1 ANTIMONY

1.1 Overview

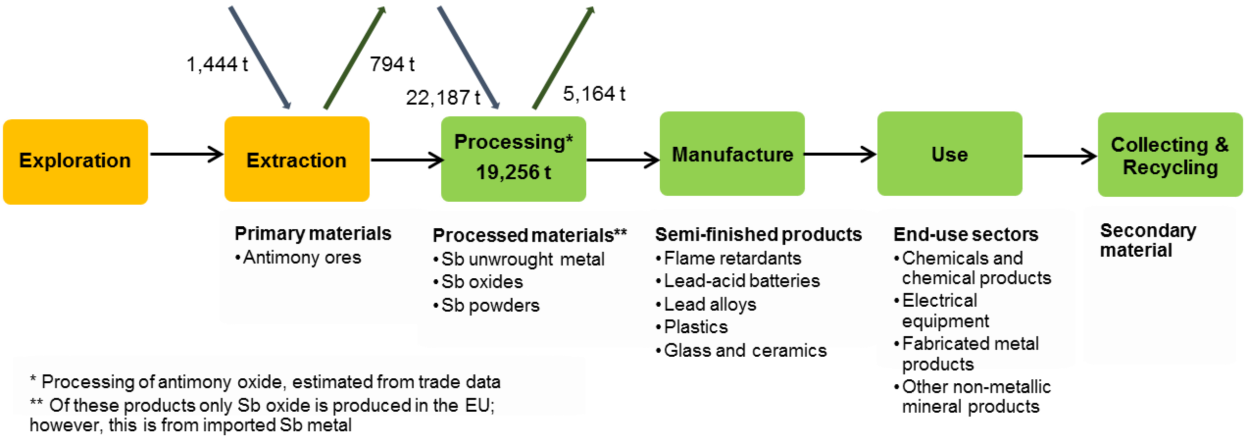

Figure 1: Simplified value chain for antimony for the EU, averaged over 2012-2016 [1]

Antimony (chemical symbol Sb) is a soft, lustrous, silver-grey metalloid. It is stable in air at room temperature, but reacts with oxygen when heated to form antimony trioxide (Sb_2O_3). It has a relatively low melting point of 630°C and a density of 6.697 g/cm^3. Antimony is rare in the Earth's crust having a (upper) crustal abundance of only 0.4 ppm (Rudnick and Gao, 2003). Antimony is found in over 100 different mineral species, typically in association with elements such as mercury, silver and gold. The principal ore mineral of antimony is stibnite (Sb_2S_3). Antimony was on the EU's lists of critical raw materials in 2011, 2014 and 2017.

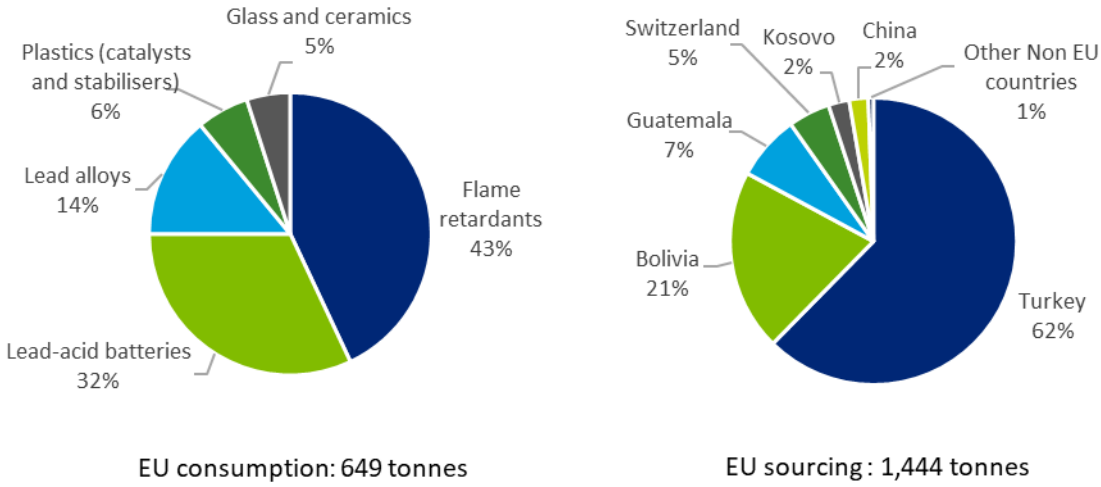

Figure 2: End uses of antimony in the EU and EU sourcing of antimony ores and concentrates (2012-2016) (Eurostat, 2019a)

[1] JRC elaboration from multiple sources (see next sections). The orange boxes of the extraction and processing stages suggest that activities are not undertaken within the EU.

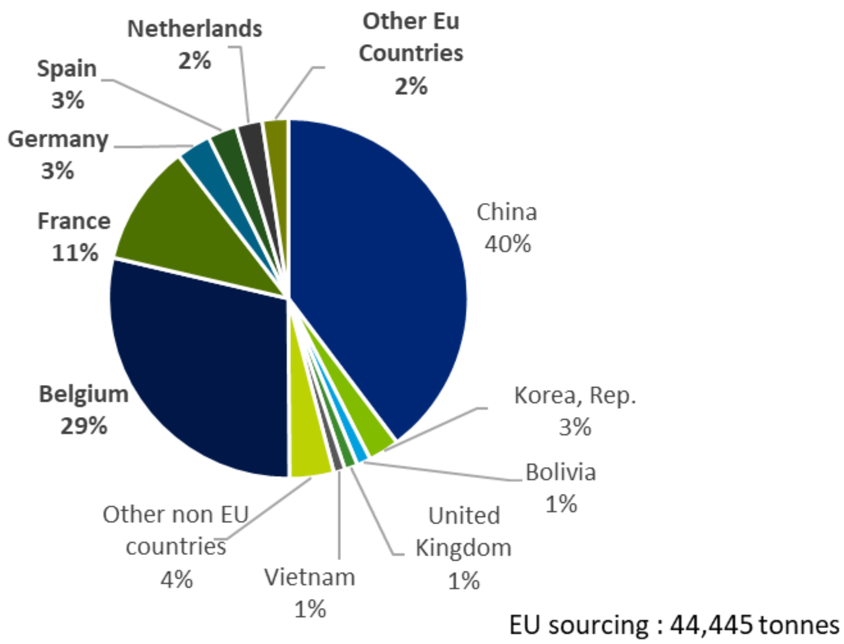

Figure 3: EU sourcing of unwrought antimony and antimony oxides (processing stage) (annual average for 2012-2016)[2]

For the purpose of this assessment antimony is analysed at both extraction and processing stage. At mine stage, antimony is assessed as antimony ores and concentrates (trade code CN26171000) and at processing stage in the form of antimony wrought and powders (trade code CN811010) and antimony oxide (trade code CN282580).

