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U.S. Rare Earths Policy: Digging Out of the Rare Earths Quandary

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"The availability of rare earth elements is a challenging international economic issue that could threaten U.S. national security interests. Rare earth elements are a group of 17 elements that have become increasingly important in the production of high-tech consumer and defense-related products. The U.S. Department of Defense (DoD) uses rare earths in a number of military technologies and is dependent on their availability.[1] Some argue DoD's dependence on rare earths is problematic because China controls an estimated 95 percent of the world's mining and production capability.[2] China's near monopoly in rare earths has the attention of American security experts, the DoD, and the U.S. Congress.

The U.S. rare earths policy is the DoD policy. Since its adoption in 2011, there has been a significant improvement in rare earths markets. The existing policy, combined with natural markets forces, are working together to improve supply, demand, and market prices. U.S. lawmakers need to resist pressures to pass needless legislation that will only disrupt natural market forces, increasing the cost while decreasing long-term availability.

Some interest groups disagree. They argue that China's near monopoly on rare earths is a national security threat, and the United States needs to do more to ensure access to these scarce but critical mineral resources. This led Congress to legislate two bills (H.R. 761 & S. 1600) that will change U.S. rare

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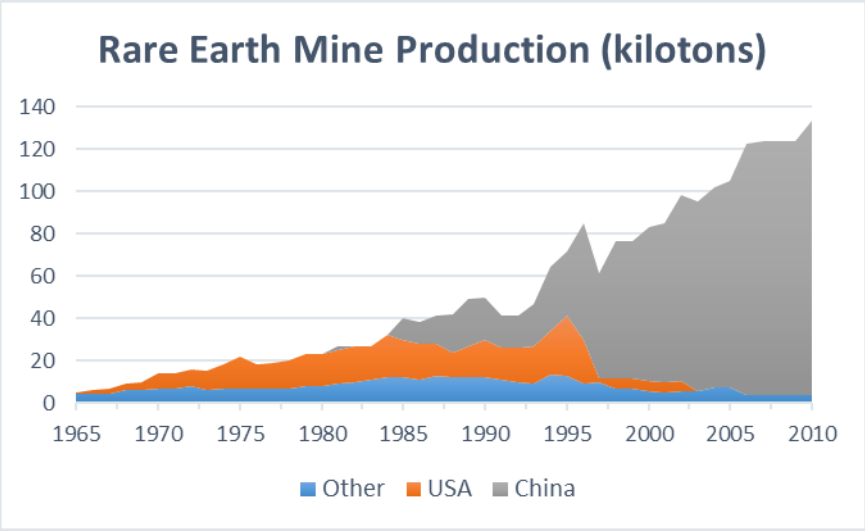
earths policy. Congress should reject these two bills because the existing policy is working with natural market forces to improve rare earths markets to the point where they are no longer a threat to national security.

Background

Rare earth elements have grown in importance over the years because of their value in producing advanced technological products. The U.S. Geological Survey (USGS) reports over 200 civilian and defense industry products rely on rare earths.[3] Consumer products include cellular phones, DVDs, rechargeable batteries, catalytic converters, and all types of high definition displays.[4] The renewable, or green, energy industry also depends on rare earths. It uses them to produce wind turbines, electric vehicles, photovoltaic thin films, and energy-efficient lighting.[5] More importantly, rare earths also play a critical role in our national defense. The DoD uses rare earths in night-vision goggles, precision-guided weapons, lasers, super magnets, GPS equipment, radar systems, and other defense related electronics.[6] Rare earths are plentiful in the earth's crust, but due to their low concentration in specific areas, the mining process is expensive and damaging to the environment.[7] In the 1970s, 80s, and 90s the United States was the leading producer of rare earths (see figure 1).[8] In the 1980s, the Chinese government started aggressively pursuing rare earths markets. The Chinese leader Deng Xiaoping reportedly said, "China's rare earth resources can be likened in importance to the Middle East's oil. They have immense strategic significance, and we must deal with rare earths issues with care, unleashing the advantages they bring."[9] Since then, Chinese companies have taken advantage of government support, cheap labor, and lax environmental regulations to dominate global rare earth markets.[10] In 1996, China overtook the United States as a leader in rare earth mining and production.

