U.S. Department of Energy
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Carbon Ore, Rare Earth, and Critical Minerals (CORE-CM) Assessment of San Juan River-Raton Coal Basin

5th Quarterly Research Performance Progress Report
Reporting Period: October 1, 2022-December 31, 2022
Project Performance Period: 10/01/2021 – 09/30/2023

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1. ACCOMPLISHMENTS

The objective of this project is to determine the rare earth elements (REE) and critical minerals (CM) resource potential in coal and related stratigraphic units in the San Juan and Raton basins, New Mexico. We will conduct the following tasks: (1) a basinal assessment for CM and REE potential, using state-of-the-art technologies to estimate basin-wide CM and REE resources in coal and related stratigraphic units; (2) identify, sample, and characterize coal waste stream products; (3) conduct bench tests to develop a basinal reuse of waste strategy; (4) illustrate the current status of the feedstock supply of REE and CM to understand the basinal REE industry's capital expenditures and obstacles to expanding REE-related business development; (5) develop a life-cycle analysis to establish pathways, process engineering, and design requirements to upgrade REE processing industry, (6) evaluate technology gaps, (7) establish a Center of Excellence and Training Center (COE) for coal ash beneficiation at San Juan County; and (8) create REE research-based activities that can be shared during the NMBGMR summer geology teacher workshop and assemble REE research-related articles for an REE-centered issue of Lite. This project will delineate favorable geologic terranes and priority areas containing potential REE and CM deposits for the DOE mandate, which is also a priority of the NMBGMR and state of NM.

A. <u>Major goals and objectives</u>
The following are the major goals of this project as described in the approved Statement of Project Objectives (SOPO):
1. Identify and quantify the distribution of critical minerals (CM), including rare earth elements (REE), in coal beds and related stratigraphic units in the San Juan and Raton basins in New Mexico (including coal, coal refuse, ash, coal seam, interstitial clays/shales, volcanic ash beds, acid mine drainage, associated sludge samples, mine dumps, other nonfuel carbon-based products, process waters, etc.).
2. Identify possible sources of CM and REE in the basins.
3. Identify the coal mine and nonfuel carbon-based waste products that could contain CM and REE.
4. Characterize the CM and REE in these materials.
5. Determine the economic viability of extracting CM and REE from these materials
6. Test and develop new technologies in identifying and quantifying CM and REE in high-fidelity geologic models.

   Table 1 describes the tasks and subtasks that will be undertaken to accomplish these goals and Table 2 provides a listing of the revised project milestones, along with anticipated delivery dates.

TABLE 1. List of tasks and subtasks

Task 1.0 Project Management and Planning

Task 2.0 Basinal Assessment of CM and REE in the San Juan and Raton Basins
    Subtask 2.1 Identification of Sampling Sites
    Subtask 2.2 Collection and Review of Existing Data
    Subtask 2.3 Develop a Sampling Plan
    Subtask 2.4 Collect Samples
    Subtask 2.5 Sample Characterization
        Subtask 2.5.1 Bulk Rock Characterization
        Subtask 2.5.2 Micro-scale Characterization
        Subtask 2.5.3 3D Multiscale Petrography
        Subtask 2.5.4 In situ LIBS/RAMAN Analyses
    Subtask 2.6 Application of Machine Learning techniques for basin-wide resource assessment

Task 3.0 Basinal Strategies for Reuse of Waste Streams
    Subtask 3.1 Waste Streams Sampling and Characterization
    Subtask 3.2 Coal Ash
    Subtask 3.3 Technology Development of Basinal Reuse Strategy

Task 4.0 Basinal Strategies for Infrastructure, Industries and Businesses
    Subtask 4.1 Infrastructure Investigation
    Subtask 4.2 Competitiveness and Challenge
    Subtask 4.3 Life-Cycle Analysis

Task 5.0 Technology Assessment, Development and Field Testing
    Subtask 5.1 Identify and Assess Existing and Novel Technologies Specific to the Resource
    Subtask 5.2 Develop Plan for Field Testing

Task 6.0 Technology Innovation Centers   Subtask 6.1 SonoAsh Center of Excellence

Task 7.0 Stakeholder Outreach and Education
    Subtask 7.1 New Mexico State and Regional Education
    Subtask 7.2 Lessons Learned and Narratives Constructed
    Subtask 7.3 Publications
    Subtask 7.4 Training and Conferencing with SJC and Sonoash COE

TABLE 2. Revised List of Milestones **(bold=completed)**

Task/ Subtask	Milestone Title	Planned Completion	Verification method	Status
	Quarterly reports	Quarterly	Report every quarter	**1-5th quarters completed** (see https://geoinfo.nmt.edu/staff/mclemore/REEinCoalWeb.html)
	Year I interim report	Year 1	Submitted this report	**completed**
	Meeting with DOE manager	12/7/22	attend	**Presentation given**
1.0	**A: Project Kick-off meeting**	**10/15/21**	**Attend, report**	**Completed** (see https://geoinfo.nmt.edu/staff/mclem