The antimony market size was reported at USD 1.77 billion in 2018 and is projected to reach USD 2.37 billion by 2023, at a CAGR of 6% between 2018 and 2023. The application of antimony in the chemical industry is projected to drive the antimony market (Marketwatch Press Release, 2019). The majority of antimony is traded on annual contracts and only small amounts are sold on the open market. According to the information from USGS, antimony prices have decreased drastically in the period 2012-2016, from USD 12,445 per tonne in 2012 to USD 7,385 per tonne in 2016.

The EU is a net importer of antimony ores and concentrates. The average annual EU consumption of antimony ores and concentrates was approximately 649 tonnes per year for the period 2012-2016, supplied exclusively by import, predominantly from Turkey (62%), Bolivia (20%), and Guatemala (7%).

The EU is a major global producer of antimony oxide for the period 2012-2016. EU production of antimony oxide depends on EU imports of unwrought antimony. Between 2012 and 2016, the apparent consumption of unwrought antimony and powder and antimony oxide in the EU averaged 39,300 tonnes per year (Sb content). The EU imported antimony metal and antimony oxides with an average (2012-2016) of 22,200 tonnes per year. The EU import originated mainly from China, with annual import of 17,650 tonnes, accounting for 40% of the total EU sourcing.

Antimony is mainly used as flame retardant. It is also as used as lead alloy, in lead-acid batteries, as catalyst and stabiliser in plastics manufacture, and in glass and ceramics. Antimony is harder to substitute as retardant than in other applications.

World antimony resources have been estimated at 5 million tonnes in 2011 (Bio Intelligence Service, 2015). Principal identified world resources are located in Australia,

[2] JRC elaboration from multiple sources. See EU demand section.

Bolivia, China, Mexico, Russia, South Africa, and Tajikistan (USGS, 2019). Additional antimony resources may occur in the Eastern United States (USGS, 2019). In Europe six countries are known to have antimony resources, including: France, Germany, Sweden, Finland, Slovakia and Greece. Most resources in Europe are based on historic estimates and are of little current economic interest.

According to the USGS, world antimony reserves amount to 1.5 million tonnes and are concentrated in China (48%), Russia (18%) and Bolivia (16%).

During the period 2012-2016, the world annual production of antimony ores and concentrates reached about 162 kt (WMD, 2019). China was the largest supplier of antimony ores and concentrates, producing 119 kt (74% of the global production). There is no reported EU production of antimony ores and concentrates in 2012-2016 (WMD, 2019).

At processing stage, the average annual quantity of unwrought antimony and powders and antimony oxides traded globally for the period 2012-2016 was 110 kt (Sb content). The main producer of antimony wrought and powders and antimony oxide during this period was China (59% of exported quantity) (UNComtrade, 2019).

The global end-of-life (EoL) recycling rate for antimony is estimated to be between 1 and 10% (UNEP, 2013). However, the Material Systems Analysis (MSA) study on antimony, undertaken by BIO by Deloitte in 2015, suggests that the EoL recycling rate for antimony in the EU is as high as 28% (BIO by Deloitte, 2015), mostly by recovery from lead-acid batteries.

The government of China set export quotas of 54.4 kt (metal content) of antimony metal and antimony trioxide in 2016 (USGS, 2016, OECD, 2019). At the beginning of 2017, the Ministry of Commerce of China lifted the export quota and introduced an export license system. Among the suppliers of antimony to the EU, a trade agreement is in place with Turkey.

A range of antimony-bearing substances falls within the EU's Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) which came into force in 2007 albeit with a phased implementation.

1.2 Market analysis, trade and prices

1.2.1 Global market analysis and outlook

The qualitative forecast of supply and demand of antimony is presented in Table 1. As halogenated antimony trioxide is still highly regarded as an effective flame retardant, this is likely to remain the principal market for antimony in the EU. The continued use of antimony-tin oxide (ATO) in flame retardants is also likely to be driven by increasingly stringent fire regulations. The use of antimony in lead-acid batteries is estimated to decrease (Goovaerts, 2019), as various producers substituted antimony in this application on environmental grounds in many developing nations (Schwarz-Schampera, 2014). The main substitute for antimony in lead-acid batteries is tin alloy with lead content, although this practice may not happen immediately.

Global consumption of antimony is expected to increase from 2015 to 2020, primarily in the use applications: flame retardants, lead-acid batteries, and plastics. Asia is projected to remain the leading region regarding consumption, accounting for about 60% of global consumption by 2020 (USGS, 2016).

China was the leading global producer of antimony ores and concentrates and antimony metal and oxides in 2012 to 2016. The ore and concentrates production in China experienced a decline in 2015 due to temporary mine closures and curtailments and environmental restrictions. Antimony mining in the Guizhou Province, one of the main antimony-producing areas, was expected to be limited from 2018 as a part of the Chinese Government's mining industry reforms aiming to reduce mine overproduction (USGS, 2019).

The government of China reduced its export quotas on antimony metal and antimony trioxide from 59,400 tonnes in 2015 to 54,400 tonnes (antimony content) in 2016 (USGS, 2016, OECD, 2019). At the beginning of 2017, the Ministry of Commerce of China lifted the export quota for antimony and introduced an export license system instead.

In the fall of 2017, as prices of antimony recovered from a general declining trend in 2011-2015, and after a series of anti-pollution checks, some private sector antimony producers in China began to re-open (USGS, 2018). Several new antimony mines were also reported to have been opened outside China. For example, in 2018, one company in the United States announced the re-opening of two of its mines in Mexico (USGS, 2019).

A new antimony plant in Oman was planned to operate in 2019. The plant was set up to treat 40,000 tonnes per year of antimony-gold concentrates to produce 20,000 tonnes per year of antimony metal and antimony trioxide, making it the largest antimony roaster outside of China (Roskill General News, 2019). Nevertheless, according to experts, most of the conversion of antimony ores into antimony metal or antimony trioxide would still takes place in China (Goovaerts, 2019).

Table 1: Qualitative forecast of supply and demand of antimony (European Commission, 2017)

Materials	Criticality of the material in 2020		Demand forecast			Supply forecast		
	Yes	No	5 years	10 years	20 years	5 years	10 years	20 years
Antimony	x		+	+	+	+	+	+

1.2.1.1 EU trade

Antimony is traded in a number of forms, e.g. ores and concentrates, antimony trioxide (ATO), unwrought antimony metal and powders, scrap.

The trend of EU imports and exports of antimony ores and concentrates are presented in Figure 4. The EU is a net importer of antimony ores and concentrates with 100% of import reliance. The EU imports over the period 2012-2016 was on average 1,444 tonnes per year (Eurostat, 2019). The main suppliers of antimony ores and concentrates to the EU are Turkey (62%), Bolivia (20%), and Guatemala (7%) (Figure 5). The annual EU exports of antimony ores and concentrates in 2012-2016 was reported at 569 tonnes, i.e. less than half of the EU imports.

China, by far the biggest global producer of antimony ores and concentrates imposed an export tax on antimony ores and concentrates: 20% on CN26171010 "Crude antimony antimony concentrates which are mineral products" and 10% on 26171090 "antimony ores and concentrates: other". The share of the imports of antimony ores and concentrates from China to the total EU supply was 2% (Figure 5).

