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Testimony before the
Committee on Resources
Subcommittee on Energy and Mineral Resources
United States House of Representatives

Oversight Hearing on
Strategic and Critical Minerals
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Good morning Madam Chair and distinguished Members of the Subcommittee. Thank you for the opportunity to testify on this critical issue relative to the industrial base of the United States.

My name is Hugh Hanes. I am a retired Brush Wellman Inc. executive with over 45 years experience in the strategic metals business, including general management of Brush's mining and metallic beryllium operations. Since retirement in December 2000, I have continued as a government affairs consultant to both Brush Wellman and the Metals Affordability Initiative Consortium.

The purpose of my testimony will be to demonstrate the linkage between hardrock minerals and strategic and critical metals. I will also give examples where these strategic metals are enabling to both the aerospace/defense and critical civilian infrastructure.

The importance of these strategic and critical metals is described in the ancient saying, "For Want of a Nail", by some unknown author:

For want of a nail, the shoe was lost,
For want of the shoe, the horse was lost,
For want of the horse, the rider was lost,
For want of the rider, the battle was lost,
For want of the battle, the kingdom was lost,
And all for the want of a nail.

It would be easy to modernize this homily by substituting mineral, metal, turbine engine disk, plane, warfighter, etc. into the text above.

<u>Strategic and Critical Metals: the Hidden Commodities</u>

Strategic and critical metals are often referred to as hidden commodities. Metals availability is usually assumed by those in the user base who are dependent on the specialty aerospace metals industry. Usually, they're only noticed when either they become unavailable, e.g., the cobalt shortage of the 1970's, or a component fails.

However, they have similar characteristics. **All of these metals are derived from hardrock minerals.** Furthermore, many of these minerals are no longer domestically mined, as is shown in Table 1. As has already been discussed in this hearing, the domestic mining and minerals industry is declining. As my colleague, Mr. Noel, will describe in his testimony that the domestic specialty metals manufacturing base is declining as well.

These strategic metals are found in both the defense/aerospace and critical civilian infrastructure. For the purpose of this testimony, the critical civilian infrastructure can be defined as automotive, commercial aircraft, computers, telecommunications, electronics, electrical transmission, and medical applications. In other words, these are market sectors which help maintain this country's world leadership and quality of life.

In many instances, the applications are hidden, or buried deeply in the systems where these metals perform critical functions. Examples would include beryllium in aerospace/defense systems, precious metals in high-performance electronics, and rare earth metals in electro-optics.

<u>Characteristics of Strategic and Critical Metals</u>

Strategic and critical metals have common characteristics. They are most often found in **high-performance applications**, where there are requirements for combinations of high temperature resistance, high strength requirements, and corrosion resistance, etc. These classes of metals are used for **high reliability**, e.g., nickel-based superalloys for aircraft turbine engines, gold-plated connectors in automotive ignition systems, and silver-plated contactors in electrical transmission. Furthermore, they are **enabling** in their applications, e.g., beryllium optics in surveillance satellites, precious metals in electronic components for computer, and copper beryllium and precious metals in automotive electronics. Usually, they are the **most expensive** solution, because competitive materials have already been eliminated for non-performance in the particular application.

As shown in Table 2, these metals are **pervasive** in systems that serve both aerospace/defense and the critical civilian infrastructure. In all cases, they are the **material of choice**, i.e., they are used because of performance requirements. In most of the cases, they are **enabling** to the operation of the particular system.

<u>Beryllium and Its Alloys: Case Study</u>

The manufacturing of beryllium and its alloys is a case study which demonstrates the interdependence of mining and specialty metals production. Beryllium is mined and extracted from minerals in Utah by Brush Wellman (a "Western issue"). The ore concentrate is shipped to their primary metals production plant in Ohio (now it becomes an “Eastern issue”). Brush does secondary fabrication of its beryllium products in plants in Arizona, Massachusetts, New York, Pennsylvania, and Rhode Island. They have distribution centers in California, Illinois, Michigan, and New Jersey (it’s really a “Domestic issue”). Brush also has distribution centers globally, serving over 5,000 customers for beryllium products globally.

In his testimony to Congress[1], Deputy Secretary Paul Wolfowitz stated, “The Department of Defense is undergoing a substantial transformation of the Armed Services. . . . by pursuing a host of transformations including precision, surveillance, networked communications, robotics and information processing.” That beryllium is critical to 4 out of 6 of the Secretary’s goals can be demonstrated by examples of both current and developmental systems that use beryllium because of its unique properties. Specific examples are shown in Figures 1 to 4.

