaterials will be the leading worldwide provider of intelligence services for innovation, education and entrepreneurship in the RM sector.

The 'InfoCenter' (1.1) provides the knowledge base of EIT RawMaterials to partners and non-partners. The service will be included in the membership fee on a basic subscription level and also provide an entrance door for non-partners (full subscription fee); it will also serve as supplier of specific, payable publications (e.g. studies, white papers).

'Customised services' (1.2) offer different customised forms of events and workshops (e.g. hackathon, U-start) and consulting support services. Customised services build on the KIC's knowledge base (e.g. on supply risks and mitigation strategies) and up-sells activities into higher valuable and payable services to partners and non-partners. Such services will be co-serviced together with the partners.

'RM Expert Fora' (1.3) are focused events in topics of high strategic relevance for EIT RawMaterials, most importantly in the field of the Lighthouse programmes. The objective is to organise 3-5 p.a. revenue expected through participation fees from non-partners and potentially from partners once the membership fee structure has been revised. In addition, sponsorship packages to contribute to revenues.

'RM Summit' (1.4) is the main annual event of EIT RawMaterials attracting partners, non-partners and investors. The first edition successfully took place in 2019, and the objective is to develop it further. Revenues generated from this event come from two sources: participation fees and sponsorship.

Key Action Area 1 is expected to contribute about 10-20% of the overall Third-party contributions.

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5.4.2 Key Action Area 2: Education services

EIT RawMaterials will be the leading KIC for HEI and Lifelong Learning activities.

'Lifelong Learning' is of highest relevance to build up a sellable service together with selected / prioritized university partners involving lecturers from industry partners whenever possible. EIT RawMaterials aims to set up between five and ten lifelong learning courses that will be co-organised by the KIC organization and the partners. The KIC can build on positive learnings from the RawMatCop activity. Another feasible model to commercialise the courses is based on the licensing of content to be provided via 'Futurelearn'.

'Human capital broker' consists of the present RM Academy where designated and governed Master and PhD programmes that are tailored to the needs of industry long term and that will work as a channel to funnel students into companies. The human capital activity also works with dedicated programmes for easy and early interaction within industry and between industry and students (RACE and RACE Pro); other channels to be developed.

Key Action Area 2 is expected to contribute about 5-10% of the overall Third-party contributions.

5.4.3 Key Action Area 3: Value creation services

EIT RawMaterials will be a key European actor for Series-A level ventures in the RM sector.

'Alternative funding' will provide the strategic and branded basis for new funding possibilities of major projects / programmes to address pressing societal needs. This includes EIT RawMaterials' leading role in the European Raw Materials Alliance (ERMA), the engagement in the European Battery Alliance (EBA), the collaboration with EIT Climate-KIC in Circular Slovenia, RawMatCop in order to enhance and increase the precision in sourcing critical and conflict raw materials and other major programmes targeted to the EIT RawMaterials objectives such as the security of raw materials supply.

'Follow up investment' comprises "Go-to-Market" support to ensure fast commercialization of up-scaling projects (acceleration of time-to-market); the acceleration to market entails a mandatory back-flow based on the revenues projected – for strategic projects where EIT RawMaterials has an interest to invest or engage, direct investment using industry-specific member fees will be considered.

"Go-to-Market" studies are an important basis for business cases to leverage follow-up funding (e.g. EIB, EBRD, etc.). "Go-to-Market support" is also the basis for up-selling 'post-project' / offboarding services to facilitate implementation of outcomes driving commercialisation and organisational transformation at industry partners, supporting consulting activities and customised services, see Action Area 1.

The 'Deal flow start-ups' activities comprise activities carried out in order to create and enhance the start-up portfolio. The 'BIC / Jumpstarter' serves as main entry point into the innovation funnel of EIT RawMaterials. The subsequent step is the 'Accelerator Programme', which provides high quality coaching to selected ventures; the 'Accelerator Programme' is also a possibility to collaborate with partners and incubators and can generate service fees as an off-balance sheet item for the start-up companies. Finally, 'Start-up & SME Booster' provides funding support to selected ventures or SMEs. Aside from revenue-

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sharing and equity participation, which are revenue streams that are already realized when supporting ventures today, there is further upside potential and leverage by tightly connecting with other investors.

'Deal flow industry' focuses on bringing start-ups or spin-offs from projects to investors and follow-up funding; brokerage fees for successful matchmaking and/or backflow through leveraged co-investment (e.g. using booster funding) will be developed; success will be highly dependent on the EIT RawMaterials brand and the quality of the associated services delivered. This also includes backflows from successful up-scaling projects.

Key Action Area 3 is expected to contribute about 70-80% of the overall Third-party contributions.

5.4.4 Key Action Area 4: Stakeholder management

EIT RawMaterials will be a key partner for strategic cross-value chain collaboration in defined key areas (e.g. Circular Economy).

'External relations' will exploit current collaborations with a clear focus on European Green Deal actors such as JRC, DG Grow, DG Environment, European Battery Alliance etc. We will also explore new avenues for collaboration and funding such as EU, national, regional actors in order to leverage the regional organization and work with existing or newly emerging PPPs. A clear assignment contained within external relations is to identify sources of public funding specifically geared towards cross-sector collaboration and to leverage successful projects in portfolio for outreach activities.

'Cross-KIC management' deals with intra-EIT activities such as joint spaces (e.g. offices and workspaces in Stockholm EIT house in Brussels etc.), joint projects such as Jumpstarter and up-coming long-term joint activities under the EIT umbrella (e.g. Higher Education Initiative).

This action area contributes to the KIC's revenues from membership fees, which are forecasted at a level of more than 50m EUR over the period of time of 2021-2027. EIT RawMaterials works with a dedicated partner retention and acquisition programme to secure a high level of membership fees as a core revenue stream.

5.4.5 Key Action Area 5: Operational Excellence

EIT RawMaterials will be the partner of choice for brokerage and matchmaking for innovation, education and entrepreneurship in the RM sector.

'Fund & portfolio management' is a necessary basis and track record to signal competence to manage comparable, exclusive funding schemes in the future (e.g. as outcome of a Lighthouse).This also includes back office functions and evaluates the possibility of shared services with other KICs and outsourcing of activities, if cost-efficient.

'Partnership management' optimises the membership strategy and evaluates the KIC's revenue diversification strategy regarding alternative income streams to complement membership fees on a continuous basis.

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Similar to the previous action area, this action area contributes to the KIC's revenues from membership fees.

