

A composite image showing the Virginia State Capitol building on the left, a world map in the center, and a carbon capture tower on the right.

Overview of the Virginia CarbonSAFE Storage (VA C-St) Phase II Project *FE0032445*

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Review Meeting**

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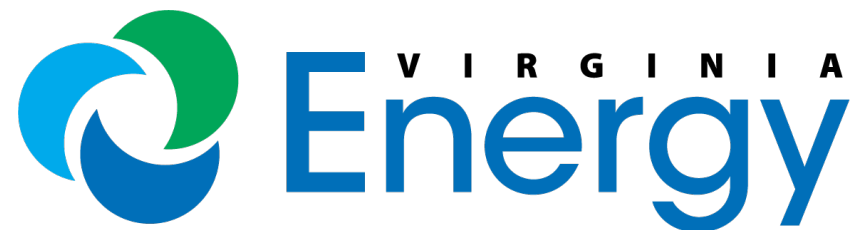
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Partnerships



**Advanced Resources
International, Inc.**



Coalfield Strategies, LLC



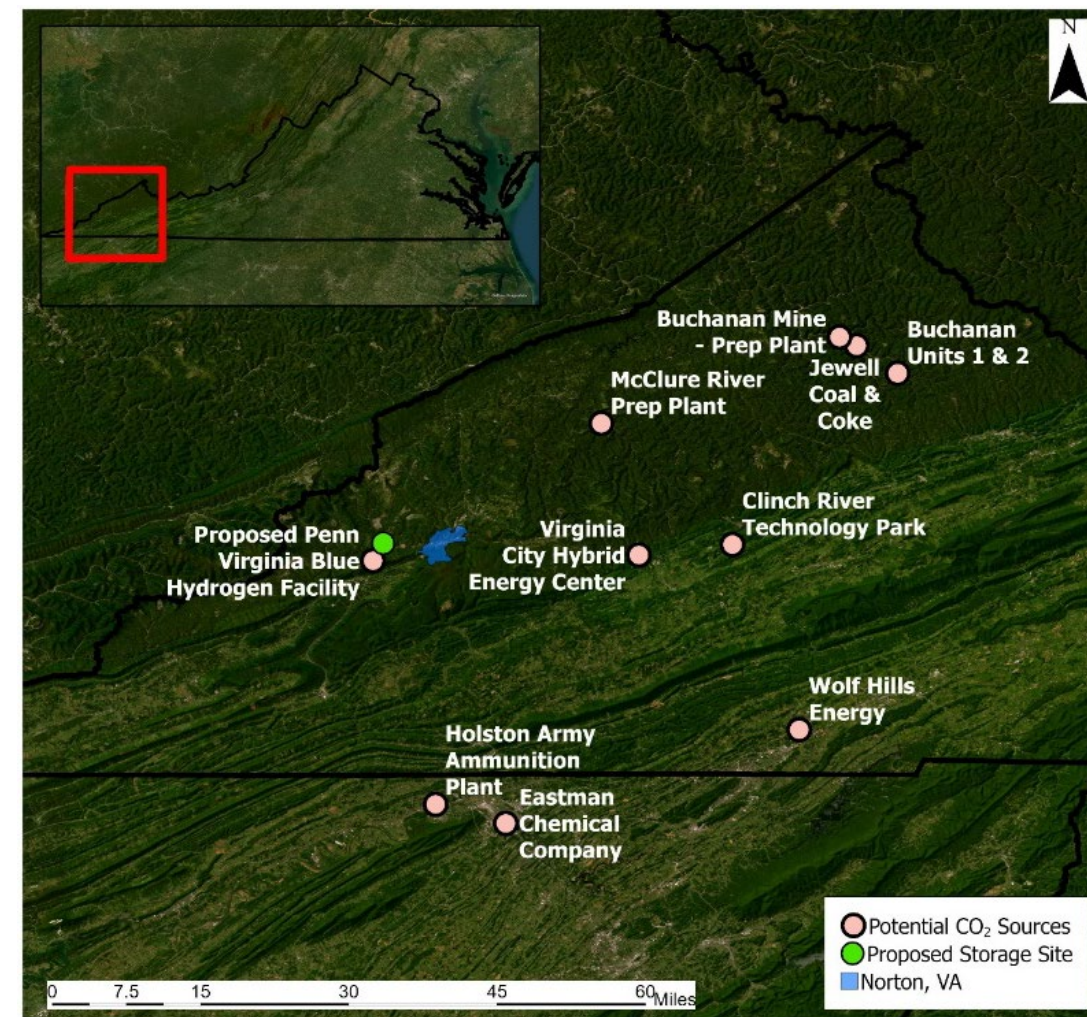
ENERVEST

**Karmis, LLC
Michael Karmis,
Ph.D., P.E**



Project Overview

- Project led by Virginia Department of Energy
- Location in Wise County, VA
- CarbonSAFE Phase II award – represents a new geologic and socio-economic opportunity in this part of rural SW Virginia
