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Rare Earths In Review A Decade of Decline & Deception

How Wall Street Darling Molycorp Undermined the U.S. Economy, Degraded our National Security and Distorted the Global Economic Balance and How These Falsehoods Continue to be Promoted Even Today

James Kennedy – ThREEConsulting.com
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Introduction & Summary

In 2007 the Molycorp Mountain Pass rare earth mine was resurrected from its desert-grave in California by its then-owner Chevron Mining. Responding to elevated rare earth prices Chevron began processing on-site rare earth concentrates left over from past mining operations that were terminated in 1998ⁱ. Chinese demand had sparked what was being described as a commodities super-cycleⁱⁱ. Commodity prices were on the move.

Wall Street smelled opportunity. In 2008 Goldman Sachs, Pegasus Partners, Resource Capital Funds, Traxys North America LLC and Carint Group LLC acquired the mining assets from Chevron. In an environment of ever-declining ethical standards and regulatory consequences the private capital group and their investment bankers would bring Molycorp to market.

Molycorp, with its high powered investment banking team of Morgan Stanley and J.P. Morganⁱⁱⁱ, easily dominated the contest. Molycorp promoted itself, largely based on its past operating history and proven reserves, as the best company to challenge China's monopoly control over the production of rare earths: a group of elements critical to most advanced technologies and U.S. defense systems^{iv}.

Most of Wall Street's hottest investment sectors were dependent on these materials: alternative energy, green technologies, computing, personal communications, advanced electronics and defense systems.

By late 2010 there were dozens of prospective rare earth start-up 'mining companies' seeking capital. Eventually the number of prospective rare earth mining companies seeking capital exceeded 400, despite the reality that supply requirements of this market were disproportionately small when compared to other natural resource sectors^v.



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In the world of finance *'smart money'* picks the winners. Consequently just two^{vi} projects attracted nearly all of the capital (Molycorp and Lynas). Wall street picked Molycorp^{vii}. This paper will primarily focus on Molycorp.

By early 2010 the words "Molycorp" and "Rare Earths" electrified many people in the mining industry, most non-Chinese manufacturing technology companies, U.S. & allied defense contractors, technocrats in the U.S. national security community and eager investors across most of the world's stock markets.

It was the hottest story of the year^{viii}. The financial, technology and defense press coverage verged on euphoric: heaping fuel on fuel until the highly combustible Molycorp-pyre cast a long shadow over all of its rivals^{ix}.

When the IPO match was lit the spectacular flaming pyre sucked all of the oxygen out of the rare earth space^x. Molycorp was ranked the most lucrative IPO of 2010, resulting in record breaking profits to its private investors and massive returns for its early stock holding investors.

Filing for bankruptcy in 2015, the ashes of Molycorp's \$3 billion fiery grave have cooled but no one has bothered to sift through its debris for answers^{xi}.

Today the words Molycorp and rare earths are associated with bankruptcy, failure and unresolved economic & national defense vulnerabilities that span most of the globe.

How did something like this happen ?

One of the key factors in its epic failure was cast in the stone of its geologic deposit nearly 1.5 billion years ago. The Molycorp Mountain Pass deposit was far from ideal, as it only contained the lower-value half of the 17 rare earth elements. The other factors were largely geo-political.

These facts were concealed from investors, Congress and the Pentagon by promoting an over-simplistic narrative that embellished Molycorp's past and future capabilities while concealing the larger geo-political realities. Wall street and the Pentagon bet the bank on Molycorp. America's financial and political resources were fully committed to this one company. There was no backup plan.

The consequences resulting from the unwarranted promotion of Molycorp has greatly contributed to the ongoing decline of the U.S. economy and national security. The damage is not limited to the U.S, but has effected and degraded all technologically advanced non-Chinese economies.

A Story of Concealment, a View from the Outer Electron Shell

From the outside the complexities and challenges related to the various levels of the rare earth market were concealed from investors, Congress and the Pentagon by a glossy exterior-narrative much like the mysteries of each Lanthanide^{xii} element's inner atomic workings are hidden by their uniform outer electron shells^{xiii}.

This narrative was carefully crafted by those with direct financial interests in the leading project: Molycorp. The core narrative was echoed by all of the second-tier and me-too rare earth prospectors^{xiv}, resulting in a harmonistic-acapella-choir of investment bankers, stock promoters, government lobbyists and for-hire 'industry experts'^{xv} & analysts^{xvi}: all basically singing the same tune.

The outer shell of this narrative was constructed from the carefully crafted reports produced from the work-product of knowledgeable and respected geologists and mineralogists^{xvii}. Geology, mineralogy and resource supply were central and foundational to most of the resulting financial and economic modeling. The absence of proper due diligence regarding nearly everything else was scarcely noticed.

Geologic and mineralogical data produced by these 'experts' was typically professional and accurate but it was ultimately re-formatted for the prospective investor into asymmetric comparisons and unrealistic market constructs. Liberties were taken. Falsehoods and erroneous technical details were peppered throughout IPO documents.

The embellished data was subjected to 'financial modeling'. When good geologic information is measured against what are mostly subjective variables, such as projected demand and hyperbolic pricing data, compounded over 17 different elements and then 'allocated' across dozens of poorly understood market applications, things go from fuzzy to frothy to fantastical.

All of this 'data' was forced into a series of matrix and black-box measures that conferred *relative valuations*. From these over simplified valuations generalized narratives were constructed and promoted.

These narratives, designed to obscure the more complex realities, were fed to industry analysts and the financial press. A generally unified 'resource supply story' emerged.

Resource supply was not the problem. Consequently, the models were categorically flawed. The *valuations* proved meaningless.

Regarding Molycorp, its IPO documentation, data and disclosures were a far cry from the more ethical due diligence standards of the 1980's, 1990's and even fell short of the ever-shrinking *standards* of today. These failings were overlooked however, because Morgan Stanley and J.P. Morgan, both respected investment banks, were leading the IPO.

Another contributing factor was in the name: *rare earths*. The name itself conferred promise and was linked to renewable energy, technology and defense. *What could go wrong..?*

If the underlying business had been something less sexy, let's say a Pot Ash mining company, the documentation and evaluations would not have been acceptable to anyone. They lacked any meaningful market analysis and instead focused on '*valuations*' arising from ore grade vs. proven reserves vs. elemental distributions subjected to aggressive production projections, supported by ever rising prices that fed double digit demand curves that were all plugged into colored metricizes: a slight-of-hand substitution for real and observable market fundamentals.

Below is a cursory list of known and observable fundamental macro-industry issues that were never disclosed, or adequately disclosed, to investors, Congress or the Pentagon:

- 1) At the time Chinese rare earth industry publications disclosed that the Chinese mining industry maintained rare earth mining capacity equal to three-times global demand^{xviii},
- 2) Most of China's rare earth production was a byproduct of iron ore mining (having no direct mining cost),
- 3) Various commodities producers in the U.S. mining industry were already dumping the recoverable equivalent of at least 85% of global demand each year to avoid regulatory changes first implemented in 1980. These regulatory changes were ultimately responsible for transferring the rare earth industry to China in the first place^{xix & lxxi},
- 4) Raw rare earth resources and oxides had no high-value uses until they were converted into a useful form: metals, alloys, magnets, garnets, phosphors, etc.,
- 5) China had the only fully integrated value chain with capacity to produce metals, alloys, magnets, garnets and other value added products from oxides,

- 6) Japan had a limited value chain with no available capacity and Japanese industry continued to rely heavily on China to meet its internal / domestic needs.
- 7) Japan was reluctant to expand internal rare earth value chain capabilities because Chinese pricing and control over the market for value added goods offered little or no profit and was ultimately subject to Chinese monopoly price manipulation,
- 8) The U.S. had no value adding capacity, (because)
- 9) China acquired, idled or bankrupt all U.S. value adding capabilities; as a consequence of the same-said regulations above ^{See lxxi},
- 10) U.S. corporations had no interest in investing or developing their own rare earth value chain capabilities because China provided these materials at reasonable prices and the cost of establishing their own value chains would greatly exceed any one company's projected demand of these materials over any time or return measure.

The list could go on.

As a result of the above undisclosed challenges any direct-mining resource producer^{xx} would need to compete 'on price' against a Chinese government sanctioned monopoly, with its mix of byproduct production (with zero direct mining cost) and lower labor, environmental & capital costs – with China as the prospective buyer for these concentrate or oxide products... To be clear, China was the market, so China was free to set the price for rare earths at every level of the value chain.