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				ore/documents/CORE-CMprojectNMfinal.pdf)
2.1	B: Identification of Sampling Sites	Quarterly	Reports every quarter (quarterly reports), environmental questionnaire	**Ongoing**, planned in 2 phases Phase 1 (https://geoinfo.nmt.edu/staff/mclemore/SampleLocations1_23.xlsx), environmental questionnaire completed and revision submitted
2.2	C: Collection and Review of Existing Data	2nd quarter	Map, description	**Report completed** (https://geoinfo.nmt.edu/staff/mclemore/documents/legacychemistryrpt23.pdf), ongoing activity, **REE in produced waters** (https://geoinfo.nmt.edu/staff/mclemore/ree_produced_waters_for_GIS.xlsx) and **USGS coal chemistry** (https://geoinfo.nmt.edu/staff/mclemore/REEcoal.mpk) are on the project web site; summary of data and preliminary interpretations https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreGSA22Wed10-12-22.pdf
2.3	D: **Sampling Plan** Database	10/31/2021, progress report 2nd quarter. 3/31/2022	**Sampling plan** Database, web forms, reports.	**Sampling plan is completed** (https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v3.pdf). Database and data entry web pages are available and being updated.
2.4	E: Collect Samples	Quarterly	Report, database	Started sampling in April 2022 (see Table 3)
2.5	F: Characterization	Quarterly	Progress report quarterly, database	**Ongoing** once samples are collected, **samples submitted to laboratories for chemical analyses, chemical analyses received (see Attachment 3)** Chemical analyses at https://geoinfo.nmt.edu/staff/mclemore/NMTcoalChem_000.xlsx
2.6	G: Application of Machine Learning techniques for Basin-wide Assessment	12/31/2022	Progress report quarterly, database	**Future activity**, due in March 2023 (revised)
3.0	H: Sampling and Characterization of Waste Streams	Quarterly	Progress report quarterly, database	**Ongoing**, see 2.5, future activity
4.0	I: Results of Basinal Infrastructure, Industries and	03/31/2023	Progress report quarterly, database, publications	Future activity; 4.3 **Life cycle analysis completed (see below)**

	Business Assessment			

Accomplishments during 5th quarter

Task 1.0 Project Management and Planning

Project management activities during this quarter included the implementation of regular procedures including regular management and biweekly working group meetings. The team also has regular meetings of the New Mexico Bureau of Geology and Mineral Resources (NMBGMR) database group to develop the project database. PIs McLemore and Mojtabai attended the DOE workshops in Pittsburg in October.

Task 2.0 Basinal Assessment of CM and REE in the San Juan and Raton Basins
Status:

Subtask 2.1 Identification of Sampling Sites (COMPLETED)

Sample sites include the coal fields and mines in the San Juan and Raton basins, shown in Figure 1. Samples from each coal field (Table 3) will be collected. Sampling began in April 2022.

2. Potential sample sites listed
   https://geoinfo.nmt.edu/staff/mclemore/SampleLocations1_23.xlsx.

Subtask 2.2 Collection and Review of Existing Data (COMPLETED)

Legacy chemistry data have been collected. See preliminary results in Geological Society of America presentation by McLemore (https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreGSA22Wed10-12-22.pdf), DOE workshop presentation (https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreDOE22Tues10-25-22.pdf), group presentation on geochemistry (11/15.22), and report (https://geoinfo.nmt.edu/staff/mclemore/documents/legacychemistryrpt23.pdf).

Subtask 2.3 Develop a Sampling Plan (COMPLETED)

