

Illinois Industrial Carbon Capture & Storage Project



Eliminating CO₂ Emissions from the Production of Bio Fuels - A 'Green' Carbon Process

Council of Industrial Boiler Owners

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Acknowledgements



- **The Industrial Carbon Capture and Storage (ICCS) project is administered by the U.S. Department of Energy's Office of Fossil Energy and managed by the National Energy Technology Laboratory (award number DE-FE-0001547) and by a cost share agreement with the Archer Daniels Midland Company, University of Illinois through the Illinois State Geological Survey, Schlumberger Carbon Services, and Richland Community College. This ICCS project received DOE funding from the American Recovery and Reinvestment Act of 2009 (\$141.4 million).**
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- **The Midwest Geological Sequestration Consortium (MGSC) is a collaboration led by the geological surveys of Illinois, Indiana, and Kentucky**



ADM Company Profile



Core Purpose

Connecting the harvest to the home and transforming crops into products that serve vital needs for food and energy.

Key Facts

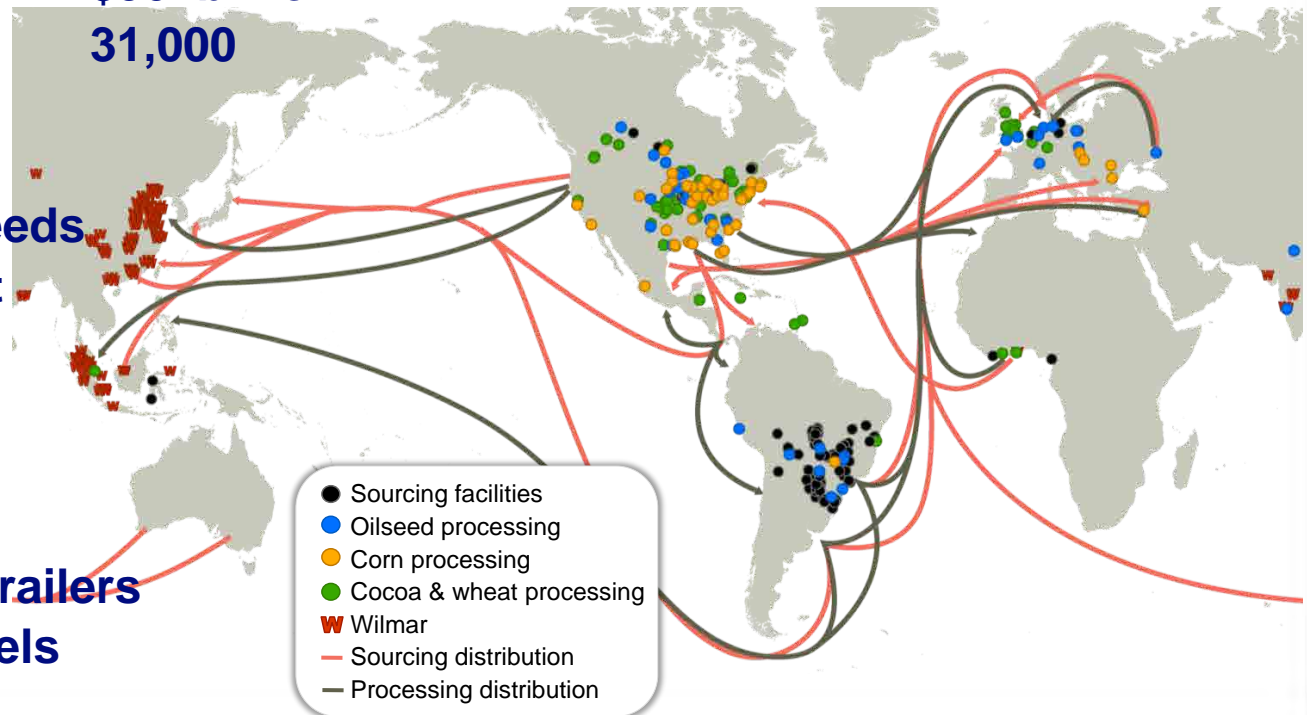
- Facilities **Over 700 with sales in 140 Countries**
- FY 2013 Net Sales: **\$90 billion**
- Employees: **31,000**

