# EVOLVE CAPP

## Evolve Central Appalachia

DE-FE0032055

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Virginia Tech

U.S. Department of Energy
National Energy Technology Laboratory
Resource Sustainability Project Review Meeting
October 25, 2022

## ACKNOWLEDGEMENT

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## DISCLAIMER

# RESEARCH TEAM

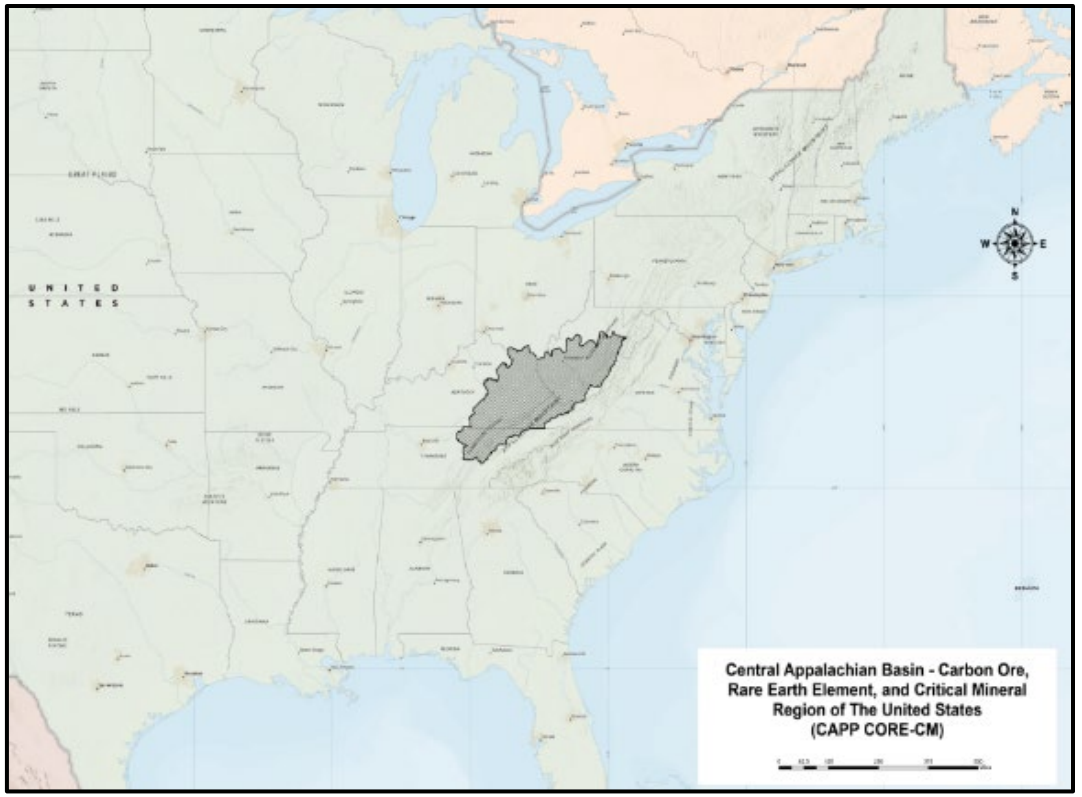
| | | |
|---|---|---|
| **West Virginia University Mining Engineering** | **Virginia Tech VCCER & Mining Engineering** | **University of Kentucky Mining Engineering** |
| **Marshall Miller & Associates** | **Gray Energy Technologies** | **Oak Ridge National Laboratory** |
| **Advanced Resources Intl.** | **Chmura Economics** | **U. S. Geological Survey** |
| **Crescent Resource Innov.** | **Southern States Energy Board** | **Virginia Dept of Energy** |

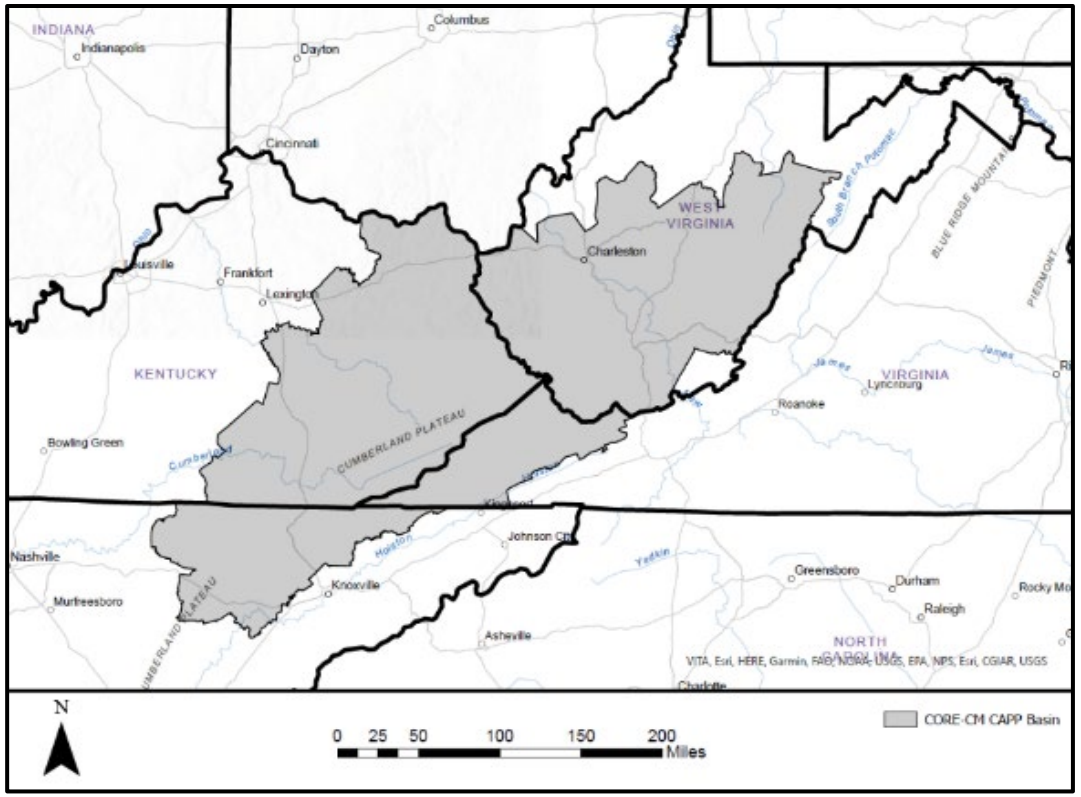
**Mountain Empire Community College Coalition**

- Mountain Empire Community College (MECC), VA
- Roane State Community College (RSCC), TN
- Southeast Kentucky Community & Tech. College (SKCTC)
- Southern West Virginia Comm. & Tech. College (SWVCTC)

# PROJECT OVERVIEW

- *Investigating the Rare Earth & Critical Minerals potential of the Central Appalachian (CAPP) basin*
- *Project Dates: October 1, 2021 – September 30, 2023; Funding: $1,584,999 DOE + $526,492 cost share*



# PROJECT SCOPE

*The general scope of the Evolve CAPP project is to:*

1) *Assess existing knowledge*
2) *Perform a gap analysis*
3) *Fill identified gaps with future projects*
4) *Provide educational & public outreach*

# EVOLVE CAPP PRIORITIES & PRINCIPLES

**Evolve CAPP Priorities:**

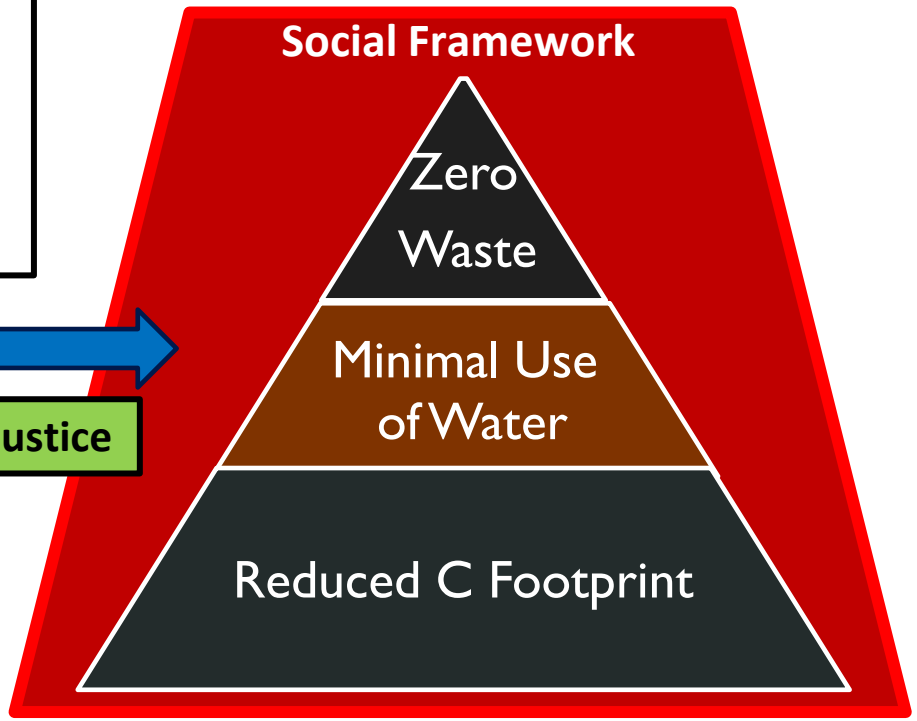
- ✓ Establish a CORE-CM Stakeholder **Community**
- ✓ Develop Vibrant CORE-CM Domestic Industries
- ✓ Supply Green & Digital Economy & Contribute to National Security
- ✓ Avoid Mineral Supply Risk, Potential Interruptions
- ✓ Create Downstream Value-Added Industries & Chains
- ✓ Stimulate Economic Growth in CAPP Region
- ✓ Foster New Job Creation & Upskilling of Local Workforce

**Evolve CAPP Principles:**

- Develop/Adopt Technologies, Processes & Best Practices that aim for "Zero Impacts" & can earn Social Acceptance
- **Sustainable/Responsible Sourcing**

