

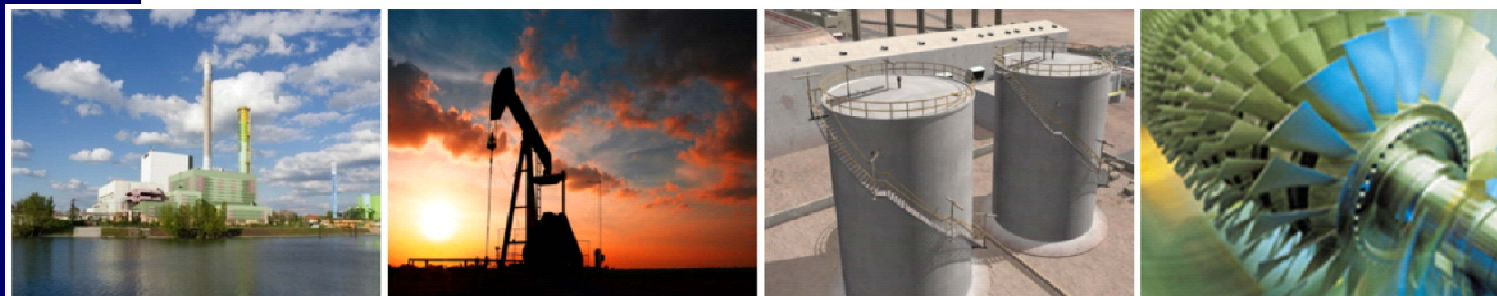


U.S. DEPARTMENT OF
ENERGY

Fossil
Energy

**National Energy
Technology Laboratory**

Fossil
Energy



Rare Earth Elements Program Overview

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Rare Earth Elements Review Meeting

Strategic and Critical Materials Stockpiling Act Amended According to FY 2017 National Defense Authorization Act Conference Report (2 Dec 2016)

§98g. Materials development and research

(a) Development, mining, preparation, treatment, and utilization of ores and other mineral substances

(1) The President shall make scientific, technologic, and economic investigations concerning the development, mining, preparation, treatment, and utilization of ores and other mineral substances that

(A) are found in the United States, or in its territories or possessions,

(B) are essential to the national defense, industrial, and essential civilian needs of the United States, and

(C) are found in known domestic sources in inadequate quantities or grades.

Rare Earth Elements Program

Objective

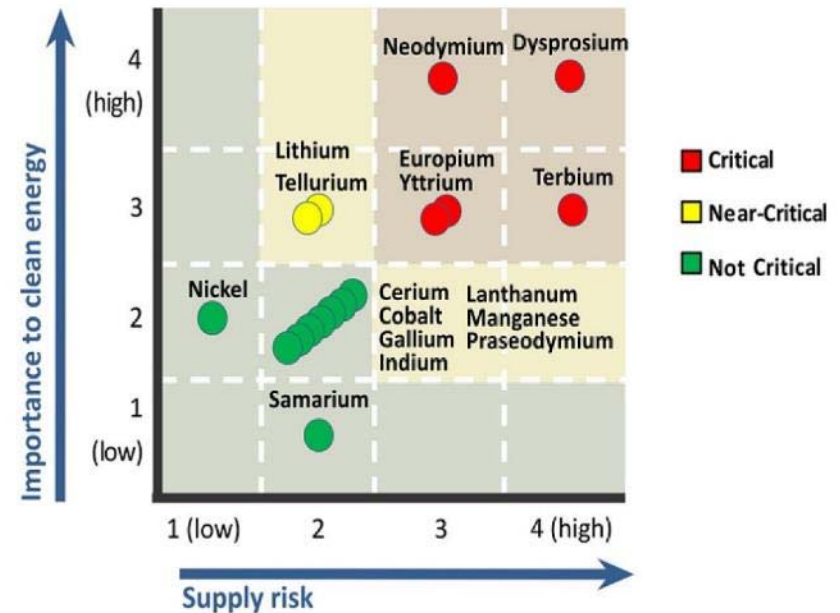
- Support economic production of rare earth elements from coal and coal byproducts from U.S. coal fields

Strategies

- Identify highest rare earth content materials in the U.S. coal value chain
- Develop ore-specific plant designs for these materials
- Project business case for rare earth production from these materials
- Engage U.S. technical resources, including industry and academia

Future Directions

- Expand search via high rare earth assays
- Scope pilot-scale operations

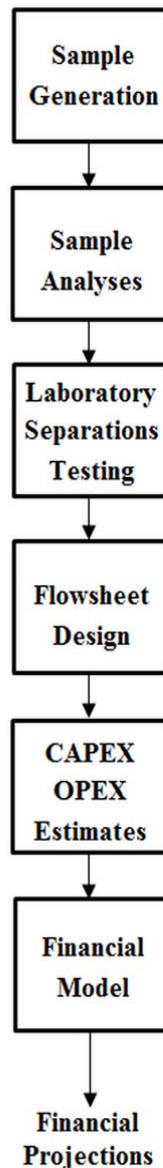


The Challenge: Develop Domestic Rare Earth Production from U.S. Coal and Coal Byproducts

Addressing the Challenge:

- Finding the Highest Assay (Rare Earth Contents) Associated with U.S. Coal Deposits
- Characterizing these Materials for Rare Earth Extraction
- Development of Processing Options
- Financial Modeling- the Processes Must Compete in the Global Rare Earth Market

How We Establish Economic Feasibility of Mineral Extraction



Challenges:

- **Finding the Highest REE Assays Possible**
Associated with Coal Production and Use- based on the discussion presented on the effect of feedstock assay on production cost.
- **Evaluation of the Responses of these Materials to Concentration and Extraction Technologies-** this is required for plant flowsheet design, and involves laboratory characterization and separation work that will be discussed in the next section.
- **REE Production System Design and Financial Model Development-** these are required to establish the economic feasibility of REE production from the materials examined.
- **Technology Development-** in the event that existing technologies cannot produce a competitive product, new separation technologies may be required.

FY 2016 Summary of Sampling and Analysis Efforts

- 400+ new analyses have been done
- More REE-enriched material is being collected and analyzed

EERE/Ames Critical Materials Institute Example Extractive Metallurgy Projects, Especially those in the Mineral Processing Sub-Discipline

- **ORNL: Advanced Beneficiation Techniques**
- **ORNL: Recovery of REEs and Uranium from Phosphate Ore Processing**
- **Simbol: Improved Methods for Lithium Extraction**
- **ORNL: Recovery of Copper Smelter By-Products**
- **INL: Enhanced Separation of Adjacent Rare Earth Elements**
- **Colorado School of Mines: Conversion to Metal, Alloys, and Materials**
- **ORNL: Development of High Cerium Content Aluminum Alloys**
- **ORNL: Membrane Solvent Extraction for Rare Earth Separations**
- **INL: Inexpensive Room Temperature Ionic Liquid (RTIL) for Electrochemical Production of High Purity Rare Earth Metals**
- **INL: Treatment of Mineral Processing Waste Streams and Recovery of Clean Water Using Sorption, Passive, and Active Microfiltration Systems**

Thank You