Midwest Regional Carbon Initiative - MRCI

(Regional Initiative to Accelerate CCUS Deployment in Midwestern and Northeastern USA)

DE-FE0031836

U.S. Department of Energy
National Energy Technology Laboratory
CO₂ Storage Project Review Meeting
August 15-19, 2022
Outline

• Background and Program Goals
• Previous Efforts in the Region and Data Collaboration
• Addressing Key Technical Challenges for CO₂ Storage
• Enhancing Infrastructure Development
• Stakeholder Outreach
• Summary
MRCI Program Goals

• Implement a collaborative Regional Initiative to accelerate CCUS deployment in the Midwestern and Northeastern US.

• Build on more than 20 years of CCUS experience in the region by combining expertise of two RCSPs (MRCSP & MGSC).

• Engage national and international stakeholders, including state geological surveys, universities, industrial partners and advisors, fossil fuel production and utilization companies, and NGOs.

• Advanced CCUS research through four tasks:
  ▪ Addressing key technical challenges.
  ▪ Obtaining and sharing data to support CCUS.
  ▪ Facilitating regional infrastructure planning.
  ▪ Performing regional technology transfer.
MRCI – Covering 20 States in Midwest and Northeast

• Battelle and Illinois State Geological Survey combine expertise from MRCSP and MGSC
• Working with State Geological Surveys and Universities across the Region to Accelerate deployment of CCUS
MRCI – Collaboration between Researchers, Industry, and Government, and non-Governmental Organizations

**Sponsor**
- Sponsor 1

**Management/ QA**
- Don Lamonaca
- Steve Whittaker
- Chris Goodman

**Project Leads**
- Neeraj Gupta, Co-PI
- Sallie Greenberg, Co-PI
- Matt Young, PM

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  - Michelle Johnson

**Task 2**
- Addressing Key Research Challenges
  - Mark Kelley
  - Hannes Leetaru
  - Stephen Greb

**Task 3**
- Facilitating Data Collection, Sharing, and Analysis
  - Joel Sminchak
  - Christopher Korose

**Task 4**
- Evaluating Regional Infrastructure
  - Jared Hawkins
  - Carl Carman

**Task 5**
- Promoting Regional Technology Transfer
  - Autumn Haagsma
  - Joy Frank-Collins
  - Jung Sun Sung

**Industry**
- ADM
- AEP
- B&W
- Consol
- Consumer Energy
- Core Energy
- Denbury
- DTE Energy
- Exxon Mobil
- GeoPetro, LLC
- Marathon
- Marquis
- Honda
- MFCC Drilling
- New Steel
- NRECA Cooperative
- Peabody
- Pilot Water Solutions
- PSFC
- Repsol

**Industry and Other Stakeholders**
- CMU
- DGS
- LANL
- MGS
- MIT
- NGS
- UH
- UW
- WGS
- NYSERDA

**GOs/Academia**
- C2ES
- CATF
- ClearPath
- CO2Geonet
- EDF
- ENOS
- Japan CCS
- NARUC

**NGOs**
- IGWS: Ryan Kammer
- Rutgers: Kenneth Miller
- KGS: Stephen Greb
- MDGS: David Brenzinski
- OOGS: James McDonald
- PAGS: Kristin Carter
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- Carbon Solutions: Richard Middleton

**Research Team**
Industrial Collaborations to Enable Deployment and Scale-up

• MRCI is interacting with a range to industry to accelerate CCUS deployment
  ▪ Regional oil and gas companies – obtain legacy seismic and wellbore data for regional mapping
  ▪ Brine Disposal Companies – piggyback logging, monitoring, modeling of large-scale operations to evaluate CO₂ storage
  ▪ Existing and future CO₂ sources – helping companies with site screening and regulatory roadmaps
    - Ethanol plants across the region
    - Planned ammonia plants
    - CoalFIRST in Pennsylvania and Indiana
    - CarbonSAFE Illinois
    - Support utilities and independent power producers
    - State agencies such as MD Energy Administration
    - CCS task forces across the region

Regional Injection Zones from Brine Disposal Wells
Project Aims to Tackle Challenges to Pave Way for CCUS in the Region

- Precambrian Basement
- Leakage
- Socio-economic
- Financial/Business

- Defining Storage Systems
- Quantity Storage
- Stacked Storage
- EOR

- Sources
- Pipelines
- Social/Economic Factors
- Linking to Storage

Storage

Risk
- Federal and State Level
- Incentives
- Permitting

Commercialization

Infrastructure

Policy and Regulations
Defining Carbon Storage Systems and Resources with State Collaborators

Geologic provinces and basins were subdivided into geologic sub-regions on the basis of stratigraphy. Stratigraphic columns were developed for each sub-region and used to identify potential reservoirs and seals.

