Critical Raw Materials – What´s the Crux of the Matter?

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Abstract

The paper takes into account mineral commodities that have been listed as critical by the EU Commission. It concentrates attention on the issue of global demand/supply balances, and summarizes causes for critical listing of these commodities.

Keywords: critical raw materials, tungsten, fluorspar, niobium, graphite

Introduction

It is a specific feature of some mineral commodities that they cannot be recuperated or their occurrence changed. As such, mineral resource utilization for smooth operation of national economies asks for some interference with free market mechanism. It is about setting of rules, extent and form of raw material exploitation to ensure considerate consumption of national resources. Significance of some mineral resources, regard to individual rights and collective interests, as well principles of sustainable growth must all be taken into account.

Securing access to a stable supply of many raw materials has become a major challenge for national and regional economies with limited production, such as the European Union economy, which relies on imports of many minerals and metals. To address the growing concern of securing valuable raw materials for the EU economy, the European Commission launched the Raw Materials Initiative in 2008. It is an integrated strategy that established targeted measures to secure and improve access to raw materials for the EU. One of the priority actions of the Initiative was to establish a list of critical non-energy raw materials at EU level. The first list was established in 2011 and it is updated every three years. List of 2017 Critical Raw Materials is following: antimony, barite, beryllium, bismuth, borate, cobalt, fluorspar, gallium, germanium, hafnium, helium, "heavy" rare earth elements, indium, "light" rare earth elements, magnesium, natural graphite, natural rubber, niobium, platinum-group metals, phosphate rock, phosphorus, scandium, silicon metal, tantalum, tungsten, vanadium (European Commission, June 2017.)

The main parameters used to determine criticality for raw materials in the EU were:

1. Economic importance: it was assessed in terms of end-use applications and the value added of corresponding EU manufacturing sectors. The economic importance is corrected by the substitutes for individual applications.
2. Supply risk: reflect the risk of disruption in the EU supply of the material. The estimation of the supply risk is based on:
   - Stability/instability of producing countries and level of concentration of producing countries.
   - Extent to which a raw material may be substituted (easily and completely, substitutable at low cost, substitutable at high cost and/or loss of performance, not substitutable).
   - Extent to which raw material needs are affected by recycling from new or old scrap. New scrap is resulting from the processing of raw materials from primary sources, old scrap refers to raw materials which have been recycled at the end of the product life.
   - The supply risk is increased if the producing countries are unstable and provide a high share in the world production, the substitutability is low, and recycled rate is low as well (European Commission, 30. July 2010).

There are different reasons for listing of raw material commodities as critical. Their listing reflects the commodity current situation regarding their stocks, supply and demand balance, sudden market imbalances, price trends, etc. We are about to concentrate on the situation of tungsten, niobium, natural graphite, and fluorite.

Materials and methods

Tungsten

Tungsten is certainly a strategic metal as it has significant use in military and many other industrial applications. Tungsten demand is influenced by the vicissitudes of world economy and occurrence of war events – World War I and II, Korean and Vietnam conflicts, world economic crisis of the 1930s and financial crisis connected with 2008.

Major tungsten deposits are located in China. In 2010, about 85% of the world´s tungsten production came from

China which is the world´s largest tungsten consumer, with approximately half of total world consumption. Europe´s import dependence for tungsten is estimated at 74% (European Commission, 2017-09-11).

Supply and demand fluctuations are subject of the current economic conditions, occurrences of war or political interventions. These influences are directly mirrored by changing quotas of production, import, or consumption. To ensure the domestic supply, the Chinese government limited foreign investment in prospecting and extraction of tungsten ores, restricted issuing of new mining licenses in 2007, and reduced export of raw materials of low added value in 2013.

Tungsten substitution possibilities are circumscribed by cost of alternative materials/technologies, lesser performance, and less environmental friendly alternatives.

Tungsten scrap has high tungsten content; therefore recycling is important in meeting the total tungsten demand. It is estimated that secondary tungsten (scrap) can cover about 34% of total tungsten demand (European Commission, 2017-09-11). Overall, the market for tungsten is expected to remain roughly in balance.

