UDK [658.7+339.5+669.75](510)
DOI: 10.5937/RKSPP2402107M

VELJKO M. MIJUŠKOVIĆ
ANA TODOROVIĆ SPASENIĆ

CHINA'S LOGISTICS AND TRADE BARRIERS AS A DETERMINANT OF CURRENT DISRUPTIONS IN GLOBAL ANTIMONY SUPPLY CHAINS

China, the leader in global antimony supply, dictates the market conditions for the sale/ purchase of this raw material on all continents. The current trade and logistics barriers that the most populous country in the world has introduced in this area have led to a deficit of this raw material affecting the supply chain management of the defense and battery manufacturing industries. The price of antimony has reached a record historical level, which makes it difficult to establish efficient and effective supply chain management in these industrial sectors from the aspect of cost efficiency. Considering that the defense industry is the driving force behind the growth and development of the world economy, it can be concluded that the long-term consequences of the long duration of the barriers will be incalculable for the GDP of many countries.

Key words: *China, trade and logistics barriers, antimony supply chain management, supply chain management of the defense industry, supply chain management of the battery manufacturing industry*

INTRODUCTION

For years, China has maintained the status of the world's largest producer of antimony with approximately 48% of global supplies.[1] It is one of the key inputs for

Dr Veljko M. Mijušković, Assistant Professor, Faculty of Economics and Business, University of Belgrade, e-mail: *veljko.mijuskovic@ekof.bg.ac.rs*.

MSc Ana Todorović Spasenić, Head of Procurement Department at the Prvi partizan j.c. Užice company, e-mail: *ana.todorovic@prvipartizan.com*.

[1] See Antimony under scrutiny: China's export restrictions and global supply chain implications, *https://corporateconnect.com.au/antimony-under-scrutiny-chinas-export-restrictions-and-global-supply-chain-implications/*, 15. 10. 2024.

producing batteries, accumulators, and lead cores for ammunition. There is a strong correlation between the success of the supply chain management of the antimony production industry – the success of the supply chain management of the battery and accumulator industry – and the defense industry supply chain management (primarily the ammunition production segment). The mentioned interdependence is based on the fact that the lead-antimony alloy has the status of an input for the defense industry, and it is achieved by 1) the production of lead-antimony alloy ingots and 2) the recycling of batteries and accumulators of which this alloy, which is poured, is an integral part. Through trade measures, China dictates the current relationship between supply and demand, as well as price conditions, in the domain of antimony on a global level,[2] which directly affects the global supply chain of the dedicated industry, the driving force behind the economic growth and development of many countries in the world. The first part of the paper deals with the global antimony production industry, with special reference to the position of China's leader. The second part of the paper deals with the impact of China's current trade and logistics barriers on the global supply chain of the lead-antimony alloy production industry, which is reflected in the supply chain management of both the battery and accumulator industry and the ammunition production industry (defense industry segment). The last, third, part analyzes future trends in the global antimony market and its effects on the supply chain management of dependent industries.

GLOBAL ANTIMONY INDUSTRY – LEADING POSITION OF CHINA

Antimony (Sb) is a pure element widely used in various industry segments: production of batteries and accumulators, production of medicines, production of ammunition, production of plumbing materials, etc. In recent years, it has become a critical element due to the increase in global demand and China's dominance in primary production.[3] Considering the global growth and development of the battery and accumulator manufacturing industry and the ammunition manufacturing industry (as a segment of the defense industry), antimony is one of the most important secondary raw materials in the global framework.[4] Antimony is used in

[2] Elmira Moosavi-khoonsari, Sina Mostaghel, Andreas Siegmund, Jean-Pierre Cloutier, "A Review on Pyrometallurgical Extraction of Antimony from Primary Resources: Current Practices and Evolving Processes", *Processes*, Nr. 10, 2022, 1590.

