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Bert Chapman

Purdue University, chapmanb@purdue.edu

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THE GEOPOLITICS OF RARE EARTH ELEMENTS: EMERGING CHALLENGE FOR U.S. NATIONAL SECURITY AND ECONOMICS

BERT CHAPMAN
chapmanb@purdue.edu
Purdue University,
West Lafayette, IN

ABSTRACT. Rare earth elements (REE) contain unique chemical and physical properties such as lanthanum, are found in small concentrations, need extensive precise processes to separate, and are critical components of modern technologies such as laser guidance systems, personal electronics such as iPhones, satellites, and military weapons systems as varied as Virginia-class fast attack submarines, DDG-51 Aegis destroyers, the F-35 Joint Strike Fighter, and precision guided munitions. The U.S. has some rare earth resources, but is heavily dependent on access to them from countries as varied as Afghanistan, Bolivia, and China. Losing access to these resources would have significant adverse economic, military, and political implications for the U.S. and its allies if their supply sources are restricted or eliminated. This article will examine the critical strategic importance of these resources, the historical origins and contemporary development of U.S. policy toward strategic minerals, and how multiple U.S. Government agencies are involved in this emerging policymaking arena. It features significant use of U.S. and foreign government statistics and analyses and scholarly journal literature. It will conclude by suggesting efforts to limit the severity of this problem to the U.S.' economy and national security interests.

JEL codes: B22; E02; L16; O11

Keywords: rare earth elements; strategic minerals; geopolitics; national security; international security; supply chain security; national security policymaking.

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Introduction

Multiple factors influence the formulation and implementation of U.S. foreign and national security policy. Besides the numerous economic, political, and psychological factors in such policymaking, the role of accessing and having dependable supplies to natural resources plays a paramount role. Most observers of international relations and security are familiar with the importance of oil and natural gas in these areas. More attention, however, needs to be devoted to the role played by other natural resources, including minerals, in U.S. foreign and national security policies. The role of Rare Earth Elements (REEs) is of particular importance due to the weakness of the U.S.' domestic REE industry and its dependence on foreign suppliers, particularly China, for its access to these materials which have become deeply interwoven into the U.S.' civilian economy and to its national security infrastructure. Failure by the U.S. to expand the growth of its REE industry could make it economically and militarily vulnerable to supply disruptions from China and other foreign suppliers who are antagonistic to U.S. economic and strategic interests.¹

What Are Rare Earth Elements?

REE are 15 elements ranging from atomic number 57 (Lanthanum) to 71 (Lutetium) on the periodic table of elements. In addition, atomic number 39 (Yttrium) and atomic number 21 (Scandium) are also regarded as REEs because of similar chemical and physical properties. Light REEs cover from Lanthanum to atomic number 64 (Gadolinium) and heavy REEs cover from atomic number 65 (Terbium) to Lutetium. REEs are not defined as rare due to supply shortages, but due to their identification during the 18th and 19th centuries as being materials which could not be changed further by heat unlike lime or magnesia. Atomic number 58 (Cerium) is the most abundant REE and is more common in the Earth's crust than copper or lead and all REEs, except Atomic number 61 (Promethium) are most abundant on average in the earth's crust than silver, gold, or platinum.

Concentrated and economically minable deposits of REEs are unusual.²

Figure 1 Rare Earth Elements

Rare Earth Elements														Y 39			
La 57	Ce 58	Pr 59	Nd 60	Pm 61	Sm 62	Eu 63	Gd 64	Tb 65	Dy 66	Ho 67	Er 68	Tm 69	Yb 70	Lu 71			
Lanthanides																	
H															He		
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac	Lr														

Source: U.S. Geological Survey

U.S. and International Civilian Uses of REEs

REEs are significantly integrated into a multiplicity of civilian applications in the U.S. and internationally. They make phosphors (substances emitting luminescence) for ray tubes and flat screen displays ranging in size from smart phone displays to stadium scoreboards with some REEs used in fluorescent and LED lighting. The glass industry is the largest single consumer of REE raw materials using them for glass polishing and additives providing color and special optical properties. Lanthanum consists of nearly 50% of digital camera lenses including cell phone cameras. Catalysts of this element are also used to refine petroleum and cerium-based catalysts are used in automobile catalytic converters.³

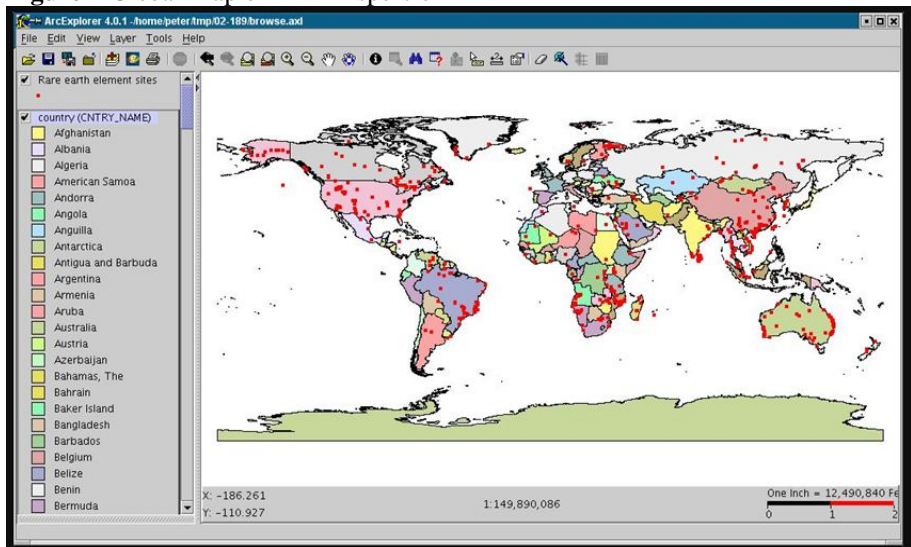
Magnets deploying REEs are receiving frequent use with neodymium-iron-boron magnets being the strongest known magnets and are very useful when space and weight are limiting factors. REE magnets are used in computer hard disks and CD-ROM and DVD disk drives. Disk drive spindles attain high stability in their spinning motion when driven by a REE magnet. Such magnets are also used in multiple conventional auto subsystems including power steering, electric windows, power seats, and audio speakers. Nickel-metal hydrides are built with lanthanum-based alloys as anodes and can be used as batteries in hybrid electric cars requiring 10–15 kilograms per vehicle. Other REEs, including cerium, lanthanum, neodymium, and praseodymium, commonly used as a mixed oxide called mischmetal, are used in steel making to remove impurities and in producing special alloys.⁴

Global Dispersion of REEs

Global REE resources are distributed throughout the world with only a small percentage being available in the U.S. A 2008 National Research Council report stressed that REEs rank high on the “criticality” factor of raw materials emphasizing they possess high technological and economic importance along with high supply side risk. This assessment went on to maintain that critical material availability can and will change as production technologies evolve and new products are developed, that the U.S. Government defines a critical mineral as one with essential uses and subject to supply restriction risk, the longer it takes to substitute a mineral increases cost and expense and increases the impact of mineral supply disruption, significant short and medium-term mineral supply disruptions may occur due to significant demand increase, thin markets, product concentration, production predominantly as a by-product, and lack of available old-scrap for recycling or the infrastructure required for recycling, long-term mineral and mineral product availability requires continued minerals education spending, and that import dependence alone is not a useful risk indicator but imports can be vulnerable to disruption if supply is concentrated in one or more REE exporting countries with high political risk or where significantly increasing internal demand may cause indigenous REE production to be directed to internal consumption.⁵

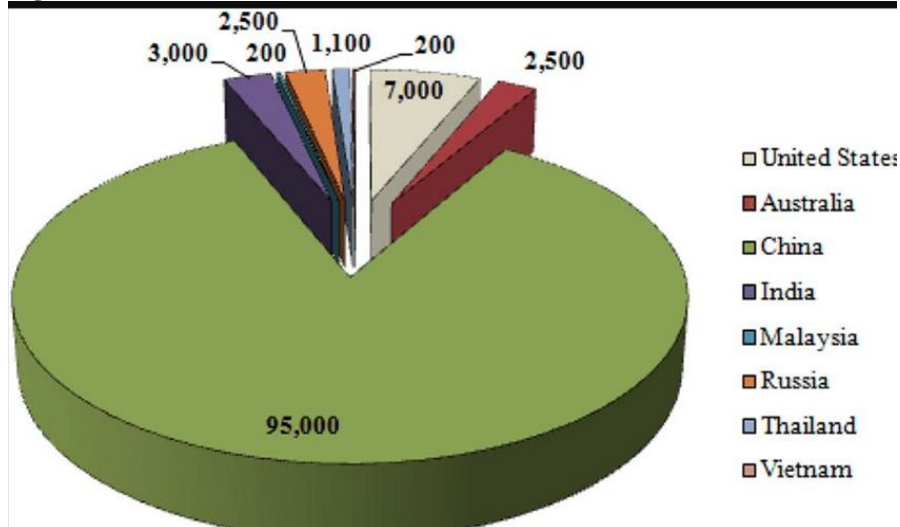
The following section will describe the REE resources, industries, and governmental policymaking of selected countries besides the U.S. which begins with charts showing global REE distribution.