Figure 1: Global Rare Earth Mine Production Rates in kilotons



Source: Compiled from U.S. Geological Survey (USGS) *Rare Earth Elements – Critical Resources from High Technology (1965-2000)* and *Mineral Commodity Summaries (2000-14)*.

Today, China produces an estimated 95 percent of the world's rare earths.[11] This went largely unnoticed until China threatened to ban the export of rare earths to the United States and Japan in 2010 in retaliation for a diplomatic spat over fishing rights near the Senkaku Islands.[12]
The ban never occurred, but the United States began taking a greater interest in China's rare earths policies. U.S. policymakers learned in 2005 that China instituted a 10 percent duty on rare earths exported out of China. This duty grew to 15 to 25 percent by 2012, depending on the particular rare

earth.[13] China also restricts the volume of rare earth exports with a quota system. This quota system has reduced Chinese rare earth exports by 47 percent from 65.6 kilotons in 2005 down to 31.1 kilotons in 2012 (see figure 2).[14] An increase in Chinese domestic consumption has counterbalanced the decrease in exports.[15]

Figure 2: Chinese Rare Earth Consumption, Exports, and Total Production (kilotons)

	2005	2006	2007	2008	2009	2010	2011	2012
Export Quota	65.6	61.1	59.6	50.0	48.2	30.3	30.2	31.1
Consumption	53.4	57.9	60.4	70	71.8	89.7	74.8	63.9
Total Production	**119.0**	**119.0**	**120.0**	**120.0**	**120.0**	**120.0**	**105.0**	**95.0**

Sources: Pui-Kwan Tse, *China's Rare Earth Industry*, U.S. Geological Survey, Open File Report 2011-1042.

China claims export quotas are necessary to minimize environmental harm, save rare earths for future generations, and promote domestic production up the value chain.[16] Critics claim China is leveraging its near monopoly in rare earths to artificially inflate the price and exert political influence. Akshat Rathi, of *The Economist* agrees, "Slashing their exports of rare-earths has little to do with dwindling supplies or environmental concerns. It is all about moving Chinese manufacturers up the supply chain, so they can sell valuable finished goods to the world rather than lowly raw materials."[17]

The combination of export duties and quotas resulted in the United States, European Union, and Japan taking China to the World Trade Organization court for unfair trade practices. In October 2013, the WTO found in favor of the United States but China is expected to appeal the WTO decision. Regardless of the final adjudication, China continues to export rare earths but the question remains, is the US dependence on China rare earths a national security threat?

Rare earths as a Threat to U.S. National Security

Many argue that China's near monopoly on rare earths is a U.S. national security threat. They often cite the Director of National Intelligence's, James Clapper, *2013 Worldwide Threat Assessment* as evidence to support their claim. Director Clapper's Congressional testimony stated competition and scarcity of natural resources are a growing security threat. He specifically addressed the threats presented by food, water, energy, climate change, and rare earths.[18] He was concerned with China's commanding monopoly over rare earths and its policy limiting exports. This export policy caused a spike in 2011 rare earth prices to as much as 600 percent, depending on the type of rare earth.[19]

Director Clapper explained how countries developed mitigation strategies in reaction to China's rare earth export policies. These strategies mostly focused on developing domestic production capabilities and finding suitable replacement materials but will have only limited effects in the short-term. Clapper closed by saying new global mining and refining capabilities are expected to be operational in the next five years.[20] Advocates for a new rare earths policy used the *2013 Worldwide Threat Assessment* to support their argument that rare earths are a national security threat and are lobbying Congress to legislate a policy to ensure access to these scarce but critical mineral resources.

U.S. Rare Earths Policy Development

In 2011, advocates for a new rare earths policy lobbied Congress to assess if rare earths are a national security threat. This led to a provision in the 2011 National Defense Authorization Act calling for an assessment of the U.S. rare earths policy. The Act mandated that DoD identifies "the rare earths

critical to national defense and those rare earths subject to supply chain interruption" while developing a mitigation strategy.[21]