**Equity & Social Justice**

**Positive Environmental & Social Outcomes**



# PROJECT TIMELINE

| Task Number | Task Name | 2021 | | | 2022 | | | | | | | | | | | | 2023 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **1.0** | Project Management and Planning | A | B | | | | | | | | | | | D | | | | | | | | | | | |
| 1.1 | Smry of Environmental Justice Considerations | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.2 | Smry of Economic Revitalization and Job Creation Outcomes | | | | | | | | | | | | | | | | | | | | | | | | |
| 1.3 | EHS Analysis for Products … from CORE-CM Resources | | | | | C | | | | | | | | | | | | | | | | | | | |
| **2.0** | Basinal Assessment of CORE-CM Resources | | | | | | | E | | | | | | | | | | | | | | | | | |
| 2.1 | Preliminary Basinal Resource Assessment | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.2 | Basinal Resource Gap Analysis | | | | | | | | | | | | | | | | | | | | | | | | |
| 2.3 | Characterization and Data Acquisition Plan | | | | | | | | | | | | | | | | | | | | | | | | |
| **3.0** | Basinal Strategies for Reuse of Waste Streams | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.1 | Assessment of Mining Refuse and CCR Waste Streams | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.2 | Assessment of Other Waste Streams | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.3 | Waste Stream Gap Analysis | | | | | | | | | | | | | | | | | | | | | | | | |
| 3.4 | Waste Stream Utilization Roadmap | | | | | | | | | | | | | | | | | | | | | | | | |
| **4.0** | Basinal Strategies for Infrastructure, Industries and Business | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.1 | Regional Infrastructure, Industry and Business Assessment | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.2 | Strategies to Spur Economic Growth | | | | | | | | | | | | | | | | | | | | | | | | |
| 4.3 | Infr Needs, Econ Challenges, and Supply Chain Gaps | | | | | | | | | | | | | | | | | | | | | | | | |
| **5.0** | Technology Assessment, Development and Field Testing | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.1 | Technology Assessment-Mining | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.2 | Technology Assessment-Separation Processes | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.3 | Technology Assessment-Carbon Products | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.4 | Technology Assessment and Testing | | | | | | | | | | | | | | | | | | | | | | | | |
| 5.5 | Technology Gap Analysis and Field-Testing | | | | | | | | | | | | | | | | | | | | | | | | |
| **6.0** | Technology Innovation Centers (TIC) | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.1 | TIC Location | | | | | | | | | | | | | | | | | | | | | | | | |
| 6.2 | Commercial Acceleration | | | | | | | | | | | | | | | | | | | | | | | | |
| **7.0** | Stakeholder Outreach and Education | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.1 | Initial Stakeholder Outreach and Education Plan | | | | | | | | | F | | | | | | | | | | | | | | | |
| 7.2 | Stakeholders Advisory Committee | | | | | G | | | | | | | | | | | | | | | | | | | |
| 7.3 | Workforce Readiness and Development | | | | | | | | | | | | | | | | | | | | | | | | |
| 7.4 | Public Outreach, Education, and Engagement | | | | | | | | | | | | | | | | | | | | | | | | |

## Milestones:

- ✓ (A) Project Kick-off Meeting
- ✓ (B) Project Management Plan
- ✓ (C) EH&S Workshop
- ✓ (D) Interim Report
- ✓ (E) Preliminary Sampling Plan
- ✓ (F) Initial Outreach & Education Plan
- ✓ (G) Stakeholder Advisory Committee

# ADDRESSING ISSUES, BARRIERS & INCENTIVES

**Issues/Barriers** (some are lost in the Technology conversation):

- ✓ Technology is not meeting Responsible Sourcing Standards!
- ✓ Asserting Minerals Titles to both Geologic & Waste Stream resources
- ✓ Waste Steams Regulations & Permitting- Authorities & Regulatory jurisdiction in Collection, Processing & Marketing
- ✓ Companies reluctance to allow access to reclaimed waste sites for sampling & testing purposes. A significantly robust safety net & financial interest may have to be devised for those owners
- ✓ Is CORE-CM the Primary Production or a Byproduct?-What Happens if Mine/Plant closes?
- ✓ Local Community Expectations
- ✓ Production costs & margins
- ✓ Dependence on Global Pricing, “Dumping” & Arbitrage Issues

**Incentives**:

- ✓ Experience with Tax Credits, Low Interest Loans, Government-Supported FEED Studies
- ✓ New ideas needed (from Long-Term Government Contracts to Robust Community Benefits)

# ASSESSMENT OF CORE-CM RESOURCES

- *Characterization & Data Acquisition Plan*
  - ➢ *Initial list of sampling locations:* ***June 2022***
- *Assessment of Mining Refuse & CCR Waste Streams*
  - ➢ *CCR sampling commenced* ***September 2022***

# MAPPING & SAMPLING PROGRESS

- Mapping a complex area with numerous historic mining sites
- Significant advancements in mapping progress
- Multiple coal seams being evaluated
- Preliminary focus on sample frequency & concentration
- Methodology in place to form an initial resource assessment

| | KENTUCKY | | | |
|---|---|---|---|---|
| | COUNT | MAX | MIN | AVERAGE |
| BLUE GEM | 41 | 193.01 | 25.05 | 68.88 |
| UPPER ELKHORN NO 2 | 33 | 191.05 | 44.92 | 72.44 |
| JELLICO | 42 | 170.06 | 44.07 | 91.84 |
| UPPER ELKHORN NO 3 | 44 | 261.06 | 45.27 | 111.84 |
| UNKNOWN-BITUMINOUS C | 46 | 485.25 | 40.93 | 117.91 |
| PEACH ORCHARD | 62 | 323.30 | 45.54 | 133.58 |
| HAZARD NO 7 | 30 | 212.49 | 40.99 | 135.81 |
| HAZARD | 59 | 420.31 | 50.79 | 140.85 |
| BROAS | 31 | 661.07 | 65.72 | 148.87 |
| HINDMAN | 30 | 413.30 | 71.79 | 164.93 |
| FIRE CLAY | 89 | 732.51 | 45.44 | 189.56 |

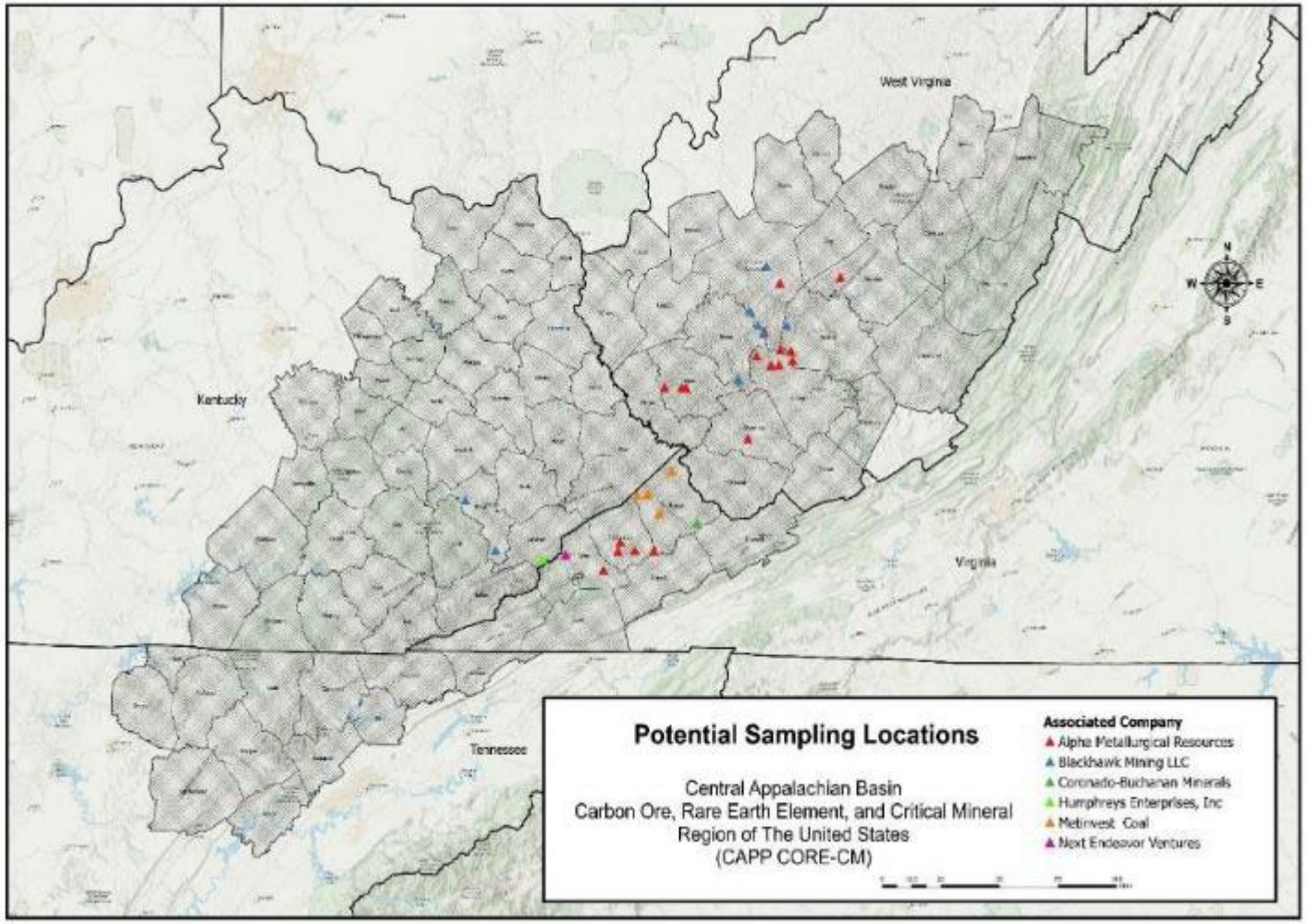
| | TENNESSEE | | | |
|---|---|---|---|---|
| | COUNT | MAX | MIN | AVERAGE |
| REX | 2 | 46.75 | 32.10 | 39.43 |
| BLUE GEM | 2 | 44.10 | 44.04 | 44.07 |
| MASON | 3 | 61.66 | 34.78 | 45.64 |
| PEWEE | 4 | 72.14 | 50.45 | 63.30 |
| JELLICO | 3 | 99.63 | 43.62 | 79.90 |
| COAL CREEK | 2 | 117.34 | 52.65 | 84.99 |
| POPLAR LICK | 3 | 140.83 | 34.94 | 100.11 |
| BIG MARY | 4 | 230.84 | 78.89 | 135.63 |
| WINDROCK | 2 | 232.17 | 55.74 | 143.95 |
| WALNUT MOUNTAIN | 2 | 186.24 | 141.95 | 164.10 |

| | VIRGINIA | | | |
|---|---|---|---|---|
| | COUNT | MAX | MIN | AVERAGE |
| LYONS | 35 | 210.98 | 30.39 | 81.41 |
| BLAIR | 18 | 149.24 | 47.06 | 82.07 |
| DORCHESTER | 71 | 273.42 | 30.70 | 91.12 |
| CLINTWOOD | 67 | 394.08 | 30.41 | 93.18 |
| NORTON | 18 | 159.34 | 39.39 | 94.20 |
| KENNEDY | 18 | 278.48 | 37.57 | 96.70 |
| UPPER BANNER | 31 | 320.15 | 56.04 | 124.21 |
| SPLASHDAM | 24 | 498.31 | 48.20 | 124.30 |
| LOWER BANNER | 19 | 413.96 | 34.49 | 131.04 |
| JAWBONE | 17 | 321.39 | 43.17 | 165.73 |

