9 FLUORSPAR

9.1 Overview

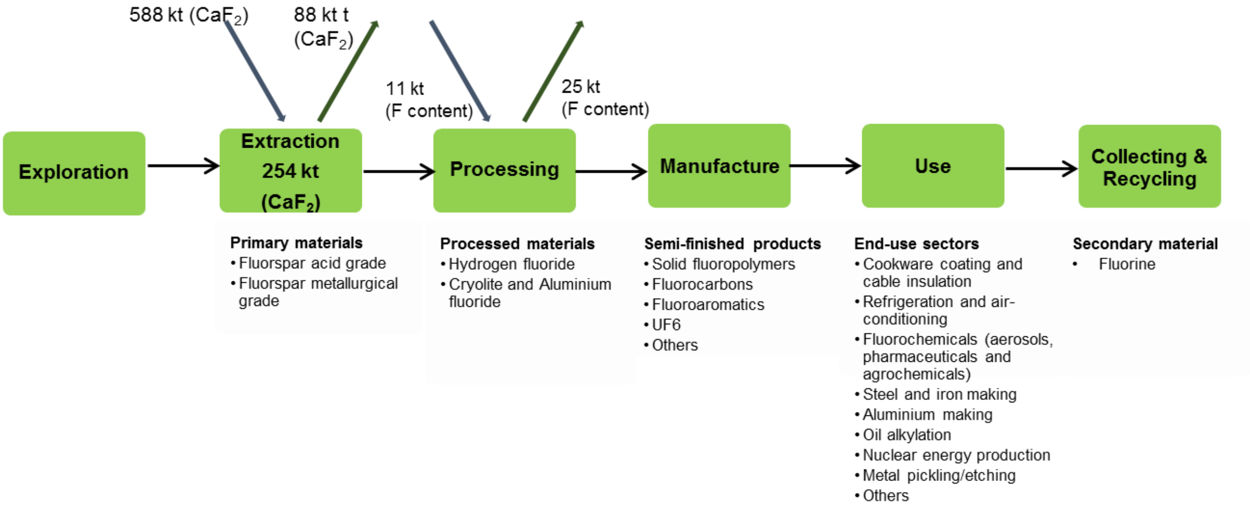

Figure 121: Simplified value chain for fluorspar[83] in the EU (average 2012 to 2016)

Fluorspar is the commercial name for the mineral fluorite (calcium fluoride, CaF_2). Fluorite is a colorful, widely occurring mineral that occurs globally with significant deposits in over 9,000 areas. Fluorspar was on the list of CRMs in 2011, 2014, 2017.

For the purpose of this assessment fluorspar at both extraction and processing stage are analysed. At mine stage, fluorspar is assessed in the form of fluorspar acid grade "AG" (assuming 97% CaF_2 contained, CN8 code 25292200) and metallurgical grade "MG" (assuming 84% CaF_2 contained, CN8 code 25292100). At processing stage, the following products are considered: hydrogen fluoride (HF, 95% F contained, HS 281111), cryolite (Na_3AlF_6, 54% F contained, HS 282630) and aluminum fluoride (AlF_3, 68% F contained, HS 282612).

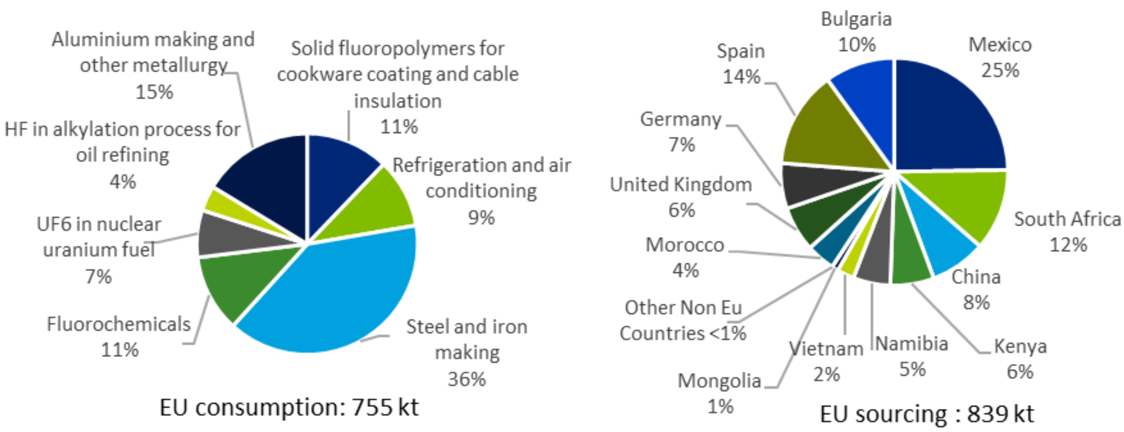

Figure 122: End uses (CRM Experts, 2019b) and EU sourcing of Fluorspar at mine stage (Acid-Grade and Metallurgical-Grade) (Eurostat Comext 2019a)

[83] JRC elaboration on multiple sources (see next sections). The quantity of processing stage in the EU represents the figure from criticality assessment 2017.

In the assessment, the figures of fluorspar reported in extraction stage is expressed in CaF_2 content while for processing stage the quantities are expressed in fluorine (F) content.

The fluorspar market is segmented into four applications: aluminum production, steel production, hydrofluoric acid, and others. Acid grade fluorite and metallurgical fluorite together account for over 95% of the global fluorspar market share (Marketwatch Press Release, 2019).[84] The majority of fluorspar is traded on annual contracts and only small amounts are sold on the open market (BGS, 2011). The average annual acidspar prices have decreased drastically in the last years, from USD 399 per tonne in 2014 to USD 265 per tonne in 2018 (DERA, 2019).

