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Industry Study

Final Report
Strategic Materials Industry

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Strategic Materials Industry

ABSTRACT: This report provides holistic and actionable policy options to enhance reduction of risk to US national security in the strategic materials industry supply chain. These options address the end-to-end "ore-to-jet" process, identifying areas where policymakers can mitigate strategic material risks to the US defense industrial base through improvements to governance, regulations, research and development, and visibility of risk in the US defense supply chain.

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Introduction

"Only when a country recognizes its critical need to adapt, and restructures burdensome policy, will it truly optimize [its] economic potential."[1]

American industries today compete in an ever increasingly global market. In this environment, driven by lower wages and rapidly increasing demand, it is difficult to find anything with a 'Made in America' label that does not contain subcomponents, parts or materials that were either produced or assembled in other countries. Despite various laws mandating domestic procurement, almost all current and future US military weapons systems contain parts or materials from other nations. This dependence on foreign supply has caused great concern within the United States government (USG) and industry.

Currently, the US is 100% dependent on foreign nations for 19 different minerals and 50% dependent or greater for 43 more.[2] The Department of Defense's (DOD) Defense Logistics Agency (DLA) claims 23 of these materials are important for defense needs and suggests congressional action is required to mitigate risk to the defense supply chain.[3] Numerous efforts throughout the Federal Government and private industry focus on the importance of strategic and critical materials, and the potential negative impacts to national defense, energy requirements, environment, or the economy from the inability to obtain materials needed to sustain current and future capabilities domestically. *This report provides holistic and actionable policy options to reduce risk in the strategic materials supply chain. These options address the end-to-end "ore-to-jet" process, identifying areas where policymakers can mitigate strategic material risks to the US defense industrial base.* These recommendations address salient strategic materials issues where the USG can take constructive, immediate action.

This report presents an overview of the strategic materials industry and its impact on US industry as discovered through domestic study and research and numerous discussions with government and industry professionals. Specifically, this paper will: 1) define the industry and examine its current conditions; 2) identify USG stakeholders and the current legal and regulatory environment; 3) highlight challenges and strategic materials supply risks; and 4) provide policy recommendations that mitigate risk in the industrial supply chain by enabling continued access to the strategic materials global market.

Industry Defined

A broad range of non-fuel metals and minerals are critical to US commercial manufacturing base, the transition to a green-energy economy, sustained innovations in the high-tech sector, and allow the US military to effectively fulfill its mission to protect the US homeland and project power around the globe.[4]

The United States Geological Survey (USGS) identifies 124 minerals mined and processed to make non-fuel materials. The scope of this paper deals with the mining, processing and application of these minerals considered strategic and critical to US national security. The strategic value of a material is based upon its criticality – a combination of importance and scarcity.[5]

In the context of US national security policy, materials are *strategically important* if they are essential for defense applications, and are *critical* if their supply is scarce or vulnerable. For the purposes of this report, *Strategic Materials* include critical non-fuel minerals required in the production of DOD weapons systems and components.[6] The strategic material needs of the US

military are influenced by defense industry stakeholders: the military defines the capability requirements; Congress provides the funding; and the private defense-industrial base develops and manufactures the capability.[7]

Firms in the *mining industry* are involved in the extraction of ore and subsequent processing of pure mineral products in the form of plates, rods, or powder.[8] The industry operates in an oligopolistic global market, characterized by a few large firms that dominate the industry. There are few substitutes for minerals with similar physical or chemical properties and large entry and exit barriers to mining due to the extremely high capital cost of facilities, the lengthy permitting process, the challenge of locating economically viable reserves, and the losses incurred during start-up.[9] Despite its oligopolistic nature, this industry is still competitive and price sensitive due to the presence of intense international competition among the major suppliers, notably from lower-cost producers in China and South America.[10] Reuters Finance analysis of March 2013, though only a financial snapshot in time, shows the industry five-year return on investment (ROI) average at 3.3%, well below the US economy average of 6.8%.[11] This is largely a result of stiff international competition faced by US mining firms.

The *non-ferrous metals and alloy industry* has many smaller recycling companies, and some low-cost Chinese entrants, but only a few global firms can produce the volume and quality of metals and alloys required by major weapon system integrators like Boeing.[12] This industry also resembles an oligopoly with a few large domestic and foreign producers, few substitutes, and high entry barriers. Metals producers offer differentiated special alloy products that create a further intellectual property barrier to entry.[13] With a broad commercial customer base and, according to Reuters, a five-year ROI average at 15.5% as of March 2013, the non-ferrous metals and alloy industry enjoys solid profitability, due to its position in the premium products market.[14]

Risk In the Strategic Materials Supply Chain

The Porters Five Forces Model shown in Figure 1, designed to identify competitive advantages in a given industry, is also a useful tool to identify value chain risks to US strategic material suppliers operating in the industry.[15]

The suppliers providing inputs to the mining companies include exploration companies that locate new reserves, as well as production inputs such as labor, capital, energy, chemicals, and water. Production inputs like energy and water are currently available at reasonable cost in the US.[16] The lack of economically viable reserves of certain strategic materials in the US creates a risky reliance on foreign sources, as is the case with rare earth elements sourced from China.[17] Thus, while production input factors represent a low risk to suppliers, US dependence on foreign supplies of selected strategic materials requires thorough visibility of the supply chain so that the USG can mitigate risk therein.

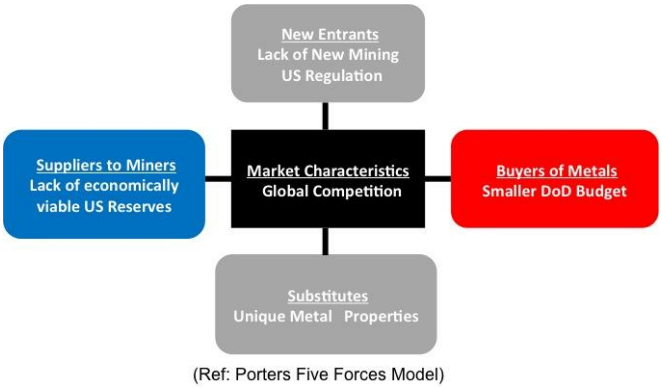

Figure 1, Industry Market Forces

Buyers in this model include the defense weapons manufacturers and component sub-contractors on the demand side of the defense-related strategic materials value chain. US defense demand represents a relatively small share of the US commercial specialty metals market, limiting

its influence on supply.[18] This market share is unlikely to increase given the looming US defense budget cuts.[19] However, commercial market growth driven by the current global economic recovery and the market opportunities in modernizing economies like China, India and Brazil have increased global demand since 2010.[20] Reduced US defense industry demand may be offset by an anticipated increase in commercial orders from developing economies, ensuring adequate global supply and reducing defense value chain risk. [21]

New entrants into the US mining and special metals production industries are restricted by prohibitive start-up costs. For mining operations specifically, the need for access to economically viable reserves of raw materials, plus the protracted periods of operating losses after operations commence, limit new mining operations.[22] Further, the extended permitting process and environmental regulation in the US makes it a uniquely challenging market for mining firms, driving global firms to other locations outside the US.[23] Restrictions on new mining operations in the US hinder industry growth and thus limit US-based production of minerals.