Processing

- 74,000 MTD of corn
- 164,000 MTD of oilseeds
- 28,000 MTD of wheat
- 1,800 MTD of cocoa

Logistics

- 27,400 Rail cars
- 2,500 Barges
- 600 Trucks – 1,300 Trailers
- 52 Oceangoing vessels



Corn = 13 acre/min

Oilseeds = 90 acre/min

Wheat = 38 acre/min

• Facilities: Over 200 with sales in 140 countries

• FY 2013 Net Sales: \$90 billion

• Employees: 31,000

Processing

• 74,000 MTD of corn

• 164,000 MTD of oilseeds

• 28,000 MTD of wheat

• 1,800 MTD of cocoa

Logistics

• 25,000 trailers

• 2,500 barges

• 600 Trucks – 1,300 Trailers

• 50 Ocean vessels

world





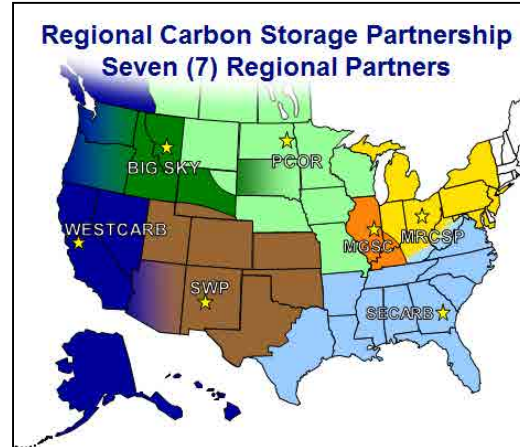
Illinois Basin Decatur Project (IBDP)



Program Objective

Large scale geologic test to inject 1.0 million tons of CO₂ over a three year period (1,000 MT/day).

Project Team Members



Characterization Phase (2003-2005)		
Search of potential storage locations and CO ₂ sources	Found potential for 100's of years of storage	
↓		
Validation Phase (2005-2010)		
20 injection tests in saline formations, depleted oil, unmineable coal seams, and basalt		
↓		
Development Phase (2008-2017+)		
9 large scale injections (over 1 million tons each)	Commercial scale understanding	Regulatory, liability, ownership issues
Partnership	Geologic Province	Type
1 Big Sky	Triassic Nugget Sandstone / Moxa Arch	Saline
2 MGSC	Deep Mt. Simon Sandstone	Saline
3 MRCSP	St. Peter Sandstone	Saline
4 PCOR	Bell Creek Field	Oil Bearing
5	Devonian Age Carbonate Rock	Saline

Knowledge Base

- Site Geological Characterization
- Risk Assessment & Reservoir Modeling
- Engineering Design & MVA

Breaking ground for anthropogenic CO₂ storage in a saline reservoir using cutting-edge storage technology





Illinois Industrial CCS Project (IL-ICCS)



Program Objectives

- Target & Demonstrate Advanced CCS Technologies at Industrial Scale Facilities
- Inject and Store One Million Tons of CO₂ Annually (3,000 tons/day)