Table 7: Forecast revenue (in MEuro)

FS forecast revenues (MEUR)	2021	2022	2023	2024	2025	2026	2027	SUM
1. INCOME GENERATED BY ROI &EQUITY	0.0	0.0	0.5	1.8	3.3	6.5	12.5	**24.6**
2. EDUCATION	0.1	0.1	0.3	0.4	0.5	0.5	0.6	**2.5**
3. SERVICES & CONSULTING	0.2	0.4	1.2	1.7	2.5	3.4	4.4	**13.8**
4. MEMBERSHIP FEES	8.0	8.0	7.5	7.5	7.5	7.5	7.5	**53.5**
5. ALTERNATIVE FUNDING SOURCES FOR KIC LE (PUBLIC AND PRIVATE)	0.5	0.5	3.0	5.0	7.5	10.0	19.0	**45.5**
6. SUM of FS REVENUES	8.8	9.0	12.5	16.4	21.3	27.9	44.0	**139.9**
7. EIT grant PROJECTION	62.5	70.0	70.0	73.0	74.0	65.0	55.0	**469.5**
8. FS COEFFICIENT (%) ([6] / [7])	**14%**	**13%**	**18%**	**22%**	**29%**	**43%**	**80%**	**30%**

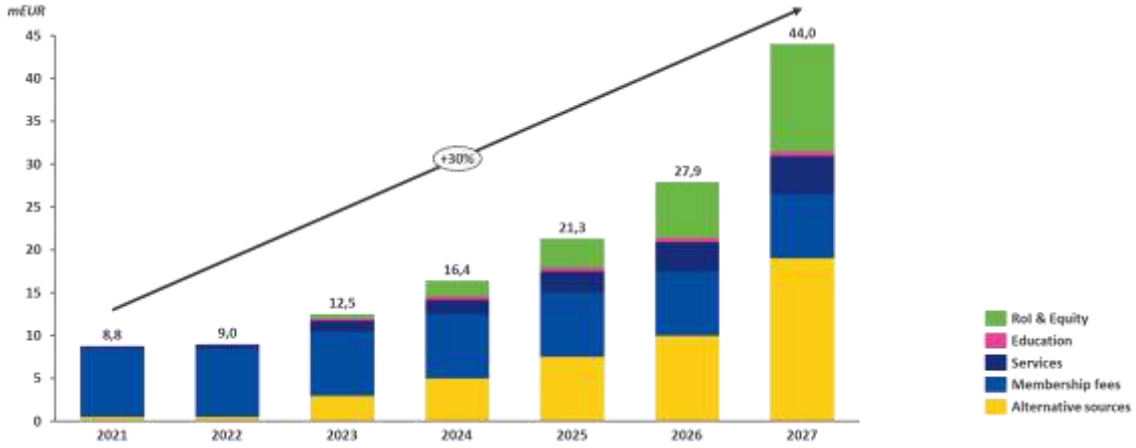

Figure 7: Graph outlining the KIC's forecast revenues (2021-2027)

Table 8: Forecast revenue (in mEuro; details of graph presented above)

Forecast revenues (mEUR)	2021	2022	2023	2024	2025	2026	2027	SUM
Alternative sources	0.5	0.5	3.0	5.0	7.5	10.0	19.0	**45.5**
Membership fees	8.0	8.0	7.5	7.5	7.5	7.5	7.5	**53.5**
Services	0.2	0.4	1.2	1.7	2.5	3.4	4.4	**13.8**
Education	0.1	0.1	0.3	0.4	0.5	0.5	0.6	**2.5**
RoI & Equity	-	-	0.5	1.8	3.3	6.5	12.5	**24.6**
SUM	**8.8**	**9.0**	**12.5**	**16.4**	**21.3**	**27.9**	**44.0**	

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5.5 Cross-cutting aspects

5.5.1 Openness and Transparency

EIT RawMaterials will continue its transparency and openness policy by keeping its partnership open to all actors relevant to its goals and challenges at global level. It will adapt its partnership to facilitate the access to start-ups and SMEs, regardless of the sector of activity. The KIC partnership is based on clear and transparent accession criteria for new partners that add value to the partnership, allowing the contribution of all stakeholders to the Strategic Agenda's implementation. Accession criteria and conditions are being published on the EIT RawMaterials website. EIT RawMaterials will continue organising events like the RM Summit that are publicly accessible, allow interested organisations to understand how the KIC is organised and to establish contacts between the KIC partners and new, interested parties.

EIT RawMaterials fosters high levels of transparency by keeping all KIC partners and external stakeholders informed about the KIC's operations and developments. For example, news and success stories are shared over the website, social media and the InfoCenter, and monthly newsletters are sent to the broad network of stakeholders of EIT RawMaterials. Stakeholders are also regularly involved through General Assemblies when defining the future strategic directions of EIT RawMaterials and when discussing priorities and annual business plans of the KIC. Partners can contribute to the identification of relevant topics and needs via the CLCs through the regular CLC partner and CLC Steering Committee meetings.

One dedicated element for the aspect of openness is the welcoming of independent board members in the Executive Board of EIT RawMaterials, which is deemed to be an important element to get additional competences from outside the partnership. Another dedicated element of openess is the publishing of the KIC's strategy documents on the EIT RawMaterials website, enabling interested stakeholders to follow developments and to engage with the KIC and its partners.

Continuing already established good-practice principles, the selection of new projects is always based on open calls and follows fair and transparent evaluation models that have proven to be successful and well recognised in the past. This does not only refer to innovation and education KAVAs, but is the same – based on the established principles and calls – as well for entrepreneurship activities like the support for start-ups. Operating under Horizon Europe from 2021, open calls for selection of KAVAs will be placed under the Competitive calls and calls for third parties section of the Funding & Tenders portal of the EC, including a wide communication of the calls launched. The calls are not restricted to the existing network of KIC partners. For other calls, like those providing financial support to third parties, a publication on the Funding & Tenders portal will be decided on a case by case basis. This openness ensures that suitable partner organisations can contribute towards the implementation of the Strategic Agenda and the business plans even though they might not be currently a KIC partner or might not become one in the future (work in progress in terms of a newly developed Membership Strategy and Structure planned to be finalised in the course of 2021). As references for good practices, the pilot SME call in 2020, which will be continued in 2021 and most likely beyond, and the activities within the European Raw Materials Alliance (ERMA) can serve as examples, especially as these activities are open for any partner, may it be from within the KIC EIT RawMaterials or not.

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5.5.2 Synergies and Collaborations

EIT RawMaterials added value lies predominantly in the fact that it covers the full value chain of metallic and mineral raw materials. By doing this it is able to target upstream, midstream and downstream part of the cycle and reach its strategic objectives of: (1) securing raw materials supply, (2) designing solutions, and (3) closing material loops. It is also the world's largest network of Partners in the raw materials sector, who come from the three sides of the Knowledge Triangle, and equally cover the full value chain of the sector. Having this focus and the support of the Partnership EIT RawMaterials is able to contribute to the transition of the European economy into a green economy. Our strategy is to actively engage and collaborate with main EU actors to actively support and shape the implementation of the overarching European Commission's priorities relevant for the Raw Materials sector, namely:

- The European Green Deal adopted on 11 December 2019 and targetting 2050 climate neutrality, recognizing access to resources as a strategic security question to fulfil EU ambitions.
- The new Industrial Strategy for a globally competitive, green and digital Europe prioritizing raw materials as one of the key enablers for a globally competitive, green and digital Europe.
- The new Circular Economy Action Plan for a cleaner and more competitive Europe, which clearly states the utmost importance of raw and advanced materials to enhance EU competitiveness within circular economy strategy framework.

EIT RawMaterials further contributes greatly to the EU's raw materials policy strategy. The overall goal of the European Raw Materials Initiative is to ensure the sustainable supply of raw materials to the European economy. The initiative has three pillars: 1) Ensure level playing field in access to resources in third countries; 2) Foster sustainable supply from European sources; 3) Boost resource efficiency and recycling.

In September 2020 the European Commission published the new list of critical raw materials and announced that it would launch a major new initiative on raw materials (European Raw Materials Alliance). EIT RawMaterials is uniquely positioned to take a lead role in this initiative and orchestrate the establishment and implementation thereof. With strong support from European raw materials industry it will create an investment platform that will select strategic resource related investments in Europe. They will benefit from EU, public and private funding sources. At the same time the involvement of EIT RawMaterials will contribute to its long term sustainability.