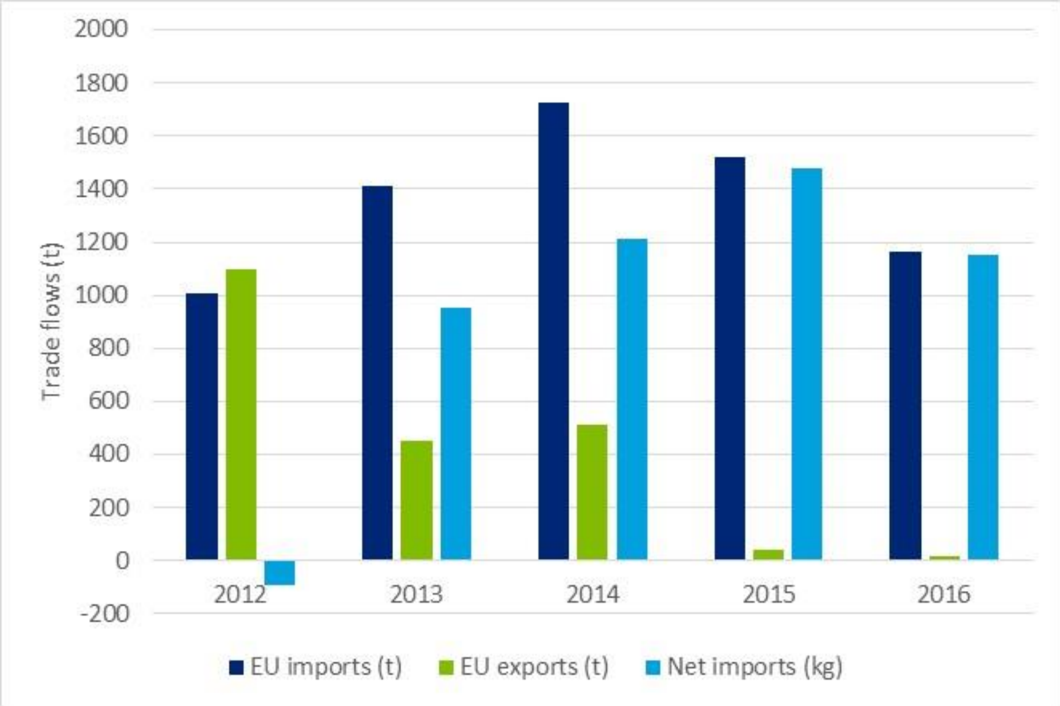

Figure 4: EU trade flows for antimony ores and concentrates, 2012-2016. (Eurostat, 2019a)

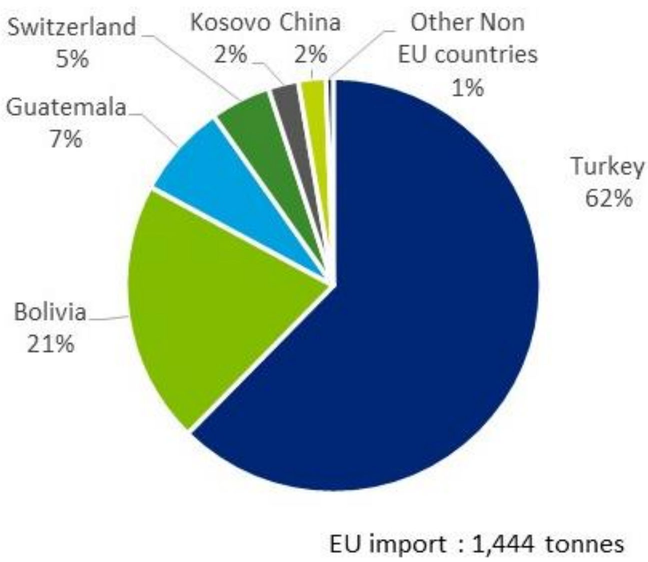

Figure 5: EU imports of antimony ores and concentrates, average 2012-2016 (Eurostat, 2019a)

The EU trade of antimony trioxide is shown in Figure 6. The EU is one of the most significant global exporters of antimony trioxide. In general, there was an increase in the EU export and a decreasing trend in the import of antimony trioxide between 2012 and 2015.

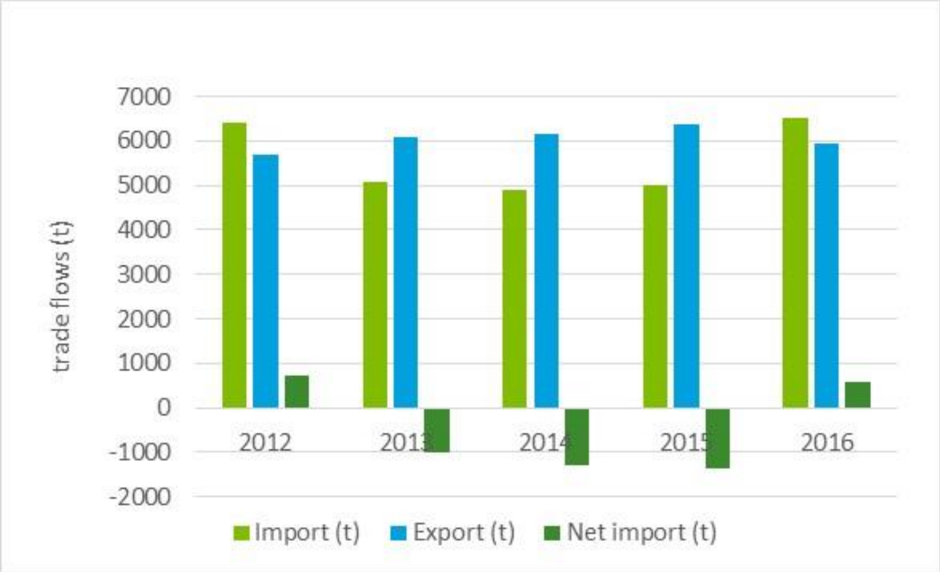

Figure 6: EU trade flows for antimony oxide (CN 282580, tonnes of antimony oxide) (Eurostat, 2019a)

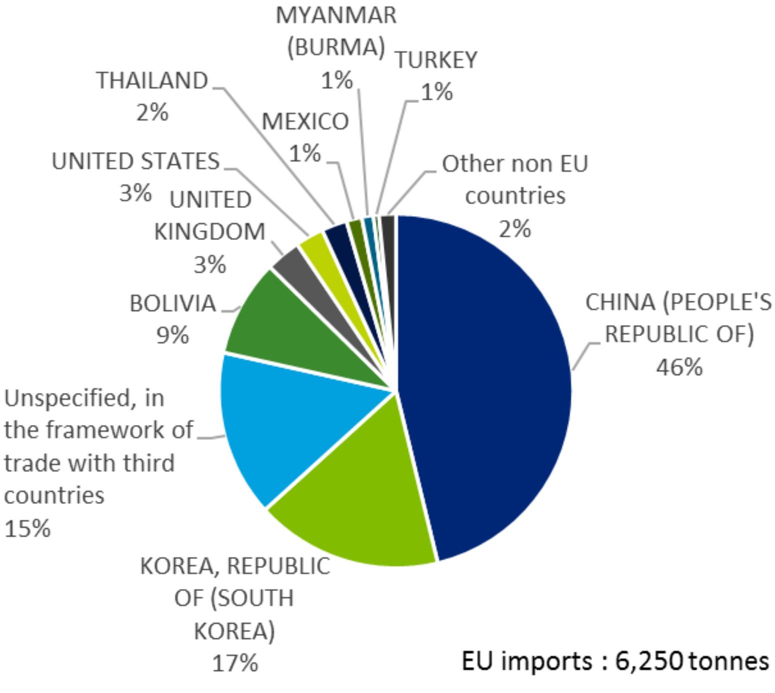

Figure 7: EU imports of antimony oxides, average 2012-2016 (Eurostat, 2019a)