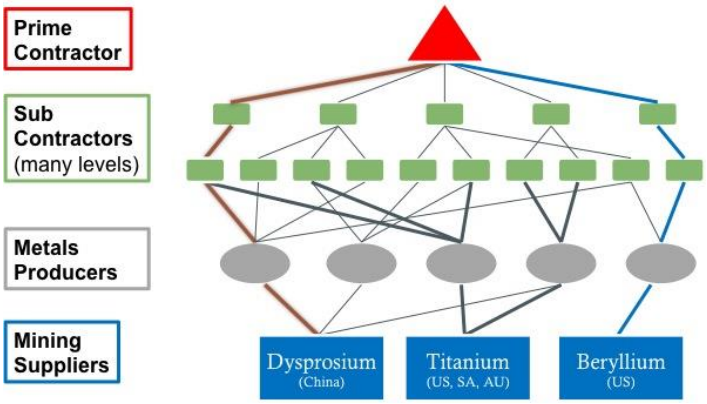

Figure 2, Defense Supply Chain Complexity

The Strategic Materials Supply Chain Today

Strategic materials flow through the defense value chain via a complex network of relationships between suppliers and manufacturers, illustrated in Figure 2, demonstrating the holistic and interdependent nature of the industry. In order to develop a broader risk profile, this analysis will focus on the supply of materials from non-ferrous mining and non-ferrous specialty metals industries, which includes strategic defense materials such as beryllium, titanium and cobalt. These and other strategic materials are important to the defense manufacturing and industrial supply chain, and as such, the USG should mitigate supply chain risks inherent in reliance on foreign suppliers.[24]

The "ore-to-jet" defense industry supply chain model shown in Figure 3 demonstrates the link between the manufacturing firms generating demand for strategic materials and the supplier industry segments.[25] Supply input originates with the mining and mineral processing firms that extract the raw materials and supply the special metal and alloy producers who create refined metal products. On the demand side of the chain, component manufacturers utilize these special metal and alloy products to create sub-components and parts that are ultimately integrated into final weapons system platforms by the prime defense contractors.

There are numerous stakeholders and issues related to the supply of strategic materials to the US defense industries. While defense industry manufacturers are not the only large-scale consumers of strategic materials—commercial markets play a critical role in the health of the industry—access to these materials is critical to their ability to produce the world-class defense technology used by the US military to protect US national security.[26]

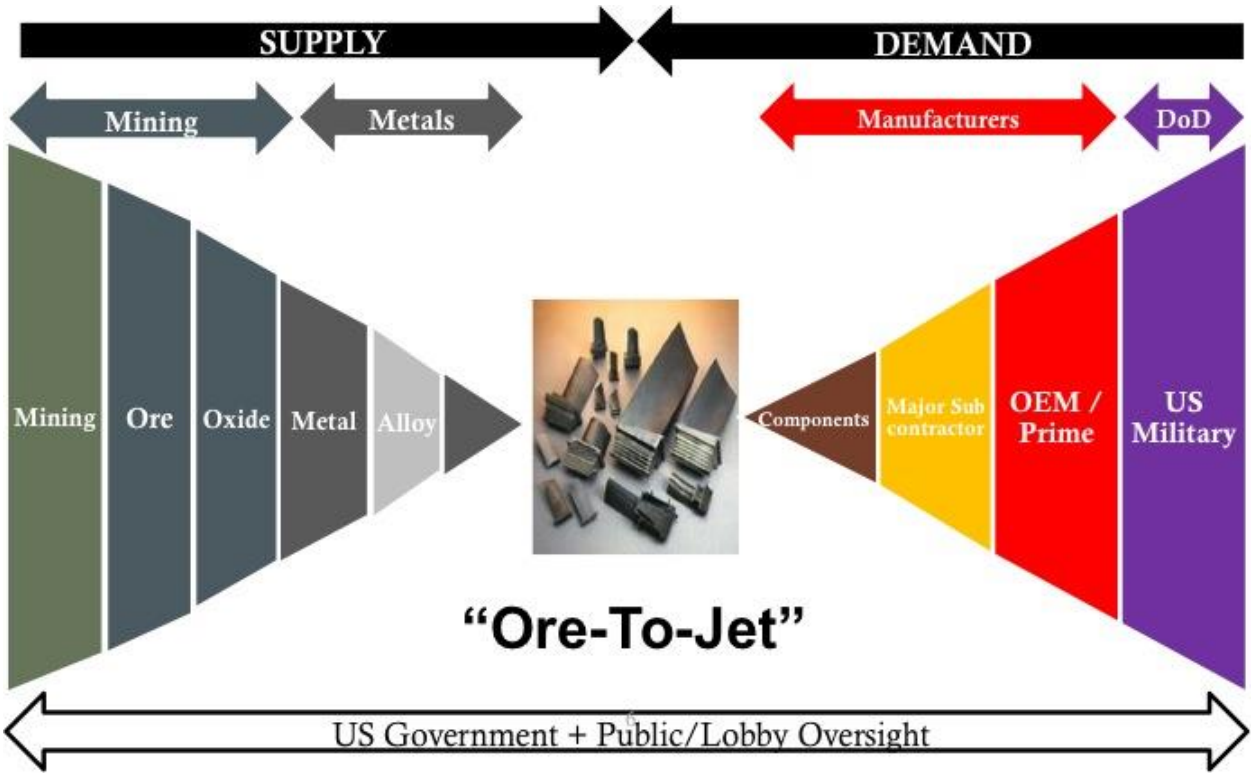

Figure 3, Defense Supply Chain

Government Stakeholders

Multiple USG agencies, such as the Department of Defense, the Department of Energy (DOE), the Department of Interior (DOI), and the Department of Commerce (DOC), focus on the aspects of the strategic materials supply chain that impact their agency's mission. DOD is concerned with material pertinent to critical weapon systems, DOE is concerned with materials essential to clean energy, DOI manages the US Geological Survey (USGS) to collect and disseminate data on minerals and mining, and the Department of Commerce is interested in strengthening US competitiveness in international and domestic markets. Congress is also concerned with the strategic materials supply chain as it impacts their constituencies. They enact regulations that address regional interests. A description of specific government roles and interests follows.

Department of Defense

The Department of Defense is the primary consumer of US defense systems requiring strategic materials. For certain systems, DOD prefers domestically procured materials in order to mitigate supply chain risk associated with procuring from foreign suppliers.[27] There are also specific materials, such as beryllium, of which DOD dominates consumption.[28] In these cases, DOD is prepared to provide assistance, e.g. through the Defense Production Act (DPA) Title III program, or pay a premium, to maintain domestic production capability.[29] For most other materials, however, DOD pursues arrangements with non-US suppliers, as long as they are reliable.[30] DOD seeks "to take full advantage of the competitive benefits offered by access to the best global suppliers; and to promote consistency and fairness in dealing with its allies."[31]

Several organizations within DOD address the issue of strategic materials security. DOD's Office of the Director of Manufacturing and Industrial Base Policy (MIBP) must ensure robust industrial capabilities exist to support military procurement. MIBP's Sector-by-Sector-Tier-by-Tier (S2T2) initiative is an effort to map the US defense industrial base from mineral to end product in order to gain visibility on the entire industrial supply chain, which MIBP admits is a challenging task. Even if successful, the S2T2 industrial map will be relevant only to the defense industrial base.