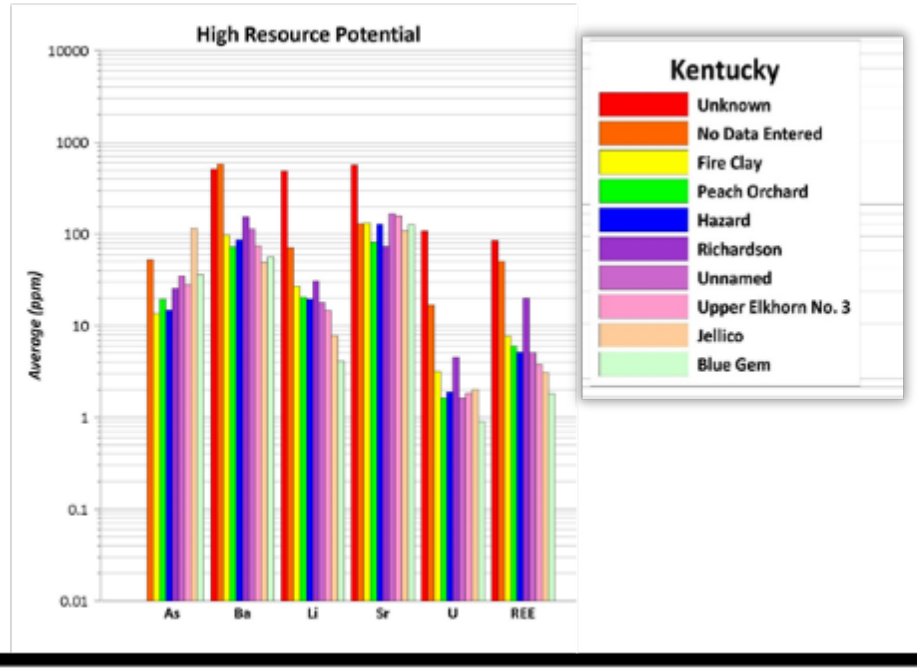
| | WEST VIRGINIA | | | |
|---|---|---|---|---|
| | COUNT | MAX | MIN | AVERAGE |
| REDSTONE | 42 | 453.77 | 43.67 | 104.65 |
| BECKLEY | 43 | 344.60 | 30.12 | 111.41 |
| SEWELL | 51 | 484.58 | 37.37 | 122.94 |
| POCAHONTAS NO 3 | 48 | 396.95 | 47.17 | 136.72 |
| NO 2 GAS | 37 | 840.13 | 60.41 | 154.99 |
| EAGLE | 54 | 833.07 | 52.64 | 156.91 |
| CAMPBELL CREEK | 30 | 766.85 | 46.51 | 196.15 |
| COALBURG | 39 | 846.04 | 52.16 | 203.98 |
| NO 5 BLOCK | 38 | 1,389.71 | 51.44 | 245.11 |
| STOCKTON | 27 | 712.13 | 70.17 | 247.86 |

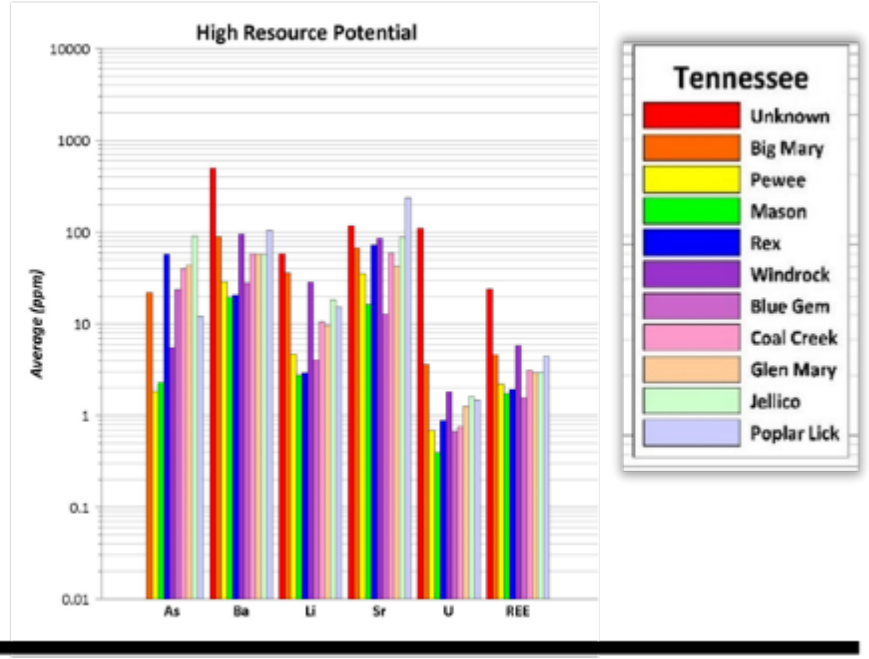
# POTENTIAL FUTURE SAMPLING LOCATIONS

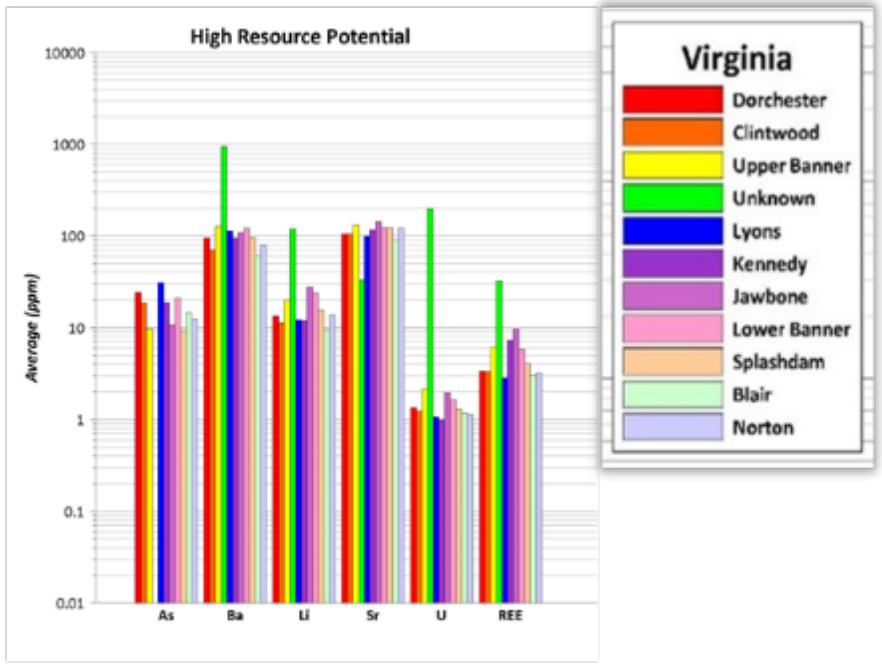
- Targeting resource gaps
- Confirming historical sampling
- Leveraging industry partnerships

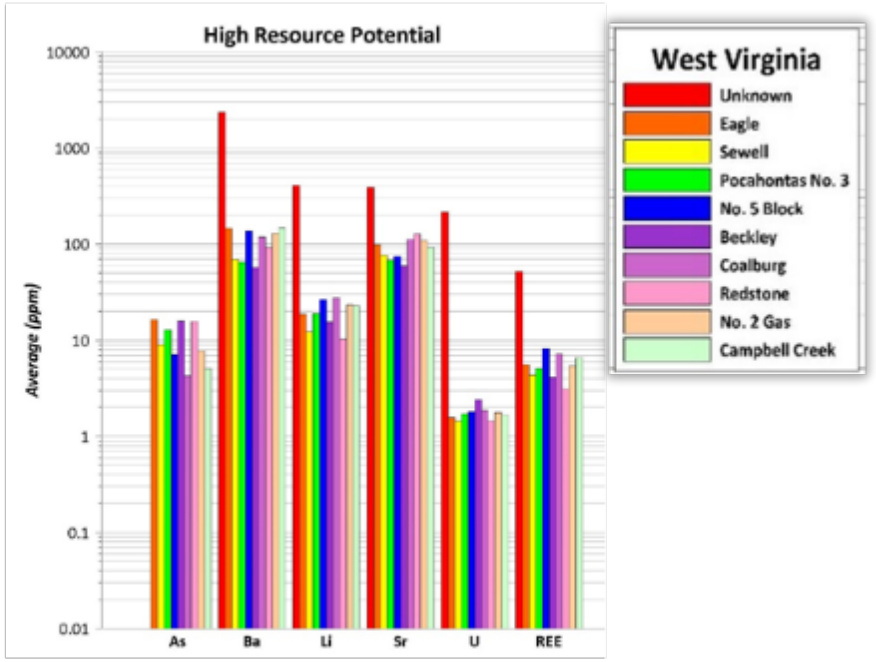


EVOLVE CAPP




"Unknown"or Non-Coal Samples often have **highest** average concentrations

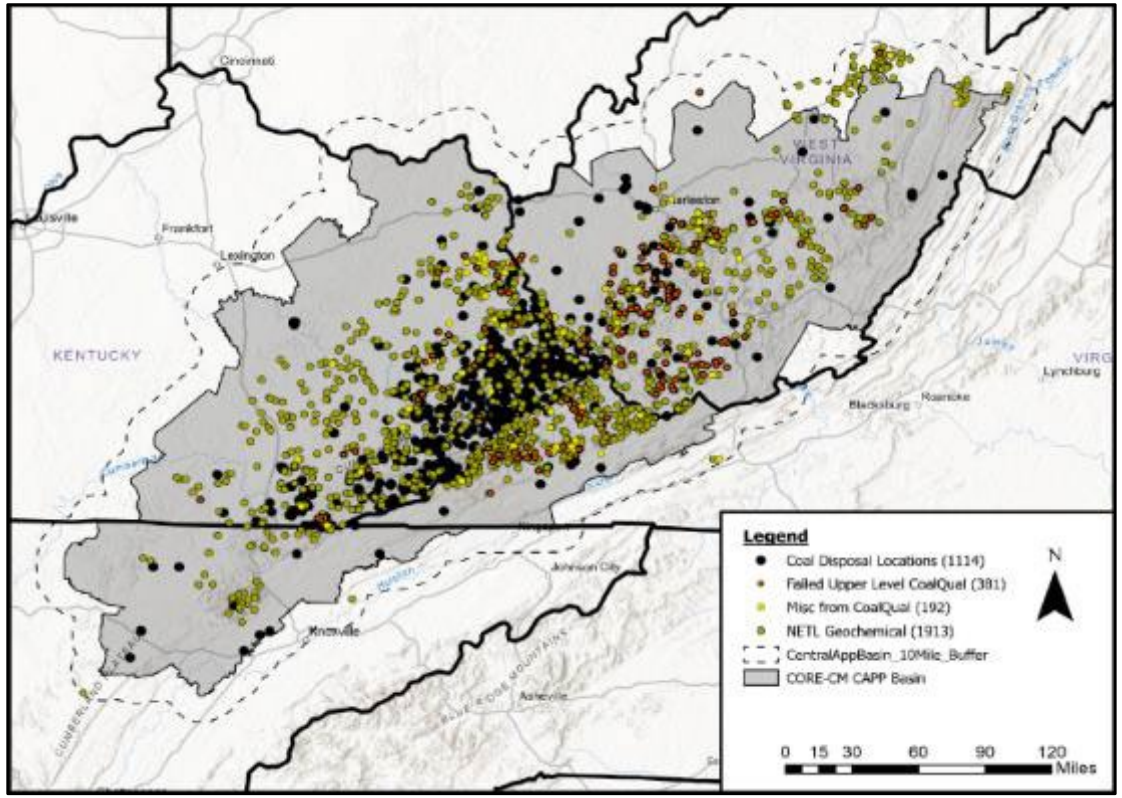
# MATERIAL TYPES FOR NON-COAL OR "UNKNOWN" SAMPLES

