



RMIS Production module

Data Sources

Last update: 28 February 2024

Joint
Research
Centre

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1 Aggregates

1.1 Production of primary materials

Coverage: EU countries.

Time period of compiled data series: 2008-2019.

Reference Year: 2019.

Data source(s): (UEPG, 2021) for 2019, (UEPG, 2020) for 2018, (UEPG, 2019) for 2008-2017.

Other collected/checked/registered datasets: Information on the production of aggregates in the EU is also collected by (BGS, 2023) (2000-2021) and (Eurostat Prodcom, 2023a) (2000-2021).

Notes: Global production data are not available. Data collated by UEPG for EU countries comprise natural aggregates (crushed rock, sand & gravel, marine aggregates), manufactured aggregates from industrial by-products, recycled aggregates, and aggregates reused on site. Figures refer to the total production of all forms of aggregates.

Latest RMIS update: October 2022.

1.2 Production of refined/processed materials

Not applicable.

1.3 Additional information and insights about production

- ✓ The product mix of quarry production is obtained from (UEPG, 2021);
- ✓ The extraction sites per EU country are sourced from (UEPG, 2021).

2 Aluminium

2.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-bauxite, 2022) (2011-2020).

Notes: Data reflect the production of bauxite.

Latest RMIS update: August 2023.

2.2 Production of refined/processed materials

2.2.1 Alumina

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-bauxite, 2022) (2011-2020), (IAI, 2023b) (2000-2022).

Notes: Where possible, figures represent the Al_2O_3 equivalent of aluminium oxide trihydrate produced, whether or not calcined. Production figures include both metallurgical-grade alumina and chemical-grade alumina.

Latest RMIS update: August 2023.

2.2.2 Primary Aluminium

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2008-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (IAI, 2023b) (2000-2022).

Notes: Production data refer to primary aluminium, i.e. the molten metal tapped from electrolytic cells or pots during the electrolytic reduction of metallurgical alumina.

Latest RMIS update: August 2023.

2.2.3 Aluminium Ingots

Coverage: World total and EU total.

Time period of compiled data series: 2000-2021 for global, 2008-2021 for the EU.

Reference Year: 2021.

Data source(s): (IAI, 2023a), (Eurostat Prodcorn, 2023b).

Other collected/checked/registered datasets: -

Notes:.. Production of aluminium ingots comprises primary and secondary ingots (from old and new scrap).
PRC codes used for the EU output: 24421130 *Unwrought non-alloy aluminium (excluding powders and flakes)*,
24421153 *Unwrought aluminium alloys in primary form (excluding aluminium powders and flakes)*,
24421154 *Unwrought aluminium alloys (excluding aluminium powders and flakes)*, 24421155 *Unwrought aluminium alloys in secondary form (excluding aluminium powders and flakes)*.

Latest RMIS update: August 2023.

2.3 Additional information and insights about production

- ✓ The breakdown of bauxite output by grade is elaborated from (Flook, 2018);
- ✓ The global production of unwrought aluminium by source is obtained from (IAI, 2023a);
- ✓ The EU production of unwrought aluminium by product category is derived from (Eurostat Prodcom, 2023b).

3 Antimony

3.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-Sb, 2022) (2000-2018).

Notes: It is deducted from the compiled information that production data reflect the antimony content of Sb-bearing ores and concentrates (e.g. of antimony, lead).

Latest RMIS update: August 2023.

3.2 Production of refined/processed materials

Production data of commercial forms of refined antimony are not available.

3.3 Additional information and insights about production

- ✓ The refined antimony production capacity is collected from (Schwarz-Schampera, 2014) (data from Roskill).

4 Arsenic

4.1 Production of primary materials

No data are available as arsenic is primarily produced as a by-product.. The extraction of arsenic mostly relies on the extraction of ores containing copper and gold; the by-products of smelting are then processed and refined to extract the arsenic.

4.2 Production of refined/processed materials

4.2.1 Arsenic (white)

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-As, 2022) (2011-2021).

Notes: As deduced from background information provided by the data sources, production data are associated with the output of arsenic trioxide and other compounds of elemental arsenic as As_2O_3 equivalent.

Latest RMIS update: August 2023.

4.3 Additional information and insights about production

-

5 Baryte

5.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2020, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (USGS myb-barite, 2022) for 2014-2020.

Notes: Data refer to the first marketable baryte product that includes crude barite (run-of-mine) and products of simple beneficiation methods. Along with baryte minerals (barium sulphate), data may include small quantities of witherite (barium carbonate).

Latest RMIS update: August 2023.

5.2 Production of refined/processed materials

Statistics on the production of processed forms of barium minerals (e.g.. various barium compounds) are not available.

5.3 Additional information and insights about production

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6 Bentonite

6.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (USGS myb-Clays, 2022) (2006-2021), (BGS, 2023) (2006-2021).

Notes: Chinese production in 2015-2021 is sourced from (USGS myb-Clays, 2022).

Latest RMIS update: August 2023.

6.2 Production of refined/processed materials

No data are available for activated bentonites.

6.3 Additional information and insights about production

-

7 Beryllium

7.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (USGS myb-Be, 2022).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (BGS, 2023) (2000-2021), (USGS, 2022) (2005-2021, in Be content).

Notes: -

Latest RMIS update: August 2023.

7.2 Production of refined/processed materials

7.2.1 Refined beryllium

Coverage: World countries.

Time period of compiled data series: 2012-2018.

Reference Year: 2018.

Data source(s): JRC estimates based on (USGS myb-Be, 2018).

Other collected/checked/registered datasets: -

Notes: Data on the production of refined beryllium are limited. US production of refined beryllium products is estimated from the annual consumption of beryllium ores and concentrates (as calculated from mine shipments, net trade, and industry stocks) and a metallurgical yield assumption of 70%. Japan's production level is estimated on the basis of information in (BRGM, 2016). Kazakhstan's production uses as feedstock stockpiles of beryllium concentrates.

Latest RMIS update: August 2023.

7.3 Additional information and insights about production

- ✓ The global production capacity for refined beryllium per product type is obtained from (BRGM, 2016) (Beryllium Science & Technology Association (BeST) data).

8 Bismuth

8.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-Bi, 2023) (2000-2015).

Notes: It is deduced from background information that data refer to both by-product production and production from bismuth minerals as principal product. Production figures for Bulgaria (2006-2013) and Romania (2006-2007) are acquired from (BGS, 2023), and for Japan in 2000-2005 from (USGS myb-Bi, 2023). The output reported by WMD for Japan in 2006-2021 is not considered as it relates to metal production according to (BGS, 2023).

Latest RMIS update: August 2023.

8.2 Production of refined/processed materials

8.2.1 Refined bismuth

Coverage: World countries.

Time period of compiled data series: 2000-2021

Reference Year: 2021.

Data source(s): (USGS myb-Bi, 2023).

Other collected/checked/registered datasets: (USGS mcs, 2023) (2016-2021).

Notes: Production of Peru in 2016-2021 is acquired from (BGS, 2023) (metal production). The output of Belgium in 2014 is taken from (Elsner, 2015), whereas in 2008-2013 and 2015-2021 is assumed to equal the average production in 2000-2007.

Latest RMIS update: August 2023.

8.3 Additional information and insights about production

-

9 Boron

9.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005. Data for Russia (in 2006-2010) and Kazakhstan (in 2011-2015) are acquired from (USGS myb-B, 2022).

Other collected/checked/registered datasets: (USGS myb-B, 2022) (2000-2021), (BGS, 2023) (2006-2021).

Notes: Data concern the production of various boron minerals (borates).

Latest RMIS update: August 2023.

9.2 Production of refined/processed materials

9.2.1 Refined borates

Available information on the production of refined borates and boron compounds worldwide is scarce. Data for EU production is sourced from (Eurostat Prodcorn, 2023b).

9.3 Additional information and insights about production

-

10 Cadmium

10.1 Production of primary materials

Cadmium production is closely tied to the production of zinc, with most of the cadmium primary supply coming from the same mines and refineries that produce zinc metal. Due to its by-product nature, mine production statistics are not available.

10.2 Production of refined/processed materials

10.2.1 Refined cadmium

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (USGS myb-Cd, 2022) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021), (USGS myb-Cd, 2022) (2006-2020).

Notes: -

Latest RMIS update: August 2023.

10.3 Additional information and insights about production

-

11 Cerium

11.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and cerium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of cerium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is collected from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

11.2 Production of refined/processed materials

Data are not available in the public domain.

11.3 Additional information and insights about production

-

12 Chromium

12.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, JRC estimate based on (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (ICDA, 2019) (2004-2018).

Notes: Production data from 2000 to 2005 reported by (BGS, 2023) in gross weight of chromium concentrates are converted to Cr_2O_3 content using a global average content in chrome concentrates of 43%. Production of Finland in 2000-2021 is derived from (BGS, 2023) using reserves' grade when production is reported as gross weight of chromium ore, and the average Cr_2O_3 content of chromium concentrates in Finland when production is reported in gross weight of chromium concentrates.

Latest RMIS update: August 2023.

12.2 Production of refined/processed materials

12.2.1 Chromium ferroalloys

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-ferroalloys, 2023) (2000-2020), (USGS myb-Cr, 2022) (2000-2021), (ICDA, 2019) (2004-2018).

Notes: Data reflect the production of chromium ferroalloys in gross weight, comprising ferro-chrome (FeCr) and ferro-silico-chrome (FeSiCr).

Latest RMIS update: August 2023.

12.2.2 Ferrochrome

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-ferroalloys, 2023) (2000-2020), (USGS myb-Cr, 2022) (2000-2021), (ICDA, 2019) (2004-2018).

Notes: Data concern the production of ferro-chrome (FeCr). Chinese ferro-chrome production from 2010 to 2021 is obtained from USGS. USGS is also the source for South Africa's ferro-chrome output from 2015 to 2021.

Latest RMIS update: August 2023.

12.2.3 Ferro-silico-chrome

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-ferroalloys, 2023) (2000-2020), (USGS myb-Cr, 2022) (2000-2021), (ICDA, 2019) (2004-2018).

Notes: Data refer to the production of ferro-silico-chrome (FeSiCr). Russia's production of ferro-silico-chrome from 2010 to 2020 is acquired from USGS.

Latest RMIS update: August 2023.

12.3 Additional information and insights about production

- ✓ Chromite's production by grade is sourced from (ICDA, 2019);
- ✓ The production of chromium ferroalloy products is obtained from (ICDA, 2019);
- ✓ The production capacity of chromium metal is collected from (USGS myb-Cr, 2022) (data from the 2021 edition);
- ✓ The production capacity of chromium metal is gathered from (USGS myb-Cr, 2022) (data from the 2021 edition).

13 Cobalt

13.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-Co, 2023) (2000-2020).

Notes:

Latest RMIS update: August 2023.

13.2 Production of refined/processed materials

13.2.1 Refined cobalt

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Co, 2023) (2000-2020), (Cobalt Institute, 2019) (2011-2018), (Eurostat Prodcum, 2023b).

Notes: Figures include the production of cobalt metal plus the cobalt content of refined compounds (oxides, carbonates, sulphates and other). Data comprise production from both primary and secondary raw materials. The split in refined cobalt production between Belgium and China is achieved using data from (USGS myb-Co, 2023) for 2013-2020, and (Roskill, 2014) for 2012; for other years it is assessed through capacity data.

Latest RMIS update: August 2023.

13.3 Additional information and insights about production

- ✓ The host metals from which cobalt is produced as a by-product is sourced from (JRC, 2021). Data include an estimate for artisanal and small-scale mining (ASM) where cobalt is the primary commodity;
- ✓ The mine capacity by product is obtained from (JRC, 2021).

14 Coking coal

14.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (USEIA, 2023) for 2000-2005.

Other collected/checked/registered datasets: (USEIA, 2023) (2006-2021).

Notes: Data refer to coking coal of various qualities (hard, semi-hard and semi-soft). Coal for Pulverized Coal Injection (PCI) is not included.