Niobium

Niobium is mainly used in the manufacture of steel for construction and high temperature applications. Worldwide, niobium is very widespread, but rarely accumulated in high concentrations. Almost all world reserves are located in Brazil and over 5% of global reserves are in Canada. It is supposed that niobium resources are more than adequate to supply future needs.

Niobium production is concentrated in Brazil (92%), niobium is also mined in Canada (7%) and Nigeria (1%). There is no production in the EU (European Commission, 2017-09-11). The EU´s share of consumption is approximately 24% of the world total consumption, other major niobium consuming regions include China (25%), Americas (21%), Japan (10%), and other Asian countries (11%). Rises in mining capacity or the opening of new deposits mean that total niobium production will keep pace with – and slightly exceed – consumption forecasts.

Substitution of niobium is possible, but it may involve higher costs and/or a loss in performance.

Reduction of niobium consumption can be achieved by the recycling of niobium-containing steels and super-alloys. The estimated share of recycling on the total consumption is 20%. Since there is no primary niobium production in Europe, scrap is the only available intra-European raw material source. Ores and concentrates, oxides, and niobium metal per se have to be imported.

Natural graphite

Nowadays, the most of graphite use refers to refractory applications. Other key industrial applications include lubricants, steel-making, metal casting, brake lining. An important emerging use for graphite is for lithium-ion batteries used in hybrid and electric vehicles.

The greatest reserves of natural graphite are in China that is followed by India. China is the world´s dominant producer accounting for 68% of the world supply in 2012. Nevertheless, China produces low quality graphite that is unsuitable for high-tech applications. To provide for their own needs, China has set export limits on natural graphite in place. China applies a 20% export tax on natural graphite. Concerning relationship of demand and supply, a balance trend has been noted. Nonetheless, long-term developmental trends will be subject of green technology standards and economic or restrictive policies of the Chinese government.

The most common substitutes for graphite are other forms of carbon (coke, anthracite). Synthetic graphite can be used as a substitute for natural graphite in some applications.

At present, recycling of graphite from old scrap is very limited. A lack of economic incentive combined with technical challenges has stalled the market for recycled graphite.

Fluorspar

More than a half of worldwide fluorspar consumption is used to produce hydrofluoric acid, the bulk of remaining fluorspar consumption is used as flux in aluminium, steel and ceramics production processes.

Taking a look at the current consumption, world reserves can meet demand for more than 40 years. Phosphate is another source of fluorine. The greatest fluorspar reserves are in South Africa, Mexico and China. China is the world´s largest consumer of fluorspar, with nearly half of consumption worldwide. China implemented an export tax (15% in 2007) and export quotas in 2010 (European Commission, 2017-09-11).

Substitution possibilities seem to be limited, fluorosilicic acid is the only substitute which could have a significant impact on global fluorspar extraction.

Recycling of the raw material mineral is impossible.

Discussion

Regarding the commodities analysed, they can be characterized as follows:

- Application significance: industry (niobium, graphite, fluorite) inclusive defence industries (tungsten) or green technologies (graphite),
- Reserves: satisfactory but nearly exclusively localized in China (tungsten, graphite) or Brazil (niobium),
- Single country prevailing production: China (tungsten, 85%; graphite, 65%; fluorite, 58%), Brazil (niobium, 92%),
- Commercial and economic restrictions: China (tungsten, graphite, fluorite),
- Substitution limitation (fluorspar) or production cost increase (niobium),
- Recycling impracticable (fluorspar) or restrained (graphite).

Conclusion

It can be assumed that listing of individual mineral commodities as critical was primarily affected by their application significance in the EU countries, stockpile availability, production/consumption of individual countries, limited or impracticable recycling, and last but not least commercial/economic restrictions. A similar situation can be anticipated as regards criticality of other raw materials.

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Lista pierwiastków krytycznych – jakie są kryteria zaliczenia pierwiastków?

W artykule przedstawiono surowce mineralne wymienione przez Komisję Europejską jako krytyczne. Koncentruje uwagę na globalnym popycie i podsumowuje przyczyny zestawienia listy pierwiatków krytyznych.

Słowa kluczowe: surowce krytyczne, wolfram, fluoryt, niob, grafit