Rare Earth Markets and Imbedded Demand

DOE/NETL

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Clockwise from top center: praseodymium, cerium, lanthanum, neodymium, samarium, and gadolinium. (Photo by Peggy Greb).
What are Rare Earth Elements (REEs)?

**Average total crustal concentration = 184 ppm**

*Wedepohl, 1995*
Uses for Rare Earth Elements

Average total crustal concentration = 184 ppm
*Wedephol, 1995
• The Annual Global Rare Earth Market was ~$8 billion in 2018
  • The US only consumes around 7% of global demand by weight
  • Almost all rare earths are currently being imported

• The US imported $2.6 trillion worth of finished products in 2018
  • The top 4 product groups account for ~50% of the imported value
    • Machinery including computers: $386.4 billion (14.8% of total imports)
    • Electrical machinery, equipment: $367.1 billion (14%)
    • Vehicles: $306.7 billion (11.7%)
    • Mineral fuels including oil: $241.4 billion (9.2%)
US REE Import Estimates

• US imported ~$160 million worth of rare earth compounds and metals (excluding Yttrium and Scandium) in 2018\textsuperscript{1}
  • The estimated distribution by end use: catalysts, 60%; ceramics and glass, 15%; metallurgical applications and alloys, 10%; polishing, 10%; and other, 5%.
  • The majority of REE’s imported into the US come in the finished goods, and not as a raw material.

\textsuperscript{1}USGS
\textsuperscript{2}Adamas International and Argus Media
Estimated Global REE Production 2017

Global Production
• Total REO Production Estimated at ~180,000 tonne/year

Global Demand
• Total REO Demand Estimated at ~150,000 tonne/year
• US accounts for ~11% of Global Demand
Changing Market?

• Lynas’ LAMP facility in Malaysia facing increased government scrutiny around handling of waste material

• China has become a net importer of REEs associated with permanent magnets
  • May become a net importer for all rare earths by 2030

• Inflection point in China due to changing market forces
  • Miners have “pushed” the market
  • Supply chain beginning to “pull” the market
• Electric Vehicles (EV) – BEVs, PHEVs, & HEVs
  • ~2.2 million EV sold in 2018
    • 93% utilized permanent magnate traction motor\(^1\)
    • ~50% sold in China
  • IEA estimates there could be between 125 and 220 million electric vehicles on the road by 2030

\(^1\) Adamas Intelligence
Market Demand Drivers

Electric Vehicles

Figure ES 1 • Evolution of the global electric car stock, 2013-17

Figure ES 2 • Global EV stock in the New Policies and EV30@30 scenarios, 2017-30

Table 2.5 • OEM announcements related to electric cars

Notes: PLDVs = passenger light duty vehicles; LCVs = light commercial vehicles; BEVs = battery electric vehicles; PHEV = plug-in hybrid electric vehicles.

Source: IEA Global EV Outlook 2018
Wind Power Capacity Worldwide Reaches ~600 GW in 2018
• ~200 GW in China
• ~100 GW in US
• Offshore ~4%
• By 2025, >10%
  • ~100 GW

Source: GWEC, Global Wind Report 2018
Opportunity

• Growing demand for high-tech and green technologies will increase the demand for rare earth elements for foreseeable future
• Changing market drivers could stabilize, and even increase, rare earth market prices for high demand compounds
• Additional uses for more abundant REEs still needed
• REE recovery from coal based feedstock has been proven technically feasible
• Economic feasibility is greatly dependent on market conditions
• Research is occurring to reduce or replace REEs in many finished goods
• Domestic rare earth industry must be coupled with domestic supply chain
• Even with a successful domestic REE industry, China will continue to control the REE market for years to come
Thank you.