

**J. A. GREEN
& COMPANY**



**The Government Response to the Rare Earth
Situation: What, When and Why?**

March 23, 2011

Introduction to Rare Earths

Periodic Table of the Elements

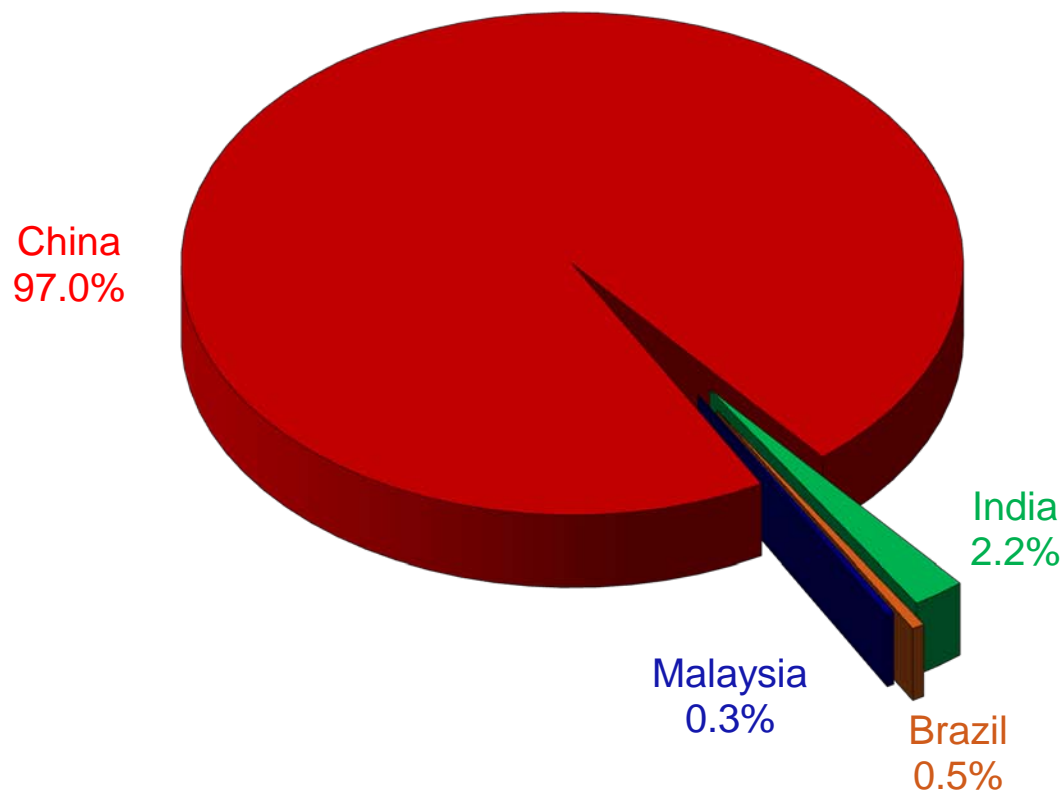
1																	18				
1																	18				
2	3	4											13	14	15	16	17	18			
2	3	4											2	3	4	5	6	7	8	9	10
3	11	12											13	14	15	16	17	18			
4	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36			
5	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54			
6	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71				
7	87	88	**	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118			
LANTHANIDE SERIES			57	58	59	60	61	62	63	64	65	66	67	68	69	70	71				
ACTINIDE SERIES			89	90	91	92	93	94	95	96	97	98	99	100	101	102	103				

Light Rare Earths (LRE's) Heavy Rare Earths (HRE's)

