CarbonSAFE Illinois – Macon Christian County
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Presentation Outline

• Project Context and Changes
• Storage Play
• CO$_2$ sources and associated challenges
• Advantages of new well location
• Summary
CarbonSAFE Progression to CCS Commercialization

IBDP: 1 MT Demonstration

ICCS: 3 - 5.5 MT Industry Site

CarbonSAFE >50 MT Commercialization
CarbonSAFE Illinois Area

- Forsyth well
- McMillen well

Map showing the location of Forsyth well and McMillen well within the CarbonSAFE Illinois Area.
CarbonSAFE Storage Complexes
Mt Simon Sandstone

- Cambrian Mt Simon Sandstone is ~1500 ft thick at CarbonSAFE site
- In CarbonSAFE region the Mt Simon can be divided into three major sections
- Lower Mt Simon is preferred storage unit; Upper Mt Simon also suitable
- Lower Mt. Simon "storage play"
- Eau Claire Formation overlies Mt Simon and is regional seal

Modified from Freiburg et al., 2016
Depositional Environment

Mt. Simon Sandstone

Upper
Middle
Lower

Argenta

Precambrian “Basement”

Dominant Depositional Environment

Tidal Flat
Eolian
Fluvial
Eolian
Fluvial
Alluvial

Feldspar sourced from proximal Precambrian highs
Lower Mt. Simon Depositional Environments

Coastal
Lagoon
Plains
River
Desert

Highly heterogeneous - but average porosity around 18%!

Maximum porosity of 27.3% and permeability of 498 mD!
Diagenesis of Arkose

1. clay coatings

Early clay coatings prevent abundant quartz cementation
Diagenesis of Arkose

2. feldspar dissolution

Abundant secondary porosity resulting from late-stage feldspar dissolution
Precambrian Basement

- Upper Basement is Rhyolite veneer (?) over felsic (granitic) rocks
- Distinct Weathering Profile. Fractured
- Dated at 1.45 Ga
Precambrian Topography
Proximal Precambrian Highs on structure source arkose
“Arkosic storage play”
CarbonSAFE CO$_2$ Sources

- **Prairie State**: ~10 MTPY
- **CWLP**: 1.6 MTPY
- **Abbott**: 0.2 - 0.4 MT/a
- **ADM**: 1 MTPY
- **Wabash Valley**: 1.7 MTPY
Abbott Site for Carbon Capture Plant Established and Evaluated
CWLP’s Dalman Unit #4: 200 MWe

- Unit #4 burned approximately 552,500 tons of Illinois coal in 2014
- Name Plate ca 1.6MT CO₂/a
Prairie State Generating Company

• The Prairie State Energy Campus includes a 1600 MW coal-fired generating plant and adjacent coal mine.

• Commercial operations began in June of 2012 for Unit 1, and November of 2012 for Unit 2.

• More than $1 billion invested in environmental emissions controls and supercritical technologies.

• Prairie State’s power plant is among cleanest plants in the nation.

• 2016 CO₂ emissions >10MT
Study Area

- Sole-source aquifer
- Forsyth well
- IBDP
- RT McMillen well

Map showing the study area with key locations and geological features.
Storage Site Interaction

Injection Schedule
- CCS1: 0.33 Mt/yr for 3 years (2011-2014)
- CCS2: 1 Mt/yr for 5 years (2017-2023)
- CCS3: 2 Mt/yr for 25 years (2025-2050)
- Post-Injection Monitoring: 20 years (2050-2070)

Plume interaction
- Little plume interaction observed for sites ~ 3 miles apart.
- Injection induced reservoir pressure increase was less than 4%.
# Storage Resource Management for Commerciality

## Storage Resource Management System

### Project Maturity Sub-classes

- On Injection
- Approved for Development
- Justified for Development
- Development Pending
- Development On Hold
- Development Not Viable
- Development Unclarified

### Range of Uncertainty

- **Discoveries**
  - Discovered Storage Resources
    - Sub-commercial
    - Commercial
  - Contingent Storage Resources
    - Sub-commercial
    - Commercial
  - Unexploitable Storage Resources
  - Total Storage Resources

### Increasing Chance of Commerciality

- **Prospects**
  - Prospect
  - Lead
  - Play

### Undiscovered Storage Resources

- Undiscovered Capacity On Injection

### Sequence Play

Characterization Well

Characterization Plan

• ~300’ Whole Core
• ~120 Sidewall Cores
• Evaluation
  – Triple Combo
  – Formation Images
  – Full Sonic
  – Elemental Spectroscopy
  – Magnetic Resonance
• Cased Hole Testing
  – VSP
  – Step Rate Tests
  – Sampling
  – Pressure Falloff
• Evaluate EOR Potential (Silurian)
• Drill into Precambrian for basement characterization
CO₂ Capture and Transportation Screening-Level Cost Estimates

• ADM Ethanol Facility in Decatur, IL
  – 55 MMscfd or 1 million tonne per year (MTPY) of CO₂
  – $0.30 - $0.71 / tonne CO₂ - Estimate is for transportation only

• CWLP Dalman Unit #4
  – 75 MMscfd or 1.4 MTPY of CO₂ capture from 200 MWe coal-fired unit
  – $63 - $82 / tonne CO₂ - Estimate includes capture, compression, cogeneration facility (to offset parasitic load), and transportation

• Next steps
  – Revise ADM and CWLP to reflect new well site
  – Develop estimates for Prairie State and Abbott
  – Integrate with SimCCS
Risk Assessment Progress

Top 3 Ranked Risks

1. CO₂ source unwilling to participate results in no commercial viability.
2. Changes in federal project funding results in significant reduction of scope or outright cancellation of the project.
3. Unable to obtain site host results in an inability to drill a stratigraphic test well.
NRAP Integrated Assessment (IAM) tool

- Simulated CO₂ and brine leakage into the proximal USDW using 4 hypothetical wells modeled as open boreholes at 0*, 1, 2, and 3km south of the injection well
- Aquifer parameters derived from the St. Peter Sandstone
- Simulation indicates that the USDW was impacted at hypothetical wells only up to 1km from injection
Project Summary

- Identified new sources of CO₂ suitable for potential capture and transportation
  - challenge presented by scale of storage resource required for very large emitters (land access, pore space ownership, subsurface requirements)
- Revised drilling target to accommodate larger potential sources of CO₂ and reduce risks associated with initial site
- Well drilling early fall 2018
- Better define “arkosic sequence play” for moving toward commercialization of Mt. Simon storage resource – implement SRMS
- Re-evaluate stakeholder engagement requirements
- Integrate costs, SimCCS for business case evaluation
Thank You

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