Figure 2 Global Map of REE Dispersion



Source: U.S. Geological Survey (USGS)

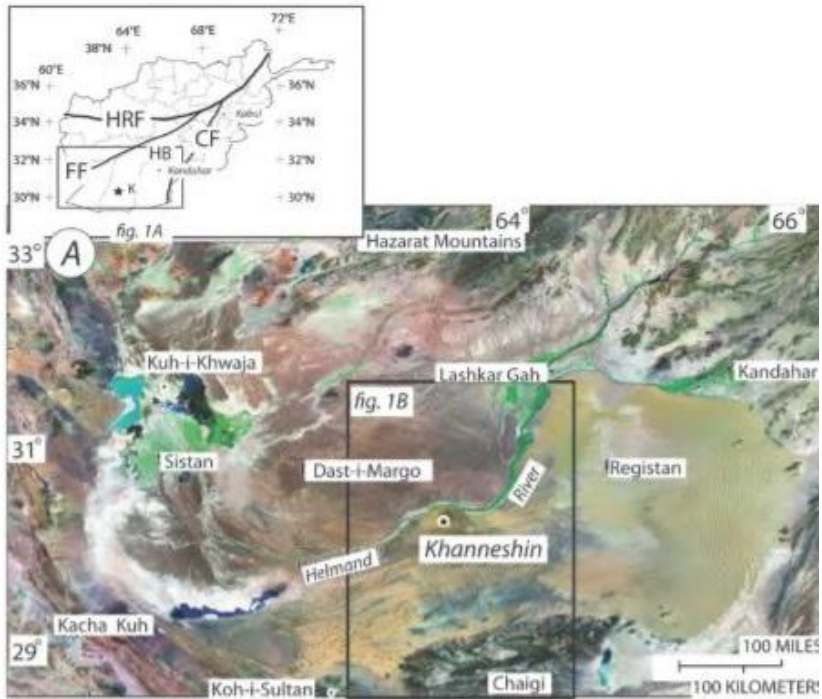
Figure 3 Global Mine Production of Rare Earth Minerals in Different Countries



Source: *Hydrometallurgy* 165 (October 2016): 6.

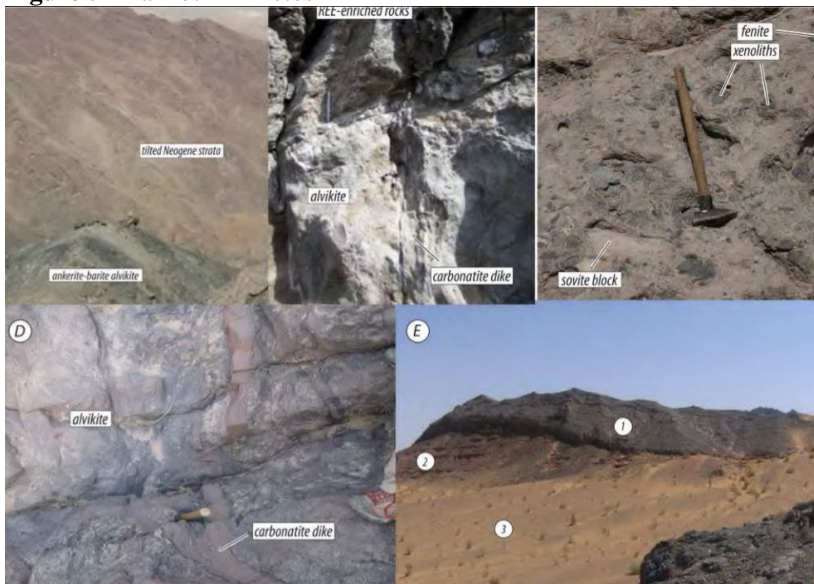
Afghanistan – The U.S. Geological Survey (USGS) reports that Afghanistan’s Helmand Province contains REEs and uranium with these concentrated in the Khan Neshin carbonite complex uncovered by Soviet investigators in the 1970s and confirmed by subsequent Afghan and USGS geological investigations. Their estimate of undiscovered REE deposits include a mean expected value of 1.4 million metric tons of REE and 3.48 million metric tons of niobium which, while not a REE, is considered a critical strategic material due to its use in various superconducting purposes including electronics, nuclear industries, and optics. Afghanistan has been unable to achieve significant development of its REE industry due to violent conditions and lack of infrastructure including electricity, mining and mineral processing facilities, and roads. However, these factors have not unduly restricted China’s interests in Afghan REE reserves and efforts to gain influence in accessing them.⁶

Figure 4 LANDSAT Imagery of Helmand REE and Khanneshin Site



Source: USGS

Figure 5 Khanneshin Photos



Source: USGS

Helmand Province has seen repeated fighting between the U.S., international coalition allies, and the Afghanistan Government against the Taliban. Operation Moshtarak lasting over several months in 2010 resulted in an eventual military victory for the U.S. and its allies. The June 2017 edition of the Defense Department’s report *Enhancing Security and Stability in Afghanistan* documented ongoing military operations in Helmand and Kandahar provinces including the Taliban claiming responsibility for fatal January 10, 2017 attacks in these provinces, ongoing Taliban efforts to contest and seize population and communication centers in these regions persist, and three U.S. military personnel were wounded during a March 20, 2017 insider attack at a Helmand Province military base.⁷

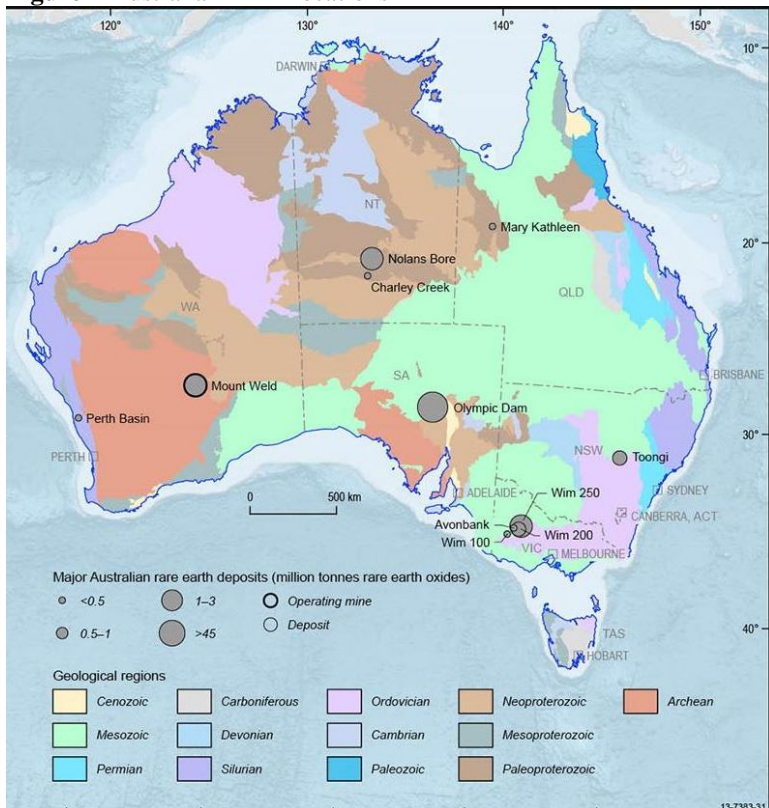
Figure 6 Map of Southwest Afghanistan including Helmand Province



Source: Institute for the Study of War

Australia – Mineral resources have played and continuing playing critically important roles in Australian economic prosperity and strategic interests.⁸ During 2015, Australian mineral exports (except petroleum products) were AUS \$141 billion representing 56% of export merchandise, 45% of exported goods and services, and nearly 9% of Gross Domestic Product. 2015 Australian REE resources are estimated to be 3.44 million metric tons (MT) up from 3.19 million MT in 2013. This represents approximately 2.6% of the world’s estimated total of 130 MT. Growth in Australian REE stem from resource upgrades at Yangibana (Hastings Technology Metals Ltd) and Browns Range (Northern Minerals Ltd) in Western Australia and Nolans Bore (Arafura Resources Ltd) in the Northern Territory. Lynas Corporation Ltd operates Australia’s only rare earths mine at Mount Weld, Western Australia which supplies Rare Earth concentrates to the Lynas Advanced Materials Plant (LAMP) in Malaysia. Mount Weld produces on a LAMP demand basis and in 2015 produced 10,900 tons of ready-for-sale RE oxides making Australia second only to China which generates 85% of this production.⁹

