Testimony of Scott Forney
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Submitted to U.S. Senate Committee on Energy and Natural Resources
"The Scope and Scale of Critical Mineral Demand and Recycling of Critical Minerals"
April 7, 2022

Chairman Manchin, Ranking Member Barrasso, and members of the Committee: thank you for this opportunity to contribute to the committee's exploration of the significant global supply chain issues affecting critical minerals. While it is not necessarily dinner table conversation for most American families, this conversation is vitally important to our national security and our way of life, and I appreciate the opportunity to testify today.

My name is Scott Forney, and I am the President of General Atomics Electromagnetic Systems (GA-EMS). GA-EMS' history of research, development, and technology innovation has led to an expanding portfolio of specialized products and integrated system solutions supporting undersea, aviation, space systems and satellites, missile defense, power and energy including fission reactors, and processing and monitoring applications for critical defense, industrial, and commercial customers worldwide. I believe General Atomics brings an important perspective on the criticality of mineral demand to our national defense sector. I hope to draw your attention to the many challenges businesses like ours face within the Defense Industrial Base as we navigate supply chain disruptions.

Today, I hope to draw your attention to the many supply chain disruptions confronting businesses like ours within the Defense Industrial Base. Let me say first that General Atomics can and does invest and manage many of these issues as we deliver products on time to support America's warfighters. Specifically, we are working with the Department of Energy on the design, construction, and operation of a Rare Earth Element (REE) Separation and Processing Demonstration Plant near Upton, Wyoming. That said, I am here today to highlight how complex and costly managing the demand for these critical minerals has become. We believe onshoring certain production capabilities and increasing the availability of critical minerals will help strengthen and protect U.S. industries and our military industrial base.

Broader supply chain challenges have caused ripple effects for all Americans. In our field, we see this especially in mining, refining, processing, and manufacturing. Specifically, these disruptions impact components in space systems, large structures, hypersonic weapons, laser weapons, fission reactors, and battery systems for the Department of Defense (DoD). In all of these areas we have experienced dramatic changes in the availability of critical materials since the beginning of the COVID-19 pandemic, and we have become more cognizant of the strong reliance the defense industry has on foreign producers and our vulnerability to supply chain disruptions. Given ongoing geopolitical challenges, disruption will continue to persist, and more domestic capability is not only an appropriate response, but a necessary one.

Rather than making choices based on the best engineering practice, unavailability of special high-strength alloys has forced design decisions and changes to complex systems dependent on these materials. Volatility in the nickel market due to speculators and Russia's war in Ukraine have effectively shut down this market. Procurement efforts for 'submarine grade' materials containing nickel including high-strength metals and Nickel Copper (NiCu), were compelled to be temporarily suspended. The future impact on nickel availability and price due to Russian sanctions is unknown. On the horizon, we see long term availability of rare earth elements for high-strength permanent magnets critical to the complex motors that drive our most sophisticated DoD assets are similarly at risk.

Related to these supply challenges is the unavailability of some standard electrical printed circuit board semiconductor components. Challenges here are driving lead time for some critical government systems from *months* to *years*. Similarly, competition with commercial industry has made procurement of high-quality lithium-ion battery cells extremely difficult. Once again, decisions are being made based on availability instead of optimum technical solutions.

Long lead material timelines and cost validities are critical for manufacture of complex weapons systems. Suppliers of high-strength steel alloys now will only provide quotes with unrealistically short validities. Many of our suppliers increasingly reserve the right to reprice their raw stock or forged materials *after* we place an order, referencing the volatility of material pricing and availability due to market conditions. Planning for multi-year procurements, which drives our largest, most critical programs, while also maintaining reasonable margins of schedule and cost-risk to maintain contract profitability is getting more and more challenging every year.

Let me provide some context on this challenge. Some DoD contracts ensure suppliers prioritize products critical to our national security with DX rated orders, per DoD Directive 4400.1 "Defense Production Act Programs." However, not *every* contract is structured in this way. Competition with commercial industry for acquiring many of these components has driven up costs. Members of the committee may be familiar with the increasing trend within DoD to award fixed-price verses cost plus contracts. The intent here is to provide defense contractors with a profit incentive for effective cost-control and performance. But these contracts do not account for the extreme type of market volatility we are experiencing today. The Defense Industrial base is paying the price for this out-of-pocket.

Solving these supply chain challenges is critical to our Nation and the health of our businesses, and General Atomics has been proactive in working with the Department of Energy to help respond to these supply chain challenges. Our work here is informed by several executive orders (EOs) and government reports.