Potential reservoirs and seals were grouped into five “mega” CS systems (Cambrian; Cambrian-Ordovician; Silurian-Mississippian; Late Triassic-Early Jurassic; and Late Jurassic-Cretaceous).
Developing a Geologic Maps Database for Site Assessment

Maps for key geologic units (depth, structure, thickness, available property data (porosity)) were compiled into an interactive ArcGIS map database containing over 600 maps.
Modeling Commercial-Scale Injectivity of Different CS Systems – Moving up the SRMS Ladder

Models were developed for selected CS systems to evaluate their feasibility for hosting a commercial-scale storage project (assumed to be >1 MMT CO₂ per year >30 years).

Modeling determined the number/spacing of injection wells and approximate Area of Review (AoR; i.e., CO₂ plume area and pressure-impacted area) required to accommodate the target injection rate/quantity of CO₂.

Pickaway County, Central Ohio - Model of Cambrian Ordovician Carbon Storage System – Results indicate that the Maryville formation in Pickaway County offers a potentially viable commercial-scale target for CO₂ sequestration if three or more injection wells are used.
Modeling Containment Risks of Different CS Systems

Generalized diagrams showing stratigraphy and cemented wellbore leakage pathway (left) and caprock leakage pathway (right) that were evaluated with the NRAP-Open-IAM Model and Seal Horizon Model.

**Cemented Wellbore Leakage:** mass of CO\(_2\) leaked into Thief Zone (left plot) and Aquifer 2 (right plot) via hypothetical cemented wells at various distances from the injection well.

**Caprock Leakage:** Cumulative CO\(_2\) mass (left plot) and Brine mass flux (right plot) over time across the Nolichucky Seal.
Precambrian Structure, Faults and Stress

- A regional Precambrian structure surface was compiled from multiple sources
- Regional faulting at the Precambrian surface was included
- Precambrian sedimentary and igneous rift fill locations were added to the map
- In the coastal plain and Atlantic offshore, Triassic rift basins were added
- A Precambrian crystalline (metamorphic-igneous) province and terrane map was made for the surface
Additional Crustal Stress Data from Earthquake Focal Mechanisms (FM)

- New Stress Data Complied by KGS
- Additional FMs from Existing Catalogs
- Earthquakes Considered for FM Calculation (63 events)

New focal mechanisms determined for magnitude 3 and greater earthquakes identified in the MRCI catalog
- FM not Constrained by Data
- Well-Constrained FM (25 of 63 events)
Compiled lists of earthquakes from 1568-2020
- national and state geological surveys
- monitoring networks
- published compilations
- research papers
- personal communications
- EarthScope (ANF)
- 8,122 unique earthquakes
- Common magnitude scale calculated

The ANF database:
- Developed by nearly uniform monitoring by EarthScope’s Transportable Array
- Composed of mostly blasts
- Machine-learning-base classifier identified 60 previously unknown earthquakes.
MRCl Research, Projects, Datasets

Facilitating Data Collection, Sharing, and Analysis

Over 930 reports, presentations, posters, technical papers, datasets inventoried from previous research on carbon storage in MRCI region.
Leveraging Legacy Seismic Datasets

Legacy seismic data was obtained, organized, summarized, and digitized so that it may support CCS in the MRCI region:

- 832 linear miles of 2D seismic data
- 43 square miles of 3D seismic data
- 57 boxes containing CD’s, cassettes, reels, field data, and paper seismic
- Six oil & gas operating companies with data from Illinois, Michigan, and Appalachian Basins

The seismic lines were cataloged in terms of acquisition parameters, vintage, quality, location, and resolution.
Additional Data Analyses

• Planning and Executing Additional Data Analyses
• Additional analysis completed with existing CCS datasets for MRCI:
  • Class I & II Underground Injection Control well injectivity analysis
  • Central MRCI Ethanol Plant CCS Screening Study
  • Greenhouse Gas Emissions Life Cycle Analysis for MRCI Sources
  • ACT collaboration for micro-seismicity
  • Machine learning for downhole pressure/temperature prediction
  • CT scan for carbonate porosity zones
  • NRAP tool validation with field data in MRCI
SMART Initiative

• Machine Learning
  - Topic areas identified for ML analysis
    - BHP/BHT Prediction from Wellhead Data Using Machine Learning
    - Carbonate Characterization using 2D and 3D Images to Predict Reservoir Properties
    - DTS/DAS processing and interpretation
  - Preliminary work plans were developed for these ML topics.
  - The project team discussed integrating data from the MGSC, MRCSP, and other portions of the MRCI into the ML efforts. These data included items like injection operational pressure/temperature data, geophysical log data, core CT scans, geophysical logs, and CO₂ storage monitoring data.
Rethinking infrastructure for Carbon Capture, Utilization, and Storage (CCUS)