Figure 7 Australian REE Locations

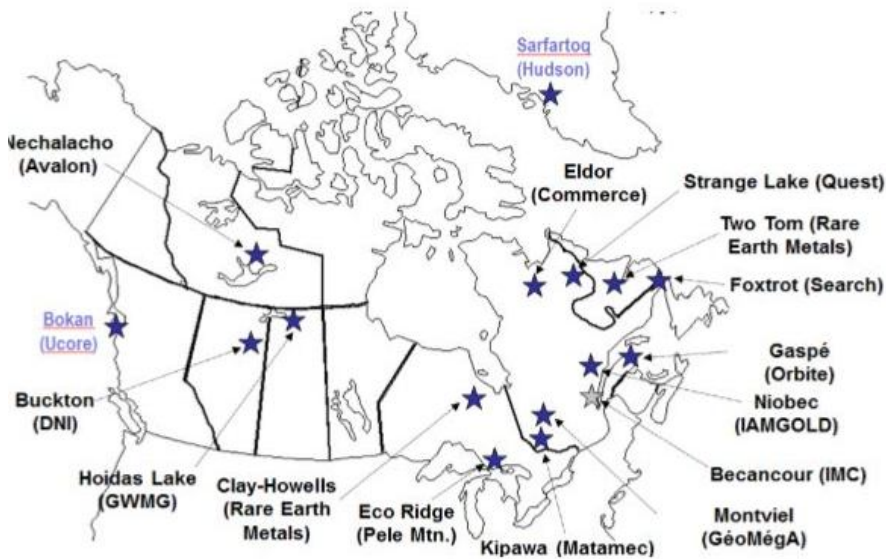


Source: Geosciences Australia

In 2011, Australia and the U.S. signed a Reciprocal Security of Supply Agreement to ensure that each country provided the other a reciprocal priority and supply of defense products, materials, and services to discharge their military commitments according to their foreign and security policy requirements.¹⁰

Canada – Canada’s geographic and geological expanses also feature potentially substantive REE reserves and Canada has a demonstrated a successful historical and contemporary record of mineral resources extraction. It has been estimated that there are over 200 individual REE demonstration projects at various stages of development in Canada with the following chart demonstrating potential future REE mines:

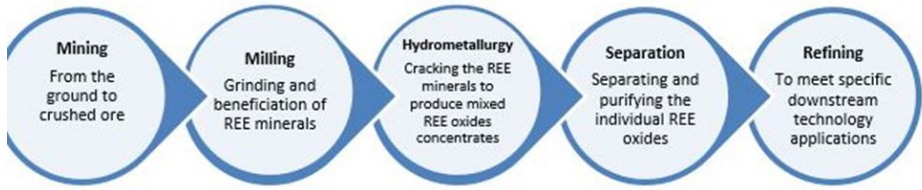
Figure 8 Rare Earth Projects (Potential Future Mines)



Source: Natural Resources Canada, brief presented to the Committee, 25 November 2013

Canadian Government officials have identified 11 REE projects in advanced exploration stage which are all Canadian owned. The capital expenditure requirements of developing a Canadian rare earth mine are estimated to range from \$CAN 106 million–\$2.5 billion which are much higher than mining traditional metals like copper. The House of Commons Natural Resources Committee learned that developing a Canadian REE mine could take between 7–10 years involving multiple development stages including prefeasibility studies and environmental assessment with the following chart reflect the multifaceted permitting process.¹¹

Figure 9 Front-End REE Supply Chain



Source: Natural Resources Canada, brief presented to the Committee, 25 November 2013, and the Canadian Rare Earth Elements Network, brief presented to the Committee, 13 February 2014

The Canadian Government has pledged to promote research on environmentally cleaner and more efficient REE and chromite extraction. Ottawa maintains that REEs are key components facilitating a transition to clean technologies behind a transition to a low carbon economy. Such programs are believed to deliver process efficiencies; economic and market analyses to inform technology gaps; laboratory and pilot-scale testing facilities; and highly qualified personnel to position Canada to develop a strategic market for REEs. Additional outputs of REE related spending are projected to include developing and demonstrating technologies to increase mining operational productivity, including techniques to break rocks without explosives in order to save time and money; engineering rock bolts (for stabilizing rock excavations) with sensors to monitor rock bolt integrity; and advancing development of a facility to cost-effectively test ground support systems.¹²

Testifying before the House of Commons Natural Resource Committee on February 25, 2014, Pierre Neatby, Vice-President of Avalon Rare Metals, stressed Canada's political and economic stability and mining engineering excellence as giving Ottawa the opportunity to become a reliable alternative REE supplier:

Canada has a history of mining excellence and companies that are looking for rare-earth products outside of China are looking for a culturally, politically stable country to invest in, and Canada fits that description. Some of the other projects that we're competing against, whether they be in South Africa, Kyrgyzstan.... Those countries may not be seen as being as politically stable as a Canada, or a U.S., or an Australia. So having the Canadian government make a signal to these potential investors that Canada is supportive of rare earths would help us tremendously in attracting that investment.¹³

China – China is the world's preeminent producer, consumer, and exporter of REE's and has demonstrated the willingness to use its geopolitical leverage in this arena to seek to achieve economic and strategic objectives. Beijing possesses almost 95% of global REE reserves. At the end of 2014,

21 mining companies and over 100 processing companies were registered with Beijing’s Ministry of Industry and Information Technology for a cumulative total rare-earth mining capacity of 300,000 tons annually and an annual rare-earth production capacity of 60,000 tons annually. Additional secondary rare-earth products are also produced from waste materials by some recycling companies.

January 2014 saw China’s State Council approve a rare-earth industry integration plan prepared by the Ministry of Industry and Information Technology and other agencies to consolidate six large rare-earth companies and improve the industry’s international competitiveness. These six companies are:

Aluminum Corporation of China Ltd. (CHINALCO)	Integrates REE companies in Guangxi, Jiangsu, Shandong, and Sichuan.
Baogang Group	Integrates REE companies in Gansu and Inner Mongolia.
China Minmetals Corporation	Integrates REE companies in Hunan plus companies it has in Fujian, Guangdong, Jiangxi, and Yunnan.
Ganzhou Mining Group	Integrates REE companies in Jianxi.
Guangdong Rising Nonferrous Group	Integrates REE companies in Guangdong.
Xiamen Tungsten Group	Integrates REE companies in Fujian. ¹⁴

Figure 10 Chinese Geographic Distribution of REE Resources



Source: MIT

China's REE Geopolitical Leverage

China's essentially monopolistic control of global REE reserves and its extensive exports of these resources have caused concerns that it might use this preeminent position to engage in geopolitical leverage against the U.S. and other REE importing countries to achieve geopolitical and strategic objectives detrimental to the importing countries. Chinese preeminence in the global REE market has occurred since the mid-1980s due to China's economic growth which has exponentially increased its appetite for REE's, a declining U.S. REE industry due to higher labor costs compared with China, environmental problems at the U.S. Mountain Pass Mine in California which resulted in this mine being temporarily shut down as a result of stringent U.S. regulatory and environmental laws, and lower Chinese labor costs and environmental standards.¹⁵

An analysis of a how a potential 2030 confrontation between the U.S. and its allies against China over Taiwan and the South China Sea could injure U.S. and allied access to REEs is described as follows:

The numerous weapons systems that rely on rare earths technology place the United States at a strategic disadvantage with regards to China. If a prolonged large-scale conflict between the two conflicts broke out over a Taiwan Strait or South China Sea dispute, the United States may find itself squeezed to obtain sufficient supplies of rare earths to manufacture replacement parts or systems to remain engaged in the fight. Much as the lack of secure access to oil was crippling to the Germans at the end of World War II, rare earths could play a similar, pivotal role in a future conflict with China. In the air-to-air arena alone, the requirement to replace expended stockpiles of advanced air-to-air missiles could become a factor very quickly based on the number of aircraft China would be capable of employing.¹⁶

In July 2010, China's Ministry of Commerce announced a 725% reduction in Rare Earth Oxide exports for the second half of that year limiting annual REE exports to 30,258 tons. In December 2010, Beijing announced that its REE export quotas for the first half of 2011 would be 14,508 tons or an 11% reduction. China also demonstrated its intention to use REEs as geopolitical leverage when a Japanese Coast Guard vessel attempted to stop a Chinese fishing boat from illegally fishing in Japanese waters in the East China Sea with the Japanese ship ramming the Chinese vessel and apprehending its captain. An ensuing political split resulted in suspension of high-level contacts between Beijing and Tokyo and China temporarily withholding REE exports to Japan.¹⁷