The field sampling plan is completed and revised (https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v5.pdf). Figure 1 shows the coal fields and mines in the area. Table 3 is a list of the coal fields.
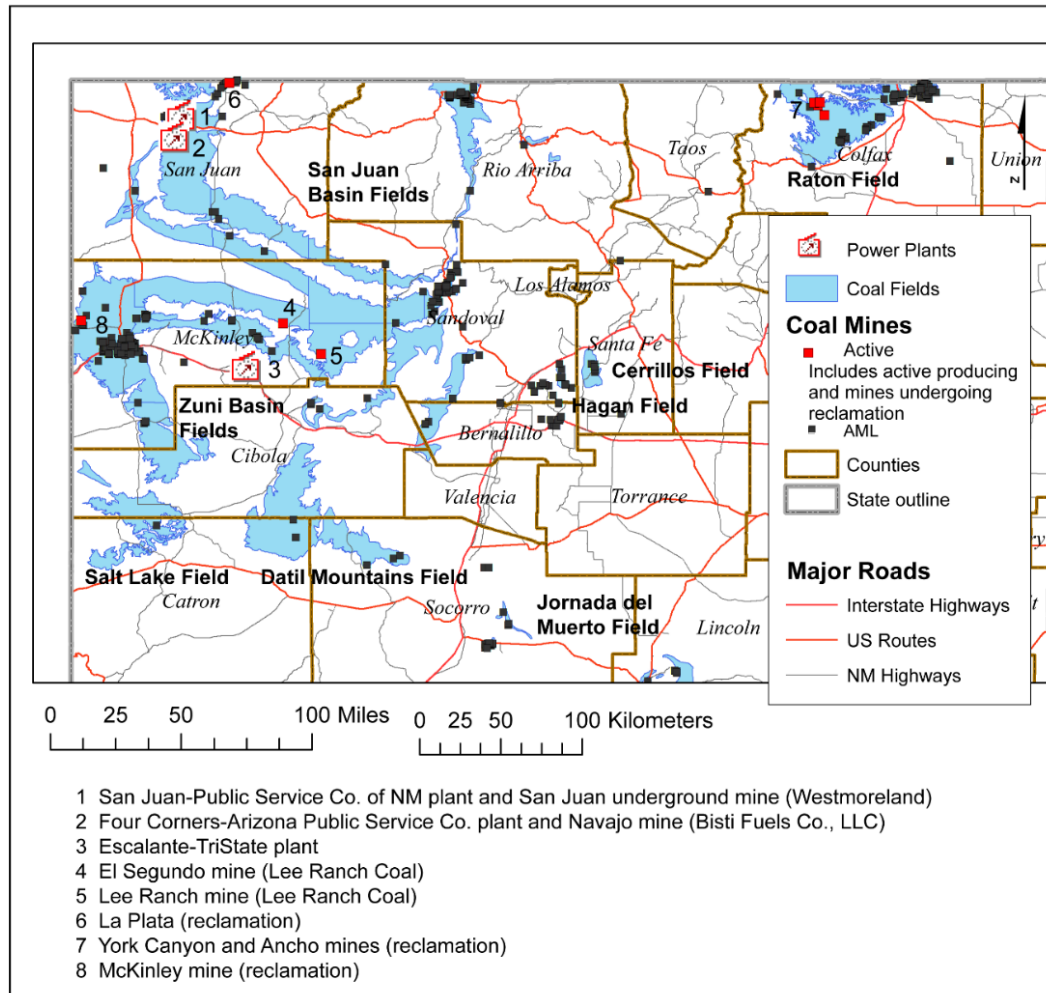
FIGURE 1. Coal fields, active mines, AML (abandoned mine lands) sites, and power plants in the San Juan and Raton Basins.

TABLE 3. Coal fields in the San Juan and Raton basins, studied in this project, delineated by Hoffman (1996, 2017). District Id is from the New Mexico Mines Database (McLemore, 2010a, 2017). Representative samples will be collected from each coal field. Each drill core sample will be identified by the hole number and depth. At least 3 samples will be collected from each coal field. Approximately 130 samples will be collected. Red=no analyses at this time

District id	District (coal field)	Year of Initial Production	Year of Last Production	Estimated Cumulative Production	Formation	Number of samples analyzed	Number of coal analyzed	Number of samples analyzed from legacy data	Number of samples to be analyzed
DIS257	Barker Creek		1905		Menefee				
DIS150	Bisti	1980	1988	40,075,148	Fruitland	6	3		11

District id	District (coal field)	Year of Initial Production	Year of Last Production	Estimated Cumulative Production	Formation	Number of samples analyzed	Number of coal analyzed	Number of samples analyzed from legacy data	Number of samples to be analyzed
DIS208	Carthage	1861	1963		Crevasse Canyon, Tres Hermanos				
DIS259	Chaco Canyon	1905			Menefee				
DIS260	Chacra Mesa		1945		Menefee	3	2		
DIS118	Crownpoint	1914	1951	20,758	Crevasse Canyon				4
DIS262	Datil	1917	1940	66,980	Crevasse Canyon, Tres Hermanos				
DIS155	Fruitland	1889	2001	3,137,957,050	Fruitland	1	1	63	4
DIS119	Gallup	1882	2001	121,522,629,885	Crevasse Canyon				13
DIS156	Hogback	1907	1971	301,237	Menefee				
DIS264	Jornada del Muerto		1927		Crevasse Canyon				
DIS174	La Ventana	1904	1983		Menefee	4	4		
DIS146	Monero	1882	1970	5,277,552	Menefee	7	7		
DIS016	Mount Taylor	1952	1953	69,948	Crevasse Canyon	6	5		1
DIS157	Navajo	1963	9999	4,714,689,147	Fruitland	8	8	1	
DIS258	Newcomb				Menefee				
DIS021	Raton	1898	2002	954,470,032	Vermejo, Raton	22	10	40	10
DIS003	Rio Puerco	1937	1944	139,555	Crevasse Canyon				
DIS009	Salt Lake	1987	1987	100,000	Moreno Hill	7	3	13	1
DIS121	San Mateo	1983	2001	954,470,032	Menefee	1	1	170	
DIS261	Standing Rock	1952	1958		Menefee				3
DIS158	Star Lake				Fruitland	27	17		4
DIS263	Tierra Amarilla	1955	1955		Menefee				
DIS159	Toadlena				Menefee				
DIS124	Zuni	1908	1926	16,010	Crevasse Canyon, Tres Hermanos			3	2
	coal ash					2		2	
	beach placer sandstone					2		103	
	uranium sandstone							22	
	Other samples					6		1	
	total samples					102	61	418	53

Health and safety plan (COMPLETED)
HASP is complete (https://geoinfo.nmt.edu/staff/mclemore/documents/HASP_v2.pdf).