In summary, had just one or more of the issues listed above been properly disclosed and evaluated Molycorp never would have received funding for the '*business plan*' it put forward.

All looks well from the outer shell – few bothered to look inside

Beyond the macro-industry issues listed above Molycorp was never a good candidate. Nothing in Molycorp's long operating record was hidden or difficult to uncover.

Historically, Molycorp's primary business was never as a key supplier to the rare earth metallurgical market. Molycorp's primary business was selling low value Lanthanum oxide to the petroleum industry (used as a catalyst to crack petroleum). The following critical and fundamental facts were glossed over or fraudulently misrepresented to the Pentagon, members of Congress and investors:

Historical Facts - Prior to its 2008 IPO:

- Molycorp never had any metallurgical capabilities
- Molycorp never produced or supplied heavy Lanthanides^{xxi} to the rare earth technology market
- Molycorp Mt. Pass deposit did not have recoverable quantities of any heavy Lanthanides in its primary Bastnasite ore^{xxii}.
- Molycorp never produced a commercial quantity of pure Yttrium oxide
 - Molycorp did produce very small quantities of Yttrium as a mixed oxide. This material was separated by other more technically capable refining operations before being used in any metallurgical or technology application.

According to the Pre-IPO Documents of the Reconstituted Molycorp:

- Over 80 percent of the companies projected income was based on metallurgy capabilities that the company did not have or projected sales into markets that did not exist (page 1, SRK Consulting "Engineering Study for Re-Start." technical document).
- Compounding these unrealistic claims was the companies disingenuous "mine to magnet" strategy. The company aggressively promoted the belief that it could domestically replicate much of China's rare earth value chain.
 - China's rare earth value chain spans two cities, referred to by the Chinese government as rare earth cities, with a combined population of 17 million people. These cities host over 400 separate rare earth companies that make over 1000 highly specific products.

This should have set off alarms for all concerned. Instead, financial and national security analysts deferred to Molycorp's assertions.

- The IPO Engineering study contradicted the fully documented and long established geochemistry of the deposit a number of times, stating that various heavy rare earths, such as Dysprosium and Terbium, were recoverable (false claims).

Post 2010 IPO

- Molycorp eventually purchased a controlling stake in the former U.S. metallurgical company Magnequench, that resides inside China, through the 2012 acquisition of Neo Materials, a Canadian company that held the majority stake in Magnequench.
 - Post IPO acquisitions like Magnequench, Santoku and Silmet^{xxiii} did little or nothing to resolve U.S. defense dependency issues or halt technology transfers to China.
- Molycorp paid over \$1 billion to acquire the company Neo Materials^{xxiv}.
- As Molycorp (and Lynas) ramped up rare earth oxide production prices declined rapidly
- The Obama Administration 'won' its World Trade Organization case against China's practice of restricting rare earth exports. To the consternation of the Administration, Molycorp and the other non-Chinese rare earth producers, prices dropped even further as China dropped export restrictions^{xxv}
- The Magnequench metallurgical magnet patents expired in 2015, resulting in falling prices for these high value rare earth magnets.
- Furthermore, to date, it is not clear if the reconstituted Molycorp ever successfully produced commercial quantities of pure Yttrium oxide.
 - This is an important technical point that had serious National Security implications. Molycorp made representations to the Pentagon that they could produce heavy rare earths^{xxvi} as early as 2008 and maintained this position even as it filed for bankruptcy in 2015. Molycorp's representations to the Pentagon were accepted as fact. National Security decisions were based on these representations.

Rare earths are classified by atomic weight. The Periodic Table's atomic numbering corresponds to atomic weight. Technically speaking the heavy rare earths are those numbered 65 – 71^{xxvii}.

The elemental abundance of the heavy rare earths numbered 65 – 71 in the Mountain Pass deposit were far too low for commercial scale recovery.

Due to non-uniform and unsettled industry terminology Yttrium is classified as a heavy rare earth in some instances despite its much lower atomic weight. Yttrium's atomic weight is 39.

Yttrium concentration levels in the Molycorp deposit were marginally inside the bottom-range for potential economic recovery. Yttrium is typically recovered as a mixed oxide. High purity Yttrium oxide separation is technically difficult, and thus costly.

If Molycorp never produced commercial quantities of pure Yttrium oxide, within rational economic constraints, its bold but thinly veiled misrepresentations to the Pentagon are entirely indefensible^{xxviii}.

In short, the entire IPO business plan '*narrative*' was constructed on elemental resources, metallurgical capabilities and commodity markets that Molycorp did not have or did not exist – and was not subjected to predictable Chinese monopoly influence and the corresponding geo-political realities.

These facts were first pointed out to members of Congress and to the Department of Defense in 2009 (and presented at the Society for Mining, Metallurgy and Exploration (SME) conference in 2009, 2010, 2011, 2012 and 2013) by this author.

Over the last 8 years this author continued to press the point with the previous Administration, this Administration, Members of Congress, House and Senate Armed Services Committee Staff, Energy and Natural Resource Staff, the Department of Defense, Energy Department & National Lab staff and Washington DC Think Tanks, resulting in over 40 trips to Washington DC and over 300 meetings.

With few exceptions the *glossy-shelled* Molycorp narrative won out over easily documented facts and the national economic and security needs of the United States.

Even today Molycorp's false narrative continues to resonate through the halls of Congress and the heart of the Pentagon. Despite Molycorp's spectacular \$3 billion financial failure, natural resource and national security experts remain unwilling to poke through Molycorp's ashes to conduct a forensic accounting^{xxix}.

The long term consequences of this go far beyond financial losses and questions of omission or fraud. On the small-side Molycorp's misdirection and predictable failure has greatly benefited China through the transfer of individual technologies, entire industries, Intellectual Property (IP) and expansion onto the leading edge of material science research and commercial application. On the big-side Molycorp's near decade long redirection of U.S. economic & national security policy has grossly undermined economic and national security norms on a global basis.

Markets, Myths & Misdirection!

Molycorp's narrative is largely responsible for the near-universal and widespread misunderstanding of China's rare earth monopoly. All mainstream reporting and research on this topic continues to conform to the central narrative, by focusing primarily on the unrealistic and improbable resource issue: mining.

This narrative, built on the intentional distortion, omission and misdirection of fact, was central to the financing efforts of every one of the +400 non-Chinese mining projects^{xxx}. Despite the spectacular failure of Molycorp and the plethora of recent bankruptcies, every surviving^{xxx} rare earth company^{xxxii}, 'industry analysts' and industry or policy group with direct or indirect ties to the various projects continue to promote these projects under the bogus resource mining narrative. This misdirection continues to drive all public policy and national security initiatives in the wrong direction(s).

Today the leading policy positions continue to be: 1) open new mines through the reduction or elimination of environmental and regulatory restrictions^{xxxiii}, 2) do nothing and let 'market forces' resolve the imbalance^{xxxiv}, 3) fund additional studies of the resource issue. All of these strategies are demonstrated failures and should be rejected as such – yet they persist.

Nearly all of the 'expert analysis' on this topic has generated flawed economic & policy responses that have only played into China's hand^{xxxv}. The truth is that all of this market and policy failure is the result of the faulty or dishonest assessment of facts – facts that are assessable and abound.

No policy solution is going to succeed against China until it is structured to survive and beat China's multi-leveled monopoly. The monopoly incorporates high-level geo-political, economic and defense goals of the Chinese Government^{xxxvi}.

U.S. policy makers are trapped within widely shared, self-referential and reinforcing mental construct regarding 'free markets', 'fair trade' and other western notions of normative economic behavior. Chinese economic and geo-political policies are ultimately not subject to any of these western notions or constraints^{xxxvii}. Continuing to look in this direction is to look down the barrel of a gun.

This is a Winner-Take-All nationalistic policy that is being played out on a global basis. The U.S. needs to construct a rational response to the resource, value adding and geopolitical issues outlined below.

This is not just a resource issue; it is a Chinese government sponsored multi-leveled strategy of global technology hegemony.