The average annual EU apparent consumption of fluorspar over the period 2012-2016 was estimated at 755 kt with 74% of consumption in the form of acid grade and 26% in metallurgical grade. The EU sourced fluorspar through domestic production (in Spain, Bulgaria and Germany) and imports (mainly from Mexico, South Africa, China, Kenya and Namibia). The EU was a net importer of fluorspar at mine stage with an EU import reliance of 66%. Between 2012 and 2016, the EU was net exporter of fluorspar containing products such as hydrogen fluoride, cryolite and aluminum fluoride.

Fluorspar is mainly used in steel and iron making, refrigeration and air conditioning, aluminium making, solid fluoropolymers for cookware and cable insulation, fluorochemicals, nuclear uranium fuel and in processes for oil refining.

Fluorspar resources are widespread globally and major deposits can be found on every continent. Identified world fluorspar resources were approximately 500 million tonnes of contained fluorspar (USGS, 2019). Resource data for some countries in Europe are available at Minerals4EU (2019) but cannot be summed as they are partial and they do not use the same reporting code. World known reserves of fluorspar are estimated at around 310 million tonnes (as 100% equivalent CaF_2,) (USGS, 2019). Mexico has the world's largest fluorspar reserves, followed by China and South Africa (USGS, 2019).

The world average annual production of fluorspar (CaF_2) at mine stage in the period 2012-2016 was reported at 6,358 kt per year. The ore production is strongly concentrated with 65% of production in China and 15% in Mexico (WMD, 2019). The European production of fluorspar was 254 kt of acid grade fluorspar (no production of metallurgical grade fluorspar in the EU) (WMD, 2019).

There was not any supply of fluorspar from secondary sources. Given the type of applications, fluorspar is not recyclable (European Commission, 2014). Fluorspar contained in waste mainly ends up in landfill (Bio Intelligence Service, 2015).

On the 1st of January 2019, The UN Environment Programme (UNEP) announced the entry of the Kigali Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer into force, following ratification by 65 countries. It has resulted in new legislation in many countries, which reduces the production and consumption of hydrofluorocarbons, shortening the demand for fluorspar (USGS, 2018).

Until 2010, China had an export quota on fluorspar (550 kt/y). China also imposed export taxes (15%) on acid grade fluorspar, which ended in 2013 (OECD, 2019). On processed products, China applied 5% of export tax for fluorides of aluminium (HS 282612) that ended in 2014. Kenya imposed an export tax of 1% to both acid and metallurgical grade fluorspar (commodities under trade code HS 252922)for its exports to Eritrea, Ethiopia,

[84] The remainder of the ceramic grade fluorite is not considered in this assessment due to minor economic relevance

and Swaziland. Mongolia also imposed a fiscal tax on exports on both acid and metallurgical grade fluorspar (OECD, 2019).

9.2 Market analysis, trade and prices

9.2.1 Global market analysis and outlook

Globally, fluorspar is used mainly in three industry fields. First, acid-grade fluorspar is used in the chemical sector for the manufacture of hydrofluoric acid (HF), a precursor to the production of most other fluorine-containing chemicals, accounting for approximately 40% of the annual global fluorspar consumption. Secondly, fluorspar is used in metallurgical-grade as steelmaking flux, accounting for 30% of the global consumption. Thirdly, acid-grade fluorspar is used in the manufacture of aluminum fluoride (AlF_3) and cryolite (Na_3AlF_6) for aluminum smelting, accounting for approximately 18% of the global consumption. In contrast to the manufacture of hydrofluoric acid and products derived from it, fluorspar is in the second and third application not incorporated in the final products. Other applications of fluorspar include use in the manufacture of cement, ceramics, enamel, glass, and welding rod coatings (Sundqvist Oeqvist, Pr. Lena et al., 2018).

China shows the largest mine production of fluorspar worldwide, with average annual production more than half of the global supply for the period 2012-2016. New fluorspar production capacity in Canada came online in 2018 that has reportedly sent fluorspar to the United States for further processing (USGS, 2019). In 2019, new capacity became available also in South Africa. These new mine production sites will contribute to significant increases of both South African and Canadian production. In Canada, the production capacity of fluorspar is expected to increase up to 200 kt per year acid-grade concentrate, while South Africa is expected to produce 180 kt per year of acid grade fluorspar plus 30 ktper year metallurgical grade fluorspar including plans to produce HF and aluminium fluoride (Roskill, 2019).

In the coming years the future demand for fluorspar will highly depend on the development and use of fluorocarbon substitutes; considering that the use of fluorocarbon in refrigeration will be phased down, especially for HFCs with high GWP (F Gas Regulation EU 517/ 2014; The Kigali Amendment to the Montreal Protocol). Hydrofluoroolefins (HFO-1234ze, HFO-1234yf, HFO-1233zd) and mixtures based on HFOs are considered to be the most likely replacement for fluorocarbons for due to their low GWP (The Chemours Company, 2016). Due to the high amount of fluorine used in the manufacturing process, the fluorspar industry will be able to take advantage of such new developments (USGS, 2016).

No reliable forecast for the EU demand and supply for the next 5, 10 and 20 years have been obtained from market and industry experts (Table 50).

An expert envisioned a slight growth in global hydrofluorocarbons production and consumption in the short term; strong growth in the production and consumption of hydrofluoroolefins (HFOs), especially for mobile air conditioning and plastic foam blowing; moderate growth for fluorochemicals used for fluoroplastic and fluoroelastomer production; and moderate continuing growth for Hydrofluoric acid (HF) for downstream fluorochemicals production and direct uses (Imformed, 2019).

Table 50: Qualitative forecast of supply and demand of fluorspar

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
Fluorspar	x		?	?	?	?	?	?

9.2.2 EU trade

At mine stage, fluorspar is assessed in the form of fluorspar acid grade "AG" (min. 97% CaF_2 contained, CN8 code 25292200) and metallurgical grade "MG" (84% CaF_2 contained, CN8 code 25292100). Ceramic grade fluorite is not considered here.