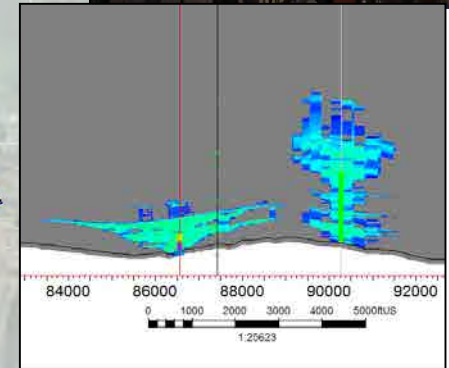
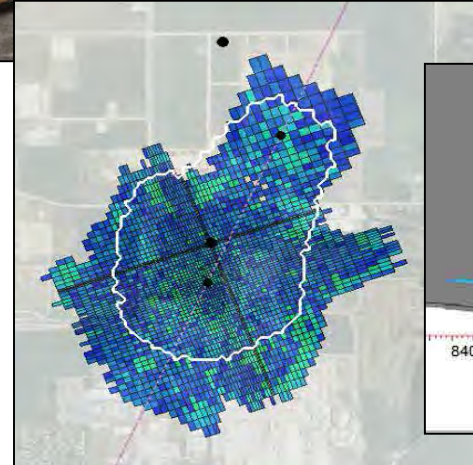
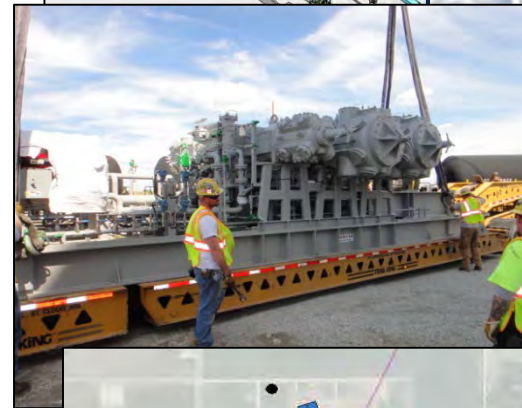
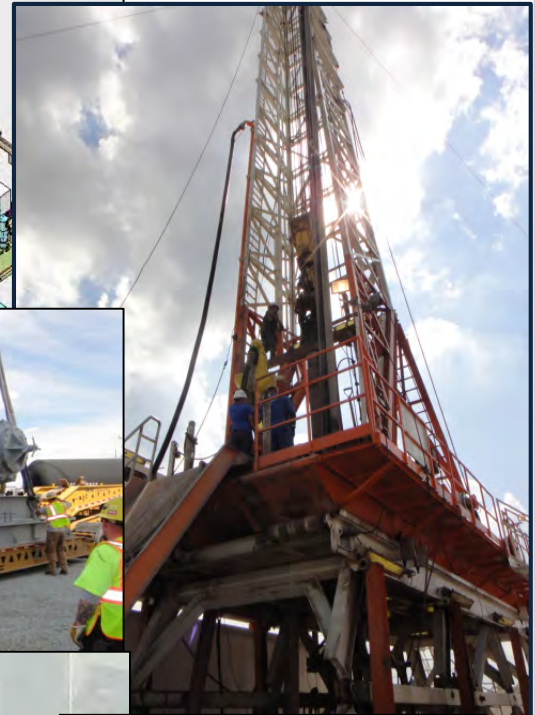
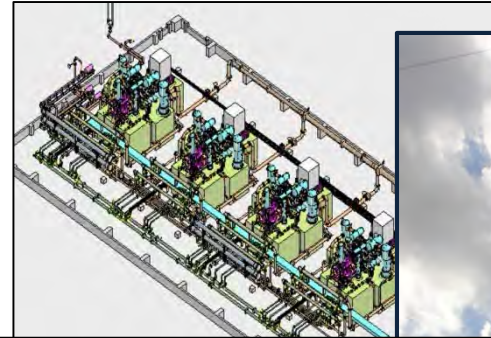
Project Team Members