World Trade Organization Ruling and U.S. Expressions of Concern

Many U.S. Government and other sources have expressed concern about China's REE export quotas and monopolistic dominance of the global REE market. On March 13, 2012, the U.S. requested consultations with China on Beijing's REE restrictions. Then U.S. Trade Representative Ron Kirk maintained "America's workers and manufacturers are being hurt in both established and budding industrial sectors by these policies. China continues to make its export restraints more restrictive, resulting in massive distortions and harmful disruptions in supply chains for these materials throughout the global marketplace."¹⁸ On March 22, 2012, the European Union and Japan requested the World Trade Organization (WTO) to join this forum's consultation on these export quotas with Canada requesting to join these consultations on March 26, 2012. China allowed these countries to participate in the WTO's Dispute Settlement Board (DSB) process with the U.S. requesting that a DSB be established on June 27, 2012. A DSB was established by the WTO later in 2012 with countries as varied as Australia, Brazil, India, Japan, and Saudi Arabia participating.¹⁹

Following over two years of deliberations, the WTO ruled on August 29, 2014, that China's export duties on rare earths, tungsten, and molybdenum were inconsistent with its accession to the WTO, that these duties were inconsistent with Article 11 of the General Agreement on Tariffs and Trade (GATT) prohibiting trade restrictions besides duties, taxes, and other charges, and that Chinese restrictions on the trading rights of REE and molybdenum exporting companies were inconsistent with justificatory arguments expressed by China in its position paper on this dispute.²⁰

China eliminated the REE export duties in January 2015 replacing them with a resources tax. This tax was announced by China's Ministry of Finance and State Administration of Taxation on April 30, 2015, setting the following levels for these categories of REEs, tungsten and molybdenum:

Light Rare Earth 11.5% in Inner Mongolia Autonomous Region, 9.5% in Sichuan Province, 7.5% in Shandong Province
Middle and Heavy Rare Earth 27%
Tungsten 6.5%
Molybdenum 11%. ²¹

U.S. concern over Chinese REE monopoly has been expressed in numerous venues. A 2014 article in *Joint Force Quarterly* described how Afghanistan's need for money could allow it to be drawn into China's geopolitical orbit as Beijing seeks to enhance its influence over Kabul's REE reserves.²² A 2010 article in this same Defense Department journal, published before the temporary Chinese ban on REE exports to Japan, reported that an online Chinese

Communist Party newspaper and several Chinese blogs encouraged banning the sale of REEs to U.S. companies following the Obama Administration approving a \$6.4 billion arms sale to Taiwan. This article contended that China has been looking at possible military applications of REEs since the 1960s, that Beijing has engaged in some REE research collaboration with Iran and North Korea, and that Beijing's REE reserves, research activities, and capabilities could potentially give it a decisive edge in military technologies in comparison with the U.S.²³

A 2016 report by the Obama Administration's National Science and Technology Council (NSTC) acknowledged that REEs and related materials including platinum-group metals, antimony, vanadium, tungsten, and germanium consistently fell into the category of strategically critical materials. However, it sidestepped the national security implications of U.S. dependence on unstable and potentially hostile foreign suppliers with the following bureaucratic rhetorical obfuscation:

For minerals ultimately identified as critical, it is fair to wonder what can be done to decrease the associated risks and vulnerabilities. As illustrated by Ku and Hung, there is a hierarchy of strategies that can be adopted to help reduce mineral supply risks. These strategies range from short-term efforts aimed at developing strategic inventories and implementing fixed-price contracts, to medium-term efforts such as improving efficiencies by reducing waste and increasing recovery rates throughout the life cycle, to longer-term efforts that include material redesign and elemental and system-level substitution. Where these efforts are best targeted can be informed by the subsequent in-depth analyses.²⁴

Russia – As a prominent geopolitical factor in global energy policy, Russia plays a lesser but potentially significant role in the international REE equation. The 1990s saw the role of REEs in Russian economic, military, and political calculations began to increase with REE resources being estimated as ranging from 18–22% of the world's total and with existing and potential resources and processing plants concentrated geographically in both European and Asian Russia in locales as varied as the Irkutsk and Murmansk Oblasts and Yakutia. During July 2013, the Russian Federation Government established rules governing the formation of a Federal Reserve Fund for subsoil lots containing minerals. February 2013 saw the Russian President issue a decree outlining a strategy for enhancing mineral industry development in the Arctic through 2020 despite Russian REE production falling from 2,600 metric tons to 2,100 metric tons between 2009 and 2013. It is highly probable that Russia will seek to use existing and potential REE resources to enhance its strategic position and may seek to do so in collaboration with China.²⁵

Figure 11 Selected Map of Russian European REE Resource Sites



Source: *European Journal of Mineralogy*, 12(6), 2000: 1230.

United States – U.S. interest in documenting indigenous mineral resources holdings predates the 1879 establishment of the U.S. Geological Survey (USGS). An 1833 report to Congress by the Secretary of War Lewis Cass (1782–1866) called for the U.S. Government to document and map such resources.²⁶

Figure 12 Report from the Secretary of War

22d CONGRESS,
2d Session.

[35]

REPORT
FROM
THE SECRETARY OF WAR,
In compliance with a resolution of the Senate, on the Memorial of George W. Featherstonhaugh.

—♦—
JANUARY 18, 1833.
Referred to the Committee on Military Affairs.

—♦—
DEPARTMENT OF WAR,
January 17th, 1833.

SIR: I have the honor to transmit, herewith, the report called for by the resolution of the Senate, of the 13th ultimo, in regard to the memorial of George W. Featherstonhaugh.

I have the honor to be,
Very respectfully,
Your obedient servant,
LEWIS CASS.

To the PRESIDENT
of the Senate of the United States.

The Secretary of War, in obedience to a resolution of the Senate, of December 13th, 1832, has the honor to submit the following report on the memorial of George W. Featherstonhaugh:

The memorialist is the editor and publisher of a Geological Journal in the city of Philadelphia, which has attained, and justly, considerable celebrity both in this country and in Europe. But the pecuniary condition of this establishment is not a prosperous one. Creditable as it is to the founder and supporter, and useful to the cause of science, its circulation is not sufficient to meet the expenses of publication, and it must either be abandoned, or find new sources of supply. This state of things may be traced to the comparatively recent introduction of the science of geology into the United States, and to the limited number of its votaries. It cannot be attributed to any want of spirit, industry, or ability, in the prosecution of the design.

Mr. Featherstonhaugh is also engaged in the collection of materials for the construction of a geological map of the United States, exhibiting the mineral formations, the metallic beds, the geological structure of chains of hills, and their continuity and elevation, together with all the facts, both topographical

Source: ProQuest Congressional

Subsequent decades have seen the U.S. place increasing emphasis on developing, conserving, and using indigenous mineral resources for a variety of civilian and military applications. As military arsenals have become more technologically advanced they have frequently required refined mineral resources to make effective use of these weapons to achieve strategic and national security objectives. While some of these mineral resources have been available domestically, others have only been available from foreign suppliers of sometimes questionable reliability. This has resulted in Congress enacting legislation requiring multiple federal agencies to ensure the U.S. military and civilian economy have dependable access to critically important strategic resources such as REEs.²⁷

Key U.S. Government Legislation

The past several decades have seen the U.S. Government enact numerous statutes intended to ensure the U.S. has access to critical natural resources and other materials for national security and domestic needs. The 1933 Buy American Act sought to protect U.S. businesses and labor by restricting the acquisition and end use of “non-domestic” products and construction materials. This statute has essentially defined these categories as unmanufactured end products or construction materials defined or produced in the U.S. and end products or construction materials manufactured in the U.S. provided that their cost of components manufactured, mined, or produced in the U.S. exceeds 50% of the cost of all components or the product is a commercially available off-the-shelf item. End products or construction materials not qualifying as domestic under these definitions are generally treated as foreign, offers supplying foreign end products or construction materials or foreign offers regardless of the suppliers’ nationality, and purchases of services are generally not subject to the Buy American Act.²⁸

This statute features five exceptions including:

1. Procuring domestic goods or using domestic construction materials is inconsistent with the national interest.
2. Domestic end products or construction materials are unavailable.
3. The contracting officer determines the costs of domestic end products or construction materials is unreasonable.
4. The agency is procuring information technology as a commercial item.
5. The goods are required specifically for commissary resale. ²⁹

The 1939 Strategic and Critical Materials Stockpiling Act was the first time the term “critical material” appeared in U.S. statutory language. A key provision of this statute’s intent declares:

The Congress finds that the natural resources of the United States in certain strategic and critical materials are deficient or insufficiently developed to supply the military, industrial, and essential civilian needs of the United States for national defense. (b) It is the purpose of this Act to provide for the acquisition and retention of stocks of certain strategic and critical materials and to encourage the conservation and development of sources of such materials within the United States and thereby to decrease and to preclude, when possible, a dangerous and costly dependence by the United States upon foreign sources or a single point of failure for supplies of such materials in times of national emergency. (c) The purpose of the National Defense Stockpile is to serve the interest of national defense only. The National Defense Stockpile is not to be used for economic or budgetary purposes.³⁰