The EU relies on import of antimony in unwrought and powder form for the production of antimony trioxide. The low export in comparison to the import suggests that most of the imported antimony unwrought and powder was consumed domestically (Figure 8). China supplied most of EU's demand of unwrought antimony and powder over the year 2012-2016, accounting for more than 80% of EU imports (Figure 9).

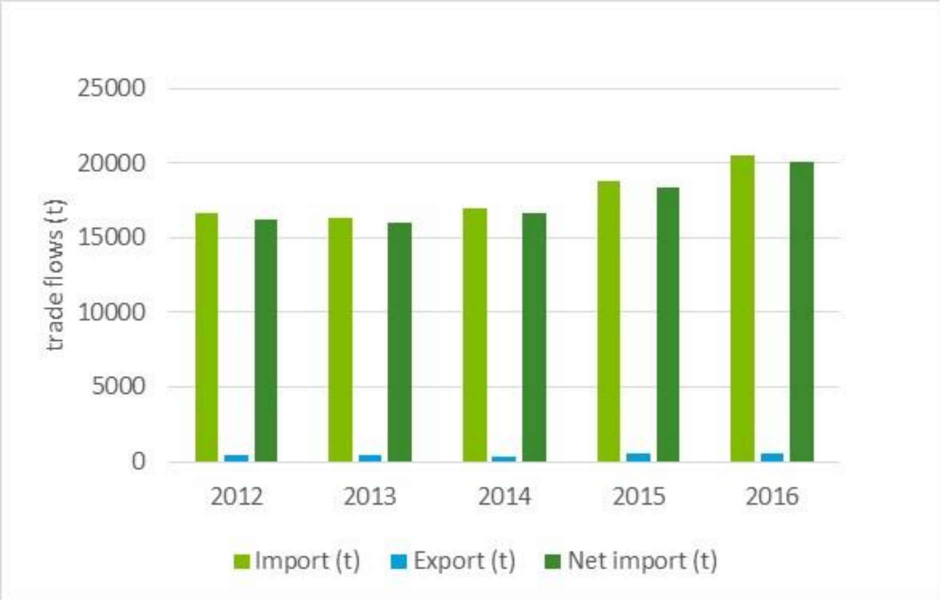

Figure 8: EU trade flows for antimony unwrought and powder (CN code 811010) (Eurostat, 2019a)

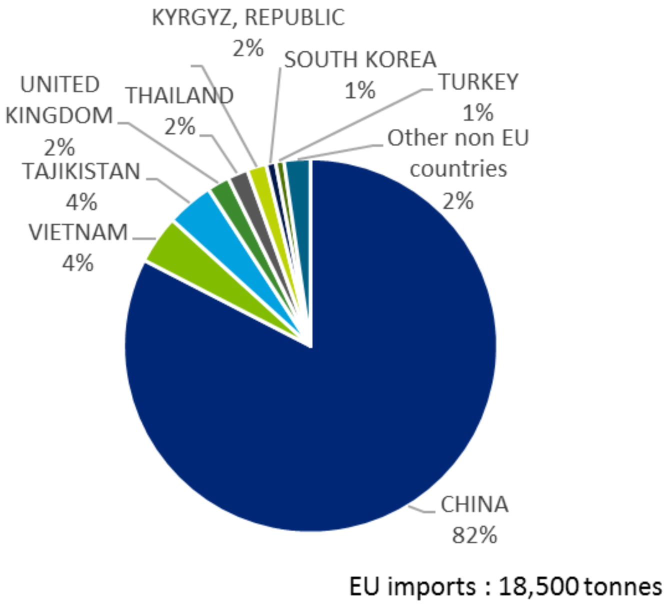

Figure 9: EU imports of antimony unwrought and powder, average 2012-2016 (Eurostat, 2019a)

1.2.1.2 Prices and price volatility

Antimony is traded in a number of forms such as ores and concentrates, antimony trioxide (ATO), unwrought antimony metal and powders, and scrap.

Figure 10 shows the price trend of antimony metal from 1991-2018 based on New York dealer prices. The price of antimony reached its peak of more than USD 14,000 per tonne in 2011. This uptrend occurred in response to Chinese mine closures and the introduction of Chinese export quotas (Schwarz-Schampera, 2014). The increased price of antimony also triggered the use of substitution of antimony. Antimony prices have generally declined from 2011 to 2015. Reports indicated that elevated producer stocks in China and lower–than-expected consumption in Europe contributed to the price decline (USGS, 2016).

In 2016 and 2017, in China many large-scale producers reduced production and many small-scale producers closed in response to price declines and, moreover, to the imposed stricter environmental standards from provincial and national governments. Antimony ingot prices have followed a steady decline since end-2018, with year-to-date prices down around 22% as of July 2019. Part of the decline in price has come from the growing volumes of stocks sold by Chinese large scale producers of ingot and trioxide since the end of 2018 (Roskill General News, 2019).