Quantities are given as CaF_2 content. At processing stage, the following products are considered: hydrogen fluoride (HF, 95% F contained, HS 281111), cryolite (Na_3AlF_6, 54% F contained, HS 282630) and aluminum fluoride (AlF_3, 68% F contained, HS 282612). In the assessment, the figures of fluorspar reported in extraction stage is expressed in CaF_2 content while for processing stage the quantities are expressed in fluorine (F) content

The EU wasa net importer of fluorspar at mine stage in 2012-2016 (AG and MG). With an average of about 588 kt per year (CaF_2 content), the EU import is six times higher than EU export over the year 2012-2016 (Eurostat Comext, 2019). The EU export is of fluorspar was estimated at 88 kt per year.

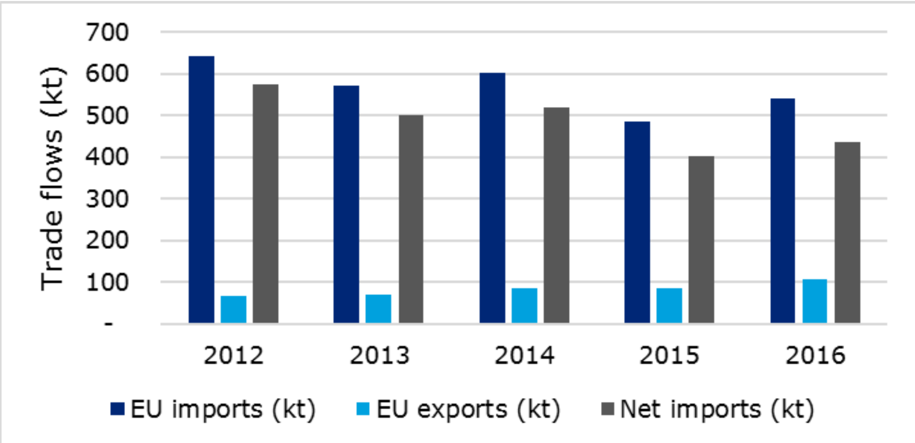

Figure 123: EU trade flows for acid grade and metallurgical grade fluorspar (Eurostat, 2019a)

The main countries from which the EU imported in the period 2012-2016 were Mexico (35%), South Africa (17%), China (11%), Kenya and Namibia (9% and 8%) (see Figure 124). Free Trade Agreements are in place between the EU and Mexico, South Africa and Namibia.

There were several export restrictions in place between the EU and its suppliers in the period 2012-2016. China imposed an export quota and export taxes on fluorspar, meanwhile the export quota (550 kt) ended in 2010 and the export taxes (15%) ended in 2013 (OECD, 2019). Mongolia also imposed a fiscal tax on exports on both acid and metallurgical grade fluorspar.

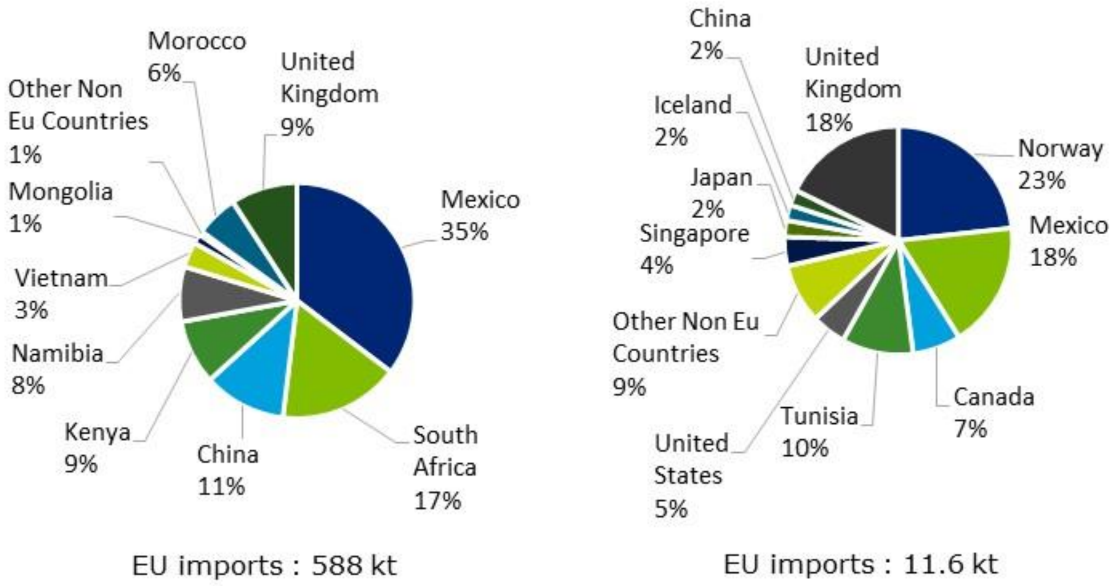

Figure 124: EU imports of acid grade and metallurgical grade Fluorspar (left) and processed Fluorspar (right) (Data source: Eurostat, 2019b)

According to the data reported in Eurostat Comext (2019), only 10% of the EU processed fluorspar supply was imported (about 12 kt per year, in average of the period 2012-2016). These imports were mainly coming from Norway (23%), United Kingdom (18%), and Mexico (18%). Over the year 2012-2016, the average annual quantities of processed fluorspar imported to the EU were as follows:

- Hydrogen fluoride "hydrofluoric acid" (HS 281111) at 4.6 kt per year of fluorine content (accounting 36% of import),
- Sodium Hexafluoroaluminate - synthetic cryolite (HS 282630) at 1.39 kt per year (12% of import),
- Fluoride of aluminium (HS 282612), 5.9 kt per year of fluorine content (52% of share).