In March 2012, the Under Secretary of Defense for Acquisition, Technology and Logistics (AT&L) sent a report to the U.S. House of Representatives detailing the DoD policy and outlining a plan for assuring the long-term availability of rare earths. The policy can be summarized as a "three-pronged" approach: "diversification of supply, pursuit of substitutes, and focus on reclamation of waste as part of a larger U.S. Government recycling effort."[22] The document also states the DoD will continue to execute its Defense Production Act Title I authorities that provide the power "to ensure the supply and timely delivery of products, materials, and services to military and civilian agencies."[23] In addition to these authorities, the plan listed three additional steps to assure rare earths access. The DoD will:

- Engage in continuous monitoring of markets and production levels;
- Undertake reviews of defense industrial base materials supply chains; and
- Prepare for the possible need to establish buffer stocks that are contractor-owned, U.S. Government-subsidized, but only implemented if certain predetermined marked indicators are met.[24]

The DoD is not the only U.S. Government department with a rare earths policy. As stated earlier, rare earths are also critically important to the renewable energy industry. The Department of Energy (DoE) also published a rare earths policy in 2011. The DoE's policy is remarkably similar to the DoD's but with only slightly different wording.

DoE's policy for addressing the challenges associated with critical minerals and rare earths challenges rests on "three-pillars."[25] First, diversified global supply chains are essential. An increase in global and domestic production facilities will reduce U.S. vulnerability to supply chain interruptions. Second, substitutes must be developed. Research leading to material and technology substitutes will improve the flexibility and help meet the material needs of the clean energy economy. Third, recycling, reuse and more efficient use could significantly lower world demand for newly extracted materials.[26] The DOE's policy is essentially the same as the DOD's policy.

Some think the U.S. Department of the Interior (DoI) should have a rare earths policy but they do not. The DoI's U.S. Geological Survey (USGS) collects, analyzes, and disseminates data and information on global rare earths and other critical minerals. This includes research on rare earths consumption, production, and reserves for supply chain analysis.[27] They inform policymakers; they do not make policy. The DoI does not have a rare earths policy and the difference between the DoD and DoE policies are mere semantics. Thus, in the absence of a higher policy, the DoD policy serves as the U.S. rare earths policy.

Assessment of the risk presented by Rare Earths

Is the DoD's dependence on rare earths a serious security risk? The Under Secretary of Defense for AT&L report on rare earths states only seven of the 17 rare earths were critical to the DoD. The report went further to say that current domestic production satisfies the consumption of six of the seven critical rare earths. This is because the DoD consumes only a small fraction, less than five percent, of the total U.S. imports of the seven critical rare earths.[28] The only rare earth identified as vulnerable to actions or events outside U.S. governmental control was yttrium.[29] Yttrium is used in the production of high-definition TVs, temperature sensors, radars, lasers, digital communications devices, supermagnets, superconductors, and superalloys.[30] The report came to this conclusion because only yttrium consumption outstripped the forecasted supply produced in the United States (see figure 3).

Figure 3: DoD Forecasted Consumption of Critical Rare Earths for 2013 (tons)

	Element	U.S. Supply	Consumption	Surplus	Deficit
1	Dysprosium	7	7	0	
2	Erbium	1.2	1.14	0.056	
3	Europium	21	11	10	
4	Gadolinium	42	4	38	
5	Neodymium	2,232	110	2,122	
6	Praseodymium	824	14	810	
7	Yttrium	26	119		93

Source: Frank Kendall, Report to Congress Rare Earth materials in Defense Applications, Under Secretary of Defense for AT&L, March 2012.

Yttrium is the only rare earth identified as critical and subject to supply chain interruptions. The DoD forecasted an 119-ton requirement, 26-ton supply, and 93-ton deficit for Yttrium in 2013.[31] According to alarmists, the United States is now at the mercy of the Chinese Communist Party (CCP) to get its national yttrium fix, and America needs an aggressive policy to ensure it is never at the mercy of the CCP again![32] While this emotional argument sounds good to the alarmist, it is very shortsighted. Just as the U.S. government does not want to be dependent on China for rare earths neither does the world economy. As you would expect, markets react quicker than governments to market trends. Supply and demand principles run the best markets, not fear mongering.