DOD also has a Defense Logistics Agency (DLA) that maintains a stockpile of strategic materials (formerly the National Defense Stockpile, now called DLA-Strategic materials). Under the Strategic and Critical Stock Piling Act of 1939, the National Defense Stockpile (NDS) was established to maintain and manage strategic and critical materials for use during times of national emergency.[32] The original stockpile identified 42 metals and minerals and was administered by the Army and Navy Munitions Boards. Throughout the years, the number of materials has risen and fallen in response to changing national security concepts.[33] Since its inception, unlike the Strategic Petroleum Reserve, many items identified and purchased for the stockpiles were never used for their intended purpose. Instead, they were sold years later due to obsolescence.[34]

Department of Energy

The DOE publishes a critical materials strategy that integrates the Department's efforts, but it is limited to a focus on sustaining the clean energy industry. The DOE strategy has three main goals: managing risk in diversified global supply chains; developing material and technology substitutes; and developing new and more efficient recycling and reuse methods.[35] It also seeks to find more efficient methods of using various materials. To directly address these goals, DOE established a Critical Materials Institute (CMI) in January 2013 that will serve as an energy innovation hub bringing together leading researchers from academia, four DOE national laboratories, and the private sector.[36]

Department of Interior / US Geological Survey

USGS, within the Department of Interior, provides policymakers an assessment of the domestic and foreign availability, reliability of the supply chain, and the use of minerals and materials.[37] Their National Minerals Information Center canvasses the non-fuel mining and mineral processing industry in the United States for data (voluntarily reported on a monthly, quarterly, annually, or semi-annually basis) on mineral production, consumption, recycling, stocks, and shipments. Unless authorized for release, the data furnished are aggregated so as not to reveal company proprietary data. According to the National Resource Council, USGS is the most comprehensive, responsible, and responsive source of non-fuel minerals information domestically and internationally, but does not have sufficient authority, autonomy, and resources to appropriately carry out its data collection, dissemination, and analysis.[38]

US Department of Commerce

The DOC is concerned with promoting economic growth.[39] The department's Bureau of Industry and Security (BIS), in collaboration with DOD, is conducting the S2T2 evaluation to provide DOD with a comprehensive understanding of the defense supply chain network that could impact US military capabilities and readiness.[40] The Commerce Department also has a 40-member advisory board focusing on increasing supply chain competiveness and investing in infrastructure development. Investments in this area have a proven track record for increasing US

competitiveness domestically and worldwide and also increasing job creation.[41] The department also participates in the Committee on Foreign Investment in the United States (CFIUS).

Congress

Members of Congress, particularly those representing mining states, are keen to promote mining industry interests and protect jobs associated with mining activities in their districts. Linking those interests to the nation's security provides an ideal platform for promoting their constituents' interests; promoting the protection of an industry for the security of the nation provides politicians a virtuous position. Congress has exercised its power to enact regulations that shape the legal and regulatory environment of the industry.

Legal and Regulatory Environment

In addition to the key governmental stakeholders, there are a variety of mining related acts, amendments and authorities that have been advanced over time to encourage domestic mining of strategic materials. Mining policy in the US started almost 150 years ago as a response to miners and prospectors in the California Gold Rush of 1849. These regulations were generally enacted to codify the informal system of acquiring and protecting mining claims on public land.[42] They did not, however, cover the federal permitting process, timelines of government response, or specific oversight responsibilities. This created tremendous confusion with respect to the legality of certain mining claims. These events led to lengthy litigation and further acts and amendments, many of which are still in effect today. Though the strategic materials industry is broad, the following examples focus primarily on mining—the first step in the supply chain—as it presents an issue that falls almost entirely in USG purview.

Protecting and promoting US mining dates back to the 1870s. To encourage exploration and settlement in the western United States, Congress passed The Land Use Act, also known as the 1872 General Mining Act. The 1872 law gave US citizens the right to the minerals discovered on federal public land, such as gold, platinum and silver.[43] Although slight reforms have been made over the years, the 1872 Act remains relatively unchanged and continues to allow mining to take place on public lands with minimal costs to the miner.[44] Today, it still costs only $189 to make a claim on federal land, and $140 a year to keep that claim.[45]

Critics of the 1872 General Mining Act argue that the law is "obsolete and inconsistent with other federal natural resource policies."[46] The environmental laws of the 1960s and 1970s addressed environmental and land reclamation issues that the 1872 Act had not. However, environmentalists assert that current protections regarding mining activities in the United States are insufficient.[47] Proponents for reforming the act also urge that the multi-billion-dollar-per-year mining industry should pay royalties, similar to those required by oil, gas and coal companies.[48] Subsequent legislation, such as the Strategic Materials Act of 1939, placed further attention on the mining industry by establishing a stockpile, later called the National Defense Stockpile (NDS).

The 1947 Berry Amendment, requiring DOD to procure one hundred percent of its clothing and food for the military from US-based companies, was amended in 1973 to include specialty metals.[49] The specialty metal clause required all end products procured by DOD to include specialty metals that were "melted or produced in the United States."[50] However, unlike the Berry Amendment, the specialty metal clause allows for DOD to procure products with specialty metals from several allied countries. Critics of these domestic preference laws claim that these restrictions "may not always represent the best value to DOD or the federal government, nor is there always a justifiable national security interest to preserve certain items currently under the Berry

Amendment."[51] Supporters of the law argue that these restrictions "are necessary to maintain a viable industrial base, and that the Berry Amendment serves as some protection for critical industries by keeping them healthy and viable in times of peace and war."[52] In support of the US industrial base, the 1950 Defense Production Act (DPA) Title III authority allows the Department of Defense to provide US companies assistance in maintaining specific production capabilities essential to national security.

In February 2013, the Committee on Natural Resources in the US Congress House of Representatives introduced a bill called the National Strategic and Critical Minerals Production Act of 2013. The bill, HR 761, proposes steps to "more efficiently develop domestic sources of the minerals and mineral materials of strategic and critical importance to United States economic and national security and manufacturing competiveness."[53] The mining industry is supportive of this bill specifically because it offers options for expediting the current permitting process, which companies complain is a costly process and delays the start of mining operations for many years.[54]

On the other hand, the Department of Interior (DOI)—one of the two agencies that would be responsible for implementing the legislation if passed—does not support HR 761. In addition to DOI's opposition to the removal of several environmental protections for mining on public lands, the requirement for DOI, through USGS, "to assess the capability of the United States to meet the demands for minerals essential to manufacturing competitiveness and economic and national security" is, according to DOI, outside of USGS's current scope and expertise.[55]

The practices of the early mining industry created a tremendous amount of environmental collateral damage that is no longer acceptable. In 1970, The National Environmental Policy Act (NEPA) was enacted to create a framework within the federal government for including environmental considerations among factors ordinarily examined in the decision-making process. NEPA requires environmental due diligence on state and local regulations, determines alternative courses of action, and represents a significant barrier to entry for mining in the US and perhaps the ripest area for regulatory improvement.

Although the General Mining Act of 1872 has not changed much since its inception, many other Federal regulations have been enacted that attempt to promote economic development of the mineral and mining industries, provide access to reliable sources of strategic and critical materials required for national security and collaboratively provide protection of the environment and its finite natural resources.