The Agreement on the European Economic Area (EEA) is in place between the EU and Norway. China applied a 5% export tax for fluorides of aluminium (HS 282612), but it ended in 2014.

The EU is a net exporter of processed fluorspar with an average export quantity of 24.8 kt of fluorine content per year in the period 2012-2016.

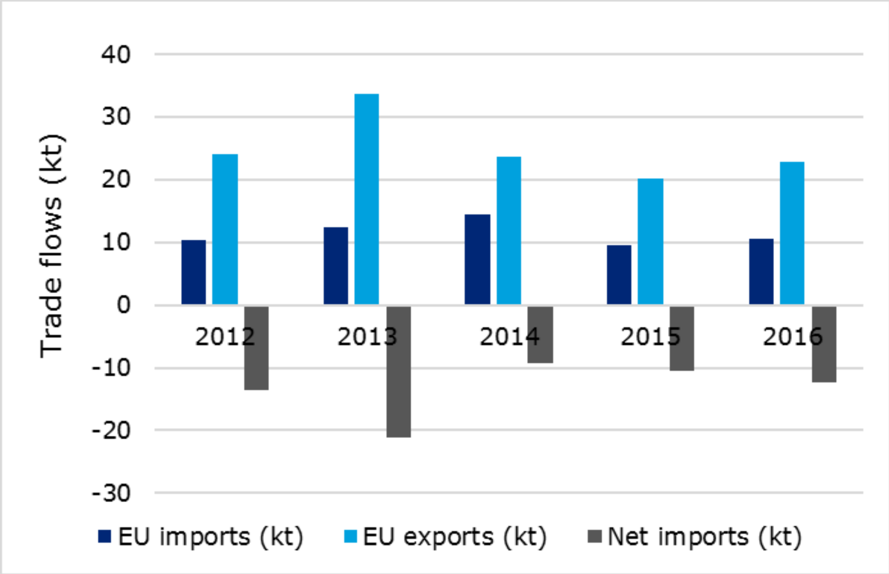

Figure 125: EU trade flows for processed fluorspar (hydrogen fluoride, synthetic cryolite, and fluoride of aluminium, in F content) (Data source: Eurostat, 2019a)

9.2.3 Prices and price volatility

The major part of fluorspar is traded on annual contracts and only small amounts are sold on the open market (BGS, 2011).

Figure 126 shows the price trends of acid grade fluorspar from 2014 to 2018 in South Africa and China. In general, the acid-grade fluorspar price has been declining steadily in both countries. The decline is believed to have been due to oversupply in acid grade fluorspar and increased regulation of fluorinated gases, such as refrigerants, aerosols, and foam-blowing agents, in Europe and North America (USGS, 2016).

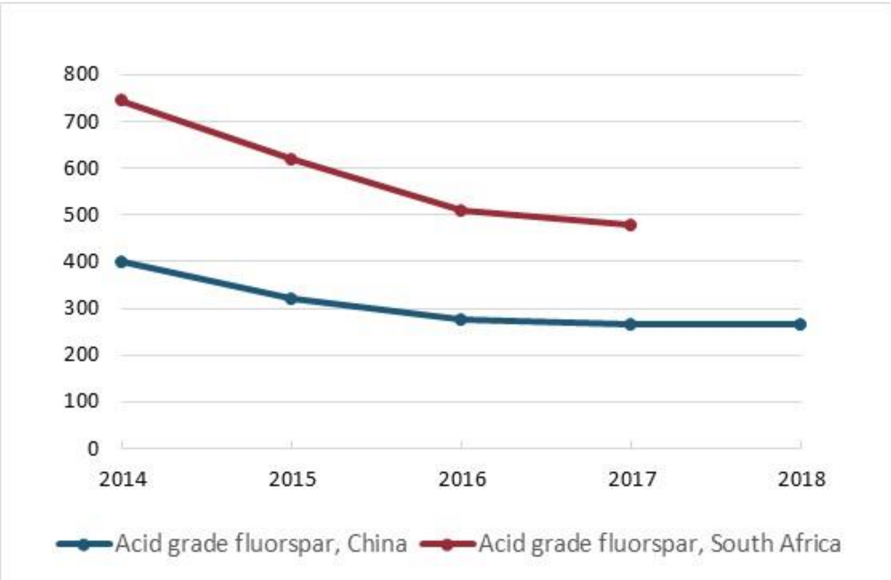

Figure 126: Prices of fluorspar (USD per tonne) from 2014 to 2018 (DERA, 2019)

9.3 EU demand

The major part of the global demand of fluorspar comes from the production of hydrofluoric acid (HF) and aluminum fluoride (AlF_3). The fluorspar market is segmented into four applications: aluminum production, steel production, hydrofluoric acid, and others. Acid grade and metallurgical grade fluorspar together account for a market share over 95% of the global fluorspar market at market stage (Marketwatch Press Release, 2019).

9.3.1 EU demand and consumption

Over the years 2012-2016, the annual average EU apparent consumption of fluorspar at mine stage was 755 kt per year (CaF_2 content), equivalent to 367 kt of fluorine content, mainly sourced from imports. The EU imports of processed fluorspar, summing the fluorine content in hydrofluoric acid, aluminum fluoride AlF_3, and cryolite, were estimated at 11.6 kt (F content).

9.3.2 Uses and end-uses of Fluorspar in the EU

Figure 127 presents the main uses of fluorspar in the EU in the period 2012-2016.

