Rare Earth Element Market Statistics and Defense Restrictions on Purchases of Neodymium Iron Boron (NdFeB), Samarium Cobalt (SmCo), and Tungsten (W)

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Industrial Policy

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Overview

- DoD is working to better secure supply chains for strategic materials and minerals including rare earth elements (REE)
- China is the worlds' largest producer of REE including oxides, metals, alloys, and magnets
- Section 871 of the National Defense Authorization for Fiscal Year 2019 (Public Law 115-232) prohibits procurement of certain REE containing alloys and magnets as well as some forms of tungsten from China, Russia, North Korea & Iran
  - **The following slides are a high level overview of supply chains and not guidance on compliance with Defense Acquisition Regulations. Please review the published regulations before procuring materials.**
- Leveraging existing friendly and domestic capabilities is the best short-term option for compliance with new restrictions in defense acquisition regulations as well as mitigating overall supply chain risk
- Longer-term, U.S. Government support for domestic production of REE at different tiers of the supply chain might be required

What are the risks to the Defense Industrial Base?

Executive Order 13806: *Assessing and Strengthening the Manufacturing and Defense Industrial Base and Supply Chain Resiliency of the United States*[1]

Three Key Findings for Strategic & Critical Materials

1. Over Reliance on Sole Foreign Sources for Unique and Proprietary Advanced Materials

2. Foreign Trade policies that Cause Injury to Domestic Companies

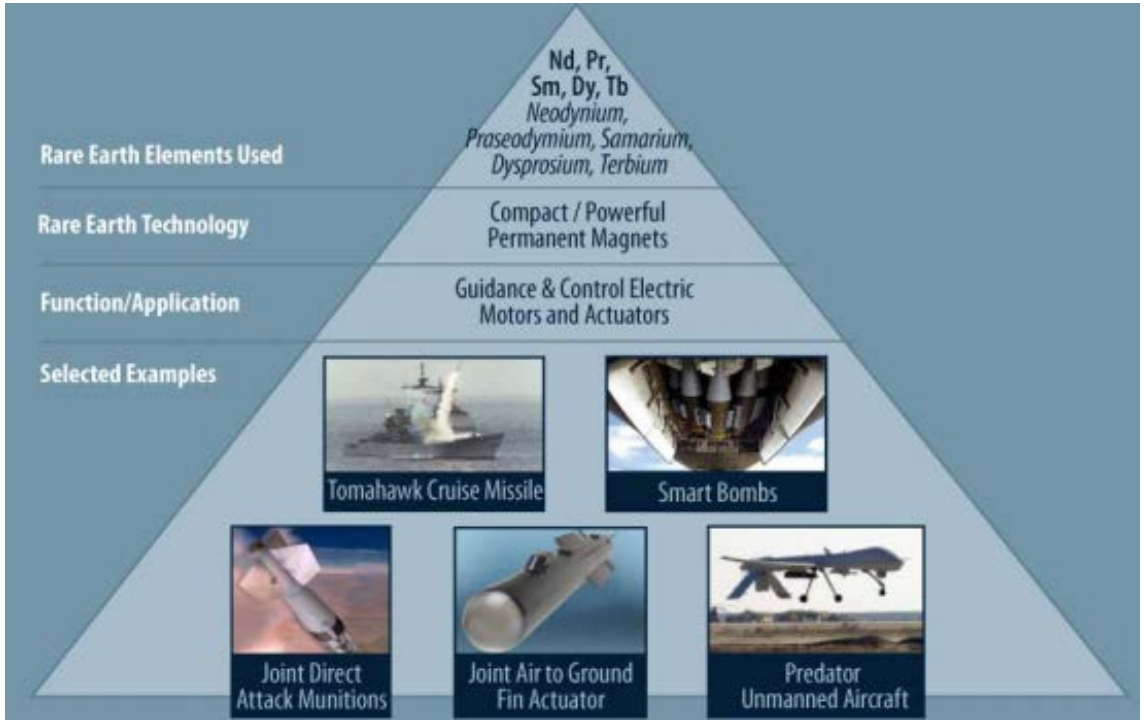
3. Overreliance on China for Strategic and Critical Materials
   - "China represents a significant and growing risk to the supply of materials deemed strategic and critical to U.S. national security."
   - "Areas of concern to America's manufacturing and defense industrial base include a growing number of both widely used and specialized metals, alloys and other materials, including rare earths and permanent magnets."
   - "When China needs to flex its soft power muscles by embargoing rare earths, it does not hesitate, as Japan learned in a 2010 maritime dispute."