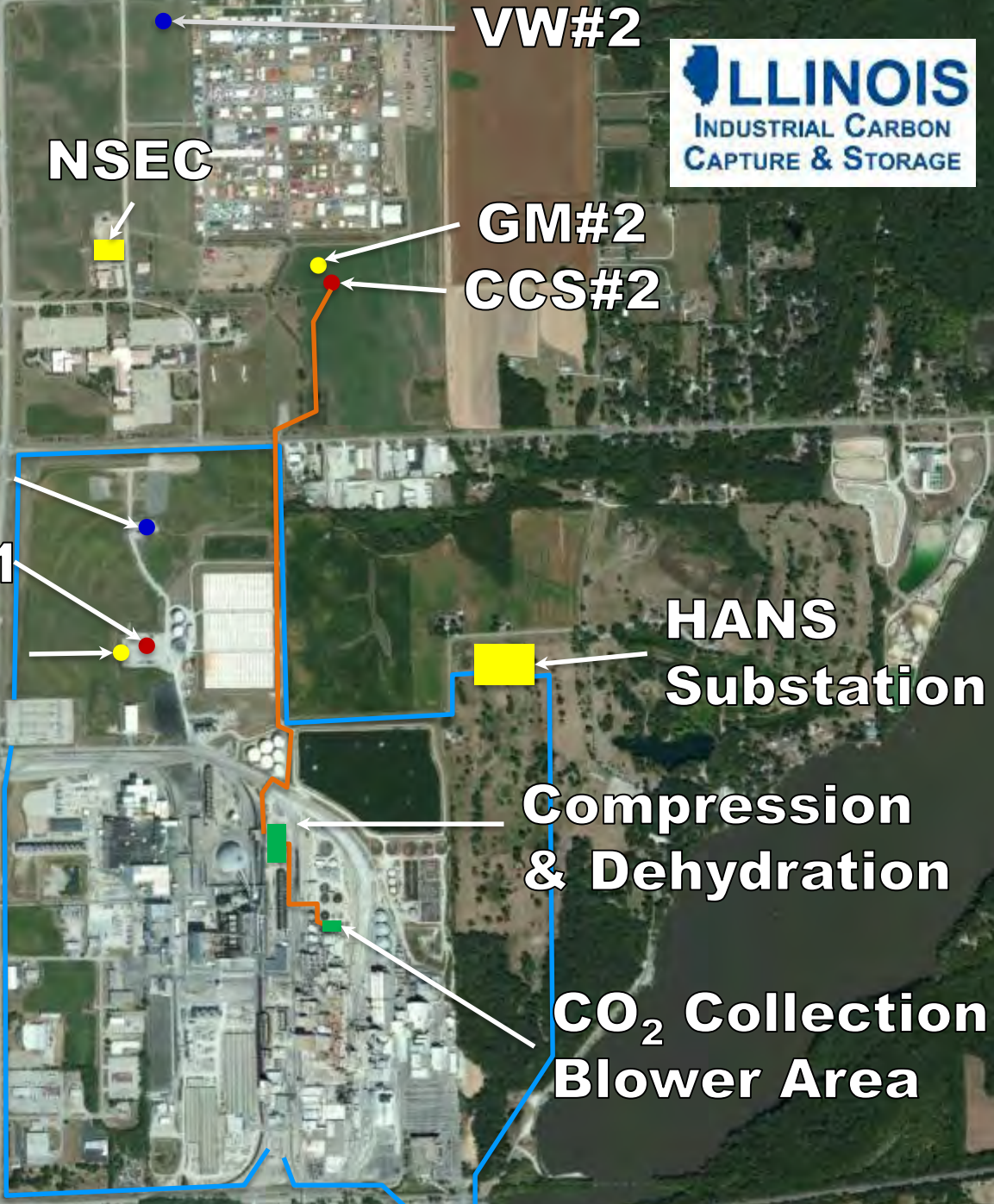
Knowledge Base

- Site Geological Characterization
- Risk Assessment & Reservoir Modeling
- Engineering Design & MVA
- Education and Public Outreach

Study the interaction between the CO₂ plumes from two injection wells within the same formation.