Innovation, entrepreneurship and supply of the necessary skilled human capital are essential elements of these pillars. The pillars are therefore captured and addressed by the EIT RawMaterials vision, mission, strategic objectives and innovation system. In addition, EIT RawMaterials complements and synergises with other programmes working towards the pillars of the Raw Materials Initiative and is actively engaged in the European Innovation Partnership on Raw Materials (EIP RM) and H2020 actions on raw materials, as well as other European programmes (e.g., Copernicus collaboration with DG GROW, SPIRE, and Prometia). It will continue to seek synergies with the new framework program Horizon Europe. As in the past R&D projects funded in H2020 and HE can be continued within EIT RawMaterials with a goal to entering the commercial markets. In addition EIT RawMaterials is able to complement efforts of EASME and EIC in the field of supporting SMEs and fostering entrepreneurship in EU in the raw materials sector. EIT RawMaterials will also be actively involved in European initiatives supporting the transition of the European economy, such as the European Raw Materials Alliance, European Battery Alliance and other initiatives on raw

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materials. EIT RawMaterials will contribute to RIS by continuing its efforts in the resource endowed RIS countries (Balkan Peninsula, Iberian Peninsula) and seeking joint efforts with regional agendas (e.g. Western Balkans Agenda on Innovation, Research, Education, Culture, Youth and Sports), structural funds and other European institutions (i.e. EBRD).

In the KIC portfolio, the Lighthouses serve as beacons for many cross-theme activities and will foster efficient value chain integration and de-siloing. Because the Lighthouses target important societal challenges, they will create synergies with other programmes and organisations dedicated to addressing societal challenges related to resource efficiency and consumption, e.g., EIT InnoEnergy and Climate-KIC, European Innovation Partnership on raw materials, UN International Resource Panel, World Resource Forum, Club of Rome, and the Global Challenges and Industrial Competitiveness Pillar of Horizon Europe (advanced materials; circular industries; smart mobility; energy storage; and circular systems).

5.5.3 Cross-KIC cooperation and Simplification/Shared Services

EIT RawMaterials views external collaborations as one of its four key activity areas going forward. This includes also cross-KIC collaboration on selected themes where the KICs can complement each other through synergies or jointly organized activities that promote the KTI model.

EIT RawMaterials has positive past experience in implementing several Cross-KIC initiatives that focus primarily on Education and Entrepreneurship. The most notable examples are Cross-KIC Skills 4 Future (focused on secondary school education) and Cross-KIC Circular Economy (aiming at higher Cross-KIC engagement and visibility on an EU level). These two activities are led by EIT RawMaterials, and ambition is to continue on the same or even higher level. In addition EIT RawMaterials will be leading the new HEI Capacity Building Initiative, with an indicative budget of 12 Mio. in 2021 only (400 Mio EUR indicated for the period of 2021-2027). Involvement in Cross-KIC RIS with its flagship Jumpstarter competition (focused on entrepreneurship) and in Cross-KIC CLC Consolidation will be continued. Participation in Cross-KIC Common Outreach will continue, however the level of participation in the setting up of satellite offices outside the EU will remain low as long as more intensive participation will not be required for achieving the objectives of the Strategic Agenda. In addition, to well established and value-adding Cross-KIC activities we see the potential to pursue other initiatives contributing to Higher Education, the Green Deal, and other yet to be defined. We also view the new KICs: Manufacturing and Urban Mobility as those, where synergies and complementarities could be explored based on cross-cutting topics that could benefit from a cooperation. Also EIT RawMaterials with its natural exposure to EIT RIS countries is interested in joint initiatives targeting the ESEE Region, the Mediterranean and the Baltic countries. The overall ambition of EIT RawMaterials is to increase cooperation between the KIC´, and where suitable will aim at doing so via dedicated activities under the Cross-KIC scheme, to ensure a maximum as Synergies as well as to increase the overall visibility of the EIT and the work of the KIC´s.

On an operational level EIT RawMaterials will further explore opportunities with other KICs to share locations similar to those already established in Sweden, Finland and Hungary. Where possible the KICs could use shared services to support the lean approach of operations EIT RawMaterials is implementing.

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5.5.4 Communication

The Communications Strategy of EIT RawMaterials is essential to leverage the added value of the KIC to increase the visibility of impact generation in the European raw materials sector. From 2021, the updated Communications Strategy will focus more on integrated communication engaging partners and leveraging the reach of this KIC to ensure sector positioning, solid reputation, though leadership and strong societal support. Innovation and continued digitalization of the function with ever growing content management tools and digital platforms will focus on personalised content and targeted marketing and will build up on the foundations, activities, channels and tools that were developed and implemented in 2016-2020.

EIT RawMaterials' Communications Strategy is aligned with the overall EIT Communications Strategy and builds on the joint EIT Community strengths in terms of brand visibility and recognition. The new Communication Strategy 2021-2027 will position EIT RawMaterials as the leading innovation, technology and entrepreneurial talent network in the raw materials value chain in Europe. To achieve this, it is essential that the value-added of the KIC innovation, entrepreneurship and education model in the field of raw materials and advanced materials is well understood, its long-term vision its mission is supported by communicated success in key areas and segments, to ensure *political support and reputation.*

Over the next R&I framework period 2021-2027, the Communications function of EIT RawMaterials will particularly address four main challenges: 1) Promoting and positioning the KIC as a key innovation, technology and entrepreneurial talent ecosystem in the European raw materials sector; 2) Visualising and communicating new EITRM mission statement of advancing Europe's transition to sustainability by driving innovation along the entire raw materials value chain. 3) Reaching out to key decision-makers 4) Raising awareness of the importance of the minerals and metals for the green energy transition and clean consumer technologies among EU citizens.

Communication, Dissemination activities and plans will be developed as the KIC will move forward with its Financial Sustainability strategy and plans focusing on developing additional partners services. All activities will emphasize an innovative and entrepreneurial mind-set to re-think, conceptualise and commercialise challenges in the European raw materials sector for enabling competitiveness, growth and attractiveness. Strong focus on innovation and digitalisation also applies for all communications activities, dissemination strategies and channel development. Project dissemination and exploitation and communications are interlinked. All project partners are encouraged to develop WP on communications activities and streamlined the project news, results to central communication function where news and success stories are amplified.

EIT RawMaterials Communications Strategy will rely on 5 pillars: 1) Brand Identity; 2) Internal Communications & Community Building; 3) External Communications & EU Citizen Engagement 4) Content generation and Key Messages; 5) Public Affairs and EU Stakeholder Engagement. Each pillar represents a strategic communications area with clear objectives and action plans.

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Figure 8: Communication Strategy 2021-2027 and communication objectives

Corporate communications function at the KIC will continue focusing on digital channels and social media platforms. It is expected and planned for the digital platform to grow 10-15% a year focusing on the objectives, and activities planned in the annual business plan. In addition to this, all corporate publications will become available digitally and printed materials will be substantially reduced. Communications activities will be monitored by dedicated tools and communications business partners such a press/media agency, branding compliance is monitored through dedicated role of Events/Brands manager.

Table 9: EITHE15.1 Reach of KIC's communication activities

	2021	2022	2023	2024	2025	2026	2027
Followers on Twitter	5,000	6,000	7,000	8,000	9,000	10,000	11,000
Followers on LinkedIn	8,000	9,000	10,000	11,000	12,000	13,000	14,000
Number of articles in European/ national/ local press	100	115	130	150	170	190	220
Number of individual website visitors	150,000	180,000	210,000	240,000	270,000	310,000	350,000

5.5.5 Dissemination of Results

Under the Horizon 2020 R&I programme, dissemination refers to sharing of research results with potential users - peers in the research field, industry, other commercial players and policymakers. By sharing the research results with the rest of the scientific community, EIT Innovation Communities are contributing to the progress of science in general.