1. https://media.defense.gov/2018/Oct/05/2002048904/-1/-1/1/ASSESSING-AND-STRENGTHENING-THE-MANUFACTURING-AND%20DEFENSE-INDUSTRIAL-BASE-AND-SUPPLY-CHAIN-RESILIENCY.PDF

Rare Earth Elements in critical DoD systems

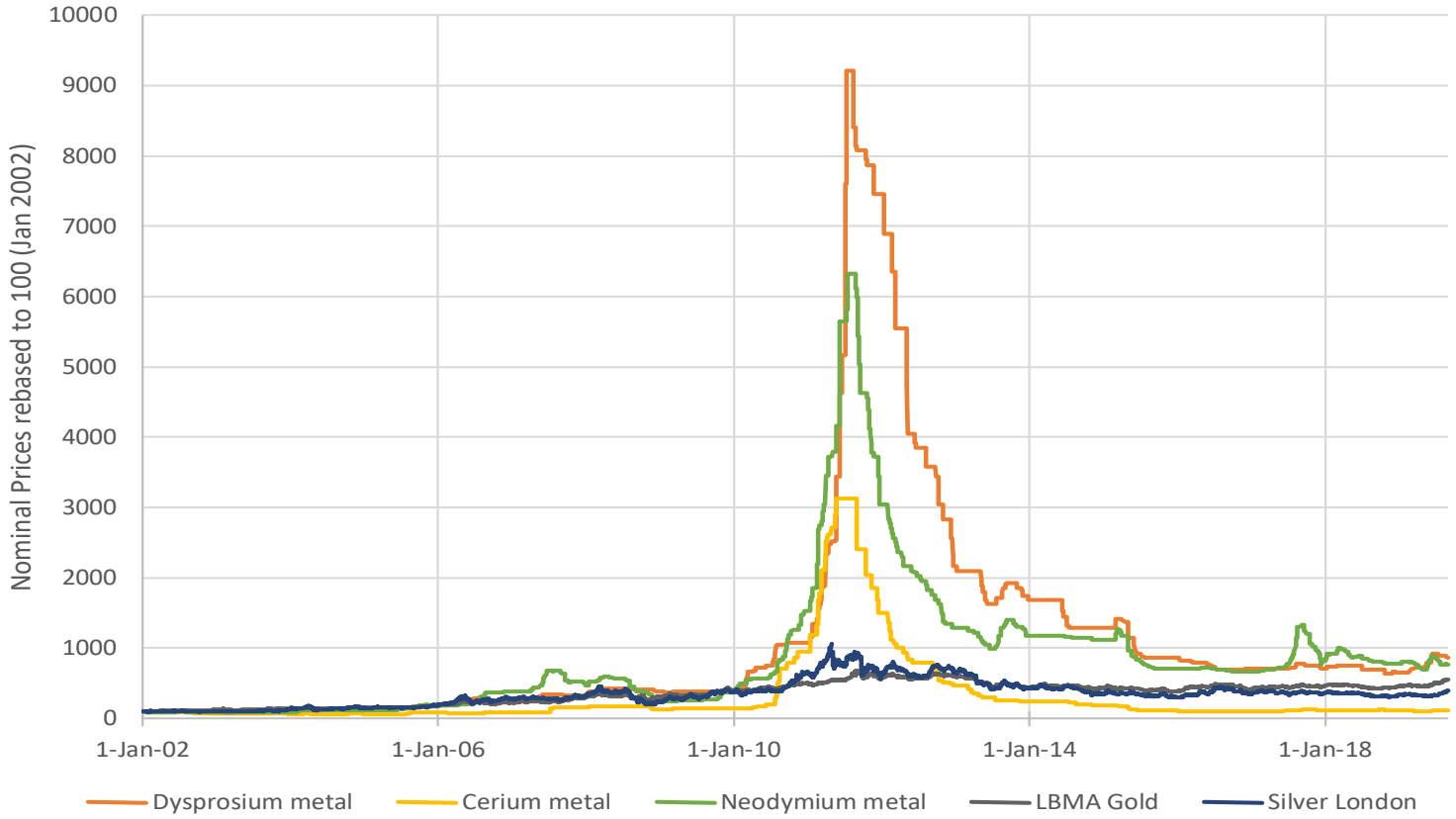
"The unique properties of REEs are indispensable to defense applications, such as in the production of jet engines, missile guidance systems, antimissile defense systems, satellites, and communication systems"- US Government Accountability Office

