

*Testimony before the House Committee on Natural Resources
Subcommittee on Energy and Mineral Resources*

*Legislative Hearing on H.R. 1937:
National Strategic and Critical Minerals Production Act of 2015*

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Chairman Lamborn, Ranking Member Lowenthal, and distinguished Members of the Committee, thank you for inviting me to offer my thoughts on H.R. 1937, the National Strategic and Critical Minerals Production Act of 2015. I have spent the last two decades in the private sector and government—including on active duty in the U.S. Air Force, in the Air Force Reserve, and as a senior professional staff member on the House Armed Services Committee—focusing on national security issues. In that time, I’ve observed the nexus between our natural resource policy and national security.

Of particular concern to me is our import reliance on a growing number of strategic and critical materials. These materials often are produced in small quantities with opaque markets, and many are controlled by our nation’s potential adversaries. These strategic and critical materials are vital and enabling components of many of our most technologically advanced weapon systems. In recognition of these risks, the U.S. Government adopted a strategy to promote mitigation measures such as thrifting, substitution, recycling, and the use of trade remedies. However, much remains to be done to establish an environment that supports production of these materials in an increasingly competitive global market.

Thus, I endorse the legislative intent underpinning the National Strategic and Critical Minerals Production Act of 2015. This bill represents an essential component in a strategic and critical materials policy that balances production and regulatory concerns.

The Link between Strategic Materials and National Security

As the Committee considers the bill, I strongly recommend a focus on the implications of our increasing reliance on imports of strategic and critical materials. This import reliance creates a real national security risk.

Many of these materials, including the case studies that I will explore later in this testimony, play a critically important role in the basic functionality of essential U.S. weapons systems, as well as a critically important role in the defense industry. First, when processed, strategic and critical materials provide unique physical characteristics required by U.S. weapon systems. For example, tungsten is a very hard metal that has several commercial applications (e.g., cutting tools); for the same reason, tungsten also is valuable for armor-piercing munitions and armor plate—an application it has served since the Second World War. Other materials, such as beryllium, have relatively few commercial uses, but military demand in nuclear weapons and electro-optical targeting systems is significant. Second, in aggregate, the use of strategic and critical materials in U.S. weapons systems allows our nation to equip, train, mobilize, and sustain modern military forces with cutting-edge capabilities. Finally, production of strategic and critical materials naturally creates high-paying jobs, spanning the value chain from research and development and exploration to primary extraction and end-of-life recycling. This economic activity boosts gross domestic product (GDP) and tax revenues to state and local governments.

Challenges associated with accessing reliable supplies of strategic and critical materials result in sometimes illogical and counterproductive business decisions. Because commercial supply chains generally do not tolerate high levels of risk, commercial companies often try to economize use of expensive or “high risk” materials in their product development efforts, rather

than focus on maximizing the potential of a materials technology. In other circumstances, internal research and development dollars are diverted from product development towards material substitution. As a result, rather than focusing on utilization of the most advanced materials available to support innovation, scarce research dollars are diverted to support substitution that can often be a technological step backward.

What truly concerns me is the impact that U.S. reliance of importing these materials can have on the defense supply chain. Foreign governments have deliberately disrupted supplies of strategic and critical materials in peacetime and wartime with remarkable effects, resulting in severe supply restrictions and prohibitive price increases.

For example, embargos are a well-known tool used to deprive a target country of strategic and critical materials by prohibiting the export or sale of such materials. Select instances involving the United States include the Soviet embargo of manganese and chromium during the Berlin Blockade (1949) and the Chinese embargo on rare earth minerals (2010). Preclusive purchasing also is a form of economic warfare whereby one country purchases resources for the purpose of reducing the ability of a target country to purchase the same resources. All other variables constant, this action increases demand, prices skyrocket, and supply shortages may result.

Real-World Examples of National Security Risks

We have learned about the national security risks of overreliance on importing strategic and critical materials and supply chain interruptions through experience with numerous materials including germanium, tantalum, and rare earths. For example, **germanium** is a rare metal that occurs in very low concentrations in the Earth's crust. Because of this rarity, germanium is recovered as a byproduct of zinc or coal mining. Today, the largest mineral producers of germanium are in China, Canada, Russia, and, to a much lesser extent, the United States. However, companies ship much of this germanium mineral concentrate to Russia and China for processing into ingots and other high value-added products. The combination of limited availability of germanium concentrates and high prices for germanium has led to significant amounts of germanium recycling outside of China and Russia as one risk mitigation measure and business opportunity. Nevertheless, at this time these programs are unlikely to produce a sufficient amount of recycled material to meet our national security needs.

From a military perspective, the most relevant germanium-related products include fiber optics, infrared optics, and solar cells. Nearly every surface vessel and fixed- and rotary-wing aircraft in the U.S. arsenal has large, forward-looking infrared systems or search-and-track systems. Many aircraft also carry "heat-seeking" missiles, which contain germanium lenses. In addition, many small arms and light weapons sights include infrared optics, and U.S. military satellites use highly-efficient germanium-based solar cells. These military applications formerly accounted for the vast majority of the U.S. market, but now infrared optics and solar products represent about half of U.S. demand.