China's rare earth monopoly operates on 4 levels:

- 1. Mining: Basic Resource Production Monopoly^{xxxviii}**
- 2. Value Chain: Integration Monopoly**
- 3. Industry & IP Capture: Leverage & Control over All End-Users**
- 4. Supplication & Resource Redirection**

1. Mining: Basic Resource Production Monopoly

- a. Mining rare earths (RE) without a value chain is pointless
- b. RE concentrates & oxides are useless to technology & defense end-users
- c. These RE resources need to pass through China which has the world's only fully integrated value chain^{xxxix}
- d. Realistically, China will undercut western production costs, resulting in bankruptcy (as evidenced by Molycorp's bankruptcy and all other 'ongoing' western efforts^{xi})

2. Value Chain: Integration monopoly:

- a. Free market actors cannot be expected to establish any part of the value chain through independent action because the capital required is significantly higher than what is required for resource production (mining), and is at risk of bankruptcy through Chinese manipulation at the value chain level and indirectly through the resource supply level^{xli}.
 - i. China has even greater monopoly pricing power at the value-added and metallurgical level
- b. Capital cost requirements to establish a value chain for the production of metals, alloys, magnets or other value added rare earth products is disproportional to the 'market value' of value added rare earth goods

when produced at the scale of any single end-user (or the defense industry collectively^{xlii}).

- c. China's value chain consists of over 400 companies that produce over 1000 ultra-high specification products spanning two cities, referred to by the Chinese government as '*rare earth cities*' (with a combined population of 17 million people)^{xliii}.
- d. U.S., E.U. Japanese and Korean Corporations relocate to China in exchange for guaranteed supply
- e. U.S. Corporations are exclusively motivated by short term profits. Relocating to China typically results in higher profits in the short-term. Short term profit incentives for publicly traded companies outweigh long term consequences, fueling China's aggressive mercantilist strategy of knocking-off non-Chinese producers through the incremental capture of their technologies and industries.

3. Industry & IP Capture: Leverage & Control over End-Users

- a. China is the only country that can guarantee an uninterrupted flow of value added rare earths^{xliv}.
- b. China has already captured much of the world's RE dependent technology and RE end-users because most of the world's leading technologies, consumer goods, commercial goods, industrial goods and defense systems are rare earth dependent.
- c. Now under China's control, China can use carrot-and-stick incentives to force these Chinese dependent companies to continue to use Chinese only value added rare earth products and prevent these companies from developing or supporting the emergence of alternative non-Chinese supply lines through the implied threat of 'supply disruptions'^{xlv}
 - i. This threat is greatly compounded for defense contractors who may be utilizing Chinese materials without federally required 'waivers' to do so (a federal crime)
- d. As time goes on, China's relative position in all of the above increases
- e. Eventually all rare earth related technology, IP and manufacturing ends up in China
 - i. Japan is the only exception, but they are losing ground
- f. Soon China's control over global technology, markets and economics will become unassailable as it continues to expand far outside the confines of rare earth related technologies, products and industries
 - i. In geo-political terms they seek economic and technological hegemony over the U.S. and the world.
 - ii. U.S. national security is impaired without these Chinese sourced materials and the necessary economic tax base to maintain our distended military

- iii. The Pentagon has no answer, solution, program or backup plan to mitigate or reverse our current position^{xlvi}.

4. Supplication & Resource Redirection:

- a. China will eventually run out of rare earths, but before that happens
- b. China's next play will be to make the rest of the world its resource supplier
- c. China will allow supplicant non-Chinese producers to feed China's rare earth value chain, but China will retain its monopoly at the value adding, metallurgy, component, system, product, industry and IP level.
 - i. Molycorp was an example of resource supplication, as it became a supplier to China's metallurgical value chain. All new non-Chinese resource producers can be expected to follow the same strategy with the same results: bankruptcy.

China will retain its monopoly at the resource level as long as it serves China's interest. China will retain its monopoly in the value chain and expand it into other areas of the global economy^{xlvii}. China will not adopt western 'free market' ideological constraints or restrictions. China will continue to win.

China's goal is *total global economic hegemony* in the 21st century. The power of its rare earth resource monopoly has already taken root, deep inside all of the world's leading economies^{xlviii}. U.S. defense companies have been compromised on many levels. The Pentagon's procurement supply line has been cut. The U.S. is vulnerable. The situation is not being managed – it is being covered up^{xlix}.

China is literally compounding all of the direct and collateral advantages that derive from its monopoly. Time is the enemy of all non-Chinese economies. At some point in the near future non-Chinese economies will pass a tipping point and recovery will be impossible^l.

This is China's version of 'the great game' and the world has become an unwitting pawn^{li}.

The Cost of Failure

Today the production of most U.S. (and NATO) advanced weapon systems^{lii} are virtually 100 percent dependent on China, and that gives China influence, and possibly control, over the outcome of any future conflict.



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This is not the prediction of some dystopian novel. This it now, today – and this is according to the U.S. governments' own reporting.

A recent Congressional Research Service (CRS) presentation made it all perfectly clear -- all rare earth dependent U.S. weapon systems are 100 percent reliant on China for advanced metallurgical materials directly or indirectly^{liii}.

The U.S. Government Accounting Office (GAO) and the Pentagon's own Inspector General (IG) Report confirm the Pentagon's inability (or possibly its unwillingness) to measure the problem or even establish the basic metrics to develop responsive action, as required by Congress.

This means that Boeing, Raytheon, General Atomics, Lockheed Martin, Northrop Grumman, General Dynamics and the rest of our nation's defense contractors are beholden to China for these critical materials.

The defense contractors themselves have remained quiet on this issue for fear of punitive action from China and to avoid drawing attention towards the ongoing illegal use of Chinese rare earth materials and components inside our weapon systems^{liv}.

Privately some have also expressed their fear over the loss of Chinese contracts if they are suspected of causing China any trouble in regards to its rare earth monopoly.

Fear of supply disruption and the desire to maintain and grow Chinese contracts has given China tangible control over the financial fortunes of the defense industry. This, perhaps, explains the Pentagon's unwillingness to recognize such an obvious U.S. vulnerability or seek a solution^{lv}.

Pentagon Failure: The Pentagon has failed to address this issue for nearly 20 years^{lvi}. In 2008 the Pentagon embraced a highly improbable 'solution' that was engineered by the finance industry via the re-launch / Initial Public Offering (IPO) of Molycorp. Proper due diligence would have precluded Molycorp from consideration.

The Molycorp Mountain Pass's mineralogical deficiencies were well established. The long list of other technical, metallurgical and geopolitical deficiencies listed above were obtainable at the time of the IPO.

These realities were deliberately concealed from the Pentagon, Congress and investors by Molycorp^{lvii}.



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The consequences of this façade have greatly contributed to the decline of the U.S. economy and our national security^{lviii}. As a result nearly all U.S. technology companies and defense contractors are compromised at one level or another.

The economic consequences of rare earths go far beyond national security. These materials are the life-blood of a modern economy. This ongoing failure has negatively impacted and will continue to degrade the future prospects for all Americans, Europeans, Japanese and Korean economies.

The U.S. Administration, Congress and our economic allies need to understand that our current and future economic prospects are directly linked to the non-Chinese world's ability to participate and lead in all areas of material sciences. To do so requires that the non-Chinese world maintain a position in the value chain and commercial production of these materials to support technology companies and manufacturing.

If the world's non-Chinese economies cannot maintain a leading position in the value chain, technology companies will continue to be forced to move manufacturing, know-how, and jobs to China. The historical precedent is undisputable; China quickly captures all IP and industry knowledge and begins pirating products.

For example, Apple was forced to manufacture its iPhones in China to gain access to rare earths^{lix}. As a consequence, China was able to copy and reproduce Apples' products on an industrial scale^{lx}. China recently sold more of its knock-offs in the 4th quarter of 2015 than Apple sold iPhones.

This trend will continue. China's growing expertise in 'branding', high quality products (they are near-perfect copies after all) and lower cost will eventually displace Apple on a global basis.

The same thing is true for any corporation that brings its technology and manufacturing to China. The list of real-world examples began with low paying apparel jobs, to the manufacturing of basic consumer products and 'white-goods', to the manufacture of high end electronics and components, to the off-shoring of high-end design and engineering jobs, to the outsourcing of U.S. and EU research and development jobs, to the transfer of leading state-of-the-art technologies, to entire industries^{lxi}, to China's recent development of next generation technologies and products^{lxii}.

What is the shared deficiency among all non-Chinese governments, national defense industrial base policy experts, think tanks, policy groups, economists and political

parties to fail to acknowledge or act regarding these easily observable historical patterns and the foreseeable consequences^{lxiii}?