- One of the most critical DoD applications for REE are rare earth permanent magnets (REPMs)
- Cost of actual magnets can often be quite low but the value add when integrated into defense systems is enormous…..systems that depend on REPM include:
  - Precision guided munitions
  - Naval radar systems
  - Lasers
  - Sensors/actuators on F-35
  - Electric propulsion for future aircraft
- Critical Commercial Uses
  - Petroleum refining
  - Auto catalysts
  - Electric Vehicle Motors



The Impact of 2010 Disruption

China cut off Japanese supply for brief period in 2010 sending the market into a panic/bubble situation



Rare Earth Oxide Production Snap Shot

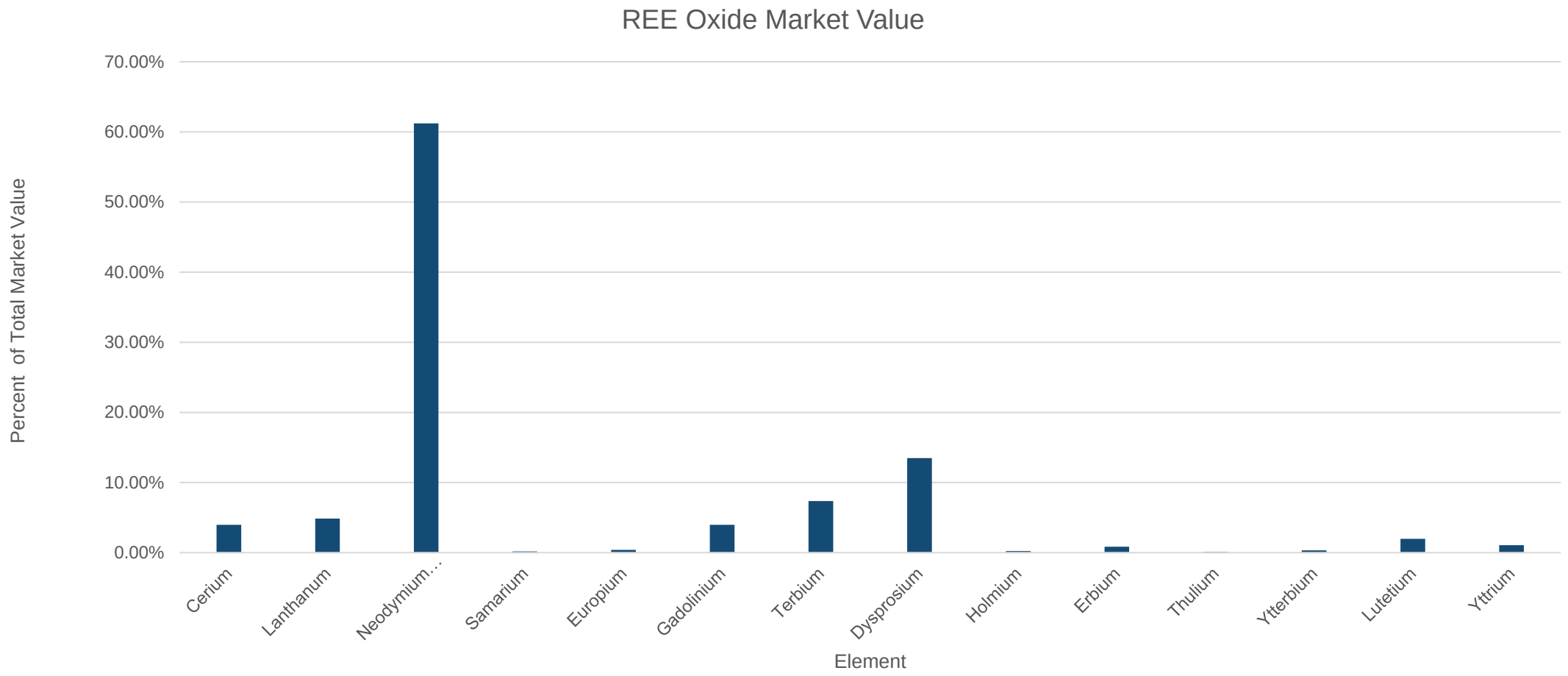
China is the dominant producer, but their industrial base is also the largest consumer (production of value-add goods)