Subsequent amendments to this statute in 1946, 1980, and 1984 represent the foundation of U.S. national minerals and materials policy while providing for the establishment of institutions such as the National Defense Stockpile and National Critical Materials Council.³¹

1941 saw Congress enact a set of domestic source restrictions which would eventually become known as the Berry Amendment and sought to require that most DOD purchased items be grown, processed, and reused in the U.S. This legislation would cause and continues causing considerable confusion for DOD purchasers and lawyers in subsequent decades and apply to areas as varied as strategic minerals and military clothing.³²

The 1950 Defense Production Act (DPA) was enacted in response to critical materials shortages encountered during World War II and the Korean War's onset. This statute expands presidential powers to give the President a broad set of authorities to influence domestic industry to benefit national defense. Broad examples of these expansive authorities include allowing the President to require persons (including businesses and corporations) to prioritize and accept contracts for national defense related materials and services, incentivizing the domestic industrial base to expand production and supply of critical materials and goods via loans, loan guarantees, direct purchases, and purchase commitments along with authority to purchase and install equipment in private industrial facilities. Additional provisions of this statute include the authority to establish voluntary agreements with private industry; authority to block proposed or pending foreign corporate mergers, acquisitions, or takeovers threatening national security, and authority to employ persons with requisite experience or ability and establish a pool of volunteer industry executives who could be called to government service for national defense purposes.³³

The 1988 Exon-Florio Amendment to this statute designates the Committee on Foreign Investment in the United States (CFIUS), an interagency entity chaired by the Secretary of the Treasury, as the mechanism through which the President acts to investigate and suspend corporate mergers and acquisitions or transactions which may be injurious to national security. In 1990, the CFIUS ordered the China National Aero-Technology Import and Export Corporation to divest itself of Seattle's NAMCO manufacturing and in 2005 CFIUS halted Chinese-owned Lenovo's acquisition of IBM's personal computer and laptop division.³⁴

1973 saw congressional enactment of the Specialty Metals Clause which saw the 1973 Defense Appropriations Act incorporate specialty metals into the Berry Amendment. Specialty metals are used in components purchased by DOD for aircraft weapons, equipment, and within integrated circuits, wiring, and electrical components. Examples of specialty metals include certain types of cobalt, nickel, steel, titanium and titanium alloys, and zirconium and zirconium base alloy. These metals were separated from the Berry Amendment in 2007. Numerous exceptions exist for requiring domestic purchase of specialty metals including national security waivers, when they are bought to support U.S. combat or contingency operations outside the U.S., when electrical components are involved, and when the Secretary of Defense certifies in writing that such materials are needed for national security.³⁵

The 1980 National Materials and Minerals Policy Research and Development Act sought to reiterate the critical importance of the U.S. having sufficient supplies of critical materials for domestic economic and national security needs stressing:

The Congress declares that it is the continuing policy of the United States to promote an adequate and stable supply of materials necessary to maintain national security, economic well-being and industrial production, with appropriate attention to a long-term balance between resource production, energy use, a healthy environment, natural resources conservation, and social needs. The Congress further declares that implementation of this policy requires that the President shall, through the Executive Office of the President, coordinate the responsible departments and agencies to, among other measures – (1) identify materials needs and assist in the pursuit of measures that would assure the availability of materials critical to commerce, the economy, and national security; (2) establish a mechanism for the coordination and evaluation of Federal materials programs, including those involving research and development so as to complement related efforts by the private sector as well as other domestic and international agencies and organizations; (3) establish a long-range assessment capability concerning materials demands, supply and needs, and provide for

the policies and programs necessary to meet those needs; (4) promote a vigorous, comprehensive, and coordinated program of materials research and development consistent with the policies and priorities set forth in the National Science and Technology Policy, Organization, and Priorities Act of 1976 (42 U.S.C. 6601 et seq.); (5) promote cooperative research and development programs with other nations for the equitable and frugal use of materials and energy; (6) promote and encourage private enterprise in the development of economically sound and stable domestic materials industries; and (7) encourage Federal agencies to facilitate availability and development of domestic resources to meet critical materials needs.³⁶

U.S. REE Policymaking Actors

Recent decades have seen a proliferation of U.S. Government agencies become involved in REE policymaking activities which has made Washington developing an effective REE national security and domestic economic policy-making essentially impossible.

The Defense Logistics Agency (DLA) Strategic Materials division serves as the U.S.’ leading agency for analyzing, planning, procuring, and managing critical national security materials. DLA administers implementation and evaluation of Strategic and Critical Materials policies set forth by the National Defense Stockpile Manager and the Strategic and Critical Materials Stockpiling Act. Strategic Materials uses its technical expertise and geopolitical material supply analysis to acquire, update, rotate, and dispose of stockpile materials provided by the Annual Materials Plan.³⁷

In its Fiscal Year 2016 annual report to Congress published in January 2017, DLA announced that it had initiated a Small Business Innovation Research (SBIR) program to develop economic methods for recycling REEs from waste and scrap streams and that the total inventory market value of the National Defense Stockpile was \$1.15 billion on September 30, 2016.³⁸ This agency’s FY 2017 Annual Materials Plan from October 1, 2016–September 30, 2017 includes the following potential sales:

Material	Unit	Ceiling Quantity
Chromium, Ferro	ST	23,500
Chromium, Metal	ST	200
Manganese, Ferro	ST	50,000
Platinum	TR OZ	8,380
Tungsten Metal, Scrap	LB	190
Tungsten Ores and Concentrates	LB W	3,000,000
Zinc	ST	7,993. ³⁹

DLA's potential upgrades and disposal plans for FY 2017 include:

Material	Unit	Ceiling Quantity
Beryllium Metal	ST	2
Germanium	Kg	5,000
Manganese, Metallurgical Grade	SDT	322,025
Nickel Based Alloys	LB	150,000
Platinum-Iridium	TrOz	489
Tantalum Carbide Powder	LB Ta	3,777
Tin	MT	804
Titanium Based Alloys	MT	75,000
Tungsten Metal Powder	LB W	77,433. ⁴⁰

In FY 2017 DOD's potential acquisitions of strategic materials were:

Material	Unit	Ceiling Quantity
Boron Carbide	MT	1,000
Carbon Fibers (High Strength)	MT	72
CZT (Cadmium Zinc Tellurium)	Cm2	32,000
Dysprosium Metal	MT	0.5
Europium	MT	18
Ferro-niobium	MT	209
Germanium Metal	KG	1,000
Lithium Cobalt Oxide (LCO)	KG	600
Lithium Nickel Cobalt Aluminum Oxide (LNCAO)	KG	2,160
Mesocarbon Microbeads (MCMB)	KG	15,552
Silicon Carbide Fibers	LB	875
Tantalum	Lb Ta	33,990
TATB (Triamino-TrinitrobenzeneO)	LB	148,000
Tungsten-3 Rhenium Metal	KG	5,000
Yttrium Oxide	MT	10. ⁴¹

The Assistant Secretary of Defense for Manufacturing and Industrial Base Policy (MIBP) serves as the principal advisor to the Undersecretary of Defense for Acquisition, Technology, and Logistics for:

- DOD policies for maintaining the defense U.S. industrial base
- Industrial base related budget matters
- Anticipating and closing gaps in manufacturing capabilities or defense systems
- Assessing impacts relating to mergers, acquisitions, and divestitures
- Monitoring and assessing the impact of foreign investments in the U.S.
- Executing legal authorities under 10 USC 2501 and 2505.⁴²

MIBP program areas include Advanced Manufacturing Capabilities covering DPA Title III, manufacturing technology, and manufacturing resilience and assurance; Industrial Base programs covering industrial base assessments, fragility and criticality methodology, mergers and acquisitions under the Hart-Scott-Rodino Act, and the Defense Priorities and Allocations System; Global Markets and Investments including the Treasury Department's Committee on Foreign Investment in the United States (CFIUS), international industrial base collaboration, and global market trends and non-notified CFIUS cases; business intelligence and analytics incorporating adaptive learning, data and text mining, predictive modeling, visibility, risk identification and management, efficient processes, and descriptive analysis; and Industry Outreach including industry and association engagement, science, technology, engineering, and mathematics (STEM) oriented industrial capabilities, and the MD5 National Security Technology Accelerator striving to promote civil-military industrial collaboration and venture creation by human centered networks to enhance DOD workforce development.⁴³

MIPB's 2017 Industrial Base Report noted that DOD had made an initial REE report to Congress in 2011. A March 2012 DOD report on REEs stressed that DOD used REEs in multiple defense applications while asserting that DOD remained committed to pursuing a tripartite approach to REE access including supply diversification, pursuing substitutes, and focusing on waste reclamation as part of larger U.S. Government recycling efforts. This document also contended DOD was committed to supply chain monitoring, preparing possible contingency plans to ensure REE availability, and implementing such plans as appropriate.⁴⁴