What follows is a breakdown of the National Security and Economic facts as published in government documents and peer reviewed works and publications.

National Security issues according to the Government Accounting Office (GAO), the Congressional Research Service (CRS) and the Pentagon's Inspector General Reports (DoD-IG):

- 1) Rare earths are a "bedrock national security issue" (GAO-16).
- 2) The Pentagon has not achieved a single one of its legal obligations to measure or resolve this issue (DoD-IG-14, GAO-16).
- 3) Rare earths are critical to many advanced U.S. weapon systems (GAO-16, GAO-10, CRS-13, All Other Sources).
- 4) China has 100% monopoly control over all metallurgical & value added rare earth products used in the defense industry (GAO-10, CRS-13, CRS-Cato)^{lxiv}.
- 5) The GAO and CRS express concerns regarding possible supply disruption (GAO-10, GAO-16, CRS-13), but the Pentagon has independently determined that China will only use rare earths as a "diplomatic tool" (DoD-ChinaThreats-16).

The fact is: China can use rare earths as a geo-political weapon at any time^{lxv}. Why the disconnect with reality?

Economic views and facts from various peer reviewed technical papers, publications^{lxvi} and government documents regarding the larger technology, economic and geo-political consequences resulting from China's monopoly:

- 1) Rare earths are critical to most advanced technologies that are part of a modern economy (NIAS-13, CRS-13, GAO-10, GAO-16, Elsevier-15 & All Other Sources).
- 2) China uses this monopoly to capture IP, technologically advanced products and manufacturing (NIAS-13, Elsevier-15), and to control defense contractors (Elsevier-15) who are dependent on China for these advanced materials (NIAS-13, CRS-13, GAO-10, GAO-16, Elsevier-15).

3) Unless the U.S. regains fully integrated capabilities for a rare earth value chain:

i) the domestic production of rare earth resources is pointless, as these base resources will continue to pass through China before becoming useful (NIAS-13, CRS-13, GAO-10, GAO-16, Elsevier-15),

ii) all technology and material science research done anywhere in the world will ultimately benefit China -- as they have the only fully integrated rare earth value chain to commercially develop these technologies (NIAS-13, Elsevier-15),

iii) the U.S. and Rest Of the World (ROW) will be displaced from the commercial development of advanced technologies and become increasingly less relevant and secure in the global economy (Elsevier-15).

4) China's strategy has real geo-political implications that have pierced the veil on industrial, commercial and defense corporations on a global basis (NIAS-13, Elsevier-15).

5) China will utilize its rare earths monopoly to maintain its monopoly -- making traditional 'market based' solutions unrealistic (Elsevier-15).

6) Consequently, any solution must be impervious to Chinese monopoly control at all levels of the value chain (Elsevier-15).

7) China's rare earth monopoly is not a 'resource issue', as many operating U.S. mining producers of basic commodities such as phosphates, titanium, zircon and iron dispose of recoverable rare earths every year.

This proven annual and recoverable resource represents the equivalent of 85%^{lxvii} of global demand (Emsbro-14, Elsevier-15). There is no need to open any new rare earth mines^{lxviii}.

i) These non-rare earth mining companies choose to divert these resources into mining waste to avoid potential liability cost stemming from a change in the application of U.S. and international regulations specific to thorium and uranium^{lxix}.

ii) A portion of this available resource, about 10 percent, was part of the historical supply chain, or equal to 100 percent of current U.S. demand.

iii) The remainder has proven low cost recovery methods, at a fraction of the cost of direct mining -- including China's internal cost of production^{lxx}.

iv) This potential resource-base has 3 times more heavy rare earths measure by distribution than China's overall production distribution.

Failing to put forward a remedy now only strengthens China's hand. The Pentagon has proven incapable of resolving, responding or even acknowledging this issue^{lxxi}. The U.S. Congress, the Administration^{lxxii} and the rest of the world must stand together and force a solution now.

A Multi-National Solution:

The U.S. has never had a rare earth resource problem. The U.S. currently dumps the equivalent of 85% of global RE demand each year^{lxxiii} to avoid the regulations that gave China its monopoly in the first place^{lxxiv}.

This historical resource was intentionally ignored because it undermined the underlying narrative that called for the creation of primary resource mining companies^{lxxv}.

The only way to defeat China is to utilize our nation's historical resource base. These many uninterrupted resource producers could feed high value heavy rare earths directly into a fully integrated and cooperatively owned value chain.

Through direct integration and handling of these resources all "source material" management issues could be performed within the existing regulatory framework. The thorium byproduct resources would be transferred to a separate entity for safe long-term storage^{lxxvi}. The cost for safe storage would be spread across the entire integrated value chain.

The only way to build a competitive value chain is through collaborative investment and mandatory off-take commitments from the owner / investor end-users. The value chain must be subservient to the end-users, operating as a cooperatively-owned enterprise, requiring this entity to sell its finished goods to its owners "at cost".^{lxxvii}

The funding for the cooperative would come from large multi-national technology companies who see value in protecting IP and their governments: Japan, Korea, Germany and possibly others^{lxxviii}.



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Under the proposed structure:

1. Supply is uninterrupted because it is a recoverable no-cost byproduct of some other commodity, not subject to Chinese monopoly pricing pressure
2. Multi-national technology companies and various governments could combine capital to form a cooperative that has firm off-take commitments. The finished goods would be sold to its owners on an at-cost basis: proportional to direct investment (any surplus sold at market prices to non-owner / investor end-users)
3. The cooperative structure assures guaranteed supply for new technologies and for companies who want to protect their IP
 - a. U.S. defense contractors will have guaranteed non-Chinese sources for critical materials: as required by law
4. The rare earth cooperative becomes the prime supplier for technologies that are withheld from China's relocation efforts
 - a. Thus, the cooperative will help ROW regain control over new rare earth dependent technologies and the application of new advances in rare earth related material science innovations
5. Western technology companies will begin relocating new and old rare earth related manufacturing facilities back home or in non-Chinese countries.

Conclusion:

It is time for leadership.

The U.S. Congress, Administration and the ROW must act collectively to resolve this debilitating crisis.

Solutions must begin with uninterrupted resources and cooperative investment in a value chain that will serve all of its members and the ROW.



2017 SME ANNUAL CONFERENCE & EXPO

CMA 119th NATIONAL WESTERN MINING CONFERENCE

Requiem: The damage is done. The U.S. and other non-Chinese economies of the world are fundamentally degraded. The defense security for the U.S. and ROW is severely compromised.

Wall Street and China have won. America lost.

The private equity investors, managers and directors of Molycorp have all moved on to their next exploits. The Pentagon pleads endlessly for ever-larger budgets. If the money does not flow, its active duty and professional staff will simply reshuffle the deck. The defense industry continues to pay invoices on Chinese-origin rare earth materials.

Reality has not set in. Over 70 rare earth penny stock companies^{lxxix} continue to seek financing and government support for direct mining schemes that will ultimately fail or feed China's value chain.

The Molycorp narrative remains alive, policy remains focused in the wrong direction, resources are misdirected and technology companies and jobs continue to flow to China.

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"All Other Sources" – Commonly accepted / undisputed information as reported by mainstream media.

Footnotes:

ⁱ Chevron was initially forced to cease mining operations in 1998. Processing and non-mining activities continued at the Mountain Pass facility until 2002, when the entire operation was shut down. The 1998 shutdown was the direct result of regulatory changes specific to source material by the Nuclear Regulatory Commission and the International Atomic Energy Agency (NRC & IAEA) in 1980. These same regulatory changes were ultimately responsible for termination of all non-Chinese rare earth mining and the transfer of U.S. value adding and metallurgical technology to China.

ⁱⁱ The commodities super-cycle resumed shortly after the September 2008 market crash. Molycorp IPOed 2010 as many commodity prices rebounding towards previous highs or setting new highs.

ⁱⁱⁱ Goldman Sachs sold its position in Molycorp shortly before the IPO. One of the reasons, disclosed to this author just prior to the IPO by the leading Goldman analysts was the fact that critical heavy rare earth elements essential to Molycorp's so-called "mine to magnets" strategy and central to its IPO documents and business plan were not recoverable from the Mt. Pass deposit.

^{iv} All guided missiles and ordnance, all laser based weapons & targeting systems, all advanced sonar & radar, all secure communications, all energy based weapon systems, most next generation weapon systems, etc.

