

Evolve Central Appalachia (Evolve-CAPP)

A Public-Private Coalition

Michael Karmis, Original Principal Investigator

Stonie Barker Professor, Department of Mining and Minerals Engineering &
Director, Virginia Center for Coal and Energy Research (VCCER)

Virginia Tech (VT) – Retired 1/1/2022

E-mail: mkarmis@vt.edu

Richard Bishop, Current Principal Investigator

Assistant Professor of Practice

E-mail: ribishop@vt.edu

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Acknowledgements:

The Division of Minerals Sustainability, Fossil Energy and Carbon Management, DOE

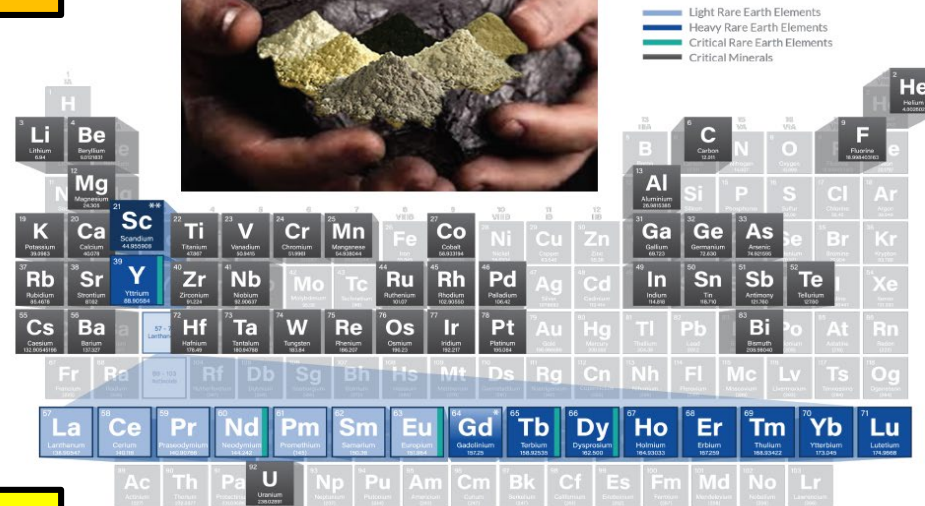
The Members of the Evolve-CAPP (E-CAPP) Research Teams

The E-CAPP Supporting Companies and Organizations

CORE-CM resources (Carbon Ore, Rare Earths-Critical Minerals)

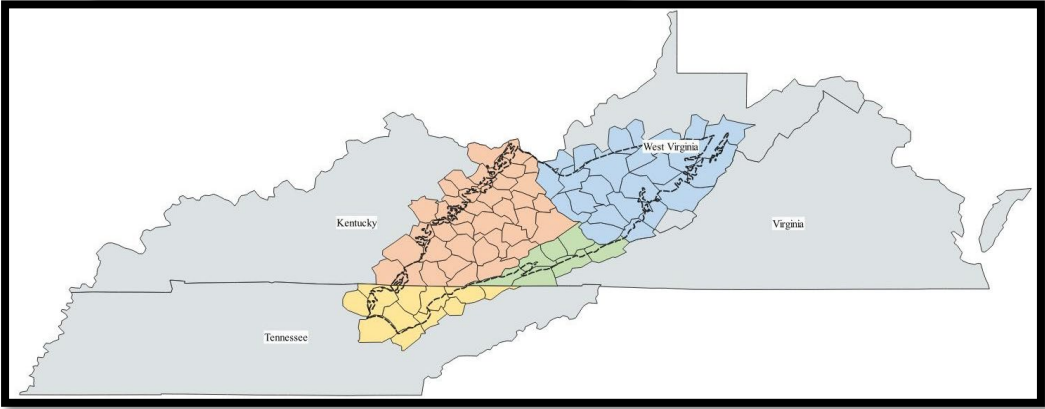
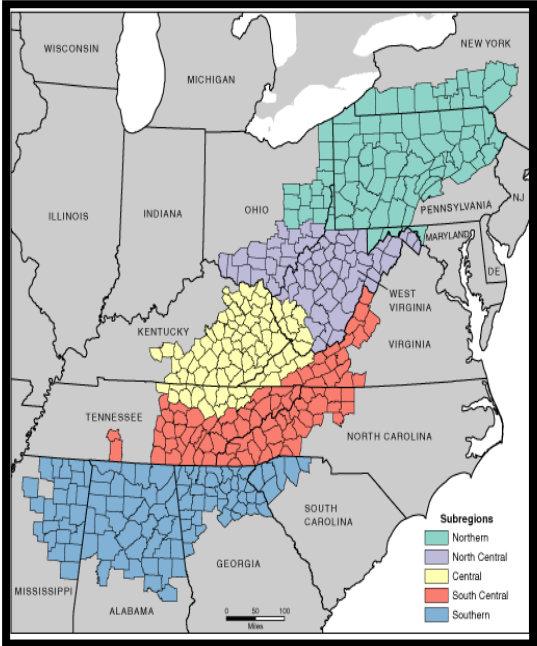