Researching the infrastructure of CCUS is more than just the physical equipment that enables CCUS; it also includes the policy, economics, and people that make CCUS work.
Evaluating Regional Infrastructure

GOAL: Evaluate current infrastructure and future needs to accelerate CCUS deployment

- Conduct a screening level assessment of surface and subsurface infrastructure
- Assess **site readiness** to rank areas
- Conduct analysis of **social, economic, and workforce development** factors
- Analyze current **regulatory, pore space issues**, gaps, policy, and tax incentives
Infrastructure Development Strategies

• Investigate infrastructure development strategies for distinct MRCI projects:
  ▪ (1) Distributive—Ohio/Pennsylvania/West Virginia
  ▪ (2) Hub—Northern Michigan,
  ▪ (3) Hub—Indiana,
  ▪ (4) Local—Central Ohio, and
  ▪ (5) Offshore—Mid-Atlantic/Northeast

• Emerging technologies: Blue Hydrogen, BioEnergy with CCS (BECCS), and Direct Air Capture (DAC).
Evaluating Regional Infrastructure Progress

- Evaluating jobs using input-output models.
- Calculating projects expenses, benefits, and tax.

Jobs and Economic Impact

- Conducting community characterization.
- Researching environmental justice and sustainability.
- Working with outreach task.

Social Characteristics

- Determining workforce characteristics.
- Outlining workforce needs.
- Identifying training institutions.

Workforce Development

Capture, Transport, and/or Storage Implementation

Process I

- Activity I-A
- Activity I-B
- Activity I-C

Task I-A1 Task I-A2 Task I-A3
Task I-B1 Task I-B2 Task I-B3
Task I-C1 Task I-C2 Task I-C3

Process II

- Activity II-A
- Activity II-B
- Activity II-C

Task II-A1 Task II-A2 Task II-A3
Task II-B1 Task II-B2 Task II-B3
Task II-C1 Task II-C2 Task II-C3

Process III

- Activity III-A
- Activity III-B
- Activity III-C

Task III-A1 Task III-A2 Task III-A3
Task III-B1 Task III-B2 Task III-B3
Task III-C1 Task III-C2 Task III-C3

2020 Census Results

Quarterly Workforce Indicators

EJScreen

EPA Environmental Protection Agency

NCES National Center for Education Statistics

CIP The Classification of Instructional Programs

MRCI Midwest Regional Carbon Initiative
Promoting Regional Technology Transfer

GOAL: Leverage existing and new relationships with critical CCUS stakeholders within the RI and globally and become a key resource for CCUS development.

- Promote acceleration of CCUS deployment by providing general support for commercialization and technology transfer
- Compile and communicate information from previous tasks to interested stakeholders
- Engage with federal and state governments, industry consortia and NGOs
- Engage with global institutions
Promoting Regional Technology Transfer

- Website development is ongoing
  - www.midwestccus.org
- Bi-monthly newsletters
- CCUS Podcast - https://soundcloud.com/energy-geos
- Numerous outreach activities documented
  - Technical presentations and panels
  - Workshops
  - Event participation
  - Information sharing, discussions with stakeholders and interested parties
  - Papers
  - Materials – Fact sheets, Infographics
Focus on Environmental Justice
Learning, Connecting, and Informing

- Formed MRCI EJ Working Group to explore the topic, learn about its roots, and how it intersects with CCUS
- Compile and communicate information about Justice40 Initiative, Energy Communities, etc. with stakeholders
- Hosting EJ Workshop at Annual Stakeholders Meeting Sept. 27-28, 2022
- Engaging with other Initiatives on EJ in late 2022, early 2023
## Aligning Outreach Strategy with Targeted Audiences

<table>
<thead>
<tr>
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<td>• Short courses</td>
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<td>• Hands-on learning opportunities</td>
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</table>

- 2020-2021 considered “passive” phase, will be moving into an “active phase”
- 2022- big things planned and more engagement on state and federal levels!
Summary and Expected Outcome

- Establishment of a broad-based consortium of researchers and stakeholders
- Collection, compilation, sharing, and utilization of CCUS related data from across the region
- Assessment and analyses to improve certainty of geologic characterization underway
- Identification of viable storage reserves, including stacked storage.
- Identification of available information and methods useful for Basement characterization
- Outline source-sink scenarios and pipeline routes for CCUS
- Application of a Risk-Based Probabilistic Model to value potential risks of CCS
- Assessment of policy, economic, and social issues, including knowledge sharing materials and workforce development plans
- **MRCI Stakeholder Meeting – Columbus, September 27-28**
**MRCI – Collaboration between Researchers, Industry, and Government, and non-Governmental Organizations**

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- US Department of Energy
- National Technology Transfer

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  - Joy Frank-Collins
  - Jung Sun Sung
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*Values correspond to Table 2.