| Material | Count | Material | Count | Material | Count | Material | Count |
|---|---|---|---|---|---|---|---|
| Alluvium | 1 | Clay | 61 | Mud | 18 | Siltstone | 1 |
| Barite Nodules | 6 | Clay and Powdered Shale | 36 | Mud Pebble Conglomerate | 1 | Silty Sandstone | 1 |
| Bituminous Coal | 50 | Clayey Siltstone | 1 | Nodule | 2 | Silty Shale | 2 |
| Bituminous Rock | 2 | Claystone | 36 | Null | 133 | Silty Claystone | 10 |
| Black Shale | 20 | Core of Nodule | 2 | Ohio Shale | 12 | Tonstein | 98 |
| Brecciated Ironstone | 1 | Diatreme Breccia | 1 | Phosphatic Claystone | 4 | Trachyte | 1 |
| Brecciated Limestone | 1 | Fault Gouge Limestone Coal | 1 | Rock | 6 | Tuff | 3 |
| Carbonaceous (Organic) | 46 | Ferruginous Claystone | 2 | Sandstone | 4 | Underclay | 1 |
| Carbonaceous Sandstone | 3 | Flintclay | 45 | Sandy Siltstone | 3 | Vitrinite | 2 |
| Carbonaceous Shale | 1 | Laminated Limestone | 1 | Semi Flintclay | 3 | | |
| Carbonaceous Siltstone | 2 | Manganese Ore | 16 | Shale | 43 | | |
| Carbonate - Dolomite | 2 | Micaceous Sandstone | 3 | Shale Pig | 1 | | |
| Carbonaceous Claystone | 1 | Micaceous Siltstone | 2 | Sideritic Nodule | 2 | | |
| Chert | 4 | Mineralized Limestone | 2 | Silicified Carbonaceous Shale | 2 | | |

# BASINAL STRATEGIES FOR REUSE OF WASTE STREAMS

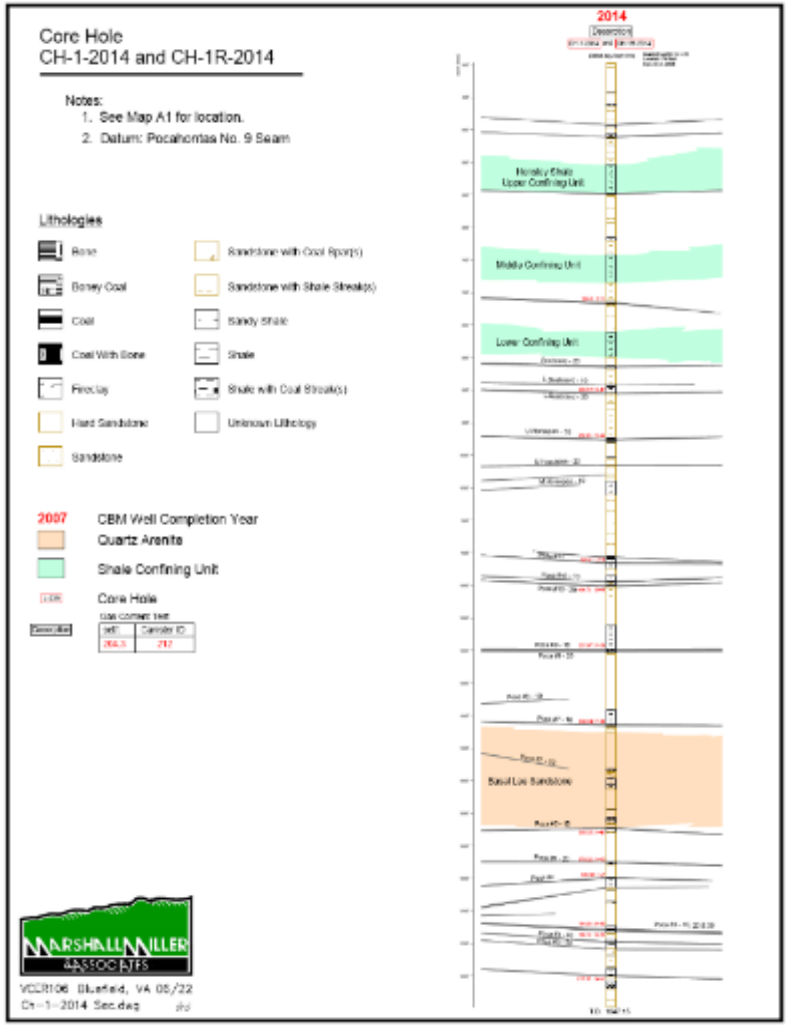
Assessment of Mine Refuse & CCR Waste Streams

- Identify “permitted” sites through State & Federal Regulatory Agencies
- Identify utility-known CCR landfills & impoundments based on EPA & State Solid Waste Database
- Contacting utilities & industry parties to identify CCR volumes, type of material stored & potential for REE-CMs
- Catalogue operational status in resource database




CAPP Basic Infrastructure
& Waste Stream Locations

# P-XRF SCREENING & LAB ANALYSIS OF DRILL CORE



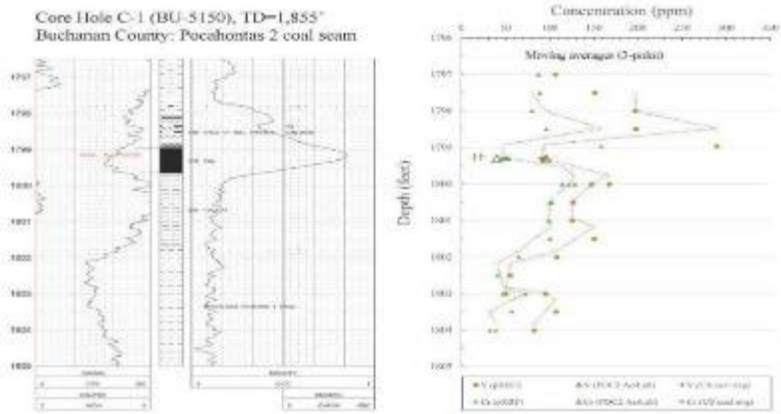

**Plan:**

- Analyze Core Hole for REE-CMs
- Compare pXRF to ICP-MS

**Status:**

✓ pXRF complete

✓ **19** samples at VT lab for ICP-MS



# SAMPLE ANALYSIS – COLLECTED SAMPLES

Fly Ash

Bed Ash

Landfill Bed Ash

Landfill Fly Ash

Core Samples

- ✓ Coal combustion ash & core samples collected
- ✓ Prepared for ICP-MS analysis
- ✓ Developing protocols for future sampling

# SAMPLE ANALYSIS – PREPARATION & DIGESTION

Solid Samples

Pulverization

Digestion

Dilution

Liquid Samples

Filtration

Dilution

ICP-MS Analysis

# USGS PRODUCED WATER DATABASE

ARI's public data search for REE-CM's in produced water:

- USGS Produced Water Database (Blondes et al, 2019) identified as most comprehensive public dataset
- Database evaluated for presence of REEs & Critical Elements

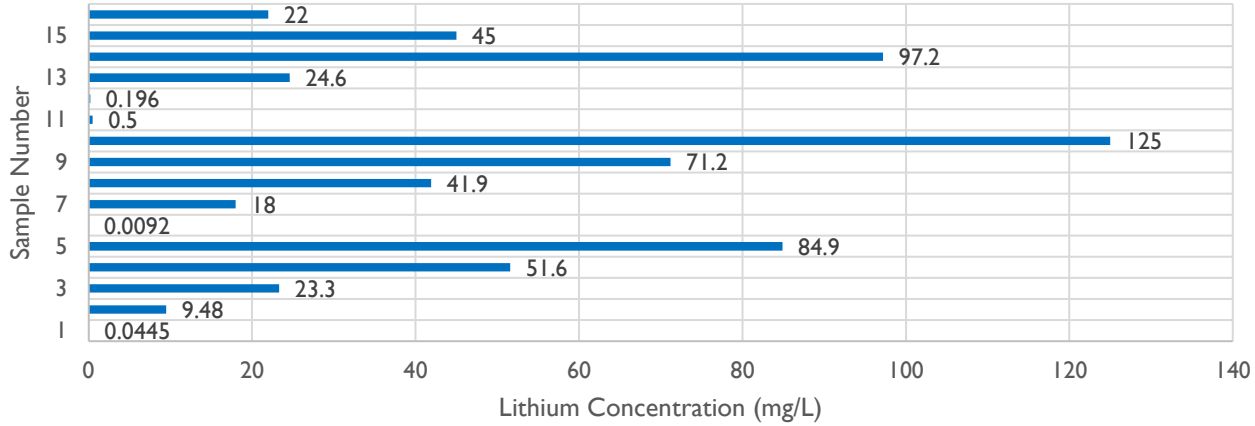
→ =data present for element within study area.