Separated Oxide	Chinese Capacity (MT)	Rest of World Capacity (MT)	U.S. Capacity (MT)*	Chinese Demand (MT)	Rest of World Demand (MT)	U.S. Demand Total (MT)
Ce	80%	20%	0%	85%	5%	10%
La	80%	20%	0%	80%	6%	14%
NdPr	80%	20%	0%	90%	8%	2%
Sm	80%	20%	0%	70%	23%	7%
Eu	80%	20%	0%	71%	15%	15%
Gd	80%	20%	0%	75%	10%	15%
Tb	80%	20%	0%	76%	16%	8%
Dy	92%	8%	0%	89%	10%	1%
Ho	90%	10%	0%	84%	10%	6%
Er	93%	7%	0%	9%	52%	39%
Th	88%	13%	0%	100%	0%	0%
Yb	96%	4%	0%	65%	17%	19%
Lu	86%	14%	0%	83%	17%	0%
Y	87%	13%	0%	72%	15%	13%

*The U.S. has two active mines producing REE ores and concentrates, but limited capacity to produce separated oxides

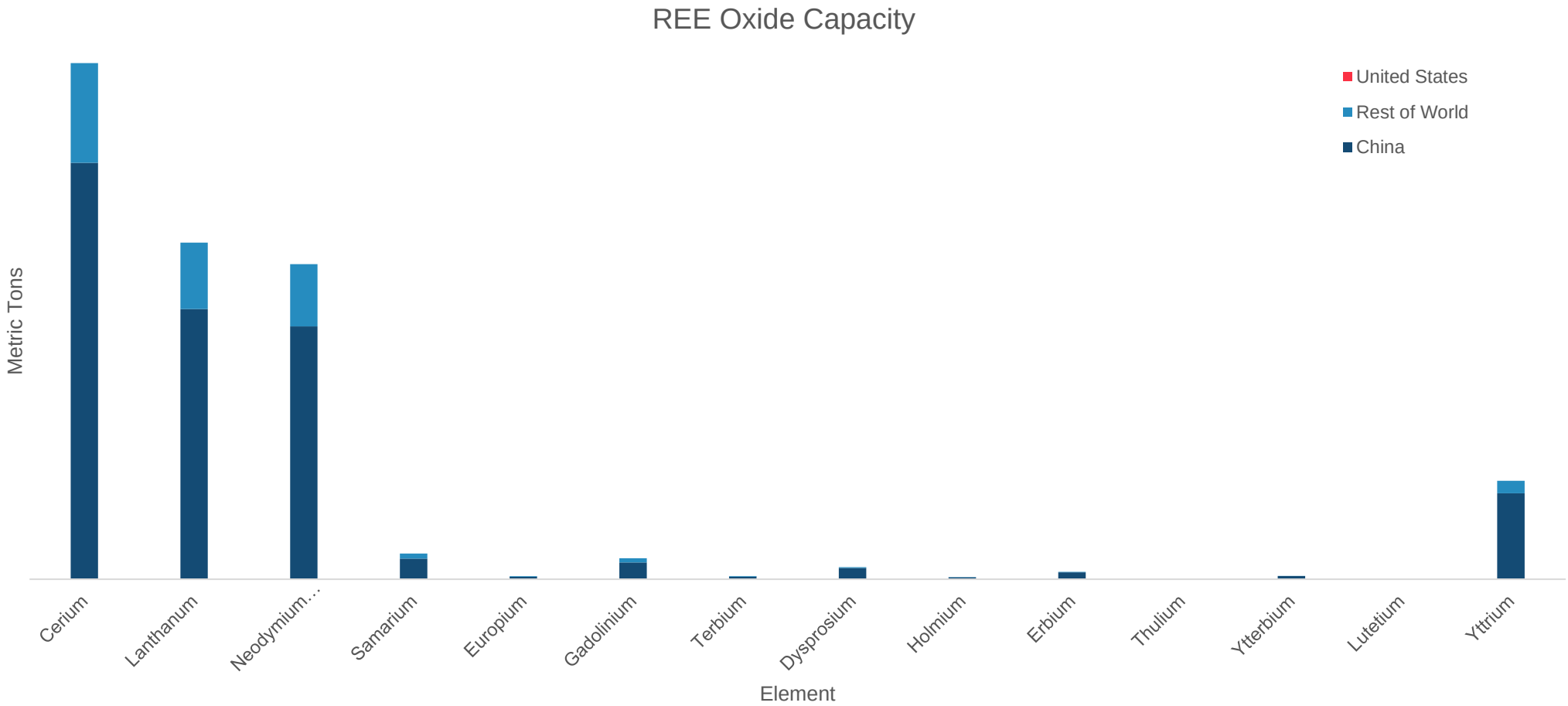
Market Value

- The entire REE oxide market is valued at approximately $3.1 billion.
  - Demand for NdFeB magnets, which typically contain NdPr and Dy or Tb are driving the market



Capacity by Element

- The LREEs represent approximately 90% of the volume for all REEs.
- In order to produce the NdPr and Dy required by the NdFeB market, most of the other REEs have to be overproduced as they are generally all co-located in the same minerals and current separation technologies generally produce all REE rather than selective production.



10 U.S.C. 2533c: Restrictions on Rare Earth Element Alloys and Magnets

- Section 871 of the National Defense Authorization for Fiscal Year 2019 (Public Law 115-232)
  - Restrictions codified at 10 U.S.C. 2533c
  - Class Deviation signed by the Office of the Undersecretary of Defense, Acquisition and Sustainment, Defense Pricing and Contracting (DPC) on January 28th, 2019
  - Interim Rule on April 30, 2019: Created new section of Defense Federal Acquisition Regulation Supplement (DFARS) 225.7018 and a clause at 252.225-7052
- Prohibits U.S. DoD Acquisition of Covered Materials
  - Samarium-cobalt magnets (SmCo)
  - Neodymium-iron-boron (NdFeB) magnets
  - Tungsten metal powder
  - Tungsten heavy alloy or any finished or semi-finished component containing tungsten heavy alloy
- From Covered Nations
  - The Democratic People's Republic of North Korea
  - The People's Republic of China
  - The Russian Federation
