CarbonSAFE - Illinois

Dr Hannes Leetaru
Mr Chris Korose
Dr Steve Whittaker
CCUS Progression in Illinois Basin

- **IBDP**: 1 MT Demonstration
- **ICCS**: 3 - 5.5 MT Industry Site
- **CarbonSAFE Illinois**: >50 MT Commercialization

*MGSC 2019*
CarbonSAFE Projects

- Phase 1: CarbonSAFE Illinois – East Basin
- Phase 2: CarbonSAFE Illinois – Macon County
- Phase 2: Wabash CarbonSAFE

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(Macon County: DE-FE0029381) (East Basin DE-FE0029445) (Wabash DE-FE0031626)
CarbonSAFE
East Basin

MGSC CO2 sources
- Primary Aluminum
- Cement
- Chemical
- Agricultural Processing
- Ethanol
- Nat. Gas Processing/Distribution
- Petroleum Refineries
- Iron and Steel
- Industrial/Manufacturing
- Electricity Generation
- Other

Region of Primary Interest
Region of Secondary Interest
City of Chicago
City of Great Lakes Field
City of Illinois Field
City of South Dakota Field
City of Texas Field
City of Wyoming Field
City of Alberta Field
City of British Columbia Field
City of Saskatchewan Field
City of Manitoba Field
City of Ontario Field
City of Quebec Field
City of Nova Scotia Field
City of New Brunswick Field
City of Prince Edward Island Field
City of Newfoundland and Labrador Field
City of Yukon Field
City of Northwest Territories Field
City of Nunavut Field
City of British Columbia Field
City of Alberta Field
City of Saskatchewan Field
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City of Northwest Territories Field
City of Nunavut Field

Abbott Power Plant
Mt. Simon storage resource
Combined St. Peter, Knox, and Mt. Simon storage resource

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CO₂ emissions > 100,000 tonnes/yr

East Basin Roadmap

Phase 2
Wabash
CarbonSAFE

2D seismic
ROZ?
CarbonSAFE Illinois – Macon County

Sole-source aquifer

RT McMillen well

Mt Auburn Trend

IBDP

CWLP

ILLINOIS BASIN

NE Missouri Arch
Kentakkee Arch
Mississippi Embayment of Gulf Coastal Plain
CO River Arch

New Madrid Rift System
Rough Creek Graben

Illinois State Geological Survey
PRARIE RESEARCH INSTITUTE

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Dominant Depositional Environment

Tidal Flat

Eolian

Fluvial

Eolian

Fluvial

Alluvial

Feldspar sourced from proximal Precambrian highs in an estuarine environment
Diagenesis of Arkose

Secondary porosity results from dissolution of feldspar
Proximal Precambrian highs source of feldspar?
2D Seismic Program

- Proterozoic (Basement) Margin contact
- Existing 2D seismic line
- CarbonSAFE 2D seismic line (approximate location)
- RT McMillen well
- Existing 3D seismic
- IBDP
- Sole-source aquifer

Existing 2D seismic line

CarbonSAFE 2D seismic line (approximate location)

RT McMillen well

Existing 3D seismic

IBDP

Sole-source aquifer
Geological Controls over Storage Complex Distribution

- Proterozoic (Basement) Margin contact
- Existing 2D seismic line
- CarbonSAFE 2D seismic line (approximate location)
- Proterozoic Margin
- Regional source of feldspar?
- Existing 3D seismic
- IBDP
- RT McMillen well

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Vertical Seismic Profiles at TR McMillen #2

- One zero-offset
- One walk-away 2D VSP
VSP: Reservoir Characterization

Ray Tracing

2D VSP Pre-stack migration

South

North
Well Testing at TR McMillen #2

- Step rate test
- Vertical Interference
- Step rate test
- Vertical Interference
- Step rate test
- Vertical Interference
- Step rate test
- Extended Well Test
  - 30 days pump; 15 shut-in

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CarbonSAFE Storage Evaluation

<table>
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<tr>
<th>Project Maturity Sub-classes</th>
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<tr>
<td>On Injection</td>
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<tr>
<td>Approved for Development</td>
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<tr>
<td>Justified for Development</td>
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<tr>
<td>Development Pending</td>
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<tr>
<td>Development On Hold</td>
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<tr>
<td>Development Not Viable</td>
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<tr>
<td>Development Unclarified</td>
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<table>
<thead>
<tr>
<th>Total Storage Resources</th>
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<tr>
<td>Discovered Storage Resources</td>
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<td>Contingent Storage Resources</td>
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<tr>
<td>Prospective Storage Resources</td>
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<tr>
<td>Unexploitable Storage Resources</td>
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Undiscovered Prospect

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CarbonSAFE Illinois – Macon County CO$_2$ Sources

- 10’s of MT/y CO$_2$
- Variety of industries

Opportunity to greatly improve commercialization decisions by defining storage resource
Wabash CarbonSAFE

- IGCC Unit 1A (DOE 1993-1995); ‘mothballed’ in Nov ‘15.
- Wabash Valley Resources purchased plant May ’16 for ammonia production from petcoke
- >95% pure stream CO$_2$ @ 1.7 million tonnes/yr
Few Mt. Simon penetrations in IL Basin
Regional thickness trend
Nearest well(s) to Wabash
- 22mi N: upper Mt. Simon only
- 25mi SE (upper)
- 50mi S (lower)
- 75mi NW: arkosic zone @ Manlove
Stratigraphic well necessary!
Early Stages

- Abandoned underground coal mines
  - Impacted location of characterization well
  - Impact on seismic acquisition?
2D Seismic

Coal mines in region

Have acquired 1 mile test line

Starting permitting process to define lines

Characterize Mt Simon and Precambrian surface

Will provide data to help determine monitoring (time lapse) potential
Wabash Characterization Well

- Drill to ~8,300-8,500 ft
- Whole Core
  - St. Peter?
  - Eau Claire – Upper Mt. Simon
  - Lower Mt. Simon
  - Precambrian (contact?)
- Sidewall Cores
- Evaluation
  - Triple Combo
  - Formation Images
  - Full Sonic
  - Elemental Spectroscopy
  - Magnetic Resonance
- Cased Hole Testing
  - VSP
  - Fluid Sampling
  - Step Rate Tests
  - Pressure Falloff
  - EWT
- Drill into Precambrian for basement characterization