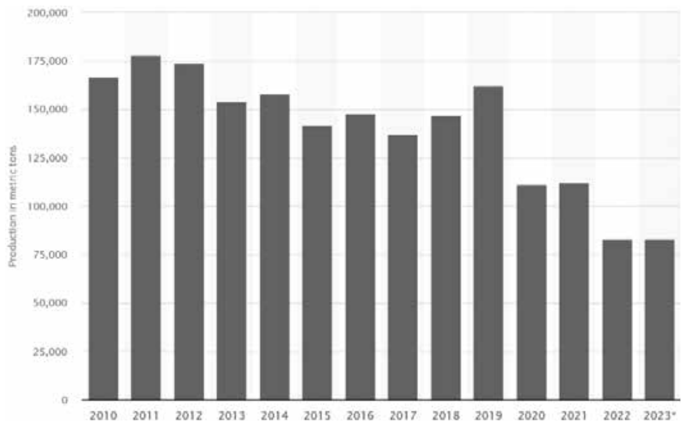
[3] Dupont David, Arnout Sander, Jones Peter Tom, Koen Binnemans, "Antimony Recovery from End-of-Life Products and Industrial Process Residues: A Critical Review", *Journal of Sustainable Metallurgy*, No. 2, 2016, 79–103.

[4] Corby G. Anderson, *Antimony production and commodities: SME mineral processing & extractive metallurgy handbook*, Society for mining, metallurgy, and exploration, Engelwood, 2019.

these industrial sectors for the production of lead-antimony alloy, which is one of the strategic inputs: 1) in the production of batteries for electronic cars,[5] 2) for the production of lead-antimony plates as part of accumulators,[6] and 3) for the production of bullet grain as a component of ammunition.[7]

The global production of antimony in 2023 was about 83.000 tons, from years 2011–2023. identified an oscillating trend with a decline in the interval 2019 to 2023. (picture 1). The positive side is that antimony has a great possibility of recycling (especially from batteries and accumulators), which somewhat offsets the decrease in the volume of production at the global level in the last ten years.[8] The main reason for the reduction of antimony placement on the global market is the goal of China, the global leader, to limit strategic supplies and protect its industry by generating a competitive advantage (especially industries that are highly dependent on antimony as an input such as the electronic car manufacturing sector and ammunition manufacturing).[9]

Figure 1. Mine production of antimony worldwide during the period 2010–2023.



Source: Global antimony production, Statista, *https://www.statista.com/statistics/1241586/global-antimony-production/*, 16. 10. 2024.

[5] Marta Iglesias-Émbil *et al.*, "Raw material use in a battery electric car–a thermodynamic rarity assessment", *Resources, Conservation and Recyling*, Vol. 158, 2020, 104820.

[6] David Dupont *et al.*, op. cit., 79–103.

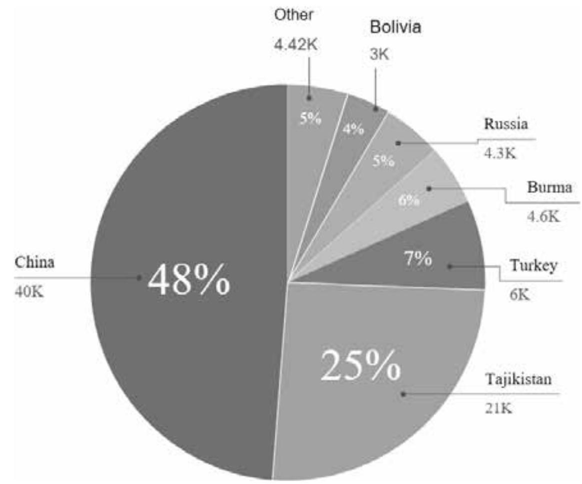
[7] Espen Mariussen, Ida Vaa Johnsen, Arnljot Einride Strømseng, "Distribution and mobility of lead (Pb), copper (Cu), zinc (Zn), and antimony (Sb) from ammunition residues on shooting ranges for small arms located on mires", *Environmental Science and Pollution Research*, Nr. 24, 2017, 10182–10196.