Latest RMIS update: August 2023.

14.2 Production of refined/processed materials

14.2.1 Metallurgical coke

Coverage: World countries.

Time period of compiled data series: 2000-2021

Reference Year: 2021.

Data source(s): (USEIA, 2023).

Other collected/checked/registered datasets: (Eurostat, 2022), (VDKI, 2022), (VDKI, 2017).

Notes: Data address the production of metallurgical coke.

Latest RMIS update: August 2023.

14.3 Additional information and insights about production

✓ The production of hard coal by product category is based on (WMD, 2023).

15 Copper

15.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-Cu, 2023) (2000-2019).

Notes: -

Latest RMIS update: August 2023.

15.2 Production of refined/processed materials

15.2.1 Refined copper

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Cu, 2023) (2000-2019).

Notes: Figures relate to both primary and secondary refined copper, whether electrolytic or fire refined. Metal recovered from secondary remelting alone is excluded. The production of Finland in 2017-2019 is compiled from (USGS myb-Cu, 2023), whereas in 2020-2021 is assumed to be equivalent to its 2019 level. Data for France, Hungary, Taiwan-SAR China, and the Republic of Congo are also based on (USGS myb-Cu, 2023).

Latest RMIS update: August 2023.

15.3 Additional information and insights about production

- ✓ The mine production by product category is obtained from (ICSG, 2022);
- ✓ The refined copper production by feedstock and process is sourced from (USGS myb-Cu, 2023).

16 Diatomite

16.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): : (BGS, 2023), except China (2016-2019) from (USGS myb-Diatomite, 2022).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (USGS myb-Diatomite, 2022) (2014-2021).

Notes: Data for Spain include tripolite. Danish production corresponds to 'moler' (an impure diatomite containing a large proportion of clay).

Latest RMIS update: August 2023.

16.2 Production of refined/processed materials

No data are available for processed (calcined) diatomite.

16.3 Additional information and insights about production

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17 Dysprosium

17.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and dysprosium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of dysprosium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is gathered from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

17.2 Production of refined/processed materials

Information is not accessible in the public domain.

17.3 Additional information and insights about production

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18 Erbium

18.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and erbium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of erbium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is collected from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

18.2 Production of refined/processed materials

Data are not publicly available.

18.3 Additional information and insights about production

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19 Europium

19.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020)

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and europium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of europium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is gathered from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

19.2 Production of refined/processed materials

Data are not publicly available.

19.3 Additional information and insights about production

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20 Feldspar

20.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (USGS myb-feldspar, 2022) (2013-2019), (Dondi, 2019a) (2012-2016), (Dondi, 2018) (2016).

Notes: Data refer to the aggregated production of feldspar minerals of various grades (crude, ground etc.), and nepheline syenite. Data for Italy (2006-2021), and Poland (2014-2021) are collected from (WMD, 2023).

Latest RMIS update: August 2023.

20.2 Production of refined/processed materials

Not applicable. Marketable feldspar is not processed beyond the typical crushing, grinding and flotation techniques.

20.3 Additional information and insights about production

- ✓ Mine production by mineral is derived from (BGS, 2023).

21 Fluorspar

21.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-fluorspar, 2022) (2012-2019).

Notes: Figures include all quality grades of fluorspar. In 2006-2021, reported data for Mexico by BGS are prioritised over WMD, after comparison with other data sources (national statistics - INEGI). Production data reported by BGS are added in the dataset for Kazakhstan and Kyrgyzstan (2006-2021).

Latest RMIS update: August 2023.

21.2 Production of refined/processed materials

21.2.1 Hydrofluoric acid

Coverage: World total and EU total.

Time period of compiled data series: 2015-2021 for world production and 2008-2021 for the EU production

Reference Year: 2021.

Data source(s): (Statista, 2022a) for global production, and (Eurostat Prodcom, 2023b) for the EU production.

Other collected/checked/registered datasets: -

Notes: Data on the global supply of hydrofluoric acid at country level are not available in the public domain.

Latest RMIS update: August 2023.

21.2.2 Synthetic cryolite (Na_3AlF_6) & Aluminium fluoride (AlF_3)

Data on other refined forms of fluorspar are not available.

21.3 Additional information and insights about production

✓ Fluorspar's mine production by grade is estimated from data provided by (USGS myb-fluorspar, 2022).

22 Gadolinium

22.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and gadolinium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of gadolinium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is collected from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

22.2 Production of refined/processed materials

The collected information is not publicly available.

22.3 Additional information and insights about production

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23 Gallium

23.1 Production of primary materials

Gallium is not extracted from one particular ore but is obtained mainly as by-product of the metallurgical processing of bauxite to alumina and from zinc metallurgy; as a consequence, production statistics on gallium extracted at the mining stage are not available.

23.2 Production of refined/processed materials

23.2.1 Refined gallium

Coverage: World countries.

Time period of compiled data series: 2006-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2009, (Butcher and Brown, 2014) for 2010, (BGS, 2023) for 2011-2021.

Other collected/checked/registered datasets: (BGS, 2023) (2007-2010), (WMD, 2023) (2010-2021), (USGS myb-Ga, 2022) (2012-2020), (USGS, 2023) (2021), (Rongguo *et al.*, 2016) (2006-2015), (Eurostat Prodcum, 2023b) (2019-2021).

Notes: Data relate to primary crude gallium. Obtaining reliable figures for actual gallium production (primary and secondary) is challenging due to the small market and the few producing companies. The production of Hungary in 2011-2014 is sourced from (USGS myb-Ga, 2022). The production of Germany in 2011-2012 is assumed similar to its 2010 level. The production of Russia in 2011-2021, the production of China in 2020-2021 as well as the production of Ukraine in 2011-2012 are collected from (WMD, 2023).

Latest RMIS update: August 2023.

23.2.2 High-purity refined gallium

Coverage: World total.

Time period of compiled data series: 2010-2022.

Reference Year: 2022.

Data source(s): (USGS mcs, 2023).

Other collected/checked/registered datasets: -

Notes: The availability of suitable data is limited. Figures for 2010, 2011 and 2018 are a JRC estimate (extrapolation).

Latest RMIS update: August 2023.

23.3 Additional information and insights about production

- ✓ Gallium's production by host material is sourced from (Liedtke and Huy, 2018);
- ✓ The production capacities of crude gallium from primary sources are derived from (USGS, 2023) and (USGS myb-Ga, 2022);
- ✓ The production capacities of high-purity refined gallium are elaborated from data in (USGS, 2023) and (Liedtke and Huy, 2018).

24 Germanium

24.1 Production of primary materials

Data on germanium mine production are not readily available as it is a by-product of zinc mining; germanium is also extracted from coal ash.

24.2 Production of refined/processed materials

24.2.1 Refined germanium

Coverage: World countries.

Time period of compiled data series: 2006-2021.

Reference Year: 2021.

Data source(s): JRC compilation built on (WMD, 2023).

Other collected/checked/registered datasets: (USGS myb-Ge, 2022) (2015-2020), (Eurostat Prodcum, 2023b) (2019-2021), (Melcher and Buchholz, 2014) (2012).

Notes: Data for germanium refinery production are generally of poor quality in terms of coverage of global producers. An estimate for the production of Germany is provided from (European Commission, 2023) and it is assumed to be constant over 2006-2021. Belgium's production is estimated by JRC on the basis of wafer capacity and it is assumed to be steady over 2006-2021. Estimates for the production of Canada from 2006 to 2013 are gathered from several sources, whereas the output in 2014-2021 is assumed stable to its 2013 level.

Latest RMIS update: August 2023.

24.3 Additional information and insights about production

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25 Gold

25.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (WGC, 2022) (2010-2021).

Notes: Mine production of gold. Data may not include an estimate for informal gold production of artisanal and small-scale mining (ASM).

Latest RMIS update: August 2023.

25.2 Production of refined/processed materials

25.2.1 Refined gold

Coverage: World total.

Time period of compiled data series: 2010-2022.

Reference Year: 2022.

Data source(s): (WGC, 2023).

Other collected/checked/registered datasets: -

Notes: Information about the breakdown of production across countries is not available. The figure represents the aggregate of annual primary (mine) and recycled gold supply.

Latest RMIS update: August 2023.

25.3 Additional information and insights about production

- ✓ Information about the main commodities extracted in the gold-producing mines is obtained from (S&P, 2023);
- ✓ Gold 's refinery production per feedstock is derived from (WGC, 2023).

26 Gypsum

26.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (USGS myb-gypsum, 2023) (2017-2021).

Notes: Data concern the production of gypsum and anhydrite minerals. The reported data may also refer to gypsum plaster production. The output of synthetic gypsum is excluded. The production of Kyrgyzstan, United Arab Emirates, and Somalia is obtained from (WMD, 2023).

Latest RMIS update: August 2023.

26.2 Production of refined/processed materials

Not applicable. The production of calcined gypsum (plasters) is considered in primary raw materials.

26.3 Additional information and insights about production

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27 Hafnium

27.1 Production of primary materials

Hafnium is extracted together with zirconium and data for mined hafnium are not reported. Hafnium is recovered only as a by-product of zirconium refining (production of zirconium tetrachloride and nuclear-grade zirconium sponge metal) at a ratio of about Zr:Hf=50:1.

27.2 Production of refined/processed materials

27.2.1 Refined hafnium and hafnium compounds

Coverage: World total.

Time period of compiled data series: 2015-2017

Reference Year: 2017

Data source(s): JRC elaboration based on various source such as (Alkane, 2017)(Alkane, 2018)(Alkane, 2020), which provide estimates for a few individual producers in specific years.

Other collected/checked/registered datasets: -

Notes: Up-to-date and comprehensive annual production figures for hafnium are not readily available. The compiled information provides only a general overview of hafnium production. Figures include secondary production that is presumed to take place entirely in the USA (revert scrap).

Latest RMIS update: August 2021.

27.2.2 Hafnium metal products

Coverage: EU countries.

Time period of compiled data series: 2019-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcom, 2023b).

Other collected/checked/registered datasets: -

Notes: Products of unwrought hafnium & hafnium powders. PRC code: 24453062 *Unwrought hafnium "celtium"; hafnium powders.*

Latest RMIS update: August 2023.

27.3 Additional information and insights about production

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28 Helium

28.1 Production of primary materials

Not applicable. Helium is a by-product recovered from natural gas extraction.

28.2 Production of refined/processed materials

28.2.1 Helium gas

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (Elsner, 2018) for 2000-2017; (USGS mcs, 2023) for 2018-2021.

Other collected/checked/registered datasets: (USGS mcs, 2023) for 2000-2017.

Notes: Production volumes are to a great extent estimates performed by the data providers. The US output includes withdrawals from helium storage facilities. The small production levels of Germany, Ukraine and India in 2018-2021 and China in 2018-2020 are a JRC estimate based on the output of 2017.

Latest RMIS update: August 2023.

28.3 Additional information and insights about production

- ✓ The production capacity by process is elaborated from data in (Elsner, 2018).

29 Heavy Rare Earth Elements (HREE)

29.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration built on the total REE production (see section 67.1).

Other collected/checked/registered datasets: -

Notes: The HREE group comprises dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium and yttrium. Figures are the aggregate of the estimated production of the each HREE.

Latest RMIS update: August 2023.

29.2 Production of refined/processed materials

29.2.1 Refined HREE

Coverage: World countries.

Time period of compiled data series: 2021.

Reference Year: 2021.

Data source(s): (Wood Mackenzie, 2022).

Other collected/checked/registered datasets: -

Notes: Data aggregate the estimated production of refined dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium and yttrium. Recycling is included.

Latest RMIS update: August 2023.

29.3 Additional information and insights about production

- ✓ The repartition of mine production by REE group is a JRC elaboration;
- ✓ The breakdown of refined HREE production by source is derived from (Wood Mackenzie, 2022).

30 Holmium

30.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and holmium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of holmium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is gathered from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

30.2 Production of refined/processed materials

The gathered information is not publicly available.