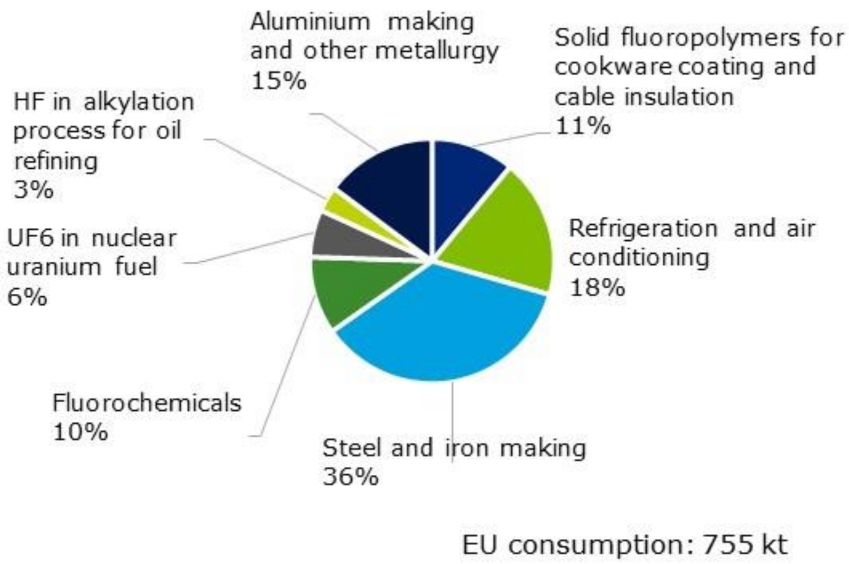

Figure 127: EU end uses of fluorspar (SCRREEN, 2019). Average figures for 2012-2016 (Data source: Eurostat, 2019a).

The EU end-uses of fluorspar products are summarised as follows (Bio Intelligence Service, 2015):

- Solid fluoropolymers for cookware coating, cable insulation and membranes: Solid fluoropolymers is used for cookware coating and cable insulation in household electrical appliances, lighting industry, telecommunications, aeronautics, nuclear, military, fuel-cells
- Refrigeration and air conditioning: fluorochemicals are used for the production of refrigerants for refrigeration (refrigerator) and air conditioning in automobiles or other vehicles (military) and heat-pumps
- Steel and iron making: Metspar in Iron & Steel making (internal process use)
- Fluorochemicals: Used as Inorganic fluorine compounds, as well as in in the form of Fluoroaromatics in pharmaceuticals and agrochemicals industry and Aerosols (dissipative)

- Uranium hexafluoride (UF_6) in nuclear uranium fuel
- Hydrogen Fluoride (HF) in alkylation process for oil refining
- Aluminium making and other metallurgy: fluorspar is used for aluminum processing (internal process use of AlF_3 and cryolite), as well as Aqueous HF for pickling/etching applications (internal process use)

The relevant industry sectors for fluorspar application are described using the NACE sector codes in Table 51.

Table 51: Fluorspar applications, 2-digit and associated 4-digit NACE sectors, and value added per sector (Eurostat, 2019b)

Applications	2-digit NACE sector	4-digit NACE sectors	Value added of NACE 2 sector (M€)
Solid fluoropolymers for cookware coating and cable insulation	C27 - Manufacture of electrical equipment	C2750- Manufacture of electric domestic appliances; C2740- Manufacture of electric lighting equipment	80,745
Refrigeration and air conditioning	C27 - Manufacture of electrical equipment	C2750- Manufacture of electric domestic appliances; C2819- Manufacture of non-domestic cooling and ventilation equipment;	80,745
Refrigeration and air conditioning	C29 - Manufacture of motor vehicles, trailers and semi-trailers	C2920- Manufacture of electrical and electronic equipment for motor vehicles	160,603
Steel and iron making	C24 - Manufacture of basic metals	C2410- Manufacture of basic iron and steel and of ferro-alloys	55,426
Fluorochemicals	C20 - Manufacture of chemicals and chemical products	C2011- Manufacture of other organic basic chemicals; C2021- Manufacture of pesticides and other agrochemical products; C2029- Manufacture of other chemical products n.e.c.	105,514
UF6 in nuclear uranium fuel	C24 - Manufacture of basic metals	C2420- Processing of nuclear fuel	55,426
HF in alkylation process for oil refining	C19 - Manufacture of coke and refined petroleum products	C1920 - Manufacture of refined petroleum products	17,289
Aluminium making and other metallurgy	C24 - Manufacture of basic metals	C2420- Aluminium production; C2029- Manufacture of other chemical products n.e.c.	55,426

9.3.3 Substitution

In the following, three particular cases for substitution of fluorspar are described.

In spite of lower performance, alternative materials for solid fluoropolymers include, (The Chemours Company, 2016):

- Plastics
- Stainless steel
- Ceramics
- Aluminum

There is a major push to substitute fluorine used in many industries (especially in the air condition and refrigerator sector) for a more environmentally friendly option (BGS, 2011). These alternative materials include hydrocarbons such as propane. Due to their low GWP, Hydrofluoroolefins (HFO-1234ze, HFO-1234yf, HFO-1233zd), and mixtures based on HFOs are considered to be the most likely replacement for fluorocarbons (The Chemours Company, 2016).

In the iron and steel making sector substitutes exist, but with a loss of performance:

- Calcium aluminate
- Aluminum smelting dross

9.4 Supply

9.4.1 EU supply chain

The flows of fluorspar through the EU economy are demonstrated in Figure 128. The EU supply chain of fluorspar includes exploration, extraction, processing, manufacturing.