[8] Susan van den Brink, René Kleijn, Benjamin Sprecher, Nabeel Mancheri, Arnold Tukker, "Resilience in the antimony supply chain", *Resources, Conservation and Recycling*, Vol. 186, 2022.

[9] Oxford Analytica, "Chinese supply squeeze to keep antimony prices high", *Emerald Expert Briefings*, oxan-db, 2024.

China has been the absolute leader in the global antimony market for decades (Figure 2). Trade policy in this domain, dictates the global relationship between supply and demand, which is directly reflected in the commercial terms of purchase/sale. Europe and the USA are the largest importers of antimony from China, which implies that there is a great influence of China's trade policy in this domain on the supply chain management of European and American industries that use Chinese antimony as an input. The European Union annually imports about 22,200 tons, of which about 17,650 tons are of Chinese origin (40% of the total EU sources of antimony). The USA bases 63% of its antimony imports on sources from China.[10]

Figure 2 China as a global leader in antimony production – 2023.



Source: Supply chain impacts China export restrictions, *https://www.exiger.com/perspectives/supply-chain-impacts-china-antimony-export-restrictions/*, 18. 10. 2024.

China's effort to maximally dictate trends in the global antimony market can also be derived from the fact that, according to the results of the World Bank's research for 2021, China is also the largest global importer of this input.[11] The most populous country in the world imported 26,153 tons of antimony worth 82,498,960 USD that year. The large volume of production and large imports are the result of the dynamic growth and development of both the battery and accumulator production industry in this country, as well as the production of ammunition as a segment

[10] See Reuters, *https://www.reuters.com/markets/commodities/*, 17. 10. 2024.

[11] See World Bank, *https://wits.worldbank.org/trade/comtrade/en/country/ALL/year/2021/261710*, 17. 10. 2024.

of the defense industry (especially medium caliber ammunition). When it comes to the ammunition production industry, it is important to emphasize the fact that China is the second largest arms producer in the world (after the USA),[12] which directly reflects the importance of stimulating the production of ammunition, and therefore antimony as an input for the production of ammunition components.

China has the status of the world's leading producer of lead alloy, and therefore of lead-antimony alloy, the final input for the production of lead wire, which is widely used in the electrical and defense industry. Trends in the lead-antimony (PbSb) segment of the Chinese economy are related to current trends in the field of antimony production and marketing, and this interdependence is directly reflected in the global supply chains of the battery, accumulator, and ammunition manufacturing industries (through the export of antimony and lead-antimony alloy as input to the industries of other countries). In the continuation of the work, the focus is on the interdependence of the supply chain management of the previously listed industrial sectors, with an analysis of the impact of China's current trade and logistics barriers on the said interdependence.

ANTIMONY SUPPLY CHAIN MANAGEMENT AS A DETERMINANT OF SUPPLY CHAIN MANAGEMENT SUCCESS OF THE BATTERY AND AMMUNITION PRODUCTION INDUSTRY IN A GLOBAL SCOPE – CHINA'S LEADERSHIP ROLE

Authors den Brink *et al*. have investigated global antimony supply chains and found that, despite the drop in sales recorded since 2018, more serious disruptions have been halted thanks to the fact that 25% of global antimony supplies are produced through recycling.[13] They emphasize that recycling is the key so that the reduction of antimony stocks does not have a drastic effect on the management of the supply chain of dependent industries, especially the defense industry because an adequate alternative for this element has not yet been found for the production of flame retardants. Quijue and co-authors came to a similar conclusion, noting that it is important to work on the ecological production and recycling of antimony, which will have a positive effect on the ecology and health of the workers who carry out the antimony smelting operation in dependent industries,[14] like pouring antimony

[12] See China is new second largest weapons producer in world arms, The Epoch Times, *https://www.theepochtimes.com/china/china-now-second-largest-weapons-producer-in-world-arms*, 17. 10. 2024.