The newest version of this report stressed that subsequent speculation about future REE shortages produced speculation based rapid price increases and demand. These price increases saw global demand rapidly decrease eventually producing a countervailing reaction of supplies increasing and REE prices collapsing. The 2017 report noted remaining gaps in the REE domestic supply chain and the 2015 closing of the U.S. only active REE mining operation (Molycorp) in California, and stressed that the U.S. has limited capabilities and capacities to produce value-added rare earth containing minerals (e.g. separated oxides, metal, alloy and magnet materials) due to unfavorable market conditions and the absence of a U.S. competitive advantage. Despite this gloomy assessment, MIBP makes the following delusional assertion "that the supply of rare earth materials for U.S. defense is not presently disrupted and future shortfalls are currently not anticipated."⁴⁵

A third DOD entity involved in REE policymaking is the Strategic Materials Protection Board (SMPB). Established in 2006 by Public Law 109-364, this organization is chaired by the Deputy Assistant Secretary of Defense for Manufacturing and Industrial Base Policy with additional

members including DLA's Strategic Materials Administrator, and designees by the Assistant Secretary of each armed service branch for acquisition, research, and technology. SMPB board responsibilities include meeting at least one every two years with additional responsibilities encompassing:

1. Determining the need to provide a long term secure supply of materials designated as critical to national security to ensure that national defense needs are met;
2. Analyzing the risk associated with each material designated as critical to national security and the effect on national defense that the nonavailability of such material would have;
3. Recommending a strategy to the Secretary to ensure a secure supply of materials designated as critical to national security;
4. Recommending such other strategies to the Secretary as the Board considers appropriate to strengthen the industrial base with respect to materials critical to national security; and
5. Publishing not less frequently than once every two years in the *Federal Register* recommendations regarding materials critical to national security, including a list of specialty metals, if any, recommended for addition to, or removal from, the definition of "specialty metal" for purposes of section 2533b of this title.⁴⁶

Despite these lofty objectives, SMPB is a barely functioning organization. The only *Federal Register* documentation of its activities were listed in this publication on November 8, 2007, July 21, 2008, February 23, 2009, and July 29, 2009.⁴⁷

U.S. Government REE research also occurs in the Department of Energy's National Energy Technology Laboratory (NETL). Aspects of NETL research include separating and recovering REEs from coal and coal by-products with a projected goal of achieving 90–99.99% high-purity, salable, individual rare earth metal oxides by 2020. Examples of these projects include NETL partnering with Physical Sciences, Inc., to produce High Yield and Economic Production of REEs from Coal Ash, collaborating with the University of Kentucky Research Foundation to extract REEs from coal and coal by-products using advanced separation technologies, partnering with the University of North Dakota to extract REEs from coal-related feedstocks, and collaborating with West Virginia University to recover REEs from coal mine drainage. NETL has awarded contracts worth over \$46 million on REE-related research for 2017.⁴⁸

U.S. Government Assessments of REE Policymaking

The U.S. Government's REE policymaking programs are widely dispersed and have been criticized by many U.S. government policy analyses. A July 3, 2014 by DOD's Office of Inspector General (DODIG) determined DOD did not have a comprehensive or reliable process for assessing REE supply and demand. DODIG also determined that DLA Strategic Materials Division officials failed to ensure that its modeling and simulation contractors used: REE supply forecasts considering market and environmental risks; complete REE demand survey results; and verified economic consumption data to forecast REE demand. Such deficiencies occurred because DLA Strategic Materials Division personnel did not possess adequate verification and validation procedures to ensure realistic supply and demand inputs and did not require the contractor to use an accredited model forecast REE supply and demand. Consequently, DOD may not have identified all REEs with expected shortfalls, increasing the risks that such shortfalls would negatively affect critical weapons systems production in the DIB and overall military readiness.⁴⁹

DODIG recommendations for rectifying these deficiencies include:

- Developing and implementing a verification and validation plan for REE supply and demand forecasting inputs;
- Developing and implementing procedures to ensure that future shortfall analyses compare DOD demand and supply for REEs under the same scenarios;
- Developing and implementing procedures for obtaining DOE REE consumption data by leveraging Service acquisition executive participation and other techniques as appropriate;
- Developing and implementing an accreditation plan for the forecasting model's intended use; and
- Ensuring that current and future contracts for models, simulations, and associated data include verification, validation, and accreditation procedures in the contract requirements.⁵⁰

These DODIG criticisms of DOD REE policymaking were reiterated in a February 2016 report by the congressional Government Accountability Office (GAO). GAO determined that while DOD has identified certain materials as critical, there was no department-wide approach for precisely defining "critical" or "strategic." This semantic ambiguity is reflected in the following statutory definitions of critical or REEs by four different DOD organizational entities involved in REE policymaking:

Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics	Strategic Materials Protection Board	Manufacturing and Industrial Base Policy	Defense Logistics Agency- Strategic Materials
Terms: Critical rare earth materials in defense applications	Materials critical to national security.	Materials critical to national security.	Strategic and critical materials
Statutory Definitions (a) The rare earth material is critical to the production, sustainment, or operation of significant U.S. military equipment, and	(a) Upon which the production or sustainment of military equipment is dependent and	(a) Upon which the production or sustainment of military equipment is dependent and	(a) Would be needed to supply the military, industrial, and essential civilian needs of the United States during a national emergency and
(b) The rare earth material is subject to interruption of supply, based on actions or events outside United States Government control.	(b) The supply of which could be restricted by actions or events outside United States Government control.	(d) The supply of which could be restricted by actions or events outside United States Government control	(b) Are not found or produced in the United States in sufficient quantities to meet such need. ⁵¹

These DOD agencies take a fragmented approach to identifying critical REEs with the yttrium being identified as critical by the Under Secretary of Defense for Acquisition, Technology, and Logistics and the Defense Logistics Agency but not by the Manufacturing and Industrial Base Policy Report and these same agencies identifying dysprosium as critical but not by the Manufacturing and Industrial Base Policy report. These same agencies also identified praseodymium, neodymium, europium, gadolinium, and erbium as being critical but the Manufacturing and Industrial Base Policy report did not.⁵²

Varying perspectives and definitions of REEs occur across armed service branches. A laser expert at Naval Surface Warfare-Crane mentions that the rare earth component in certain defense lasers creates and focuses the light beam. Army Program Executive Office for Ammunition personnel said rare

earth magnets enable guided artillery ammunition to move in flight to their target. Army Research Laboratory officials told GAO they could sharpen their focus on specific rare earths if there was a DOD-wide list of REEs critical to national security.⁵³

Other deficiencies in DOD REE policy identified by GAO included:

- DOD identifying supply disruption risk in a limited manner and not proactively analyzing the impact of rare earths unavailability.
- DLA Strategic Materials estimating the risk of supply shortfalls using national emergency scenarios limited to four year time frames and recommending materials to stockpiles.
- These estimates cover scenarios of four years in which the first year is assumed to be a conflict period and years two through four are assumed to be a recovery period.
- MIBP has identified some risks relating to ensuring secure rare earth supplies but its mitigation strategy is reactive; and
- SMPB has not taken a broader approach to comprehensively addressing the underlying risks of the unavailability of rare earths.⁵⁴

GAO recommendations to DOD for resolving these problems include the Secretary of Defense:

- Directing SMPB to designate which rare earth materials are critical to national security and providing a common DOD understanding of these materials and focusing resources.
- Directing SMPB to analyze the effect of unavailability of national security critical rare earths and develop a strategy to ensure a secure supply for those designated critical to national security.
- Directing MIBP to define reliable sources and secure supply for rare earths in measurable terms and provide metrics of its actions to better ensure continued availability.⁵⁵

U.S. Rare Earth Element Reserves and Industry Developments

U.S. REE reserves are scattered at many locations across the U.S. They were not mined domestically in 2016. The Mountain Pass, CA, site has been the primary center of U.S. REE mining with its peak period being between the mid-1960s through the 1980s. By 2000, nearly all U.S. REEs were imported, primarily from China. Chinese oversupply, lower cost production, various environmental problems, including a pipeline spill carrying contaminated water, and regulatory problems resulted in Molycorp's initial production cessation in 2002. Under new ownership in 2008, Molycorp resumed production in 2008 and attempts were made to improve environmental practices. However, these owners have experienced repeated financial problems influ-

enced, in part, by Chinese export practices. During 2016 the estimated value of REE compounds and materials imported by the U.S. was \$120 million as compared to \$160 million in imports in 2015. Distribution of U.S. rare earths by end use is:

Catalysts	55%
Metallurgical Applications and Alloys	15%
Ceramics and Glass	10%
Polishing	10%
Other	10%. ⁵⁶

