

REE Technology Development

Phase 2: REE Recovery Projects



OBJECTIVES

Develop and test technology to determine the techno-economic feasibility of domestic REE separation technologies by 2020

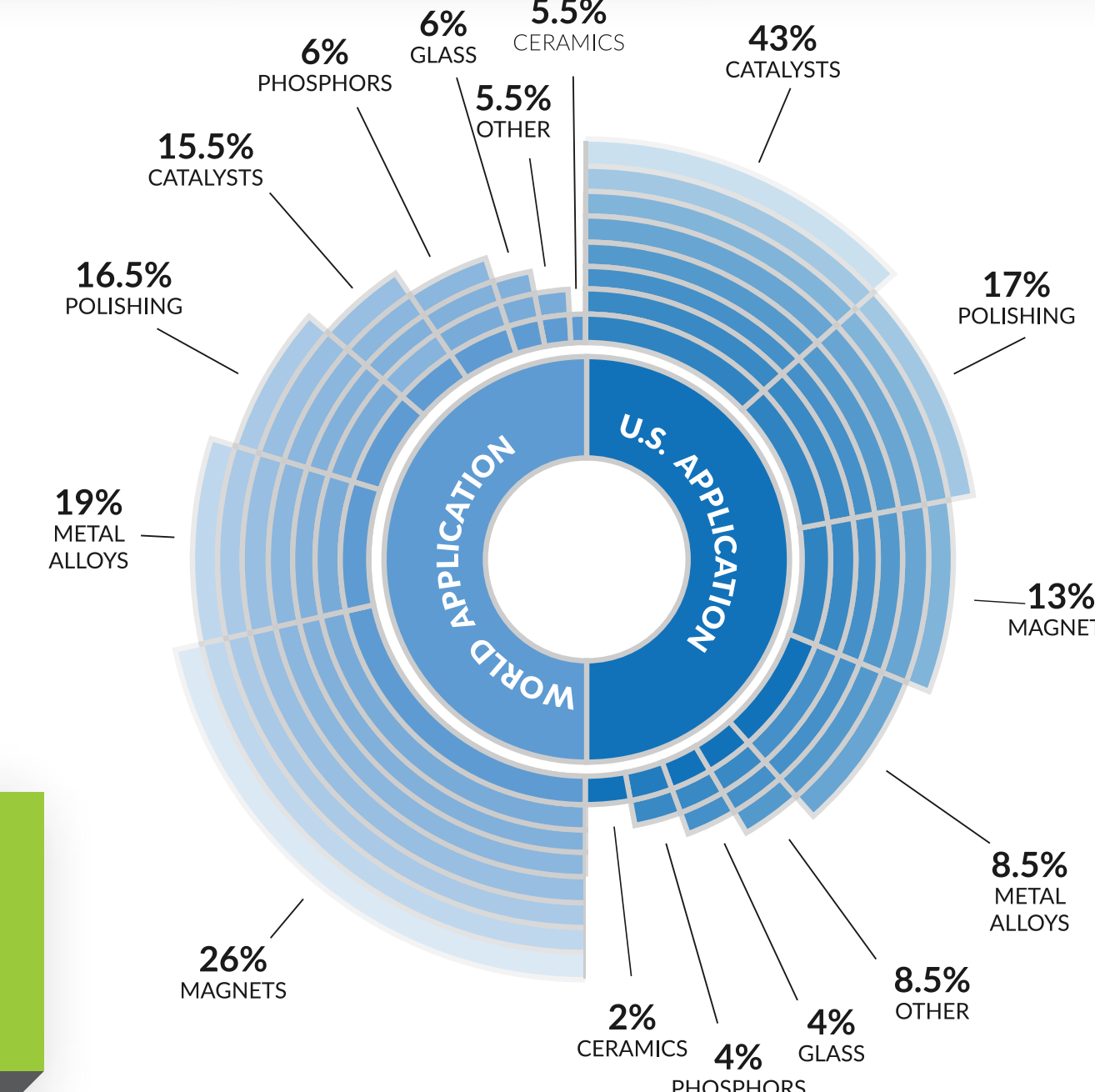
PILOT-SCALE PERFORMERS

Goal: Achieve approximately 2% REE elemental concentration in the output product. Optimize separation and extraction methods and establish cost-competitive processes for recovery of REE through pilot-scale testing.



