



# Green Technology

Rare Earth Dependent

## Critical and Strategic Failure of Rare Earth Resources National Security and Industrial Policy Failures

The U.S. and the World find themselves dependent upon China for a group of minerals and metals that are critical to many commercial, environmental and defense applications. China's monopoly position is poised to capture emerging technologies and manufacturing facilities from around the world, in exchange for supply contracts. China's National Industrial Policy of Rare Earth Dominance cannot be challenged by private investment.

The U.S. must develop a National Domestic Rare Earth Refinery to Survive.



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# National Security

Rare Earth Dependent

# Critical Strategic Failure in Rare Earth Resources

A National Defense and Industrial  
Policy Failure

# What are Rare Earths

- Lanthanides are the group of elements on the Periodic Table beginning with the atomic number 57 (Cerium) through 70 (Ytterbium), including Lutetium (71).
- The term Rare Earths typically incorporate all of the Lanthanides, Yttrium and Scandium.
- However, due to strong elemental associations and strategic considerations, I include Thorium in the full grouping.

# What Makes REs Important

This group of elements represents the only known bridge to the next level of improved performance in the material properties for many metallurgical alloys, electrical conductivity, and instrument sensitivity and in some cases a mechanical or physical change in form or function.

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**Below: Elemental Grouping, Atomic Weight vs. Crustal Abundance and Military & Commercial Applications**

The Periodic Table of the Elements

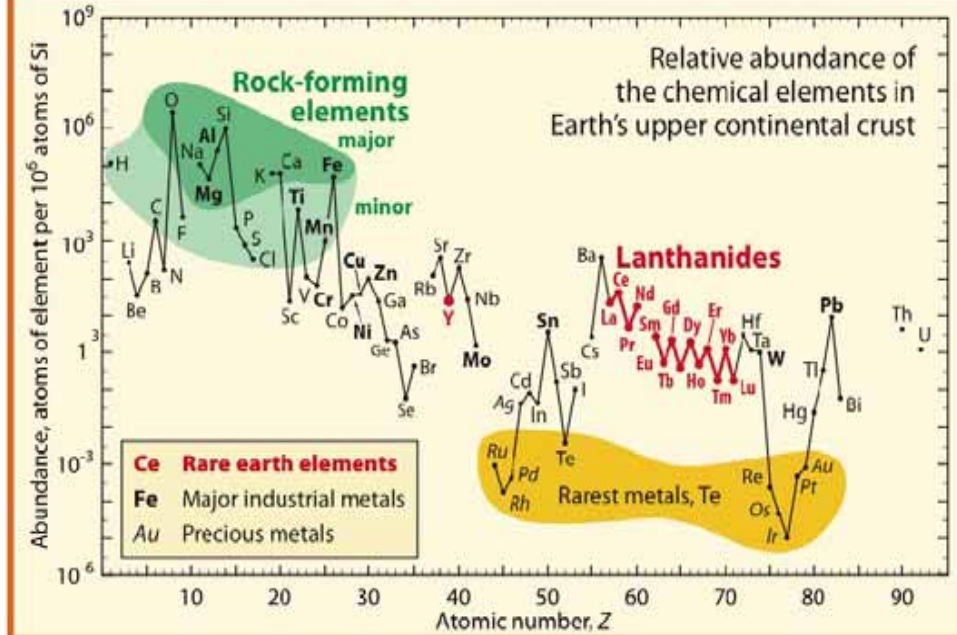
1	2											18	19	20			
H	He											Ar	K	Ca			
3	4											13	14	15	16	17	18
Li	Be											B	C	N	O	F	Ne
11	12											Al	Si	P	S	Cl	Ar
19	20											31	32	33	34	35	36
Na	Mg											Ga	Ge	As	Se	Br	Kr
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
137	138	139	140	141	142	143	144	145	146	147	148	149	150	151	152	153	154
Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub	Uuq	Uur	Uus	Uut	Uuq	Uuv

**Lanthanide Series**  
Rare Earths and associated elements, Lutetium, Yttrium, Thorium and Scandium

**Rare Earth Elements**

• Lanthanide series  
• Actinide series

57	58	59	60	61	62	63	64	65	66	67	68	69	70	71
La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr



**GLASS AND MIRRORS  
POLISHING POWDER**

- Cerium

**UV CUT GLASS**

- Cerium

**DIESEL FUEL  
ADDITIVE**

- Cerium
- Lanthanum

**LCD SCREEN**

- Europium
- Yttrium
- Cerium

**HYBRID ELECTRIC  
MOTOR AND GENERATOR**

- Neodymium
- Praseodymium
- Dysprosium
- Terbium

**25+ ELECTRIC MOTORS  
THROUGHOUT VEHICLE**

- Neodymium Magnets

**CATALYTIC CONVERTER**

- Cerium/Zirconium
- Lanthanum

**HYBRID NIMH  
BATTERY**

- Lanthanum
- Cerium



# No Known Substitutions

- These lanthanides hold unique chemical, magnetic, electrical, luminescence and radioactive shielding characteristics.
- Combined with other materials they can help maintain or alter physical and structural characteristics under changing conditions.