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The objective of dissemination is to transfer knowledge & results with the aim to enable relevant stakeholders to use and take up results, thus maximising the impact of EU-funded projects.

Partners of consortia are encouraged to publish their results in peer-reviewed international journals and conference proceedings. These are typically listed as deliverables in the KAVA. To date, we have not collated this information. Many KAVAs include the organization of thematic conferences for dissemination of results across the community. Some of these events are very focused on specific topics and attract only a specialist audience, while others target a wider group of researchers and operators. In the context of the Lighthouse activities, EIT RawMaterials organizes 'expert fora', open to partner and non-partners, where experts in a specific field or value chain gather to exchange views on recent and future developments. Besides their value in terms of research and innovation, these events represent important networking and partner recruitment activities. Some EIT RawMaterials staff have an academic record and a strong research profile and continue to publish their research in international peer-reviewed journals.

With the digitalization of information flow and data management there is an overlap between dissemination, exploitation and communication of project results, especially for close-to-market projects. EIT RawMaterials uses a range of established tools to disseminate project results, including organising and participating at (brokerage) events, publishing the latest project result news including and leveraging partner media and stakeholder engagement to make results and good practices available for use.

In addition, EIT RawMaterials will continue investing resources into training partners in Science Communications and will continue developing additional toolkits for successful project communication and dissemination. EIT RawMaterials InfoCenter – a digital collaboration and networking platform is currently under development and is planned to fully relaunch in 2021 will become the leading European intelligent raw materials data platform including an access to all project results data and raw materials innovations. The Infocenter digital platform will be able to monitor and provide user analytics.

EIT RawMaterials project results are also disseminated in Open Access/Online Data repositories, and industry raw materials related publications and also presented on trade fairs, industrial events, combined with other communication channels (LinkedIn, Twitter, YouTube). The Raw Materials project portfolio will be mapped against the SDG's- one of the key the priorities of the EC Green Deal and climate neutrality ambition, which will result in and impactful and engaging materials representing the impact of EIT RM projects portfolio contributing to the overall KIC wide communications and dissemination efforts. Target indicators for the dissemination activities is the number of published project results in scientific papers. EIT RM Annual Business Plan will specify yearly targeted KPIs.

5.5.6 Stakeholder Engagement

The EIT RawMaterials Public Affairs and EU Stakeholder engagement Communications strategy pillar focuses on building the knowledge and awareness of EIT RawMaterials among policy- and decision makers at local, national, EU and international levels. This is done through participation at high-level events and coordination groups that are directly connected with various organisations. Reaching out to EU member states and regional authorities at CLC Level and in RIS countries will be prioritised. Through a carefully selected mix of activities and actions in consultations with partners, the KIC will work towards positioning

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EIT RawMaterials as a raw materials innovation leader that will play an increased role in the EU's future raw materials sector, having an impact on the EU's green deal, climate neutrality ambition and the contribution to the Sustainable Development Goals.

EIT RawMaterials will ensure the interest of the KIC community and be well positioned with EU stakeholders. EIT RawMaterials will aim to have a strong direct collaboration with the European Commission (i.e. DGS GROW, DG EAC, DG ENVIRONMENT, DG CLIMA, JRC, DG RTD, DG CNECT, DG REGIO and other DGs) as well as European Parliament, EU Permanent Representations, EU regions, EU bodies, EU partnerships and international alliances and organisations (e.g., European Battery Alliance, International Resource Panel, World Resources Forum). When relevant, the KIC will be active also through position paper coordination, stakeholder mapping and reacting visibly to raw materials-related policy news.

EIT RawMaterials will ensure the interest of the Community, Projects and the impact KIC delivers are well positioned with EU stakeholders. EIT RawMaterials is aiming at stronger cooperation and coordination with the DG Grow, European Battery Alliance and European Commission. Position paper coordination, further stakeholder mapping, reacting to the raw materials related news seizing the opportunity will be a focus here.

Through carefully selected mix of activities and actions in consultations with relevant stakeholders form the Partner Community, the KIC will be working towards positioning the EIT RawMaterials as a raw materials innovation leader that will play an increased role in EU's future raw materials sector delivering an impact to EU's industrial competitiveness, increased knowledge & Innovation capacity, growing human capital and entrepreneurship.

In parallel and strict synergy with the strategy run at EU level, the stakeholders engagement strategy at regional level will build upon the outreach activities that each CLC has already developed over the past years. This activity, led by each CLC, consisted in reaching out to national and regional authorities as well as other relevant organizations within the raw material value chain.

Each CLC – Central, Baltic, North, East, West and South - will set up structured collaboration in terms of timely provision of information to the EIT National Contact Points in order to widen the Community outreach, prioritize and engage with relevant stakeholders at Member State and Regional levels. CLC contacts with national and regional authorities will be pursued through prior alignment among the KICs being present in a given country, with the aim of increasing the critical mass and efficacy of the message.

5.5.7 Global Outreach

The raw materials sector is inherently international as a result of economic, geological and geopolitical factors. EIT RawMaterials focuses its Global Outreach activities on three main directions:

1. Export partner network (meeting targets 1, 2, 4 and 8 of the Strategic Framework for EIT Community Global Outreach Activities)

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Focusing on China, Latin America, Canada, Australia, South Africa, and the Central African Copperbelt region, the KIC shall use existing well-known and new promising events as platforms for EIT RawMaterials supported start-ups and SMEs to meet investors and potential customers. Furthermore, the KIC EIT will co-operate with the networks and contacts of the Member State local representations in order to pave way for start-up and SME export. In particular, the activities will be designed together with the national funding agencies of the target countries, as well as the World Bank programmes in the developing countries. This way of co-funding the KICs activities also will contribute to the financial Sustainability of the EIT RawMaterials. With knowledge transfer of the KIC partners' innovations especially on the digitalization of the mineral value chain in non-European regions, this network shares the objectives of the EU's digital strategy.

2. Developing Access to the Pool of Global Talent (meeting target 3 of the Strategic Framework for EIT Community Global Outreach Activities)

   This action is creating a two-way benefit of talent from 3rd countries entering EIT RawMaterials education programmes, as well as graduates and start-ups from EIT Labelled and other education activities finding business opportunities with industry in 3rd countries. Trough promotion of partner driven education programmes as well as the RACE concept in overseas trade shows / conferences, creation of internship positions in Europe for overseas talents, and sending European students as trainees to overseas companies, the KIC shall transcend its talent pool beyond Europe securing the best resources to benefit the European raw and advanced materials industries.

3. Establishing strategic alliances

   The target is to identify relevant ecosystems in target regions and then adapt best practices from them. Examples are AMIRA (AU) and CEMI (CA). This benchmarking is particularly expected to serve the Financial Sustainability of the KIC. EIT RawMaterials has been closely involved in the cross-KIC outreach programme establishing a new EIT Hub in China, and the KIC will seek for further opportunities to join hubs in other strategically important regions. This activity will utilize the EU Bodies in 3rd countries, such as ENRICH, e.g when organizing start-up sessions in target countries. Finally, the KIC will continue to contribute to the EU-LAC round tables and at the same time promote European start-ups and SMEs. This activity supports the international dimension of the Green Deal, where Green Alliances with partner countries and regions shall be formed with partner countries and regions in order to prevent ecological collapse and fight climate change. The KIC's strategic objectives on sustainable sourcing of raw materials particularly for electric mobility and energy storage directly support minimizing ecological harm to third countries from mining activities as well as reduce carbon dioxide emissions from traffic and industry.