Industry Outlook

The global market for advanced specialty metals made from strategic materials is one of growing significance due to steadily rising demand in recent years. This demand is driven by advancement in telecommunications, automotive, and aerospace technologies.[56] Manufacturers seek specialty metals for their unique properties including high strength-to-weight ratios and their ability to withstand extreme temperatures.[57] These products are sold to manufacturers downstream in the supply chain for government use in defense, space, and science applications, as well as commercial use in aerospace, electronics, and medical products.[58] In the US, the market for specialty metals has expanded in recent decades, with major US corporations such as Alcoa, TIMKEN, and Materion, all making investments in new capabilities for the high-end metals market.[59]

This high-end specialty metals market is globally vibrant, as each firm typically supplies many hundreds of customers who add further value through placing these products into end-use

goods.[60] These customers include major defense firms such as Lockheed-Martin, General Dynamics, and Rockwell-Collins as well as commercial manufacturers such Ford Motor, Boeing, and Baxter Health. The industry outlook is solid for these firms, since there continues to be growing demand for these products and the specialty metal industry maintains a five-year ROI average of 11.5%.[61]

Although the US mining industry has shrunk over the past half century, it still provides an important source of raw material to US manufacturers.[62] Mining is a significant portion of the economies of Australia, Dominican Republic, and other countries with resource-based economies.[63] While not a significant part of GDP, the US mining industry has moderate potential for increased growth due to cheapening US energy. Additionally, according to the Australian ambassador to the US, the US economy is undergoing an energy revolution with natural gas that will likely repatriate much of the manufacturing that had moved overseas many years ago.[64] According to his economic councilor, economic activity and growth—particularly the energy intensive mining and mineral processing industries—often follows inexpensive energy.[65] Should this trend continue, US mining, minerals processing, and metals manufacturing may experience resurgence and reclaim capacity once lost to foreign competitive advantage.

Challenges

Government Strategy

According to the American Resources Policy Network, the USG lacks a coherent strategy regarding strategic materials security, offering that while seven governmental and non-governmental agencies have published reports considering critical metals, each agency was bound by its mission perspective.[66] There are even different perspectives within DOD itself as several departmental organizations independently addressing strategic materials security. DOD's Office of the Director of Manufacturing and Industrial Base Policy (MIBP) labors to ensure private industry provides critical capabilities to the military. However, to hedge against industry inventory shortfalls, the DOD Defense Logistics Agency (DLA) maintains a stockpile of strategic materials (formerly the National Defense Stockpile (DNS), now called DLA-Strategic Materials).

Additionally, by Congressional mandate the DOD formed the Strategic Materials Protection Board to "determine the need to provide a long-term domestic supply of strategic materials designated as critical to national security, and analyze the risk associated with each material and the effect on national defense that non-availability from a domestic source would have."[67] In February 2013, Congress revamped this defense-centric board to spur action by instituting MIBP and DLA-Strategic Materials as the chair and co-chair, and mandated the board take a balanced look at the viability of raw materials suppliers to the defense supply chain in addition to the traditional DOD focus on prime-contractor manufacturers.[68]

In contrast to the DOD, the DOE's critical materials strategy integrates the department's efforts. Unfortunately, while their strategy reflects focus and direction, the scope narrowly focuses on clean energy alone.[69] Despite their clean energy industry focus, DOE recognizes the need for a comprehensive interagency and even multinational approach to addressing the critical materials issue. DOE is working with other departments to develop a coordinated, cross-government critical materials agenda, and since March 2010, has participated in an interagency working group on critical materials and their supply chains convened by the White House Office of Science and Technology Policy.[70] This group examined issues including market risk, critical materials in emerging high-growth industries and opportunities for long-term benefit through innovation.[71]

DOE has also organized several workshops with the European Union, Japan, Australia and Canada to identify possible R&D collaboration topics.[72] With this progressive approach, DOE helped set the stage for a more comprehensive US strategic materials policy.

Regulatory Challenges for the Industrial Supply Chain

With respect to governmental regulation, this report narrows its focus to the start point of the industrial supply chain—mining—as it is an area within the strategic materials industry ripe for regulatory improvement. Within the complex governmental architecture, private mining ventures in the US face one of the most aggressive and burdensome regulatory systems in the world.[73] According to Mr. Hal Quinn, President and CEO of the National Mining Association, testifying to Congress, federal regulations are estimated to cost US industry $1.75 trillion annually, and the proportion of this regulatory burden for the mining industry is intense, since mining companies "must make regulatory filings and obtain government approvals for even the slightest changes in operating plans."[74] Numerous federal and state laws—including the Clean Water Act, the Clean Air Act, the Endangered Species Act, the Resources Conservation and Recovery Act, and the National Environmental Policy Act—require compliance and comprehensive documentation with hundreds of standards. The large number of compliance items, coupled with the confusing and duplicative matrix of federal, state, and local oversight agencies, significantly increases the timeline and cost associated with opening a new mine.[75] In spite of the intent of the compliance items, Mr. Quinn assesses the regulatory agency oversight as slow, "poorly coordinated, excessively expensive, and of uneven value in protecting the environment."[76] As a result of the increased risk created by the "costly and inefficient regulatory structure," Mr. Quinn further states investment and development of US domestic mining has been significantly curtailed.[77]

Over time, the excessive costs, time delays and inefficiencies associated with the burdensome regulatory process have forced many US and international mining and venture capital companies overseas in search of more profitable investments. This has resulted in a dramatic increase in US import dependence over the past two decades for non-fuel materials, many of which are deemed critical and strategic to our nation's defense. Behre Dolbear Group Inc., one of the oldest, continuously operating mineral industry advisory firms in the world, has been recognized internationally for their independent reports and services as being among the most accurate and reliable in the industry. Since 1999, they have ranked the 25 leading mining countries around the world based on seven criteria; the most telling of which is "delays in receiving permits due to bureaucratic and other issues."[78] In the 2011, 2012 and 2013 reports, the United States has been ranked either last or tied for last (among the 25 countries for which data was available) with Papua New Guinea as the country with the longest, most inefficient and least transparent permitting timelines due to bureaucratic bottlenecks and litigation delays with an average 7- to 10- year periods required before mine development can begin.[79]

Based on first hand reports from senior leaders in US mining companies, national and regional mining associations, investors, Colorado School of Mines subject matter experts, and key Congressional staffers, it can take upwards of a fifteen to twenty year waiting period before mine development can begin on public land.[80] As a result of inefficient permitting, mining companies have and continue to look outside the US for new ventures even though the US has abundant domestic reserves.[81] Canada and Australia, for example, have environmental laws that are just as rigorous as the US. However, their efficient permitting processes of 2-3 years encourages investment and stimulates domestic production.[82] Arguably, the second order effects of ineffective

permitting have included significant reductions in skilled labor and technical expertise within the US, causing adverse impacts on the job market, but more significantly, have led to an increase in foreign reliance on critical and strategic materials vital to the US defense industrial base and the security of the nation.

Supply Chain Risk

The aforementioned incoherent governmental strategy, inefficient regulatory structure, as well as other factors (such as an expensive workforce) contributed to a relatively uninviting US business environment and the globalization of many supply chains in the strategic materials industry. While an economist might argue the US and its consumers benefit from a globalized free market, a strategist concerned with national security must examine the risks associated with US dependence on international sources for strategic materials. The defense industry's reliance on rare earth elements (REEs), where China dominates with 97 percent of global production, highlights the need for visibility of the defense supply chain in order to mitigate risk.[83]

Dependence on strategic material imports required in the manufacture of key weapons systems critical to maintaining the technological superiority of US defense capabilities should be of concern to policy-makers, especially if from unreliable partners. Japan learned the consequences of strategic materials dependency in late 2010 during a disagreement with China over disputed maritime territories.[84] When the Government of Japan detained the captain of a Chinese fishing boat found operating in the vicinity of the disputed Senkaku Islands, the Chinese government stopped the shipment of all REEs to Japan.[85] This abrupt disruption in the supply chain had a significant adverse impact on Japanese manufacturing and its economy.