- Commitment letters from Penn Virginia and Eastman Chemical Co. to provide CO₂ for the project
 - Penn Virginia has planned blue hydrogen facility to be developed outside of Norton, VA
 - Combined emissions from this facility and Eastman Chemical are substantial, accommodate the 50 MMT CarbonSAFE metric
- Additional emissions sources have been identified within a 50mi radius

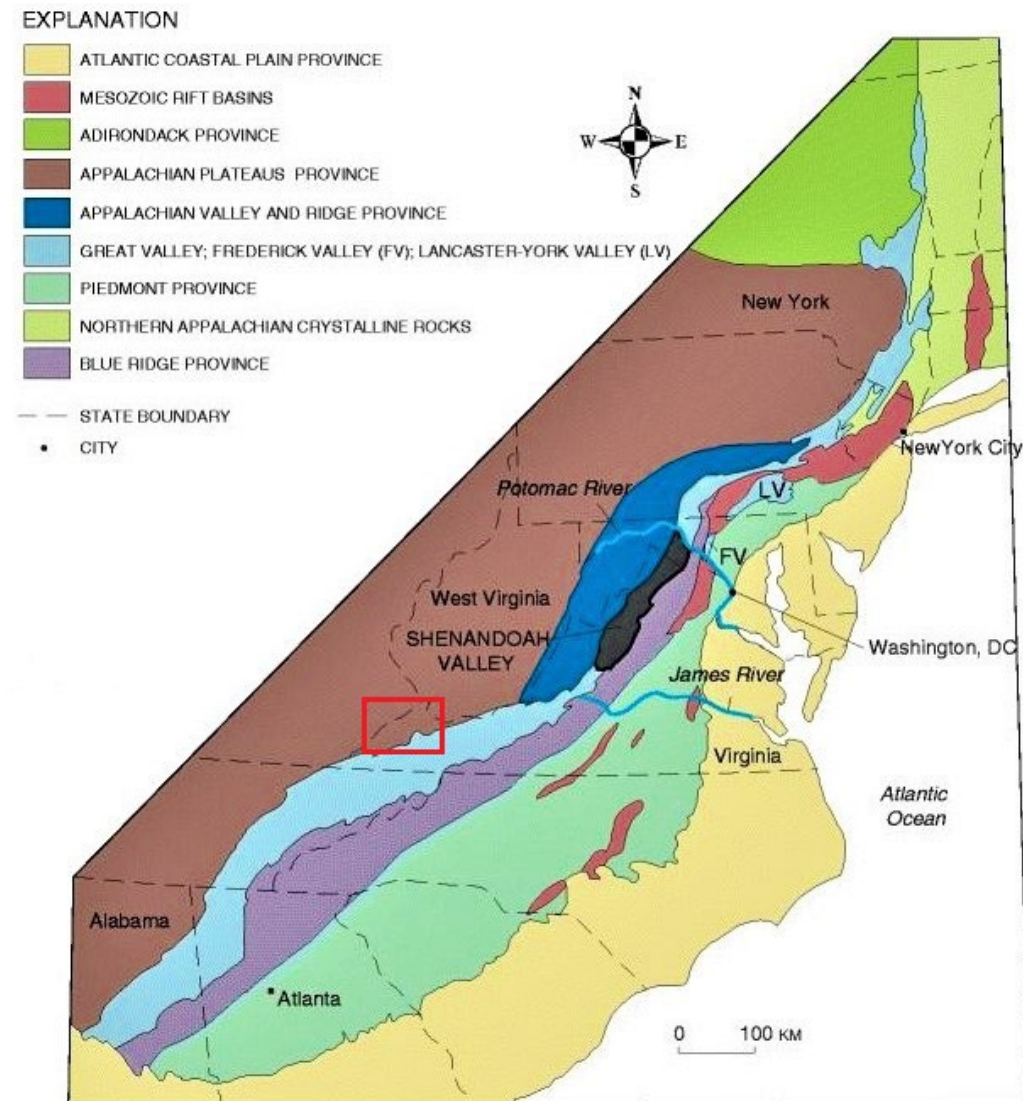
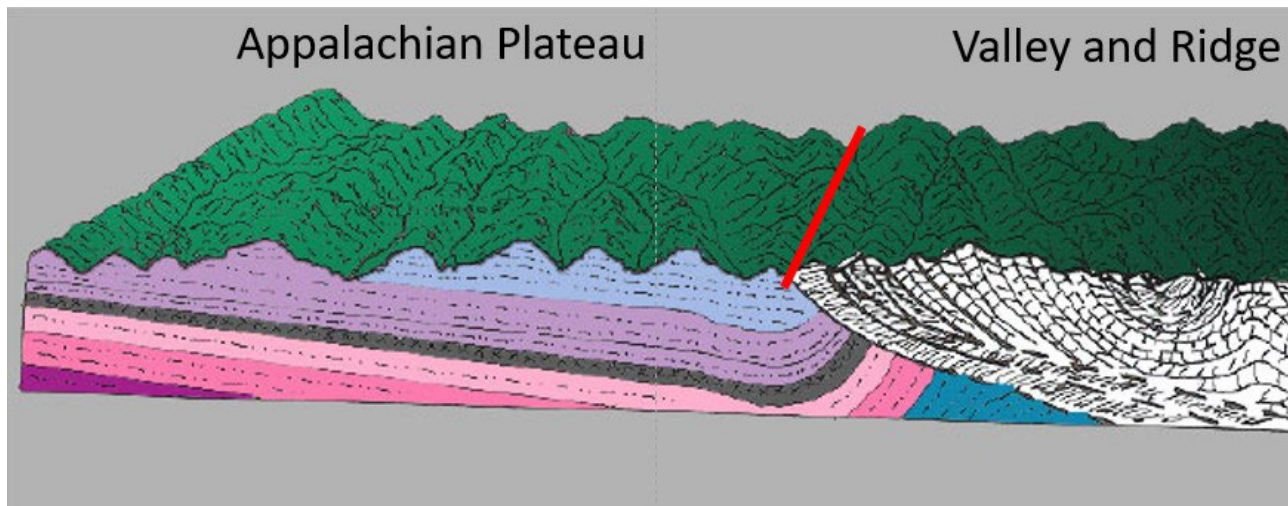