Subtask 2.4 Collect Samples
Sampling was delayed due to poor weather, vacation schedules, closures of Federal land because of fire danger, and students not available because of school schedule. We started sampling in April.
We have logged 3162 ft of core (33 holes). We have collected 155 samples (Table 3; Attachment 3, https://geoinfo.nmt.edu/staff/mclemore/Attachment3-NETLREE-SEDSampleDataNM.xlsx).
Additional samples will be collected.
Photographs of drill core are at https://photoarchive.nmt.edu/ (you need to search by coal and sample)

Subtask 2.5 Sample Characterization
Attended the DOE CORE-CM Characterization Working Group - Planning Meetings on April 11, 19, May 9, June 13, 2022 and October 24, 2022
Chemical analyses have been delayed due to obtaining quotes and proper paperwork required by NM Tech (completed August 2022)
Samples have been analyzed for major and trace elements (see Attachment 3, https://geoinfo.nmt.edu/staff/mclemore/NMTcoalChem_000.xls

Subtask 2.6 Application of Machine Learning techniques for basin-wide resource assessment
There is no update on this subtask.

Task 3.0 Basinal Strategies for Reuse of Waste Streams
Subtask 3.1 Waste Streams Sampling and Characterization
There is no update on this subtask.

Subtask 3.2 Coal Ash
We have collected 2 coal ash samples from San Juan Generating Plant prior to closure.

Subtask 3.3 Technology Development of Basinal Reuse Strategy
There is no update on this subtask.

Task 4.0 Basinal Strategies for Infrastructure, Industries and Businesses
Subtask 4.1 Infrastructure Investigation
There is no update on this subtask.

Subtask 4.2 Competitiveness and Challenge
There is no update on this subtask.

Subtask 4.3 Life-Cycle Analysis (UPDATED AND COMPLETED)
The project team is utilizing the cradle-to-grave concept, which would be adopted to set the boundary of energy and material flows for all the processes involved in the REE industry. Life-cycle analysis including energy and material analysis, environmental impact assessment,

scalability assessment and detailed economic analysis shall be conducted to the current REE and CM supply chain and investigate the potential upgrading of the REE and CM process industry, in order to establish pathways toward net neutral carbon emission and the process engineering and design requirements to accomplish this. Typical REE production route is describe in Figure 2:
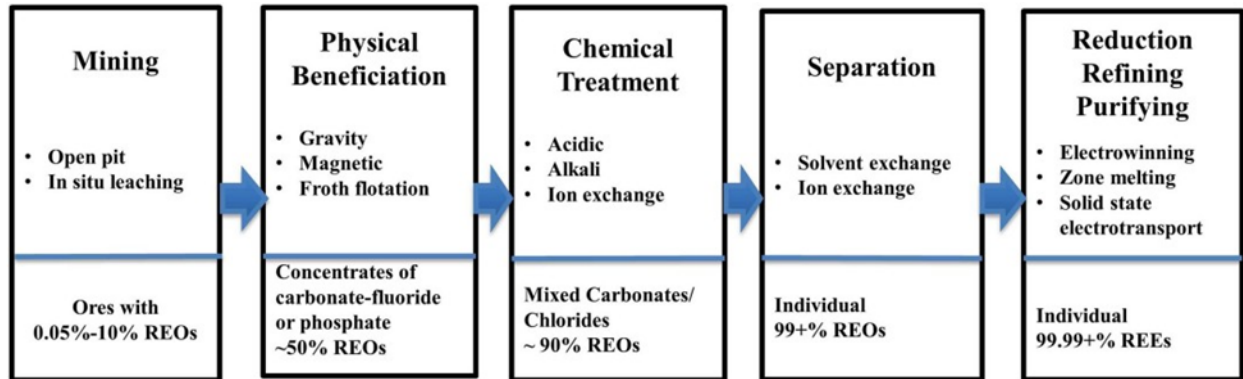
Figure 2. Generalize REE production flow chart