  - The Islamic Republic of Iran

What are the restrictions?

- Except as provided in DFARS 225.7018-3 and 225.7018-4, do not acquire any covered material melted or produced in any covered country, or any end item, manufactured in any covered country, that contains a covered material (10 U.S.C. 2533c)

- For samarium-cobalt magnets and neodymium iron-boron magnets, this restriction includes-

  – Melting samarium with cobalt to produce the samarium-cobalt alloy or melting neodymium with iron and boron to produce the neodymium-iron-boron alloy; and

  – All subsequent phases of production of the magnets, such as powder formation, pressing, sintering or bonding, and magnetization;

  – The restriction on melting and producing of samarium-cobalt magnets is in addition to any applicable restrictions on melting of specialty metals at 225.7003 and the clause at 252.225-7009, Restriction on Acquisition of Certain Articles Containing Specialty Metals.

What are the Exceptions?

- The restriction in section 225.7018-2 does not apply to an acquisition—
  - (a) At or below the simplified acquisition threshold;
  - (b) Outside the United States of an item for use outside the United States; or
  - (c) Of an end item that is—
    - (1) A commercially available off-the-shelf item other than—
      - (i) A commercially available off-the-shelf item that is 50 percent or more tungsten by weight; or
      - (ii) A tungsten heavy alloy mill product, such as bar, billet, slab, wire, cube, sphere, block, blank, plate, or sheet, that has not been incorporated into an end item, subsystem, assembly, or component;
    - (2) An electronic device, unless the Secretary of Defense, upon the recommendation of the Strategic Materials Protection Board pursuant to 10 U.S.C. 187 determines that the domestic availability of a particular electronic device is critical to national security
    - (3) A neodymium-iron-boron magnet manufactured from recycled material if the milling of the recycled material and sintering of the final magnet takes place in the United States.

What is the Current Process for a Nonavailability Determination?