^v Total 2010 consumption was less than 130,000 tons, with 95% of those resources produced by China who utilized at least 75% its production internally.

^{vi} Lynas, an Australian mining company, had a superior geologic resource and a significantly better business plan (relying on integration with primarily Japanese end-users). However, based on China's control over rare earth oxide pricing the company would have filed for bankrupt long ago, without past and ongoing industry and Japanese government support.

^{vii} Molycorp monopolized at least 99% of financing committed to U.S. rare earth mining projects.

^{viii} The 2010 *Japanese fishing boat incident* initiated a price spike in rare earth prices, that coincided with Molycorp's IPO, and allowed Molycorp's financial promoters capitalize on the ensuing panic: <http://www.nytimes.com/2010/09/23/business/global/23rare.html? r=0>

^{ix} Lynas, an Australian rare earth mining project with heavy backing from the Japanese government and industry and newly constructed refining operations in Malaysia, was the only other company to attract a meaningful level of capital.

^x At one point the flames of Molycorp climbed to a \$7 billion market capitalization – as swarms of moths feed the rising flams.

^{xi} Forensic accounting and analysis of Molycorp will confirm that it was never a strategic or realistic resource supplier as it relates to our national security needs. However, its well-known, long-established and immutable geo-chemistry made that obvious to any marginally competent geologist or metallurgist long before the mine re-opened. Fortunately for the financial operatives who resurrected Molycorp, 'expert opinion' and technical reporting can be commissioned to reflect, suppress or misdirect facts to suit a target audience(s).

^{xii} Lanthanides are categorized as a unique set of elements on the periodic table. They represent 15 of the 17 elements that are classified as rare earths. The other two elements are Scandium and Yttrium.

^{xiii} All of the Lanthanides, the 15 rare earth elements numbered 57 – 71, have near-identical outer electron shells with de minimis and sequential descending exterior dimensions. Consequentially all internal differences are effectively 'hidden', making chemical separation so incredibly challenging.

^{xiv} Lynas and other rare earth promoters could be counted on to promote the same story line because their collective financial fortunes were based on a collective miss-direction of fact. The facts were that:

- 1) China had monopoly pricing power over the mining and oxide markets for rare earths,
- 2) There was no shortage of abundant and available rare earths – the western world was dumping these recoverable resources to avoid regulations introduced in 1980, resulting in China's current monopoly position,
- 3) Any rare earth mining project outside of China was subject to China's monopoly pricing power (read: bankruptcy was the predictable consequence),
- 4) That mined rare earth resources and oxides are essentially useless without further processing into metals, alloys, magnets, garnets or other value added products,
- 5) And that China has the world's only fully integrated value chain for value added rare earth products.

^{xxv} To be precise, the 'industry' turned out to be an industry of puffed-up penny-stock promoters all seeking spectacular Initial Public Offering (IPO) and stock market returns.

^{xvi} Mercenary *experts* and *analysts* are created, crafted and turned on like tap water in today's financialized world. They are the rule, not the exception.

^{xvii} Outside of China the exhaustive list of legitimate rare earth experts was depressingly short. Most of these experts were woefully under-employed or out of work, as the entire rare earth industry was now in China. With the scent of opportunity in the air, the very best and the very worst of them queued up for contracts or positions at the leading firms: Molycorp and Lynas. Beyond these two anointed projects anything else was a big step down. Some of these 'experts' accepted equity or some derivative form of equity as part of their overall compensation package.

In short order the entire non-Chinese roll-a-decks of rare earth experts found themselves working directly under the control and direction of stock promoters and investment bankers or seeking potential employment through their 'unsolicited' published works.

The consequence was that all work-product vectored towards a conforming or generally unified narrative.

^{xviii} Various Chinese publications, available on-line and in English, outlined China's internal production capacity and capabilities. Credible sources listed Chinese internal rare earth production capacity at 3-times global demand. According to these sources one-third of this capacity was decommissioned, beginning sometime in 2013.

^{xix} China's rare earth monopoly would never have been established without this tragic misapplication of regulations, as the termination of all heavy rare earth resources and the transfer of all rare earth technology and value chain assets were a direct result of this regulatory change.

^{xx} Meaning, a single product mining company whose primary revenue and profit was derived from rare earth resources.

^{xxi} The 15 elements that classified as Lanthanides on the Periodic table that make up 15 of the 17 elements that are classified as rare earths.

^{xxii} The Mt. Pass deposit did have recoverable quantities of Monazite, a mineralization that typically contains heavy rare earths and Thorium. Due to the Thorium content in the Monazite Molycorp disposed of this valuable ore by pumping it into a nearby tailings impoundment. In 1997 a mildly radioactive thorium discharge from the tailings pipeline resulted in the closure of all mining operations in 1998 (also see¹).

^{xxiii} Molycorp shipped all of its higher value rare earths to Magnequench, inside China, to be converted into metals, alloys and magnets.

Santoku did not have any primary metallurgical capabilities. Santoku's expertise was based on the production of specialized alloys; an expertise dependent on transforming highly purified rare earth metals that were supplied by someone else (i.e. China).

Silmet AS is a former Soviet Union facility located in Estonia that dates back to the beginning of the cold war. Silmet's rare earth metallurgical capabilities were limited to a single blended rare earth alloy. Silmet's total annual production of its single rare earth alloy represented less far less than 1% of global demand and had little or no direct applications for U.S. defense contractors.

Collectively all of the Molycorp acquired metallurgical assets represented a small fraction of value chain capabilities and remained subject to Chinese monopoly pricing and value chain interdependency.

Note: Refined rare earth oxides could not be utilized by the defense or technology industry (other than polishing glass, or other low value, low tech applications).

^{xxiv} This acquisition was central to Molycorp's "mine to magnets" strategy but was wholly inconsistent with the assurances that were made to the Pentagon and members of Congress regarding U.S. National Security. The expectation was for Molycorp to become a domestic producer of these critical value added rare earth materials (or even, possibly, alternative non-Chinese value added production).

^{xxv} The Administration and Congressional Staff were warned that this would happen by this author.

^{xxvi} Molycorp's Monazite mineralization does contain recoverable quantities of heavy rare earths. However, due to the 1980 NRC / IAEA classifications related to 'source material' Molycorp continued its long tradition of disposing of its Thorium bearing Monazite, but encased in concrete and deposited it into an onsite tailings impoundment.

^{xxvii} It was universally understood by geologists, mineralogists and mining processing professionals that the mineral concentrations of these heavy rare earth elements in the Molycorp Mt. Pass deposit were far too low for economic recovery.

Rather than deal with this fact, Molycorp management unilaterally change the definitional parameters of heavy vs. light rare earths. They simply shifted lighter elements that Molycorp was capable of producing into the heavy category. Molycorp did this in their financial reporting, press releases, investor presentations and in meetings with members of Congress and the Defense Department. Many in the financial press went along with this practice.

^{xxviii} Are there any consequences for undermining national security or misleading investors ?

^{xxix} In fact, Pentagon 'experts' and some members of Congress implausibly anticipated that Molycorp would perform a Phoenix like resurrection: as if Harry Potter-like magic was the solution to our economic and national security troubles.

^{xxx} Disclosure or discussion beyond superficial supply and demand projections was anathema to these financial speculators. To be specific there was what amounted to as an rule or understanding to never discuss the existence of abundant and available rare earths (in the form of Monazite and other byproduct resources) that were intentionally disposed of, or that China's central government supported and promoted a global monopoly over resources, oxides and rare earth value chain products: producing and consuming over 85% of all production and application of these materials.

^{xxxi} Most if not all of them are technically bankrupt by any standard measure.

^{xxxii} Technically they are nothing more than penny stocks promoting themselves as the best solution to an economic National Security issue that spans the non-Chinese globe. That any government would look to penny stock promoters for a solution to a problem this enormous is the ultimate measure of failed governments and failed politicians.

^{xxxiii} 'Experts' writing on this issue never look past the mining / resource point in the value chain. Ask yourself how it is possible that not one single 'expert' is able to note the primacy of the value chain? See xvi, xvii, xviii & xxii

^{xxxiv} Other 'experts' argue that China must have our western economic value-system, somehow subject to our rules of 'the free market', a love of money that supersedes national goals and aspiration.... that eventually they will succumb to the *universal and overwhelming desire to make money above all other things*, and thus, China will eventually level the playing field and play by our rules. But why level the playing field when cheating

assures 100% victory all of the time? (btw, it is only cheating in the U.S. rule book. In the Chinese rule book it is called a winning strategy).