Similar disruptions in the strategic materials supply chain can also directly impact important national security priorities. The USG experienced this during the invasion of Iraq in 2003, when Switzerland's Swatch Group AG refused to ship components of a key JDAM guidance system containing REEs and gallium to demonstrate their lack of support for the US action in Iraq.[86] DOD successfully procured an alternate supplier to manufacture the parts for a significantly increased cost following a brief delay, thus averting adverse effects in the battlespace.[87] Regardless, the actions of a normally reliable US partner led to national concerns, and as stated by Representative Duncan Hunter, Chairman of the House Armed Services Committee, "The Swiss experience…should raise a red flag with security-minded Americans."[88] The examples of the Chinese withholding of REEs and the US experience with JDAM guidance system supply disruption during the war in Iraq provides compelling evidence of the potential national security impact of reliance on imported strategic materials. Nevertheless, the following policy recommendations do not advocate for protectionism; on the contrary, they provide actionable options that help mitigate the risk to the defense supply chain through constructive, economically sustainable means.

Policy Areas

Current USG efforts to address strategic materials and supply risks are compartmentalized and lack the broad perspective of a whole-of-government approach. This disjointed approach, coupled with a regulatory environment unfavorable to domestic mining, increases risk to the defense supply chain. As US reliance on foreign sources of material will likely continue, and as the complexity of supply chains will likely increase, the USG must collectively work to mitigate risks therein. The following policy framework to address these issues consists of synchronizing

US governance, streamlining the regulatory oversight for domestic mining, enhancing R&D, and increasing visibility of supply chain risks follows.

US Governance

As stated earlier, multiple USG organizations address strategic materials policy through their agency's particular perspective. While all are diligent, none of these independent approaches provides a cohesive, singular US strategic material security strategy that integrates essential domestic industry partners. This lack of a unified US strategic materials framework forces individual government agencies to work with industry in a fragmented, piecemeal manner, impeding domestic production and creating supply chain risks. Thus, a synchronized US strategy based on a government-industry partnership—harnessing the capabilities of the various government agencies through a coordinated, whole-of-government approach—would allow the US to address strategic materials supply chain security more effectively and efficiently.

Germany, a major manufacturer and exporter highly reliant on imported minerals, provides a salient example of a government-industry framework worth emulating. The German Federal Government includes strategic materials as part of its comprehensive raw materials strategy. This strategy seeks to reduce trade barriers, diversify supply, improve material use efficiency, improve regulatory processes, and bolster domestic production.[89] The German framework provides financial and political support to domestic industry to mitigate supply chain risks, while placing the onus of exploration, extraction, and stockpiles of materials on domestic industry.[90] Through a lead agency—the *Bundesministerium fuer Wirtschaft und Technologie* (Federal Ministry of Economics and Technology, BMWi)—which integrates strategic materials policy and initiatives across government agencies, the German government works closely with industry to nurture an integrated, diversified, and economically focused strategic materials security strategy.[91] Most recently, BMWi established the *Deutsche Rohstoffagentur* (German Mineral Resources Agency, DERA) to not only collect data on raw material markets, but also to advise industry and government on supply risks, diversification, exploration, extraction, and processing.[92] DERA also takes an active role in engaging mineral-rich countries to develop commercial opportunities for German industry.[93] In partnership with the government, German industry has coordinated its own initiatives to address strategic materials and the industrial supply chain, most notably the *Rohstoff Allianz*—an alliance of German companies that works to secure its associates' and partners' supply of materials.[94] This promising organization has the support of German Chancellor Angela Merkel, BMWi, the Federal Foreign Office, and the Ministry of Economic Development.[95]

Taking a lesson from the German framework and using an approach similar to the Department of Homeland Security (DHS) led national cyber framework—in which DHS partners with private industry across the nation's critical infrastructure to bolster cyber security—***the Executive Branch should develop a government-industry partnership to remove impediments to domestic strategic material production and mitigate supply chain risk.*** As the foundation of this framework, the DOI, DOC, DOE, DOD, and other government agencies would team with private industry to develop consensual and mutually beneficial strategies to bolster strategic material supply chain security. Through this collaborative framework, the intellectual power of industry, lobby groups, think tanks, public policy groups, and the Executive Branch could be leveraged to address aforementioned challenges to domestic production and supply chain security. Instead of a formal, government-controlled structure, the government-industry partnership should be voluntary and fully collaborative, allowing the experts to focus on areas of agreement, providing for US national security and economic prosperity. As with the German model, US industry should

be supported by effective strategy that empowers companies with the necessary financial tools and political support to mitigate supply chain risks. Further, to ensure successful integration across the various US government agencies and to facilitate the collaborative effort with industry and advocacy groups, a lead agency should be appointed. Given the need for a holistic, economically based focus, the DOC may be an appropriate choice. Nonetheless, the lead agency could be any one of the stakeholders mentioned above, but all should be members of the interagency steering committee that addresses strategic materials security. To galvanize this effort, a Presidential directive—much the same as developed for the national cyber security initiative—will be required to energize the formation and delineate the responsibilities of the group. Since the group would be voluntary and collaborative, the broad consensus required to drive change may be difficult to obtain, but well worth the effort required.

Once established, the government-industry partnership must pursue several specific items in order to catalyze this effort. ***First, USGS should be empowered to not only collect strategic material information, but like the German organization DERA, provide policy recommendations to mitigate supply chain disruptions and vulnerabilities.*** DERA's other primary responsibility—fostering economic opportunities for domestic industry with other mineral-rich countries—should be handled by a committee of the new government-industry partnership. ***As part of the support provided to domestic industry partners, the government-industry partnership should also consider providing the necessary financial support and incentives to develop inventories of critical material.*** Most US domestic companies maintain internal material surpluses, or inventories, to hedge against market fluctuations and supply disruptions. The size and makeup of these inventories is bounded by the company's specific economic considerations. To promote a larger inventory in order to protect against supply disruptions, the US government could provide tax and other incentives to companies willing to house larger supplies of strategic materials. While DLA has established a nascent strategic material buffer initiative (e.g. contract for titanium and titanium alloy)[96], evaluating the cost of this recommendation is problematic due to the complexities inherent in the industrial supply chain. ***Finally, the government-industry partnership should encourage industry-led initiatives—much the same as the German Rohstoff Allianz—to further hedge against supply disruptions, secure supply chains, and bolster domestic production.***

In addition to the focus on domestic industry, the government-industry framework must also foster broad, overarching diplomatic arrangements with key allies to further hedge against potential strategic material supply risks. Disproportionate material-dependence on countries that do not align with objectives of US National Security Strategy—from peer competitors to regimes which perpetuate corruption and human rights abuses—not only puts the US at risk of strategic material supply disruption, but also conflicts with fundamental US values. Some US government agencies do negotiate strategic material supply arrangements for certain material and timeframes. However, these arrangements are typically department-specific, and lack the flexibility and fungibility to provide collective supply security for government and industry holistically. Thus, through the authority and expertise of the government-industry framework, the US can leverage international engagements with allies and partners to ensure continued access to materials during geopolitical instability or conflict. These partners can include historical allies such as the members of North Atlantic Treaty Organization, as well as allies in the Pacific which the US maintains mutual defense treaties with including Australia, Japan, and South Korea. In addition to traditional allies, the US can also coordinate with countries that are not formal allies, but are still reliable partners such as the members of the Gulf Cooperation Council or members of Association of

Southeast Asian Nations. Collective strategic materials planning with these nations will not only reduce strategic materials supply chain risk for the US, but also enhance critical relationships with key partners throughout the globe.