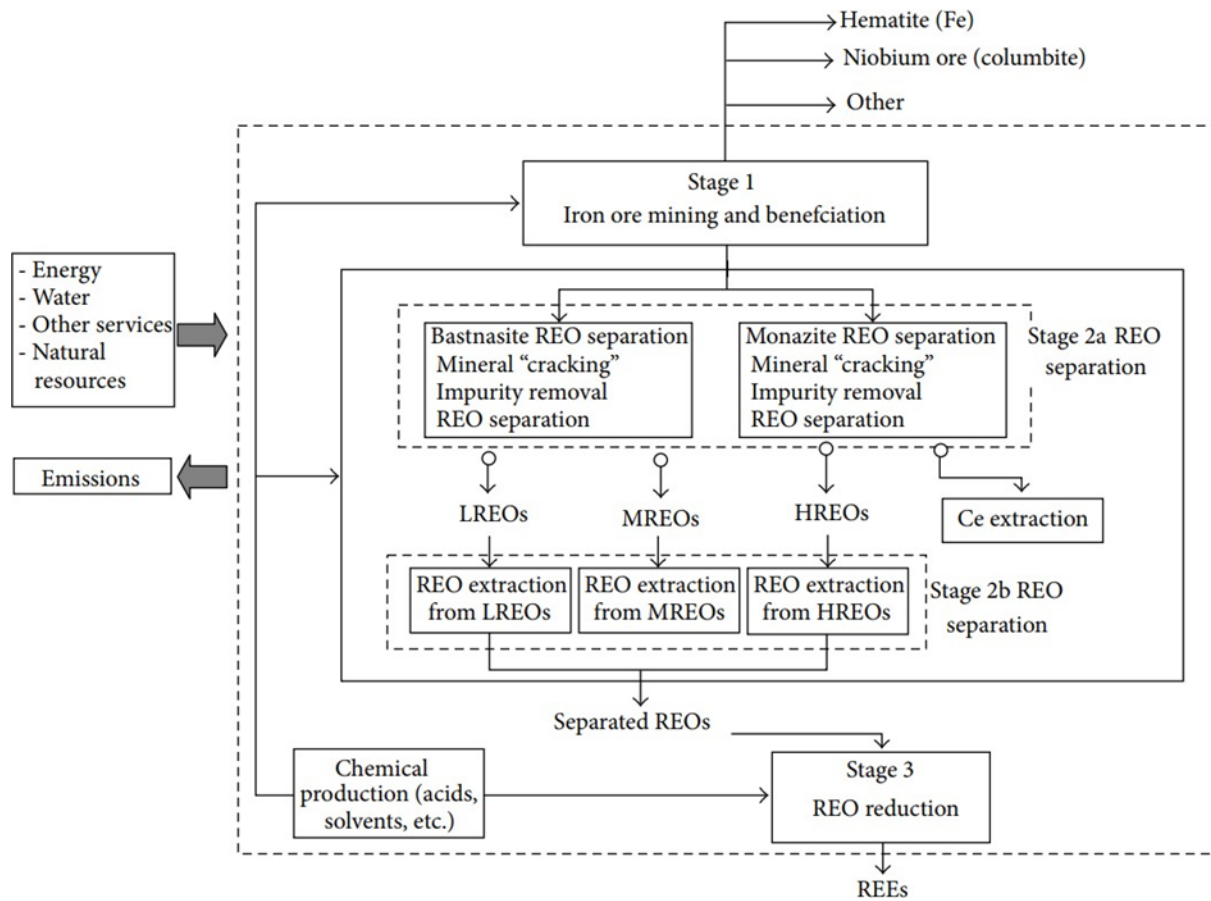Proposed boundary for this task would be simplified as Figure 3.

Figure 3. Simplified boundary. (To be modified with details of each unit processes for LCI)

Real Earth Element (REE)/Critical Mineral (CM) Extraction Technique

The focus extraction technology is the utilization of supercritical CO_2 Chelator fluids to mine these minerals (Sandia National Laboratories). In this approach, the solvent dissolves CM and extracted selectively. Also the solvent enhances solution mining by being used to fracture ores (Mark J. et al). A detail assessment of the processes involved in this technique with respect to its green or carbon neutral importance in comparison to current techniques ought to be conducted.

Overview of Life Cycle Assessment (LCA)

Calculating and evaluating all inputs and outputs of environmental stressors and products' potential impact on the environment, from raw material extraction and acquisition, manufacturing, transportation and distribution, use and maintenance, reuse and recycle, and all the way to disposal and waste management describes LCA. This study follows the ISO 14000 and frame work (Fig. 4).
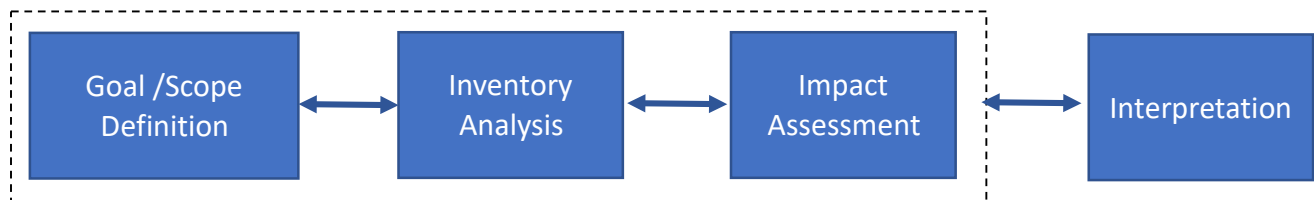

Figure 4. Life Cycle Assessment framework

Goal and scope

Life-Cycle Analysis: Life-cycle analysis including energy and material analysis, environmental impact assessment, scalability assessment and detailed economic analysis shall be conducted to the current REE and CM supply chain and investigate the potential upgrading of the REE and CM process industry, in order to establish pathways toward net neutral carbon emission and the process engineering and design requirements to accomplish this.

Lifecycle Inventory Analysis (LCI)

The LCI is a critical component as it is the data foundation of the LCA study. The approach adopted by ISO 14044 is to compile the inventory based on the inputs and outputs from each of the processes (referred to as unit processes) involved in a product's life cycle.