President Biden's EO 14017 of February 2021, "America's Supply Chains," ordered a review of vulnerabilities in our critical mineral and material supply chains including rare magnet elements. In June 2021, the Biden Administration released a supply chain assessment that found U.S. over-reliance on foreign sources and adversarial nations for critical minerals and materials posed national and economic security threats.

The Commerce Department's Bureau of Industry and Security (BIS) also initiated an investigation under Section 232 of the Trade Expansion Act of 1962, as amended (19 U.S.C. § 1862), to determine the effects on U.S. national security from imports of Neodymium-iron-boron (NdFeB) permanent magnets. Critical national security systems rely on NdFeB permanent magnets, including submarine propulsion motors and missile guidance systems. NdFeB permanent magnets are critical components of our infrastructure, including electric vehicle propulsion motors, wind turbine generators, computer hard drives, audio equipment, and magnetic resonance imaging (MRI) machines.

To support the aims of both these executive orders and investigation, General Atomics is working with our partners at the Department of Energy (DOE) Advanced Manufacturing Office and industry members for design, construction and operation of a Rare Earth Element (REE) Separation and Processing Demonstration Plant near Upton, Wyoming. We have already extracted a 1,000 ton sample of Bear Lodge, Wyoming, ore in anticipation of the demonstration facility start-up. By the end of the project, we expect to demonstrate a process to separate rare earth oxides into useable elements such as Neodymium and Praseodymium in less time, more efficiently with greater purity, and with less environmental impact than current extraction technologies worldwide.

With the processes demonstrated, we believe that we will transition to a follow-on commercial-scale mining and processing facility which supports U.S. national security defense-related applications and critical infrastructure. The demonstration plant is a good first step to develop domestic capability. Figure 1 shows the Upton, Wyoming, location for this demonstration plant.