Establishing effective governance is the first step required to address the challenges created from the USG's disjointed strategic materials approach, unfavorable regulatory environment, and resulting foreign supply dependencies. Charging the USGS with developing policy recommendations, partnering with industry to develop virtual stockpiles and industry-led initiatives, and fostering diplomatic agreements with key allies will all enhance the USG's ability to mitigate supply risks. The development of a government-industry partnership—which synchronizes and integrates the strategic material perspectives across the whole-of-government—is essential not only to the above recommendations, but provides the agile and broad foundation required to streamline the regulatory oversight for domestic mining, enhance R&D, and increase the visibility of supply chain risks.

US Mining Regulations

In examining the supply chain from the exploration and mine permitting process to the distribution of finished products, this industry study determined mining to be the most impacted by regulation. As such, these recommendations focus on that critical step in the supply chain. The USG, in close coordination with state and local governments, must streamline the onerous permitting process, in order to make new mining activities viable in a reasonable timeframe for investors. The following recommendations include Executive and Legislative branch actions that facilitate this goal, yet simultaneously ensure preservation and protection of the environment. A constructive, pragmatic permitting process would not only decrease the potential risk to national security but also increase the global competitiveness of the US mining industry.[97]

Executive Branch. In an effort to circumvent Congress, who up to this point has been unable to pass effective legislation necessary to streamline the Federal permitting process for infrastructure projects, the President issued Executive Order (EO) 13604, *Improving the Performance of Federal Permitting and Review of Infrastructure Projects,* in March 2012. EO 13604 addresses the need to "significantly reduce the aggregate time required to make decisions in the permitting and review of infrastructure projects by the Federal Government, while improving environmental and community outcomes."[98] It does this by directing an interagency steering group (similar to the aforementioned government-industry partnership, but with an environmental focus), and committing to measurable performance improvements such as: institutionalizing best practices, improving the communication platforms, and identifying review timeframes—all of which would greatly enhance the permitting process for Federal infrastructure projects. The infrastructure projects covered by EO 13604 include: surface transportation, aviation, ports and waterways, water resource projects, renewable energy generation, electricity transmission, broadband, pipelines, and other such sectors as determined by the Steering Committee.[99] Unfortunately, EO 13604 has been interpreted as *not* including Federal permitting for mining projects, but instead, has been more narrowly translated.[100]

The first recommendation is for the President to update and reissue Executive Order (EO) 13604, to include domestic mining of strategic and critical minerals in the definition of "infrastructure projects." The update shall also provide specific direction and guidance to the interagency as to the organization responsible for coordinating Federal permitting timelines and requirements.

The second recommendation associated with the updated EO is for the President to direct the Federal Agency Steering Committee, within one year of issuance, to produce an interagency handbook on "how to submit a mining permit," annually updated and published electronically.

As the third part of the EO, the President would direct the interagency steering committee to conduct an assessment of all federally owned lands and determine which areas should be protected natural resources and made off limits to mining for a designated future period of time, at which time the areas will be reassessed. For example, in January 2012, Secretary of the Interior Ken Salazar announced his decision to protect over 1 million acres around the Grand Canyon and within its vital watershed from the potential adverse effects of uranium and other hard rock mining of the federal lands for a period of 20 years.[101]

The fourth and final update to the EO would include a codified process allowing Department of Defense to enter into interagency agreements with federal land managers to fund and conduct preliminary National Environmental Policy Act (NEPA) analysis in the support of Defense Production Act Title III Authority for mineral deposits deemed as strategic and critical to national security and national defense.

Legislative. An actionable legislative recommendation already exists in House Resolution 761, which supports the proposed Executive Branch action above… ***Congressional passage of House Resolution 761, National Strategic and Critical Minerals Production Act of 2013, dated February 15, 2013 with the incorporation of Section 104, Permitting as proposed in Senate Bill 1113, dated May 26, 2013*** (as recorded in by the 1st session of the 112th Congress) that, if passed will improve the timeline for processing mining permits by reducing redundancies and inefficiencies while also ensuring that regulatory groups are not bypassed or overlooked.

HR 761 mandates selection of a "lead agency with responsibility for issuing a mineral exploration or benefit shall appoint a project lead who shall coordinate and consult with other agencies, cooperating agencies, project proponents and contractors to ensure that agencies minimize delays, set and adhere to timelines and schedules for completion of reviews, set clear permitting goals and track progress against those goals."[102] Specifically, it would mandate a maximum permitting timeline of 30 months and reduce litigation measures and costs. As Ms. Laura Skaer, reports, litigation against the federal government in connection with permits sought from the mining industry is a significant reason why the US is ranked 25th out of 25 in the 2012 Behre Dolbear report on leading mining countries. [103] [104]

Incorporation of section 104, from S.1113, directs the study of issues and extensive time delays within the current permitting process. Prior to any implementation of changes to the permanent law, S.1113 requires the formation of a secretary-level interagency working group charged with optimizing "efficiencies associated with the permitting of activities that will increase exploration and development of domestic, critical minerals, while maintaining environmental standards,…reviewing laws and policies that discourage investment in exploration and development of domestic, critical minerals," and assessing "policies that adversely impact the global competitiveness of domestic mining."[105]

The combination of these executive and legislative actions could potentially make the mining industry once again viable in the US by focusing mining operations on selected public lands and improving the current complex and inefficient permitting process while continuing to mitigate impacts to the natural environment.

Enhanced Strategic Materials R&D to Mitigate National Security Risk

In addition to the policy recommendations proposed for a holistic government effort, as well as improving the regulatory environment, a policy recommendation is also required to address

strategic materials supply chain risk and import dependency. With global demand for *strategic materials* projected to rapidly increase in the 21st century, disruption in the strategic materials supply chain threatens the ability of the US industrial base to meet requirements supporting US national security.[106] In 2011, DOE published a strategy to address these "*critical materials challenges,*" and highlighted the importance of research and development (R&D) to support the strategy.[107] In addition to emphasizing R&D to mitigate risk in the strategic materials supply chain, this strategy details the value of *developing processing improvements and substitutes* as key components to acquire solutions meeting future US strategic materials demands. To achieve this goal, a ***USG policy that funds R&D efforts, including sustained basic research, improved human resource development, and public-private partnership support as proposed in the President's FY14 Budget would help reduce risk in the DOD strategic materials supply chain and strengthen overall US national security***.

Methods to reduce the risk of disruption in the supply chain due to strategic materials shortfalls include the development of *improved processing* and *substitution* techniques. These actions can "be viewed as a virtual stockpile [inventory], which could stabilize supply" and resolve concerns caused by shortages of strategic materials threatening US national security. [108] Processing methods have a key role in expanding strategic materials supply since strategic materials do not exist in large quantities. Instead, many tons of ore are required to obtain only a few pounds of the highly sought strategic material.[109] With the large volume of ore required to create the final product, improving yields through processing efficiency could lead to significant gains. R&D designed to improve processing may yield increase available amounts of strategic materials and reduce supply risk.