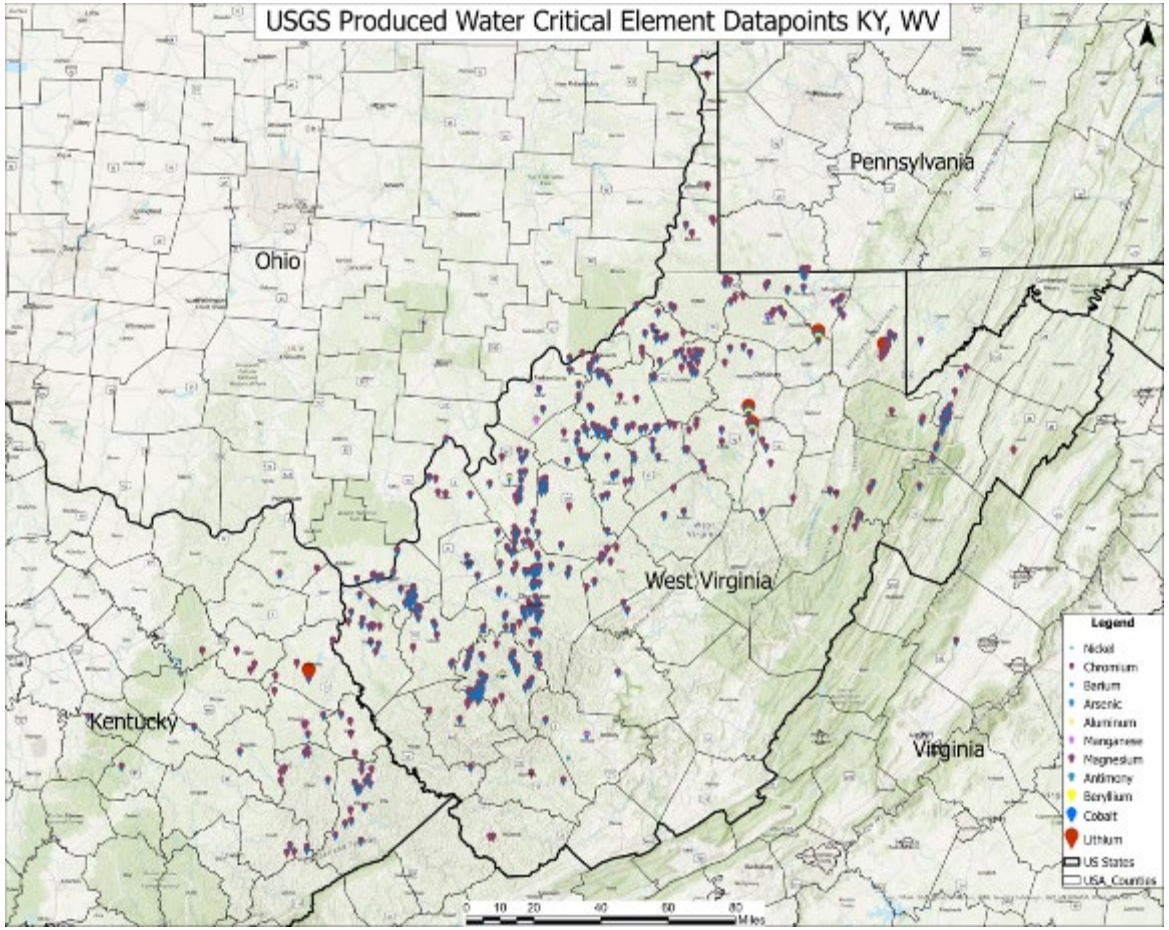
**USGS 2022 Critical Minerals List**

| | | | |
|---|---|---|---|
| → Aluminum | Gadolinium | → Nickel | Tin |
| → Antimony | Gallium | Niobium | Titanium |
| → Arsenic | Germanium | Palladium | Tungsten |
| → Barite (Barium) | Graphite | Platinum | Vanadium |
| → Beryllium | Hafnium | Praseodymium | Ytterbium |
| Bismuth | Holmium | Rhodium | Yttrium |
| Cerium | Indium | Rubidium | Zinc |
| → Cesium | Iridium | Ruthenium | Zirconium |
| → Chromium | Lanthanum | Samarium | |
| → Cobalt | → Lithium | Scandium | |
| Dysprosium | Lutetium | Tantalum | |
| Erbium | → Magnesium | Tellurium | |
| Europium | → Manganese | Terbium | |
| Fluorspar | Neodymium | Thulium | |

# USGS PRODUCED WATER DATABASE

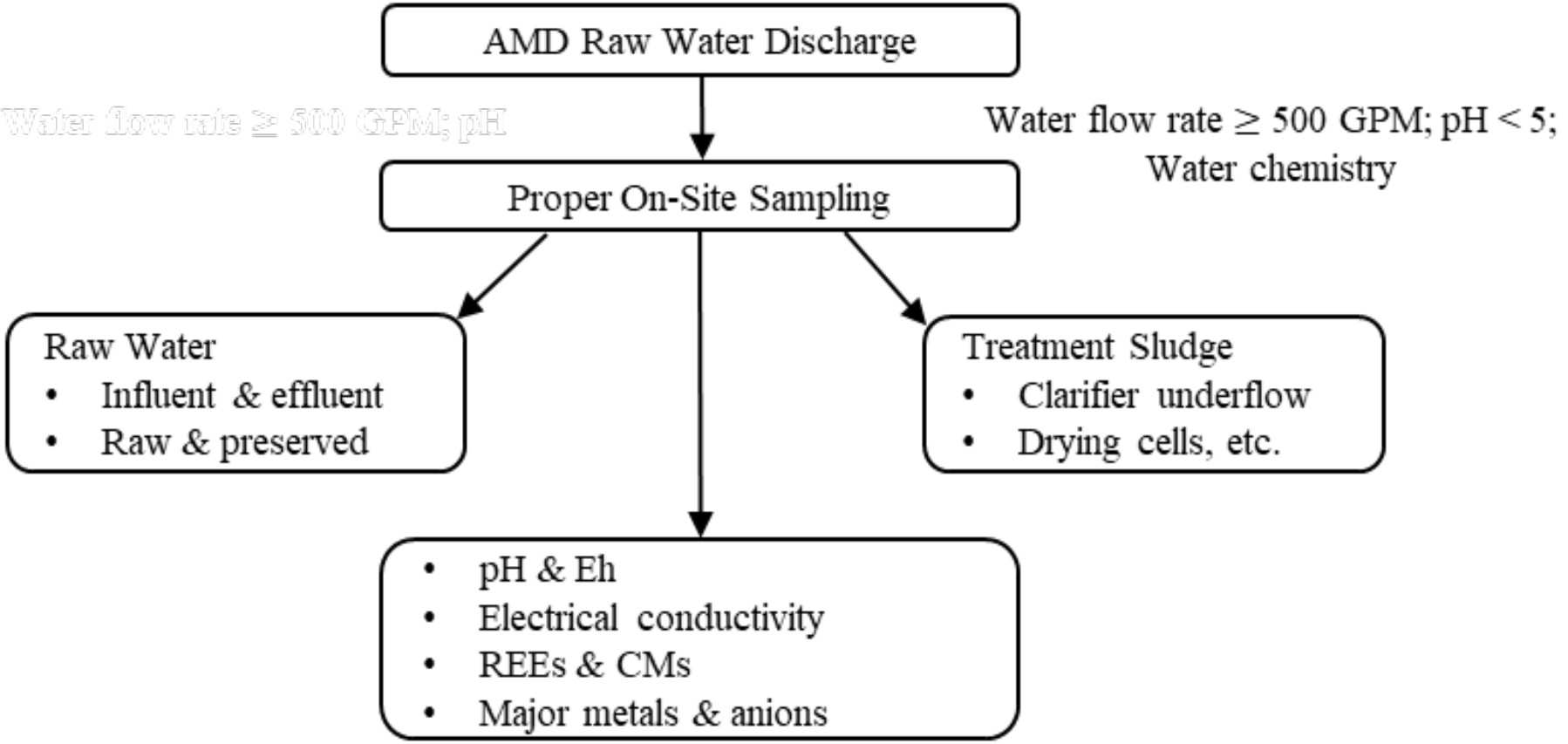
- 1280 samples were identified for KY & WV
- No REE data present within database across study area
- Subset of 11 critical elements present include:
  - Antimony (Sb) – 14
  - Beryllium (Be) – 14
  - Cobalt (Co) – 14
  - Lithium (Li) – 16 (see below)
  - Magnesium (Mg) – 715
  - Manganese (Mn) – 19
  - Aluminum (Al) – 16
  - Arsenic (As) – 14
  - Barium (Ba) – 430
  - Chromium (Cr) – 14
  - Nickel (Ni) – 14




Blondes, M. S., Gans, K. D., Engle, M. A., Kharaka, Y. K., Reidy, M. E., Saraswathula, V., Thordsen, J. J., Rowan, E. L., & Morrissey, E. A. (2019). U.S. Geological Survey National Produced Waters Geochemical Database v2.3 [Data set]. U.S. Geological Survey. https://doi.org/10.5066/F7J964W8

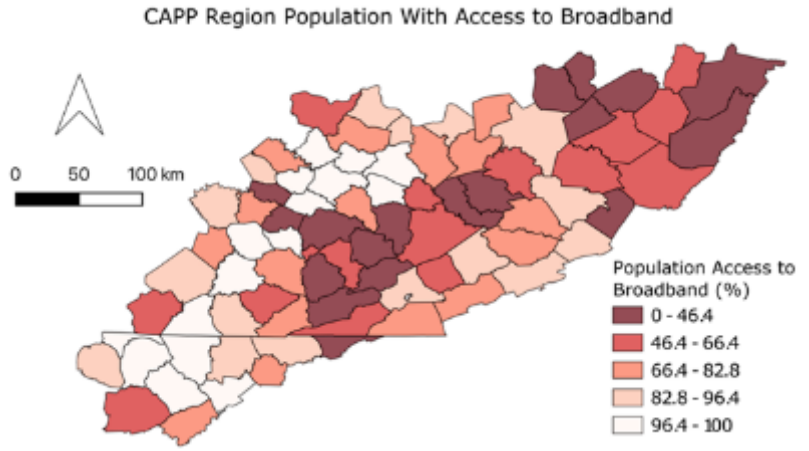
# TESTING POTENTIAL SOURCES FROM ACID MINE DRAINAGE (AMD)

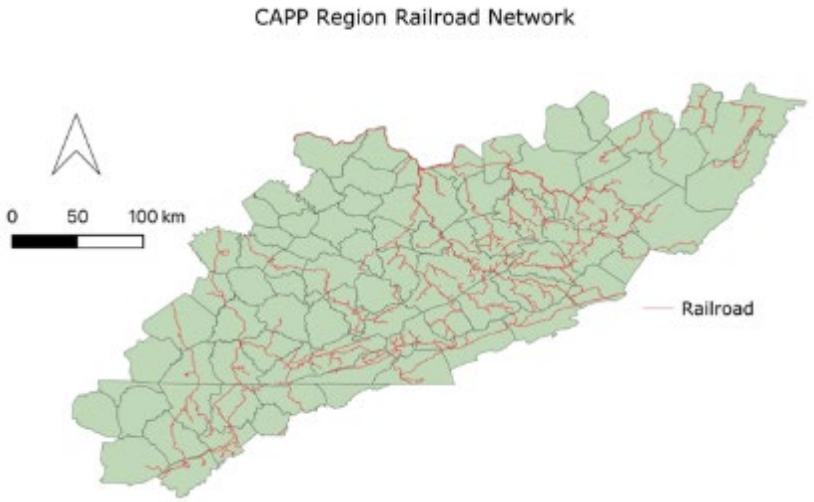


# INITIAL INFRASTRUCTURE ASSESSMENT

Screening for various metrics, including:

- Cheapest source of electricity
- Primary & secondary roads
- Power generation
- Railroad networks
- Commercially navigable waterways
- Fly ash pond locations
- Population with access to broadband
- Educational opportunities
- Etc.