Exception for Non-Availability: If the authorized agency official concerned determines that covered materials of satisfactory quality and quantity, in the required form, cannot be procured as and when needed at a reasonable price.

This Exception requires a nonavailability determination. There are 2 types:

1. Individual nonavailability determinations (applies to only one contract)

   – Currently, the Undersecretary of Defense for Acquisition and Sustainment (USD(A&S)), the three Service Secretaries and the Director of Defense Logistics Agency can sign these determinations

   – Requirements:
     I. An analysis of alternatives that would not require a nonavailability determination; and
     II. A written certification by the requiring activity that describes, with specificity, why such alternatives are unacceptable.

   Copies of approved or rejected nonavailability determinations must be sent to USD(A&S) Industrial Policy

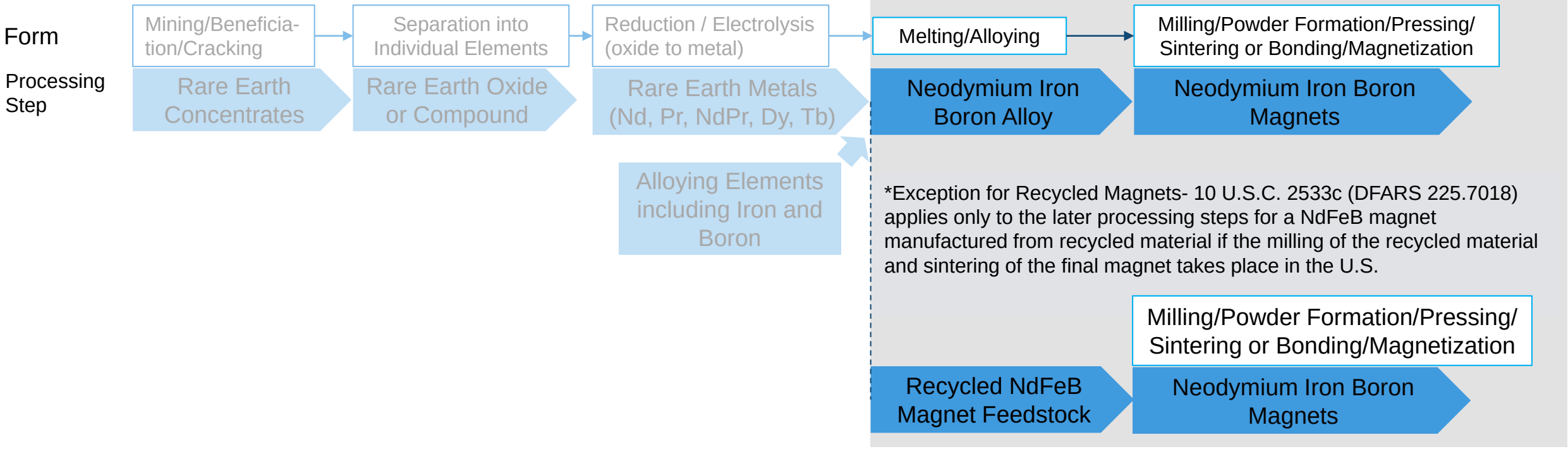
2. A class nonavailability determination (i.e., a nonavailability determinations that applies to more than one contract) requires the approval of the USD(A&S).

   – Only the USD(A&S) can approve
   – Requires public notification including a posting on fedbizopps.gov
   – Lead-time of at least 30 days

Simplified Neodymium Iron Boron (NdFeB) Magnet Supply Chain

The restrictions on the NdFeB supply chain apply only to the final steps of the supply chain

NdFeB magnets typically contain the rare earth elements Neodymium (Nd), Praseodymium (Pr), Dysprosium (Dy), and/or Terbium (Tb)



Where are NdFeB Magnets & Alloys Produced?