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6 RISKS

Table 10: Risk assessment

Key risk (title and description, including cause and potential consequence)	**Risk type**	**Objective /thematic area** affected by the risk	**Impact** (Low 1-2 Medium 3 High 4-5)	**Likelihood** (Low 1-2 Medium 3 High 4-5)	**Key control(s)/mitigating factor(s)**	**Action plan Summary**		
						Description	**Owner**	**Deadline**
Geographical and / or topical siloing	Planning, processes and systems (Macro-environment)	All areas	3	1	Balance of partners across CLC´s and countries & Balance of project topics across topics/ active partner and project scouting	Monitoring of partnership composition & Monitoring of project portfolio composition	CLC Managers & Managing Board	Ongoing
Financial Sustainability Strategy not in line with market demands	Planning, processes and systems (Financial Processes and Budget Allocation)	KIC´s Financial Sustainability	5	3	Number of new contracts concluded, portfolio of funding sources / Adoption of portfolio of FS activities, like service offers, backflow schemes and alternative financing sources	Monitoring of successfully concluded contract negotiations with external stakeholders and partners	COO	Closing of financial year
Lighthouse programs and / or Strategic Agenda not in line with Europe´s needs	External environment (Internal and External Partners)	All thematic areas	4	2	Feedback from partnership & stakeholders / Update of Strategic Agenda in cooperation with partnership and stakeholders	Continuous exchange with stakeholders & monitoring of developments in the sector	Director Innovation	Bi-Annually

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Key risk (title and description, including cause and potential consequence)	**Risk type**	**Objective /thematic area** affected by the risk	**Impact** (Low 1-2 Medium 3 High 4-5)	**Likelihood** (Low 1-2 Medium 3 High 4-5)	**Key control(s)/mitigating factor(s)**	**Action plan Summary**		
						Description	**Owner**	**Deadline**
Geopolitical developments hinder participation of partners in KIC	External environment (Macro-environment)	Implementation of SA at large	3	1	Political landscape and decisions announced / outside of EIT RawMaterials control	Continuous Monitoring of Geopolitical developments on EU level	CEO	Ongoing
Innovation project portfolio not suitable to meet targets of the SA	Planning, processes and systems (Operational Processes)	All thematic areas	4	2	Constitution of activities within EIT RawMaterials project portfolio / Change of focus of Calls launched by EIT RawMaterials	Monitoring of project portfolio	Director Innovation	Selection date of new projects to be taken on board to EIT RawMaterials´ project portfolio
Business Creation Programs attractiveness	Communication & Information (Communication methods and channels)	All thematic areas	4	3	Number & Quality of applications received/ Increased budget and collaboration with entrepreneurship eco-systems across Europe	Portfolio analysis and continuous promotion of the KIC programs	Head of Business Development	Yearly review cycles on Q1
Education offers not in line with needs from EIT RawMaterials partners, other stakeholders and not attractive to participants	Planning, processes and systems (Operational Processes)	All thematic areas	4	2	Constitution of activities within EIT RawMaterials project portfolio / Change of focus of Calls launched by EIT RawMaterials and increase Communication	Monitoring of project portfolio & matching of this with identified educational needs	Director Education	Selection date of new projects to be taken on board to EIT RawMaterials´ project portfolio
Partnership not suitable to implement SA	People & Organization (internal organisation)	All thematic areas	5	2	Constitution of Partnership towards defined SA / Monitoring of Partnership & active partner scouting	Partnership management to ensure required competences to implement SA are with EIT RawMaterials	CLC Managers	After annual reporting

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ANNEX 1 KIC IMPACT

KIC Strategic Objective	Problem/ issue related to the societal challenge	Societal and economic impact to be created by 2027	Impact KPIs	Targets to be achieved by 2024*	Targets to be achieved by the FPA end year [2022]*	Targets to be achieved by 2027*	Relevant UN SDG Targets	Source of verification (to be completed only for the societal impacts)
(i)	*(ii)*	*(iii)*	*(iv)*	*(v)*	*(vi)*	*(vii)*	*(viii)*	*(ix)*
Securing raw materials supply	Dependency on imported raw and advanced materials, leading to vulnerability to external disruptions in supply chains	Business creation	Investment attracted in resources	300 M EUR	150 M EUR	500 M EUR	9.1-5, 12.4-8	Internal data, JRC data
		Improve industrial competitiveness	Savings and increases in sales	15 M EUR	8 M EUR	40 M EUR	9.1-5, 12.4-8	
		Infrastructure investment	New pilot/demo plants, prototypes	150	200	300	9.1-5, 12.4-8	
		Raw materials concentrate produced	Percentage increase	2%	-	5%	9.1-5, 11.2, 11.3, 12.4-8	
Securing raw materials supply	Low social acceptance of the raw and advanced materials extraction and production, leading to public perception that the sector is not compatible with the goals of the Green Deal	Integration of the RIS region	% funding to RIS in non-RIS projects	20%	20%	20%	8.4	Internal data, JRC data
		Ensure stable RM workforce	Created/maintained/re-skilled jobs	2,000	650	6,000	4.4, 4.7	
		Improve gender balance	Women graduating from RM courses	40%	37%	50%	4.3, 4.5, 5.5	
		Carbon savings	% CO2 emitted savings	5%	2%	20%	7.2, 7.3, 11.2, 11.3, 13.2	

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KIC Strategic Objective *(i)*	Problem/ issue related to the societal challenge *(ii)*	Societal and economic impact to be created by 2027 *(iii)*	Impact KPIs *(iv)*	Targets to be achieved by 2024* *(v)*	Targets to be achieved by the FPA end year [2022]* *(vi)*	Targets to be achieved by 2027* *(vii)*	Relevant UN SDG Targets *(viii)*	Source of verification (to be completed only for the societal impacts) *(ix)*
Designing materials solutions	The design and production of advanced materials, components and products that enable the transition to a carbon-neutral Europe have increasingly moved to non-European countries, putting European innovation capacity at risk	Business creation	Investment attracted in resources	300 M EUR	150 M EUR	500 M EUR	9.1-5, 12.4-8	Internal data, JRC data
		Improve industrial competitiveness	Savings and increases in sales	15 M EUR	8 M EUR	40 M EUR	9.1-5, 12.4-8	
		Infrastructure investment	New pilot/demo plants, prototypes	150	200	300	9.1-5, 12.4-8	
		Integration of the RIS region	% funding to RIS in non-RIS projects	20%	20%	20%	8.4	
		Improve gender balance	Women graduating from RM courses	40%	37%	50%	4.3, 4.5, 5.5, 12.4-8	
		CRM substitution/reduction	Number of cases	80	70	100	7.2, 7.3, 11.2, 11.3, 12.4-8	
		Advanced materials produced	Percentage increase	2%	-	5%	9.1-5, 11.2, 11.3, 12.4-8	
Designing materials solutions	Need to transition from the 'brown energy' to the 'green energy', and from the linear economy to the circular economy to fulfil the aspirational goals of the Green Deal	Advanced materials development	Number of new advanced materials	2	1	5	9.1-5, 11.2, 11.3, 12.4-8	Internal data, JRC data
		Advanced materials development	Improved products with less toxic materials	58	50	70	7.2, 7.3, 11.2, 11.3, 12.4-8	
		Ensure stable RM workforce	Created/maintained/re-skilled jobs	500	400	4,000	4.4, 4.7	
		Carbon savings	% CO2 emitted savings	5%	2%	20%	13.2	