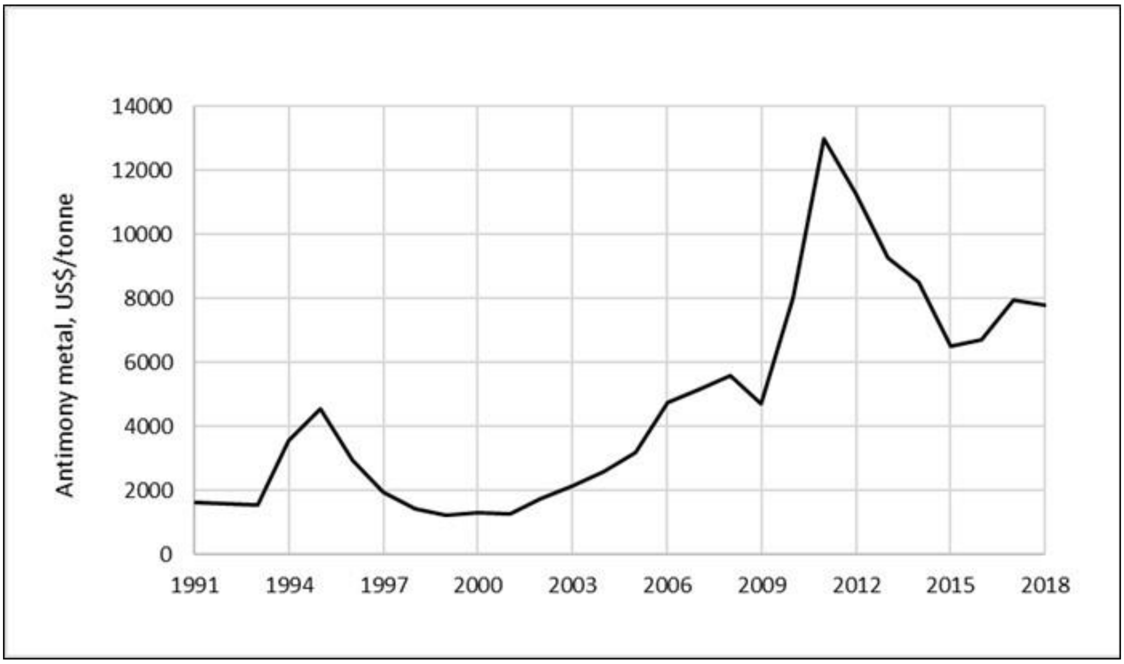

Figure 10: Prices of antimony (USD per tonne) from 1991 to 2018 (Data from USGS[3])

1.3 EU demand

1.3.1 EU demand and consumption

The EU is both an importer and producer of antimony trioxide. The main demand for antimony in the EU came from flame retardants (in the form of antimony trioxide) and in battery applications. The EU production of antimony trioxide also relies largely on the import of unwrought antimony metal.

The EU is a net importer of unwrought antimony metal. In the period 2012-2016, the EU imported 18,5000 tonnes per year of unwrought antimony metal. The supply of unwrought antimony for the EU came mainly from China (83%), Vietnam (4%), and Tajikistan (4%).

1.3.2 Uses and end-uses of antimony in the EU

Figure 11 presents the main uses of antimony in the EU from 2012 to 2016.

[3] https://www.usgs.gov/centers/nmic/antimony-statistics-and-information

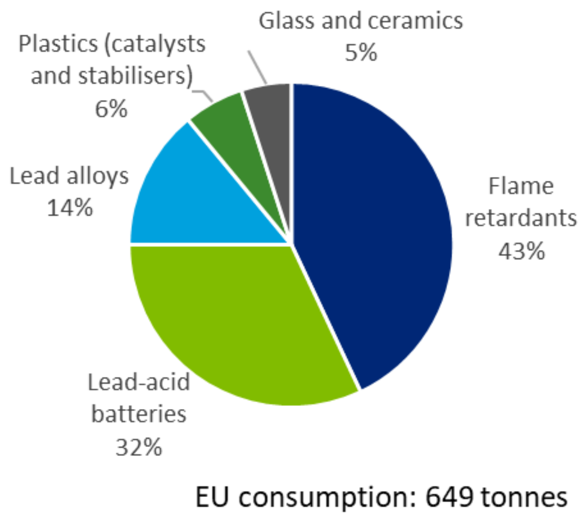

Figure 11: EU end uses of antimony. Average EU import figures of antimony ores and concentrates for 2012-2016 (SCRREEN, 2019).

Approximately 43% of antimony (in the form of antimony trioxide, or ATO) is used in the production of flame retardants. Antimony trioxide is not a flame retardant in itself but it is combined with halogenated (i.e. brominated or chlorinated) flame retardant compounds. Halogenated antimony compounds are effective dehydrating agents, which inhibit ignition and pyrolysis in solids, liquids and gases. They also promote the formation of a char-rich layer on the substrate, which reduces oxygen availability and volatile-gas formation (Schwarz-Schampera, 2014). Antimony-based flame retardants are used in plastics, cable coatings, upholstered furniture, car seats, fabrics and household appliances (i2a, 2014).

Another important use of antimony, accounting for about 32% of global antimony consumption, is the production of antimonial or hard-lead alloys used in the manufacture of lead-acid batteries. The incorporation of 1-15 % antimony in these alloys improves tensile strength and thus charging characteristics. Further, it also prevents the production of unwanted hydrogen during charging. Antimony-lead alloys that contain 1-3% antimony are easy to cast and are used in the production of grid plates, straps and terminals in lead-acid batteries (Schwarz-Schampera, 2014; CRM_InnoNet, 2015).

The production of lead alloys accounts for about 14% of the global antimony use. Examples for this application are in the manufacture of low-load bearings used in the automotive sector, as well as in the manufacture of household and decorative items such as teapots, vases and lamp stands. Tin-lead-antimony solders are used extensively in the electronics industry (Schwarz-Schampera, 2014; CRM_InnoNet, 2015).

About 6% of antimony, in the form of antimony trioxide (ATO), is used as a catalyst in the production of polyethylene terephthalate (PET). PET is one of the key input materials for the manufacture of plastic bottles, also for water and food bottles. ATO is also used as a heat stabiliser in polyvinyl chloride (PVC) (Schwarz-Schampera, 2014).

Antimony in the form of sodium hexahydroxyantimonate, is used in the manufacture of high-quality clear glass. This use accounts for about 5% of the global antinomy consumption. In this particular application, antimonates are primarily used as degassing agents, which act to remove trapped air bubbles from the cooling glass. They also act as a fining agent for removing impurities (e.g. iron) that may produce unwanted colouration (Schwarz-Schampera, 2014).

Other minor uses of antimony (accounting for less than 1% of the EU demand) are (Braibant, 2019):

- Functional pigments used in plastics, rubber, paints and enamels (mainly Sb oxides and sulfides)
- Lubricants used in brake pads and disk clutches (mainly Sb trisulfide)
- Ammunition primer in blasting caps, ignition agents and smoking agents (mainly Sb trisulfide)
- Catalysts for oil refining (mainly Sb oxides)
- Medical treatment of leishmaniosis (mainly pentavalent Sb species)

Antimony-compounds are used also as cross-linking catalyst and stabilizers in explosive formulation, serving a function similar to catalysts and stabilizers (Castresana-Pelayo, 2019).

Relevant industry sectors are described using the NACE sector codes (Eurostat, 2016c), presented in Table 2.

Table 2: Antimony applications, 2-digit and associated 6-digit CPA sectors, and value added per sector (Based on value added from Eurostat, 2019b)

Applications	2-digit NACE sector	Value added per sector	4-digit CPA
Flame retardants	C20 - Manufacture of chemicals and chemical products	105,514	C2059 - Manufacture of other chemical products n.e.c.
Lead-acid batteries	C27 - Manufacture of electrical equipment	80,745	C2720 - Manufacture of batteries and accumulators
Lead alloys	C25 - Manufacture of fabricated metal products, except machinery and equipment	148,351	C2599 - Manufacture of other fabricated metal products n.e.c.
Plastics (catalysts and stabilisers)	C20 - Manufacture of chemicals and chemical products	105,514	C2016 - Manufacture of plastic in primary forms
Glass and ceramics	C23 - Manufacture of other non-metallic mineral products	57,255	C2311 - Manufacture of flat glass

1.3.3 Substitution

Substitution of antimony remains similar to with what was described at the critical raw material assessment in 2017. Antimony is reasonably easy to substitute in some of its applications (CRM_InnoNet, 2015). For example, compounds of chromium, tin, titanium, zinc and zirconium can substitute for antimony in the manufacture of pigments and glass. However, in its main application (i.e. as a flame retardant) antimony is much harder to substitute. Compounds such as alumina trihydrate, magnesium hydroxide and zinc borate may partially substitute for antimony in flame-retardant materials. However, their performance is inferior to antimony-based flame retardants.