- Industrial Policy's current understanding of the world capacity for sintered NdFeB Magnets

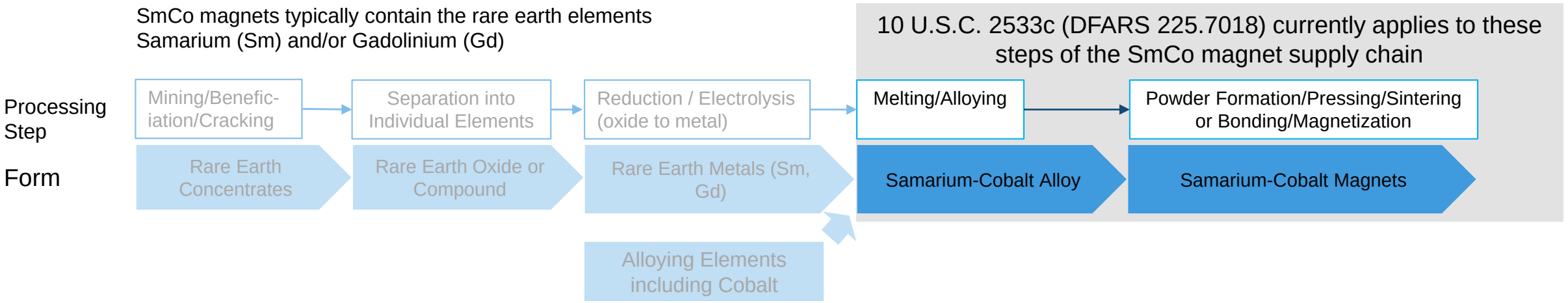
Country/Region	Neodymium Iron Boron Magnet % Capacity (MT/Total MT)
China	71%
Rest of World	29%
United States	0%

  - Japan has multiple companies producing NdFeB magnets
  - There are at least two companies producing NdFeB magnets in the European Union
  - There is U.S. expertise and capabilities in NdFeB magnet design, finishing, and building of advanced components, but the U.S. has relatively limited (but growing) capacity for sintered and alternative NdFeB
  - U.S. companies and researchers are actively developing and/or pursuing NdFeB magnet capabilities through traditional processing routes, new technological approaches, and innovative recycling technologies

- DoD Industrial Policy is aware of NdFeB alloy facilities in China, United Kingdom, Vietnam, and Japan, but there are possibly others worldwide
  - These companies generally have existing relationships with magnet production companies

- DoD requirements are small compared to total world capacity outside of China

Simplified Samarium-Cobalt (SmCo) Magnet Supply Chain



- Samarium Cobalt (SmCo) magnets are already covered under 10 U.S.C. 2533b through *DFARS 225.7003: Restrictions on acquisition of specialty metals*
  - 10 U.S.C. 2533b compliant capacity exists in the U.S., Europe, and Japan

- Vendors need to ensure that SmCo magnets are compliant with both laws and corresponding DFARS clauses including ensuring that the source of SmCo magnets contained in finished components purchased in qualifying countries is compliant with 10 U.S.C. 2533c (DFARS 225.7018).

Where Can I Find More Information on the Restrictions?

- DFARS Clauses
  - https://www.acq.osd.mil/dpap/dars/dfars/html/current/225_70.htm

- U.S. Code 10 U.S.C. 2533b
  - https://uscode.house.gov/view.xhtml?hl=false&edition=prelim&req=granuleid%3AUSC-prelim-title10-section2533b&num=0&saved=%7CZ3JhbnVsZWlkOlVTQy1wcmVsaW0tdGl0bGUxMC1zZWN0aW9uMjUzM2M%3D%7C%7C%7C0%7Cfalse%7Cprelim

- U.S. Code 10 U.S.C. 2533c
  - https://uscode.house.gov/view.xhtml?hl=false&edition=prelim&req=granuleid%3AUSC-prelim-title10-section2533c&num=0&saved=%7CZ3JhbnVsZWlkOlVTQy1wcmVsaW0tdGl0bGUxMC1zZWN0aW9uMjUzM2M%3D%7C%7C%7C0%7Cfalse%7Cprelim

- John S. McCain National Defense Authorization Act for Fiscal Year 2019 (Public Law 115-232)
  - https://www.congress.gov/bill/115th-congress/house-bill/5515/text