^{xxxv} Nearly every rare earth or critical materials bill offered in Congress over the last 8 years focuses on generating the production of resources through the reduction of environmental protections to promote rare earth mining, additional studies of the resource issue, federal funding of National Labs instructed to develop alternatives to rare earths or stockpiling of rare earths.

^{xxxvi} None of these so called 'experts' is capable of recognizing that China has a national policy of technology-capture and sees more value in giving rare earths away below cost -- to gain entire industries. It is simple math. Giving away rare earths below cost to capture technology and industries is good business. This strategy is a MASSIVE NET POSITIVE RETURN on investment [let's do the math: the global rare earth mining to oxide business is less than \$3 billion, but supports over \$7 trillion in value added goods] . Or consider it a strategy of giving away rare earths as an *accounting expense* in a business strategy of market dominance (Re: China Inc.). They are basically gaining control over nearly all high value goods on a global basis for a hand full of trinkets and shells.

^{xxxvii} Case in point, the Administrations WTO 'victory' on the rare earth case was, in fact, a victory for China. The outcome was for the WTO to demand that China eliminate trade restrictions that were ultimately supporting higher rare earth prices. China complied by opening the flood-gates, predictably disproportionately effecting the low value rare earths, thus plunging prices far below western productions cost (83% of Molycorp's mining production was the lowest value rare earth resources).

This author warned the Administration and Congressional staff that it was a pre-conceived trap designed to utilize the predictable WTO outcome in China's favor.

^{xxxviii} Direct mining of rare earths outside of China is a non-starter for so many reasons, not just its monopoly control over pricing. The majority of Chinese rare earth production is a byproduct of some other mined resource (read: no direct mining cost). How can any stand-alone U.S. rare earth mining company compete with China if China has no direct mining cost for the majority of its production?

^{xxxix} Japan's semi-integrated rare earth value chain is a pale shadow, when compared to China's fully integrated value chain. Japan's collective production of rare earth metals, alloys, magnets and other value chain products, including its facilities in Vietnam and Malaysia, account for less than 20% of Japan's internal needs. Japan relies on China for over 80% of its rare earth needs.

None of these facilities have any available production for the U.S. or our NATO partners. This situation is "not under control" or "being managed".

^{xl} The Molycorp bankruptcy represents a \$3 billion financial failure. Collectively the total global loss of capital exceeds \$10 billion, with many companies technically bankrupt but continuing to trade as penny stocks. For example, Lynas is on financial life support from its investor-end-users and the Japanese government. The remaining 48 projects from a 2012 high of over 400 projects have an average share price of less than 15 cents (some not trading for days or weeks).

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- ^{xlii} China can bankrupt the value chain directly or bankrupt the resource supplier (the rare earth mine(s)): a two-tiered strategy.
- ^{xliii} Total U.S. rare earth demand equates to about 10% of global demand. The defense industry uses less than 1% of total U.S. demand.
- ^{xliiii} The cost of replicating China's value chain is beyond the resources and capabilities of any one company or even many companies. Chinese newspapers and other publications reference the extensive rare earth capabilities of Baotou and Ganzho, officially referred to as 'rare earth cities', yet this highly relevant fact is not available, referenced or detailed in a single IPO, financial disclosure or government document that discusses this issue, nor is it referenced in any of the many research documents, policy pieces or Op-Eds that circulate inside Wall Street or Washington's beltway.
- ^{xliiii} China used its monopoly control over rare earths to incrementally capture non-Chinese technologies and manufacturing: first by capturing the production of rare earth dependent components, then component sub-assemblies, then product lines, then entire industries.
- ^{xliiii} This has become commonplace for technology companies worldwide and for all U.S. and NATO defense contractors (directly or indirectly).
- ^{xliiii} There is no 'secret' Pentagon solution or value chain facility(s). The GAO even commented that the Pentagon's investment into potential rare earth value chain producers is not realistic, as these are poorly financed companies with no real commercial prospects or demonstrated abilities. Betting National Security on start-up companies, essentially doing lab and bench scale work, is foolish on many levels. The most obvious is, assuming they were ever able to begin commercial production, they would become subject to China's monopoly pricing power and be forced into bankruptcy like Molycorp. Note: To date, no government report has pointed out that China's value chain spans two cities, referred to by the Chinese government as rare earth cities, that have a combined population of 17 million people. Nor has any government report pointed out that there are over 400 different Chinese rare earth companies producing over 1000 different and highly specialized value added products. Based on these facts it should be obvious that the Pentagon's insignificant financial commitments to undercapitalized, unproven, one-off, laboratory scale, value chain 'suppliers' does not reflect the size and scope of the challenge, the Pentagon's duties & obligations or reality.
- ^{xliiii} The manufacture of all carbon free energy systems & green technologies will end up in China, as all of these technologies require rare earths and other strategic resources that the U.S. can no longer self-supply. Regarding advanced & next generation nuclear reactor technology, the U.S. regulatory environment is designed to protect the existing fleet and limit new designs to be built on their legacy technological foundation. That foundation is an historical relic that amounts to a 'first concept' design: the equivalent of requiring all new automobiles to be built on pre Model-T engineering principles. China is free of this regulatory insanity and is developing the next generation of nuclear reactors, ultra-safe, low CAPEX reactors that will be deployed globally based on proven U.S. designs. The technology was transferred to China by the U.S. Department of Energy and Oak Ridge National Lab (possibly illegally).
- ^{xliiii} "Leading Economies", a common parlance used to describe the U.S., E.U. and Japan will soon be a dated misnomer.

^{xlix} The Pentagon likes to say that “the situation is under control” or “the situation is being managed”. When I called John McGinn, DoD’s Principal Deputy Director of the Manufacturing and Industrial Base Policy, for a comment on the recent GAO report he said “we don’t see a problem... rare earth materials are abundant and inexpensive”. For someone charged with the responsibility of ensuring our nations ‘Manufacturing and Industrial Base’ in the name of National Security to make such a statement reflects a deep, ongoing and willful state of cognitive dissidence, or worse. Based on my meeting with Assistance Secretary of Defense Al Shafer regarding Chinese control over the procurement of critical rare earth materials for U.S. weapon systems, he flatly stated “rare earths are not critical to our weapon systems”, suggesting a more traditional diagnosis: a cover-up.

^l Of course, it may feel like we have passed that point, but if the U.S. can create a multi-national unified counteroffensive we can win. The only risk to this strategy is that we have lost all of our goodwill and assumed position for leadership through a long standing and visible lack of conviction to act boldly.

ⁱⁱ U.S. policy failure is largely based on what has become a fundamentalist ideological worship of ‘free markets’, a construct of Milton Friedman and the Chicago School of Economics -- an ideology totally divorced from the free market ideas of Smith and the other Classical Economists.

ⁱⁱⁱ U.S. National Security is largely built on rare earth dependent weapons. China has complete control over the supply lines for these materials, representing an incalculable economic and national security liability. All guided missiles and ordnance, all laser based weapons & targeting systems, all advanced sonar & radar, all secure communications, all energy based weapon systems, most next generation weapon systems, etc.

^{liii} CRS-Cato: CRS Marc Humphries speaks at Cato – view at 33 min. and 26 sec.
<http://www.cato.org/multimedia/events/americas-need-critical-minerals-versus-federal-land-management>

^{liv} This is not a highly guarded secret and is easily deduced through our government’s disclosure that China controls 100 percent of all metallurgical rare earths (directly or indirectly). It would be easy to measure because so many of our advanced weapon systems require rare earth metals (or other value added rare earth materials produced in China) but not all of these weapon system have a “waiver”. Much of this is papered over by the use of U.S. rare earth fabricators who purchase Chinese metallurgical materials and ‘*modify or upgrade them*’ in the U.S. The Pentagon may be satisfied with the ruse, but the law is being broken and no one points it out or admits it until they get caught (e.g. the F-35 and other violations: <http://www.reuters.com/article/us-lockheed-f-idUSBREA020VA20140103>).

^{lv} The Pentagon has largely become a revolving door of weapon system advocates seeking favor in the private sector and political power for Congressional Representatives seeking to retain or grow defense related industries in their states or respective districts.