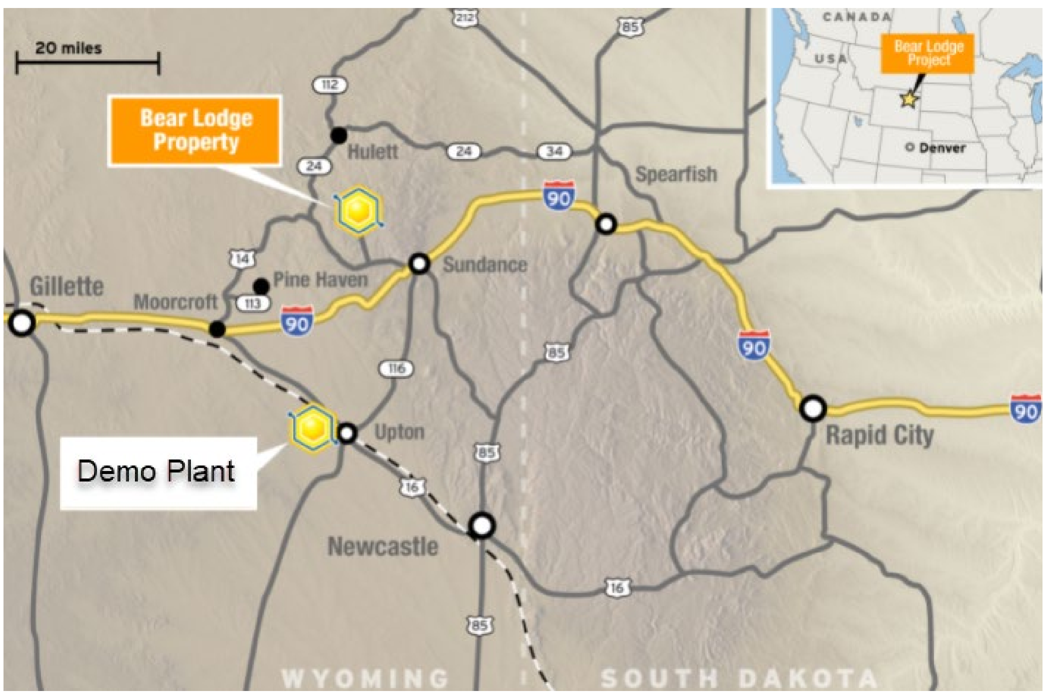

Figure 1. Upton, Wyoming Separation and Processing Demonstration Plant

Proliferation of the color television due to the major networks broadcasting most of their programming in color increased Rare Earth Element demand dramatically by 1965 which resulted in the U.S. capturing the Rare Earth Element market. Between the mid-1960s and mid-1980s, the California Mountain Pass Mine supplied 85% of the world's REE demand. Rare Earth Element deposits often contain radioactive elements including thorium and uranium. The U.S. Nuclear Regulatory Commission enacted new regulations in 1985 due to the fallout from the Three Mile Island disaster. The new regulations categorized rare earth mining under the same regulations as mining thorium. That meant much higher costs associated with mining and refining Rare Earth Elements. The U.S. mining prices went up and China reduced their prices in the 1980s-1990s. China reduced exports of Rare Earth Elements in 2010, which resulted in significant increases in Rare Earth Elements prices. China not only has the highest reserves of rare earth minerals at 44 million metric tons (MT) but also is the world's leading rare earths producer of separated rare earths and related products. In 2020 China produced 140,000 MT of rare earths. By contrast, the U.S. has a 1.5 million MT reserve with a 38,000 MT output of rare earths in 2020. Russia has 12 million MT of reserves and produced 2,700 MT of rare earths in 2020. Ukraine is not one of the world's largest producers of Rare Earth Elements but possesses untapped concentrations of rare minerals in the subsoil. The web site Mining World points out that the only problem is that Ukraine is not doing anything to extract them and that the country needs investments from outside to reach its potential. Ukraine's subsurface resources include a concentration of 100 types of minerals. If properly funded, it is believed that the market value can reach $7.5 trillion USD. Figure 2 provides history from 1950 to 2020 of Rare Earth Element production. Chart data is referenced from the U.S. Geological Survey Mineral Commodity Summaries and related publications.

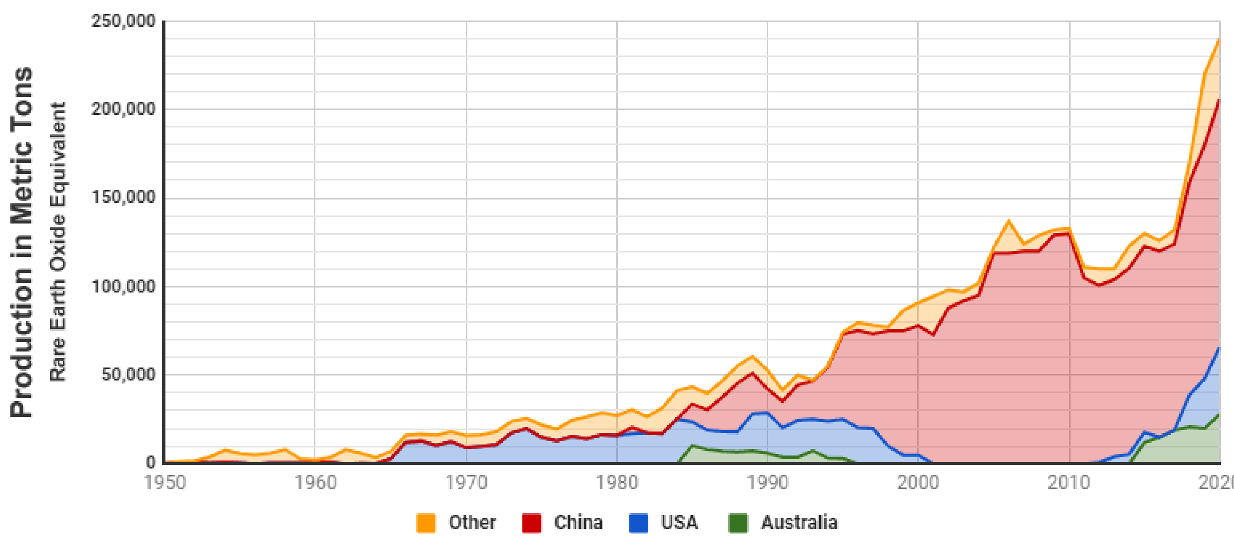

Figure 2. Rare Earth Element Production by Major Location (from Geology.com)

The Bear Lodge plant is a good first step to developing domestic capability, but as you can see in Figure (1), the availability of Rare Earth Elements is widely non-domestic. Since COVID-19, and now with the Russia/Ukraine conflict, prices are triple what they were before COVID-19 (see example Rare Earth Element historical prices in Figure 3 and Figure 4). The prices are expected to continue to climb due to this conflict and associated sanctions.