Project Objectives

- Demonstrate that subsurface saline formations within the storage complex can store commercial volumes of CO₂ safely and permanently.
- Create a comprehensive community and stakeholder engagement plan that includes diversity, equity, inclusion, and accessibility;
 - Through Justice40 initiatives and economic revitalization and job creation considerations
- Develop the infrastructure framework for a CO₂ storage hub
- Establish a rigorous risk registry and conduct a comprehensive risk assessment
- Conduct a comprehensive site characterization to support the development and submission of a US EPA UIC Class VI Permit Application during Phase III efforts
- Evaluate the overall commerciality of a regional southwest Virginia storage complex

Geologic Setting

- Proposed storage complex is located within the Appalachian Plateau region of southwestern VA
- Characterized by relatively flat-lying stratigraphy, gentle dips expected to the NW
- Sedimentary package approximately 3,000 ft thick of Devonian – Mississippian age strata is the primary zone of investigation for the storage complex

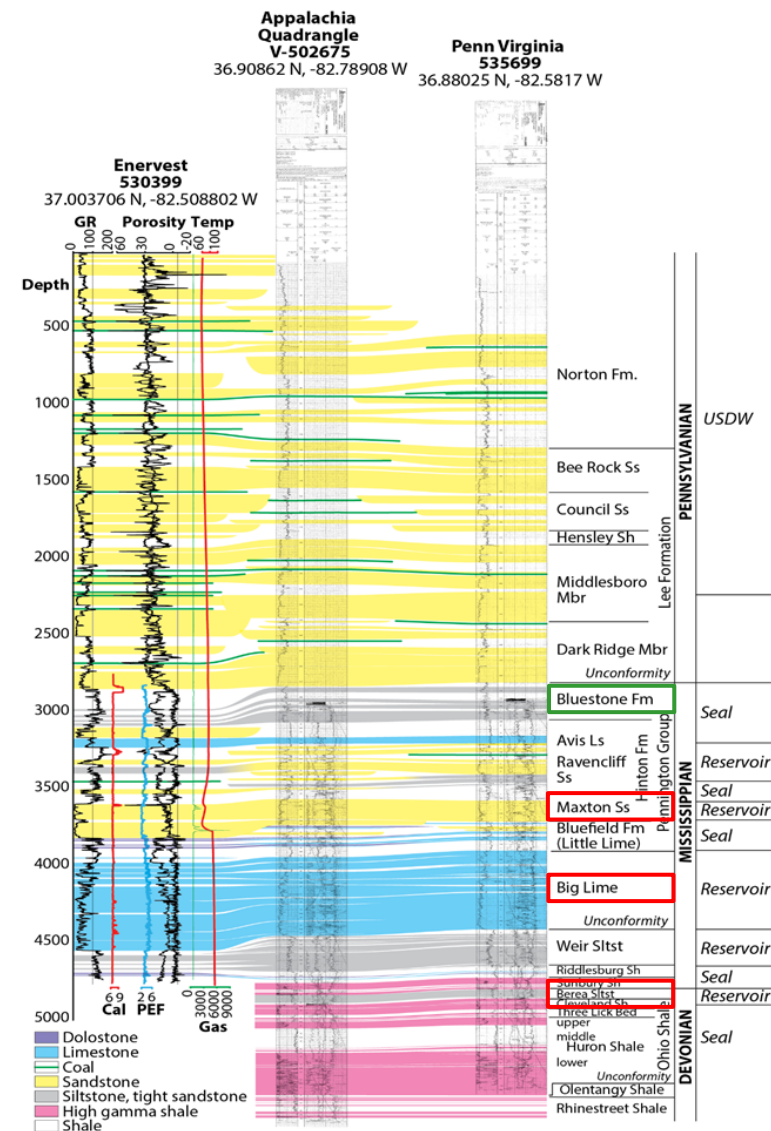


Geologic Setting

- Interbedded shales and tight carbonates present throughout the sedimentary package to act as confining units
- Stacked storage approach: 3 primary storage intervals
 - Maxton Sandstone, Big Lime (Greenbrier), and Berea Sandstone

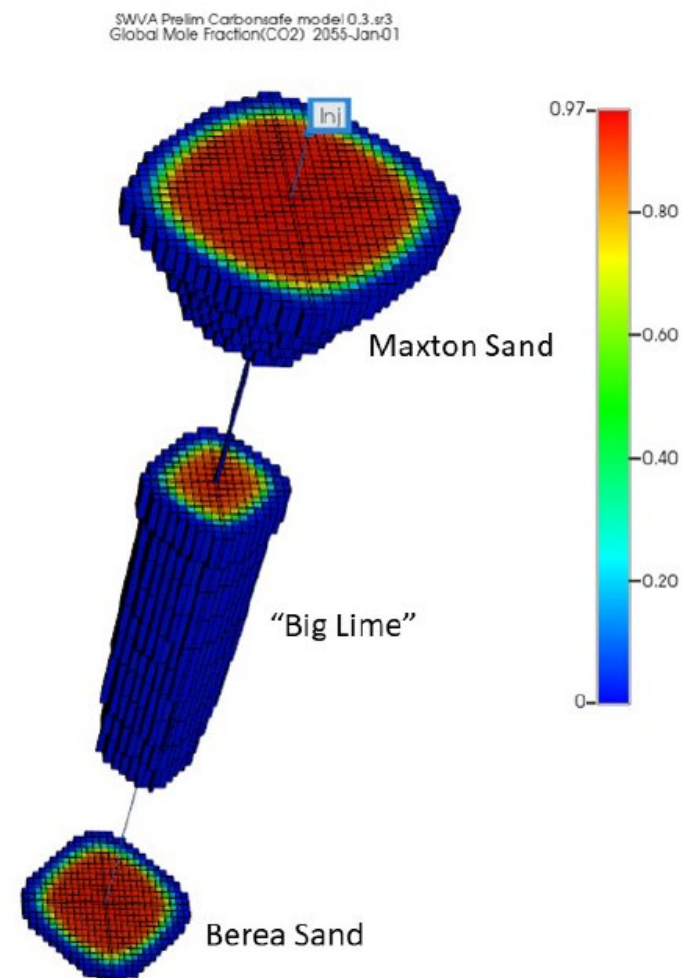
Additional secondary opportunities pending further characterization (Ravenclyff Sandstone, as well as deeper Silurian-aged targets)

