## CarbonSAFE Illinois Macon County DE-FE0029381

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U.S. Department of Energy

National Energy Technology Laboratory

Carbon Capture Front End Engineering Design Studies and CarbonSafe 2020 Integrated Review Webinar

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# **Program Overview**

## – Funding

- Federal Share: \$9,209,104
- Non-Federal Share \$2,613,270
- Total: \$11,822,374
- Overall Project Performance Dates
  - April 1 2017 March 31 2021
- Overall Project Objectives
  - Acquire subsurface data, perform analyses and modeling and related work to establish feasibility for geological storage of 50Mt CO<sub>2</sub> over 30 years in east-central Illinois.

## **Program Overview**



# **Technology Section**

Site Selection in central Illinois







**ILLINOIS** Illinois State Geological Survey Prairie research institute

# **Technology Section**

## Previous Characterization

#### **I** ILLINOIS

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# Technical Approach/Project Scope

A. Technical Approach/Project Scope

- Characterize Site for storage potential
- Conduct 2D seismic
- Drill characterization well, core, log, test, VSP
- Build Static Geocellular model
- Simulate injection of 50Mt CO<sub>2</sub> over 30 years
- Evaluate commercialization environment

# Technical Approach/Project Scope

## B. Project success criteria

- Execute data acquisition program
- Evaluate storage complex for storage
- Determine whether potential exists for injecting  $>50Mt CO_2$  over 30 years
- C. Significant project risks and mitigation strategies
  - Primary geology unsuitable secondary storage zones exist
  - Inability to collect sufficient or appropriate data -
  - Project cost over runs monitor costs esp during drilling

## **Progress and Current Status** Regional Integration

- Commercialization (Ethanol)
  - Storage: plants can breakeven on project costs by capturing and injecting at least 250 kta and utilizing or selling 45Q credits
  - Utilization: plants must capture at least 360 kta to breakeven – but additional costs re transport likely needed
  - Storage HUB potential

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## Progress and Current Status SimCCS

IU and ISGS teams are using results from the static and dynamic modeling tasks to parameterize the storage model for *SimCCS* via SCO<sub>2</sub>T ROM approach.





SimCCS Gateway has been configured to run scenarios ranging from 0.25-10.5 Mtpa  $CO_2$  capture from 5 sites in the study area

## **Progress and Current Status**

## Synergy with IBDP

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CarbonSAFE

IBDP

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## **Progress and Current Status Dynamic Simulations**



# Progress and Current Status Dynamic Simulations

80 acre spacing: **three well injection** for 30 years Cumulative injection: >190Mt  $CO_2$ 

CO<sub>2</sub> saturation after 30 years injection shown





# Progress and Current Status Dynamic Simulations



## **Progress and Current Status** Geomechanical Characterization



#### ENGINEERING AT ILLINOIS

## Progress and Current Status Stress Analyses

- FMI log shows natural fractures with varying strike directions
- Wellbore failures (i.e. DITFs and WBOs) indicate
   S<sub>Hmax</sub> = 68°









## **Progress and Current Status** Geomechanical Characterization







# **NRAP** Application

### Risk assessment workflow for CarbonSAFE Macon (Christian Co.)

#### System Description

#### Define stratigraphy

- Units, depths, thicknesses, properties
- Uncertainty in select properties
- Storage operations
  - · Well locations, properties
  - Injection scenario

#### STOMP Reservoir Simulations

- Define stratigraphy
  - Units, depths, thicknesses, properties
  - Uncertainty in select properties
- Storage operations
  - · Well locations, properties
  - Injection scenario

#### NRAP-Open-IAM Risk Assessment

# Define geometry Define experiment matrix Build system model with the following components: Reservoir look up table Stratigraphy Well leakage ROM Latin Hypercube Sampling for stochastic analysis Aquifer impact ROM Time to first detect (ttfd) files Risk based Area of Review Run simulations Visualize results Output ttfd for DREAM

#### DREAM Analysis

- · Import ttfd files
- Run DREAM
- Determine optimum monitoring technologies and locations

#### Risk assessment using NRAP tools:

- Conservative exercise, assumes injection and monitoring well are leaking
- Estimates leakage rates and impacts to aquifer/AZMI from CO<sub>2</sub> and brine
- Stochastically vary leak path permeability to observe range of behaviors

#### Outcome:

- Impacts are localized around leaky well
- Inform how NRAP tools can be improved to be more
- Inform which uncertain parameters need to be constrained for next phase of project

# Summary Slide

- The CarbonSAFE Macon County project has improved understanding of the nature and distribution of quality reservoir within the Mt Simon Sandstone in the Illinois Basin
- Characterization and modeling of the project site indicates that injection of over 50Mt CO<sub>2</sub> over 30 years can be performed
- The area has the capacity for large-scale storage hubs
- Future activities
  - Refining dynamic simulations
  - Integrating geomechanical & well test studies
  - Developmental plan

# Appendix

These slides will not be discussed during the presentation, but are mandatory.