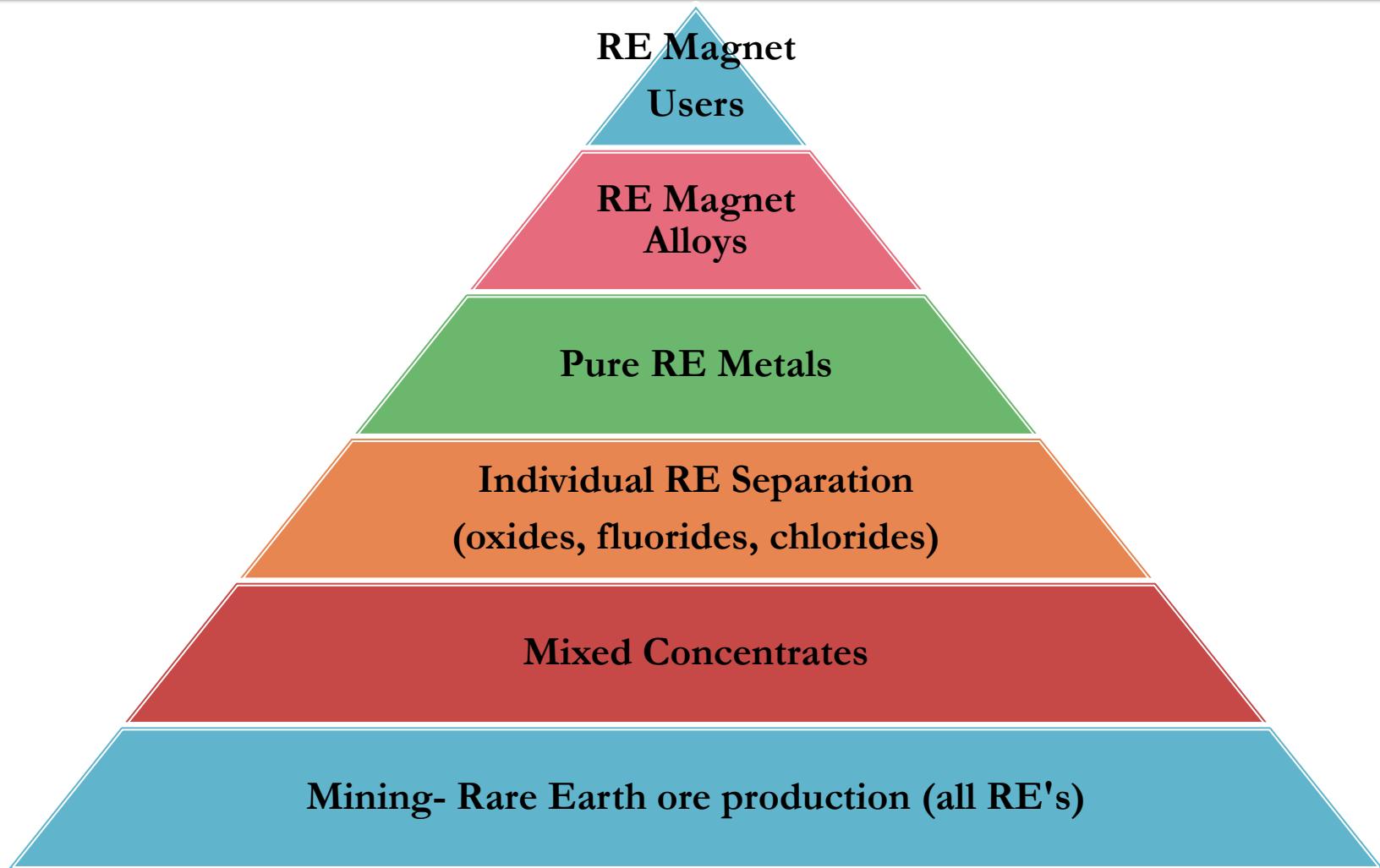
- 17 total
- Light-Heavy
- “Rare” is a misnomer – ability to economically process is “rare”
- Radioactivity typical around deposits (Thorium)

REO World Production in 2008

124,000 metric tons of contained rare-earth oxide (REO)