In addition to improved processing techniques, expanded substitution also reduces the dependency on limited strategic materials supplies by allowing the use of other materials to achieve similar results. REEs are an example of ongoing substitute development efforts that could have a significant positive impact on availability in the supply chain and lower the risk of defense systems heavily reliant on REEs. Following the withholding of REEs by China during a regional dispute, Japan developed a plan to free the auto manufacturing industry from the restrictive rare earth supply. The Japanese Ministry of Economy, Trade, and Industry led an effort in 2011 allocating $650M toward projects to reduce rare earth supply risks and "directly fund research projects on substitutes for and efficient use of rare metals."[110] This effort led to a recent breakthrough by Toyota in the development of an alternative technology that will allow the company to produce hybrid and electric vehicles with reduced amounts of expensive rare earth metals.[111] Although this work to develop rare earth substitutes has not yet been brought forth in production, the positive impact of this discovery may free Japan from the restrictive REE supply requirement and highlights the value of substitutes.

Achieving Improved Processing & Substitution: Enhanced R&D Options

As an overall approach, pursuit of *enhanced R&D* to achieve the processing improvements and expansion of substitutes is required to reduce strategic materials defense supply chain risk. For the US, this is a logical extension of the strategy it has maintained for many decades since it relied on technological superiority as a primary focus of US national security strategy.[112] The importance of enhanced R&D is also visible in key strategic documents published by the Obama Administration, including the DOE's 2011 *Critical Materials Strategy*, which emphasizes a critical materials R&D plan as a key component supporting supply diversification through processing improvements and development of substitutes.[113] To advance processing and substitute efforts,

programs supporting R&D efforts are required. ***Sustained basic research, improved human resource development, and public-private partnership support*** are three viable methods to bolster R&D efforts. These options provide the required support necessary to enhance strategic materials R&D, maintain broad reach across multiple departments, and are sustainable in a period when concerns over the fiscal state of the USG must also be considered.[114]

The first critical component of the effort to support enhanced strategic materials R&D is ***sustained basic research***. Basic research is vital to advancement in materials science, and these efforts have a history of leading to groundbreaking success within the federal government,[115] most recently with the development of nanotechnology products, which were the offshoot of government funded basic research into activity at the atomic level funded by the National Science Foundation (NSF). Basic research is also a good fit for the advancement of strategic materials science since, "advanced study of the…material properties…of critical elements would not only aid in mining, separating, processing…but also allow scientists to better find substitutes for them."[116] Basic research requires federal support since it can be "too risky for industry alone to undertake," and is often the catalyst that has "proven to be groundbreaking and [led to] economic successes in the end."[117] For these reasons basic research must be both well funded and directed at the science of strategic materials. A suitable area for basic research is REE substitute science, with emphasis on rare earth magnets, since magnet technology has not made significant advances in over two decades. By focusing basic research on aspects of "the development of materials-level alternatives" as well as "combining materials on a nanoscale" discoveries of substitutes for rare earth magnets could be found.[118] There are ongoing efforts funded by DOE exploring these areas,[119] but due to sequestration the outlook for continuing these vital basic research programs is at risk, and efforts must be taken to prevent this.

The second critical component of the effort to support enhanced strategic material R&D is ***improved human resource development***. Without appropriate workers possessing necessary skills, R&D efforts required to develop processing improvements and substitutes cannot be successfully carried out. For example, thirty years ago the rare earth industry employed about 25,000 people in the US, with many thousands holding advanced degrees. By 2011, the US rare earth industry employed less than 1500 people, with only a few hundred of those with advanced degrees.[120] Molycorp, the single US firm operating a rare earth mine, has struggled to maintain its workforce and conducts significant on-the-job training to meet its labor requirements.[121] As long as the shortages in the highly skilled strategic materials workforce continue, supporting enhanced R&D efforts is challenging. The USG acknowledged the shortfalls in human resource development, and the President's Budget for FY 2014 recognized the need for additional Science, Technology, Engineering, and Math (STEM) education goals across all levels, and allocated $3.1B toward the effort.[122] To bolster the graduation of scientists who could support strategic materials research in the near-term, $325M was provided in grants to the NSF's Graduate Research Fellowship Program to support 2000 scholarship awards in 2014.[123] In addition to supporting increased STEM graduates, the Obama Administration sought increased funding to the agencies responsible for providing key financial support to much of the USG R&D workforce, with proposed budget increases to the NSF and other agencies responsible for critical basic research.[124] For the US to grow the necessary human capital required to support enhanced strategic material R&D, these proposals must be funded and sustained.

The third component to support enhanced strategic material R&D is ***public-private partnership (PPP) support***. Partnerships harvest the potential of the commercial sector while reducing costs to the USG, ideal in a fiscally constrained environment. One effective PPP is

DOD's exercise of the Defense Production Act authority to invest $90M in a partnership with Materion Corporation to produce high-purity beryllium metal for the manufacture of US defense systems.[125] This led to the construction of a facility able to convert beryllium ore into high quality beryllium metal for manufacturing use.[126] Through this partnership beryllium production is active in the US and this strategic material is available to DOD without supply chain disruption risk due to excessive import reliance.[127] Another PPP planned to directly support strategic materials research is the CMI, which received a $120M award from DOE and will be led by the Ames Laboratory located at Iowa State University.[128] The CMI will carry out research aimed at advancing rare earth material science and, "bring together the best and brightest research minds from universities, national laboratories, and the private sector to find innovative technology solutions that will help avoid a (strategic material) supply shortage that would threaten…our security interests."[129] Expansion of PPPs that enhance materials basic research, bolster the development of human capital in the strategic materials industry, and synchronize technological knowledge from government, academia, and industry must be continued in the years ahead, even with a fiscally constrained USG.

Full Funding of Enhanced R&D to Reduce Supply Chain Risk

To meet the goal of enhanced strategic material R&D achieving the advancements in processing and substitutes to reduce defense supply chain risk, ***a USG policy supporting full funding of enhanced R&D efforts including sustained basic research, improved human resource development, and public-private partnership support as proposed in the President's FY14 Budget is recommended.*** To build a vibrant USG strategic materials foundation, federal departments must prioritize basic research at the expense of other programs if budget cuts are required.[130] Human resources development initiatives such as expanded STEM education and programs providing scholarships to engineers and scientists should also receive full funding with inflation-adjusted growth in the years ahead.[131] The USG must also continue the very significant progress made with Materion Corporation and the CMI, and implement other public-private partnerships as planned.[132] All of these efforts are vital to the success of strategic materials enhanced R&D and critical to achieve the gains needed in the development of processing improvements and substitution. By implementing a policy of maintaining full funding for strategic materials related enhanced R&D including sustained basic research, improved human resource development, and public-private partnership support, the US will improve its strategic materials posture and protect US national security.

Increased Supply Chain Visibility

The weaknesses in the current approach to managing strategic material risks in the defense supply chain cannot be effectively addressed without increased visibility into the specific risks within the chain. To address these risks, the USG must first have sufficient intelligence about those risks to support development of effective solutions. The proposed approach, Distributed Defense Material Management (D2M2) will address this problem through three main elements: an Implementing Regulation, a Strategic Materials Watch List, and Defense System Strategic Material Risk Management Plans.