Various combinations of cadmium, barium, calcium, lead, tin, zinc and germanium may substitute for antimony in the production of plastics (e.g. as stabilisers or catalysts), but this option is commonly more expensive. There are several metals that may substitute for antimony in the production of lead alloys (e.g. cadmium, calcium, selenium, tin and copper). However, assuming 1:1 substitution in alloys is overly simplistic, for the simple reason that the properties of a given alloy are not controlled by a single metal, but rather by the combination of several metals, where each metal may produce a range of effects in the alloy (Schwarz-Schampera, 2014) (CRM_InnoNet, 2015). Accordingly, any substitution would be associated with a price and/or performance penalty. In general there appears to be little economic or technical incentive to substitute antimony in its principal applications.

1.4 Supply

1.4.1 EU supply chain

The flows of antimony through the EU economy are demonstrated in Figure 12.

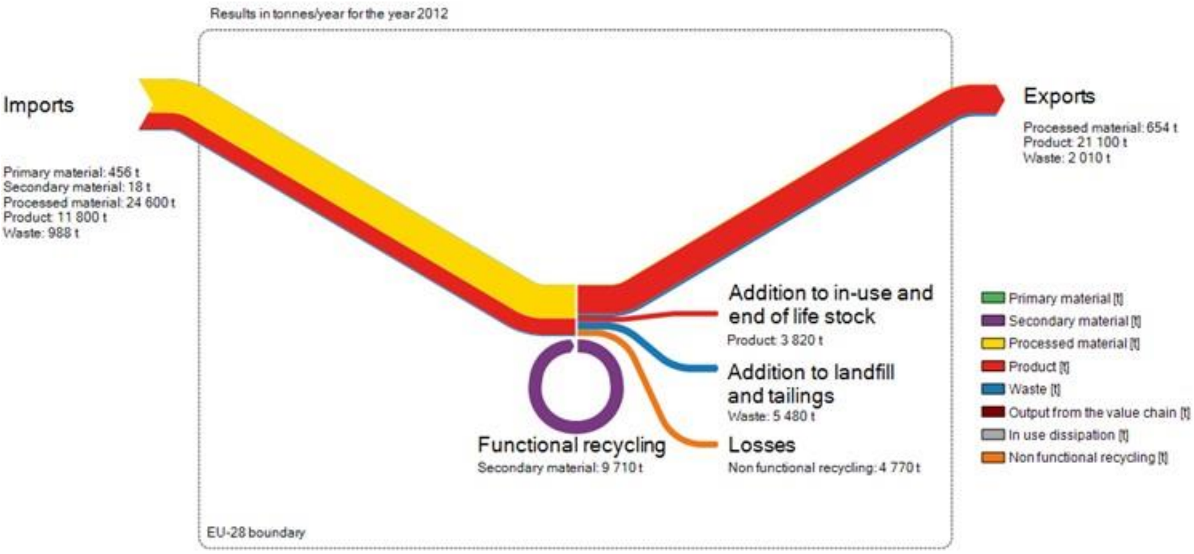

Figure 12: Material System Analysis of antimony in 2012, EU-28 (Bio Intelligence Service, 2015)

The extraction of antimony ores and the production of antimony concentrates does not occur in the EU. The EU is a net importer of antimony ores and concentrates with an import reliance of 100%.

At processing stage, it is difficult to quantify the volume of antimony trioxide produced in EU because such data are unavailable in the Eurostat Prodcom database. For this reason, antimony oxide trade figures from the UNComtrade were used as proxy as production data. Based on the quantity of antimony trioxide traded globally in the period 2012-2016, the EU countries, together with China, were among the most important exporters of antimony trioxide. The EU export of antimony trioxide accounted for more than 30% of the average global exports for the period 2012-2016.

However, for the production of antimony trioxide, the EU relies on import of antimony in unwrought and powder form.

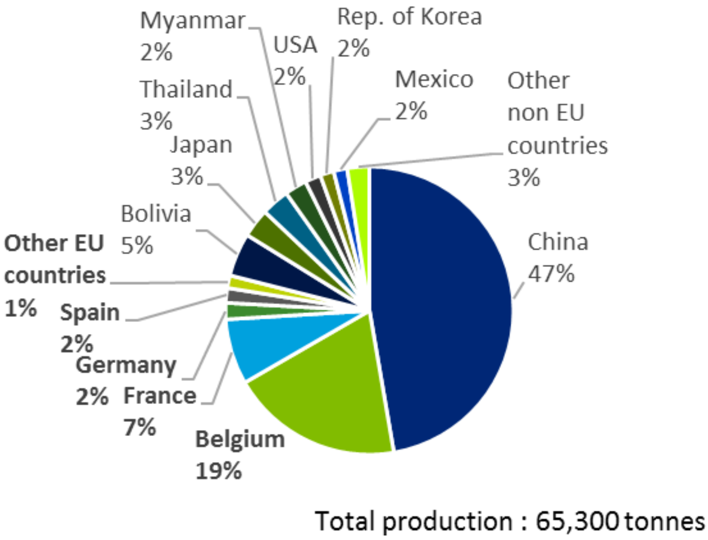

Figure 13: Global production of antimony trioxide, average 2012-2016 (UN Comtrade, 2019)

1.4.2 Supply from primary materials

1.4.2.1 Geology, resources and reserves of antimony

Geological occurrence:

The most important antimony deposits, based on their antimony content, include: (1) greenstone-hosted quartz-carbonate veins and carbonate replacement deposits; (2) gold-antimony (epithermal) deposits; and (3) reduced magmatic gold systems. In many of these deposits, stibnite (Sb_2S_3) is the principal ore mineral (Schwarz-Schampera, 2014).

Greenstone-hosted antimony deposits are of particular economically importance. They are estimated to tens of millions of tonnes in size and typically contain between 1.5 and 25% Sb_2S_3. These deposits typically comprise a stockwork of gold-antimony-quartz-carbonate veins hosted by metavolcanic and/or metasedimentary rocks. Carbonate replacement deposits are also found in some of these metasedimentary sequences (e.g. Xikuangshan, China), which are thought to form by hydrothermal alteration of the host material (Schwarz-Schampera, 2014).

Epithermal gold-antimony deposits are generally smaller than greenstone-hosted deposits. They are typically up to 1 million tonnes in size, and have lower ore grades (up to 3.5% Sb_2S_3). The formation of these epithermal deposits is linked to the emplacement of magmatic porphyry copper systems in the shallow crust (upper 1.5 km). The mineralisation generally takes the form of veins, or disseminations of stibnite and/or tetrahedrite ((Cu,Fe)12Sb4S13) in the host rocks (Schwarz-Schampera, 2014).