Figure 13 U.S. REE Reserve Sites



Source: USGS

U.S. import sources for REEs between 2012 and 2015 included China 72%; Estonia 7%; France 5%; Japan 5%; and other countries 11%. Imports of compounds and metals from these non-Chinese countries are derived from mineral concentrates produced in China and elsewhere. Ad valorem tariffs paid by the U.S. for REE imports are free for lanthanum oxides and other oxides, and range from 3.7% for lanthanum carbonates, other carbonates, and other REE compounds; 5% for scandium and yttrium whether or not mixed or intermixed; 5.5% for cerium compounds such as oxides; and 5.9% for

ferrocenium and other pyrophoric allies. REE recycling occurs in limited quantities from batteries, permanent magnets, and fluorescent lamps.⁵⁷

DLA's Annual Materials Plan for FY 2016 included a ceiling acquisition of 0.5 tons of dysprosium metal and 10 tons of yttrium oxide. DLA acquired 8.8 tons of yttrium oxide during this year. Exploration and development efforts of REE projects within the U.S. occurring in 2017 included Bear Lodge, WY; Bokan Mountain, AK; Diamond Creek, ID; Elk Creek, NE; La Paz, AZ; Lemhi Pass-ID-MT, Pea Ridge, MO; Round Top, TX, and Thor, NV. Estimated U.S. REE reserves are 1,400,000 tons.⁵⁸

Declining mineral prices and unsustainable debt forced Molycorp, Inc., the owner of the Mountain Pass, CA, REE mine, to file for bankruptcy in June 2015.

During June 2016, an investor group with alleged ties to the Chinese Government purchased Molycorp raising the possibility that CFIUS would intervene to stop the sale on national security grounds. The case remains under litigation in the U.S. Bankruptcy Court for the Delaware District. During July 2017, American Elements Corp. Chief Executive Officer Michael Silver publicly advocated to former Trump Administration officials Steve Bannon, Sebastian Gorka, and Reince Preibus that the U.S. should nationalize Molycorp's Mountain Pass mine on national security grounds.⁵⁹

Specific U.S. Weapons Systems using REEs

REEs have become increasingly important to a growing number of U.S. defense applications. General REE defense applications include precision-guided missiles, smart bombs, and aircraft. Additional military relevant REE applications include:

- Smaller and lighter weapons systems magnets;
- Fin actuators in missile guidance and control systems, controlling the direction of the missile;
- Disk drive motors installed in aircraft, tanks, missile systems, and command and control centers;
- Lasers for enemy mine detection, interrogators, underwater mines, and countermeasures;
- Satellite communications, radar, and sonar on submarines and surface ships; and
- Optical equipment and speakers.⁶⁰

The following three charts provide specific examples of REE military applications.

Figure 14 Rare Earth Elements in Guidance and Control Systems

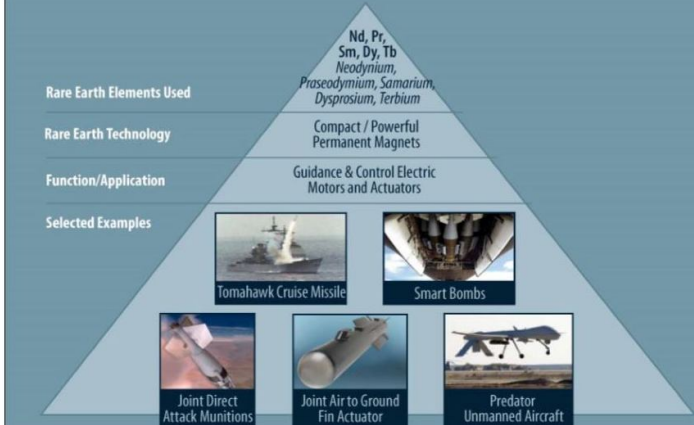


Figure 15 Rare Earth Elements in Defense Electronic Warfare

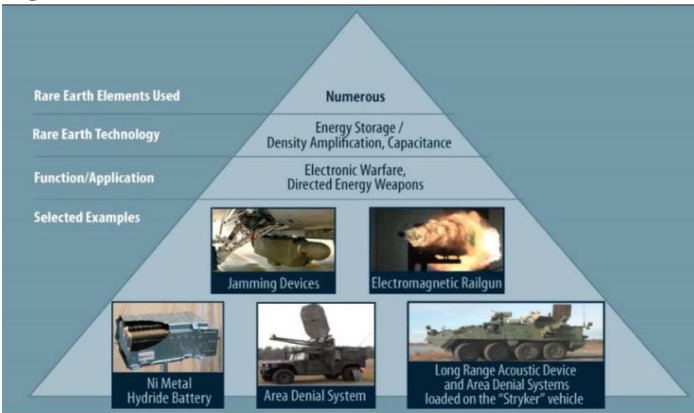


Figure 16 Rare Earth Elements in Targeting and Weapon Systems



Source: Congressional Research Service

Recent Congressional REE Legislation

Recent Congressional sessions have regularly seen legislation proposed to address the strategic importance of REE and rectify the U.S. dependence on these materials from unreliable foreign sources. On November 16, 2011, Rep. Paul Ryan (R-WI) introduced H.R. 3449 requiring DOD to develop a defense supply chain and industrial base strategy to secure the U.S. supply chain and industrial base sectors the Secretary of Defense considers critical to U.S. national security. H.R. 4402, the National Strategic and Critical Materials Protection Act of 2012 passed the House on July 12, 2012, and was referred to the Senate four days later. It would have required both the Secretaries of the Interior and Agriculture to more efficiently develop domestic mineral and materials sources of strategic and critical importance to U.S. economic and national security, and manufacturing competitiveness.⁶¹

On March 26, 2015, Senate Energy and Natural Resources Committee Chair Lisa Murkowski (R-AK) introduced S. 883 The American Mineral Security Act of 2015. This proposed legislation would have required the USGS to consult with other federal agencies and invite public comment on a draft methodology for determining which minerals qualify as critical and subject to potential supply restrictions stemming from foreign political risk, abrupt demand growth, military conflict, violent unrest, anti-competitive or protectionist behaviors, and are important in energy technology, defense, currency, agriculture, consumer electronics and health related applications. A detailed hearing was held on this legislation by this committee on May 12, 2015, but no further action was taken on this legislation during the 114th Congress in 2015–2016.⁶²

REE-related congressional legislation introduced during 2017 includes H.R. 1407 Materials Essential to American Leadership and Security Act by Rep. Duncan Hunter (R-CA) calling for the U.S. to develop a domestic industrial base for producing strategic and critical materials, divesting the U.S. from dependence on critical foreign-produced strategic and critical materials, and creating a fund using 1% of internal programmatic administrative costs of major aircraft and missile systems to promote investment in domestic production of critical and strategic materials; and H.R. 2053 Mining School Enhancement Act by Rep. Martha McSally (R-AZ) et al. calling for amending the 1977 Surface Mining Control and Reclamation Act by enhancing financial support for mining engineering programs at U.S. educational institutions by reducing dependence on foreign energy supplies, enhancing the competitiveness of U.S. energy technology exports, and augmenting “the extraction or processing of coinciding mineralization, including rare earth elements, within coal, coal processing byproduct, overburden or coal residue.”⁶³

On October 12, 2017, Senate Judiciary Committee Chair Charles Grassley (R-IA) wrote letters to various cabinet department heads, following up on June 30, 2015, letters to CFIUS agency leaders expressing concern about acquisition of U.S.-based Uranium One by the Atomredmetzoloto (ARMZ) subsidiary of the Russian state energy company Rosatom. This purchase gave the Russian Government 20% of U.S. uranium production capacity which Grassley's letter expressed concern with while also noting that Uranium One Chair Ian Telfer had made donations of over \$1 million to the Clinton Foundation. Grassley's letter to these CFIUS agency leaders requested that respondents answer the following questions and requests by October 26, 2017:

- List the dates of each CFIUS meeting involving the Uranium One/Rosatom transaction, attendees by agency, and all relevant transcripts and communications.
- Whether agency personnel assigned to this transaction knew of ongoing criminal and intelligence investigation into senior managers of Rosatom and Tenex and Tenam before CFIUS' October 2010 approval of the Uranium One transaction?
- Provide a copy of the analysis that articulated the risk and vulnerabilities presented by the transaction and any mitigation terms considered.
- Provide a copy of all records related to the presentation provided by Uranium One/Rosatom to CFIUS staffers prior to filing a formal notice on August 4, 2010.
- Provide a copy of your agency's official confirmation to Treasury that the transaction did not raise any unresolved national security concerns.
- Provide all records relating to your agency's determination that the Uranium One/Rosatom transaction did not raise any unresolved national security concerns.
- Provide all records relating to communications with respect to Secretary Clinton and donations to the Clinton Foundation by parties interested in the Uranium One/Rosatom transaction.⁶⁴

Trump Administration Policy Actions

The Trump Administration's opening months have seen some tentative evidence that it may take a more serious geopolitical approach to REEs and other strategic materials critical to U.S. national security. Executive Order 13788 Buy American and Hire American signed on April 18, 2017, required executive branch U.S. agencies to privilege purchasing American products including those "produced in the United States such as all stages of iron, steel, and manufactured goods from the initial melting stage through the application of coatings occurring in the U.S. It also called for federal agencies to "scrupulously, monitor, enforce, and comply with Buy American Laws."