Figure 5, presents the key processes involved and hence a summary of the project boundary. Inventory of key units to be collected are based on this boundary.
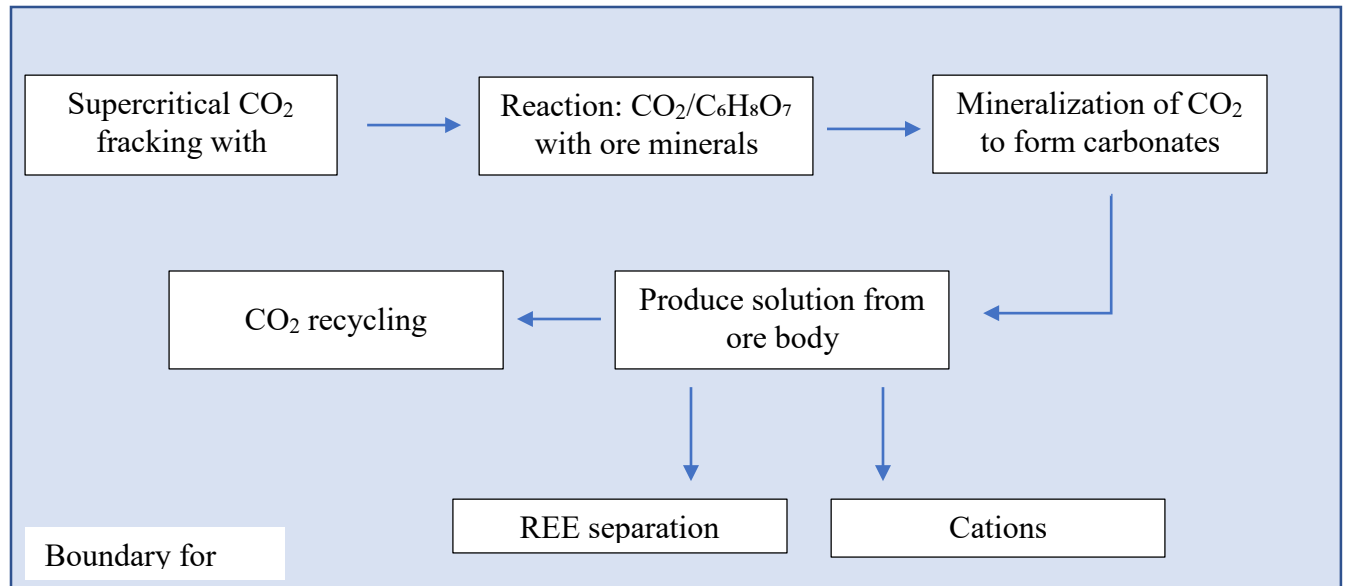
Figure 5. Summary of Key process steps involved/Boundary for LCA

Life Cycle Impact assessment (LCIA)
The LCIA step of an LCA study is used to evaluate the significance of potential environmental impacts using inventory data, and providing information for the interpretation step. This study will focus on evaluating the impact of global warming through a midpoint assessment of measuring global warming potential. Hence the relative potency of different greenhouse gases such as CO_2, N_2O and methane and the results in $kgCO_2$ equivalent (Equations 1 and 2) and other environmental impacts.

$$Impact = \sum_{p \epsilon P} CF_{ip} . MassEmittedp$$ Equ. 1

$$GWP[kgCO_{2eq}] = \sum_{p \epsilon P} GWP_p \left[\frac{kgCO_{2e}}{kg\ p}\right] . MassEmittedp\ [kg\ p]$$ Equ. 2

Interpretation of Results
The last step in an LCA study is the interpretation of results. The findings from the LCI and LCIA are considered together. The results will be discussed and summarized in the form of conclusions and recommendations, and presented to decision makers. And this will be in line with the goals of the analysis.

Other Environmental Impacts
TRACI Global Warming Air, Acidification Air, Eutrophication Water, Smog Air, all Ecotoxicity categories, and all Human Health categories. m3 water consumed/ton ore produced. Extractability of toxins per EPA Method 1311.

Selected References
    Mark J. Rigali, Yifeng Wang, Yongliang Xiong, Green Mining of Critical Metals Using
        Supercritical CO2-H2O-Chelator Fluids Sandia National Laboratories (Albuquerque,
        NM); Guangping Xu

N. A. Azzolina, J. A. Hamling, W. D. Peck, C. D. Gorecki, D. V Nakles, and L. S. Melzer, "A Life Cycle Analysis of Incremental Oil Produced via CO2 EOR," *Energy Procedia*, vol. 114, pp. 6588–6596, 2017.

ISO 14041: Environmental Management - Life Cycle Assessment - Goal and Scope Definition and Inventory Analysis. 199

Navarro J and Zhao F (2014) Life-cycle assessment of the production of rare-earth elements for energy applications: a review. Front. Energy Res. 2:45. doi: 10.3389/fenrg.2014.00045

Task 5.0 Technology Assessment, Development and Field Testing
Subtask 5.1 Identify and Assess Existing and Novel Technologies Specific to the Resource
There is no update on this subtask.