- Regional seal identified as the Bluestone Fm
 - Additional seals present as regionally consistent shales above targeted injection intervals



Potential Storage Resource

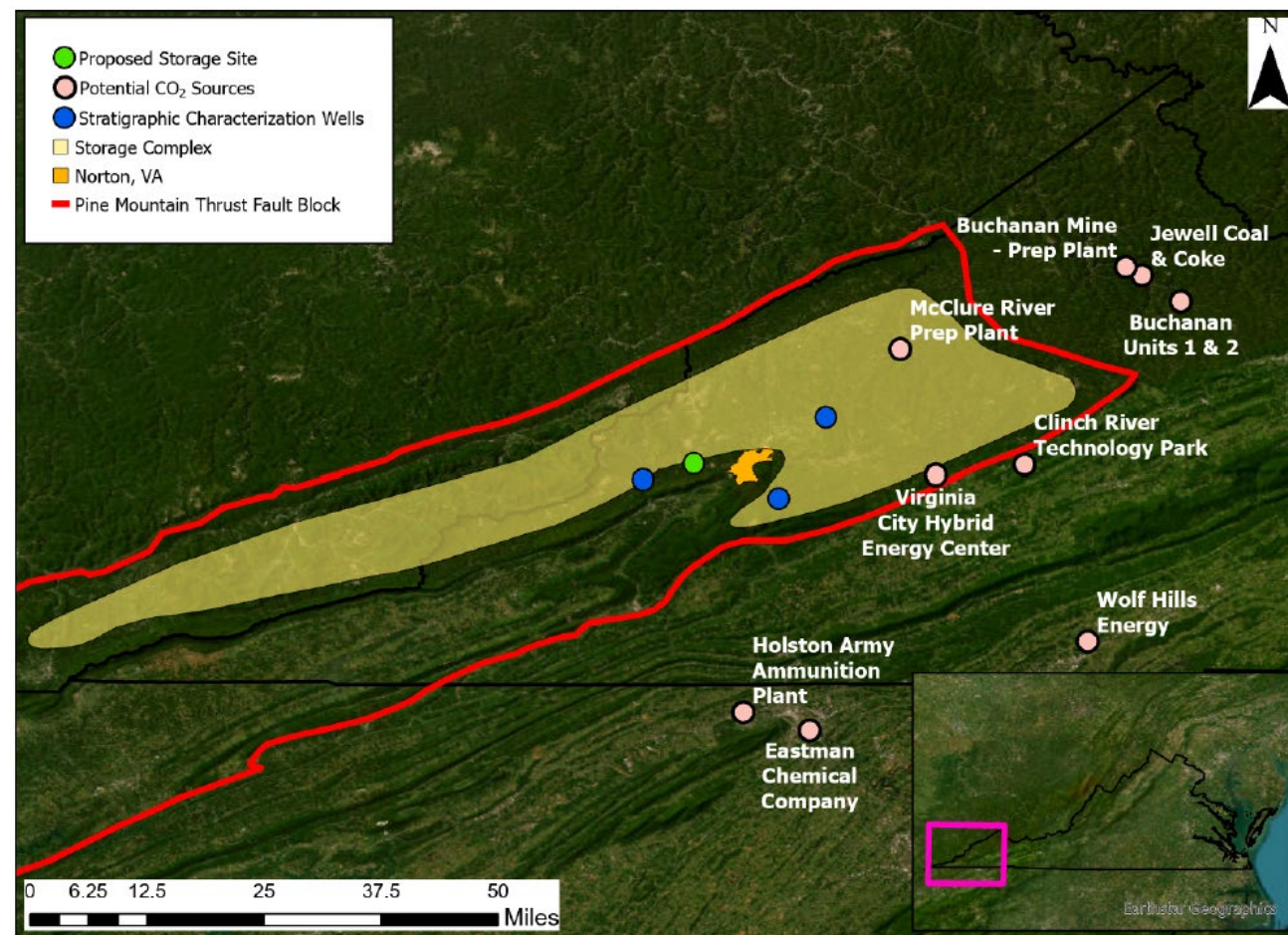
- Preliminary dynamic modeling conducted using estimated reservoir property values from legacy wells
- Allows for a more accurate assessment of the storage potential along with observations for the CO₂ plume and pressure front development
- Utilizing the stacked storage approach, model highlights the variation in plume development between each reservoir
- Will require multi-injection well plan to accommodate 50 Mt of total storage