Multi-Year Program Plan for Division of Minerals Sustainability



October 2021

CAPP: VCCER Definition: Integrates Administrative Units (counties per ARC) and Geologic Coal Regions (USGS)



VCCER CAPP Counties

Kentucky (38)	Bath, Bell, Boyd, Breathitt, Carter, Clay, Elliott, Estill, Floyd, Greenup, Harlan, Jackson, Johnson, Knott, Knox, Laurel, Lawrence, Lee, Leslie, Letcher, Lewis, Madison, Magoffin, Martin, McCreary, Menifee, Montgomery, Morgan, Owsley, Perry, Pike, Powell, Pulaski, Rockcastle, Rowan, Wayne, Whitley, Wolfe
Tennessee (12)	Anderson, Campbell, Claiborne, Cumberland, Fentress, Hancock, Morgan, Overton, Pickett, Roane, Scott, Union
Virginia (8)	Buchanan, Dickenson, Lee, Norton, Russell, Scott, Tazewell, Wise
West Virginia (24)	Boone, Braxton, Cabell, Calhoun, Clay, Fayette, Greenbrier, Kanawha, Lincoln, Logan, McDowell, Mercer, Mingo, Nicholas, Pocahontas, Putnam, Raleigh, Randolph, Roane, Summers, Upshur, Wayne, Webster, Wyoming

Evolve-CAPP: Research Team

VCCER & Mining Engineering, Virginia Tech

**Mining Engineering
West Virginia University**

**Marshall Miller &
Associates**

**Advanced Resources
International (ARI)**

Crescent RI

Carpenter Global

Gray Energy Technologies

Chmura Economics & Analytics

**Southern States Energy Board
(SSEB)**

**Mountain Empire Community
College Coalition***

**Mining Engineering
University of Kentucky**

Oak Ridge National Laboratory

U. S. Geological Survey

**VA Department of Energy
(VaDoe)**

***Mount Empire Comm. College (MECC)**
-Roane State Comm. College (RSCC), TN
-SE Kentucky Comm. & Tech. College (SKCTC)
-Southern West Virginia Comm. & Tech.
College (SWVCTC)

Evolve-CAPP: Supporting Partners

Provide Expertise, Assistance, Guidance, Facility Accesses, “Open” Information Exchange

☐ Land and Minerals Owners

- Natural Resource Partners (NRP)
- Harrison-Wyatt & Buchanan Energy Properties
- Kentucky River Properties

☐ Coal Producers

- Blackhawk Mining
- Ramaco Resources
- Coronado-Buchanan Minerals
- Alpha Metallurgical Resources
- Metinvest-United Coal Company
- American Consolidated Natural Resources
- Consol Energy

☐ Gas Producers

- EnerVest

☐ Power Producers

- Dominion Energy
- Tennessee Valley Authority (TVA)
- American Electric Power Company (AEP)

☐ CAPP Economic Development

- Lenowisco Planning District Commission
- Coalfield Strategy, LLC
- Invest SWVA
- SWVA Energy R&D Authority

