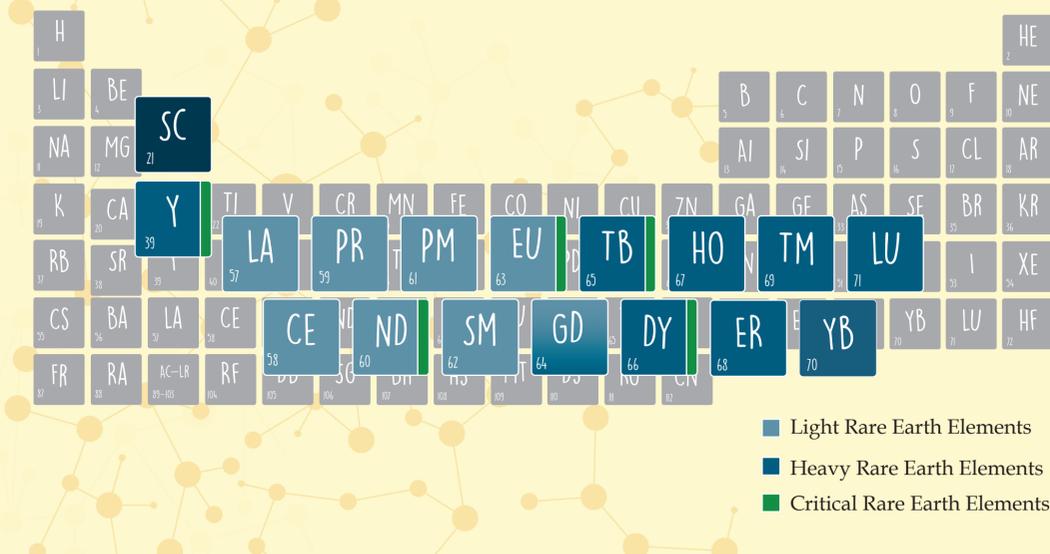


# RARE EARTH ELEMENTS 101

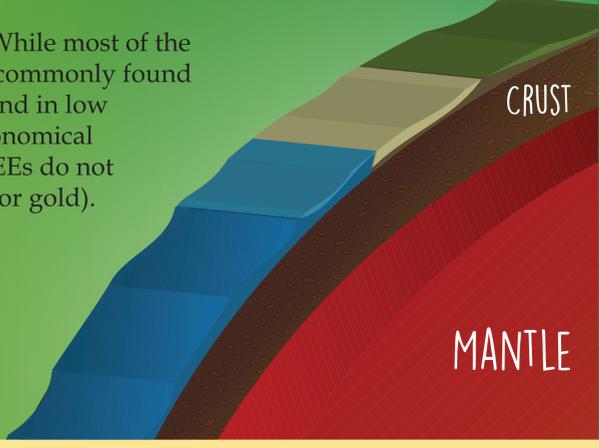
## WHAT ARE RARE EARTH ELEMENTS (REEs)?

REEs are a group of 17 chemical elements that are included in the periodic table of elements. All have similar properties that can be found together in geologic deposits: 8 REEs are from the lanthanide series and 7 are from the actinides series, plus scandium and yttrium.



## ARE REEs ACTUALLY "RARE," AND WHERE ARE THEY FOUND?

Despite their name, REEs are not rare! While most of the elements are relatively bountiful—and commonly found in the Earth's crust—REEs are often found in low concentrations that are too small for economical extraction. This is because, in nature, REEs do not exist as individual entities (e.g., copper or gold). Instead, they are usually found mixed together in other mineral deposits and uncommon geologic rock settings (e.g., carbonatites and alkaline rocks).



## WHAT ARE REEs USED FOR?

REEs are integral to the way we live and to America's economic growth and national security. They have unique magnetic, heat-resistant, and phosphorescent properties unlike any other elements. REEs are used in most modern technologies—principally as catalysts and in magnets—and are essential components for critical defense and homeland security applications, "green" energy technologies, hybrid and electric vehicles, and high-value electronics. For example, the REE neodymium is used to create one of the strongest magnets available, which is a necessary component of hard drives and smartphones.



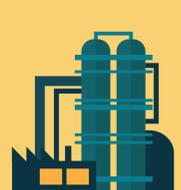
### MAGNETICS

- Computer Hard Drives
- Disk Drive Motors
- Anti-Lock Brakes
- Automotive Parts
- Frictionless Bearings
- Magnetic Refrigeration
- Microwave Power Tubes
- Power Generation
- Microphones & Speakers
- Communication Systems
- MRI



### METAL ALLOYS

- NiMH Batteries
- Fuel Cells
- Steel
- Super Alloys
- Aluminum/Magnesium



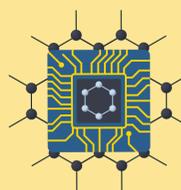
### CATALYSTS

- Petroleum Refining
- Catalytic Converter
- Fuel Additives
- Chemical Processing
- Air Pollution Controls



### GLASS AND POLISHING

- Polishing Compounds
- Pigments & Coatings
- UV Resistant Glass
- Photo Optical Glass
- X-Ray Imaging



### CERAMICS

- Capacitors
- Sensors
- Colorants
- Scintillators
- Refineries



### PHOSPHORS

- Display Phosphors
- CRT, LPD, LCD
- Fluorescents
- Medical Imaging
- Lasers
- Fiber Optics



## WHERE ARE REEs PRODUCED AND SUPPLIED?

Up until the mid-1980s, the United States was the leading global producer of REEs. But, these elements are hard to separate and expensive to extract; that's why the United States now relies heavily on imports. In fact, China holds the lion's share of the market, accounting for more than 90 percent of the global production and supply of REEs during the past decade. Approximately 80 percent of the REEs used domestically in the United States are imported from China.

Because these elements are integral to our everyday lives, the U.S. Department of Energy's Office of Fossil Energy is working to help the Nation produce and supply its own REEs.



## WHAT ARE THE BENEFITS OF DEVELOPING A DOMESTIC REE SUPPLY?

A vast quantity of REEs exist as trace elements within the United States' large supply of coal resources. They offer the potential for an economically competitive domestic supply. Current conventional U.S. REE reserves are estimated at 1.4 million tons. Coal basins across 10 states could produce an additional 11 million tons of REEs. In addition to maintaining national security, economic growth, and competitiveness in the global marketplace, tapping into this potential will:



**Reduce U.S. dependence on foreign sources**



**Create new industries**



**Revitalize the workforce in coal-producing regions**

LEARN MORE about how the U.S. Department of Energy's Office of Fossil Energy is working to develop a sustainable, domestic REE supply through its **Feasibility of Recovering REEs** program.

Visit [fossil.energy.gov](http://fossil.energy.gov)

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