30.3 Additional information and insights about production

-

31 Hydrogen

31.1 Production of primary materials

Not applicable. The production of fossil fuels (natural gas, coal, oil), from which hydrogen is almost entirely produced, is not considered.

31.2 Production of refined/processed materials

31.2.1 Hydrogen gas

Coverage: World total, EU total.

Time period of compiled data series: 2020-2021.

Reference Year: 2021.

Data source(s): (IEA, 2022a), (FCHO, 2022), (Hydrogen Europe, 2022), (HyARC, 2016).

Other collected/checked/registered datasets: -

Notes: Hydrogen production volumes are not available in long time series. The total production in 2021 is collected from (IEA, 2022a). It includes pure hydrogen production and hydrogen with carbon-containing gases in methanol production and steel manufacturing. It excludes by-product hydrogen from the chlor-alkali industry, and hydrogen present in residual gases from industrial processes used for heat and electricity generation. The top EU producers are derived from (HyARC, 2016), (FCHO, 2022) and (Hydrogen Europe, 2022). The EU share in global refined production refers to 2020, and it is estimated on the basis of data provided by (FCHO, 2022) and (IEA, 2022a).

Latest RMIS update: August 2023.

31.3 Additional information and insights about production

- ✓ The total production capacity (captive & merchant) in 2016 is derived from (HyARC, 2016);
- ✓ Total hydrogen's production by technology is sourced from (IEA, 2022a);
- ✓ The distribution of low-carbon hydrogen capacity (for all uses) by country is elaborated from (IEA, 2022b);
- ✓ The distribution of low-carbon hydrogen capacity (for all uses) by technology is derived from (IEA, 2022b).

32 Indium

32.1 Production of primary materials

Indium is principally produced through the extraction and processing of zinc ores. There is scarce information about indium's mine production due to its by-product nature.

32.2 Production of refined/processed materials

32.2.1 Refined indium

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2013-2021, (USGS myb-In, 2023) for 2000-2012.

Other collected/checked/registered datasets: (BGS, 2023) for 2006-2021, (USGS myb-In, 2023) for 2013-2021.

Notes: Indium is mostly recovered as a by-product of zinc metal production. The dataset includes the production of refined indium from primary and secondary feed.

Latest RMIS update: August 2023.

32.3 Additional information and insights about production

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33 Industrial Diamonds

33.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) in 2006-2021, (USGS myb-diamond(industrial), 2023) for 2000-2005.

Other data sources checked and/or compiled: (USGS myb-diamond(industrial), 2023) (2006-2021).

Notes: Data relate to natural industrial diamonds; synthetic are excluded.

Latest RMIS update: August 2023.

33.2 Production of refined/processed materials

Not applicable.

33.3 Additional information and insights about production

- ✓ The mine production of natural diamonds by product category is elaborated from (WMD, 2023).

34 Industrial Roundwood

34.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (FAOSTAT, 2023a).

Other collected/checked/registered datasets: -

Notes: Data comprise the aggregate of production of sawlogs and veneer logs (coniferous & non-coniferous), pulpwood (coniferous & non-coniferous), and other industrial roundwood (coniferous & non-coniferous).

Latest RMIS update: August 2023.

34.2 Production of refined/processed materials

34.2.1 Sawnwood, Wood-based panels, Veneer sheets & Wood Pulp

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on (FAOSTAT, 2023a).

Other collected/checked/registered datasets: -

Notes: Data correspond to the aggregate of processed forms of industrial roundwood (sawnwood, wood-based panels, veneer sheets and wood pulp). Data are harmonised to m³ swe (cubic metres of solid wood equivalent, a unit that corresponds with the wood fibre contained in the product and the roundwood equivalent volume needed to produce the product when there are no losses or wood residues) using the following generic conversion factors in accordance with (UNECE/FAO, 2010): 1 m³ of Sawnwood=1.05; 1 m³ of veneer sheets=1.08; wood-based panels=1.50; 1 t of wood pulp=2.50 m³ of swe.

Latest RMIS update: August 2023.

34.2.2 Sawnwood

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (FAOSTAT, 2023a).

Other collected/checked/registered datasets: -

Notes: -

Latest RMIS update: August 2023.

34.2.3 Wood-based panels

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (FAOSTAT, 2023a).

Other collected/checked/registered datasets: -

Notes: -

Latest RMIS update: August 2023.

34.2.4 Veneer sheets

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (FAOSTAT, 2023a).

Other collected/checked/registered datasets: -

Notes: -

Latest RMIS update: August 2023.

34.2.5 Wood Pulp

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (FAOSTAT, 2023a).

Other collected/checked/registered datasets: -

Notes: -

Latest RMIS update: August 2023.

34.3 Additional information and insights about production

- ✓ The removals of roundwood by type of wood are obtained from (Eurostat, 2023);
- ✓ The removals of industrial roundwood by assortment are sourced from (Eurostat, 2023).

35 Iridium

35.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (USGS myb-PGM, 2023) for 2014-2021, JRC estimate for 2000-2013.

Other collected/checked/registered datasets: -

Notes: The assessment of production in 2000-2013 is based on production data from (BGS, 2023) for 'Other than Pt and Pd platinum-group metals', rhodium production from (WMD, 2023) and (JM, 2019a), osmium production from (Girolami, 2012), and Johnson Matthey's background data for ruthenium and iridium annual demand. To achieve the split between ruthenium and iridium primary production in 2000-2013, it is assumed that their yearly output was proportional to annual demand. Osmium production is considered steady each year. Production figures indicate where the initial mining took place (rather than the location of subsequent refining).

Latest RMIS update: August 2023.

35.2 Production of refined/processed materials

Data are not available for secondary supply; therefore, the total annual production cannot be determined.

35.3 Additional information and insights about production

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36 Iron & Steel

36.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) (2000-2021), (WorldSteel, 2018) (2000-2017), (WorldSteel, 2022b) (2000-2021).

Notes: Data from (WorldSteel, 2018) for 2000-2017, and (WorldSteel, 2022b) for 2018-2020 are used for China, where the Chinese production is adjusted so that the Fe content of iron ore is comparable to world average. For the same reason, China's output in 2021 is estimated based on (WMD, 2023) and (WorldSteel, 2022b).

Latest RMIS update: August 2023.

36.2 Production of refined/processed materials

36.2.1 Pig iron

Coverage: World countries.

Time period of compiled data series: 2000-2022.

Reference Year: 2022.

Data source(s): (WorldSteel, 2018) for years 2000-2017, (WorldSteel, 2023b) for years 2018-2022.

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021, incl. Direct reduced iron).

Notes: Data comprise pig iron for steelmaking and foundry iron and all qualities (carbon, stainless, and other alloy).

Latest RMIS update: August 2023.

36.2.2 Direct Reduced Iron (DRI)

Coverage: World countries.

Time period of compiled data series: 2000-2022.

Reference Year: 2022.

Data source(s): (WorldSteel, 2018) for years 2000-2017, (WorldSteel, 2023b) for years 2018-2022.

Other collected/checked/registered datasets: -

Notes:

Latest RMIS update: August 2023.

36.2.3 Crude steel

Coverage: World countries.

Time period of compiled data series: 2000-2022.

Reference Year: 2022.

Data source(s): (WorldSteel, 2023a) for 2018-2022, (WorldSteel, 2022a) for 2017, (BGS, 2023) for 2000-2016.

Other collected/checked/registered datasets: (BGS, 2023) (2017-2021).

Notes: The output of crude steel includes production from scrap. Data comprise all qualities (carbon, stainless, and other alloy).

Latest RMIS update: August 2023.

36.2.4 Stainless steel & heat-resisting steel

Coverage: World countries.

Time period of compiled data series: 2011-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on (ISSF, 2018) for 2011, (WorldStainless, 2020) for 2012-2014, (WorldStainless, 2023) for 2015-2021.

Other collected/checked/registered datasets: -

Notes: Several assumptions and estimates are applied in order to cover gaps in data coverage. The aggregated production of Sweden, United Kingdom and Finland in 2016-2021 is estimated on the basis of reported data in 2011-2014. The reported production of Belgium/Austria in 2016-2021 is allocated entirely to Belgium. The production of Brazil, South Korea, Indonesia, South Africa and Russia in 2021 is estimated from the reported production in 2011-2020.

Latest RMIS update: August 2023.

36.3 Additional information and insights about production

- ✓ Iron ore's EU production by product category is estimated from (Eurostat Prodcom, 2023a);
- ✓ The production of crude steel in the EU by process is provided by (Eurofer, 2022);
- ✓ The production of crude steel in the EU by quality is obtained from (Eurofer, 2022).

37 Kaolin

37.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (Eurostat Prodcum, 2023b) (2006-2021), (Dondi, 2019b) (2012-2016).

Notes: Available production statistics refer to kaolin (China-clay), whether natural for direct use, beneficiated or washed. Kaolinitic clays (ball and plastic clays) may not be included in the dataset.

Latest RMIS update: August 2023.

37.2 Production of refined/processed materials

Not applicable. Calcined kaolin is considered as primary raw material.

37.3 Additional information and insights about production

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38 Krypton

38.1 Production of primary materials

Not applicable. Krypton is produced from air by fractional separation of liquefied air in air separation units.

38.2 Production of refined/processed materials

38.2.1 Krypton gas

Coverage: World total.

Time period of compiled data series: 2000-2017.

Reference Year: 2017.

Data source(s): (Elsner, 2018).

Other collected/checked/registered datasets: -

Notes: Publicly-available and country-specific data on production are insufficient to present the global distribution by countries.

Latest RMIS update: August 2023.

38.3 Additional information and insights about production

✓ The rare gas output distribution is derived from (Elsner, 2018).

39 Lanthanum

39.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and lanthanum content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of lanthanum is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is collected from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

39.2 Production of refined/processed materials

The collected information is not publicly available.

39.3 Additional information and insights about production

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40 Lead

40.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (USGS myb-Pb, 2022) (2015-2019), (ILZSG, 2022) (2016-2021).

Notes: Mine production of lead.

Latest RMIS update: August 2023.

40.2 Production of refined/processed materials

40.2.1 Refined lead

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Pb, 2022) (2015-2019), (ILZSG, 2022) (2016-2021).

Notes: Figures relate to both primary and secondary production and include the lead content of antimonial lead.

Latest RMIS update: August 2023.

40.3 Additional information and insights about production

- ✓ The split of refinery production by feedstock origin is sourced from (USGS myb-Pb, 2022).

41 Limestone

41.1 Production of primary materials

Coverage: EU countries (partial).

Time period of compiled data series: 2008-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcum, 2023b).

Other collected/checked/registered datasets: -

Notes: Production data with a global coverage are not available. Data concern the product aggregate of limestone flux, limestone used for the manufacture of lime and cement, and chalk. PRC codes: 8112050 *Limestone flux, limestone and other calcareous stone used for the manufacture of lime or cement (excluding crushed limestone aggregate and calcareous dimension stone)*; 8113010 *Chalk*.

Latest RMIS update: August 2023.

41.2 Production of refined/processed materials

41.2.1 Lime (all products)

Coverage: EU total.

Time period of compiled data series: 2003-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcum, 2023a).

Other collected/checked/registered datasets:

Notes: Available information is inadequate to make reliable estimates of output for several countries worldwide. Data concern the product aggregate of quicklime, slaked lime & hydraulic lime. PRC codes: 23521033 *Quicklime*, 23521035 *Slaked lime*, 23521050 *Hydraulic lime*.

Latest RMIS update: August 2023.

41.2.2 Quicklime

Coverage: EU countries (partial).

Time period of compiled data series: 2003-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcum, 2023a).

Other collected/checked/registered datasets: -

Notes: PRC code 23521033 *Quicklime*.

Latest RMIS update: August 2023..

41.2.3 Slaked lime

Coverage: EU countries (partial).

Time period of compiled data series: 2003-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcum, 2023a).

Other collected/checked/registered datasets: -

Notes: PRC code 23521035 *Slaked lime*.