Potential Storage Resource

- Storage complex is located within the Pine Mountain Thrust fault block
- Signifies approximately 900mi² of subsurface to be developed over time
- Geologic data acquisition and model development will be implemented to fine-tune site specific reservoir properties and demonstrate regional congruity

Storage Resource (Total Complex)	High Probability (Mt)	Medium Probability (Mt)	Low Probability (Mt)
Maxton Sand	99	189	315
"Big Lime"	270	504	873
Berea Sand	108	198	342
Total:	477	891	1,530





Task Outline

- Task 1: Project Management and Planning
- Task 2: Site Specific Characterization and Assessment of the CO₂ Storage Complex
- Task 3: Preliminary Project Risk Assessment with Mitigation and Management Plans
- Task 4: Plan for Subsequent Detailed Site Characterization and UIC VI Application
- Task 5: Project Technical and Economic Feasibility Assessment, Including Conceptual-Level Design Study for CO₂ Transport
- Task 6: Community Benefits

Roles and Responsibilities

Project Partner	Project Contributions
Virginia Energy	- Principal Investigator - Project management - Involved in overseeing the development of Tasks 1 – 6
Advanced Resources International, Inc.	- Extensive experience in CCUS project development from technical and project management perspective - Task 2 – Site Specific Characterization - Support in Tasks 3, 4, and 5.
Coalfield Strategies, LLC	- Experience working in SW Virginia with a focus on business development and community outreach - Establishing strategic partnerships between local industry and communities - Lead effort on Task 6, Community Benefits
Crescent Resource Innovation, LLC	- Experience in risk and environmental concerns in integration, infrastructure planning, and financial needs of regional storage facilities - Participated in several CarbonSAFE projects over previous 6 years - Lead efforts in Task 3, support provided to Tasks 5 and 6
EnerVest, Ltd	- Experienced technical staff and working history of oil and gas development in SW VA - Support for Tasks 2, 3, 4, and 5
Karmis Consulting, LLC	- Significant experience in CO₂ storage research in SW VA, serving as PI on multiple previous DOE-funded projects - Continued Engagement in local communities - Will provide supporting efforts on Tasks 1 – 6
Oklahoma State University	- Long history of teaching, research, and service to the energy industry as well as involvement in CarbonSAFE and other DOE-funded projects - Efforts will be led by Dr. Jack Pashin - Support efforts in Task 2, 4, and 5

Project Management and Planning (Task 1)

- Project Team will develop and provide to the DOE a Project Management Plan detailing the technical report deliverables, their schedule and budget objectives and requirements
- Development of a Data Management Plan
- Project Coordination and Communication
- Documents to be continuously reviewed and updated, as required, throughout the project lifecycle



Site Specific Characterization and Assessment of the CO₂ Storage Complex (Task 2)

- Partnership with EnerVest Ltd – experienced O&G operator with a proven track record of development in conventional gas fields of SW VA
- Planned reentry of a previously drilled well, which will be drilled deeper for acquisition of geophysical logs and whole/sidewall cores (pending hole conditions)
 - Development of drilling design
- Geologic Characterization: planned acquisition of 2D seismic over study location, incorporation of geologic data from online databases, subscription services, available literature
 - This will include evaluation of secondary reservoirs
- Updated reservoir properties from characterization implemented in dynamic modeling approach to determine a more accurate representation of storage potential within the identified storage intervals