Subtask 5.2 Develop Plan for Field Testing
There is no update on this subtask.

Task 6.0 Technology Innovation Centers
Subtask 6.1 SonoAsh Center of Excellence
Memo written describing meetings with parties to establish COE..

Task 7.0 Stakeholder Outreach and Education
Subtask 7.1 New Mexico State and Regional Education
A short summary of the project was written for Gold Pan (https://nmt.edu/advancement/goldpan_archives/2022_Summer_GoldPan_Digital2.pdf), NMIMT Alumni Newsletter.
Another short summary of the project written for Lite Geology.
The NMBGMR Rockin' Around New Mexico was in Farmington, NM July 6-8, 2022 (https://geoinfo.nmt.edu/education/rockin/home.html). Lectures on critical minerals and a tour of the Navajo coal mine were included (https://geoinfo.nmt.edu/staff/mclemore/home.html) .
Attended CORE-CM Environmental Justice and Social Responsibility Working Group meeting July 12, 2022
Presented short radio spot on critical minerals during Earth Science Week

Subtask 7.2 Lessons Learned and Narratives Constructed
There is no update on this subtask.

Subtask 7.3 Publications and presentations
See Section 2 below

Subtask 7.4 Training and Conferencing with SJC and Sonoash COE
There is no update on this subtask.

2. PRODUCTS
A. Publications, conference papers, and presentations
1st quarter

Kickoff presentation October 15, 2021
    (https://geoinfo.nmt.edu/staff/mclemore/documents/CORE-CMprojectNMfinal.pdf)
DOE Division of Critical Minerals Program Plan Rollout on December 8, 2021
    (https://geoinfo.nmt.edu/staff/mclemore/documents/CORE-
    CMprojectNMDOEsummary12_21.pdf)

2nd quarter
New Mexico Geological Society abstract: Badonie, M.N. and McLemore, V.T., 2022, REE in
    coalbeds in the San Juan-Raton coal basins (abstr.): New Mexico Geological Society,
    Spring Meeting, https://nmgs.nmt.edu/meeting/abstracts/view.cfm?aid=2838. Poster at
    https://geoinfo.nmt.edu/staff/mclemore/documents/NMSG.Poster2022COPY2.pdf.

3rd quarter
Rockin' 22 Critical Minerals presentation
    (https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreRockinCM22.pdf)
Rockin' 22 Critical Minerals activities
    (https://geoinfo.nmt.edu/staff/mclemore/documents/Rockin22.pdf)

4th quarter
New Mexico Mining Association abstract and presentation: REE in the coal and associated strata
    in the San Juan and Raton Basins, New Mexico, 2022, Megan Badonie, Jakob
    Newcomer, Devlon Shaver Advised by: Dr. Virginia T. McLemore,
    https://geoinfo.nmt.edu/staff/mclemore/documents/NMAAPresentationNMMAFINAL20
    22.pdf
McLemore, V.T., 2022, Rare Earth Elements (REE) in Late Cretaceous coal and beach-placer
    sandstone deposits in the San Juan Basin, New Mexico: Preliminary Observations
    (abstr.): Geological Society of America, Annual Conference, October,
    https://gsa.confex.com/gsa/2022AM/meetingapp.cgi/Paper/378264, presentation
    https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreGSA22Wed10-12-22.pdf

5th quarter
McLemore, V.T., 2022, Rare earth elements (REE) in Late Cretaceous coal and beach-placer
    sandstone deposits in the San Juan Basin, New Mexico: Preliminary results: presentation
    at the DOE National Energy Technology Laboratory Resource Sustainability Project
    Review Meeting, Oct. 25-27, 2022
    https://geoinfo.nmt.edu/staff/mclemore/documents/McLemoreDOE22Tues10-25-22.pdf

B. Website(s) or other Internet site(s)
See project web page at https://geoinfo.nmt.edu/staff/mclemore/REEinCoalWeb.html

C. Technologies or techniques
No update

D. Inventions, patent applications, and/or licenses
No update

E. Other products

1st quarter
Sampling plan
Health and safety plan (https://geoinfo.nmt.edu/staff/mclemore/documents/HASP_v2.pdf)
SOP17 Drillhole logging
      https://geoinfo.nmt.edu/staff/mclemore/documents/SOP17DrillholeLoggingupdated.pdf

3rd quarter
Revised sampling plan
      (https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v5.pdf)
REE in produced waters
      (https://geoinfo.nmt.edu/staff/mclemore/ree_produced_waters_for_GIS.xlsx) and USGS
      coal chemistry (https://geoinfo.nmt.edu/staff/mclemore/REEcoal.mpk)
McLemore attended Mining and Metallurgical Society of America AML summit in Phoenix
      April 6-7, 2022
Rockin' was held in Farmington July 5-8, 2022

3. PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS
A. Individuals involved in project
New Mexico Tech
Dr. Navid Mojtabai (PI) is a professor and department chair in the Mineral Engineering Department at New Mexico Tech - Tasks 1, 3, 5, and 7.
Dr. Virginia McLemore (Co-PI) is the Principal Senior Economic Geologist for the NMBGMR - Tasks 1, 2, 3, 5 and 7.
Dr. Robert Balch (PM) is the Project manager for this project and is the Director of the PRRC – Task 1, 2, 4 and 7.
Dr. William Ampomah (Co-PI) is a Research Engineer and Section Head at PRRC – Task 1, 4, 5 and 7.
Dr. Sai Wang is a Research Associate at PRRC - Tasks 4.
Dr. William Chavez is a professor in the Mineral Engineering department at New Mexico Tech – Task 2 and 3.
Mr. Mark Leo-Russell is the NMBGMR database specialist - Task 2 and 3.
Mr. Mark Mansell: is the NMBGMR GIS specialist - Task 2.
Ms. Cynthia Connolly is the Education Outreach Manager at the NMBGMR – Task 7.
Dr. Shari Kelley is a senior field geologist and geophysicist at the NMBGMR – Task 2 and 7.
Mr. Christopher Armijo is the NMBGMR computer specialist - Task 1 and 2.
Mr. Brian Wheeler is the NMBGMR fleet manager - Tasks 2 and 3.
Ms. Gretchen Hoffman is the NMBGMR emeritus coal geologist - Task 2 and 3.
Mr. Evan Owen is Economic Geologist at NMBGMR- Task 2 and 3.

Sandia National Laboratories(SANL)
Dr. Jason Heath is a hydrogeologist at SANL. –Task 2 and 5.
Dr. Guangpring Xu is an experimental geochemist at SANL - Tasks 2, 3 and 5.
Dr. Mark J Rigali

San Juan College
Dr. John Burris: is a Professor of Geology and Department Chair at San Juan College - Tasks 7.
Summer Begay
Craig J. Williams

Los Alamos National Laboratory (LANL)
Dr. Kirsten Sauer is a Scientist at LANL - Task 5.
Dr. Hakim Boukhalfa is a Senior Scientist at LANL – Task 5
Dr. Sam Clegg is Senior Scientist st LANL – Task 2
Dr. Brent Goehring

SonoAsh
Mr. Claudio Arato is the CTO of SonoAsh company - Task 3, 4, 5, 6 and 7.
Mr. Brad MacKenzie is the VP of SonoAsh company – Task 4 and 6
Bruce Sifton

B. Change in support levels of key persons
Dr. Rajesh Pawar had shifted his responsibilities on this project to Dr. Kirsten Sauer.
Craig Williams and Summer Begay are now representing San Juan College.
Evan Owen added to project at NMBGMR to assist with Tasks

4. SPECIAL REPORTING REQUIREMENTS: Mandatory
No update

5. BUDGETARY INFORMATION: MANDATORY

Spend Plan by Fiscal Year Format						
	FY 2022		FY 2023		Total	
	DOE funds	Cost Share	DOE funds	Cost Share	DOE	Cost Share
NMIMT	564,432	101,114	544,856	104,147	1,109,287	205,261
Los Alamos National Laboratory	93,750	-	93,750	-	187,500	-
Sandia National Laboratories	99,946	-	87,054	-	187,000	-
SonoAsh LLC	-	115,000	-	115,000	-	230,000
Total ($)	758,128	216,114	725,660	219,147	1,483,787	435,261
Total Cost Share %		22.2%		23.2%		22.7%

Table for Actual Incurred Costs

Table for Remaining Balance

6. REFERENCES

7. APPENDICES

APPENDIX 1. List of SOPs and plans
(see https://geoinfo.nmt.edu/staff/mclemore/REEinCoalWeb.html for copies as they are completed)

Number	Name	Description
HASP	Health and Safety Plan (HASP)	Health and safety plan for field and laboratory work (https://geoinfo.nmt.edu/staff/mclemore/documents/HASP_v2.pdf)
FSP	Field Sampling Plan (FSP)	Field sampling plan (https://geoinfo.nmt.edu/staff/mclemore/documents/samplingplan_v3.pdf)
SOP 1	Data management	entering, reporting, verification, and validation of data to the database
SOP 2	Photography	procedures taking photographs in the field and laboratory
SOP 3	GPS surveying	Procedures for use of handheld GPS surveying
SOP 4	Sampling outcrops, rock piles, and drill core	field procedures for taking surface solid samples
SOP 17	Drillhole logging	procedures for drilling, logging, and sampling of subsurface samples (solids) (https://geoinfo.nmt.edu/staff/mclemore/documents/SOP17DrillholeLoggingupdated.pdf)
SOP 6	Soil paste pH and paste conductivity	laboratory procedures for soil paste pH and paste conductivity
SOP 7	Field measurements of water	field procedures for measuring water flow, pH, conductivity, alkalinity, temperature when collecting water samples
SOP 8	Surface water and seep sampling	field procedures for collecting samples of surface and seep water samples
SOP 9	Petrographic analysis	laboratory procedures for describing petrographic samples
SOP 10	Electron microprobe analyses	laboratory procedures use for analyses using the electron microprobe
SOP 12	X-ray diffraction (XRD) analyses	laboratory procedures for mineralogical analyses by x-ray diffraction (XRD)