Latest RMIS update: August 2023.

41.2.4 Hydraulic lime

Coverage: EU countries (partial).

Time period of compiled data series: 2003–2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcom, 2023a).

Other collected/checked/registered datasets: -

Notes: PRC code 23521050 *Hydraulic lime*.

Latest RMIS update: August 2023.

41.2.5 Cement clinker

Coverage: EU countries (partial).

Time period of compiled data series: 2009–2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcom, 2023a).

Other collected/checked/registered datasets: -

Notes: PRC code 23511100 *Cement clinker*.

Latest RMIS update: August 2023.

41.2.6 Precipitated Calcium Carbonate

Coverage: EU countries (partial).

Time period of compiled data series: 2003–2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcom, 2023a).

Other collected/checked/registered datasets: -

Notes: PRC code 20134340 Calcium carbonate (precipitated).

Latest RMIS update: August 2023.

41.3 Additional information and insights about production

- ✓ Limestone's production by product category in the EU is derived from (Eurostat Prodcom, 2023b).

42 Lithium

42.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) and (USGS myb-Li, 2022) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021) (USGS myb-Li, 2022) (2000-2020).

Notes: Data are converted to LCE from the units reported by the data sources.

Latest RMIS update: August 2023.

42.2 Production of refined/processed materials

42.2.1 Refined lithium

Coverage: World total.

Time period of compiled data series: 2011-2020.

Reference Year: 2020.

Data source(s): (JRC, 2021).

Other collected/checked/registered datasets: -

Notes: Production statistics of refined lithium compounds are not published. The data shown are a JRC estimate, based on several sources and information, of the global output of lithium chemicals (carbonate, hydroxide, chloride) via chemical conversion of lithium concentrates and brine processing at integrated refineries.

Latest RMIS update: August 2023.

42.3 Additional information and insights about production

- ✓ The mine capacity per lithium deposit category is built on JRC analysis (JRC, 2021);
- ✓ The production capacity of refined lithium (by country and by product & grade) originates from JRC analysis (JRC, 2021).

43 Light Rare Earth Elements (LREE)

43.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on the total REE production (see section 67.1).

Other collected/checked/registered datasets: -

Notes: The LREE group comprises lanthanum, cerium, praseodymium, neodymium and samarium. Figures are the aggregate of the estimated production of each LREE.

Latest RMIS update: August 2023.

43.2 Production of refined/processed materials

43.2.1 Refined LREE

Coverage: World countries.

Time period of compiled data series: 2021.

Reference Year: 2021.

Data source(s): (Wood Mackenzie, 2022).

Other collected/checked/registered datasets: -

Notes: Data aggregate the estimated production of refined lanthanum, cerium, praseodymium, neodymium and samarium. Recycling is included.

Latest RMIS update: August 2023.

43.3 Additional information and insights about production

- ✓ The repartition of mine production by REE group is based on JRC analysis;
- ✓ The breakdown of refined LREE production by source is elaborated from (Wood Mackenzie, 2022).

44 Lutetium

44.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and lutetium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of lutetium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is gathered from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

44.2 Production of refined/processed materials

The gathered information is not accessible in the public domain.

44.3 Additional information and insights about production

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45 Magnesite

45.1 Production of primary materials

Coverage: World.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (USGS myb-Mg compounds, 2023) for 2000-2005.

Other collected/checked/registered datasets: (USGS myb-Mg compounds, 2023) (2006-2021), (BGS, 2023) (2000-2021).

Notes: Production of magnesium chloride and other magnesium-bearing compounds that can be recovered from seawater or brines is excluded.

Latest RMIS update: August 2023.

45.2 Production of refined/processed materials

Production data on processed magnesia compounds (caustic-calcined, dead-burned and fused magnesia) are not available.

45.3 Additional information and insights about production

- ✓ Data on the annual production capacity of magnesia (by feedstock, country and compound) are obtained from (USGS myb-Mg compounds, 2023). Magnesia's production capacity comprises installations treating magnesite and magnesium compounds from seawater or brines.

46 Magnesium

46.1 Production of primary materials

Dolomite (calcium–magnesium carbonate), magnesite (magnesium carbonate), and brines (magnesium chloride) are the most commonly used mineral resources for the metallurgical extraction of magnesium. Data on the quantities of the above minerals destined for the production of magnesium metal are not available. Magnesite producing countries are presented in the Raw Material *Magnesite*.

46.2 Production of refined/processed materials

46.2.1 Magnesium metal

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Mg, 2023) (2000-2021).

Notes: Data refer to magnesium metal production from primary sources. Data for Russia (2000-2021), Ukraine and Kazakhstan (2012-2021) are collected from (USGS myb-Mg, 2023) in order to include magnesium used within the process of titanium sponge production (even though it is not marketed as primary magnesium metal).

Latest RMIS update: August 2023.

46.3 Additional information and insights about production

- ✓ The production capacity of magnesium metal is acquired from (USGS myb-Mg, 2023).

47 Manganese

47.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2001-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (InMnI, 2016) for 2001-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021), (InMnI, 2016) (2006-2013), (USGS myb-Mn, 2023) (2000-2021).

Notes: Data represent the production of manganese ore.

Latest RMIS update: August 2023.

47.2 Production of refined/processed materials

47.2.1 Manganese ferroalloys

Coverage: World countries.

Time period of compiled data series: 2000-2020.

Reference Year: 2020.

Data source(s): (USGS myb-ferroalloys, 2023).

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021), (InMnI, 2016) (2006-2013), (USGS myb-Mn, 2023) (2000-2021).

Notes: Data present the aggregated production of manganese ferroalloys, consisting of ferro-manganese (FeMn) and silico-manganese (SiMn).

RMIS Dashboard update: August 2023.

47.2.2 Ferromanganese

Coverage: World countries.

Time period of compiled data series: 2000-2020.

Reference Year: 2020.

Data source(s): (USGS myb-ferroalloys, 2023).

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021), (InMnI, 2016) (2006-2013), (USGS myb-Mn, 2023) (2000-2021).

Notes: Data concern the production of ferro-manganese (FeMn).

Latest RMIS update: August 2023.

47.2.3 Silicomanganese

Coverage: World countries.

Time period of compiled data series: 2000-2020.

Reference Year: 2020.

Data source(s): (USGS myb-ferroalloys, 2023).

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021), (InMnI, 2016) (2006-2013), (USGS myb-Mn, 2023) (2000-2021).

Notes: Data show the production of silico-manganese (SiMn) .

Latest RMIS update: August 2023.

47.2.4 Electrolytic manganese metal (EMM)

Coverage: World countries.

Time period of compiled data series: 2012-2020.

Reference Year: 2020.

Data source(s): JRC elaboration built on (InMnI, 2021), (JRC, 2021) and (UN Comtrade, 2023).

Other collected/checked/registered datasets: -

Notes: The output of Ukraine in 2012-2020 and Gabon in 2015-2020 is approximated on the basis of reported exports and imports declared by trade partners, respectively (HS 811100). South African production is assumed to consist entirely of High-Purity Electrolytic manganese metal (HP EMM) in 2014-2020. Indonesia's captive output in 2019-2020 is estimated capacity information for steel production.

Latest RMIS update: June 2023

47.3 Additional information and insights about production

- ✓ The production capacity of manganese mines is built on JRC analysis and data collection (JRC, 2021);
- ✓ The capacity of refined manganese products is based on (JRC, 2021) and (InMnI, 2021);
- ✓ Data related to the production capacity of battery-grade manganese (EMD+HP EMM+HP MSM) are collected from (InMnI, 2021).

48 Mica

48.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source: (BGS, 2023)

Other data sources checked and/or compiled: (USGS myb-mica, 2022) (2000-2021).

Notes: Data relate to all grades of mica (crude, concentrates, ground, scrap & waste) and minerals of the mica group (e.g. biotite). Data for Austria, Nigeria and Peru are gathered from (USGS myb-mica, 2022), as well as Brazil's production in 2014.

Latest RMIS update: August 2023.

48.2 Production of refined/processed materials

No data are available for processed products of mica.

48.3 Additional information and insights about production

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49 Molybdenum

49.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (USGS myb-Mo, 2023) (2000-2021).

Notes: Data indicate the mine production of molybdenum.

Latest RMIS update: August 2023.

49.2 Production of refined/processed materials

49.2.1 Ferromolybdenum

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023) (USGS myb-ferroalloys, 2023).

Other collected/checked/registered datasets: -

Notes: Belgium's production is a JRC estimate based on (Eurostat Prodcom, 2023a) (PRC code 24101275). China's and Chile's production is sourced from (USGS myb-ferroalloys, 2023) for 2000-2020 and 2000-2011, respectively. The Chinese production for 2021 is assumed identical to 2020.

Latest RMIS update: August 2023.

49.2.2 Molybdenum oxides & hydroxides

Coverage: EU total.

Time period of compiled data series: 2014-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcom, 2023b).

Other collected/checked/registered datasets: -

Notes: PRC code: 20121973. The figure for 2020 is an estimate (interpolation).

Latest RMIS update: August 2023.

49.2.3 Molybdenum metal

Coverage: EU total.

Time period of compiled data series: 2014-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcom, 2023b).

Other collected/checked/registered datasets: -

Notes: Data comprise unwrought, powders & wrought molybdenum. PRC code: 24453017. The figure in 2017 is estimated (interpolation).

Latest RMIS update: August 2023.

49.3 Additional information and insights about production

- ✓ Data regarding the principal commodity in the molybdenum producing mines are collected from (S&P, 2023).

50 Natural cork

50.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2013-2020.

Reference Year: 2020.

Data source(s): (APCOR, 2021)(APCOR, 2019b).

Other collected/checked/registered datasets: Supplementary sources used for data assessment: (APCOR, 2015)(APCOR, 2020)(APCOR, 2019a)(Rives *et al.*, 2011)(Sierra-Pérez *et al.*, 2015).

Notes: Production data are obtained from the yearly APCOR publications. The production figures are annual average estimates of extracted raw natural cork. The estimates for Portugal were updated in 2019, whereas for the rest of the countries the estimates of output are derived from FAO data for year 2010.

Latest RMIS update: October 2022.

50.2 Production of refined/processed materials

50.2.1 Prepared natural cork

Coverage: EU countries.

Time period of compiled data series: 2003-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcom, 2023a).

Other collected/checked/registered datasets: -

Notes: Data for processed forms of natural cork are not available at the global level. Figures for prepared natural cork are associated with PRC code 16292150 *Natural cork, debarked or roughly squared, in rectangular or square blocks, plates, sheets or strips.*

Latest RMIS update: June 2023.

50.3 Additional information and insights about production

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51 Natural graphite

51.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-graphite, 2023) (2000-2021).

Notes: Production data concern all forms of mined natural graphite (flake, amorphous, vein). Data for China in 2013-2021 are obtained from USGS. Data for Pakistan and Tanzania in 2006-2021 are collected from (BGS, 2023). Data for Uzbekistan in 2000-2021 are derived from (USGS myb-graphite, 2023).

Latest RMIS update: August 2023.

51.2 Production of refined/processed materials

Production statistics concerning the refined forms of natural graphite (e.g. spherical graphite) are not readily available.

51.3 Additional information and insights about production

- ✓ The mine production per graphite type is based on JRC analysis and data collection (JRC, 2021);
- ✓ The mine capacity of flake natural graphite is derived from JRC analysis and data collection (JRC, 2021);
- ✓ The total production capacity of battery anode precursors originates from (JRC, 2021) and (BMI, 2021);
- ✓ The production capacity of purified spherical graphite (PSG) for battery anodes stems from (JRC, 2021) and (BMI, 2021).

52 Natural rubber

52.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (FAOSTAT, 2023b).

Other collected/checked/registered datasets:

Notes: Data relate to the production of natural rubber in primary forms.

Latest RMIS update: August 2023.

52.2 Production of refined/processed materials

No publicly available data exist for the production of natural rubber in processed forms.