[13] S. van den Brink *et al*., op. cit.

[14] Wu Qiujie, Lv Zhenfu, Cao Jincheng, "Distribution and Supply of Antimony Resources in China and Abroad and Development Status of Antimony Industry Chain", *Multipurpose Utilization of Mineral Resources*, No. 5, Vol. 43, 2022, 77–82.

and lead to produce lead wire which is an input for ammunition grain. The authors emphasize that China dictates the rules of the game on the global antimony market and that without its involvement it is impossible to implement ecological production and recycling. This is confirmed by Wang and co-authors analyzing in detail China's intensive work on improving mining technology, improved production and supply of strategic minerals, including antimony.[15] Li, Xu, and Zhu dealt with antimony supply risk assessment and pointed out that China, USA, and Germany play a key role in regulating supply chains on a global level. They state that China is the regulator of the game as the largest producer, exporter, and importer, and the USA and Germany as major importers and political powers.[16]

On August 14, 2024, China took trade and logistics measures to limit global antimony shipments in the name of national security.[17] The Chinese government points out that taking these measures is aimed at protecting the national industry due to the continuous decline in the volume of antimony production in the period 2023–2024. Trade analysts point out that this is one of the reasons, but that this decision was also contributed to by the high customs rates introduced by the EU and the USA for electric cars originating in China (customs rate approximately 38% of the EU and 100% of the USA).[18] The global antimony market was tight even before the introduction of antimony export restrictions due to limited sources of supply outside of China (Figure 2). This concentration of an important production input leads to the fact that any reduction in Chinese exports opens the door to price instability (price jump after China's restrictions shown in Figure 3), disruption in global supply chains, and endangering the timeliness of procurement and production of all industrial sectors that use antimony as an input. Russia (5%), Turkey (7%), and Tajikistan (24%) produce antimony (Figure 2), but without the production and placement of China, they cover a negligible part of the global demand for this input. All of the above indicates a major challenge faced by the management of the supply chain of companies that use antimony as an input in the production process, both from the aspect of timeliness of production and delivery of the final product and from the aspect of generating cost efficiency of the procurement and production process.

---

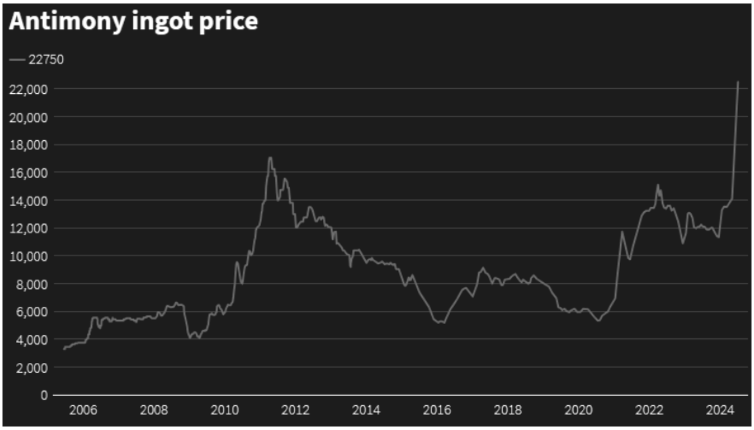
15 Wang Yunming *et al.*, "Guidance and review: Advancing mining technology for enhanced production and supply of strategic minerals in China", *Green and Smart Mining Engineering*, 2024.

16 Li Junhui, Deyi Xu, Yongguang Zhu, "Global antimony supply risk assessment through the industry chain", *Frontiers in Energy Research*, Vol. 10, 2022, 1007260.

17 See What is antimony and why is China curbing its exports, Reuters, *https://www.reuters.com/markets/commodities/what-is-antimony-why-is-china-curbing-its-exports-2024-08-16/*, 17. 10. 2024.