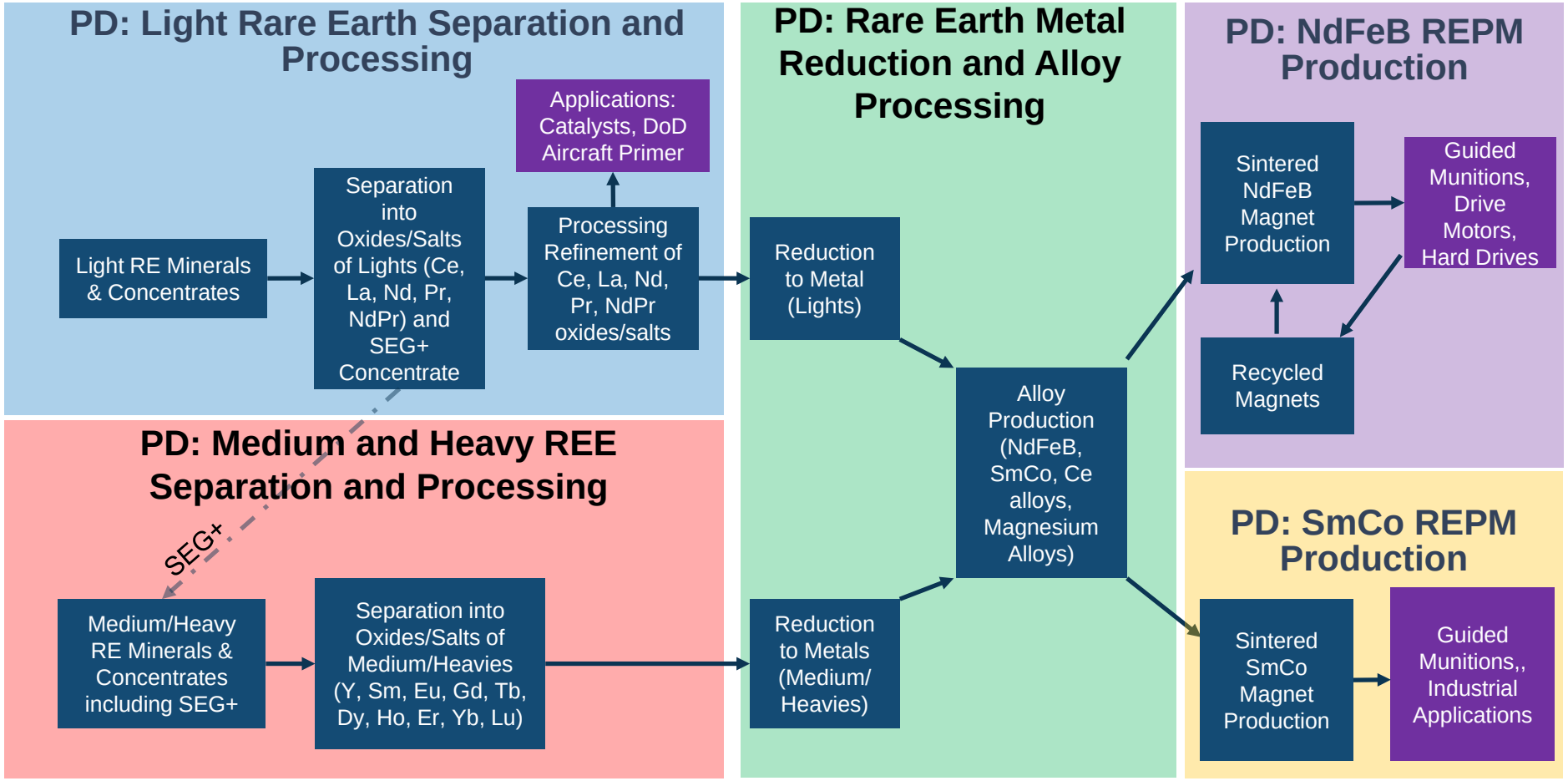
Defense Production Act Presidential Determinations (PDs)

- DoD is considering further actions to secure rare earth element supply
  - Further enhancing relationships with allies and partners
  - Increasing stockpiles
  - Investing in new technologies
    - DoD has been leveraging Small Business Programs in the areas of rare earth recycling for oxides and metals as well as rare earth separation
    - These programs have already help develop capacity

- On July 22, 2019, President Trump Authorized the use of the Defense Production Act for five focus areas in the Rare Earth Elements (REE) sector

1. Light REE Separation and Processing
2. Heavy REE Separation and Processing
3. REE Metals and Alloys
4. Samarium-Cobalt Magnets
5. Neodymium Iron Boron Magnets

Potential Areas DoD Support in REEs Supply Chain



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Simplified Tungsten (W) Supply Chain