52.3 Additional information and insights about production

-

53 Neodymium

53.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and neodymium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of neodymium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is collected from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

53.2 Production of refined/processed materials

The collected information is not publicly available.

53.3 Additional information and insights about production

-

54 Neon

54.1 Production of primary materials

Not applicable. Neon is produced from air in air separation units by fractional separation of liquefied air.

54.2 Production of refined/processed materials

54.2.1.1 Neon gas

Coverage: World total.

Time period of compiled data series: 2000-2017.

Reference Year: 2017.

Data source(s): (Elsner, 2018).

Other collected/checked/registered datasets: -

Notes: Publicly-available and country-specific data of production are insufficient for having the global distribution by countries.

Latest RMIS update: August 2023.

54.3 Additional information and insights about production

✓ The rare gas output distribution originates from data reported by (Elsner, 2018).

55 Nickel

55.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-Ni, 2023) (2000-2019).

Notes: It is deduced from the various data sources that nickel mine statistics represent the recoverable mine production of nickel or the nickel content of a more highly processed form (as an indication of the magnitude of mine output where actual mine output is not available).

Latest RMIS update: August 2023.

55.2 Production of refined/processed materials

55.2.1 Refined nickel(metal, salts, oxide) & ferronickel

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: -

Notes: Smelter/refinery production of nickel. Data relate to refined nickel metal plus the nickel content of ferronickel, nickel oxide and nickel salts. From 2012 onwards data do not include nickel content of nickel hydroxide cake or nickel matte as these are further refined elsewhere.

Latest RMIS update: August 2023.

55.2.2 Refined nickel(Class I incl. salts & oxide)

Coverage: World countries.

Time period of compiled data series: 2000-2019.

Reference Year: 2019.

Data source(s): JRC based on (USGS myb-Ni, 2023).

Other collected/checked/registered datasets: (Fraser *et al.*, 2021) (2010-2019).

Notes: Data relate to Class I refined nickel plus the nickel content of nickel oxide and salts from primary sources.

Latest RMIS update: August 2023.

55.2.3 Ferronickel & nickel pig iron

Coverage: World countries.

Time period of compiled data series: 2000-2019.

Reference Year: 2019.

Data source(s): JRC based on (USGS myb-Ni, 2023).

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021 in gross weight), (USGS myb-ferroalloys, 2023) (2000-2020 in gross weight).

Notes: Data represent the production of Class II nickel production including ferronickel and nickel pig iron (NPI).

Latest RMIS update: August 2023.

55.2.4 Nickel sulphate

Coverage: World total (2010-2019), by world countries (2020).

Time period of compiled data series: 2010-2020.

Reference Year: 2020.

Data source(s): (Fraser *et al.*, 2021).

Other collected/checked/registered datasets: -

Notes: Data refer to primary nickel sulphate produced from intermediates. Additional production from Class I metal or recycled feedstocks is not included.

Latest RMIS update: August 2023.

55.3 Additional information and insights about production

- ✓ Nickel's mine production by deposit type stems from JRC analysis and data collection (JRC, 2021);
- ✓ The product mix of Class I nickel is acquired from (Fraser *et al.*, 2021);
- ✓ The distribution of the various feedstocks for the production of nickel sulphate is obtained from (Fraser *et al.*, 2021).

56 Niobium

56.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2008-2021, (USGS myb-Nb, 2013) for 2000-2007.

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021), (USGS myb-Nb, 2013) (2008-2021).

Notes: Data refer to concentrates of Nb-bearing minerals, e.g. columbite, tantalite, pyrochlore.

Latest RMIS update: August 2023.

56.2 Production of refined/processed materials

56.2.1 Ferroniobium

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on (BGS, 2023) for 2000-2002, (USGS myb-ferroalloys, 2023) for 2003-2020, (USGS myb-Nb, 2022) for 2021, (Eurostat Prodcom, 2023b) for 2019-2021.

Other collected/checked/registered datasets: (TIC, 2020) (2009-2018), (BGS, 2023) (2003-2021), (USGS myb-Nb, 2022) (2004-2020), (BIO by Deloitte, 2015) (2013).

Notes: Figures are associated to ferroniobium that represents about 90% of total refinery production. The total EU production in 2019-2021 is derived from (Eurostat Prodcom, 2023b); in 2013, it is collected from (BIO by Deloitte, 2015), whereas in 2012 and 2014-2018 is a JRC estimate..

Latest RMIS update: August 2023.

56.2.2 Processed Nb products

Coverage: World total.

Time period of compiled data series: 2009-2018.

Reference Year: 2018.

Data source(s): (TIC, 2020).

Other collected/checked/registered datasets: -

Notes: Niobium products shipments by processors.

Latest RMIS update: August 2023.

56.3 Additional information and insights about production

- ✓ Information on the shipments of processed niobium products is obtained from (TIC, 2020).

57 Ornamental and building stones

57.1 Production of primary materials

Coverage: By EU countries (partial).

Time period of compiled data series: 2008-2021.

Reference Year: 2021.

Data source: (Eurostat Prodcom, 2023a).

Other data sources checked and/or compiled: -

Notes: The Ornamental and building stones (crude, roughly trimmed, simply cut, or in rough blocks and slabs) analysed are: quartzite, slate, marble and travertine, granite, sandstone, ecaussine, alabaster, porphyry, basalt and other monumental or building stones. PRC codes used: 08111290, 08114000, 08111133, 08111136, 08111150, 08111233, 08111236, 08111250, 08111290, 08111220, 08111260. As production figures reported by Prodcom are withheld for some EU countries in each year, JRC estimated the missing values (by interpolation) in order to complete the dataset for specific EU countries. When reasonable estimates were not possible from the existing production figures or when production figures are withheld for each years for individual EU countries, the production of these countries is included in 'Other EU'.

Latest RMIS update: August 2023.

57.2 Production of refined/processed materials

57.2.1 Worked ornamental and building stones (all stones)

Coverage: EU total.

Time period of compiled data series: 2003-2020.

Reference Year: 2020.

Data source: (Eurostat Prodcom, 2023a).

Other data sources checked and/or compiled: -

Notes: The product aggregate covers various stones used in construction and decoration that have been worked beyond the stage of the normal quarry products, i.e. further processed than mere shaping into blocks, sheets or slabs by splitting, roughly cutting or squaring, or squaring by sawing. The stones considered comprise: quartzite, slate, marble, travertine, alabaster granite, slate, natural stones and other undifferentiated stones. PRC codes used: PRC 23701100, 23701210, 23701230, 23701260, 23701270, 23701280.

Latest RMIS update: August 2023.

57.2.2 Worked granite

Coverage: By EU countries (partial).

Time period of compiled data series: 2003-2020.

Reference Year: 2020.

Data source: (Eurostat Prodcom, 2023a)

Other data sources checked and/or compiled: -

Notes: Data concern processed articles of granite. PRC code used: 23701260. Production data provided by Prodcom are withheld for some EU countries in each year, thus, JRC estimated the missing values (by interpolation) in order to complete the dataset for specific EU countries. When reasonable estimates were not possible from the reported production figures or when production figures are withheld for each years for individual EU countries, the production of these countries is included in 'Other EU'.

Latest RMIS update: August 2023.

57.2.3 Worked marble, travertine and alabaster

Coverage: By EU countries (partial).

Time period of compiled data series: 2003-2020.

Reference Year: 2020.

Data source: (Eurostat Prodcum, 2023a).

Other data sources checked and/or compiled: -

Notes: Data relate to processed articles of marble, travertine and alabaster. PRC code used: 23701100. Production figures provided by Prodcum are withheld for some EU countries in each year; therefore, missing values were estimated (by interpolation) in order to complete the gaps for specific EU countries. When reasonable estimates were not possible from the reported production figures or when production figures are withheld for each years for individual EU countries, the production of these countries is included in 'Other EU'.

Latest RMIS update: August 2023.

57.2.4 Worked slate

Coverage: By EU countries (partial).

Time period of compiled data series: 2003-2020.

Reference Year: 2020.

Data source: (Eurostat Prodcum, 2023a).

Other data sources checked and/or compiled: -

Notes: Data relate to processed articles of slate (roofing and wall slate). PRC code used: 23701280. As production figures reported by Prodcum are withheld for some EU countries in each year, JRC estimated the missing values (by interpolation) in order to complete the dataset for specific EU countries. When reasonable estimates were not possible from the reported production figures or when production figures are withheld for each years for individual EU countries, the production of these countries is included in 'Other EU'.

Latest RMIS update: August 2023.

57.2.5 Worked natural stone

Coverage: By EU countries (partial).

Time period of compiled data series: 2003-2020.

Reference Year: 2020.

Data source: (Eurostat Prodcum, 2023a).

Other data sources checked and/or compiled: -

Notes: Data concern setts, kerbstones and flagstones (excluding of slate) and other processed articles (tiles, cubes and other) of natural stone (including slate). PRC codes used: 23701210, 23701230. As production figures reported by Prodcum are withheld for some EU countries in each year, JRC estimated the missing values (by interpolation) in order to complete the dataset for specific EU countries. When reasonable estimates were not possible from the existing production figures or when production figures are withheld for each years for individual EU countries, the production of these countries is included in 'Other EU'.

Latest RMIS update: August 2023.

57.2.6 Worked Ornamental and Building stones (other)

Coverage: By EU countries (partial).

Time period of compiled data series: 2003-2020.

Reference Year: 2020.

Data source: (Eurostat Prodcom, 2023a).

Other data sources checked and/or compiled: -

Notes: Data comprise processed articles of calcareous and other stones (PRC code 23701270). As production figures reported by Prodcom are withheld for some EU countries in each year, JRC estimated the missing values (by interpolation) in order to complete the dataset for specific EU countries. When reasonable estimates were not possible from the existing production figures or when production figures are withheld for each years for individual EU countries, the production of these countries is included in 'Other EU'.

Latest RMIS update: August 2023.

57.3 Additional information and insights about production

- ✓ The distribution of production by stone of crude or roughly worked ornamental and building stones is derived from (Eurostat Prodcom, 2023a);
- ✓ The distribution of production by stone of worked ornamental and building stones is based on data from (Eurostat Prodcom, 2023a).

58 Palladium

58.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (JM, 2019a) (2000-2013), (JM, 2019b) (2014-2016), (JM, 2022) (2017-2021), (Heraeus-SFA Oxford, 2022) (2018-2021), (USGS myb-PGM, 2023) (2000-2021), (WMD, 2023) (2006-2021).

Notes: Production figures are allocated to where the initial mining took place rather than the location of refining. Russia's production includes sales from stocks. Data for Australia are acquired from (WMD, 2023).

Latest RMIS update: August 2023.

58.2 Production of refined/processed materials

58.2.1 Refined palladium

Coverage: World total.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): Data for palladium's primary production and data for secondary production from (JM, 2019a) for 2000-2013, (JM, 2019b) for 2014-2016, and (JM, 2022) for 2017-2021.

Other collected/checked/registered datasets: (Heraeus-SFA Oxford, 2022) (2018-2021)

Notes: Figures refer to the total production of palladium (primary & secondary). The primary metallurgical production is matching mining production (mine producers report metallurgically produced palladium or palladium payable, therefore recoverable). Secondary production (supply) is the quantity of metal recovered from open-loop recycling; closed-loop recycling is excluded. Thorough information on refined palladium production at national level (location of refining) is not available.

Latest RMIS update: August 2023.

58.2.2 Refined palladium products

Coverage: EU countries.

Time period of compiled data series: 2011-2021.

Reference Year: 2021.

Data source(s): JRC estimate based on (Eurostat Prodcom, 2023a) and (Eurostat Comext, 2022).

Other collected/checked/registered datasets: -

Notes: The products relate to palladium unwrought & powder (PRC code 24413015 *Palladium. Unwrought or in powder form*) that covers palladium metal and alloys in which palladium predominates by weight. The production in Germany in 2019-2020 is sourced from (Eurostat Prodcom, 2023a); for 2011-2018 it was estimated from aggregated data for all PGM as reported by (Eurostat Prodcom, 2023a). The production in Belgium is approximated on the basis of operating capacity (25 kt per year) and the assumption that it followed yearly the trend of global demand. Exports (EU-intra and EU-extra) are used as a proxy for the production in the rest of countries (Italy, Austria, Czechia, France, Netherlands, Spain) after accounting for re-exports.