BENCH-SCALE PERFORMERS

Goal: Achieve approximately 2% REE elemental concentration in the output product. Determine the feasibility of recovering REEs from coal-related feedstocks to enable future scale-up of the technologies to pilot scale.



WORLD APPLICATION

MAGNETS	26%
METAL ALLOYS	19%
POLISHING	16.5%
CATALYSTS	15.5%
GLASS	6%
PHOSPHORS	6%
OTHER	5.5%
CERAMICS	5.5%

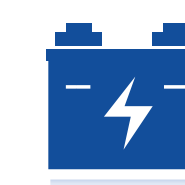
U.S. APPLICATION

CATALYSTS	43%
POLISHING	17%
MAGNETS	13%
METAL ALLOYS	8.5%
OTHER	8.5%
GLASS	4%
PHOSPHORS	4%
CERAMICS	2%



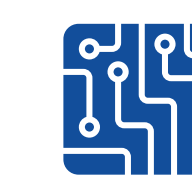
GLASS & POLISHING
Polishing Compounds
Pigments & Coatings
UV Resistant Glass
Photo-Optical Glass
X-Ray Imaging

Nd Gd Er Ho La Ce Pr



METAL ALLOYS
NiMH Batteries
Fuel Cells
Steel
Super Alloys
Aluminum/Magnesium

Nd Y La Ce Pr



CERAMICS
Capacitors
Sensors
Colorants
Scintillators
Refractories

Nd Y Eu Dy Lu Gd La Ce Pr



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

Nd La Ce Pr



PHOSPHORS
Display phosphors-CRT/LD/LCD
Fluorescents
Medical Imaging
Lasers
Fiber Optics

Nd Eu Tb Y Er Gd Ce Pr



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

Nd Tb Dy Pr



DEFENSE
Satellite Communications
Guidance Systems
Aircraft Structures
Fly-by-Wire
Smart Missiles

Nd Eu Tb Dy Y Lu Sm Pr La

ACCOMPLISHMENTS

- These projects have **shown promise in REE recovery and extraction findings**, which is evidenced by their down-selection for further development.
- Achievements in lab experiments to date**, expressed as % REE elemental concentration in the output product at the associated % recovery of REE mass contained in the feedstock:
 - UK: >80% REE concentration at >75% REE recovery
 - PSI: 40% REE concentration at 15% REE recovery
 - UND: 2% REE concentration at 35% REE recovery
 - WVU: 5% REE concentration at > 90% REE recovery
- These efforts **are successfully planning and testing the scale-up of recovery and extraction** activities based on their REE recovery findings.
- The researchers have started **analyzing commercialization feasibility** of their respective approaches.

IMPORTANCE

Advance technologies for commercial U.S. REE recovery

DOMESTIC REE RECOVERY BENEFITS THE UNITED STATES

INCREASE NATIONAL SECURITY: Domestic REEs would lessen or eliminate dependence on foreign REE production.

ECONOMIC GROWTH: Domestic REE recovery would allow the U.S. to export REEs to other countries and developing industries in places where coal has played an important economic role.

INCREASE EFFICIENCY: Utilization of coal byproducts as a feedstock for REE recovery realizes additional benefits and efficiencies to fossil energy generation practices.

PROJECT AWARD TOTALS

DE-FE0027035 UNIVERSITY OF KENTUCKY

79% DOE
\$6,999,797

21% PERFORMER
\$1,820,212

TOTAL: \$8,820,009

DE-FE0027167 PHYSICAL SCIENCES, INC.

80% DOE
\$6,999,165

20% PERFORMER
\$1,751,001

TOTAL: \$8,750,166

DE-FE0026927 WEST VIRGINIA UNIVERSITY

79% DOE
\$3,411,874

21% PERFORMER
\$927,540

TOTAL: \$4,339,414

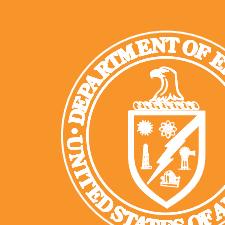
DE-FE0027006 UNIVERSITY OF NORTH DAKOTA

78% DOE
\$3,343,847

22% PERFORMER
\$965,500

TOTAL: \$4,309,347

Technology Manager – Mary Anne Alvin
Team Supervisor – Patricia Rawls



U.S. DEPARTMENT OF
ENERGY