The existing approaches to both gathering information on risks and addressing those risks are centralized within Office of Secretary of Defense (OSD)-MIBP and DLA-Strategic Materials.[133] This centralization limits both the quality of the data available and the range of tools or actions used to deal with supply chain risks. The proposed policy/regulation directly addresses those deficiencies. The regulation will require each DOD item manager or program office to

analyze their products supply chain for risk associated with strategic materials. The Strategic Materials Watch List will be the basis for that analysis. The watch list leverages the existing supply side data collection efforts by the USGS and establishes a baseline list of materials of concern. These analyses will be captured in management plans that will be the basis for addressing supply risks. To ensure various program offices do not duplicate actions all plans will be submitted to OSD for a centralized analysis of risks. The centralization of information generated in a distributed manner will allow for OSD to have visibility into the overall risks and to develop and implement higher-level solutions where appropriate. Regardless of OSD actions the responsibility for managing these risks needs to reside at the lowest level.

Implementing Regulation

In order to be effective, the D2M2 initiative must be implemented in the form of a federal or DOD regulation. Current efforts to manage supply risk are a mix of federal laws (Specialty Metals, Defense National Stockpile), surveys (S2T2), and ad hoc identification of problems after they happen. The approach implied within D2M2 will require a much wider distribution of actions and responsibilities. An array of acquisition organizations is not currently accountable for strategic materials supply chain risks will be expected to pick up new responsibilities. Based on discussions with multiple DOD acquisition professionals a strong push back against this additional requirement will occur. Only a regulatory approach will ensure the risks are addressed proactively and in detail.[134] Proposed language for a D2M2 specific DFAR would be:

> No DOD contract may include a specification or standard that requires, directly or indirectly, the use of any of the materials listed on the most current Strategic Materials Watch List or that can be met only through the use of such a substance unless the inclusion of the specification or standard is specifically authorized at a level no lower than a general or flag officer or a member of the Senior Executive Service of the requiring activity. Even when appropriately authorized, a report of the authorization and an associated Defense System Materials Supply Risk Plan shall be submitted to the cognizant office within the Office of the Secretary of Defense.[135]

The approach has effectively managed the environmental risk associated with the use of ozone depleting substances in the DOD supply chain and would likely have a similar impact of the management of strategic materials risk. This language is intentionally broad to ensure the widest application to include organizations with accountability for defense system development through disposal and from service specific procurement officials through large joint program executive offices.

Strategic Materials Watch List

D2M2 starts with the identification of those strategic materials on the left side of the supply chain (rawest form) that have implicit risks in their availability due to such factors as a reliance on foreign sources or limited/single sources within the US. The current approach used by the DLA-SM to establish an initial list of strategic materials for analysis in their biennial report would form the basis for this new watch list. However, rather than feeding into subsequent DNS analysis steps where it would be weighed against a modeled estimation of market demand, the list will be provided with wide distribution to defense program and procurement offices. This watch list will then become the starting point for creation of Defense System Materials Supply Risk Plans. Critical differences in the new watch list will include USGS providing predictive estimates of

future availability out ten years and making the list as inclusive as practical to limit year on year changes. A starting point could be the 72-material list used to begin the process for the recent 2013 report.[136]

Defense System Strategic Material Risk Management Plans

The intent of the Defense System Materials Supply Risk Plans are to push the impact analysis down the supply chain as far as possible to maximize data accuracy and delegate responsibility for planning to that level. This approach is more likely to be self-sustaining since the market or the defense program owners would be responsible for identifying and managing the risks. This will address a DLA-SM weakness by capturing the full supply chain and S2T2's weakness associated with centralization of management in a complex changing market environment. The resultant plans will provide an additional information source for DOD level planning, coordination, and action. Where lower level offices cannot appropriately address risks themselves or lower level actions would result in increased costs due to duplication, OSD can use the tools and programs available at its level. In this case OSD is the appropriate authority to aggregate the information and to collaborate with suppliers on global risk mitigation techniques.

While the world has progressed from a protectionist approach to industrial capacity for our commercial enterprises, the DOD's responsibility for national defense does not give it the luxury of relying on Adam Smith to address the impact of globalization on its supply chain should war result in the interdiction of reliable peacetime sources. However, DOD's response to this risk has not been a proactive one. Instead, it relies on a pre-WWII model for managing risk by focusing on the raw materials and, as a result, simply being surprised when shortages occur that were not foreseen. The proposed approach is a first step toward in a more active supply chain monitoring system.

Summary of Recommendations

Within the context of the strategic materials industry and an enterprise view of its role in US national security, this report provides practical recommendations for government action that will mitigate risk to the defense industrial supply chain. These recommendations start from overall USG policy and work down to the DOD industrial supply chain level:

1. **US Governance.**
    - **a.** ***The Executive Branch should develop a government-industry partnership to remove impediments to domestic strategic material production and mitigate supply chain risk***
    - **b.** ***USGS should be empowered to not only collect strategic material information, but like the German organization DERA, provide policy recommendations to mitigate supply chain disruptions and vulnerabilities.***
    - **c.** ***As part of the support provided to domestic industry partners, the government-industry partnership should also consider providing the necessary financial support and incentives to develop inventories of critical material***
    - **d.** ***The government-industry partnership should encourage industry-led initiatives, much the same as the German Rohstoff Allianz, to further hedge against supply disruptions, secure supply chains, and bolster domestic production.***

e. ***The government-industry framework must also foster broad, overarching diplomatic arrangements with key allies to further hedge against potential strategic material supply risks***

2. **Regulatory improvements.**
    a. ***Update and reissue EO 13604 to: include domestic mining of strategic and critical minerals in the definition of "infrastructure projects," and assign a lead agency responsible for coordinating Federal permitting timelines and requirements.***
3. ***Direct the interagency steering committee, within one year of issuance, to produce an interagency handbook on "how to submit a mining permit," annually updated and published electronically;***
    a. ***Direct the interagency steering committee to conduct an assessment of all federally owned lands and determine which areas should be protected natural resources and made off limits to mining for a designated future period of time, at which time the areas will be reassessed;***
    b. ***Codify a process allowing DoD to enter into interagency agreements with federal land managers to fund and conduct preliminary NEPA analysis in the support of DPA Title III Authority for mineral deposits deemed as strategic and critical to national security and national defense.***
    c. ***Congress should pass House Resolution 761, National Strategic and Critical Minerals Production Act of 2013, with the incorporation of Section 104, Permitting as proposed in Senate Bill 1113.***
4. **Strategic Materials R&D.** ***Sustain government's basic R&D support, improve human resource development, and sustain public-private partnership support.***
5. **Mitigate risk in the defense supply chain.** ***Establish a Distributed Defense Material Management (D2M2) through an Implementing Regulation, a Strategic Materials Watch List, and Defense System Strategic Material Risk Management Plans as described above.***

These recommendations, while not presuming to solve all strategic material problems, provide actionable policy options that the USG can use to improve its strategic material security.

Conclusion

The inherent complexity of the strategic material industry in many ways reflects the convoluted array of stakeholders, interests, and approaches to addressing strategic material security. While secure access to strategic materials directly affects national security and defense capabilities, the DOD cannot ensure that access on its own. Rather, the DOD must partner with other agencies and industry to develop a holistic approach to strategic material security—one that recognizes the economic truths of globalized supply chains in an enormous industry. Commercial and defense interests alike benefit from constructive government policy and a healthy business environment. Though the recommendations in this report do not solve strategic materials security, they address what this industry study has found to be salient issues, and provides pragmatic, actionable policy options that will facilitate greater US strategic materials security. Implementation of these initiatives will significantly improve the ability of the US to be ready to

fight the next major war—a war that is likely to be about natural resource access and could be won or lost due to the DOD being unable to meet its obligations due to supply chain risks.

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