Antimony: A Critical Material You've Probably Never Heard Of

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Antimony has been listed as a mineral critical to U.S. economic and national security by the U.S. Department of Interior, a distinction also held by rare earth elements (REEs), cobalt, and uranium. Despite this designation, there has been comparatively little attention on antimony and its importance in the current environment, as well as potential future uses. This Executive Briefing on Trade will explore the current and future uses for antimony, as well as the U.S. position in antimony production. It will conclude with a discussion of contemporary global production of antimony (principally concentrated in China).

What is antimony and why is it deemed critical?

Antimony (Sb), a silvery metalloid,[1] is isolated and processed from the mineral stibnite (Sb_2S_3) for commercial use in a variety of downstream products and industries; its key properties are its ability to harden and strengthen certain metals. During World War II, antimony was key to U.S. production of tungsten steel and the hardening of lead bullets used in combat; at the time up to 90 percent of antimony demand was fulfilled through domestic production. Today, antimony is used across numerous industrial sectors, resulting in diffuse consumption compared to some other critical materials. As of 2020, the leading uses of antimony in the United States were in flame retardants, lead-acid batteries, as a key alloying material for strength (e.g., shielding materials), and antifriction alloys. Additionally, antimony is used in a variety of military applications, including night vision goggles, explosive formulations, flares, nuclear weapons production, and infrared sensors.

Expanded uses for antimony contribute to its inclusion as a critical material, particularly with respect to battery technology. Antimony has become increasingly prevalent in electrical and energy related technologies. Over the past decade, antimony appeared in over a thousand U.S. electrical applications patents. Liquid metal batteries (LMBs), an emerging battery technology, incorporates antimony in the cathodic material.[2] The all-liquid contents of LMBs have longer life cycles than contemporary lithium-ion batteries. LMBs also have a higher current density, comparatively simpler manufacturing processes, do not self-ignite, and are purportedly cheaper to manufacture.[3] While LMBs are not yet reasonable alternatives for portable batteries and are still in the development phase, they reportedly show great promise for grid-scale energy storage. This application will likely become more significant for the United States and other economies as electricity generation increasingly shifts to renewable technologies requiring energy storage capacity from batteries (particularly wind and solar power).

Global Market Characteristics and Production

Historically, production of antimony has occurred in countries with large antimony deposits, including China, Russia, Bolivia, Canada, Mexico, South Africa, Tajikistan, Turkey, and the United States. Currently, China is the top producer of antimony, but other producers—notably Russia and Tajikistan—have more than tripled their production since 2015.

U.S. deposits of antimony are concentrated largely in the mountain Western states (Idaho, Montana, Utah, and Arizona), as well as Alaska. Despite the history of U.S. antimony production for domestic use, environmental and commercial viability concerns have reduced contemporary U.S. antimony production. The largest facility to

[1] A chemical element that has properties between that of a metal and a nonmetal.
[2] The electrodes and electrolyte layers are heated until all components are in their respective liquid states; the varying density of the materials allows the materials to layer within the battery (i.e., no solid separators).
[3] Ambri, U.S. manufacturer of LMBs, claims that the calcium-antimony electrodes are less than one-third the cost of lithium, nickel, manganese, cobalt electrodes commonly used in lithium-ion batteries.

produce antimony in the United States was the Stibnite Gold mine in the panhandle of Idaho, which ceased production in the mid-1990s. With ongoing environmental concerns, particularly the potential for mine runoff to damage river ecosystems, it is uncertain whether the firm that now owns the mine will be able to restore the mine and restart production, despite ongoing interest in diversifying supply.[4] As of 2020, U.S. production of antimony was solely from recycling (primarily spent lead-acid batteries), with no measurable amount mined domestically. Consequently, domestic users of antimony rely on imports for production of end use products.

For more than 20 years, China has produced a major portion of the world's antimony supply.[5] Between 2011 and 2015, China produced between 75 to 83 percent of global raw antimony supply, which totaled approximately 115,000 metric tons (MT) in 2015. By 2020, however, China's share of global production declined to around 53 percent, or approximately 80,000 MT.[6] The decline in global market share and production of antimony in China coincides with a clampdown on illegal mining and enforcement of environmental protections that began in the early 2000s. Between 2003 and the present, the number of firms legally producing antimony in China fell from 400 to roughly 16 companies. China is not only the top producer, but also boasts the majority of antimony processing facilities,[7] somewhat analogous to China's role in REEs production.[8] Due to its ability and capacity to process a major portion of the world's antimony, China's downward trend in mining antimony production has not affected its rank as a top antimony producer. This is also due to China sourcing from other producers that have recently substantially increased antimony mining, such as Russia (30,000 MT of production in 2020), Tajikistan (28,000 MT), and Burma (6,000 MT).

Heavy concentration of antimony processing in China ensures that a large share (14,000 MT, 79 percent) of U.S. antimony imports is sourced from China, similar to other critical materials like REEs and cobalt.[9] This reliance on China increases the potential for policy developments in China to influence antimony pricing. Developments in China's policies (such as closing illegal or environmentally damaging mines) contributed to antimony global prices doubling between 2011 and 2012 and drove a recent spike in antimony global prices in early 2021. Collectively, industry concentration, fluctuating global prices, and antimony's growing importance in emerging technologies contribute to growing interest in the development of U.S. antimony production. However, establishing U.S. production will take time and U.S. antimony users will likely rely on imports for at least the next several years.

Sources: Hansell, "All Manner of Antimony," 2015; Blackmon, "Antimony: The Most Important Mineral You Never Heard of," May 6, 2021; USGS, "Interior Releases 2018's Final List of 35 Minerals," May 18, 2018; U.S. Geological Survey, "Antimony: Professional Paper 1802-C ," December 19, 2017, 12; Statista, "World Antimony Production: 2018-20," 2021; Financial Times, "Antimony price doubles after China mine purge," January 17, 2021; Argus Media, "China's antimony prices at 7-year high on ore shortage," March 2, 2021; Hill, "Bill Gates-backed liquid metal battery company secures $A200 million," August 13, 2021; CBS News, "For 150 years, miners came to the Stibnite Mine to dig for gold. A Plan to reopen it has stirred an environmental debate," August 14, 2021; Junior Mining Network, "Perpetua Resources Announces Antimony Supply Agreement for Ambri Battery Production," August 9, 2021.

[4] Perpetua Resources, the company leading the restoration of the mine recently announced an agreement to supply a portion of antimony production to a U.S.-based company, Ambri.

[5] Usually representing between 60 percent to nearly all global unalloyed antimony production.

[6] It is worth noting that Bolivia has the third largest reserves of antimony (310,000 MT), behind China (480,000 MT) and Russia (350,000 MT), but produces (3,000 MT in 2020) less than China, Russia, or Tajikistan.

[7] Antimony is primarily processed into antimony trioxide (HTS 2825.80.0000), the commonly traded form of antimony along with metallic antimony (HTS 2617.10.0000).

[8] See Daigle and DeCarlo, "Rare Earths and the U.S. Electronics Sector: Supply Chain Developments and Trends," June 2021, and Van Veen and Melton, "Rare Earth Elements Supply Chains, Part 1: An Update on Global Production and Trade," December 2020.

[9] Data represents imports of antimony oxides entering under 2825.80.0000 in 2020, as this is how antimony is commonly traded.