58.3 Additional information and insights about production

- ✓ The refinery production by source is based on the associated data for primary and secondary production.

59 Perlite

59.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) for 2006-2021, (USGS myb-perlite, 2022) (2000-2021).

Notes: Data relate to perlite production.

Latest RMIS update: August 2023.

59.2 Production of refined/processed materials

Data on the production of expanded perlite are uncommon.

59.3 Additional information and insights about production

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60 Phosphate rock

60.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (USGS myb-phosphate, 2022) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021) (IFAStat, 2023) (2010-2021).

Notes: Data for Canada in 2006-2013 are compiled from (USGS myb-phosphate, 2022).

Latest RMIS update: August 2023.

60.2 Production of refined/processed materials

60.2.1 Phosphoric acid

Coverage: World total.

Time period of compiled data series: 2010-2021.

Reference Year: 2021.

Data source(s): (IFAStat, 2023).

Other collected/checked/registered datasets: -

Notes: Country-specific data are not publicly available.

Latest RMIS update: August 2023.

60.2.2 Processed phosphates

Coverage: World countries.

Time period of compiled data series: 2000-2020.

Reference Year: 2020.

Data source(s): (IFAStat, 2023).

Other collected/checked/registered datasets: -

Notes: Processed phosphate products relate to fertilisers and other industrial products. Data shown on a nutrient basis comprise the aggregate of basic slag, ground phosphate rock directly applicable, single superphosphate, triple superphosphate, other P straight fertilisers, ammonium phosphate (DAP), PK compound fertiliser, other NP compound fertilisers, NPK compound fertilisers.

Latest RMIS update: August 2023.

60.3 Additional information and insights about production

✓ The regional output of phosphoric acid is sourced from (IFAStat, 2023).

61 Phosphorus

61.1 Production of primary materials

Phosphate rock is the raw material for the production of elemental phosphorus (see *Phosphate rock*).

61.2 Production of refined/processed materials

61.2.1 Yellow phosphorus

Coverage: World countries.

Time period of compiled data series: 2013-2018.

Reference Year: 2018.

Data source(s): CCM (2018) in (European Commission, 2020a) for 2013, JRC estimate based on (HDIN Research, 2019) for 2014-2018, (Statista, 2022b) for Vietnam's production.

Other collected/checked/registered datasets: -

Notes: Information regarding the production of elemental phosphorus (P₄) is scarce in the public domain.

Latest RMIS update: August 2023.

61.3 Additional information and insights about production

✓ The production capacity by country is reported by (HDIN Research, 2019).

62 Platinum

62.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (JM, 2019a) (2000-2013), (JM, 2019b) (2014-2016), (JM, 2022) (2017-2021), (Heraeus-SFA Oxford, 2022) (2018-2021), (WPIC, 2023) (2014-2021), (USGS myb-PGM, 2023) (2000-2021), (WMD, 2023) (2006-2021).

Notes: Production figures are allocated to where the initial mining took place rather than the location of refining.

Latest RMIS update: August 2023.

62.2 Production of refined/processed materials

62.2.1 Refined platinum

Coverage: World total.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): Data for platinum's primary production and data for secondary production from (JM, 2019a) for 2000-2013, (JM, 2019b) for 2014-2016, and (JM, 2022) for 2017-2021.

Other collected/checked/registered datasets: (Heraeus-SFA Oxford, 2022) (2018-2021), (WPIC, 2023) (2014-2021).

Notes: Figures refer to the total production of platinum (primary & secondary). The primary metallurgical production is identical to mining production (mine producers report metallurgically produced platinum or platinum payable, therefore recoverable). Secondary production (supply) is the quantity of metal recovered from open-loop recycling; closed-loop recycling is excluded. Comprehensive data for refined platinum production by world countries (location of refining) are not available.

Latest RMIS update: August 2023.

62.2.2 Refined platinum products

Coverage: EU countries.

Time period of compiled data series: 2011-2021.

Reference Year: 2021.

Data source(s): JRC estimate based on (Eurostat Prodcum, 2023a) and (Eurostat Comext, 2022).

Other collected/checked/registered datasets: -

Notes: The products relate to platinum unwrought & powder (PRC code 24413010 *Platinum. Unwrought or in powder form*) that comprises platinum metal and alloys in which platinum predominates by weight. The production in Germany in 2019-2020 is provided by (Eurostat Prodcum, 2023a); for 2011-2018 it was estimated from aggregated data for all PGM as reported by (Eurostat Prodcum, 2023a). The production in Belgium is approximated on the basis of operating capacity (25 kt per year) and the assumption that it followed the trend of global demand. Exports (EU-intra and EU-extra) are used as a proxy for the output in other producing countries (Italy, Austria, Czechia, France, Ireland) after accounting for re-exports.

62.3 Additional information and insights about production

- ✓ The refinery production by source is derived from the relevant data of primary and secondary production.

63 Platinum-Group Metals (PGM)

63.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on the production of each individual material of the group.

Other collected/checked/registered datasets: (BGS, 2023).

Notes: Production figures are allocated to where the initial mining took place rather than the location of refining.

Latest RMIS update: August 2023.

63.2 Production of refined/processed materials

63.2.1 Refined Platinum-Group Metals

Coverage: World total.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): Sources used for the compilation of primary and secondary production of platinum, palladium, and rhodium, and the primary production of ruthenium and iridium.

Other collected/checked/registered datasets: -

Notes: Figures represent the total aggregated production of platinum-group metals (primary & secondary). The primary metallurgical production is almost identical to mining production (mine producers report metallurgically produced PGM payable, therefore recoverable). Secondary production (supply) is the quantity of metal recovered from open-loop recycling; closed-loop recycling is excluded.

Latest RMIS update: August 2023.

63.3 Additional information and insights about production

- ✓ The breakdown of PGM primary production by metal is obtained from data for each element;
- ✓ The refined PGM production by source is derived from data for each element (except for the secondary production of iridium and ruthenium).

64 Potash

64.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-potash, 2022) (2014-2020).

Notes: Data relate to concentrates of various forms of potash and potassium-rich minerals such as potassium chloride, potassium sulphate, potassium nitrate and crude chloride salts (e.g. carnallite, sylvite).

Latest RMIS update: August 2023.

64.2 Production of refined/processed materials

64.2.1 Processed potash products

Coverage: World countries.

Time period of compiled data series: 2000-2020.

Reference Year: 2020.

Data source(s): (IFASat, 2023).

Other collected/checked/registered datasets: -

Notes: Data reported on a nutrient basis are associated with straight & compound potassium-related fertilisers, as well as products for animal feed and industrial uses. Potash products covered include muriate of potash (MOP) (potassium chloride), sulphate of potash (SOP) (potassium sulphate), PK compounds, NK compounds, NPK compounds, NK compounds, and other K straight fertilisers.

Latest RMIS update: August 2023.

64.3 Additional information and insights about production

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65 Praseodymium

65.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and praseodymium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of praseodymium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is gathered from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

65.2 Production of refined/processed materials

The gathered information is not publicly available.

65.3 Additional information and insights about production

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66 Pumice

66.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source: (USGS myb-pumice, 2022).

Other data sources checked and/or compiled: -

Notes: Data cover the production of pumice and pumice-like materials (pozzolan, volcanic tuff & cinder, trass).

Latest RMIS update: August 2023.

66.2 Production of refined/processed materials

Not applicable.

66.3 Additional information and insights about production

- ✓ The production distribution by pumicite material is collected from (USGS myb-pumice, 2022).

67 Rare Earth Elements (REE)

67.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC compilation based on (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-REE, 2022) (2000-2019), (USGS, 2022) (2020), (USGS, 2023) (2021), (S&P, 2023) (2000-2021).

Notes: Data indicate the mine production of rare earth concentrates. For the formulation of a more comprehensive estimate of the output level, the dataset is complemented with figures for Thailand (2009-2021), Vietnam (2010-2021), and Kyrgyzstan (2000-2003) from USGS, and data for Brazil (2000-2002) and the US (2005-2011, 2020-2021) from (S&P, 2023). The undocumented production in China is not quantified by the various data sources.

Latest RMIS update: August 2023.

67.2 Production of refined/processed materials

67.2.1 Refined REE

Coverage: World countries.

Time period of compiled data series: 2021.

Reference Year: 2021.

Data source(s): JRC elaboration from (Wood Mackenzie, 2022).

Other collected/checked/registered datasets: -

Notes: Data aggregate the estimated refinery production of cerium, dysprosium, erbium, europium, gadolinium, holmium, lanthanum, lutetium, neodymium, praseodymium, samarium, terbium, thulium, yttrium, and ytterbium. Recycling is included.

Latest RMIS update: August 2023.

67.3 Additional information and insights about production

- ✓ The estimate for the repartition of REE mine production by element is based on JRC analysis;
- ✓ The breakdown of refined REE production by source is derived from (Wood Mackenzie, 2022).

68 Rare Earth Elements for magnets

68.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on the total REE production (see section 67.1).

Other collected/checked/registered datasets: -

Notes: The REE for magnets group involves cerium, dysprosium, gadolinium, neodymium, praseodymium, samarium, and terbium. Figures reflect the cumulative production of the each of the above REE, with the exception of cerium.

Latest RMIS update: August 2023.

68.2 Production of refined/processed materials

68.2.1 Refined REE for magnets

Coverage: World countries.

Time period of compiled data series: 2021.

Reference Year: 2021.

Data source(s): (Wood Mackenzie, 2022).

Other collected/checked/registered datasets: -

Notes: Data aggregate the estimated refinery production of dysprosium, gadolinium, neodymium, praseodymium, samarium, and terbium (cerium is excluded). Recycling is included.

Latest RMIS update: August 2023.

68.3 Additional information and insights about production

- ✓ The share of REE for magnets in total REE mine production is based on JRC analysis;
- ✓ The breakdown of refined production by source is elaborated from (Wood Mackenzie, 2022).

69 Rhenium

69.1 Production of primary materials

No data are available for rhenium's mine production. Primary rhenium is predominantly extracted as a by-product from the extraction and processing of molybdenum ores associated with copper deposits.

69.2 Production of refined/processed materials

69.2.1 Refined rhenium

Coverage: World countries.

Time period of compiled data series: 2004-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2008-2021, (Roskill, 2015a) for 2004-2007.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021) (USGS myb-Re, 2022) (2011-2021)

Notes: Recovered rhenium from molybdenite and copper concentrates. Secondary rhenium production is not included, e.g. from Germany, Estonia, USA and Canada. The dataset is complemented with data points for South Korea and Japan collected from (USGS myb-Re, 2022) & (Roskill, 2015a), and from Lipmann Walton & Co Ltd in (European Commission, 2020b) & (Roskill, 2015a), respectively.

Latest RMIS update: August 2023.

69.3 Additional information and insights about production

- ✓ The refinery output by feed raw materials is estimated from information in (USGS myb-Re, 2021) related to the amount of rhenium recycled in 2017;
- ✓ The refinery capacity by countries is provided by (Roskill, 2015a).

70 Rhodium

70.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (JM, 2019a) for 2000-2005.

Other collected/checked/registered datasets: (JM, 2019a) (2006-2013), (JM, 2019b) (2014-2016), (JM, 2022) (2017-2021), (Heraeus-SFA Oxford, 2022) (2018-2021), (USGS myb-PGM, 2023) (2014-2021).

Notes: Figures represent sales of primary rhodium by producers and are assigned to where the initial mining took place (rather than the location of subsequent refining).

Latest RMIS update: August 2023.