18 See "CN-EU-US tarrifs on electric cars", *AEB magazine*, *https://www.aeb.com/en/magazine/articles/CN-EU-US-tarrifs-on-electric-cars*, 17. 10. 2024.

Figure 3 Antimony ingots price during the period 2006–2024.



Source: Reuters, Antimony prices gear up for new records on China export curbs, *https://www.reuters.com/markets/commodities/antimony-prices-gear-up-new-records-china-export-curbs-2024-08-15/*, 18. 10. 2024.

China's trade and logistics barriers in the domain of antimony affected battery and accumulator companies less than ammunition companies because this segment of the industry is largely involved in the recycling of old batteries and accumulators, which facilitates the path to new inputs. What is problematic for supply chain management in this segment of the economy is the fact that the recycling process is long and relying exclusively on this source of supply makes it impossible to generate the timeliness of production as a determinant of the success of supply chain management, while at the same time generating the goal of cost efficiency (observing the current price of antimony on the global level). Therefore, this segment of production can't survive only based on recycling, but it nevertheless significantly facilitates the procurement of inputs at cost-acceptable conditions (compared to the price of Sb ingots on the market – Figure 3). Many companies from this segment of the economy, both in Europe and the USA, took advantage of the possibility of recycling antimony and combining it with lead alloy to offer PbSb alloys as input to companies from the defense industry domain, which would generate additional earnings. Many companies have directed the money earned in this way towards the investment of improving recycling to, in addition to securing their production, also earn additional money from the placement of the PbSb alloy defense industry. The business practices of these companies confirmed the conclusions made by Quijue and co-authors that recycling is the key to combating the challenge of unequal distribution of antimony resources globally under the baton of China's trade policy.

The supply chain management of ammunition companies has faced a greater challenge than the industrial sector of battery and accumulator production. In the defense industry, more precisely the production of ammunition as a segment of this industry, there is no possibility of recycling the PbSb alloy that is used as an input for the production of ammunition grains. Before the introduction of China's restrictions, the companies involved in the production of ammunition based their grain production on the procurement of lead ingots and antimony ingots, and then in their lead mills, they made a PbSb alloy where the % of antimony varied depending on the type of ammunition caliber whose grain was produced. Procurement of this category of strategic material is approached in a planned manner, and procurement managers in these companies faced a major challenge in August of this year after being informed by suppliers that delivery plans for September and October would not be met due to China's restrictions and a shortage of antimony in ports around the world (parallel the effect of trade and logistics barriers). To overcome the problem and ensure the timely procurement of quality raw materials with the aim of not jeopardizing the efficiency and effectiveness of the supply chain management in this industrial sector, a direct procurement plan for PbSb alloy was created based on a precise analysis of production and shipping plans by caliber. Success in this domain is generated for procurement plans until the end of the year thanks to 1) recycling of batteries and accumulators carried out by companies from this domain, after which they form a PbSb alloy (% antimony varies according to customer requirements) and 2) antimony reserves at individual retailers and 3) to the gradual penetration of antimony originating from India, Bolivia, and Tajikistan. However, options 1 and 2 are more affordable compared to option 3 because the prices of antimony originating from other parts of the world are also determined by China's trade moves as the leader in the global market. Analysts point out that recycling significantly eased the impact on the management of the supply chain of the dedicated industry, but that the long-term consequences, if China's measures last longer than half a year, will be unfathomable, especially in generating cost efficiency from the goal of supply chain management. An example is the USA ammunition production industry (the leader at the global level), which overcomes this problem thanks to the recycling of lead-acid batteries and the import of antimony from India and Bolivia, with stocks of about 1.100 tons from an earlier period.[19] The US government is aware of the long-term effects of China's trade and logistics restrictions on the production of both military and commercial ammunition, which is why it is actively working on:[20]

---

[19] See China's Antimony Export Restrictions: The Impact on U.S. National Security, *https://www.csis.org/analysis/chinas-antimony-export-restrictions-impact-us-national-security*, 19. 10. 2024.