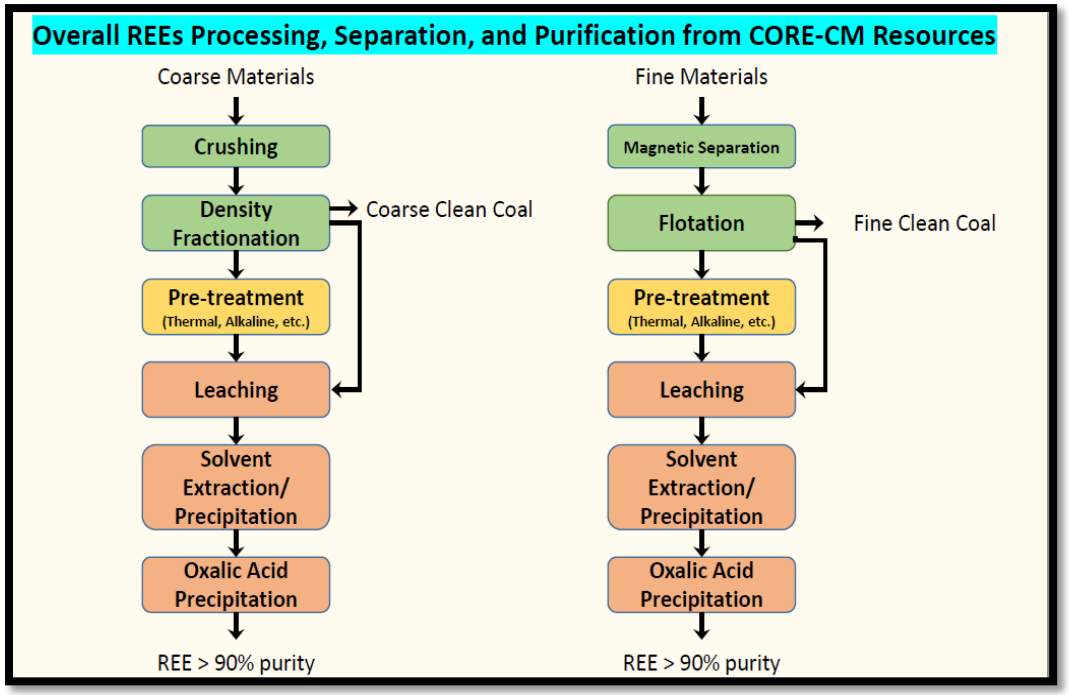
# TECHNOLOGY ASSESSMENT, DEVELOPMENT & FIELD TESTING

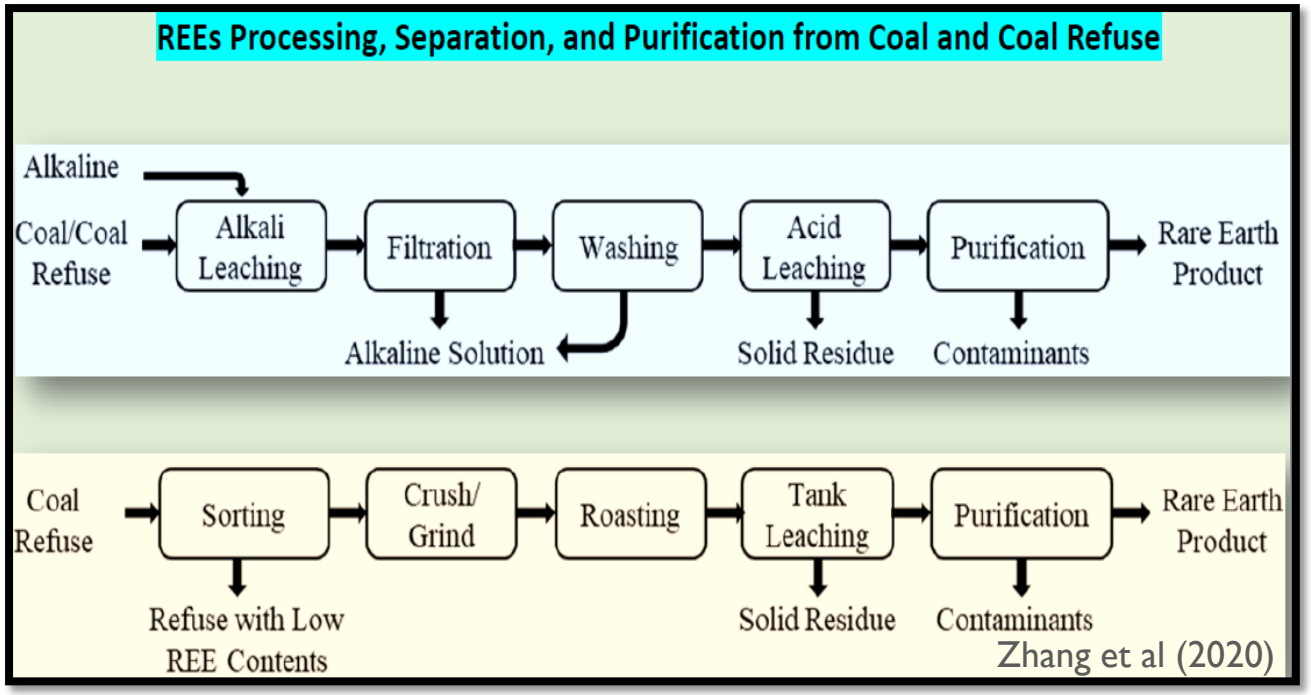
- Mining (primary, co-products, re-mining)
- Separation Processes
- Carbon Products

- Technology Assessment
- Field-Testing
- Gap Analysis

# TECHNOLOGY ASSESSMENT – SEPARATION PROCESSES

- Existing separation technologies being assessed & evaluated for best results under the geologic & waste stream conditions encountered in CAPP basin
- Technologies & processes screened based on **responsible extraction & processing** principles




Zhang et al (2020)

# OUTREACH INTEGRATED WITH PROJECT MANAGEMENT

## Project Management & Planning

- EJ Considerations
- Economic Revitalization & Job Creation Outcomes
- EH&S Analysis

## Stakeholder Outreach & Education

## Initial Stakeholder Outreach & Education Plan

- Stakeholder Advisory Committee
- Workforce Readiness & Development
- Public Outreach, Education & Engagement

# WORKFORCE READINESS & DEVELOPMENT

- Workforce Readiness Plan
- Workshops & Forums
  - Engage stakeholders/entrepreneurs, public, future workforce personnel
  - Identify & assess skillsets & employment opportunities
  - Offer programs, certifications & skills training to match needs of projects in basin

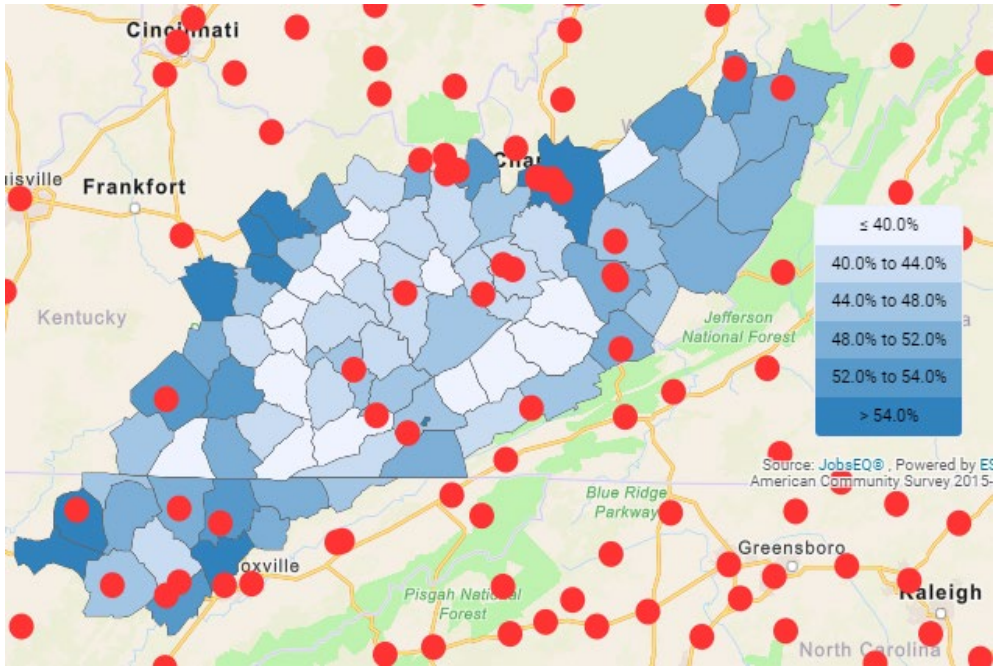
**Workforce Readiness Plan**

**Step 1**
***Assess*** the Workforce

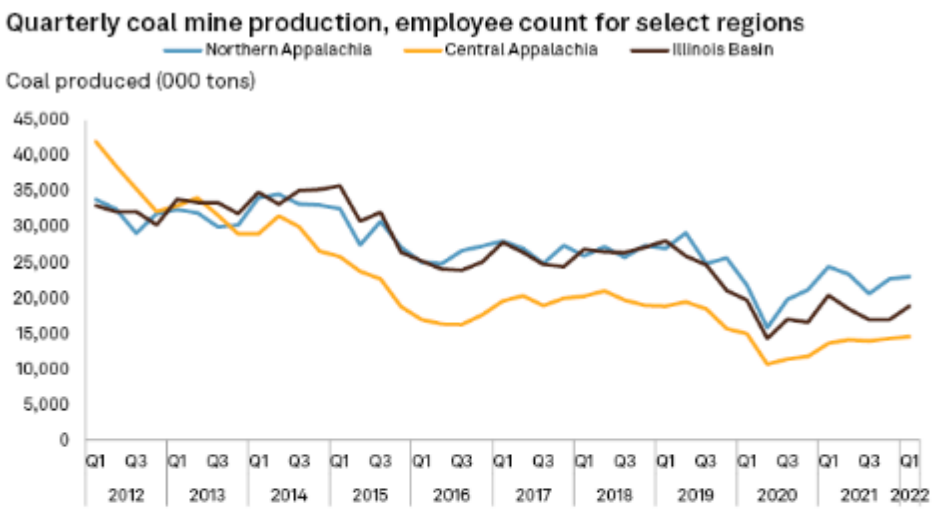
**Step 2**
***Identify*** Supporting Organizations