- Homeland Security – “U.S. forces must protect critical bases of operations and defeat weapons of mass destruction and their means of delivery.” *Beryllium is a key structural element in both the PAC-3 system and those interceptor systems under development.*
- Deny Enemies Sanctuary – “Space denial capabilities, such as ground-based lasers . . . require the development and acquisition of robust capabilities to conduct persistent surveillance of vast geographic areas and long-range precision strike.” *Beryllium is used in long-range surveillance systems, guidance, and is in development as seekers in new missile and ground-based lasers systems.*
- Projecting and Sustaining Forces – “increasing U.S. advantages in stealth, standoff, hypersonic and unmanned systems for power projection; and developing ground forces that are lighter, more lethal, more versatile, more survivable, more sustainable, and rapidly deployable.” *Beryllium is used extensively in reconnaissance satellites, FLIR’s, improving stand-off ranges for virtually every new generation targeting device, and battlefield surveillance, including the tank commander’s sight on the M1A2 Abrams.*

- Enhancing Space Capabilities – “become more dependent on space systems for communications, situational awareness, positioning, navigation, and timing.” *Applications of beryllium include instruments and critical structures in reconnaissance and surveillance satellites, defense weather satellites such as NPOESS, and the new generation of military communications satellites.*

Mr. Wolfowitz goes on to describe systems under development, *and in all cases, beryllium plays an **enabling** role:*

- Joint direct attack munitions (JDAM's) and other precision guided munitions
- Stealthy F-22’s
- Development of missiles defenses, including the Airborne Laser program

[1] “Prepared Statement for the Senate Armed Services Committee Hearing on Military Transformation”, by Deputy Secretary of Defense Paul Wolfowitz, April 9, 2002.

- Enhanced electro-optical capability for Global Hawk and other UCAV upgrades
- Precision weapons – weapons that are precise in time, space, and in their effects
- Missile defense – pursuing parallel technologies to meet the same objectives—for example, the kinetic kill boost vehicle and a space-based laser (beryllium is critical to both concepts)

Thus, beryllium processing clearly demonstrates the linkage between mineral resources in the Western US and metals manufacturing in the Domestic industrial base.

Precious Metals Perform Critical Functions in the Civilian Infrastructure

Precious metals are often portrayed by opponents of hardrock mining as unnecessary metals, but they perform critically enabling functions in the civilian infrastructure. Between 25 and 55% of the so-called noble metals mined and produced domestically are used in critical, high-reliability electronic applications because of their combination of oxidation resistance, electrical and thermal conductivity, and their resistance to corrosive environments. These high-reliability requirements dictate the selection of precious metals for many applications in a wide variety of industries, including the electrical, electronics, automotive, telecommunications, semiconductor, computer and medical industries. Examples of typical applications can be found in Table 3 and are illustrated in Figure 5 of this testimony.

Because of their high intrinsic cost, precious metals are often plated or laminated onto base metals to give added strength and to lower the cost of the component. Although gold remains the industry standard in many of these applications, gold and gold alloys as a cover over palladium and palladium-silver alloys are often used.

One of the major uses of high-reliability components containing precious metals can be found in automotive electronics. Under-hood interconnects for computerized ignition systems, mass air flow sensors, automatic transmissions, cruise control devices, anti-lock braking systems, and new generation suspension control systems all are made more reliable by employing precious metal containing components. Society benefits extensively from the use of these electronic components because of the increased safety, increased fleet mileage, and decreased emissions of the modern automobile.

Silver finds many used in both medicine and in electrical transmission. While silver's importance as a bactericide has been documented only since the late 1800's, its use in purification has been known throughout the ages. Silver also has a variety of uses in pharmaceuticals forming the most powerful compounds for burn treatment, for example. Silver is the best electrical conductor of all metals and is hence used in many electrical applications, particularly in conductors, switches, contacts, circuit breakers, and fuses. Thus, silver enhances the quality of life and safety even in our own homes.

To portray the usage of precious metals as trivial, as has been done by opponents of mining, is to totally ignore the benefits and increased quality of life we all enjoy from the judicious application of precious metals in the critical civilian infrastructure.

The Value of the USGS Mineral Information Team

The USGS Mineral Resource Program's Mineral Information Team is the only comprehensive source of statistical data on Mining and mineral commodities both domestically and internationally and is critical to the mining industry and to the nation as a whole. As a net importer of minerals, including many strategic minerals, the United States' ability to develop and implement global mineral-related strategy could be severely compromised without the availability of reports produced by this program. In addition, the analytical expertise of the program's mineral commodity and country specialists is vital to answering mineral related questions of a domestic and an international nature. A loss or reduction in expertise for tracking the world "hot spots" with respect to strategic and critical materials could negatively impact U.S. intelligence and national security. As a world leader, the U.S. must have a comprehensive and essential understanding of the worldwide commodity markets necessary for strategic and critical materials necessary to a healthy economy.