Reduced magmatic gold systems are associated with the intrusion of metaluminous granite plutons, the mineralisation taking the form of quartz-carbonate sheeted veins, replacement bodies and/or skarns. The mineralisation may be enriched in several metals, including gold, tellurium, tungsten, arsenic and antimony. These deposits are similar in size to the greenstone-hosted antimony deposits, but have typically much lower grades (0.1 to 1.5% Sb_2S_3) (Schwarz-Schampera, 2014).

Global resources and reserves[4]*:*

Identified principal world resources of antimony are located in Australia, Bolivia, China, Mexico, Russia, South Africa, Turkey and Tajikistan. Additional antimony resources may occur in the Eastern United States (USGS, 2019).

USGS listed countries and the quantity of reserves of antimony (Table 3). The reserves originating from these countries were approximately 1.5 million tonnes of contained antimony (USGS, 2019). Apart from the countries listed in Table 3, reserves are known to exist in Myanmar, Guatemala, Iran, Kazakhstan, Laos, Pakistan, and Vietnam but there was no data on the quantity.

Table 3: Global reserves of antimony in year 2019 (Data from USGS, 2019).

Country	Antimony Reserves (tonnes of antimony content)
United States	60,000
Australia	140,000
Bolivia	310,000
China	480,000
Mexico	18,000
Russia (recoverable)	350,000
Tajikistan	50,000
Turkey	100,000

EU resources and reserves[5]*:*

In Europe six countries are known to have antimony resources: France, Germany, Sweden, Finland, Slovakia and Greece (Minerals4EU, 2019). Most resource figures in Europe are based on historic estimates and thus not reported in accordance with the UNFC system of reporting. These resources are currently considered to be of little economic interest. Data for Germany are not reported because data collection in that country is under the responsibility of authorities at federal state level (Minerals4EU, 2019). Resource data for

[4] There is no single source of comprehensive evaluations for resources and reserves that apply the same criteria to deposits of antimony in different geographic areas of the EU or globally. The USGS collects information about the quantity and quality of mineral resources but does not directly measure reserves, and companies or governments do not directly report reserves to the USGS. Individual companies may publish regular mineral resource and reserve reports, but reporting is done using a variety of systems of reporting depending on the location of their operation, their corporate identity and stock market requirements. Translations between national reporting codes are possible by application of the CRIRSCO template.[4], which is also consistent with the United Nations Framework Classification (UNFC) system. However, reserve and resource data are changing continuously as exploration and mining proceed and are thus influenced by market conditions and should be followed continuously.

[5] For Europe, there is no complete and harmonised dataset that presents total EU resource and reserve estimates for antimony. The Minerals4EU project is the only EU-level repository of some mineral resource and reserve data for antimony, but this information does not provide a complete picture for Europe. It includes estimates based on a variety of reporting codes used by different countries, and different types of non-comparable datasets (e.g. historic estimates, inferred reserves figures only, etc.). In addition, translations of Minerals4EU data by application of the CRIRSCO template is not always possible, meaning that not all resource and reserve data for antimony the national/regional level is consistent with the United Nations Framework Classification (UNFC) system (Minerals4EU 2019).Many documented resources in Europe are based on historic estimates and are of little current economic interest. Data for these may not always be presentable in accordance with the UNFC system. However a very solid estimation can be done by experts.

some countries in Europe are available on the Minerals4EU (2019) website (see Table 4) but cannot be summed as they are partial and they do not use the same reporting code.

Other than the resource estimation reported on Minerals4EU website, deposit of antimony was reported in Rockliden, Sweden at 10 Mt with 0.18% Sb, (also contains 4.03% Zn, 1.82% Cu, 52 ppm Ag, 0.06 ppm Au) (Depauw, G., 2019).

In addition, antimony occurrences were also reported to exist in Austria, Bulgaria, Czechia, Hungary, Italy, Luxembourg, Portugal, Romania, Slovenia, and Spain (Lauri et al., 2018).

Austria was reported to have several deposits or occurrences and past production of antimony as either main commodity or by-product. The ProMine database estimated about 20,000 tonnes of Sb reserves and resources for Italy, of which 400 tonnes of antimony was at Su Suergiu deposit in Sardinia (Lauri et al., 2018). No information on resources were available concerning occurrences of antimony in Czechia, Hungary, Romania, and Slovenia.

In Portugal, antimony was mined until 1967, when the Barroca da Mina/Barroca da Santa mine was closed. Portuguese deposits were estimated to have 17,700 tonnes of remaining resources of of antimony (Lauri et al., 2018).

In Bulgaria, an exploration activity for gold-antimony deposits took place in 2017. According to the reported exploration license, the estimated total endowment of antimony from these deposits was 124,000 tonnes.

Table 4: Resource data for the EU compiled in the European Minerals Yearbook of the Minerals4EU website (Minerals4EU, 2019)

Country	Reporting code	Quantity	Unit	Grade	Code Resource Type
France	None	26,250	t	Metal content	Historic Resource Estimates
Greece	UGSG	90	kt	2.5%	Indicated
Slovakia	None	3.206	Mt	1.71% sub-economic	-
Finland	none	0.3	Mt	0.41%	Historic Resource Estimates
Sweden	Historic	17	Mt	0.06%	Historic Resource Estimates

1.4.2.2 World and EU mine production

During the period 2012-2016, the world annual production of antimony ores and concentrates reached about 162,000 tonnes per year. China was the largest supplier of antimony ores and concentrates, producing 119,000 tonnes or approximately 74% of the global production. Tajikistan followed behind China with an annual production of 12,900 tonnes, constituting 8% of the global production. Russia, Myanmar, and Bolivia were the third, fourth, and fifth biggest global producers of antimony ores and concentrates during the period 2012-2016, producing in total 10% of world production of ores and concentrates (WMD, 2019). There is no EU production of antimony (WMD, 2019) (Figure 14).

In 2016, several new antimony mine projects were being evaluated and developed in Armenia, Australia, Burma, Canada, China, Georgia, Italy, Laos, Russia, South Africa, and Turkey. In Oman, a producer announced plans to construct an antimony smelter that would have the capacity to produce 20,000 tonnes per year of antimony metal and oxide (Roskill General News, 2019). The Omani antimony project would be the largest antimony roaster outside of China. In 2018, a company in the United States announced the re-opening of two of its mines in Mexico (USGS, 2019). In the next several years after 2018, antimony mining in the Guizhou Province was expected to be limited as a part of the Chinese Government's mining industry reforms aiming to reduce mine overproduction (USGS, 2019).