70.2 Production of refined/processed materials

70.2.1 Refined rhodium

Coverage: World total.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): Data for rhodium's primary production as above and data for secondary production from (JM, 2019a) for 2000-2013, (JM, 2019b) for 2014-2016, and (JM, 2022) for 2017-2021.

Other collected/checked/registered datasets: (Heraeus-SFA Oxford, 2022) (2018-2021).

Notes: Figures concern the total production of rhodium (primary & secondary).. The primary metallurgical production is almost equivalent to mining production (mine producers report metallurgically produced rhodium or rhodium payable, therefore recoverable). Secondary production (supply) is the quantity of metal recovered from open-loop recycling; closed-loop recycling is excluded. Country-specific data, covering also the production from secondary sources, are unavailable.

Latest RMIS update: August 2023.

70.3 Additional information and insights about production

- ✓ The refinery production by source is based on the relevant data of primary and secondary production.

71 Ruthenium

71.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (USGS myb-PGM, 2023) for 2014-2021, JRC estimate for 2000-2013.

Other collected/checked/registered datasets: -

Notes: The assessment of production in 2000-2013 is founded on production data from (BGS, 2023) for 'Other than Pt and Pd platinum-group metals', rhodium production reported by (WMD, 2023) and (JM, 2019a), osmium production provided by (Girolami, 2012), and Johnson Matthey's background data for ruthenium and iridium annual demand. To achieve the split between ruthenium and iridium primary production in 2000-2013, it is assumed that their yearly output was proportional to annual demand. Osmium production is considered steady each year. Production figures indicate the location of initial mining (rather than the location of subsequent refining).

Latest RMIS update: August 2023.

71.2 Production of refined/processed materials

Data are not available for secondary supply; therefore, the total annual production cannot be determined.

71.3 Additional information and insights about production

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72 Salt

72.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other data sources checked and/or compiled: (USGS myb-salt, 2023) (2000-2019), (BGS, 2023) (2006-2021).

Notes: Data include rock salt and evaporated salt (marine and brine). The output of Djibouti, Bonaire, Ecuador, Guinea, Mauritania, Mali, Netherland Antilles and Uzbekistan is compiled from BGS in 2006-2021.

Latest RMIS update: August 2023.

72.2 Production of refined/processed materials

Not applicable. Refined salt products are considered as primary materials.

72.3 Additional information and insights about production

- ✓ The distribution of salt's output by extraction method is sourced from (EUsalt, 2023).

73 Samarium

73.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and samarium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of samarium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is retrieved from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

73.2 Production of refined/processed materials

The compiled information is not publicly available.

73.3 Additional information and insights about production

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74 Sapele wood

74.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2008-2021.

Reference Year: 2021.

Data source(s): JRC estimate based on (UN Comtrade, 2023).

Other collected/checked/registered datasets: -

Notes: Credible information on the global production of sapele wood is missing. Net exports (and exports derived indirectly from reported imports by destination countries) for sapele sawnwood (HS 440727) originating from countries in which the sapele tree is naturally distributed, i.e. West, Central and East Africa, (from Ivory Coast to Uganda), are employed as a proxy of world's production of sapele roundwood. Trade data for sapele timber in the natural state (roundwood) are reported under HS 440349, but they cannot be used to approximate production as the trade code includes several species of tropical timber.

Latest RMIS update: August 2023.

74.2 Production of refined/processed materials

No data are available for the production of sapele sawnwood worldwide.

74.3 Additional information and insights about production

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75 Scandium

75.1 Production of primary materials

Existing information is insufficient to estimate scandium's primary production by countries.

75.2 Production of refined/processed materials

75.2.1 Refined scandium

Coverage: World countries.

Time period of compiled data series: 2015-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on various sources such as (Lipmann, 2016)(BRGM, 2017)(CM, 2018)(Grandfield, 2019)(MMTA, 2022)(USGS, 2021)(USGS, 2022)(USGS, 2023)(S&P, 2022).

Other collected/checked/registered datasets: -

Notes: Scandium production statistics are not available; the Chinese output is presumed to be stable over 2019-2021. The production of primary intermediate scandium compounds in Philippines is allocated to Japan where it is further refined.

Latest RMIS update: August 2023.

75.3 Additional information and insights about production

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76 Selenium

76.1 Production of primary materials

No data are available. Selenium is mostly recovered from anode slimes generated during the electrolytic refining of copper.

76.2 Production of refined/processed materials

76.2.1 Refined selenium

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2008-2021, (BGS, 2023) for 2000-2007.

Other collected/checked/registered datasets: (BGS, 2023) (2008-2021), (USGS myb-Se&Te, 2022) (2000-2020).

Notes: Data relate to refinery output (selenium compounds and elemental selenium).

Latest RMIS update: August 2023.

76.3 Additional information and insights about production

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77 Silica

77.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (Eurostat Prodcum, 2023a)(USGS myb-Silica, 2022).

Other collected/checked/registered datasets: -

Notes: Data for silica production cover silica sand (industrial and quartz sand), quartz, quartzite, and other silica products. For EU countries, priority is given to the dataset provided by Prodcum (PRC code 8121150). Data gaps in the Prodcum dataset are covered by USGS data or are estimated through interpolation. The Chinese output from 2000 to 2016 (unreported) is estimated assuming an equal CAGR with 2017-2021 (output reported).

Latest RMIS update: August 2023.

77.2 Production of refined/processed materials

Not applicable

77.3 Additional information and insights about production

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78 Silicon metal

78.1 Production of primary materials

No data are available for the output of the particular grades of silica (quartz) required for the production of silicon metal. Information on the production of all forms and qualities of silica are available in the Raw Material *Silica*.

78.2 Production of refined/processed materials

78.2.1 Silicon metal

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Si, 2022) (2009-2021), (USGS myb-ferroalloys, 2023) (2000-2008).

Notes: Data for South Africa in 2015-2021, and for Bosnia-Herzegovina, Iceland, Kazakhstan, Uzbekistan, and Laos in 2000-2021 are obtained from USGS. The US production from 2011 onwards is a JRC estimate relying on the assumption of 40% Si metal in the overall reported US production of FeSi+Si metal, as derived from historical data in 2000-2010. Publicly-available data for the production of the highly refined form of silicon metal (electrical-grade) are not available.

Latest RMIS update: August 2023.

78.2.2 Ferrosilicon

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Si, 2022) (2007-2021), (USGS myb-ferroalloys, 2023) (2000-2006).

Notes: Ferrosilicon has a distinct value chain from silicon metal e.g. different production method and applications; however, it is presented here as an important refined product of silicon (element). Data for China, Bosnia-Herzegovina, Hungary, Italy, Malaysia, Paraguay and Uruguay in 2000-2021 are provided by USGS. The US production in 2011-2021 is a JRC estimate based on the assumption of 60% FeSi in total reported US production of FeSi+Si metal, as derived from historical data in 2000-2010.

Latest RMIS update: August 2023.

78.3 Additional information and insights about production

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79 Silver

79.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (Silver Institute, 2022)(The Silver Institute & Metal Focus, 2021) (2011-2021), (USGS myb-Ag, 2022) (2015-2020)

Notes: The data pertain to mined silver production.

Latest RMIS update: August 2023.

79.2 Production of refined/processed materials

79.2.1 Refined silver

Coverage: World total.

Time period of compiled data series: 2000-2022.

Reference Year: 2022.

Data source(s): (The Silver Institute & Metal Focus, 2023) for 2014-2022, (Silver Institute, 2022) for 2013, (The Silver Institute & Metal Focus, 2021) for 2012, (The Silver Institute & Metal Focus, 2020) for 2011, (The Silver Institute and Refinitiv, 2019) for 2009-2010, (The Silver Institute & Thomson Reuters, 2018) for 2008, (The Silver Institute & Thomson Reuters, 2017) for 2007, (Silver Institute, 2016) for 2000-2006.

Other collected/checked/registered datasets: -

Notes: The total silver supply (primary & secondary) is used as a proxy for silver's refined production, i.e. production of silver bullion or grain.

Latest RMIS update: August 2021.

79.3 Additional information and insights about production

- ✓ Information on the distribution of silver's mine production by host metal is provided by (The Silver Institute & Metal Focus, 2023);
- ✓ The production of refined silver by feedstock is sourced from (The Silver Institute & Metal Focus, 2023).

80 Strontium

80.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Sr, 2022) (2000-2021).

Notes: Production data relate to concentrates of strontium minerals (celestite) .

Latest RMIS update: August 2023.

80.2 Production of refined/processed materials

Absence of publicly available information on the production of refined materials (e.g. strontium compounds such as strontium carbonate and nitrate).

80.3 Additional information and insights about production

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81 Sulphur

81.1 Production of primary materials

The production of native (elemental) sulphur and pyrites is allocated to refinery production.

81.2 Production of refined/processed materials

81.2.1 Sulphur (in all forms)

Coverage: World countries.

Time period of compiled data series: 2006-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023).

Other collected/checked/registered datasets: (USGS myb-S, 2023) (2000-2021).

Notes: It is deduced from background information in the collected sources that data reflect the production of Frasch sulphur, other native sulphur, pyrites-derived sulphur, by-product sulphur recovered as elemental sulphur or as sulphur compounds from metallurgical operations, petroleum refineries, from extraction of crude oil and natural gas, mined gypsum-derived sulphur and sulphur recovered from oil sands. The production of Belgium, Netherlands and Uzbekistan is collected from (USGS myb-S, 2023).

Latest RMIS update: August 2023.

81.3 Additional information and insights about production

- ✓ The sulphur output by industrial segment and by raw material is based on (USGS myb-S, 2023).

82 Talc

82.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) for 2006-2021, (USGS myb-talc, 2022) (2014-2021).

Notes: Figures specify the production of talc, pyrophyllite and other similar minerals (e.g. steatite). The output of Afghanistan in 2016-2021 is sourced from (USGS myb-talc, 2022).

Latest RMIS update: August 2023.

82.2 Production of refined/processed materials

Not applicable.

82.3 Additional information and insights about production

✓ The split of production per mineral is based on (USGS myb-talc, 2022).

83 Tantalum

83.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (USGS myb-Ta, 2022).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (BGS, 2023) (2000-2021), (TIC, 2020) (2009-2018).

Notes: Data relate to marketable tantalum mineral concentrates; it is assessed that tantalum-bearing tin slags are not included. The production of Spain, Malaysia and Sierra Leone is sourced from (WMD, 2023). The French production is assumed steady over 2000-2021 based on information from (BRGM, 2012) and (BRGM, 2020). Zimbabwe's output in 2017-2021 is collected from (BGS, 2023).

Latest RMIS update: August 2023.

83.2 Production of refined/processed materials

83.2.1 Processed tantalum products

Coverage: World total.

Time period of compiled data series: 2002-2018.

Reference Year: 2018.

Data source(s): (TIC, 2020) for 2009-2018, (TIC, 2013) for 2002-2008.

Other collected/checked/registered datasets: -

Notes: Data relate to tantalum product shipments by processors.

Latest RMIS update: August 2021.

83.3 Additional information and insights about production

- ✓ The production of primary tantalum by source is obtained from (Roskill, 2016);
- ✓ The distribution by country of smelters, refiners, and processors is collected from (RMI, 2023). The list comprises conformant installations with the Responsible Minerals Initiative's (RMI) standards and eligible installations to undergo an RMI assessment;
- ✓ The shipments of processed tantalum products in 2018 are provided by (TIC, 2020).

84 Teak wood

84.1 Production of primary materials

Coverage: World countries (partial).

Time period of compiled data series: 2010.

Reference Year: 2010.

Data source(s): (Kollert and Cherubini, 2012).

Other collected/checked/registered datasets: -

Notes: Minimal data exist on the total commercial teak volume harvested globally from natural and planted teak forests. Several teak-producing countries are not covered by the dataset, e.g.. India, a major source of native teak. The estimated total production of natural teak and plantation teak is derived if all teak-growing countries are considered.

Latest RMIS update: August 2023.

84.2 Production of refined/processed materials

No data are available for the production of teak sawnwood.