[20] The same as 22.

1) research and investments in the improvement of recycling technologies

2) finding: a) alternative sources of antimony (intensive negotiations with Tajikistan are underway to develop a long-term partnership in this domain) and b) alternative elements that would replace antimony in grains of certain calibers.

3) investments in antimony refinery projects on other continents - current investment in the Australian project – The Hillgrove site in Australia is the 10th-largest antimony project in the world.

The ammunition production industry in Europe is facing identical consequences, with the USA as the leader in the field of this production having stronger negotiating power in the development of potential partnerships that would somewhat overcome the problem of disruption in the supply chain. At the same time, the USA has greater opportunities for recycling lead acid batteries due to the greater volume of production of the same throughout North America (in Europe, a small percentage of production is located in Spain, France, Germany, and Italy).[21] All of the above will affect the creation of a new competitive advantage of the USA ammunition production industry against the same sector of the economy in Europe.

The consulting agency Expire has analyzed in detail China's current trade and logistics barriers in the domain of antimony and their consequences for the supply chain management of various industrial sectors. He points out that all companies that have faced a supply chain disruption should thoroughly assess their vulnerability and work intensively on creating resilience. At the same time, the importance of establishing efficient and effective risk management for establishing efficient and effective supply chain management is emphasized. Experts from this consulting firm highlighted key steps to mitigate risks and manage challenges exemplified by China's antimony export controls:[22]

1) *Understand concentration risk* – Companies should assess how much they rely on China in the domain of all antimony-like raw materials, with a clear mapping of the supply chain process. The goal, in addition to minimizing the risks caused by antimony restrictions, is to prepare for new potential risks in the domain of the supply chain of other inputs of Chinese origin.

2) *Mitigate the risk of counterfeiting* – Minimize the risk of entering PbSb alloy of poor quality while establishing and maintaining cooperation with proven and reliable suppliers. Only by building correct partnership relations will suppliers continuously work to ensure the supply of PbSb alloy of proven quality and safety.

[21] See Lead Acid Baterry – Market Size and Scope, *https://www.marketresearchintellect.com/product/global-lead-acid-battery-energy-storage-system-bess-market/*, 19. 10. 2024.

[22] See Expect Supply Chain Impacts from China's Antimony Export Restrictions, *https://www.exiger.com/perspectives/supply-chain-impacts-china-antimony-export-restrictions*, 18. 10. 2024.

3) *Rank affected products by criticality* – Company managers must rank inputs based on antimony in terms of importance for generating the key goal of supply chain management – timely delivery of quality products under favorable commercial conditions to satisfied customers. At the same time, state governments should focus on ensuring the uninterrupted supply of industrial sectors that are important for economic growth and development and national security (focus on the defense industry).

4) *Illuminate the entire value chain* – Managers must analyze all potential chances and opportunities in the domain of the supply chain (beyond the current sources of supply). By parallel application of risk management and SWOT analysis, it is possible to crystallize how to maximize opportunities/internal strengths and minimize risks/internal weaknesses while generating the goal of 1) finding alternative suppliers of antimony, 2) geographical diversification, and 3) finding alternative materials that will be used as inputs in the production process replace antimony.

5) *Engage in strategic sourcing* as a proactive approach to identify and secure alternative sources of supply, stockpile critical materials, and investigate material replacement.