☐ Technology Companies

- Ramaco Carbon
- Separation Technologies (STET)
- Carbon Technology Company
- Alios Pty Ltd (Australia)

☐ Associations

- US Energy Association (USEA)
- West Virginia Coal Association (WVCA)
- Metallurgical Coal Producers Association (MCPA)

☐ International Institutions/Research Organizations

- University of New South Wales (UNSW), Australia
- CSIRO, Australia

Coal Producers in E-CAPP companies represent about 90% of coal production in CAPP in 2020 and 86% in 2019

<https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/coal-output-declined-14-3-at-top-25-central-appalachian-mines-in-2020-62685755>

Evolve-CAPP Priorities and Principles: Positive Environmental and Social Outcomes

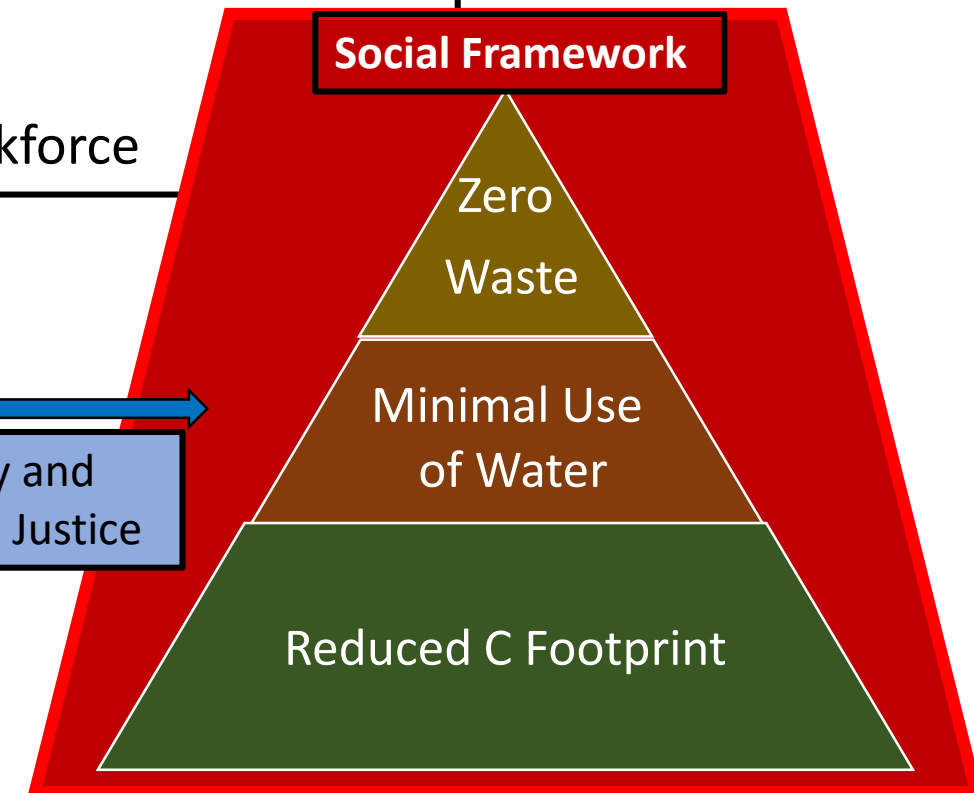
Evolve-CAPP Priorities:

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

Evolve-CAPP Principles:

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

Equity and
Social Justice



Toward Sustainable Procurement-Supply Chain is Going Green

“Two-thirds of the average company’s environment, social and governance (ESG) footprint lies with suppliers. Procurement leaders who take bold action can make a decisive difference in sustainability.”