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KIC Strategic Objective *(i)*	Problem/ issue related to the societal challenge *(ii)*	Societal and economic impact to be created by 2027 *(iii)*	Impact KPIs *(iv)*	Targets to be achieved by 2024* *(v)*	Targets to be achieved by the FPA end year [2022]* *(vi)*	Targets to be achieved by 2027* *(vii)*	Relevant UN SDG Targets *(viii)*	Source of verification (to be completed only for the societal impacts) *(ix)*
Closing materials loops	Low social acceptance of the raw and advanced materials extraction and production, leading to public perception that the sector is not compatible with the goals of the Green Deal	Infrastructure investment	New pilot/demo plants, prototypes	50	100	100	9.1-5, 11.2, 11.3, 12.4-8	Internal data, JRC data
		Integration of the RIS region	% funding to RIS in non-RIS projects	20	20	20	8.4	
		Ensure stable RM workforce	Created/maintained/re-skilled jobs	300	250	2,000	4.4, 4.7	
		Improve gender balance	Women graduating from RM courses	40%	37%	50%	4.3, 4.5, 5.5	
Closing materials loops	Need to transition from the 'brown energy' to the 'green energy', and from the linear economy to the circular economy to fulfil the aspirational goals of the Green Deal	Business creation	Investment attracted in resources	200 M EUR	150 M EUR	300 M EUR	9.1-5, 12.4-8	Internal data, JRC data
		Improve industrial competitiveness	Savings and increases in sales	10 M EUR	4 M EUR	20 M EUR	9.1-5, 12.4-8	
		Increased recycling rate over current rate	Recovery of selected CRM	2% increase	1% increase	5% increase	9.1-5, 11.2, 11.3, 12.4-8	
		Enhanced sustainability	% new and existing processing plants with reduced discharge	20%	10%	50%	6.3, 6.4, 12.4-8	
		Enhanced sustainability	% European companies using sustainability standards	1%	0%	5%	9.1-5, 12.4-8	
		Carbon savings	% CO2 emitted savings	5%	2%	20%	7.2, 7.3, 11.2, 11.3, 13.2	

*Targets should be accumulative for the period of the KIC up to this year.

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CONSULTAZIONE NELL'AMBITO DELLA VERIANTE DEL PIANO INFRAREGIONALE DELLE ATTIVITA' ESTRATTIVE

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OSSERVAZIONI ALLA PROPOSTA DI VARIANTE GENERALE DEL PIANO INFRAREGIONALE DELLE ATTIVITA' ESTRATTIVE (PIAE)

CONTRIBUTO TECNICO DI SAINT-GOBAIN ITALIA NELL'AMBITO DELLA VARIANTE GENERALE AL PIAE DEL POLO ESTRATTIVO DI MONTE TONDO

26 ottobre 2023

SAINT-GOBAIN gyproc SAINT-GOBAIN isover SAINT-GOBAIN weber SAINT-GOBAIN

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1. PREMESSA

Il Presidente della Provincia con provvedimento n. 58 del 15.05.2023 ha **assunto** la proposta di variante relativa al Polo Estrattivo Cava di Monte Tondo nei Comuni di Riolo Terme e Casola Valsenio, nell'ambito della variante generale del Piano Infraregionale delle Attività Estrattive (PIAE) con valenza di Piano Attività Estrattive (PAE).

A seguito del deposito, con la presente la scrivente Società Saint-Gobain Italia S.p.A. presenta le osservazioni al Piano in oggetto ai sensi dell'art. 45 della L.R. 24/2017.

2. LA CAVA DI MONTE TONDO

La Cava di Monte Tondo rappresenta il **principale Polo regionale per l'estrazione di gesso** previsto nel Piano Territoriale dell'**Emilia-Romagna**. Ha svolto e svolge la propria attività in **perfetta simbiosi con il paesaggio, la flora e la fauna del Parco.** La Cava stessa, inoltre, è sede di diverse attività fortemente legate al territorio, come ad esempio tra le **iniziative culturali** è importante citare il **percorso di visita della Grotta del Re Tiberio,** testimonianza storica della presenza dell'uomo negli ambienti coltivati.

Tale percorso culturale è stato reso possibile grazie al rispetto di Saint-Gobain per i **valori storici** e **culturali nazionali** e **locali**, e grazie alle tecniche di coltivazione attivate e regolarmente autorizzate, che garantiscono da sempre attività minerarie a ridotto impatto ambientale. Oggi la risorsa della Cava di Monte Tondo rappresenta un punto di riferimento fondamentale per l'industria dell'edilizia sostenibile dei sistemi a secco e leggeri che si sono sviluppati a partire dalla lavorazione del gesso. La Cava, infatti, alimenta il **limitrofo stabilimento produttivo** di lastre in gesso rivestito sito nel **Comune di Casola Valsenio**, nato nella **seconda metà degli anni '70** con l'obiettivo di **creare concrete prospettive occupazionali alla popolazione locale, evitandone l'allontanamento verso luoghi con maggiori**

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possibilità lavorative. Il **sito produttivo casolano è uno tra i più importanti della zona e della Regione**; in esso **si producono i principali elementi costruttivi dell'edilizia sostenibile dei sistemi a secco** come cartongesso, intonaci a base gesso, lastre accoppiate e profili metallici.
Lo stabilimento è stato interessato negli ultimi anni da un **ricco piano di investimenti** che ha permesso di implementare una **nuova linea produttiva** e rimodernare la linea produttiva degli intonaci partita nella nuova veste nel 2016. Questa importante attività estrattiva oggi risulta essere **oggetto di acceso dibattito mettendone in pericolo il futuro**, **con enormi conseguenze negative sull'indotto economico ed occupazionale della zona**.

3. STUDIO PRELIMINARE AL RINNOVO DEL PIAE: GLI SCENARI PROPOSTI E I VOLUMI REDISUI

In occasione del rinnovo del PIAE, la **Regione Emilia-Romagna** ha **commissionato** uno **studio** per la valutazione delle componenti ambientali, paesaggistiche e socio-economiche dell'area di Monte Tondo.
Il lavoro ha evidenziato **quattro diversi scenari per l'area estrattiva**:

- **Scenario A,** alternativa zero, completamento dell'attività estrattiva alla fine dell'autorizzazione in corso, ottobre 2022 (salvo ulteriore proroga al 2023);
- **Scenario B,** ipotesi di prosecuzione attività estrattiva all'interno dello scenario 4 dello studio di ARPA nell'anno 2001;
- **Scenario C,** completamento dell'attività estrattiva dello scenario 4 in attuazione dell'ipotesi di cui al cap. 13.5 dello studio di ARPA nell'anno 2001, ovvero con un incremento dei volumi da estrarre estendendo gli scavi esterni al perimetro PIAE con una ipotesi di un ulteriore 1.000.000 di m^3. Tale scenario prevede un ampliamento del perimetro del PIAE attualmente vigente che intercetta le zone B e C definite dal Decreto Istitutivo del Parco Regionale della Vena del Gesso Romagnola, il Sito della Rete Natura 2000 ZSC/ZPS IT4070011 "Vena del Gesso Romagnola", nonché le "Zone di

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tutela naturalistica - di conservazione" e le "Zone di tutela naturalistica - di limitata trasformazione" ed infine alcune aree forestali individuate nella Carta Forestale della Provincia di Ravenna e rientranti nel Sistema forestale regionale del D.Lgs 42/2004 e del D.Lgs 34/2018;

- **Scenario D, proposta di Saint-Gobain,** che prevede l'estrazione di ulteriori 2.400.000 di m³ mediante l'ampliamento del perimetro del PIAE attualmente vigente, nel rispetto di ogni vincolo esistente (Parco, Grotta del Re Tiberio e Grotta dell'Abisso Mezzano) che permetterebbe una prospettiva di vita utile a pianificare ulteriori investimenti.