RARE EARTHS SUPPLY, DEMAND, AND PRICING

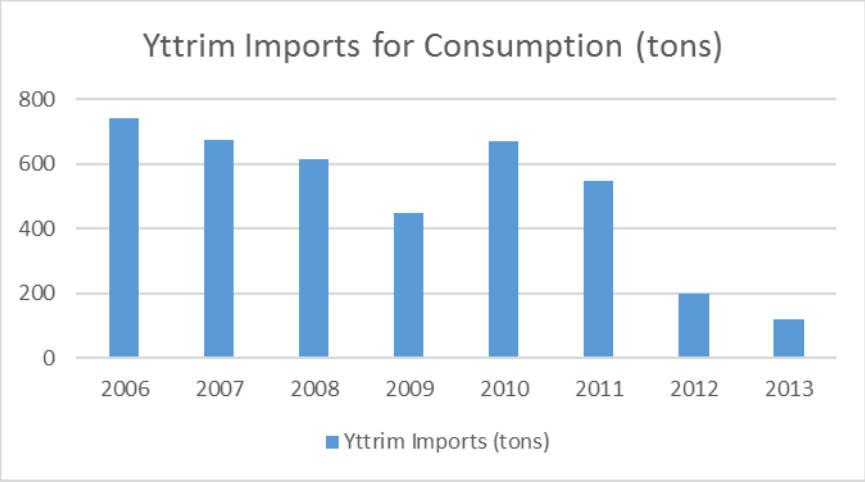
The existing U.S. rare earths policy is appropriate and requires no modification because supply, demand, and pricing are all improving. U.S. and global markets have responded to market conditions for rare earths with new investments in rare earth mining and production facilities. Technical advances are also increasing the use of alternative materials and increasing reclamation through recycling and reuse. These responses have increased supply and decreased demand. According to the DoD's *Rare Earths Report*, the overall yttrium market is trending positively to assure the U.S. will have future access to yttrium.[33] Some in Congress have called for legislation to develop a more robust policy to deal with rare earths. Yet, the current policy is working, and the United States does not need to legislate a new one. Indeed, government management of these markets will cause more problems than it will fix.

The first prong of the U.S. "three-pronged" policy is diversification of supply. The USGS reported the United States returned to the rare earths markets in 2012 by producing 800 kt of various rare earths and increased production to 4,000 kt in 2013.[34] This makes the United States the second largest producer of rare earths in the world, with a small but growing 4 percent market share. The USGS expects the United States "to continue to increase its production rate in 2014."[35] Additionally, the DoD's *Rare Earths Report* assesses domestic yttrium production will be capable of meeting future U.S. Government demand in 3-5 years.[36]

There are also other yttrium producers besides China. Brazil, India, and Malaysia also produce yttrium, and their capacity grows every year. If China banned the export of yttrium, Brazil, India, and Malaysia could probably supply the low levels of yttrium required by the DoD. It is the U.S. civilian market, consuming 95 percent of yttrium imports, which is most dependent on Chinese yttrium. Civilian industry is the most vulnerable to market uncertainty, not the DoD. Yttrium supply may be a U.S.

economic problem at large, but the low levels used by the DoD do not make it a national security issue. Special interest groups need to stop using the DoD as an excuse to push through self-serving legislation.
The second reason the United States does not need to legislate a new rare earths policy is because U.S. demand for yttrium is decreasing. According to the USGS, the total U.S. demand for yttrium has decreased 84 percent over the last seven years (see figure 4). In 2006, the U.S. consumed a high of 742 tons but dropped to 119 tons by 2013. This trend is expected to continue downward in 2014.[37]

Figure 4: Yttrium Imports for US Consumption (tons)