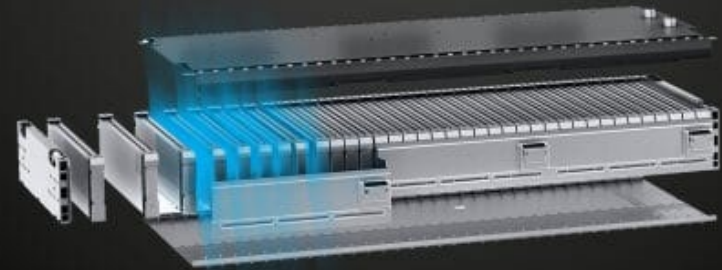
Source: Buying into a more sustainable value chain, McKinsey Consultants (September 2021)

Tesla addressed Zero-Cobalt future in its Impact Report (June 8, 2020)

Plans to produce a zero-cobalt battery for its vehicles and energy products, in a bid to source metals in a responsible fashion that maintains not only the integrity of the company but also the human rights of those involved in the sourcing of raw materials.

(Re: Supply Chain Introduction: Responsible Material Sourcing)

Mercedes-Benz will in future only source battery cells with cobalt & lithium from **certified mining sites** ...



... while significantly **reducing cobalt**



<https://media.daimler.com>

Evolve-CAPP Tasks

Project Specifies Tasks/Subtasks, Milestones/Deliverables, Schedule, etc.

MAIN TASKS TO BE PERFORMED

- Task 1.0 - Project Management and Planning
- Task 2.0 - Basinal Assessment of CORE-CM Resources
- Task 3.0 - Basinal Strategies for Reuse of Waste Streams
- Task 4.0 - Basinal Strategies for Infrastructure, Industries and Business
- Task 5.0 - Technology Assessment, Development and Field Testing
- Task 6.0 - Technology Innovation Centers (TIC)
- Task 7.0 - Stakeholder Outreach and Education

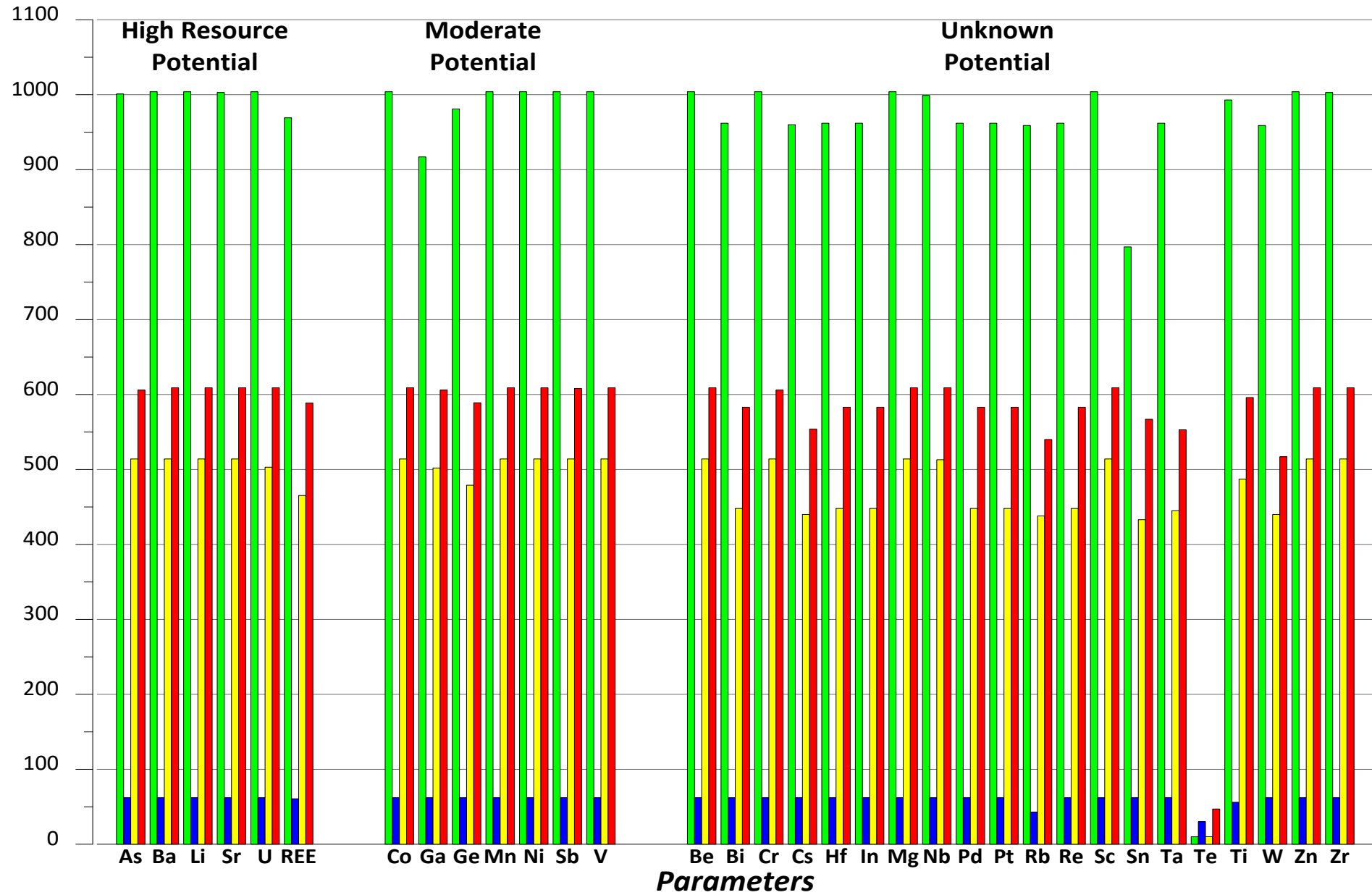
Task 2.0: Basinal Assessment of CORE-CM Resources