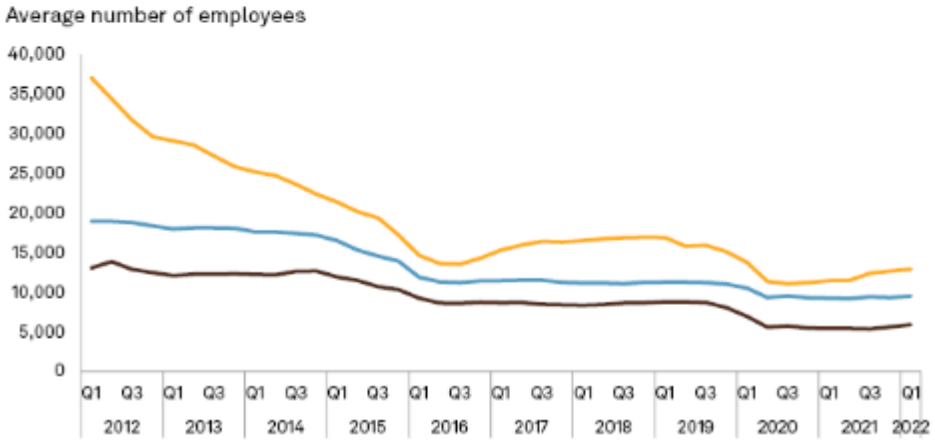
**Step 3**
***Develop*** the Workforce

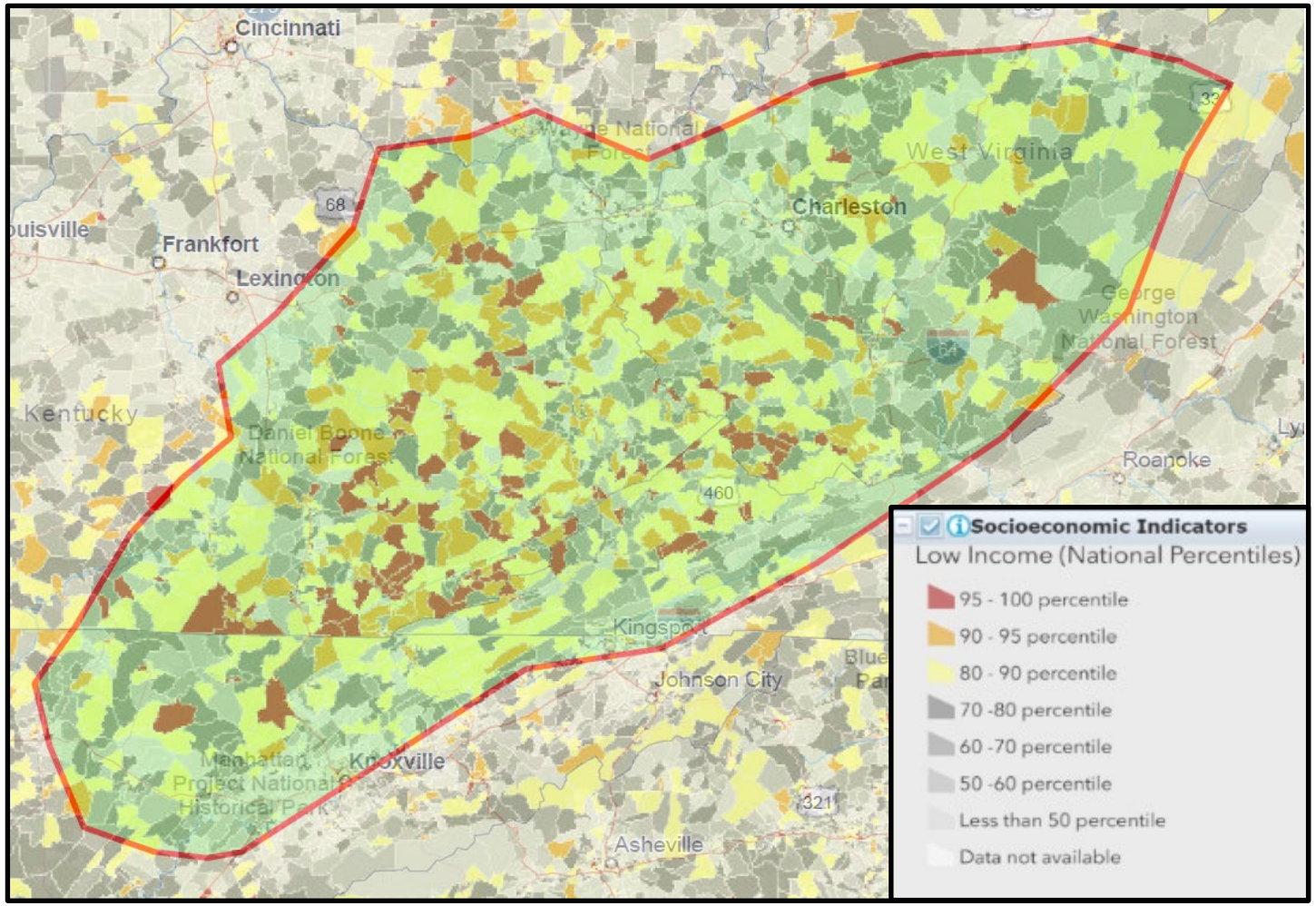
Labor Force Participation Rate with locations of Public 2-year or Less Training Facilities



# CAPP EMPLOYMENT TRENDS & SOCIOECONOMIC INDICATORS




Source: S&P Global Market Intelligence (May 2022)

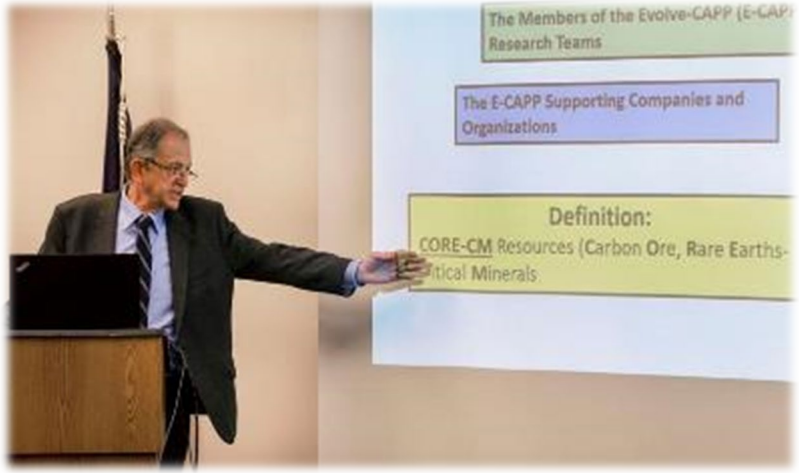
# EDUCATION & TRAINING – CAPP REGION

| School | Commercial Vehicle | Construction/ Heavy Equp. | Diesel Mech. & Technician | Drafting & Design Tech. | Electrical & Electronic Tech. | Electrical & Electronic Comm. | Electrician | Industrial Mechanics | Information Technologies | Machine Shop Tech. | Welding |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Academy of Careers and Technology | x | | x | x | | | x | | | | x |
| Ashland Community and Technical College | x | | x | x | | | x | x | x | x | |
| Ben Franklin Career Center | | x | x | | | | | | | | x |
| Berea College | | | | | | | | | x | | |
| Big Sandy Community and Technical College | x | | x | x | x | | x | x | x | x | x |
| Bluefield State College | | | | | | x | | | x | | |
| BridgeValley Community & Technical College | | | x | x | | x | | | | | x |
| Cabell County Career Technology Center | | | | | | | x | | | x | x |
| Carver Career Center | | | | | | | x | | | | |
| Eastern Kentucky University | | | | | | | | | x | | |
| Fayette Institute of Technology | | | | | | | x | | | | |
| Fortis Institute-Cookeville | x | | | | | | | | | | |
| Fred W Eberle Technical Center | x | | x | | | | x | | | | x |
| Hazard Community and Technical College | x | x | x | x | | | x | | x | | x |
| Marshall University | | | | | | | | | x | | |
| Mercer County Technical Education Center | | | | | | | x | | | | x |
| Morehead State University | | | | | | | | | x | | |
| Mountain Empire Community College | | | | | | x | | | x | | x |
| Mountwest Community and Technical College | | | | | | x | | | | x | x |
| New River Community and Technical College | | | x | | | | | | | | x |
| Somerset Community College | x | | x | | x | | x | x | x | x | |
| Southeast Kentucky Community | | | x | x | x | | x | x | | x | x |
| Southern WV Community and Technical College | | | | | | x | x | | | | x |
| Southwest Virginia Community College | | | | | | x | | | x | | x |
| TN College of Applied Technology-Crossville | x | | x | | | | | x | | | x |
| TN College of Applied Technology-Harriman | | | x | | | | | x | | | x |
| TN College of Applied Technology-Jacksboro | | | | | | | x | | | | x |
| TN College of Applied Technology-Livingston | | | x | | | | | x | | | x |
| TN College of Applied Technology-Oneida-Huntsville | | | | | | | | | | | x |
| University of the Cumberlands | | | | | | | | | x | | |
| University of Pikeville | | | | | | | | | x | | |
| West Virginia University Institute of Technology | | | | | x | | | | x | | |

# STAKEHOLDER OUTREACH & EDUCATION

- *Open Public Session, Stakeholders Advisory Committee:* ***March 2022*** ✓
- *Initial Stakeholder Outreach & Education Plan:* ***June 2022*** ✓
- *Public Outreach, Education & Engagement:* ***11 presentations..***