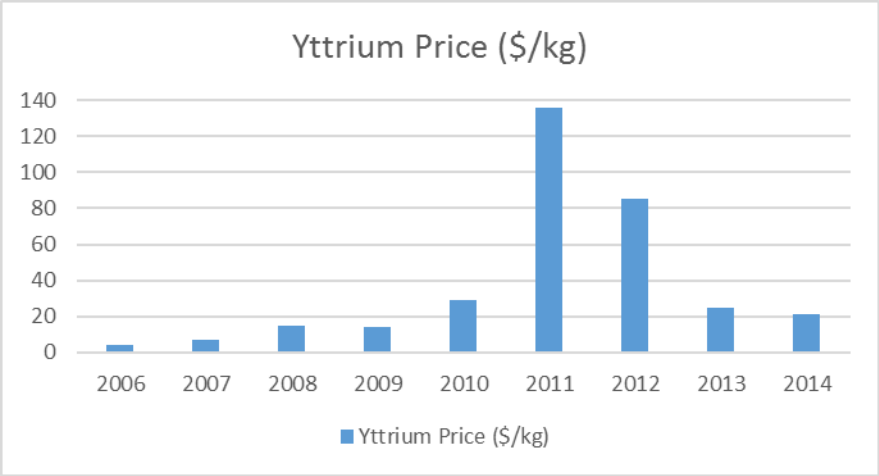


Source: U.S. Geological Survey, Yttrium - Mineral Commodity Summaries (2006-13).

The explanation for this decrease in yttrium demand is a combination of two factors. U.S. industry is finding substitute materials, and there is an increase in recycling opportunities. The DoD rare earths policy is committed to pursuing suitable rare earth substitutes. Substitutes for yttrium are available for some applications. In industrial ceramics, yttrium oxide may be substituted with calcium oxide; it is less effective but still useful in many cases.[38] Technical advances will increase the number of cases where calcium oxide can be substituted for yttrium oxide
The second factor is increased reclamation through urban mining. The DoD policy states it will "focus on reclamation as part of a larger recycling effort." Urban mining is the process of reclaiming compounds and elements from products, buildings, and waste.[39] A successful example of urban mining is Honda's recycling of rare earth materials found in used nickel-metal hydride batteries to make new hybrid vehicle batteries.[40]
Recycling technology is improving, and urban mining opportunities are increasing. For example, scientists at the U.S. DoE Ames Laboratory identified a process to remove heavy metal rare earths from recycled material while maintaining the critical properties required when producing powerful supermagnets.[41] The USGS also reports a small but growing quantity of recycled yttrium through the reclamation of laser crystals and synthetic garnets.[42] Advancements in recycling technology are increasing urban mining opportunities and ultimately reducing U.S. demand for all rare earths, specifically yttrium.
Much of the rhetoric calling for more governmental action in the rare earths markets is linked to national security due to DoD's dependence on rare earths. In reality, the DoD uses a small fraction, less than 5 percent of total domestic consumption of rare earths.[43] It is the civilian sector that has far more to gain with government intervention.
The U.S. rare earths policy combined with market forces are solving U.S. rare earths challenges. The combination of increased supply and decreased demand is evident in the yttrium market price (see

figure 5). In 2010, the price of yttrium was only $29/kg.[44] When China instituted duties and export quotas in 2011, yttrium prices skyrocketed to $136/kg.[45]

Figure 5: Average Yttrium Prices ($US/kg)



Sources: Arafura Resources Limited, Rare Earths Pricing, January 2013

Since the DoD and DoE instituted their rare earth policies in 2011, we have seen improvements in the rare earths and yttrium markets. The yttrium supply chain options are increasing while demand is decreasing. The proof is in the yttrium pricing. Since 2011, U.S. consumption of yttrium has dropped 78 percent while the price for yttrium has dropped 84 percent to $21.5/kg.[46] The situation is improving.

The National Strategic and Critical Minerals Policy Act of 2013

If the U.S. rare earths policy was working effectively, then why did the U.S. House of Representatives pass *The National Strategic and Critical Minerals Policy Act of 2013*? The Act requires the Secretary of the Interior to assess the capability of the Nation "to meet our current and future demands for the minerals critical to the United States manufacturing and economic and national security in a time of expanding resource nationalism."[47] The intent of the Act is to rewrite the U.S. critical minerals and rare earths policy.

The actors who have a vested interest in the U.S. rare earths policy are varied and substantial. The domestic political actors include Congress, Department of Defense (DoD), U.S. National Research Council (NRC), and the mining industry. The mining industry with the support of the NRC is lobbying members of Congress to pass the National Strategic and Critical Minerals Policy Act of 2013. The legislation authorizes a $60 million dollar subsidy to support critical minerals and rare earths policy.[48]

The mining industry is pushing for the legislation for a few reasons. First, they hope to change the review process for issuing mining permits on federal lands to make it faster and cheaper to mine.[49] Second, it authorizes spending $8 million for the U.S. Geological Survey to conduct a new rare earths study.[50] The mining industry hopes the new study will lead to subsidies to restart rare earths mining in the United States and recommend relaxing environmental standards when mining and refining rare earths.