Preliminary Project Risk Assessment, Mitigation and Management Plans (Task 3)

- Project Team will host workshops to first compile and then provide updates to a risk registry
 - Identification and evaluation of risks associated with field activities and commercial-scale capture, transport, and storage at the site
 - Updates will be provided to include site-specific information
- Conduct Risk Assessments
 - Identify, analyze, and respond to perceived risks associated with the project
 - Initial compilation of perceived risks, to be updated 90 days post award
 - Develop a risk register and approach to risk management through creation of a risk matrix
 - Matrix will outline project risks, likelihood of occurrence, and potential consequence
 - These will be tracked and updated during the project lifecycle
- Develop Mitigation and Management Plans



Plan for Subsequent Detailed Site Characterization and UIC Class VI Application (Task 4)

- Data collected during characterization phase in combination with modeling simulations to be carried out will be evaluated to determine the potential for continued development of generating a UIC Class VI permit
- Class VI Readiness
 - Evaluate existing and collected data to identify gaps and determine readiness
 - Project Team to develop preliminary plan to acquire additional data during subsequent phases required to advance the project to Class VI readiness
- Injection Well Design and Initial Monitoring, Verification, and Accounting
 - Task 2 work to be utilized in developing a refined wellbore model for injection well design and installation, including completion schematics
 - Preliminary monitoring plan will be developed based on modeling results



Project Technical and Economic Feasibility Assessment, Including Conceptual-Level Design Study for CO₂ Transport (Task 5)

- Project Team will develop an initial design for the Storage Complex
 - Include recommendation of capture technologies where appropriate
- Potential CO₂ Source Screening and Selection
 - Letters of Commitment in hand from 2 sources
 - Historic and projected emissions sufficient to meet CarbonSAFE injection volume (>50MT)
 - Opportunity for inclusion of additional sources within the region as project evolves
- Pore/Surface Rights and Right of Way Requirements
 - Assessment of required pore space rights will be negotiated through Penn Virginia in association with the development of their planned blue hydrogen facility
 - Will include assessment of identified transport routes



Project Technical and Economic Feasibility Assessment, Including Conceptual-Level Design Study for CO₂ Transport (Task 5)

- Conceptual Level Design Study for CO₂ Transportation
 - Generate maps containing local transport pathways and locations of booster stations, monitoring locations, and well pads associated with commercial-scale development
 - Will need to consider existing right of ways and minimized social and environmental impact
 - ROW analysis will demonstrate the capability of transporting necessary CO₂ volumes for a minimum duration of 20 years
- Technical and Economic Feasibility Assessment
 - Development of Commercial Development Plan
 - To include plans for the Storage Complex's continued characterization (to meet Class VI requirements), well design, monitoring, and infrastructure/transportation requirements
 - Goal of proving financial success of commercial development

Community Benefits (Task 6)

- To be led by Coalfield Strategies, LLC
- List of commitments and milestones contained within the Community Benefits Outcomes and Objectives (CBOO) will be followed
- Actionable items: Community and Labor Engagement, Investment in Job Quality and Skilled Workforce, Diversity, Equity, Inclusion, and Accessibility, Justice40 Initiative
- Project team will leverage relationships established through previous efforts within this region
- Vested interest in continuing efforts to build a diverse and talented workforce by partnering with regional organizations including InvestSWVA, local community colleges, and labor unions
- Partnerships with InvestSWVA and Energy DELTA Lab focused exclusively on the economic development and related workforce training needs for coal-impacted communities

Summary

- Virginia Dept. of Energy led project focused on establishing a CO₂ storage hub in the central Appalachian Region (Wise County, VA)
- 2 Letters of Commitment currently in hand, project will be bolstered by the Penn Virginia construction plans of a Blue Hydrogen facility
- Preliminary geologic evaluation proves favorable, adopting a stacked-storage approach
- Further characterization efforts will provide updated reservoir properties for storage and seal intervals, giving more accurate inputs for dynamic modeling efforts to more accurately assess the storage resource
- Project represents a significant industrial development opportunity within rural SW VA, which can provide economic gains in an area that has suffered the impact of the larger scale energy transition to cleaner fuel sources



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