Decatur Site Overview



NSEC

VW#2

GM#2

CCS#2

VW#1

CCS#1

GM#1

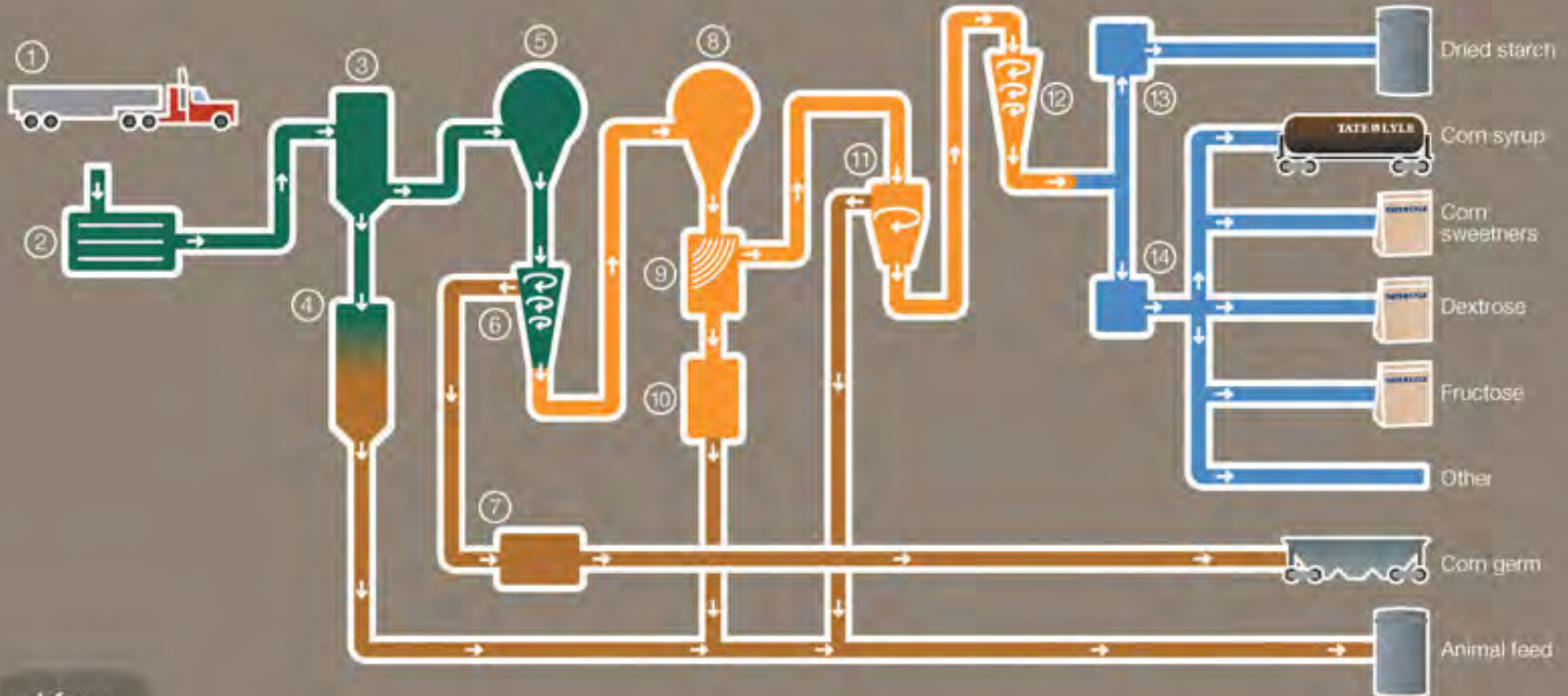
HANS Substation

Compression & Dehydration

CO₂ Collection Blower Area

0.15 mi

The corn wet milling process



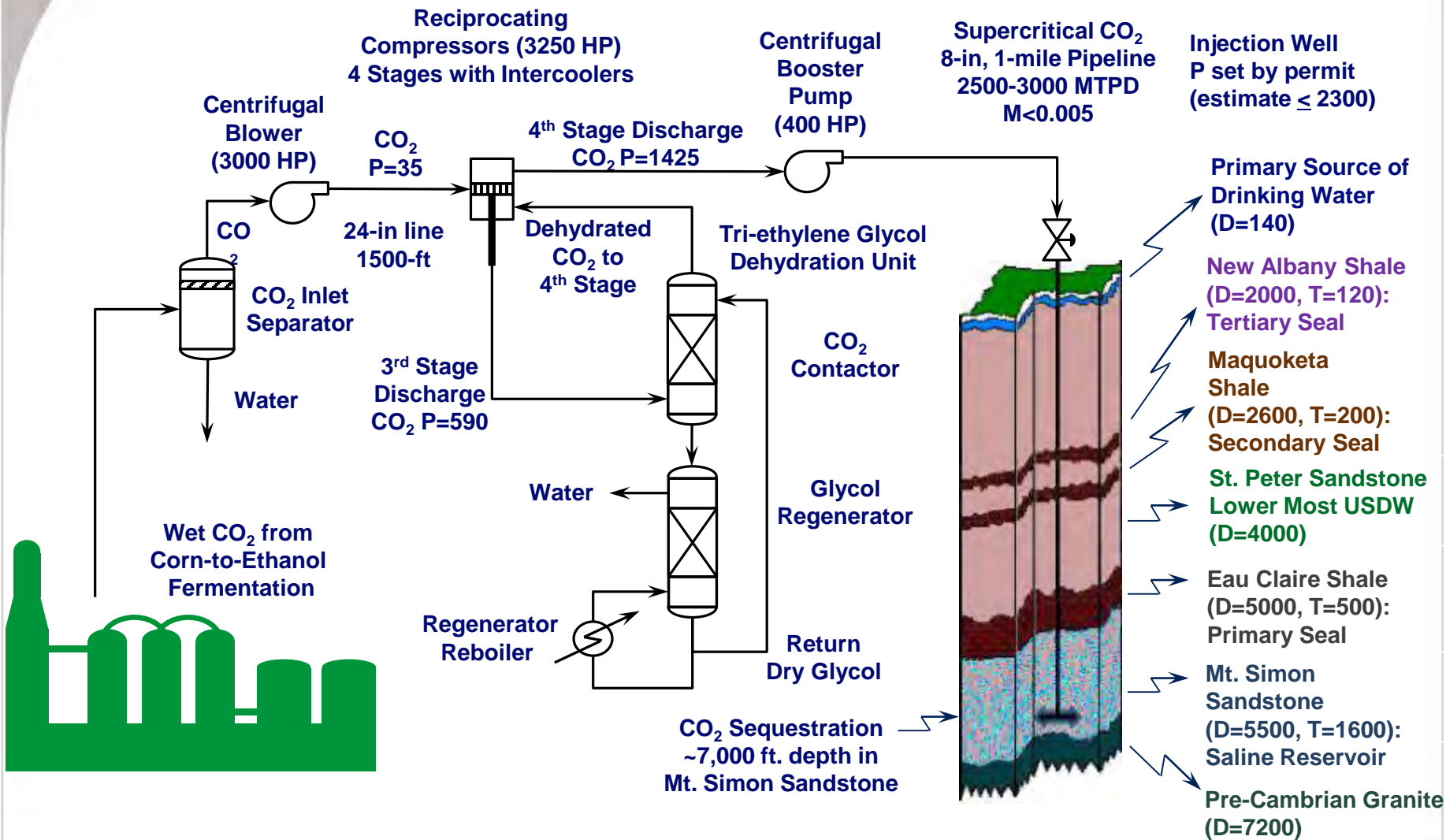
Key

- | | | | |
|-------------------|---------------------------|--------------------------|----------------------|
| ① Receiving | ⑤ Cracking mills | ⑨ Screen washing | ⑬ Drier |
| ② Screen cleaning | ⑥ Germ/cyclone separators | ⑩ Fiber drying | ⑭ Further processing |
| ③ Steeping | ⑦ Germ drying | ⑪ Centrifugal separators | |
| ④ Evaporation | ⑧ Fine grinding mills | ⑫ Starch washing | |

<http://www.youtube.com/watch?v=uE7DJVCa5h0>



Project Process Flow Diagram





CO₂ Collection Facility



3000 hp Centrifugal Compressor



CO₂ Collection Facility



1750 hp Centrifugal Compressor



Low Pressure CO₂ Delivery



24" CO₂ Transfer Line (1,800 ft)