Subtask 2.1

Preliminary Basinal Resource Estimate

- Identify CORE-CM, and other important minerals, most likely available within the study area and develop a comprehensive database of existing data sources, including unpublished company data available to E-CAPP team
- Preliminary quantification of CORE-CM resources using a geologic model based on individual volumetric representations of coal seam of interest that captures the spatial variability of properties such as stratigraphic thickness, mineral concentration and recovery factors
- Restrictive aspects of resource recovery, such as ownership and legal restrictions, will be considered in estimating recoverable resources and will be included in the Initial Basinal Resource Assessment deliverable
- E-CAPP team has significant experience in developing resource assessment studies for the coal and gas sectors, based on accepted international standards and reporting to the SEC

Number of samples



Source:

EVOLVE Central Appalachia
(Evolve CAPP)

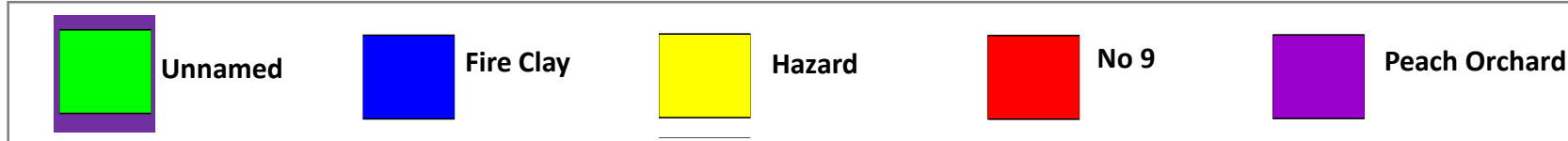
Task 2
Phase 1 Basinal Assessment of CORE-CM
Resources