FUTURE TRENDS IN THE GLOBAL ANTIMONY MARKET AND ITS EFFECTS ON THE SUPPLY CHAIN MANAGEMENT OF DEPENDENT INDUSTRIES

Many analysts deal with the projection of future trends in the relation between supply and demand for antimony globally. The results of their analysis are as follows:

1) It is expected that the value of the market will continuously grow in the period 2024–2036 (approximately from USD 243.56 million to USD 374.82 million), while China's trade policy in this domain will dictate the parameters of value growth: price and quantities.[23]

2) In the following years, the defense industry will maintain the status of the largest user of Sb alloy as an input in the production process (the chemical industry and the battery production industry follow).[24]

3) Growth in the value of the global ammunition market is expected, but this growth will be significantly lower compared to the growth of the antimony market

---

[23] See Antimony Market Size, Share & Industry Analysis, By Application (Flame Retardants, Chemicals & Alloys, Lead Acid Batteries, Ceramics & Glass, and Others) and Regional Forecast, 2024–2032, *https://www.fortunebusinessinsights.com/antimony-market-104295*, 19. 10. 2024.

[24] The same as 25.

(growth rate projection 1.89% for the period 2024–2034), which will somewhat reduce the risk of growth in the need for antimony as input in the production process.[25]

4) At the same time, the growth of investments in the improvement of recycling technology, both antimony and lead-antimony alloy, is expected, which will provide a significant reserve source of supply to all dependent industries around the world (especially the defense industry). For years, China and the USA have strategically approached planning investments in smelting and chemical extraction technologies for extracting antimony from complex materials, while minimizing negative effects on the environment.[26]

It can be concluded that the current trends in the global antimony market will be maintained in the next ten years (according to the previously listed projections), which implies that the success factors of the management of the supply chain of industries that use Sb or PbSb alloy as input will remain unchanged: 1) establishing efficient and effective risk management, 2) intensive work on building reliable partnership relations with suppliers of antimony and lead-antimony alloy, 3) continuous work on finding alternative sources of supply, 4) investments in recycling PbSb alloy and 5) investments in research and development activities aimed towards finding alternative inputs that will replace antimony in the production process.

CONCLUSION

China has the status of the absolute leader in the global antimony market and in the years to come, it will hold the baton in determining the supply and demand relationship for this input at the global level. Industries that use antimony and lead-antimony alloy as inputs in the production process are currently facing the great challenge of successfully overcoming the risks posed by disruptions in the global supply chains of these raw materials, which, according to analysts' forecasts, will last the entire next decade. The establishment of efficient and effective management of the supply chain of the battery and accumulator manufacturing and ammunition manufacturing industries, as the main users of PbSb alloy in the production process, will in the following years be determined by: 1) establishing efficient and effective risk management, 2) intensive work on building reliable partnership relations with suppliers of antimony and lead-antimony alloy, 3) continuous work on finding alternative sources of supply, 4) investments in recycling PbSb alloy and 5) investments in research

[25] See Global Ammunition Market 2024–2034, *https://www.giiresearch.com/report/avd1508613-global-ammunition-market.html*, 19. 10. 2024.

[26] See Recycled Antimony Market Size, Review: Share Projections for 2024–2031, *https://www.linkedin.com/pulse/recycled-antimony-market-size-review-share-projections-whmbf/*, 19. 10. 2024.

and development activities aimed towards finding alternative inputs that will replace antimony in the production process. The previously listed factors are the basis for the survival and success of companies belonging to these industrial sectors, both in the European market and in the US market.

Dr VELJKO M. MIJUŠKOVIĆ
Docent, Ekonomski fakultet
Univerziteta u Beogradu
MSc ANA TODOROVIĆ SPASENIĆ
Prvi partizan a. d. Užice

KINESKE LOGISTIČKE I TRGOVINSKE BARIJERE KAO DETERMINANTA AKTUELNIH POREMEĆAJA U GLOBALNIM LANCIMA SNABDEVANJA ANTIMONOM

Rezime

Kina, lider u globalnom snabdevanju antimonom, diktira tržišne uslove za prodaju/nabavku ove sirovine na svim kontinentima. Aktuelne trgovinske i logističke barijere koje je najmnogoljudnija zemlja sveta uvela u ovoj oblasti dovele su do deficita ove sirovine, što utiče na lance snabdevanja namenske industrije i industrije proizvodnje baterija. Cena atimona je dostigla rekordan istorijski nivo, što otežava uspostavljanje efikasnog i efektivnog menadžmenta lanca snabdevanja u ovim industrijskim sektorima sa aspekta troškovne efikasnosti. S obzirom na to da je namenska industrija pokretačka snaga rasta i razvoja svetske privrede, može se zaključiti da će dugoročne posledice dugotrajnosti barijera biti nesagledive po BDP mnogih zemalja u svetu.