- Exploration: Occurrences in the EU have been detected in several countries in the EU
- Extraction stage: The EU remained very dependent on imports of fluorspar at mine stage, with an import reliance of 66% (average 2012-2016). The EU production of primary fluorspar over the period 2012-2016 was estimated at 254 kt per year (CaF_2 content) acid grade fluorspar (World Mining Data, 2019). There is no production of metallurgical grade fluorspar in the EU. Between 2012 and 2016, the EU production of fluorspar took place mainly in Spain, Germany and Bulgaria (WMD, 2019). There was some production in France and in Italy, but both activities ceased in 2006. Fluorspar mine in Bulgaria was closed in early 2016, taking approximatively 30 kt per year of EU production capacity out of the market. This has an impact on the EU import reliance (CRM Alliance, 2016). At Processing stage, the EU imports and exports several important fluorspar-based products. Between 2012-2016, average EU fluorspar production was estimated at around 84 kt/y (F content, derived from global trade data). Average over 2012-2016 EU import was 12 kt per year while the export is 25 kt per year, suggesting that the EU was a net exporter of processed fluorspar during this period.

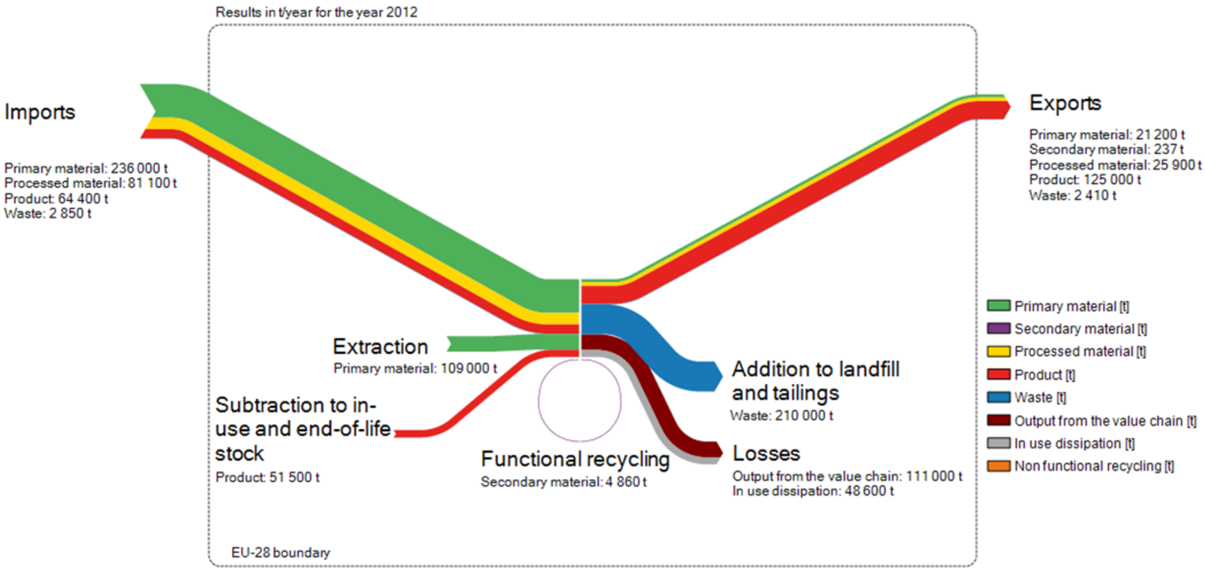

Figure 128: Simplified Material System Analysis diagram of fluorspar, reference year 2012, EU27 and the UK(BioIntelligence, 2015)

9.4.2 Supply from primary materials

9.4.2.1 Geology, resources and reserves of fluorspar

Geological occurrence: Most fluorspar occurs as vein fillings in rocks that have been subjected to hydrothermal activity (BGS, 2011). These veins often contain metallic ores which can include sulfides of tin, silver, lead, zinc, copper and other metals. Fluorite is also found in the fractures and vugs of some limestones and dolomites (BGS, 2011). Fluorite is a common mineral in hydrothermal and carbonate rocks worldwide.

Global resources and reserves[85]: Fluorspar resources are widespread globally and major deposits can be found on every continent. Identified world fluorspar resources were approximately 500 million tonnes of contained fluorspar (USGS, 2016).

World known reserves of fluorspar are estimated at around 310 million tonnes of CaF_2 (USGS, 2019). Mexico has the world's largest fluorspar reserves, followed by China and South Africa.

[85] There is no single source of comprehensive evaluations for resources and reserves that apply the same criteria to deposits of fluorspar 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.[85], 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.

Table 52: Global reserves of fluorspar (USGS, 2019)

Country	Fluorspar Reserves (million tonnes CaF_2)
Argentina	NA
Brazil	1.5
China	42
Germany	NA
Iran	3.4
Kenya	2
Mexico	68
Mongolia	22
Morocco	0.46
South Africa	41
Spain	6
Thailand	3.6
United Kingdom	4
United States	4
Vietnam	5
Other countries	110

EU resources and reserves[86]:

Resource data for some countries in Europe are available at Minerals4EU (2019))[87] but cannot be summed as they are partial and they do not use the same reporting code (Table 53).

Table 53: Resource data for the EU compiled in the European Minerals Yearbook (Minerals4EU, 2019)

Country	Reporting code	Quantity	Unit	Grade	Code Resource Type
Spain	Adapted version of the USGS Circular 831 of 1980	4,794	kt	-	Measured
France	-	9.6	Mt (CaF_2 content)	-	Historic Resource Estimates
UK	-	25	Mt (CaF_2 content)	-	Historic Resource Estimates
Sweden	JORC	25	Mt	10.28%	Indicated
Norway	JORC	4	Mt	24.6%	Inferred
Poland	Nat. rep. code	0.54	Mt	-	C2+D
Ukraine	Russian Classification	18,500	kt	-	P1

[86] For Europe, there is no complete and harmonised dataset that presents total EU resource and reserve estimates for fluorspar. The Minerals4EU project is the only EU-level repository of some mineral resource and reserve data for fluorspar, 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 fluorspar 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.

[87] There has not been any updates on the information in Minerals4EU website since the publication of criticality assessment 2017.