^{lvi} The U.S. was once the world leader in the production of rare earths and the more critical value added and metallurgical materials that are derived from rare earths. U.S. Nuclear Regulatory Agency (NRC) and International Atomic Energy Agency (IAEA) regulations disrupted the flow of all heavy rare earth resources into the value chain causing these technology companies to atrophy, close down or move to China.

In 1998 General Motors sold the world's most technologically advanced rare earth metallurgical facility to China. This facility was the last intergraded metallurgical producers in the U.S., and sole supplier of rare earth magnets for cruise missiles and other guided ordinance. The company, Magnequench, was sold to members of Deng Xiaoping's family through a *highly-transparent* straw-man transaction (Deng Xiaoping was China's Paramount Leader from 1978 – 1989 and was responsible for initiating China's massive government sponsored rare earth programs). EPA and California state environmental action related to a 1998 thorium discharge resulted in the termination of all Molycorp mining operations under the ownership of Chevron. The Molycorp mine was then sold to private investors, reopened as a spectacular IPO and recently filed for bankruptcy.

The U.S. Congress and Pentagon failed to block the sale of these critical technology companies to China – thus handing China its dual monopoly on the production of rare earth resources and all value added and metallurgical finished products. Technical note: Japan has a limited value chain but relies on China for 87 percent of its value added and metallurgical rare earth products. Japan has no capacity to supply U.S. or our NATO's rare earth needs.

^{lvii} And all of the other prospective rare earth mining ventures who were seeking out-sized financial rewards through the initiation of public offerings (IPOs).

^{lix} This fact was never stated or acknowledged by Apple, but a fact nonetheless. Apple and other technology companies cannot move out of China if there is no alternative rare earth value chain.

^{lx} China is able to update its knockoff products in virtual real-time.

^{lxi} China is the world's leading producer of all renewable energy products, largely due to their control over rare earths. They have also captured most of the world's green technologies in automobiles through rare earth dependent 'component capture' strategies made possible through its fully integrated value chain monopoly.

^{lxii} China is leading the world in next generation nuclear technology. China has more experimental reactor programs than the rest of the world combined. They have publicly stated and demonstrated that they intend to lead the world in the design, production and distribution of carbon free nuclear energy.

^{lxiii} Contemporary economic policy is increasingly defined by those with the most to gain. Today's economic policy is built on a post 1970 economic ideology that measures economic outcomes exclusively on the basis of transferring wealth to shareholders: regardless of all other variables. The short term financial gains to shareholders (managers and board members) resulting from the wholesale transfer of manufacturing jobs, industry and technology to China is the ideal outcome of this ideological policy (and has no historical precedent in pre 1970 U.S. economic history).

^{lxiv} The GAO estimated it could take 15 years for the U.S. to rebuild its own rare earth value chain (GAO-10). The GAO also said (GAO-16) that stockpiling was not a viable strategy as the necessary upgrading into useful materials and components would need to take place "outside the United States", resulting in "supply disruptions".

^{lxv} China used rare earths as a '*diplomatic weapon*' against Japan in 2010. The dispute was over territorial fishing waters and the arrest of a Chinese fishing boat captain. What happens if the U.S. and China get into a more heated dispute over China's man-made islands in the South China Sea, or China withholds these materials in an ongoing military action or proxy war with China's growing list of regional allies? Btw: War is defined as diplomacy by other means.

^{lxvi} Including my own published work (Elsevier: First Edition "Rare Earth Industry – Technology, Economic, and Environmental Implications" 09.22.15). This is the only published work that covers the larger and longer term geo-political implications of China's monopoly. With the exception of the NIAS work, most/all other published works view the rare earth issue as a 'resource issue', when, in fact, it is a value chain issue. The U.S. value chain was sold-off and moved to China as a result of these well intended regulations (Elsevier-15).

Note: The leading narrative most frequently cited by the media, '*industry experts*' and '*experts*' inside the Pentagon was developed by the finance industry to promote Molycorp, a stand-alone rare earth mining company that has since gone bankrupt. Molycorp's control over the narrative was cited in the Pentagon's own Inspector General report (DoD-IG-14). The Inspector General report was highly critical of the Pentagon's exclusive reliance on Molycorp's unrealistic production and supply forecasts: overly optimistic forecast used to attract investors (DoD-IG-14).

^{lxvii} The 85 percent figure accounts for only the easiest and lowest cost recoverable rare earth resources – estimated to be recoverable below China's actual direct mining cost. Additional resources, with higher recovery cost (but no direct mining cost), would easily equal an additional 25 percent or more of global demand.

^{lxviii} No new 'stand-alone' rare earth mine could be expected to produce these resources at a lower cost than China. Note: Molycorp, a \$3 billion enterprise is now bankrupt. The total global investment into non-Chinese rare earth production may exceed \$10 billion. The net result is that all of these enterprises are insolvent or are kept on financial life support by their end-user / investors (Lynas Corp). Consequently, financial failure is inevitable. However, it must be emphasized that most or all of these failed enterprises intended to send their rare earth resources to China to be processed into something usable by industry or defense contractors. This is also true for Molycorp, who's "mines to magnets" strategy was based on sending its rare earth oxides to China to be processed into metals, magnets and other value added goods (in a sad and ironic twist of fate Molycorp purchased the Chinese based Magnequench company to do its metallurgical processing).

^{lxix} In 1980 the Nuclear Regulatory Commission (NRC) and the International Atomic Energy Agency (IAEA) agreed to apply "source material" regulations specific to uranium mining across the entire mining industry. The U.S. regulatory change was part 75 of U.S. 10 CFR 40 regulations. The NRC regulatory term "source material" defines any processed or refined material with a thorium or uranium concentration above .05% as an input to nuclear fuel. Due to the application of this NRC and IAEA rule towards all mining companies in any IAEA member states – the production of all heavy rare earth resource outside of China were indiscriminately defined as "source material". To avoid the onerous regulations, costs and liabilities associated with source material all of the world's heavy rare earth producers eventually terminated the sale of this material – as it was primarily a byproduct of their

primary mining operations. Note: Heavy rare earths are always associated with thorium or uranium, with the exception of Ionic Clays that are exclusively mined in China.

^{lxx} None of this material will become available to the market under the existing regulatory framework. The proposed solution redirects these costs and liabilities into a separate entity that would comply within the existing regulatory framework.

^{lxxi} When asked about the recent GAO report John McGinn with DoD Manufacturing and Industrial Base Policy responded to me: "we don't see a problem... rare earth materials are abundant and inexpensive". Our face to face meetings with DoD's Industrial Base Policy were not much better. At our last meeting inside the Pentagon the DoD Industrial Policy's '*rare earth expert*' outlined the Pentagon's belief that Molycorp would solve the problem -- despite the fact that Molycorp had declared bankruptcy a few weeks before our meeting. .

^{lxxii} In our fourth and most recent meeting with bipartisan SASC leadership staff the proposed legislative solution continued to have wide support and no expressed opposition. However, the minority staff redirected the responsibility to force a solution on the Administration. The majority staff agreed and said they would support the Administration if it was willing to enact our proposed solution (via Executive Order).

^{lxxiii} There are no technical, safety or regulatory challenges associated with the long term storage of thorium. Thorium is considered a low level actinide. The only issue was / is the cost of transfer and storage. Historical byproduct producers of thorium bearing rare earths found these new costs (resulting from the 1980 regulatory change) to be uneconomical within their ongoing primary business models. Consequently they chose to divert these resources into regulated waste impoundments to avoid the corresponding cost and liabilities.

^{lxxiv} 10 CFR 40, and the corresponding IAEA regulations, define any 'processed or refined material' with thorium and or uranium concentration above .05% as "source material". These regulations regarding source material were originally only applied and enforced within the uranium mining and processing industry. In 1980 the NRC implemented part 75 of 10 CFR 40 to mirror similar regulatory changes under the IAEA's regulatory regime. The application of part 75 brought all mining operations and material processing under 10 CFR 40 or its IAEA counterpart.

In nature heavy rare earths and thorium are companion elements. Historically global heavy rare earth production was typically a byproduct of some other commodity or came from thorium rich deposits. As a result of part 75 of 10 CFR 40, and its IAEA counterpart, every heavy rare earth producer outside of China met the technical definition of a source material producer.

The cost and liabilities associated with managing source material far exceeded the value of the corresponding rare earths. In order to protect their primary business of mining titanium, zircon, phosphates or some other commodity, the mining companies diverted the rare earth rich thorium back into the ground or into tailings storage facilities.