Ključne reči: Kina, trgovinske i logističke barijere, menadžment lanca snabdevanja antimonom, menadžment lanca snabdevanja namenske industrije, menadžment lanca snabdevanja industrije proizvodnje baterija

Bibliography

Anderson, C. G., *Antimony production and commodities: SME mineral processing & extractive metallurgy handbook,* Society for mining, metallurgy, and exploration, Englewood, 2019.

"CN-EU-US tarrifs on electric cars", *AEB magazine*, *https://www.aeb.com/en/magazine/articles/CN-EU-US-tarrifs-on-electric-cars*.

CSIS organization, "China's Antimony Export Restrictions: The Impact on U.S. National Security", *https://www.csis.org/analysis/chinas-antimony-export-restrictions-impact-us-national-security*.

Dupont D., Arnout S., Jones P. T., Koen B., "Antimony Recovery from End-of-Life Products and Industrial Process Residues: A Critical Review", *Journal of Sustainable Metallurgy*, No. 2, 2016.

Exiger Consultant Site, "Supply chain impacts China export restrictions", *https://www.exiger.com/perspectives/supply-chain-impacts-china-antimony-export-restrictions/*.

Iglesias-Émbil M. *et al.* "Raw material used in a battery electric car–a thermodynamic rarity assessment", *Resources, Conservation and Recycling*, Vol. 158, 2020.

Li, J., Xu, D., Zhu, Y., "Global antimony supply risk assessment through the industry chain", *Frontiers in Energy Research*, No. 10, 2022.

Mariussen, E., Johnsen, I. V., Strømseng, A. E., "Distribution and mobility of lead (Pb), copper (Cu), zinc (Zn), and antimony (Sb) from ammunition residues on shooting ranges for small arms located on mires", *Environmental Science and Pollution Research*, No. 24, 2017.

Moosavi-Khoonsari E., Mostaghel S., Siegmund A., Cloutier J-P., "A Review on Pyrometallurgical Extraction of Antimony from Primary Resources: Current Practices and Evolving Processes", *Processes*, No. 10, 2022.

Oxford Analytica, "Chinese supply squeeze to keep antimony prices high", *Emerald Expert Briefings*, oxen-db, 2024.

Reuters, "Antimony prices gear up for new records on China export curbs", *https://www.reuters.com/markets/commodities/antimony-prices-gear-up-new-records-china-export-curbs-2024-08-15/*.

Reuters, "What is antimony and why is China curbing its exports", *https://www.reuters.com/markets/commodities/what-is-antimony-why-is-china-curbing-its-exports-2024-08-16/*.

The Epoch Times, "China is now the second largest weapons producer in world arms, Times", *https://www.theepochtimes.com/china/china-now-second-largest-weapons-producer-in-world-arms*.

Van den Brink S. *et al.*, "Resilience in the antimony supply chain", *Resources, Conservation and Recycling*, Vol. 186, 2022.

Wang Y. *et al.*, "Guidance and review: Advancing mining technology for enhanced production and supply of strategic minerals in China", *Green and Smart Mining Engineering*, 2024.

Wu Q., Lv Z., Cao J., "Distribution and Supply of Antimony Resources in China and Abroad and Development Status of Antimony Industry Chain", *Multipurpose Utilization of Mineral Resources*, No. 5, Vol. 43, 2022.

Article history
Received: 13.10.2024.
Accepted: 03.11.2024.

REVIEW PAPER