If the legislation fails to restart the rare earths mining industry, it might recommend purchasing and maintaining a strategic stockpile of critical rare earths. Congress would then appropriate money for the mining industry to purchase and store the strategic stockpile. Either way, the mining industry stands to win.

The NRC represents the scientific research community. They also support the legislation because it authorizes $3 million to fund research into critical minerals and material sciences.[51] NRC support for any legislation spending money on research is never surprising. It is their job. That does not necessarily translate into a better rare earths policy.

Regarding the DoD, bill advocates want the DoD to make two arguments. First, rare earths are critical to the production of significant U.S. military equipment. Second, rare earths are vulnerable to supply chain interruption outside U.S. governmental control.[52] If the DoD made these two arguments, then it would be in U.S. national interest to ensure unfettered access to rare earths. This would lead to either subsidy to restart the rare earths mining industry or authorize the stockpiling of critical rare earths.

The DoD conducted a study and briefed Congress in March 2012, but some special interest groups did not agree with the findings. The report stated "a number of positive developments with regard to both supply and demand within the rare earths markets helped to stabilize overall markets and improved the availability of rare earth materials."[53] The report acknowledged rare earths are an important issue, but the DoD has a mitigation plan and will continue to monitor the situation. In essence, there is no need for Congress to legislate a new solution that the existing policy and market forces are fixing.

Despite DoD's conclusion, this did not stop special interest groups from campaigning for a change in the U.S. rare earths policy. They continue to paint China as withholding a vital substance that is critical to our national defense. China is not, but this has not stopped the lobbying of the Congress and the House passing of The National Strategic and Critical Minerals Policy Act of 2013. As of April 2014, the bill is in the Senate and in the words of John Kemp, Reuters Senior Market Analyst for Commodities, "The National Strategic and Critical Minerals Policy Act of 2013 is one of those pieces of special-interest legislation that deserves to die in the U.S. Congress."[54] I could not agree more.

Conclusion

The United States has a well-conceived policy that understands what it can influence within the global rare earth markets. This policy has seen a reduction in the consumption of rare earths, particularly yttrium. The market has also seen an increase in the availability of rare earths as China is starting to lose market share to other global competitors. The extraction and production of rare earths is very costly on the environment. There are advantages to having the strongest economy and military in the world. One of them is that we should not have to sacrifice our environment to produce a commodity when other countries are ready and willing to produce them for the United States.

The DoD's *Rare Earths Report* demonstrates that availability of rare earths is not a national security threat. The DoD assesses that all rare earth markets are "trending positive for a market capable of meeting future U.S. Government demand."[55] The only rare earth that outstripped domestic supply was yttrium but over the last four years yttrium demand decreased significantly. The DoD's *Rare Earths Report* closes by reiterating its belief that by 2015 the DoD will no longer be dependent on China for any rare earths, including yttrium.

When the Director of National Intelligence testified about the availability of rare earths as a national security threat in 2013 he must have been referring to their availability to the civilian market, not the DoD. Thus, *The National Strategic and Critical Minerals Policy Act of 2013* has nothing to do with national security but domestic economic concerns. Special interest groups need to stop arguing that rare earths are a national security threat and stop using the DoD as an excuse to push through self-serving legislation.

Further evidence can be seen in the recently released Director of National Intelligence's *2014 Worldwide Threat Assessment*. In the 27-page document, rare earths are not mentioned once. Mr. Clapper reiterates his belief that "competition for and secure access to natural resources (e.g. food, water, and energy) are growing security threats" but rare earths are replaced by the Arctic as the threat du jour.[56]

He has moved on to a different national security emergency and perhaps Congress should heed the Director's assessment.

The United States would be well served to maintain the existing policy that is improving rare earths markets. New investments and technical advances are improving the situation. The new investments in rare earth mining and production facilities are increasing rare earth supplies. Technical advances are decreasing demand by increasing recycling efforts and the use of alternative materials. All these efforts are increasing supply, decreasing demand, and improving market pricing. The existing policy is working and legislating new policy will only disrupt natural market forces and increase the long-term cost and availability these scarce but critical mineral resources.

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