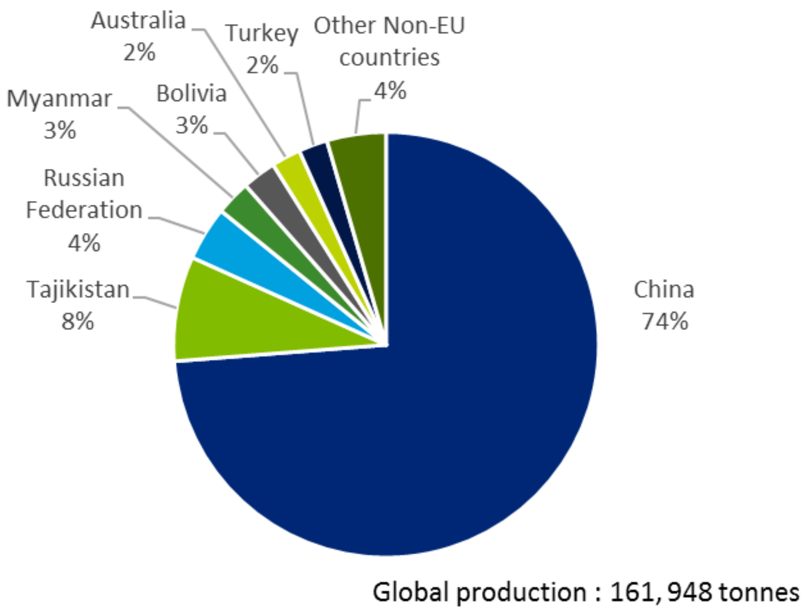

Figure 14: Global mine production of antimony. Average for the years 2012-2016. (WMD, 2019)

1.4.3 Supply from secondary materials/recycling

Secondary antimony can be found in two main types of sources: in waste from processing antimony bearing materials as well as in end of life products from urban mines and manufacturing residues (Sundqvist Oeqvist, Pr. Lena et al., 2018).

The global end-of-life (EoL) recycling rate for antimony is estimated to be between 1 and 10% (UNEP, 2013). The Raw Materials Supply Assessment (RMSA) study, undertaken by BIO by Deloitte in 2015, suggests that the EoL recycling rate in the EU for antimony is as high as 28% (BIO by Deloitte, 2015). Secondary antimony is chiefly recovered from lead-acid batteries. Therefore, the availability of secondary antimony is almost entirely dependent on the extent of lead recycling and the market conditions for lead and lead-acid battery scrap. Since the supply of primary antimony is heavily concentrated in a few countries, the recovery of secondary antimony is an important part of the supply chain in countries like, for example, the United States, Japan, Canada and the EU. On a global scale, it was estimated, that in 2010 the secondary production of antimony accounted for about 20% of total antimony supply (Sundqvist Oeqvist, Pr. Lena et al., 2018).

In the EU, there are companies dealing with secondary antimony. Umicore is a company headquartered in Belgium, which recovers antimony from end-of-life batteries, mostly from electric cars. Solvay in France recycles halophosphate from spent fluorescent batteries (Sundqvist Oeqvist, Pr. Lena et al. ,2018).

Antimony used in the manufacture of plastics and flame retardants is generally not recovered because antimony is dispersed in these products (Schwarz-Schampera, 2014). However, antimony could potentially be recovered from the bottom ash resulting from the incineration of some of these products at their end-of-ife stage, but this currently does not appear to be economically viable (BraibantC., 2017).

Table 5: Material flows relevant to the EOL-RIR of antimony[6]

MSA Flow	Value (t)
B.1.1 Production of primary material as main product in EU sent to processing in EU	87312
B.1.2 Production of primary material as by product in EU sent to processing in EU	0
C.1.3 Imports to EU of primary material	236303
C.1.4 Imports to EU of secondary material	0
D.1.3 Imports to EU of processed material	81142
E.1.6 Products at end of life in EU collected for treatment	130813
F.1.1 Exports from EU of manufactured products at end-of-life	193
F.1.2 Imports to EU of manufactured products at end-of-life	2847
G.1.1 Production of secondary material from post consumer functional recycling in EU sent to processing in EU	0
G.1.2 Production of secondary material from post consumer functional recycling in EU sent to manufacture in EU	4861

1.4.4 Processing of Antimony

There is no official data on the global production of antimony products. Based on the estimation from the global trade data, the quantity of antimony contained in antimony wrought and powders supplied to the market in the period 2012-2016 was 45,700 tonnes per year. The main suppliers of antimony wrought and powders, are China (79%) followed by Vietnam (9%) and India (4%) (Comtrade, 2019). This figure was estimated from the export figures of antimony wrought and powders from Comtrade.

However, when interpreting these trade figures, there are uncertainties about the possible "Rotterdam effect", i.e. some countries re-exports of antimony products appear misleadingly as production figures.

1.5 Other considerations

1.5.1 Environmental and health and safety issues

A range of antimony-bearing substances fall within the EU's Regulation on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), which came into force in 2007 albeit with a phased implementation.

1.6 Comparison with previous EU assessments

The assessment has been conducted using the same methodology as for the 2017 list.

In criticality assessment 2014, supply risk of antimony was assessed at mine stage, with trade figures referring to antimony ores and concentrates. At the CRM assessment 2017, the supply risk of antimony was assessed only at processing stage, focusing on unwrought antimony, which was considered a bottleneck for the EU supply. Since there was no data on global supply of unwrought antimony, the trade data (UN Comtrade) for unwrought antimony was used as a proxy of production capacity. The figure of unwrought antimony exported from the EU, however, was omitted from the global picture of production capacity, since the EU relied 100% on imports of antimony ores and concentrates as raw materials. This consideration was reflected on the high supply risk value in CRM 2017. In criticality assessment 2020, supply risk of antimony was calculated at both mine stage and refined stage. Following the input from experts, in criticality assessment 2020, supply

[6] EOL-RIR=(G.1.1+G.1.2)/(B.1.1+B.1.2+C.1.3+D.1.3+C.1.4+G.1.1+G.1.2)

risk of refined antimony was assessed for the sum of unwrought antimony and antimony oxides. The assessment also took into account the EU production capacity (Braibant, C., 2019). The taken approach resulted in a lower supply risk value at refined stage since the global supply is less concentrated and the EU has a production capacity. The supply risk value for antimony is higher at mine stage, the stage where the EU has no production and therefore relies 100% on imports from extra-EU countries. Therefore, the supply risk figure reported in Table 6 refers to mine stage.

The economic importance of antimony showed a higher value in comparison with criticality assessment 00000000000000000002017, while the end uses in the EU remained the same. The increase economic importance parameter in 2020 can be explained by the change in the value added of the sectors for which antimony is assigned.

The results of the current criticality assessment and earlier assessments are shown in Table 6.

Table 6: Economic importance and supply risk results for antimony in the assessments of 2011, 2014, 2017, 2020 (European Commission, 2011; European Commission, 2014; European Commission, 2017)

Assessment	2011			2014			2017			2020	
Indicator	EI	SR		EI	SR		EI	SR		EI	SR
Antimony	5.84	2.56		7.07	2.54		4.3	4.3		4.77	2.01

1.7 Data sources

Data for the production of processed antimony (unwrought antimony and antimony oxides) are not available at global level. Therefore, the calculation of supply risk at processing stage was done using trade data from UN-Comtrade as a proxy, which is an approach that has to be carefully interpreted due to the possible 'Rotterdam effect'. In exceptional cases, certain production figures may be overestimated as re-exports might be counted as antimony production.

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