La **proposta dell'azienda** è basata sull'**analisi puntuale** dei **dati estrattivi** effettuati **a partire dal 2001**, **anno in cui è iniziata l'attività estrattiva relativa al PIAE in fase di revisione,** e che evidenzia la disponibilità a novembre 2021 di soli **506.000 m³ complessivi residui**.

Attualmente, visto l'anno intercorso, i **volumi residui si sono ulteriormente ridotti**. Il rilievo topografico svolto a **settembre 2023** attesta volumi per **372.100 m³** complessivi entro il perimetro di PIAE.

In considerazione di tali volumi residui e in attesa dell'approvazione di una variante al PIAE attualmente vigente che permetta l'ampliamento del perimetro dello stesso al fine di garantire la prosecuzione delle attività di cava al fine di salvaguardare le attività economiche connesse alla cava e le relative prospettive occupazionale, la scrivente società provvederà in ogni caso a presentare una istanza di PAUR, che porterà nel 2027 l'esaurimento dell'attuale e futuro – qualora non vi fosse revisione di confini – PIAE.

Tale **disponibilità è ben lontana dai volumi proposti nello studio**, ed in particolare nello scenario B che è definito come il più favorevole nello studio medesimo, **ma questa discrepanza è dovuta a due errati presupposti fattuali facilmente dimostrabili:**
i) **lo studio considera i dati di estrazione a partire dal 2006 e non dal 2001**;

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ii) lo studio **non prende in considerazione i volumi inesistenti e non estratti** a causa dei **vuoti delle gallerie** e dello **sterile**;
iii) **lo studio NON è basato su alcun rilievo topografico reale svolto sul campo, bensì su dati teorici non verificati**, come già evidenziato nelle comunicazioni presentate ufficialmente dalla scrivente agli Enti Competenti rispettivamente nel 2019 e 2020 sui volumi residui, in occasione della prevista variante di PIAE.

Inoltre, tale studio non può essere considerato una base tecnica affidabile/attendibile, tale da sostenere una scelta strategica quale uno scenario di pianificazione pubblica, in quanto applica:

- **Valutazioni discrezionali e prive di oggettività** nelle affermazioni inerenti i ritmi produttivi della cava e i relativi impatti sul reticolo carsico (pag. 7);
- **Valutazioni discrezionali e prive di oggettività** circa recupero ambientale svolto, il quale ha messo operativamente e legittimamente in pratica quanto previsto dal progetto autorizzato oggetto di VIA e dunque in linea con tutte le normative ambientali e paesaggistiche, in aggiunta seguito e monitorato da esperti dell'Università (pag. 11);
- **Valutazioni discrezionali e prive di oggettività, oltre che palesemente sbilanciate** in merito al peso attribuito ai criteri di scelta degli scenari, a partire dall'ordine in cui questi sono stati indicati (pag. 15);
- **Tendenzioso** nell'espressione della priorità dei valori per il territorio: viene considerata degna di tutela esclusivamente la parte naturalistica, tralasciando tutti i valori sociali, storici, economici ed antropologici (pag. 18);
- **Discrezionale e autoreferenziale** con riferimenti ormai superati e non ufficiali (es.: "limite invalicabile Forti-Marabini-Vai", pag. 19);
- **Discrezionale, superficiale e ultroneo** nell'individuazione di scelte paesaggistiche arbitrarie, in contrasto con quelle effettuate a suo tempo dalle PP.AA. coinvolte (pag. 22);
- **Non pertinente e discrezionale** con gli obiettivi di una pianificazione territoriale complessiva perché

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dichiaratamente mirato alla conservazione del perimetro di PIAE (pag. 24);
- **Errato** nelle affermazioni sullo scenario D individuato dall'azienda Saint-Gobain, che non prevede l'intercettazione della zona B del Parco (pag. 25), diversamente da quanto affermato;
- **Per espressa ammissione, privo di qualsiasi approccio tecnico e scientifico** con sistemi di calcolo nella valutazione degli scenari, che vengono espressi con numeri non giustificati (pag. 35).

Per quanto evidenziato sopra, si richiede di **eliminare / superare il presupposto dell'assunzione dello scenario B dello Studio Servin come base della valutazione dei volumi disponibili e delle possibilità progettuali ipotizzate,** in quanto **non supportato da rilievi in campo, e manifestamente errato in quanto basato sui predetti errati presupposti**.

A conferma di quanto evidenziato sopra, Saint-Gobain ha incaricato lo **Studio Topografico Faenza** di effettuare un rilievo dello stato di fatto del sito a novembre 2021 e di **verificare i volumi di materiale residuo estraibili.**

Tale perizia è basata sul rilievo topografico realizzato con metodo aerofotogrammetrico; operazione che Saint-Gobain – come da norma di legge – **svolge annualmente** per verificare e dichiarare **il volume di materiale estratto e il residuo ancora estraibile rispetto al progetto autorizzato.** Il risultato della perizia, asseverata al Tribunale di Ravenna a firma del geometra Nevio Kristancic, evidenzia chiaramente i numeri dei volumi residui e commerciali di gesso estraibile come citati sopra. (All.1_Perizia Giurata Volumi)

Quanto affermato dalla perizia asseverata è stato inoltre **confermato dall'ingegnere minerario Roberto Bruno, professore** dell'**Università di Bologna,** a cui Saint-Gobain ha chiesto un parere tecnico (All.2_Parere su perizia UNIBO)

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4. IL DETTAGLIO DELLA PROPOSTA PROGETTUALE DI SAINT-GOBAIN

Dalla analisi puntuale e verificata dei volumi residui, Saint-Gobain stima, **ai ritmi attuali e all'interno degli attuali limiti del PIAE vigente**, **una vita dello stabilimento di Casola Valsenio fino al 2027.** Per tale ragione, Saint-Gobain ha avanzato l'ipotesi dello scenario D proponendo, quindi un progetto di estrazione **che necessariamente prevede un ampliamento del PIAE.**

Il progetto proposto da Saint-Gobain prevede **l'estrazione di ulteriori 2.400.000 m³, nel rispetto di ogni vincolo esistente, da estrarre in un arco temporale altresì utile e imprescindibile** per **poter investire in ricerca e sviluppo, sostenibilità ed economia circolare per il tessuto economico del territorio.**

Sul punto si deve rimarcare che l'ampliamento del perimetro PIAE proposto prevede comunque che il sito ricada esclusivamente all'interno di Rete 2000 (SIC/ZPS – Zone di Protezione Speciale) e in Area Contigua del Parco Vena del Gesso (AC.CAV), che non pregiudica la possibilità di estendere cave già esistenti.