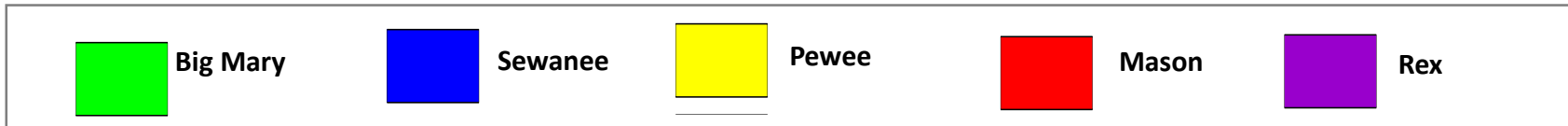
Potential Clusters

Major Coal Strata of Interest in CAPP

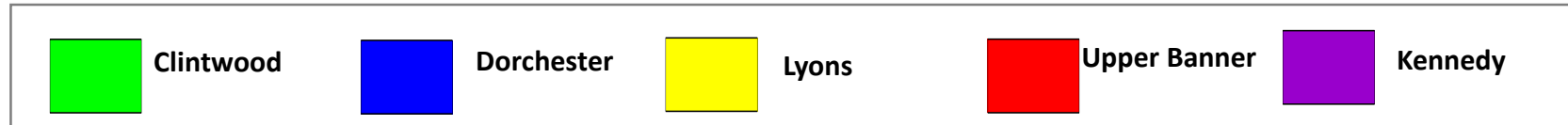
Kentucky – Top 5 Sampled Coal Seam



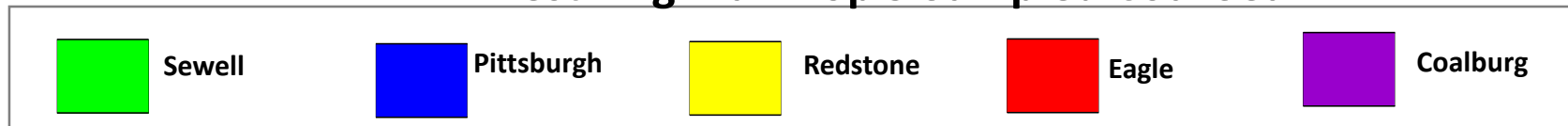
Tennessee – Top 5 Sampled Coal Seam



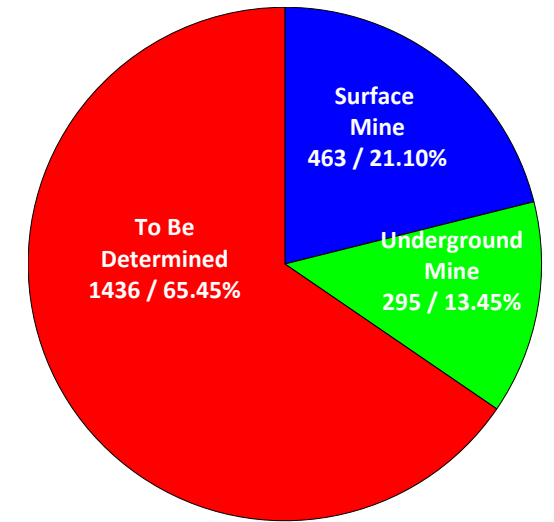
Virginia – Top 5 Sampled Coal Seam



West Virginia – Top 5 Sampled Coal Seam



Data Sources by Origin



USGS COALQUAL DATA - Preliminary Summary-VIRGINIA)

517 Samples
69 Related Samples
586 Total Samples

569 Samples Within Evolve CAPP Project Area
17 Samples Outside Evolve CAPP Project Area

Samples collected between 1973 and 1989

Samples by County – Evolve CAPP Project Area

COUNTY	COUNT
WISE	193
BUCHANAN	131
DICKENSON	104
RUSSELL	55
TAZEWELL	48
LEE	28
SCOTT	10
Grand Total	569

Sample Types

SAMPLE TYPE	Number of Samples
Channel	283
Weathered Channel	208
Drill Core	76
Grab	1
Road Cut	1
Grand Total	569

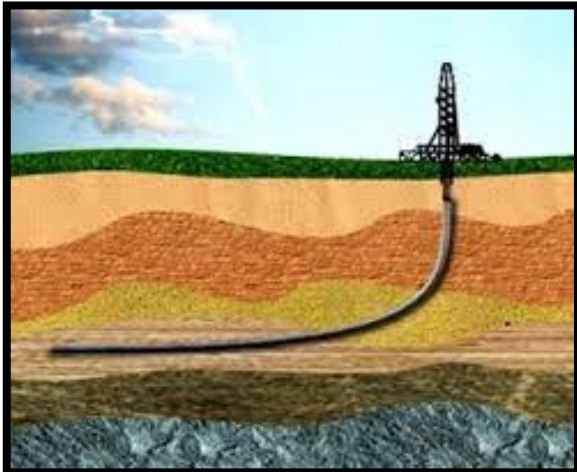
Note: Drill Core samples from 28 individual locations, 68 channel locations have multiple coal bench samples. Samples from 315 unique locations