Rare Earth Magnet Value Chain



Rare Earth Magnet Supply Chain

Oxides	Metals, Alloys & Powders	Phosphors	Magnets	
Lynas – exp. 2011 Australia	Santoku Corporation <i>Japan/ US</i>	Rhodia <i>US, France</i>	<u>Distributors/ Fabricators*</u>	<u>Manufacturers**</u>
Molycorp – exp. 2012 US	Shin Etsu <i>Japan</i>		Integrated Magnetics ^{1,2} <i>US</i>	Electron Energy Corporation ¹ <i>US</i>
Japan Oil, Gas and Metals National Corp <i>Japan</i>	Great Western Minerals Group/ Less Common Metals <i>Canada/ UK/ US</i>		Dexter Magnetic Technologies ^{1,2} <i>US, UK, China</i>	Thomas and Skinner ³ <i>US</i>
China produces 97% of world supply	Neo Materials (Magnaquench) <i>China</i>		Allstar ² <i>US</i>	Arnold Magnetic Technologies ^{1,3} <i>US/ Switzerland</i>
Sichuan Mianning Mining Co <i>China</i>	CAS Key Laboratory of Rare Earth Chemistry and Physics <i>China</i>		Quadrant ^{1,2} <i>US</i>	Molycorp (intends to pursue joint venture w/ Hitachi) <i>US/ Japan</i>
Jiangxi Copper <i>China</i>			Adams ^{1,2} <i>US</i>	Vacuumschmelze GmbH/ Neorem ^{1,2/2} <i>Germany/ Finland</i>
Baotou Steel Rare Earth <i>China</i>			Bunting ^{1,2} <i>US</i>	Hitachi Metals ^{1,2} <i>Japan</i>
Sichuan Hanxin Mining Industrial Co <i>China</i>	Molycorp (JV w/ Sumitomo - Sumikin Molycorp) <i>US/ Japan</i>		Magnetic Component Engineering, Inc. ^{1,2} <i>US</i>	Chengdu Magnetic Material Science & Technology Company ¹ <i>China</i>
<p>*Distributor/Fabricators typically import overseas material and resell it to domestic customers. Many merely pass product through from manufacturers to end-users. Others do some minimal grinding. The more sophisticated of the lot will fabricate higher value components using imported magnets.</p> <p>**Manufacturers typically create their own proprietary alloys, and either cast or sinter magnets from those alloys. Control over the quality of the alloys is an important distinction of this group, as they are not typically dependent on overseas material suppliers. In addition to cast and sintering capabilities, the magnet manufacturers also typically utilize heat treating processes, in order to further enhance the properties of the magnets. The magnet manufacturers generally maintain a full range of manufacturing capabilities, to enable them to manufacture all forms of custom designs and applications. Magnet manufacturers can also fabricate high value components utilizing the magnets they have made.</p> <p>¹ Including Samarium Cobalt Magnets (SmCo) ² Including Neodymium Magnets (NdFeB) ³ Plans to manufacture Neodymium Magnets (NdFeB) ⁴ Plans to manufacture Samarium Cobalt Magnets (SmCo) +Examples, not an inclusive list</p>			Magnet Sales ^{1,2} <i>US</i>	Zhejiang Tinnau Group ¹ <i>China</i>
			Stanford Magnetics ^{1,2} <i>US</i>	Ningbo Co-Star Material High Tech Co. Ltd ^{1,2} <i>China</i>
			Dura magnetic ^{1,2} <i>US</i>	Nanjing Chuangken Magnetism Co. Ltd ^{1,2} <i>China</i>
			KJ Magnetics ² <i>US</i>	Ningbo Ninggang Permanent Magnetic Materials Co. Ltd ^{1,2} <i>China</i>
				Advanced Technology & Materials Co., Ltd. ² <i>China</i>
				Beijing Jingci Magnetism Technology Co. ² <i>China</i>
				Thinova Co., Ltd. ² <i>China</i>
				Ningbo Yunsheng Co., Ltd. ² <i>China</i>
				Shin Etsu ^{1,2} <i>Japan</i>
				San Huan New Material High-Tech Inc. ² <i>China</i>

REE Energy and Defense Applications



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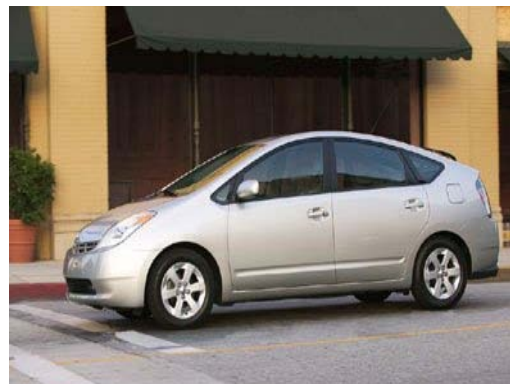
JDAM



**Wind
Turbines**



Global Hawk UAV



Hybrid Vehicles



M1A1 Abrams

US Magnetic Materials Association 6 Point Plan

- Establish a baseline—studies by DOD, ~~DOE~~, ~~GAO~~
- Stockpile — DLA procurements
- Ensure fair trade — USTR
- DOE led grant and loan guarantee for downstream manufacturing processes (i.e. oxide to metal/metal to magnet manufacturing)
- Defense critical components support — Defense Production Act programs
- Innovation, training and workforce development
- USMMA “Manufacturing First” strategy

What's Happening?