Con riguardo alle cave site all'interno di aree di **Rete Natura 2000**, si deve infatti tener presente che:

- L'art. 5 comma 5 del DM 17.10.2007, "Per tutte le ZPS, le regioni e le province autonome, con l'atto di cui all'art. 3 comma 1 del presente decreto provvedono a porre i seguenti divieti: lett. n) apertura di nuove cave e ampliamento di quelle esistenti, **ad eccezione di quelle previste negli strumenti di pianificazione generali e di settore vigenti alla data di emanazione del presente atto o che verranno approvati entro il periodo di transizione**".
- Nello stesso senso, la DGR 1147/2018 "È vietato aprire nuove cave o ampliare quelle esistenti, **ad eccezione di quelle previste negli strumenti di pianificazione generali e di settore**, comunali, provinciali e dei parchi nazionali e

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regionali, **in corso di approvazione alla data del 7 ottobre 2013, per quanto concerne i SIC, e vigenti alla data del 7 novembre 2006, per quanto riguarda le ZPS ed i SIC-ZPS**.

- La Cava di Monte Tondo è inserita nel PIAE approvato nel 2005 (PIAE 2003-2012), successivamente oggetto di variante approvata nel 2009. La cava rientra quindi pacificamente nell'ipotesi derogatoria prevista da DM 2007 e DGR 2018.

Con riguardo alle cave site nell'ambito di un'Area Contigua del Parco Vena del Gesso (AC.CAV). si deve innanzitutto rilevare che allo stato non è ancora stato approvato il Piano dello stesso Parco, trovando quindi applicazione l'art. 6 della LR 10/2005, ai sensi del quale "fino all'approvazione del Piano del Parco", trovano applicazione i seguenti limiti:

- In Zona Area Contigua "**si applicano le norme degli strumenti urbanistici comunali vigenti fatta eccezione per le seguenti attività che sono vietate**: a) l'accesso non regolamentato alle grotte e alle cavità naturali; b) la modifica o l'alterazione del sistema idraulico sotterraneo; c) la modifica o l'alterazione di grotte, doline, risorgenti o altri fenomeni carsici superficiali o sotterranei; d) l'eliminazione delle siepi e della vegetazione di ripa di torrenti e fossi; e) la conversione dei prati seminaturali e dei pascoli nelle sole aree calanchive".
- In ogni caso, si deve rilevare che il progetto di ampliamento non risulta neppure in contrasto con il Piano del Parco (assunto dall'amministrazione competente e ancora non formalmente approvato in via definitiva), il cui art. 27 comma 13 prevede quanto segue: "*La sottozona AC.CAV comprende la cava di Monte Tondo. In tale sottozona le attività estrattive sono consentite e regolamentate dalla sovraordinata D.G.R. n.1147 del 16-07-2018, emanate dalla Regione Emilia-Romagna: "E' vietato aprire nuove cave o ampliare quelle esistenti,* ***ad eccezione*** *di quelle previste negli strumenti di pianificazione generali e di settore, comunali, provinciali e dei parchi nazionali e regionali, in corso di approvazione alla data del 7 ottobre 2013, per quanto concerne i SIC, e vigenti alla data del 7 novembre 2006, per quanto riguarda le ZPS ed i SIC-ZPS".*

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È importante sottolineare che, come si evince dalla documentazione presentata (All.3_Proposta Futuro Planimetria), seppur sviluppato oltre l'attuale perimetro dei PIAE, la proposta **rientra comunque, diversamente da quanto sostenuto nel provvedimento Valsat, nei limiti dell'area contigua del Parco all'interno della quale non vi sono vincoli ambientali ostativi all'esecuzione dello stesso**. Tale peculiarità è facilmente osservabile anche consultando la cartografia tematica sul tema.

Il progetto, inoltre, **non coinvolge in nessun modo l'abisso mezzano,** ovvero la cavità carsica che si trova più a sud di tutte quelle interessanti l'area di Cava (All.4_Proposta Futuro Sezioni).

Alla **proposta progettuale relativa alla fase di estrazione è affiancata la dovuta fase di ripristino**. Questa sezione è stata sviluppata a partire dallo **Studio commissionato** all'**Università di Bologna** e guidato dal **Dott. Enrico Muzzi,** del Dipartimento di Scienze e Tecnologie Agro-Alimentari (All.5_Confronto degli stati di progetto e ripristino). Lo Studio ha sperimentato in loco la **piantumazione di differenti specie autoctone e pioniere** mettendo in evidenza da un lato le tipologie più adatte al terreno e al microclima presente, dall'altro la metodologia di piantumazione che prevede un percorso a step da portare avanti contestualmente all'attività estrattiva. (All.6_Studio Dott.Muzzi).

5. IL GESSO: UNA RISORSA

Saint-Gobain, infine, tiene a **rimarcare l'importanza del gesso** in un'ottica di **edilizia sostenibile**: **impiegare un sistema a secco in cartongesso riduce le emissioni di CO_2 lungo tutto il ciclo di vita del costruito,** isola acusticamente e termicamente dall'esterno e dall'interno, minimizzando i consumi energetici necessari per riscaldare e raffrescare gli ambienti.

Le lastre in cartongesso sono studiate per resistere e **reagire al fuoco,** offrendo standard di sicurezza elevati; inoltre, sono resistenti all'azione sismica.

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Inoltre, **proprio nello stabilimento di Casola Valsenio viene prodotta l'innovativa lastra Gyproc DuraGyp ECO Activ'Air®,** composta dal **più alto contenuto di materiale riciclato (35%) presente oggi sul mercato italiano**, in linea con la volontà di Saint-Gobain di rendere il settore delle costruzioni sempre più sostenibile e incentivare il passaggio ad un sistema di economia circolare.

In conclusione, non si può non tenere in considerazione che l'**OCSE prevede che la domanda globale di materiali raddoppierà**, dai 79 miliardi di tonnellate di oggi (2022) a 167 miliardi di tonnellate nel 2060. La concorrenza globale per le risorse diventerà sempre più serrata nel prossimo decennio. **La dipendenza dalle materie prime critiche potrebbe presto sostituire l'odierna dipendenza dal petrolio.**

Per tale ragione l'**Unione Europea** nell'adottare il **Green Deal** nel **dicembre 2019 ha riconosciuto** l'**accesso alle risorse** come una **questione strategica di sicurezza** per realizzare l'ambizioso obiettivo della **neutralità climatica entro il 2050**.

Già nel **2008** la **Commissione Europea** ha lanciato la **Raw Materials Initiative** (RMI). Questa politica dell'UE persegue una **diversificazione strategia per garantire materie prime non energetiche per le catene del valore industriali e sociali del benessere UE**.

La **nuova strategia industriale europea** affronta la sicurezza e sfida della sostenibilità e chiede un piano d'azione sulle **materie prime critiche** e per alleanze sulle materie prime che guidano l'industria

Vengono considerate **materie prime critiche** quelle che hanno un'**elevata importanza economica per l'Unione Europea e un alto rischio di approvvigionamento.**

È importante avere ben presente che **dall'ultima valutazione del 2020** è emerso chiaramente come **tra le materie prime critiche e considerate <u>strategicamente importanti</u> per l'industria**

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europea vi è il **Gesso** (All.7.1_Studio Ue materie prime e All.7.2_Agenda strategica Ue materie prime 2021 - 2027).

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Allegati:
All.1 - Perizia Giurata Volumi
All.2 - Parere su perizia UNIBO
All.3 - Proposta Futuro Planimetria
All.4 - Proposta Futuro Sezioni
All.5 - Confronto degli stati di progetto e ripristino
All.6 - Studio Dott. Muzzi
All.7.1 - Studio Ue materie prime
All.7.2 - Agenda strategica Ue materie prime 2021 - 2027

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