This resulted in the eventual termination of all rare earth byproduct production in all IAEA compliant countries and the U.S.

Consequently all operating rare earth value chain producers lost access to the critical heavy rare earths that only came from these sources on a global basis. The result was that rare earth resource mining and value chain production quickly shifted to China.

Technical Notes: To conform with state and federal environmental regulations and not exceed the threshold standards of the NRC these mining operations devised various processes to dilute the thorium bearing rare earths below threshold and background radiation levels. This costly diversion continues today even though these materials are easily recoverable at little or no cost (less cost than the existing dilutive process).

Even light rare earths, like those found in Molycorp’s Mt. Pass deposit, contain low levels of thorium. For the record, it was a thorium spill that caused Mt. Pass to shut down in 1998, not lower cost rare earth products from China: a key feature of the dominant narrative.

^{lxxv} Industry insiders typically referred to the historical rare earth byproduct resource Monazite as the 800 pound gorilla. It was clearly understood by corporate leadership and the geologists and mineralogist under contract that the reutilization of Monazite would render their businesses obsolete. Monazite was the primary historical mineralization for rare earths. Monazite was and continues to be a potential byproduct in the production of other commodities. Monazite utilization was discontinued due to 1980 regulations regarding thorium and uranium.

^{lxxvi} This thorium corporation would provide long term storage and develop industrial uses and markets for thorium, including energy. The storage facility would be financed through the sale of rare earth products to the owners of the cooperative and into the larger market. The development of uses, markets and energy applications would be funded on a multi-national level, much like the cooperative.

^{lxxvii} This structure assures financial stability to the cooperative. And, yes the U.S. could beat China on cost, because China uses 1980 technology and processes to make its metallurgical and other finished goods.

^{lxxviii} I would not expect much participation from U.S. corporations and defense contractors. Their participation may develop over time. Very few U.S. corporations have shown a willingness to risk Chinese ire and possible retaliatory wrath.

^{lxxix}

Global Listing of all Rare Earth Companies (Search: Rare Earths listed as target, core or primary business)

Company Name / Exchange Listing	Ticker	Last Price Nov. 25, 2016	Total Market Capitalization Canadian Dollars (.0 = 000)
 Ucore Rare Metals Inc.	UCU.V	0.33	64,901.8
 Critical Elements Corp.	CRE.V	0.55	58,648.1
 Cornerstone Capital Resources	CGP.V	0.17	36,058.2

 Strategic Metals Ltd.	SMD.V	0.43	28,134.0
 American Manganese Inc	AMY.V	0.27	27,173.0
 Mawson Resources Ltd.	MAW.TO	0.40	26,699.9
 Hudson Resources Inc.	HUD.V	0.35	24,408.4
 Houston Lake Mining Inc.	HLM.V	0.25	23,070.4
 Avalon Rare Metals Inc.	AVL.TO	0.17	22,575.2
 Arafura Resources Limited	ARU.AX	0.06	21,021.9
 Tsodilo Resources Ltd.	TSD.V	0.81	20,690.2
 Globex Mining Enterprises Inc.	GMX.TO	0.43	19,760.0
 BonTerra Resources Inc.	BTR.V	0.25	16,565.5
 Astron Ltd.	ATR.AX	0.15	13,674.6
 Commerce Resources Corp.	CCE.V	0.06	11,509.3
 Azimut Exploration Inc.	AZM.V	0.34	11,428.0
 Focus Metals Inc.	FMS.V	0.07	8,922.1
 Latin American Minerals Inc.	LAT.V	0.17	8,848.2
 Dacha Strategic Metals Inc.	DSM.V	0.31	8,360.4
 Canada Rare Earths Inc.	CJC.V	0.13	7,258.9
 Search Minerals Inc.	SMY.V	0.07	6,911.5
 Avonlea Minerals Limited	AVZ.AX	0.01	6,587.9

 Archer Exploration Limited	AXE.AX	0.08	6,401.8
 Artemis Resources Limited	ARV.AX	0.00	6,133.9
 Matamec Explorations Inc.	MAT.V	0.05	5,063.5
 BE Resources Inc.	BER.V	0.35	5,011.8
 Playfair Mining Ltd.	PLY.V	0.12	4,531.3
 Endurance Gold Corp.	EDG.V	0.06	4,472.2
 Stelmine Canada Limited	STH.V	0.34	4,176.5
 Fancamp Exploration Ltd.	FNC.V	0.04	3,925.2
 Pele Mountain Resources Inc.	GEM.V	0.03	3,880.8
 Alix Resources Corp.	AIX.V	0.08	3,067.7
 Alturas Minerals Corp	ALT.V	0.03	2,934.6
 Redhill Resources Corp.	RHR.V	0.19	2,905.1
 Dios Exploration Inc.	DOS.V	0.07	2,853.3
 Mkango Resources Ltd.	MKA.V	0.05	2,365.4
 Fieldex Exploration Inc.	FLX.V	0.03	1,907.1
 Aben Resources Ltd.	ABN.V	0.09	1,885.0
 Belmont Resources Inc.	BEA.V	0.07	1,781.5
 Bison Gold Exploration Inc.	BGE.V	0.30	1,781.5
 Cache Exploration Inc.	CAY.V	0.09	1,759.3

 Montero Mining and Exploration Ltd.	MON.V	0.03	1,567.1
 Medallion Resources Ltd.	MDL.V	0.03	1,552.3
 Greenlight Resources Inc	GR.V	0.11	1,485.8
 Nortec Minerals Corp.	NVT.V	0.06	1,352.7
 Vanstar Mining Resources Inc.	VSR.V	0.05	1,301.0
 International Montoro Resources, Inc.	IMT.V	0.02	1,123.6
 Hinterland Metals Inc.	HMI.V	0.04	1,094.0
 Slam Exploration Ltd.	SXL.V	0.05	1,064.5
 Exploration NQ Inc.	NQE.V	0.02	1,012.7
 Arctic Star Exploration Corp.	ADD.V	0.06	990.5
 Gitennes Exploration, Inc.	GIT.V	0.02	953.6
 Canadian International Minerals Inc.	CIN.V	0.03	946.2
 Pacific Bay Minerals Ltd.	PBM.V	0.04	887.0
 Strategic Resources Inc.	STI.V	0.13	879.6
 Bolero Resources Corp.	BRU.V	0.04	879.6
 Western Troy Capital Resources, Inc.	WRY.V	0.03	746.6
 Micrex Development Corp.	MIX.V	0.01	464.6
 Galaxy Resources Ltd.	GXY.AX	0.40	382.4
 Paget Minerals Corp.	PGS.V	0.05	343.0

 Lynas Corp. Limited	LYC.AX	0.07	176.6
 Geodex Minerals Ltd.	GXM.V	0.07	133.6
 RockBridge Resources Inc	RBE.V	0.01	118.2
 Kidman Resources Limited	KDR.AX	0.42	74.2
 Northern Minerals Limited	NTU.AX	0.13	46.4
 Greenland Minerals & Energy	GGG.AX	0.06	37.1
 Hastings Rare Metals Ltd	HAS.AX	0.08	28.9
 Peak Resources Limited	PEK.AX	0.07	23.0
 Oklo Resources Limited	OKU.AX	0.11	19.7
 Red Metal Ltd.	RDM.AX	0.11	13.7
 Tasman Metals Ltd.	TSM.V	0.26	12.5
 Minotaur Exploration Ltd.	MEP.AX	0.08	12.2
 Latin Resources Limited	LRS.AX	0.01	11.8

Even today, there are at least 70 penny stock companies continue to seek capital for rare earth mining & resource development. This list does not include a significant number of private rare earth resource mining projects that continue to seek capital.

^{lxxx} This published work is the product of James Kennedy.

Full disclosure: James Kennedy works with an alliance of interests who directly advocate for the creation of a fully integrated rare earth value chain that uses existing resources that are currently disposed of to avoid regulations and liabilities.

These efforts include a number of stand-alone bills and amendments that were filed in the U.S. Senate and House in various formats, including the S. 2006 Rare Earth Cooperative Act (<https://www.congress.gov/bill/113th-congress/senate-bill/2006>) and more recent efforts



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to have the legislative solution introduced into the NDAA. Our Washington DC representative, J.J. Brown, can be contacted via 703.498.7422 or jjbrown@thinkpolicy.org .