84.3 Additional information and insights about production

- ✓ The teak harvest by forest type is provided by (Kollert and Cherubini, 2012).

85 Tellurium

85.1 Production of primary materials

As tellurium is mainly a by-product of copper mining, no data are available for mine production, i.e. tellurium contained in copper ores and concentrates.

85.2 Production of refined/processed materials

85.2.1 Refined tellurium

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on (USGS myb-Se&Te, 2022) for 2000-2020, and (USGS, 2023) for 2021.

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (BGS, 2023) (2000-2021), (Eurostat Prodcom, 2023b) (2019-2021).

Notes: Data relate to the countries where tellurium is recovered and refined. Obtaining comprehensive and robust data for the annual output of refined tellurium is challenging due to its by-product nature and the unreported production in major producing countries. The US and Chinese production are sourced from (BGS, 2023). The production of Germany and Belgium is a JRC estimate based on (Nassar *et al.*, 2022) and the production of Finland is approximated from (Eurostat Prodcom, 2023b). The output of Uzbekistan is obtained from (WMD, 2023).

Latest RMIS update: August 2023.

85.3 Additional information and insights about production

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86 Terbium

86.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and terbium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of terbium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is retrieved from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

86.2 Production of refined/processed materials

The compiled information is not publicly available.

86.3 Additional information and insights about production

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87 Thulium

87.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and thulium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of thulium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is derived from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

87.2 Production of refined/processed materials

The collected information is not publicly available.

87.3 Additional information and insights about production

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88 Tin

88.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other collected/checked/registered datasets: (BGS, 2023) (2006-2021), (USGS myb-Sn, 2022) (2000-2020)

Notes: Data reflect the mine production of tin.

Latest RMIS update: August 2023.

88.2 Production of refined/processed materials

88.2.1 Refined tin

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (USGS myb-Sn, 2022) (2000-2020).

Notes: Figures relate to tin smelter production and comprise both primary (from ores and concentrates) and secondary metal (tin metal recovered from old scrap). Small quantities produced in Bulgaria, Czechia, Denmark, Greece, Norway and Spain are sourced from (USGS myb-Sn, 2022).

Latest RMIS update: August 2023.

88.3 Additional information and insights about production

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89 Titanium

89.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023) (in gross weight of Ti minerals).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021, in TiO_2 content), (USGS myb-Ti, 2023).

Notes: The figures refer to the production of titanium concentrates (rutile, ilmenite, leucoxene).

Latest RMIS update: August 2023.

89.2 Production of refined/processed materials

Production data for titanium dioxide (TiO_2) pigments are not available.

89.3 Additional information and insights about production

- ✓ The allocation of mine production by mineral is sourced from (USGS myb-Ti, 2023);
- ✓ The consumption of titanium minerals by downstream industry is sourced from (Murphy and Frick, 2006);
- ✓ Information on the capacity of titanium pigments is collected from (USGS, 2023).

90 Titanium metal

90.1 Production of primary materials

The production of primary raw materials associated with the extraction of titanium metal is presented in the Raw Material *Titanium*.

90.2 Production of refined/processed materials

90.2.1 Titanium sponge

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC elaboration on the basis of several sources i.e. (USGS mcs, 2023)(ITA, 2021)(Gehler, 2013)(Gehler, 2020)(CNIA, 2021).

Other collected/checked/registered datasets: -

Notes: Data indicate the production of titanium sponge.

Latest RMIS update: August 2023.

90.2.2 Titanium metal products

Coverage: EU countries (partial).

Time period of compiled data series: 2009-2020.

Reference Year: 2020.

Data source(s): JRC elaboration based on (Eurostat Prodcom, 2023a).

Other collected/checked/registered datasets: -

Notes: Data reflect the sold production of titanium products (unwrought, powders, wrought) (PRC code: 24453043 *Titanium and articles thereof (excluding waste and scrap), n.e.c.* The output of countries for which figures are withheld in the data source is included in the group "Other EU".

Latest RMIS update: August 2023.

90.2.3 Ferrotitanium

Coverage: World countries.

Time period of compiled data series: 2010-2020.

Reference Year: 2020.

Data source(s): (USGS myb-ferroalloys, 2023).

Other collected/checked/registered datasets: (BGS, 2023) (2000-2021).

Notes: China's production from 2012 to 2020 is assumed equal to the annual average of 2006-2011.

Latest RMIS update: August 2023.

90.3 Additional information and insights about production

- ✓ The production capacity of titanium ingots is elaborated from (Louvigné, 2021).

91 Tungsten

91.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (WMD, 2023) (2006-2021), (USGS myb-W, 2021) (2000-2019).

Notes: Figures present the production of tungsten concentrates.

Latest RMIS update: August 2023.

91.2 Production of refined/processed materials

91.2.1 Products of refined tungsten

Coverage: EU countries.

Time period of compiled data series: 2011-2021.

Reference Year: 2021.

Data source(s): JRC elaboration based on (Eurostat Prodcom, 2023a) (Eurostat Prodcom, 2023b).

Other collected/checked/registered datasets: -

Notes: The dataset comprises the production of tungsten products (unwrought, powders & wrought). PRC code: 24453013 *Tungsten (wolfram) and articles thereof (excluding waste and scrap), n.e.c.* Data concern total production (except Germany for which data available data refer to sold production). Data for France in 2019, and figures for 'Other EU' (including Sweden, Poland, and Czechia) are a JRC estimate.

Latest RMIS update: August 2023.

91.3 Additional information and insights about production

- ✓ The country distribution of smelters, refiners, and processors is elaborated from (RMI, 2023). The list of facilities includes facilities conformant with the Responsible Minerals Initiative's (RMI) standards and eligible to undergo an RMI assessment.

92 Vanadium

92.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other sources checked and/or compiled: (WMD, 2023) (2006-2021), (USGS myb-V, 2023) (2000-2021).

Notes: Figures include the production ores and co-production from steel slag but exclude vanadium recovered as a by-product from secondary sources and residues e.g. spent catalysts used in crude oil refining.

Latest RMIS update: August 2021.

92.2 Production of refined/processed materials

92.2.1 Refined vanadium

Coverage: World countries (2019), World total (2011-2022).

Time period of compiled data series: 2011-2022.

Reference Year: 2019.

Data source(s): (Perles, 2020b) for 2019 (by world countries), (Vanitec, 2023) for 2011-2022 (world total).

Other collected/checked/registered datasets: (Perles, 2020a) for 2016-2020, (BM, 2023) for 2021, (BM, 2021) for 2019.

Notes: The output of refined vanadium is defined as the V content in all vanadium oxides produced, plus other V-compounds (e.g. V-chemicals) that have not been produced via oxide route, plus ferrovanadium that has not been produced via V₂O₅-route (e.g. from certain recycling processes).

Latest RMIS update: August 2023.

92.2.2 Ferrovanadium

Coverage: World countries.

Time period of compiled data series: 2000-2020.

Reference Year: 2020.

Data source(s): JRC elaboration based on (USGS myb-ferroalloys, 2023) and (BGS, 2023).

Other collected/checked/registered datasets:

Notes: Data for Austria, Belgium, Czechia, Japan (2000-2013), Russia (2008-2020), and Eswatini are compiled from BGS. Data for Canada, China (2000, 2012-2020), Japan (2014-2020), India, Russia (2000-2007), and South Africa are collected from USGS. The Chinese production in 2001-2011 is estimated on the basis of the CAGR between 2000 and 2012.

Latest RMIS update: August 2023.

92.3 Additional information and insights about production

- ✓ The distribution of vanadium-bearing raw material sources is obtained from (BM, 2023);
- ✓ The production capacity for vanadium oxides is sourced from (Roskill, 2015b).

93 Vermiculite

93.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source: (BGS, 2023).

Other data sources checked and/or compiled: (USGS myb-vermiculite, 2022) (2000-2021), (WMD, 2023) (2006-2021)

Notes: Uzbekistan's production is sourced from (USGS myb-vermiculite, 2022) in 2016-2021.

Latest RMIS update: August 2023.

93.2 Production of refined/processed materials

No information is available on the production of exfoliated vermiculite.

93.3 Additional information and insights about production

-

94 Wollastonite

94.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other data sources checked and/or compiled: (USGS myb-Wollastonite, 2021) (2000-2018)

Notes: Data may include crude and processed (refined) wollastonite. The production of Canada in 2014-2021 is sourced from (USGS myb-Wollastonite, 2021), (USGS, 2021), (USGS, 2022), and (USGS, 2023). Spain's production in 2006 is assumed equal to 2005.

Latest RMIS update: August 2023.

94.2 Production of refined/processed materials

Processed wollastonite of higher purity (refined wollastonite) is classified as a primary raw material.

94.3 Additional information and insights about production

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95 Xenon

95.1 Production of primary materials

Not applicable. Xenon is obtained from air in air separation units by fractional separation of liquefied air.

95.2 Production of refined/processed materials

95.2.1 Xenon gas

Coverage: World total.

Time period of compiled data series: 2000-2017.

Reference Year: 2017.

Data source(s): (Elsner, 2018).

Other collected/checked/registered datasets: -

Notes: Publicly-available and country-specific production data are insufficient to present the global distribution of production by countries.

Latest RMIS update: August 2023.

95.3 Additional information and insights about production

✓ The rare gas output distribution is derived from (Elsner, 2018).

96 Ytterbium

96.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and ytterbium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of ytterbium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is acquired from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

96.2 Production of refined/processed materials

The gathered information is not publicly available.

96.3 Additional information and insights about production

-

97 Yttrium

97.1 Production of primary materials

Coverage: World countries (2021), World total (2000-2020).

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): JRC analysis based on the total REE production and yttrium content in REE minerals of each operating mine.

Other collected/checked/registered datasets: -

Notes: The mine production of yttrium is estimated from the allocation of total REE production (see section 67.1) to every operating mine over 2000-2021 and the grade of Rare Earth Elements in individual deposits. Information on the relative distribution of in-situ rare-earth oxides in mined REE deposits is collected from several sources such as (Alves Dias *et al.*, 2020), (USGS myb-REE, 2022), (TMR, 2015) etc. Information about the operation and output of individual REE mines is derived from (S&P, 2023) and other sources.

Latest RMIS update: August 2023.

97.2 Production of refined/processed materials

The compiled information is not publicly available.

97.3 Additional information and insights about production

-

98 Zinc

98.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other sources checked and/or compiled: (ILZSG, 2022) (2016-2021), (BGS, 2023) (2006-2021).

Notes: Figures present the mine production of zinc.

Latest RMIS update: August 2021.

98.2 Production of refined/processed materials

98.2.1 Refined Zinc

Coverage: World countries.

Time period of compiled data series: 2000-2021.

Reference Year: 2021.

Data source(s): (BGS, 2023).

Other collected/checked/registered datasets: (ILZSG, 2022) (2016-2021), (USGS myb-Zn, 2023) (2013-2021).

Notes: On the basis of collected background information, data correspond to the production of refined zinc metal by smelters or refineries regardless of the type of source material, i.e. primary (ores and concentrates) or secondary sources (scrap, residues, and slag). Remelted zinc and zinc dust are excluded.

Latest RMIS update: August 2023.

98.3 Additional information and insights about production

- ✓ The distribution of the main commodities extracted in the zinc-producing mines is retrieved from (S&P, 2023);
- ✓ The output of refined zinc by source is obtained from (USGS myb-Zn, 2023).

99 Zirconium

99.1 Production of primary materials

Coverage: World countries.

Time period of compiled data series: 2000-2021

Reference Year: 2021.

Data source(s): (WMD, 2023) for 2006-2021, (BGS, 2023) for 2000-2005.

Other sources checked and/or compiled: (BGS, 2023) (2006-2021) (USGS myb-Zr&Hf, 2023) (2006-2020).

Notes: The information concerns the mining of zirconium minerals.

Latest RMIS update: August 2021.

99.2 Production of refined/processed materials

Production statistics are not available for refined zirconium metal and compounds.

99.3 Additional information and insights about production

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