# Military Applications

- **National Defense** - The following U.S. Defense Systems are rare earth dependent: all guided missile systems, 'smart bombs,' unmanned drones, advanced sonar, secure communications, advanced jet aircraft engines, advanced armor, advanced radar, stealth technologies and targeting and triggering systems.



# Future Military Applications

- Rare earths will be critical to the next generation of advanced weapons systems:
  - Future advances in sonar, radar and secure communications.
  - Future advances in armor and Structurally Amorphous Metals.
  - Future advances in jet propulsion and airframe technology.
  - Future advances in guided ordinance, missiles and unmanned drones.

# Green Technology Applications

- **Environmental** - The following Green Technologies are rare earth dependent: hybrid and zero emission automobiles such as the batteries and motors used in the Toyota Prius and Chevy Volt, high capacity Wind Turbines, advanced solar panels, high efficiency lighting, petroleum and pollution control catalysts for automobiles, and High Speed Rail.

# Future Green Technologies

- Magnetic Refrigeration – Rare earth magnets will make it possible to reduce up to 15% of global fossil fuel consumption associated with cooling and refrigeration while eliminating harmful chemical compounds currently used.
- Thorium Based Nuclear Energy – Thorium is much more abundant than Uranium and is a much safer nuclear fuel. Configured as a LFTR reactor it cannot “melt down,” greatly reducing the cost of power plant construction. Thorium energy eliminates the risk of nuclear weapons proliferation, as it cannot be converted into fissile material. Thorium produces a fraction of the Actinide waste associated with current LW Reactors, greatly reducing waste storage issues. A Thorium LFTR nuclear reactor can be configured to “deep-burn” the existing nuclear waste stock piles and would actually create valuable rare earths as a byproduct. Thorium nuclear energy is the future.

# Commercial Applications

- **Commercial** - The following Commercial Applications are rare earth dependent: cell phones, the Blackberry, iPods, computer hard drives, color televisions, fiber optics, advanced electric motors, high strength permanent magnets, lasers, superconductors, microwave communications, advanced metallurgy and x-ray equipment.

# Future Commercial Applications

- Electronic and computer applications such as advanced superconductors, sub-light-speed computer processors and advanced satellite communications.
- Advances in material science such as metallurgical and carbon fiber applications, including nano-particle technologies.
- Rare earth related metallurgical and structural advances may help reshape aviation and the auto industry through the science of making structural component and body parts lighter and safer, thus more fuel efficient.

# Governmental and NGO Assessment

- The National Minerals Advisory Board has classified Rare Earths as “Strategic and Critical” as defined under the legislation governing the National Defense Stockpile.
- The National Academy of Science, the National Academy of Engineering, the National Research Council and the National Academy of Medicine all conclude that Rare Earths are “Critical” to our Nation’s industrial interests.
- The United States Geological Survey has listed Rare Earth Oxides as one of 19 minerals or materials that the United States is 100% import dependent upon.

# Resource Failure

- The United States, and the rest of the world, are dependent on China who produces over 90% of the low value and up to 99% of the high value Rare Earth Oxides for world consumption.
- Published global production and consumption estimates show that Asia alone could consume 100% of world production for many of the Rare Earth Elements and Alloys as early as 2015, if no new production comes on line.
- Many of the jobs of today and tomorrow are Rare Earth dependent.

# Scope of National Defense Failure

- The U.S. Military is 100% import dependent upon rare earth magnets, critical to all guided missile systems and ordinance. There are no substitutes.
- The U.S. Military's first strike, communications and most of its advanced weapons systems and armor are rare earth dependent.
- The U.S. is 100% import dependent on rare earths, with as much as 99% originating in China.



# Defense Failure Cont.

America's military contractors are three steps removed from a secure source of these Strategic and Critical materials:

1. There are no active Rare Earth producers in The United States.
  2. There are no refining capabilities for Heavy Rare Earth Elements in The United States.
  3. There are no active Heavy Rare Earth Alloy production capabilities in The United States.
- Our nation's defense contractors are having difficulty procuring these Strategic and Critical materials in the current environment.
  - The United States does not maintain a "strategic reserve" of Rare Earth Oxides, Elements or Alloys.
  - The defense of the United States is Rare Earth dependent.