Main Compression Building



3,250 hp Reciprocating Compressors

Main Compression Building



6 Cylinder with 4 Stages of Compression



Phase 1 Compression Building



Main Compressor & Separator

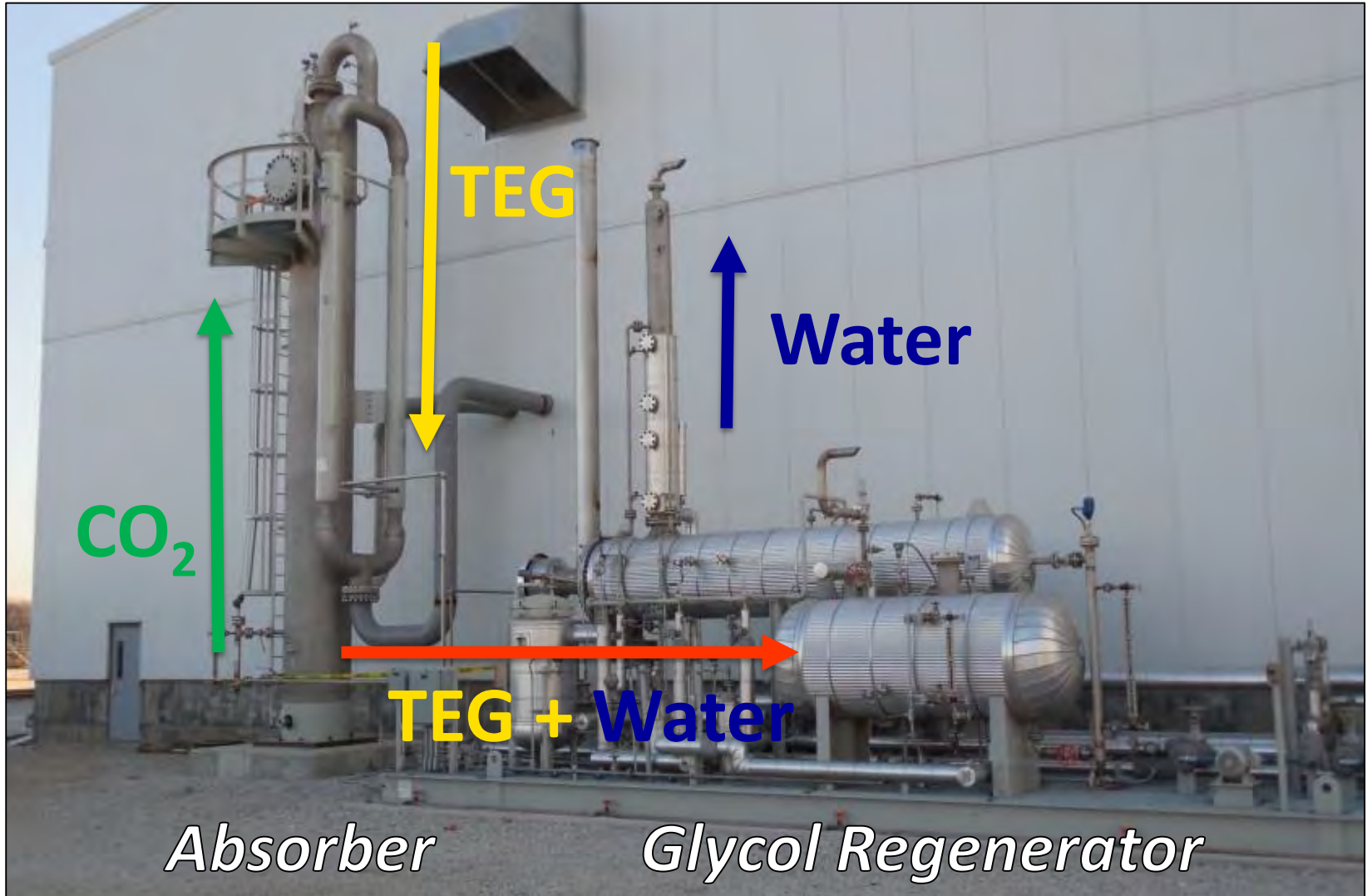


Main Compression Building



Interstage CO₂ Coolers

