Securing the U.S. Aerospace and Defense Critical Minerals Supply Chain

The race for technological supremacy has rapidly increased demand for critical minerals and elevated market access as a top national security priority. Volatile and non-transparent global markets, uneven concentrations of geologic sources, foreign ownership concerns, and environmental, energy, and labor-intense production processes continue to stress fragile supply chains and encumber access.

Rare earths, cobalt, and manganese metal, among others, are used in the production of high-end, cutting-edge commercial and defense technologies, ranging from engines to microelectronics to castings and forgings. Securing access to these resources is vital as the security environment demands the U.S. and its allies and partners modernize their defense capabilities to maintain the technological edge and combat growing global threats.

Commercial and defense industries operate a shared supply chain. The economic disruptions resulting from the COVID-19 pandemic had an adverse impact on the commercial aviation market and a negative downstream effect on the defense operations of many Aerospace Industries Association (AIA) member companies. Conflict in Ukraine and challenges in the Indo-Pacific also highlight the risks posed by the disruption of critical markets and continue to expose the impact of restricted access on U.S. readiness. Overall, policies and lines of effort required to ensure reliable U.S. sourcing and reduce trade dependencies on adversaries remain uncertain which introduces risk.

With additional legislative and regulatory restrictions on sourcing critical minerals under consideration, policies that drive such restrictions must first reflect the realities of today's global markets. Transitioning supply chains to alternative sources should be deliberate, strategic, and incentivize U.S. industry's early adoption of risk mitigation strategies, supplier criteria, domestic suppliers, and investment in trusted sources, where U.S. capacity is unavailable. Closing markets without readily available alternatives, in the short term, may have the unintended consequences of augmenting U.S. vulnerabilities. Therefore, engagement with U.S. industry at all tiers of the supply chain – from producers to end users – is critical to ensure that measures aimed at increasing transparency in strategic and critical mineral supply chains do not impose undue administrative burdens on suppliers or lead to unintended consequences.

The U.S. aerospace and defense (A&D) industry is dedicated to being a resource of near and long-term policy solutions as policies on global sourcing of minerals are considered. AIA, representing over 320 A&D companies, therefore, recommends a comprehensive approach that is rooted in understanding the critical minerals market, targeted investments in U.S. supply chains, and increased engagement with allies and partners.

Aerospace and Defense Supply Chains Experience Unique Challenges

Policymakers should ensure sourcing requirements and/or mandated transition timelines, aimed at mitigating U.S. national security concerns, are both reasonable and reflective of standard market practices for establishing new suppliers in the A&D industry. A&D applications typically require high-purity, aerospace-grade materials that rely on qualified

processing and smelting operations. Due to the risk and complexity of these applications, it can take up to ten years to transition and certify new suppliers. Companies throughout the A&D supply chain also employ several risk mitigation strategies to reduce their exposure: pursuing longer-term agreements with suppliers; securing material well in advance of need; building material buffers and stockpiles; and incorporating high-quality, non-contaminated scrap material into products. Additionally, A&D grade minerals are purchased in smaller quantities than those of industrial grade (e.g., automotive applications). Automotive and other commercial industries enjoy large purchasing power which often takes priority over small-quantity – and often higher-quality material – buys regardless of the national security imperative.

Understanding the Market is a National Security Priority

Executive Order (E.O) 14017 'America's Supply Chains' directed the Department of Defense (DoD) to assess critical supply chains to improve the United States' capacity to deter threats. Specific attention was given to critical minerals, including a commitment to invest in production capabilities that promote a resilient, modern, and technology-enabled defense industrial base. U.S. officials and policymakers should continue to leverage the E.O.'s findings outlined in "Securing Defense Critical Supply Chains" to understand the unique challenges and solutions impacting the A&D industry. The critical sectors identified in the report, such as critical minerals, should therefore be prioritized for U.S. attention and investment.

Global Partnerships Drive Critical Mineral Priorities

Cooperation with U.S. allies and partners is essential to strengthening U.S. critical mineral supply chains. The use of bilateral and multilateral sectoral agreements, such as the U.S. – Japan Critical Minerals Agreement announced in February 2023, provides incentives for reliable market access (e.g., non-imposition of export duties, measures to address non-market practices, commitment to not impose new trade barriers, etc.) and are critical to building U.S. resiliency. These agreements should continue to be leveraged by the U.S. to create a clear list of trusted sources on which the A&D industry can rely as companies develop risk mitigation strategies and supplier criteria to meet emerging regulatory and legislative restrictions. Overall, international supply chain agreements on critical minerals should be more expansive to reflect U.S. national security imperatives in addition to automotive and clean energy.