The risks associated with the germanium market are two-fold. First, there is generally limited primary production of germanium, and to the extent that it occurs, much of that material is redirected to smelters in China and Russia. A great deal of the secondary materials market (i.e.,

scrap) meets a similar fate because: (1) it is cheaper to conduct these activities in China and Russia and (2) Chinese and Russian companies bid very aggressively for such material when it becomes available. Secondly, even though companies based in the United States and NATO countries have advantages in the high value-added manufacturing of germanium components, their competition in Russia and China consists of state-owned enterprises that simultaneously receive millions of dollars per year in price subsidies and other government grants to support downstream research and development. As these companies' product lines mature, it is likely that much of China's and Russia's current semi-finished germanium exports will be consumed domestically.

Tantalum is a very hard metal that is highly resistant to corrosion and deformation at high temperatures. Like many other metals, tantalum can be extracted by typical industrial methods, such as underground or open pit mining. However, because of tantalum's natural hardness, artisanal mines are very common. At some deposits, the gangue material around tantalum-bearing minerals has eroded over the past millennia, leaving a relatively high-grade concentrate at surface. Artisanal collection and beneficiation of the latter is typical of Central African and some South American tantalum mines.

In addition to the characteristics noted above, tantalum also is an excellent conductor of electricity, and nearly 75% of tantalum demand is focused on electronic materials and capacitors. As such, tantalum capacitors are one of the key building blocks of nearly every piece of high-tech equipment operated by U.S. armed forces. Separate from electronics, another important demand segment for tantalum is the turbine engine market, particularly for single-crystal nickel superalloys. In third-generation nickel superalloys, tantalum content ranges from about 6% to 8%. Smaller military applications for tantalum include explosively formed projectiles in anti-tank missiles.

The principal risk associated with the tantalum supply chain lies at the furthest upstream portions of the supply chain, and under the Dodd-Frank Wall Street Reform and Consumer Protection Act (P.L. 111-203), tantalum is a conflict mineral. According to U.S. Geological Survey statistics, more than two-thirds of global tantalum production emanates from the "covered countries", which include the Democratic Republic of Congo and those countries that border it. Though there are many public and private sector initiatives aimed at alleviating this problem, extreme violence in the region and ongoing structural problems within upstream due diligence schemes remain highly problematic and may result in some future supply disruption.

Rare earth materials consist of 17 elements (yttrium, scandium, and the lanthanide series). With regard to U.S. national defense, rare earth elements are a force multiplier. The aerospace industry uses yttrium for the investment casting of titanium parts, and yttrium-based ceramics act as thermal barrier coatings in jet engines. Yttrium, neodymium, and dysprosium are additives to magnesium alloys that compose the transmission and gearbox casings for fixed- and rotary-wing aircraft. When one of these aircraft elects to place a munition on a target, the fin actuators and seeker head of that munition likely will be powered by neodymium-iron-boron or samarium-cobalt magnets. If that munition is laser-guided, a target designator using a neodymium-doped yttrium-aluminum garnet may be used. If that munition uses radar guidance, then the microwave-

sensing devices incorporated in that munition likely will be powered by samarium-cobalt magnets.

The primary concern associated with the rare earth supply chain is the near complete dominance of China at every stage of the value chain. The Chinese rare earth industry is in the midst of consolidation into six large, state-owned enterprises, which receive considerable direct and indirect government subsidies and benefits that, like germanium, are targeted at downstream, valued-added manufacturing. Moreover, prolonged inactivity within the U.S. industrial base already has led to a massive intellectual capital deficit; even now there is a very limited pool of experienced rare earth plant operators and engineers outside of China. Though the use of rare earths in defense applications is relatively minor in volume, their criticality to the functionality of many key weapons technologies is indisputable, and the dominance of Chinese supply remains virtually unchanged nearly five years after the 2010 embargo.

Conclusion

These examples—germanium, tantalum, and rare earths—illustrate a continuum of risk to the defense industrial base as a result of strategic and critical material supply chains. In the case of tantalum, the central risk is isolated at the mine site and the trade routes along which those materials flow into the global market. For germanium, upstream mining risk is showing signs of creeping into downstream, value-added manufacturing segments. In the rare earth sector though, we continue to witness the complete dominance by China of an enabling technology for many weapon systems.

To date, the U.S. Government has initiated a number of programs that address these risks focused on increased due diligence, trade enforcement, research and development grants for substitution and recycling, optimized material use, and a dogged belief that the free market will diversify the supply chain. As the rare earth market shows, the global market for strategic and critical materials is highly competitive, with often insurmountable barriers to entry. Therefore, a myopic and unshakeable belief in market solutions ignores global reality and national security risk. What has been lacking in our approach to these challenges is any encouragement of production of strategic and critical materials in the United States.

The legislation introduced by Congressman Amodei provides common-sense steps that will allow the United States to streamline the permitting process and reduce bureaucratic red tape. The economics of competing with the rest of the world in strategic and critical materials is difficult enough without self-imposing barriers to entry. Removing those barriers at points that are upstream in the value chain is an excellent first step.

It is, however, just a first step. I encourage the Members of this Committee to evaluate the definition of strategic and critical materials, beginning the necessary work that we, as a country, need to undertake to create a framework for focusing national-level activities and promoting true competitiveness at each value-added downstream segment of the supply chain. Only then will our nation have the opportunity to increase our competitiveness and mitigate our growing national security risks associated with import overreliance.