## **Organization Chart**



21

## **Gantt Chart**

Table 3: Gantt Chart	2017			2018			2019				2020					2021				
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2 0	13 Q4	
Revised PMP_CarbonSAFE Illinois Macon County as of 12.04.18_amendment																				]
Task																				1
1.0 PROJECT MANAGEMENT AND PLANNING									1											lon
1.1 Manage all project activities, objectives, and milestones						1														511
A. Project Kick-off Meeting		٠																		
1.2 Project Management Plan																				1
B. Revised Project Management Plan								•												
1.3 Project Evaluation and Assessment																				]
1.4 Knowledge Sharing and Best Practice Manuals																				]
1.5 Communications						1														]
C. Finalized Communication Plan			٠																	lnt
1.6 Data Management						1			1											
2.0 RISK ASSESSMENT																				
2.1 Risk Assessment						1			1											
D. Risk Assessment Summary																	•			]
2.2 Develop Risk Mitigation Stratgey																				
2.3 Identify Risk Pathways for Storage Complex Development																				]
- 3.0 STAKEHOLDER ENGAGEMENT AND OUTREACH						1			1											
3.1 Conduct Stakeholder Analysis																				1
3.2 Develop Stakeholder Engagement and Outreach Plan																				
3.3 Develop Outreach Materials																				1
3.4 Conduct Stakeholder Engagement and Public Outreach																				
- 4 BUSINESS AND ECONOMIC DEVELOPMENT ASSESSMENT			-																	
4.1 Business and Financial Case Study																				
E. Complete Business/Financial Case Study															4	•				
5 PERMITTING AND COMPLIANCE																				]
5.1 Policy, Regulatory, Legal, and Permitting Case Study																				
5.2 Obtain necessary permits for characterization activities						1														
F. Obtain Stratigraphic Well Drilling Permit								•												
5.3 Develop UIC Permitting Plan						1			1											
6.0 SUBSURFACE CHARACTERIZATION																				]
6.1 Collect, Assemble, Evaluate Existing Subsurface Data																				]
6.2 Conduct Pre-drilling Site Assessment																				
G. Pre-Drilling Site Assessment Complete				•																
6.3 Assess Data Collected from Stratigraphic Well																				22
6.4 Integrate Well data with Conceptual Geologic Models																				
H. Deliver Integrated Data for Modeling															4	•				]
6.5 Evaluate Geologic Data Sources and Identify Data Gaps																				]

## Gantt Chart (cont.)

Table 3: Gantt Chart		20	17		2018					20	)19		2020				2021			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
6.6 Acquire 2-D Seismic																				
I. Complete 2-D Seismic Survey									•											
7 WELL DRILLING AND TESTING																				
7.1 Desgin Well Drilling Program																				
7.2 Conduct Drill on Paper Exercise																				
J. Complete Drill on Paper Exercise								•												
7.3 Drill and Construct Stratigraphic Test Well																				
K. Complete Testing in Stratigraphic Test Well												•								
7.4 Testing and Data Collection																				
8 STORAGE COMPLEX MODELING																ĺ				
8.1 Development of Static Model																				
8.2 Development of Dynamic Reservoir Model																				
8.3 Calibrate and Test Model Outputs															i					
9 NATIONAL RISK ASSESSMENT PARTNERSHIP (NRAP) SCREENING																				
9.1 Conduct NRAP Toolkit Assessment																				
L. Conduct NRAP Tool Assessment Evaluation													•							
10 INFRASTRUCTURE DEVELOPMENT																				
10.1 CO2 Source Assessment																				
10.2 Transportation and Infrastructure Assessment																				
10.3 Develop Regional Roadmap for Source Network and Storage Development																				
M. Regional Roadmap for Source Network														4	•					
11 STORAGE COMPLEX DEVELOPMENT PLANNING								1												
11.1 Develop Detailed Site Characterization Plan																				
N. Detailed Site Characterization Plan																	•			
11.2 Integrated Regional Overview for Commercialization																				