# How did this happen

- In 1986 the Chinese Government placed rare earths on a list of top secret National Priorities called Program-863. In 1992 the Premier Deng Xiaoping boldly stated to the world “The Middle East has oil, China has rare earths.”
- By 1997 Mountain Pass, the only other significant REO producer outside of China, was forced to stop mining under increasing pricing pressure from China and environmental pressure from the State of California, ceasing all operations by 2002.
- By 2003 China had acquired, closed and transplanted America’s most advanced rare earth magnetic facility into China (including its portfolio of patents).
- In less than 30 years China made rare earths into a national monopoly.

# Creating Scarcity

- China is increasing taxes, export restrictions and imposing VAT penalties on all Chinese exporters of Rare Earth Oxides, Elements and Alloys.
- China has closed many small REO mines and ceased issuing mining permits for the production of Rare Earth Oxides.
- China has imposed strict production quotas and has begun enforcing environmental law on current producers of Rare Earth Oxides.
- High export taxes and restrictions on rare earth oxides and elements are resulting in the financial failure of all non-Chinese refineries, consequently expanding China's monopoly up the value chain into metals and alloys.

# Leveraging Resource Advantages

- China's current restrictive production, export policy and tax regime on Rare Earth Oxides, Elements and Alloys is designed to restrict global supply outside of China and to lure rare earth technology dependent manufacturing facilities into China.
- The Recent Chinese threat of banning the export of some of the rarest and most valuable elements may be intended to highlight supply risk, in order to push more rare earth technology dependent manufacturing facilities inside China's borders.

# U.S. Production Status

- There are currently no active Rare Earth mines in the United States.
- The United States has two permitted world class rare earth mines.
  - The recent financial collapse caused financial institutions and banks to withdraw funding from rare earth mining projects globally.
- China has stepped in to provide financing in a number of cases, further consolidating its grip.

# Refining Prospects

- There are no active rare earth refineries in the U.S. or North America.
- Consequently, in the event that any Heavy Rare Earth Oxides were mined in The United States these oxides would be sold to an overseas refinery for further elemental or alloy processing.
- A modern Rare Earth Refinery would cost about \$1 billion (+20,000 tpy capacity).

# Free Market Failure

- China's strategic resource monopoly is seen by many as a "Monroe Doctrine," or sovereign dominion, over these critical resources and increasingly the related technology and intellectual property that comes with it.
- China has been stockpiling REs and can easily control rare earth pricing to bankrupt any new/independent producers of rare earths globally.
- The financial markets are not willing to bear this risk.

# Resource & Technology War

- The U.S. is engaged in an *economic war* of technology transfer and a *resource war* over the future supply of commodities and energy.
  - China is currently leveraging its advantage around the control of rare earths and rare earth dependent technologies.
  - China is engaged in a global buying spree of mineral resources and energy.

The U.S. has no ‘discernable plan’ and is unable to respond rationally: China is our largest debt holder and we are fighting at least 2 wars in the mid-east over oil and energy pipeline routes.



# A Simple Two-Step Plan

The development of a National Rare Earth Refinery  
Breaks China's RE monopoly – ebbing the flow of  
Technology transfer.

– A National Refinery would accept RE feeds from multiple  
producers, lowering risk and capital cost for all.

Developing a National Rare Earth Refinery would set  
the stage for future energy independence through the  
byproduct production and stockpiling of Thorium.

# Thorium Energy = Energy Independence

- The U.S. can produce 100% of the Thorium necessary to power all of the electrical power needs of our country simply as a byproduct of the rare earth refining process.
- Thorium nuclear power plants and energy production will be one-tenth cost of existing LW Reactors.
- With low cost energy the U.S. could meet all of our liquid fuel needs via plasma gasification and other off the shelf technologies.

# What Can Be Done..?

- The U.S. must fund/finance a domestic Rare Earth Refinery.
- This refinery must be tied to the production of domestic rare earth mines.
- This refinery must be tied to domestic metallurgical and alloy producers.
- This refinery must be partially owned by the DoE.
- This refinery must have DoD price supports.

# Success Requires Political Support

- The development of a domestic Rare Earth Refinery will require the direct support from professionals in fields of:
  - Materials Science
  - Environmental Science
  - Universities and Research Institutions
  - DoD Contractors
  - Commercial Manufacturers of Electronics
  - Skilled Labor and Union Representatives

# How to Help

- Write letters to your Federal Legislators, Scientific, Engineering and Trade Group Representatives and alert them to this issues

Copy these letters to Wings Enterprises, Inc.  
1185 Ross Rd. St. Louis, Missouri 63146 c/o  
James Kennedy, or email them to  
[jkennedy@wingsenterprises.com](mailto:jkennedy@wingsenterprises.com)

Please contact me for additional information.