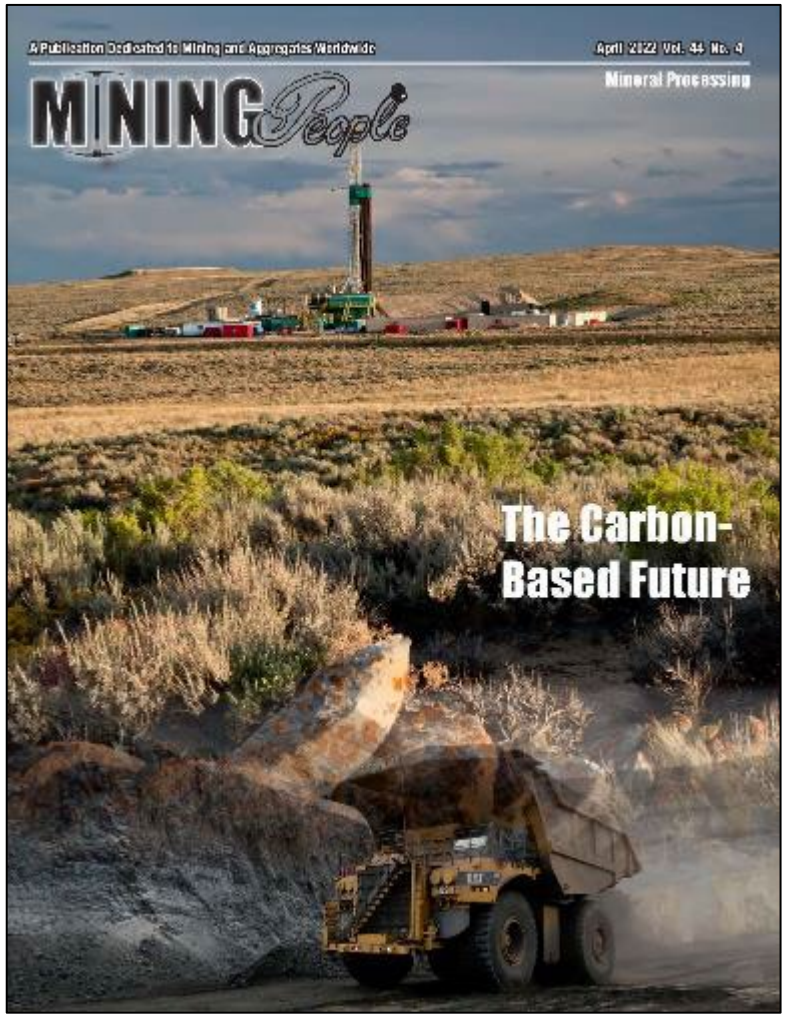
➢ ***MCPA, USEA, SSEB, Open Session, SME-CAS, FL-SME, etc.***

# ADDITIONAL OUTREACH

- ✓ Open Session Public Outreach event on March 16th, 2022 in Abingdon, VA
- ✓ 1st Stakeholder Advisory Committee (SAC) meeting - March 16th, 2022 in Abingdon, VA
- ✓ Multiple regional news agencies reporting on Evolve CAPP after Open Session
- ✓ Cardinal News article published on September 14th
- ✓ VT News article published on September 22nd
- ✓ 2022 SME-FL Regional Mining Conference – Evolve CAPP presentation on October 12th
- ➢ 2nd SAC meeting will be on December 2nd, 2022 in Lexington, KY
- ➢ 3rd SAC meeting will be in WV
- ➢ Planning 2023 SME Annual Conference CORE-CM technical session on March 1st, 2023
- ➢ Planning future stakeholder outreach events in WV & KY

# IN THE MEDIA..




**Carbon-Based Future continued**

There's also a hope of eventually bringing something that can be in short supply in rural communities: good-paying jobs, ideally utilizing existing local skillsets.

"The very same fossil fuel communities that have powered our nation for decades can be at the forefront of the clean energy economy by producing the critical minerals needed to build electric vehicles, wind turbines, and so much more," said Secretary of Energy Jennifer M. Granholm (left), according to DOE's funding announcement last year.

"By building clean energy products here at home, we're securing the supply chain for the innovative solutions needed to reach net-zero carbon emissions by 2050 – all while creating good paying jobs in all parts of America."

That's a hope discussed eagerly in regions that have historically relied upon coal mining for employment, such as Wyoming and parts of Appalachia.

"We basically put together a large team of experts with a variety of backgrounds," says Richard Bishop (right), principal investigator for Evolve Central Appalachia (CAPP), a project based at Virginia Polytechnic Institute and State University (Virginia Tech) where he says they're currently engaged in "desktop due diligence" to collect all the data.

"Initially the focus is putting together all the existing information that's out there, so what information has already been sampled in the region… but also where those gaps are [and] what kind of sampling program we need to really identify a resource in our region, whether it be from coal waste or in situ in the ground," Bishop says.

"We're coming up with strategies to utilize existing infrastructure that is in place but also to really move these projects forward in a safe and environmentally friendly way."

Once the resource is identified, he says, they'll be reviewing the various processing methods available to recover the minerals they're looking for. He says there's been a lot of research done in this area over the last five years or so – and there's also the potential to learn about processing methods from other industries.

There also seems to be a lot of technologies showing up on conference agendas this year, some of them already at pilot or even small commercial scale – from techniques to chemically screen ever-smaller particles to improved dewatering processes to a system for grinding coal to separate impurities from the hydrocarbons.

In several of the DOE-funded projects, the possibility of using coal waste – whether mine drainage, old coal waste piles, or power plant ash – as a source of rare earth elements and critical minerals – is one that's being looked at heavily.

It may be a particularly relevant option in Appalachian states with a long history of mining – and literally hundreds of waste piles left behind by companies that operated generations ago, before current processing technologies and reclamation capabilities were in place.

Often, those waste piles contain a lot of usable coal. In Virginia, some of it has even been burned in a power plant designed to handle the material, which has enabled the cleanup of a few longstanding waste sites in recent years. But a lot more remain.

Now, those waste sites are being eyed for the materials that could be extracted – and the win-win that could occur if funding available to help clean up the piles can also help to advance research efforts.

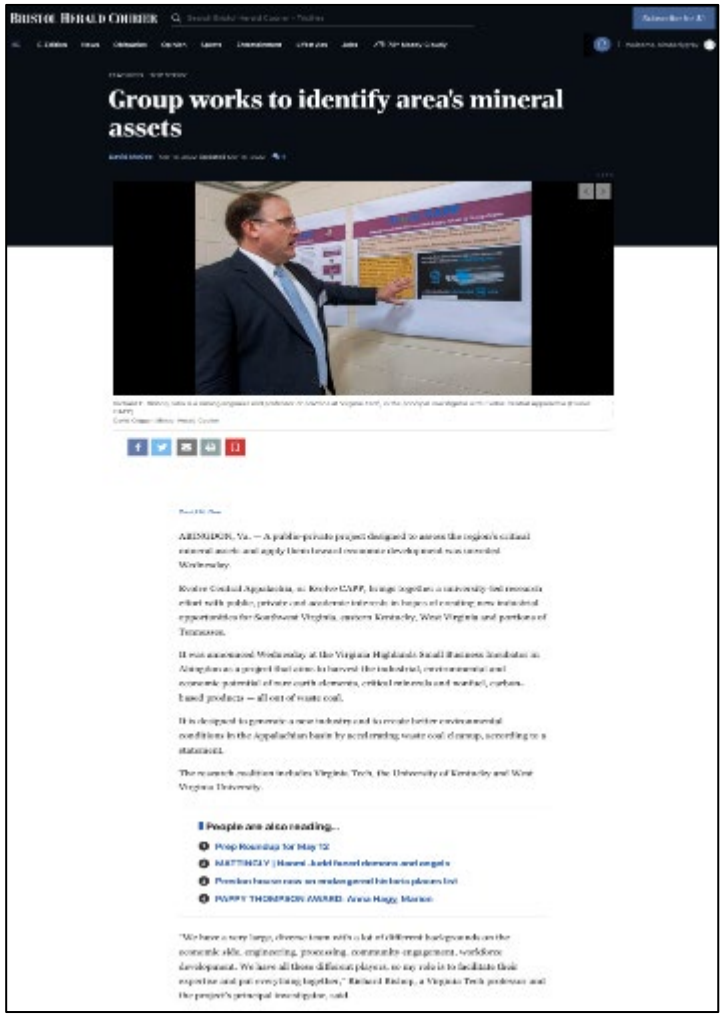
In the western U.S., the University of Wyoming is overseeing two of the DOE-funded projects, covering two regions: the Powder River Basin of Wyoming and Montana, a production powerhouse that contains the nation's largest coal mines; and the Wind River Basin, which includes parts of Colorado and Wyoming.

In Wyoming, where the coal region is branding itself as "Carbon Valley" – a name inspired by aspirations to follow in the footsteps of California's "Silicon Valley" technology hub – these DOE-funded projects are only part of the energy around finding new uses for coal. Wyoming, which reportedly produces

continue

Above: Research lab at the University of Wyoming. Right: Coal core sample for rare earth elements.





Bristol Herald Courier

# Group works to identify area's mineral assets

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# IN THE MEDIA..

## Group works to identify Appalachia's mineral assets

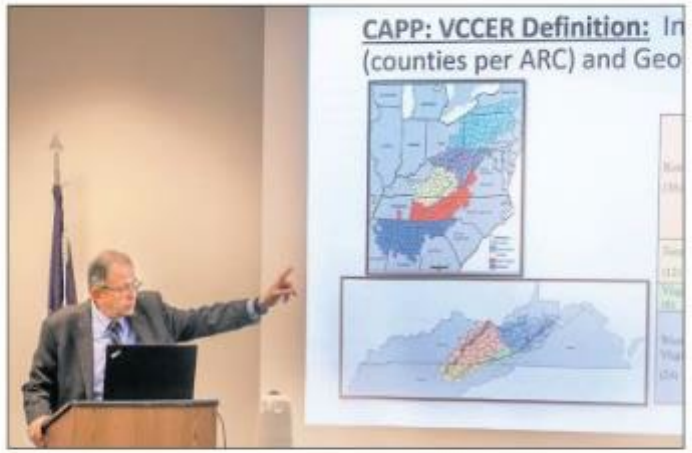
BY DAVID MCGEE
BRISTOL HERALD COURIER

ABINGDON, Va. — A public-private project designed to assess the region's critical mineral assets and apply them toward economic development was unveiled Wednesday.

Evolve Central Appalachia, or Evolve CAPP, brings together a university-led research effort with public, private and academic interests in hopes of creating new industrial opportunities for Southwest Virginia, eastern Kentucky, West Virginia and portions of Tennessee.

It was announced Wednesday at the Virginia Highlands Small Business Incubator in Abingdon as a project that aims to harvest the industrial, environmental and economic potential of rare earth elements, critical minerals and nonfuel, carbon-based products — all out of waste coal.

It is designed to generate a new industry and to create better environmental conditions in the Appalachian basin by accelerating waste coal cleanup, according to a statement.




DAVID CRIGGER/BRISTOL HERALD COURIER

**Michael Karmis, original principal investigator, talks about the purpose of Evolve Central Appalachia (Evolve CAPP).**

The research coalition includes Virginia Tech, the University of Kentucky and West Virginia University.

"We have a very large, diverse team with a lot of different

See **CAPP**, Page A4

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## Tech scientists see rare opportunity in Appalachia

*Rare earth elements, extracted from coal waste, could help build a new industry.*

by Randy Walker
September 14, 2022

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# QUESTIONS?

EVOLVE CAPP

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*Scan QR code for more info:*

https://energy.vt.edu/research/evolve-capp.html