Task 5.0: Technology Assessment, Development and Field Testing

Subtask 5.1

Technology Assessment – Mining

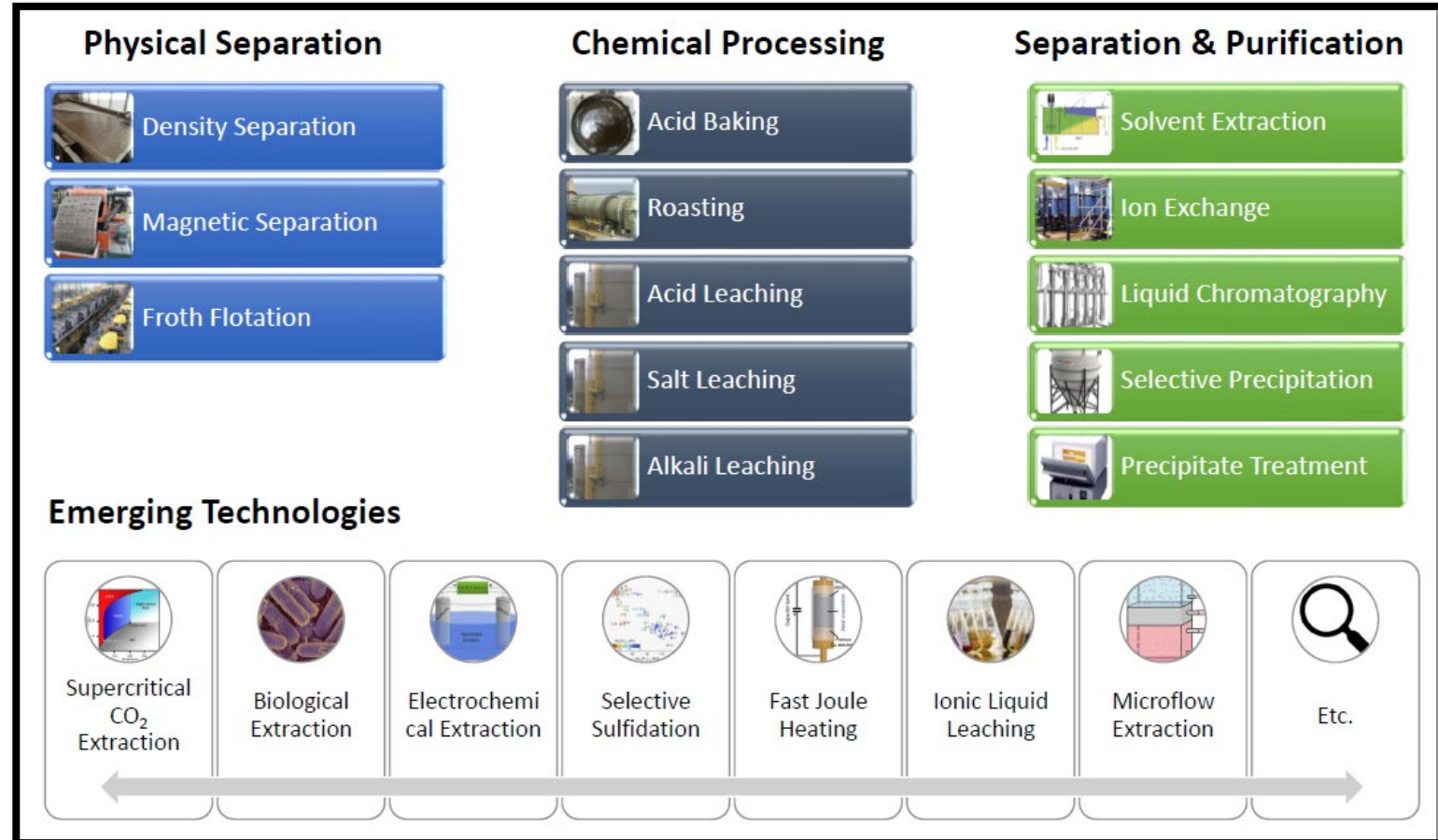
- Follow extraction methods and operational needs that are identified by ESG and EJ considerations
- Introduce “**precision**” mining concepts, emphasizing “low waste” mining to economically access and produce CORE-CM from in-place resources
- Adapt technologies and practices from other industries (e.g., directional drilling, micro-tunneling, highwall mining, mine floor mining, to solution mining) for CORE-CM applications
- Emphasis on advanced technologies, including use of digital controls, immersive technologies, AI and analytics, novel extraction options and modular facilities