Country	Reporting code	Quantity	Unit	Grade	Code Resource Type
Hungary	Russian Classification	?	Million m^3	2.9t/m^3	-
Serbia	-	0.8	Mt	27.01%	Historic Resource Estimates
Czech Republic	Nat. rep. code	2,033	kt	-	Potentially economic

The USGS reported EU reserves of fluorspar in Germany and Spain (Table 52). Spain has 262 occurrences of fluorspar in Asturias, Andalusia, Catalonia, Madrid, Aragón, Vizcaya, Segovia, Guadalajara, and Galicia, hosting in total 5 million tonnes of reserves (Imformed, 2019).

SCRREEN[88] listed occurrences of fluorspar in the following EU countries:

- France : Numerous occurrences were reported, with an estimate resources at about 7.3 Mt.
- Germany : Several deposits and occurrences are known, with fluorite resouces estimated at 0.92 Mt
- Italy: Approximately 35 Mt of fluorite resources were reported. Italy had fluorspar production until 2006. There is mainly only mineralogical interests for fluorspar in Italy.
- Poland: resources of fluorspar were estimated at 0.54 Mt
- Spain: resources estimated at 3.8 Mt. Spain has several tens of known fluorite deposits in several areas, the most important one Asturias in northern Spain.
- Sweden: the total estimated resource includes 25.0 Mt of Indicated resources and 2.7 Mt of Inferred resources. There are other three small historic closed mines with no resource estimates available.
- Occurrences were also reported for Austria, Czechia, Hungary, and Ireland, with no quantitative resource information. However, the resources in these countries are known to be uneconomic.

9.4.2.2 World and EU mine production

After extraction, fluorspar ore is directly transformed into fluorspar acid grade (AG, 97% of CaF_2 contained) and metallurgical grade (MG, 84% of CaF_2 contained). The world annual production of fluorspar ores in average between 2012 and 2016 is around 6,400 ktonnes of CaF_2 content, extracted mainly in China and Mexico (see Figure 129).

[88] Lauri, L. et al. (2018) Identification and quantification of primary CRM resources in Europe. SCRREEN project D3.1. Available at: http://scrreen.eu/results/.

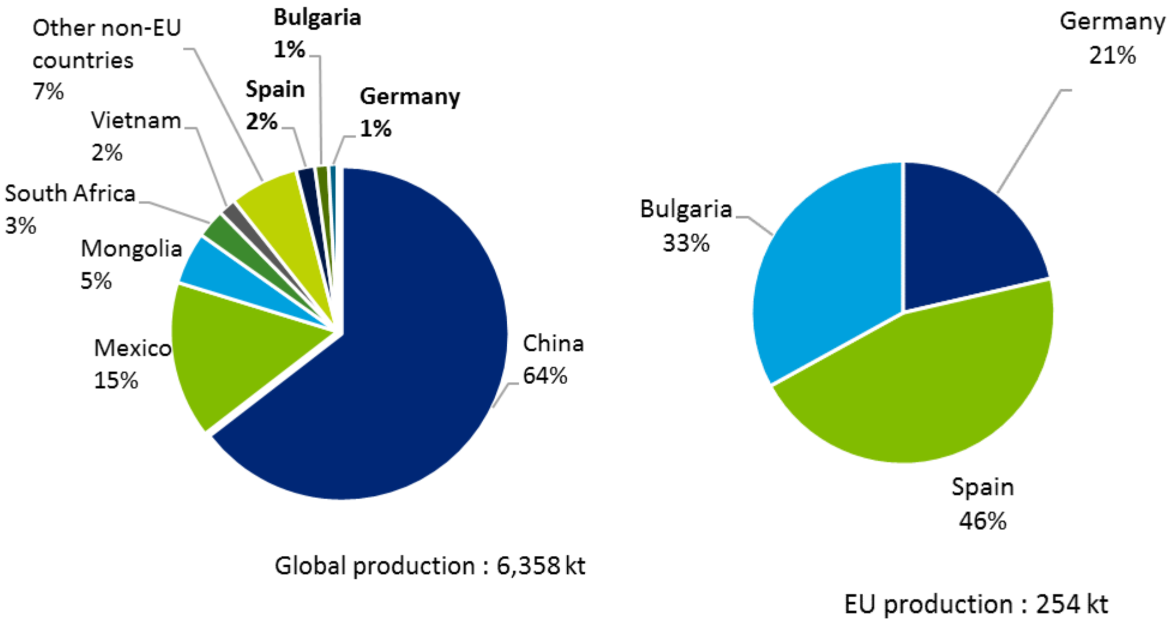

Figure 129: Global and EU mine production of Fluorspar in tonnes and percentage. Average for the years 2012-2016. (WMD, 2019)

9.4.3 Supply from secondary materials/recycling

Fluorspar is recycled only to a minor extent since its uses are dissipative, or recycling is not practicable (Sundqvist Oeqvist, Pr. Lena et al. ,2018).

9.4.3.1 Post-consumer recycling (old scrap)

Fluorspar is generally not recovered from manufactured products such as flint glass, enamels, and fibreglass insulation, since it is highly dispersed in those applications. Limited recycling of fluorspar from end of life products is theoretically feasible. However, there is no information of any recycling operations ongoing in the EU and worldwide (Sundqvist Oeqvist, Pr. Lena et al. ,2018).

Fluorspar is practically not recyclable, therefore fluorspar contained in the waste mainly ends up in landfills (European Commission, 2014). According to the MSA study of fluorspar, the end of life recycling input rate is 1%. (Bio Intelligence Service, 2015).

Table 54 show the quantity of flows relevant to the end-of-life recycling input rate of fluorspar in the EU. The data refers to 2012.

