



of novel recovery concepts that apply to low REE concentration feedstock materials.

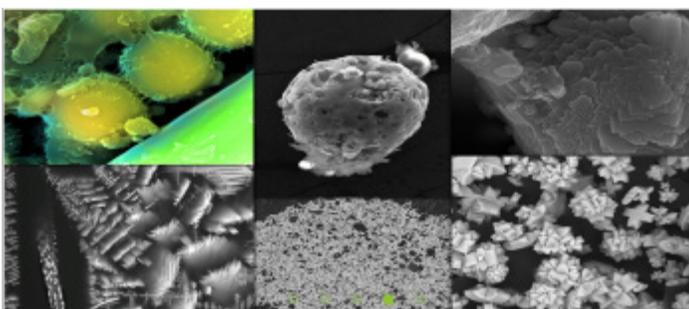
These new processes and systems must incorporate steps to recover, separate, and refine REEs without generating additional unwanted products. These advances may facilitate recovery of REEs from large volumes of fly ash and bottom ash, as well as other low REE-containing materials such as AMD effluents and/or sludges. Moreover, co-production of REEs with other useful materials present in coal-based resources makes REE recovery more economically favorable.

### Program Structure

The REE program portfolio currently consists of both intramural and extramural projects, ranging from concept definition and development—Technology Readiness Level (TRL 1–3), through laboratory and bench-scale testing (TRL 3–5), and additionally, small pilot-scale testing (TRL 4–6). Those steps are necessary to validate the design, construction, and operation of functional prototype coal-based facilities that can produce salable, high-purity REEs.

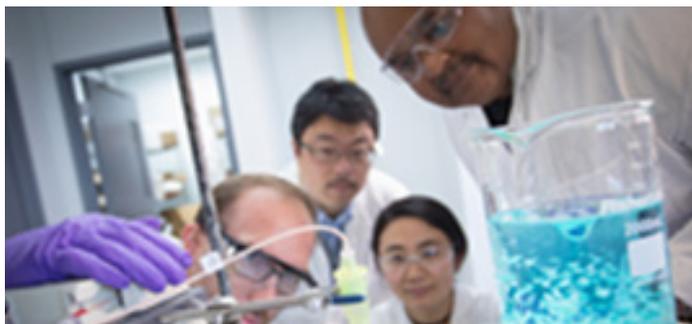
The program’s core technology areas include:

- **Enabling Technologies** – Develop technology knowledge bases through resource identification, field sampling and characterization, techno-economic analysis development, and field and/or process sensor development.



- **Separations Technologies** – Address the viability of utilizing commercially available extraction and separation equipment and/or systems developed for alternate technologies. Demonstrate their capability for the extraction and separation of REEs from coal-based

materials by technology transfer. In parallel, develop new transformational REE extraction and separation concepts.



- **Process Systems** – Design, construct, and operate bench-scale and/or small, pilot-scale systems to validate the capability of producing REEs from coal-based resources.



### Program Summary

- **Prospecting** – Field sampling, characterization, and identification of ‘best’ materials for obtaining REEs and their reserves.
- **Processing** – REE extraction, separation, and recovery projects, as well as demonstration of concept feasibility from bench-scale through pilot-scale integrated process system testing.
- **Production** – Generation of market-ready REEs.

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