Summary and Conclusions

The purpose of this paper has been to demonstrate the linkage between hardrock minerals and the pervasive use of strategic and critical metals in the Domestic industrial base

1. Strategic and critical metals are derived from hardrock minerals, both domestic and foreign.

2. Component manufacturing is located across the country but primarily in Eastern (non-mineral) states and is dependent on hardrock minerals as the source of primary metals.

3. Both domestic aerospace and defense and critical civilian industries are dependent on a shrinking industrial base for their strategic and critical metals.

4. Continuation of the USGS Mineral Information Team will assure a comprehensive and essential understanding of the worldwide commodity markets necessary for strategic and critical materials necessary to a healthy domestic economy.

A well-conceived minerals and metals policy should protect and encourage maintaining both the development of domestic mineral resources and the strategic and critical metals industry. We have lost or are losing these capabilities as we speak. They have been precipitated by a series of unwise political decisions largely over the last 10 years which discounted the importance of a U.S. minerals base.

I look forward to working with Resource Committee members and my mining colleagues to reconstruct these vital elements of our national infrastructure.

Madam Chair and distinguished Members of the Subcommittee, I sincerely appreciate the opportunity to testify before you and would be glad to answer any questions you may have.

Table 1. U.S. Reliance on Mineral and Metal Imports

100% Reliance Bauxite and Alumina, Columbium, Manganese, Strontium, Yttrium	60-69% Reliance Titanium (Sponge), Tungsten
80-89% Reliance Platinum, Tantalum, Tin	50-59% Reliance Nickel, Silver
70-79% Reliance Chromium, Cobalt, Rare Earths, Titanium Concentrates	< 50% Reliance Aluminum, Beryllium, Copper, Iron Ore, Magnesium

Source: Mineral Commodity Summaries 2001, USGS

Table 2. Strategic and Critical Metals in Defense Systems

System	Percent Metal Content	Primary Metals	Secondary (Alloying) Metals
Airframe and Structures	67% of typical airframe	Titanium, Aluminum	Beryllium, Chromium, Iron, Magnesium, Manganese, Scandium, Silicon, Tin, Vanadium, Zirconium
Turbine Engines	80% of typical engine	Titanium, Aluminum, Nickel	Beryllium, Chromium, Cobalt, Iron, Magnesium, Manganese, Scandium, Silicon, Tin, Vanadium
Space and Missiles	Enabling for space propulsion; critical for structures	Aluminum, Titanium, Nickel, Beryllium	Cobalt, Chromium, Iron, Scandium, Magnesium, Manganese, Silicon, Tin, Vanadium

Source: Air Force Research Laboratory presentation
to the House Mining Caucus, July 16, 2002

Table 3. Some Typical Applications for Precious (Noble) Metals in the Critical Civilian Infrastructure

Industrial Sector	Typical Applications
Automotive:	Connectors Terminals Switches Bond Pads Lead Frames for: Air Bags Anti-Lock Brakes Mass Airflow Controls Speed Controls Powered Accessories Sensors
Telecommunications:	Connectors Switching Systems Cellular Phones Shielding Materials
Computers:	Connectors Switches Lead Frames Heat Sinks Multichip Modules Storage media
Medical:	Pharmaceuticals, home health-care equipment
Aircraft:	High-reliability switches, connectors and contactors
Power Transmission:	High-voltage switching gear, conductors, switches, contacts and fuses

Sources: Brush Engineered Materials and the Silver Institute

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Mr. Hanes is a retired executive with extensive experience in technology, manufacturing, sales and marketing, media communications, and government relations. His forty-five year career has been focused on specialty materials development and manufacturing, including beryllium, titanium, super alloys, and nuclear materials. He is currently a government affairs consultant to Brush Wellman Inc and the Metals Affordability Initiative (MAI) Consortium.

Prior to retirement, Mr. Hanes served Brush Wellman as Vice President, Government and Environmental Affairs and Vice President and General Manager of the Beryllium/Mining Division where he was responsible for the operation of the mining, extraction, and metallic beryllium manufacturing operations of the corporation.

During a 20-year period in the early part of his career, Mr. Hanes was employed by Battelle's Columbus (Ohio) Laboratories where he developed and managed projects for the advanced manufacturing of specialty materials for aerospace/defense, nuclear, and commercial applications.

Mr. Hanes served as a member of the Government-Industry Advisory Committee on the Operation and Modernization of the National Defense Stockpile in the mid-1990's. He also was Chairman of the Minerals Availability Committee of the American Mining Congress, has served as a Director of the National Mining Association (NMA), and continues as an active member of the NMA's Government Affairs Committee.

Mr. Hanes was named a Fellow of ASM International in 1993 "for the successful development and commercialization of hot isostatic pressing technology for the net-shape fabrication of particulate materials, including applications in beryllium manufacturing."

He has degrees in Metallurgy from both Purdue University and The Ohio State University.