A June 20, 2017, memorandum from the Office of the Under Secretary of Defense for Acquisitions, Technology, and Logistics to various DOD and armed services acquisition authorities stressed that DODIG audits of compliance with the Berry Amendment and Buy American Act had found numerous contracts where these statutes should have been included in contracts, but were not such as a July 7, 2017, DODIG report finding that DLA had only complied Berry Amendment provisions in 13 of 32 contracts reviewed with the non-compliant 19 contracts totaling \$453.2 million.⁶⁵

On July 21, 2017 President Trump issued Executive Order (EO) 13806 “Strengthening Defense Industrial Base & Supply Chain Security.” This document called for the Secretaries of Defense, Commerce, Interior, Labor, Homeland Security, and Health and Human Services, in consultation with the Directors of Office of Management and Budget, National Intelligence, the National Security Advisor, Assistant to the President for Economic Policy, Director of the Office of Trade and Manufacturing Policy, and other relevant policymakers to prepare a report within 270 days (by April 17, 2018) containing classified and unclassified assessments of the U.S. manufacturing capacity, defense industrial base, and supply chain resiliency.

Specific contents of this report include:

- Identifying military and civilian material, raw materials, other goods essential to national security;
- Identifying manufacturing capabilities essential to producing these goods including emerging capabilities;
- Identifying defense, intelligence, homeland, economic, natural, geopolitical, or other contingencies capable of disrupting, straining, compromising, or eliminating supply chains of these goods;
- Assessing the resilience and capacity of U.S. manufacturing and defense industrial base and supply chains to support national security needs including current domestic education and manufacturing workforce skills, exclusive or dominant supply of goods or components by or through nations likely to become unfriendly or unstable; and the availability of substitutes or alternative sources of these goods;
- Identifying the causes of any aspect of the defense industrial base or national-security-related supply chains assessed as deficient; and
- Recommending legislative, policy, and regulatory changes by the President or other agency heads, based on a reasoned assessment that the benefits of such changes outweigh costs, to disruptions to U.S. national security supply chains and strengthen the U.S. manufacturing capacity and defense industrial base resiliency.⁶⁶

The September 5, 2017, *Federal Register* saw the Commerce Department’s Bureau of Industry and Security (BIS) seek public comment by October 5,

2017, on the potential market impact of the proposed FY 2019 National Defense Stockpile Annual Materials Plan. This plan is compiled by the Commerce and State Department co-chaired Domestic Stockpile Market Impact Committee on the projected defense and foreign economic effects of all acquisitions, conversions, and disposals involving the stockpile and related material research and development projects as stipulated by the 1979 Strategic and Critical Materials Stock Piling Revision Act of 1979.⁶⁷

In addition to being chaired by Commerce and State, the Domestic Stockpile Market Impact Committee includes representatives from Agriculture, Defense, Energy, Homeland Security, and Treasury Departments and portions of the proposed FY 2019 Materials Plan calls for potentially disposing of 6 tons of beryllium metal and 190 pounds of tantalum scrap; the potential acquisition of 0.5 metric tons of dysprosium, 416 metric tons of REEs, and 100 metric tons of rare earth magnet feedstock; potential conversions (upgrading, rotating, and reprocessing) of 72 metric tons of dysprosium and 416 metric tons of rare earth elements; and the potential recovery from government sources of 25 metric tons of lithium ion precursors, 100 metric tons of rare earth elements-magnets, and 10 metric tons of tantalum.⁶⁸

On September 13, 2017, Trump issued an administrative order prohibiting Chinese acquisition of Lattice Semiconductor Corporation citing section 721 of the 1950 DPA that Canyon Bridge Acquisition Company and Hong-Kong based Yitai and its parent company China Venture Capital Fund Corporation Limited could threaten U.S. national security by exercising control over Lattice. This order directed the purchasers and Lattice to permanently abandon this transaction within 30 days unless CFIUS extends abandoning this order up to 90 days and requires the Purchasers and Lattice to inform CFIUS in writing that the proposed transaction has been abandoned with the Attorney General receiving authority to enforce this order.⁶⁹

Recommendations

Multiple decades of U.S. Government policymaking on strategic materials, including REEs, have created a policymaking structure of labyrinthine complexity producing bureaucratic sclerosis at a time when the U.S.' economy and defense weapons systems have become increasingly dependent on REEs requiring agile response capabilities to counter potential supply disruptions. There are several steps the U.S. Government should consider taking to enhance domestic REE development and lessen national security supply chain disruptions.

An initial critical step is expediting the permitting process for approving new mines. The U.S. has one of the longest global mining permitting processes often requiring nearly ten years to complete depending on project com-

plexity. This is expensive from the perspectives of industry and regulators, creates uncertain outcomes, discourages investment in U.S. mining, and contributes to offshoring of mining and manufacturing and increased U.S. import dependency. Testifying before a House Natural Resources Committee Subcommittee on October 10, 2013, West Virginia Coal Association Senior Vice President and Chair Chris R. Hamilton stressed that nearly 1/3 of U.S. coal mines operating in 2008 had closed by 2013 impacting both surface and underground mines. Such actions have also affected the U.S. critical minerals industry with some laws providing opportunities to delay, stop, and require major modifications making projects become economically unfeasible due to the risk of litigation. Voluminous federal mining regulations covering three volumes and exceeding 2,200 pages in Title 30 of the 2017 *Code of Federal Regulations* already govern U.S. mining activity sufficiently ensuring mineral extraction industries comply with environmental regulations.⁷⁰

The U.S. should also seriously consider nationalizing indigenous REE reserves and mines to prevent possible takeover by unreliable and unfriendly foreign suppliers. This would be a controversial step that would go against the traditional free market leanings of a Republican presidential administration and Congress. The Heritage Foundation has contended that the U.S. should cheaply import REEs, that the U.S. should not subsidize technologies the private sector won't invest in, and that the federal government should open access to REEs in states where they are known to exist and establish sufficient regulatory frameworks proving companies with the certainty needed to extract REEs. China's temporary 2010 embargo on REE exports casts doubt on the notion that the U.S. can consistently rely on a dependable REE supply chain from non-allied countries.⁷¹

Another problematic precedent to government nationalization of a major industry is provided by the Truman Administration's attempted takeover of the U.S. steel industry during the Korean War. This action was protested by the steel industry and resulted in the 1952 U.S. Supreme Court ruling in *Youngstown Sheet & Tube Co. v. Sawyer* that the President did not have the inherent authority to seize private property without specifically enumerated authority in Article 2 of the U.S. Constitution or congressionally confirmed legal authority.⁷²

Potential U.S. tax reform legislation during the Trump Administration should also consider tax incentives to the U.S. mineral resources industry to facilitate exploration and develop of national REE resources. Consequently, the Trump Administration's review of the U.S. defense industrial base and supply chain capacity mandated by EO 13866 should also seriously consider whether nationalizing REE resources is an essential national security objective given the increasing use of REEs in U.S. weapons systems and civilian technological applications and be prepared to defend this in court.

The U.S. should also require the military and defense industry to take all steps necessary to acquire REEs from U.S. companies and from companies from defense treaty allied countries; the U.S. should take appropriate administrative and regulatory action to require CFIUS to prohibit non-defense treaty aligned foreign companies or countries from acquiring U.S. REE industries; Congress should explicitly link DLA and MIBP budget appropriations to how effectively they strengthen U.S. defense access to REEs; Congress should legislate that only one DOD agency have responsibility for rare earth and strategic minerals policymaking and consider dissolving the SMPB due to its inactivity; Congress should restrict jurisdiction over defense REE programs to the House and Senate Armed Services Committees due to the increasing criticality of these programs to U.S. national security; and Congress should continue providing financial incentives to promote REE education, research, and development to U.S. university and corporate education programs.

Conclusion

REE's have become critically important to U.S. economic development and national security. A 2014 assessment by the National Center for Policy Analysis maintains REEs support more than \$298 billion in revenue from downstream economic activity, 535,000 U.S. jobs, and over \$33 billion in payrolls.⁷³ Relying on unreliable and even hostile foreign suppliers of REEs such as Afghanistan, China, and others is geopolitical folly of the highest order! The U.S. must ensure that it provides effective regulatory, research and development, and tax incentives to its REE industry to ensure it can meet continually increasing economic and national security needs for REEs and structure government acquisition of these resources so they only come from U.S. companies or from companies or governments with whom the U.S. has a defense treaty alliance.

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