Table 54: Material flows relevant to the EOL-RIR of Fluorspar[89]

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

9.4.3.2 Industrial recycling (new scrap)

Although fluorspar itself is not recyclable, a few thousand tons of synthetic fluorspar are recovered each year during the uranium enrichment (as well as stainless steel pickling and petroleum alkylation). In the case of aluminum producers, hydrofluoric acid (HF) and fluorides are recovered during the smelting operations (USGS, 2015). In the air-conditioning and refrigeration sector, close to 60-70% of the fluorochemicals are recycled (The Chemours Company, 2016).

9.4.4 Processing of fluorspar

The acid grade (AG) and metallurgical grade (MG) fluorspar are processed into hydrofluoric acid (HF), cryolite (Na_3AlF_6) and aluminum fluoride (AlF_3).

Fluorspar MG is also used in iron and steel making, but is not incorporated into the iron and steel products. The processed material HF is converted into semi-finished products such as fluorocarbons, fluoropolymers, fluoroaromatics and uranium hexafluoride (UF_6, used in nuclear energy production), or it is directly converted into finished products such as inorganic fluorine compounds. HF is also used for etching and pickling of metals and for alkylation process in oil refining, however, fluorine is not transferred in the final products for these applications. In the same way, cryolite and aluminum fluoride are used for aluminum processing, but are not incorporated in aluminum alloys. Fluorocarbons, fluoropolymers and fluoroaromatics are used in finished products in various applications such as cable insulation, fire protection, refrigerants, pharmaceuticals, etc.

There is no official data on the global supply of processed fluorspar, or on its components: of global hydrofluoric acid (HF), cryolite (Na_3AlF_6) and aluminum fluoride (AlF_3). Based on the export quantity of processed fluorspar reported by UNComtrade (2019), the average annual processed fluorspar in the period 2012-2016 was 839 kt per year of fluorine content. As shown in Figure 130, the production of processed fluorspar is concentrated mainly in China (34%) and Mexico (16%).

[89] 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)

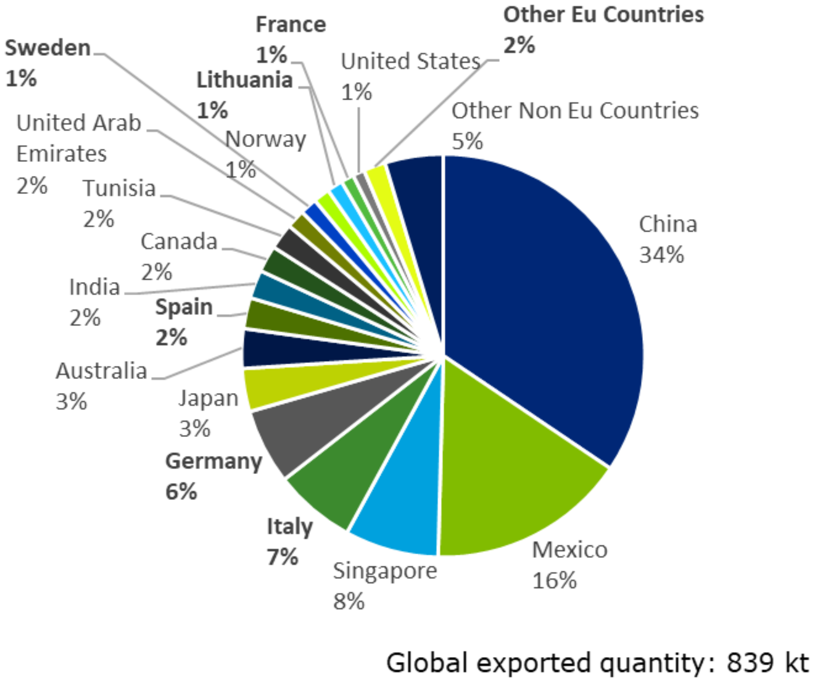

Figure 130: Global and EU production of fluorspar products, in fluorine content. Average for the period 2012-2016 (Comtrade, 2019)

9.5 Other considerations

9.5.1 Environmental and health and safety issues

In the coming years, the demand for fluorspar will highly depend on the development and use of fluorocarbon substitutes; considering the phase-out of the use of fluorocarbon in refrigeration, especially for HFCs with high greenhouse warming potential (GWP) (F Gas Regulation EU 517/ 2014; The Kigali Amendment to the Montreal Protocol). Hydrofluoroolefins (HFOs) (HFO-1234ze, HFO-1234yf, HFO-1233zd) and mixtures based on HFOs are considered to be the most likely replacement due to their low GWP (The Chemours Company, 2016). Due to the high amount of fluorine used in the manufacturing process, the fluorspar industry will be able to take advantage of such new developments (USGS, 2016).

9.6 Comparison with previous EU assessments

The assessment has been conducted using the same methodology as for the 2017 list. The results of the criticality assessment 2020 and earlier assessments are shown in Table 55.

Supply risk for fluorspar has been analysed at both extraction and processing stage. No data on the global supply of processed fluorspar was available, therefore the supply risk at processing stage was calculated using EU supply risk. The lower supply risk of processed fluorspar is caused by a lower concentration of source countries. The value reported in Table 55 refers to the supply risk at mine stage.

The economic importance increased in comparison to the 2017 assessment. This is a consequence of the sector-specific economic development in the EU since 2017, reflected in altered value added in the sectors, for which fluorspar was important.

Table 55: Economic importance and supply risk results for fluorspar in the assessments of 2011, 2014, 2017, 2020 (European Commission, 2011-2014-2017)

Assessment	2011			2014			2017			2020	
Indicator	EI	SR		EI	SR		EI	SR		EI	SR
Fluorspar	7.5	1.63		7.18	1.72		4.2	1.3		3.34	1.27

9.7 Data sources

Data for the production of processed fluorspar in HF, cyrolite, and aluminium fluoride are not available at global level. Therefore, the calculation of the supply risk indicator at processing stage was done using the EU-28 HHI only.

9.7.1 Data sources used in the factsheet

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