Subtask 5.2

Technology Assessment - Separation Processes

- Existing separation technologies of interest, in the USA and globally, are evaluated for best results for CORE-CM resources and waste streams encountered in the CAPP
- Technologies and processes are screened based on the **responsible extraction- processing** principles used in the study
- Consideration will be given to **downstream chains and utilization** that can enhance economical recovery and workforce opportunities in the region



Resources to Reserves (Source: ICSC/IEA, G. Chapman Webinar, 8-25-2021)

- Two international bodies **CRIRSCO** and **UNFC**
- **CRIRSCO** similar to JORC Code, requires a CP but is an advisory code
- **UNFC** wider scope, includes 'uneconomic' and 'undiscovered' resources – it is not a reporting standard system
- **CRIRSCO** aims to promote best practice
- **UNFC** is generic and aims to improve global communications



“Reserve” is an Economic Definition!

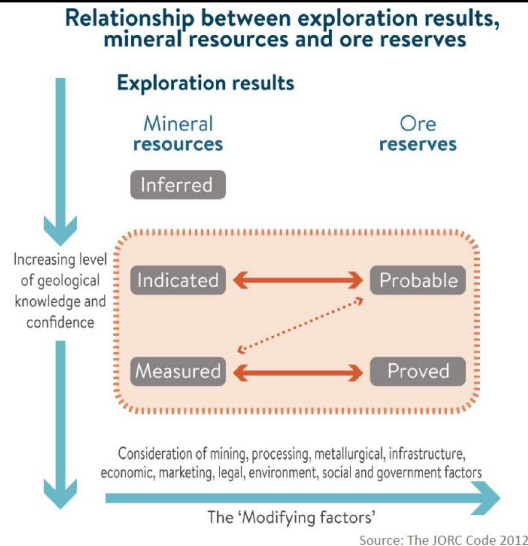
Define CORE-CM production economics, i.e.:

- Cost of mining/extraction
- Cost of separation and processing
- Transportation cost to downstream facilities/ markets
- Capital cost of the project
- Operating cost

Determine CORE-CM pricing economics

Overall production costs must be less than the selling price to allow a reserve to be defined, factoring in an adequate financial return

- Most ore deposits are classified as **resources** and **reserves**
- **Resources** - three categories of increasing confidence, but does not include economic parameters in the assessment
- **Reserves** - two categories, the economically mineable part of Measured and Indicated resources
- Competent Person (CP) with 5 years+ relevant experience makes the assessment



Global Price is subject to “Dumping” and Arbitrage Trading

Evolve-CAPP Will Address Issues, Barriers and Incentives

Issues/Barriers (some lost in the technology conversation):

- Asserting minerals titles to both geologic and waste stream resources
- CORE-CM waste streams permitting authorities and regulatory jurisdiction in extraction and processing
- Reluctance to allow access to reclaimed waste sites for sampling, testing and future development
- Mineral/waste stream owners need a robust safety net with a financial interest
- Is CORE-CM the primary product, or a byproduct of another process? what happens if the mine/plant closes?
- Understanding and meeting local community expectations
- Co-location of prime production with downstream processing and advance manufacturing of CORE-CM facilities is paramount for the CAPP economic development and workforce development
- Estimating production cost and margins

Incentives:

- Experience with tax credits, low interest loans, government-supported FEED studies
- New ideas needed (from long-term government contracts to robust community benefits)