- **Legislative Branch**
- **Executive Branch**

Overview of Legislative Actions

- **FY 2010 NDAA**
- **GAO and CRS Reports on Rare Earths**
- **RESTART x3/Dahlkemper**
- **FY 2011 NDAA**
- **Congressional Hearings and Testimony**
- **Current Legislation**

FY 2010 NDAA

- **SEC.843**
 - **Report on rare earth materials in the defense supply chain**
 - **“Not later than April 1, 2010, the Comptroller General shall submit to the Committees on Armed Services of the Senate and House of Representatives a report on rare earth materials in the supply chain of the Department of Defense.”**

April 2010 GAO Report

- Reconstructing a U.S. rare earth supply chain may take up to 15 years
- DOD defense systems currently use REE from China for crucial components
- It is likely that defense systems will continue to depend on rare earths, as there are no effective substitutes
- DOD is currently assessing security risks due to REE supply concerns

July 2010 CRS Report

- In recent years, the U.S. has become 100% dependent on REE imports, most from China
- Worldwide demand for REE is approximately 134,000 tons per year, while global production is around 124,000 tons
- Global demand is expected to increase to 180,000 tons per year by 2012, which is unlikely to be met
- Congress should authorize and appropriate funding for rare earth R&D
- Challenge China on its REE export restrictions in the WTO
- Establish a government-run stockpile for use in defense and clean energy applications

2010 Legislation – 111th Congress

- **Rare Earths Supply-Chain Technology and Resources Transformation Act of 2010 (RESTART Act)**
 - H.R.4866
 - S.3521
 - S.4031
- **Rare Earths and Critical Materials Revitalization Act of 2010**
 - H.R.6160 – Passed U.S. House of Representatives on September 29, 2010

FY 2011 NDAA

- **SEC. 843**
 - **Assessment and Plan for Critical Rare Earth Materials in Defense Applications**
 - Requires DOD to assess which rare earth minerals are critical to national defense and which are susceptible to supply disruption
 - Includes an assessment of the full supply-chain (mine to market)
 - Requires aggregation of total defense demand
 - Pre-identifies neodymium iron boron magnets as a qualifying material
 - Requires a plan to ensure the long-term supply of these materials
 - The plan must consider
 - Stockpiling
 - WTO action
 - Defense Production Act

Legislative Branch

■ Hearings

- **House Committee on Oversight and Government Reform, Subcommittee on National Security and Foreign Affairs**
 - U.S. Manufacturing Policy
 - “It would take about 15 years to establish a domestic supply chain. The national security implications of this imbalance are impossible to ignore.” –Chairman Tierney
 - “The offshore movement of manufacturing is weakening U.S. R&D capabilities in several materials technologies vital to national security, including night vision systems, lanthanides (rare earth elements), and specialty metals.” –Robert Baugh, AFL-CIO
- **Senate Committee on Energy and Natural Resources, Subcommittee on Energy**
 - Examining the Role of Strategic Minerals in Clean Energy Technologies
 - DOE Strategic Plan for REE will focus on four core technologies that are crucial to clean energy: permanent magnets, batteries, phosphors, and photovoltaic thin films
 - Global RE demand will continue to grow as nations pursue clean energy technology, and the U.S. must prevent supply disruptions to remain a leader in this field

2011 Legislation – 112th Congress

- **H.R. 618 - Rare Earths and Critical Materials Revitalization Act of 2011 (Boswell – D-IA)**
- **S.323 - Critical Minerals and Materials Promotion Act of 2011 (Udall – D-CO)**
- **H.R. 952 - Energy Critical Elements Renewal Act of 2011 (Miller – NC)**
- **Resource Assessment of Rare Earths (RARE) Act of 2011 (Johnson D-GA/Markey D-MA) – Pending submission**
- **Rare Earth Supply Chain Technology and Resources Transformation and Act (RESTART) of 2011?**

Executive Branch

■ DOC –

- 2009 Rare Earth Materials Roundtable

■ DOD –

- Industrial Policy report delayed, Executive Summary may be released soon
- Defense supply-demand assessment due in July 2010

■ DOE –

- Critical Materials Strategy issued in December 2010
 - Identifies as critical Dy, Nd, Tb, Eu and Y
- ~\$20M earmarked for “Rare Earth Energy Hub” in FY 12 budget - <http://www.slideshare.net/energy/secretary-chus-fy-2012-budget-briefing>

■ USGS –

- 18% budget cuts to MRP proposed in 2012

■ OSTP Interagency Working Group

- DOC, DOD, DOE, DOS, EPA, JCS, OSTP, USGS, etc
- NSTC Subcommittee on strategic materials established

Summary

- Rare earth materials are critical to energy and defense applications
- Congress has recognized the need for a domestic supply chain
- Several government agencies are working to address rare earths supply issues and future prospects
- The United State Government needs a comprehensive strategic materials strategy for the entire value chain

Contact Information

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