Incentives are Required for Reliable Domestic Access

To ensure reliable access to critical minerals for commercial and defense applications, the U.S. government should provide financial support to American companies to incentivize secure supply agreements with trusted suppliers at home and abroad, acquire existing overseas mines, and establish new domestic mines and production facilities. Resilience requires creative solutions, shared resources, and trusted partners, U.S. companies should be encouraged to invest and work with experienced global entities. The inclusion of global sources should be considered an extension of U.S. manufacturing prowess and the domestic supplier base. Efforts like the Mineral Security Partnership should attract public and private investment – leveraging U.S. financing through the

Export-Import Bank or International Development Finance Corporation – and increase transparency throughout critical minerals supply chains.

Strategically Significant A&D Critical Minerals

The following commentary initially lists specific strategic and critical minerals utilized in A&D supply chains. The information and data are drawn from commentary provided by the U.S. Geological Survey (USGS) and proprietary data, among other sources.[1] **Of note:** the USGS found that "in 2022 the United States was 100% net import reliant for 12 of the 50 individually listed critical minerals and was more than 50% net import reliant for an additional 31 critical mineral commodities. Meanwhile, China was the leading producing nation for 30 of the 50 critical minerals."

- **Arsenic Metal**: The U.S. has a net import reliance of 100%. Arsenic metal has not been produced in the United States since 1985. In 2022, China was the leading world producer of arsenic metal and accounted for approximately 94% of the United States import sources. High-purity arsenic metal is used in semiconductors for solar cells, space research, and telecommunications.
- **Cobalt**: The U.S. has net reliance of 76%. The Congo continues to be the leading source of mined cobalt, accounting for approximately 70% of the world's production. Alternative sources of cobalt reside in the U.S. (Alaska, Idaho, California, Minnesota, Michigan, Missouri, Oregon, and Pennsylvania); however, except for resources in Idaho and Missouri, cobalt production from these deposits is a byproduct of other metals. Cobalt is used in jet engines (cobalt alloys) – due to its stability at high temperatures – and electronic batteries.
- **Copper**: The U.S. is 48% net reliant. Copper is used as a strengthening agent and is added to steel and other metals as an alloying element to improve corrosion resistance and strength, in addition to other characteristics. China is the world's largest consumer of refined copper, consuming 52% of the global copper volume in 2021. It is estimated that copper demand will increase nearly 600 percent in the coming years resulting from the growing needs of renewable energy and electric vehicle transition.
- **Gallium**: The U.S. has a 100% net reliance. China is the primary source and producer of gallium, accounting for 98% of the world supply. No domestic primary (low-purity, unrefined) gallium has been recovered since 1987. Gallium is used in the production of semiconductor chips, radars, sensors, and secure communications.
- **Germanium**: U.S. net reliance is over 50%. In 2022, China was a leading global producer and exporter of germanium. Germanium is primarily used in electronics and solar applications, fiber-optic systems, infrared optics, and polymerization catalysts.
- **Hafnium:** China is responsible for 26% of global production capacity and is a significant source of processed hafnium used in aerospace alloys. The market has

[1] 'Mineral Commodity Summaries 2023,' U.S. Geological Survey, accessed March '23

reached previously unseen high levels – pricing reflecting multiples of historical trends – as demand from use in semiconductor and space (C-103 alloy) industries and supply remains tight.

- **Magnesium Metal:** U.S. net reliance is at more than 50%, with Israel (31%), Russia (29%), and Turkey (37%) accounting for the top three importers of magnesium metal. The leading use for primary magnesium metal, which accounted for 58% of reported consumption, was in castings. In 2022, the primary domestic magnesium metal producer, located in Utah, shut down production due to water sourcing and permitting issues which led to market disruptions and shortages.
- **Molybdenum:** An estimated 90% of aerospace-grade material is produced in China. China remains the largest global producer of molybdenum, and last year, prices reached multi-decade-highs as molybdenum bearing steel consumption remained high. Non-Chinese sources of molybdenum are mainly generated from scrap, and molybdenum recycled as part of new and old steel and other scrap may be as much as 30% of the apparent supply.
- **Scandium:** The U.S. has net import reliance of 100%. The primary import source is Europe with China (through a State-Owned Enterprise), the Philippines, and Russia being the leading producers. Scandium was last produced domestically in 1969. The principal uses for scandium are in aluminum-scandium alloys. Other uses for scandium include electronics, lasers, and radioactive isotopes.
- **Tantalum:** The U.S. has net import reliance of 100%. No significant U.S. mine production has been reported since 1959. According to USGS, 42% of tantalum metal and powder imported into the U.S. is from China. Raw material resource found in Brazil, Congo, Nigeria, and Rwanda, which are responsible for 85% of global production. Around 50% of tantalum smelters are in China.
- **Titanium Sponge:** The U.S. has net import reliance of 100%. Titanium sponge is a feedstock material used to produce titanium and titanium alloys for aerospace applications. No significant sponge production exists domestically following the closure of the last U.S. titanium sponge production facility in 2020. Russia's invasion of Ukraine disrupted the supply of titanium sponge – Ukraine was the leading source of titanium mineral concentrates suppling Russia's titanium metal industry – and led aerospace consumers to seek alternative sources of supply, including from long established domestic producers. Over 90% of U.S. imports used by domestic titanium metal producers come from long-standing U.S. ally Japan. All U.S. imports of titanium sponge are subject to a 15% tariff, which limits U.S. manufacturers' access to international sources.
- **Tungsten:** U.S. net import reliance is over 50%. World tungsten supply is dominated by production in and exports from China, which has regulated its tungsten industry by prohibiting foreign investment in exploration and mining, and imposed quotas on concentrate production and processing. China ranks first in the world in terms of tungsten resources and reserves and has some of the largest

