Rare-Earth Elements

EERC | UND UNIVERSITY OF NORTH DAKOTA

WHY ARE RARE-EARTH ELEMENTS IMPORTANT?

Rare-earth elements (REEs) are elements with special properties that make them useful in high-technology products, such as smart phones, catalysts, hard drives, hybrid electric vehicle engines, lasers, magnets, medical devices, and televisions.

NEW SOURCES OF REEs ARE NEEDED

Currently, the United States is 100% reliant on imports of REEs. China dominates the global market, with over 80% of REE production in 2017. Major growth market, sectors such as wind turbines, hybrid/electric vehicles, and electronics are dependent on REEs. The lack of domestic resources of REEs could be considered a risk to national security and economic prosperity. Coal and coal by-products have been identified as promising domestic sources of REEs.

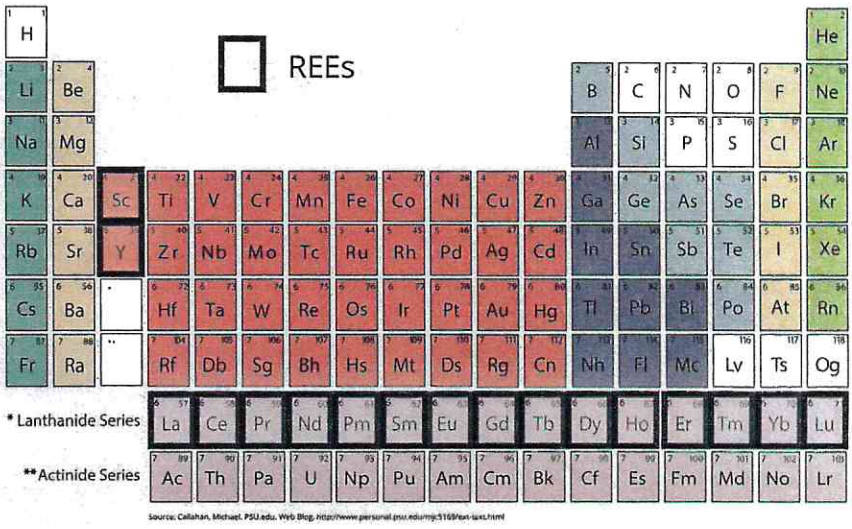
It is estimated that China's high REE resources will be gone by 2025. The most critical REEs are those deemed as having a supply risk and being highly important to U.S. national security and clean energy technologies going forward.

iPhone

Color Screen	Y, La, Pr, Eu, Gd, Tb, Dy
Phone Circuitry	La, Pr, Nd, Eu, Gd
Speakers	Pr, Nd, Gd, Dy
Vibration unit	Nd, Tb, Dy

Hybrid Electric Vehicle

Motor	Nd, Pr, Tb,Dy
Batteries	La, Ce, Pr, Nd
Operating System	Nd, Pr, Tb,Dy



Source: Callahan, Michael. PSU.edu. Web Blog. http://www.personal.psu.edu/mjc5168/ext-sust.html

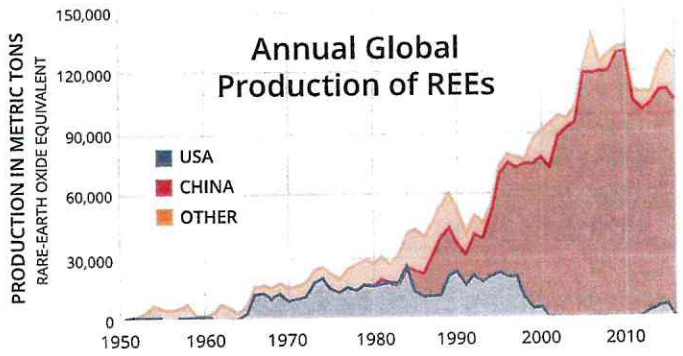
lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium (Ho), erbium (Er), thulium (Tm), ytterbium (Yb), lutetium (Lu) and transition elements scandium (Sc) and yttrium (Y)

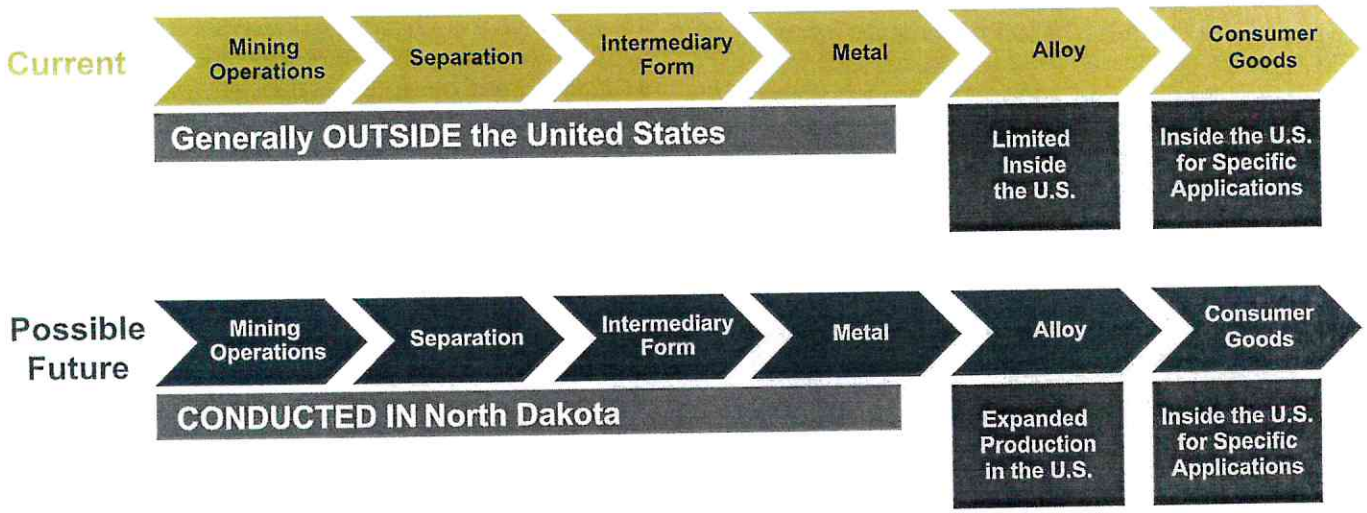
ADVANCING NEW SOURCES OF REEs

The Energy & Environmental Research Center (EERC) is leading several research projects on REEs. We are targeting resources that are associated with the lignite industry in North Dakota for REE recovery. This provides a unique opportunity for leveraging an existing industry that has taken the time and expense to develop the coal mines and utilization infrastructure, reducing the time line to begin an operation for extracting and producing REEs. Value-added usage of low-cost materials associated with the lignite industry also provides unique opportunities to be economically and environmentally responsible.

Despite their name, REEs are not actually rare but are highly distributed. This results in ores where REE content is measured in parts per million (ppm).

Our work has identified coal seams in North Dakota with REE concentrations as high as anything ever measured in coal in the United States. North Dakota is home to the world's largest lignite deposit – 350 billion tons, or enough to provide electricity for the next 800 years. In just one identified coal seam in North Dakota, the potential REE reserves could be 2 million tons. The United States currently uses approximately 16,000 tons of REEs a year.





We are leading the way in REE research and in identifying domestic resources.

For more information on our work with REEs, contact:

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