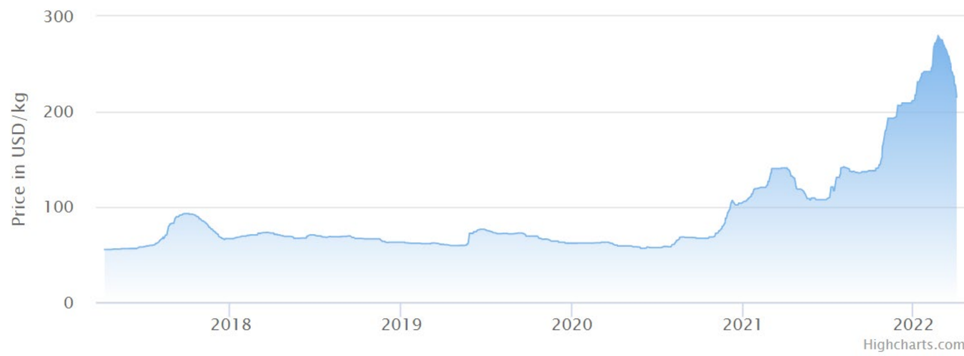

Figure 3. Neodymium Oxide (Nd) Price

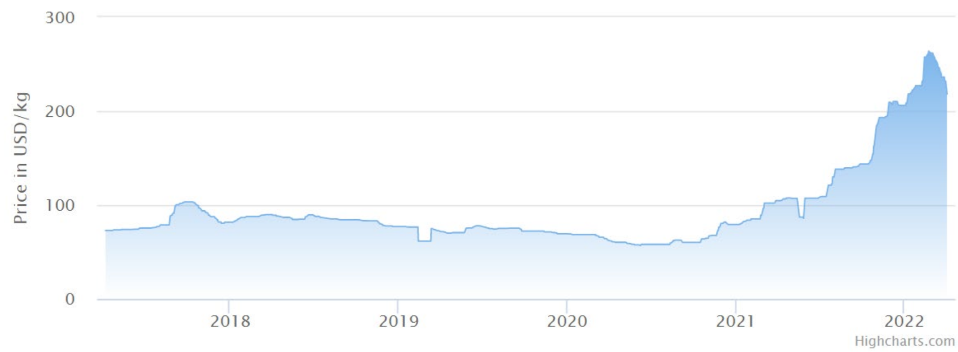

Figure 4. Praseodymium Oxide (Pr) Price

NOTES:

- Figure 3 provides price history 2017 until 2022 for Neodymium Oxide (Nd) referenced from https://www.kitco.com/strategic-metals/ and Highcharts.com. Neodymium is used in permanent magnets for motors and generators, dyeing of glass, lasers, and infrared lasers.
- Figure 4 provides 2017 – 2022 pricing for Rare Earth Element Praseodymium Oxide (Pr). Reference found from https://www.kitco.com/strategic-metals/ and Highcharts.com. Praseodymium is used in Magnets for electric motors, speakers, etc., colorant for pigments and glass, and electrically conductive ceramics.

The Rare Earth Elements are found in Figure 5 including yttrium, scandium and the 15 lanthanide series elements.

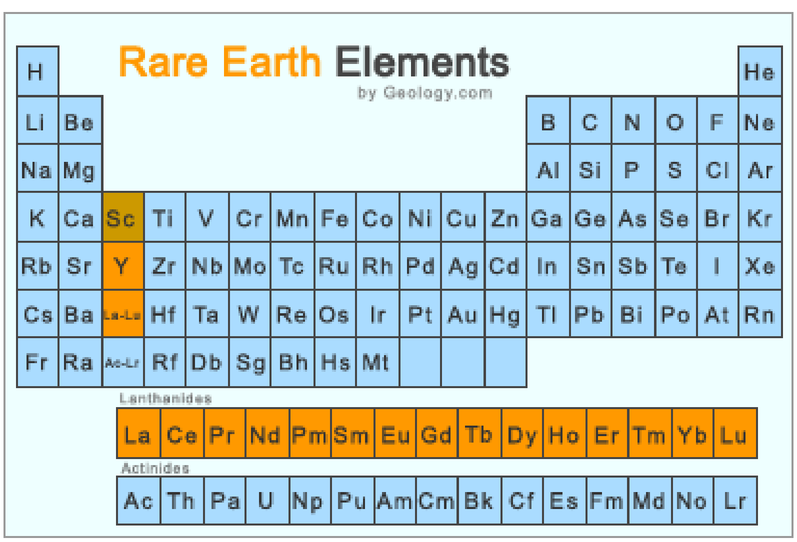

Figure (4) Rare Earth Periodic Table from Geology.com

General Atomics is involved in several nuclear-related programs critical to our Nation's defense. We have challenges acquiring relevant fissile isotopes. We continue to make critical design choices based upon material availability.

In conclusion, it grows more and more difficult for industry to accurately inform the government how much something will cost and subsequently to submit reasonable, accurate proposals. Established *Price Indexes* for costing consideration in future years of contract execution cannot be accurately relied upon to reduce risk. They cannot be relied upon to allow for generation of proposals that are both reasonably priced and which cover cost risk for volatile material in future years. Many of our government customers are exploring other capabilities to adjust contract values due to material volatility.

Thank you again for your time and the opportunity to speak on this important subject. I look forward to your questions.

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