deposits. Concentrate production outside of China is estimated to be less than 20% of world production.

- **Other Minerals/Rare Earth Elements of Concern:** Praseodymium (lasers, aircraft engines, semiconductors), ytterbium (lasers to heat turbine blades, super alloys for jet engines, infrared lasers), and yttrium (Metallic alloy, ceramic layers in jet engines, heat-resistant superalloys for jet engines).

Recommendations

A comprehensive approach is required to address dependencies, and AIA recommends the following initial recommendations to spur investment in and access to critical mineral supply chains both domestically and internationally.

- **Revitalize the National Defense Stockpile (NDS).** Congress should appropriate funds in line with the full $1 billion in authority for appropriations to revitalize the National Defense Stockpile Transaction Fund that was included in the FY23 NDAA. In addition to stockpiling material (titanium sponge and ingot), the NDS has existing authority to fund recycling initiatives from military surplus, fund studies and qualification of domestic sources, and loan material, among other statutory responsibilities.

- **Issue Section 45x(c)(6) Guidance.** The U.S. Department of the Treasury should promptly issue guidance for Section 45x(c)(6) of the Inflation Reduction Act which provides a 10% production tax credit for applicable critical minerals. The guidance should clearly define eligibility requirements including purity levels for each mineral listed. We recommend that the U.S. government solicit input from A&D industry once guidance is released and establish a clear process to expand the minerals list and eligibility criteria.

- **Infrastructure Investment.** With the absence of domestic production capacity for many of the critical minerals utilized in A&D supply chains, the U.S. will be dependent on imports and lack the surge capacity required to support national security and critical infrastructure needs. Congress and the Administration should consider providing incentives, in addition to Section 45x(c)(6) of the Inflation Reduction Act, to re-start domestic production and investment in new infrastructure development that will increase capacity. Increasing domestic mining and refinery of minerals, key to the A&D industry, should also be encouraged.

- **DoD/Department of Energy (DOE) Investment.** The Administration should use all funding tools – Defense Production Act Title III authority, Industrial Base Analysis and Sustainment support, DoE Loan Programs Office, etc. – to support development of domestic critical minerals projects. Qualification of domestic suppliers of the above listed resources and processes that encourage new ore refinement, re-use and recycling of the above resources, among others, with a specific focus on high purity, aerospace applications are needed. The current focus of existing resources appears focused on industrial markets, primarily minerals and materials used in automotive Electric Vehicle (EV) applications.

- **Pursue Permitting Reform.** Congress should pass permitting reform legislation streamlining approval timelines for domestic, critical minerals projects. Independent of permitting activities, a reasonable industry benchmark for development of a mineral-based strategic and critical materials has historically been not less than 10 years.
- **Metals Recycling Incentives**: While the recycling process often differs by commodity, there are few essential steps in recycling: segregation, collection, processing, and re-melting into new products. Local segregation reduces the need for secondary segregation, which is capital, energy, and labor intensive. Creating local and national recycling incentives such as recycling grants and an income tax credit for investments in recycling facilities, machinery, or equipment for metals segregation, pucking and automated sorting should be considered for minerals deemed critical to the A&D sector.
- **International Engagement.** Congress and the Administration should seek to remove barriers to trade, including tariffs on critical minerals utilized in A&D supply chains, with allies and key trading partners and use initiatives like the Mineral Security Partnership to bolster development, exploration, and refining within those supply chains.