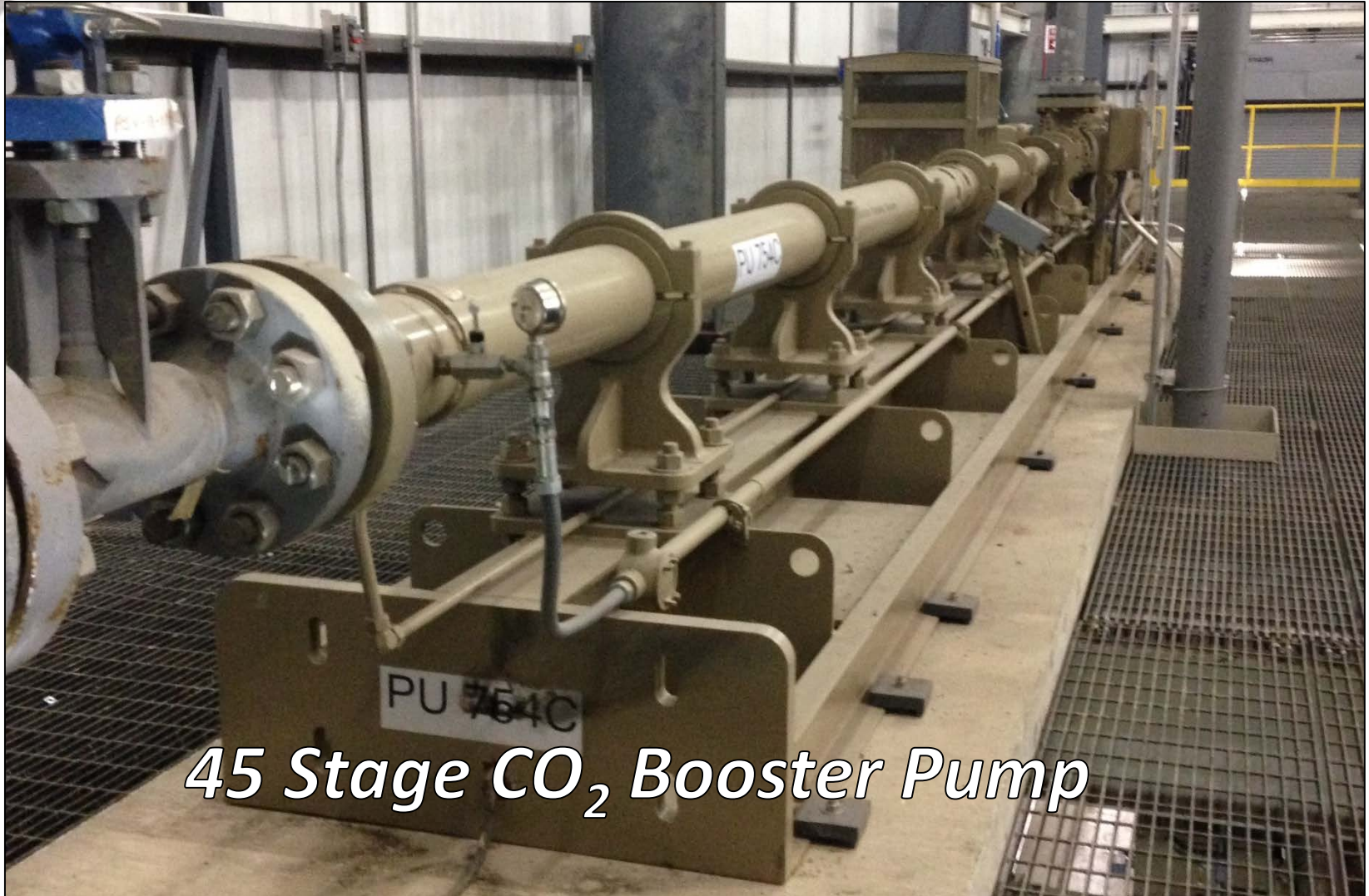
CO₂ Dehydration Unit



Absorber

Glycol Regenerator

Main Compression Building



45 Stage CO₂ Booster Pump



HP CO₂ Transmission Line



8" HP CO₂ Transmission Line (1 Mile)

IBDP Injection Well

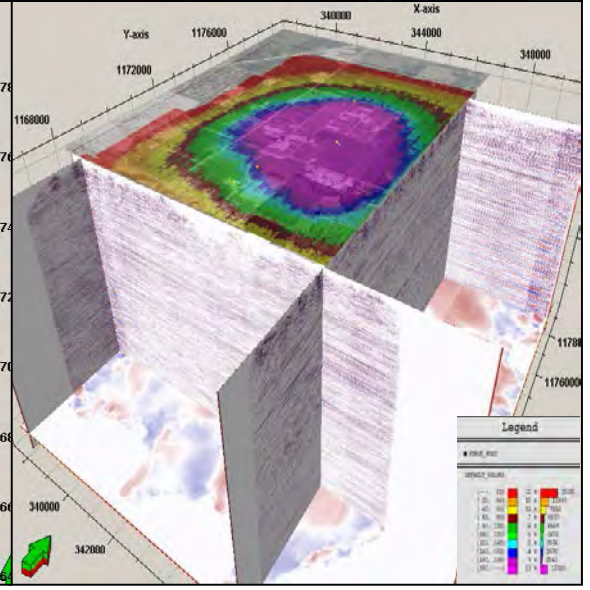
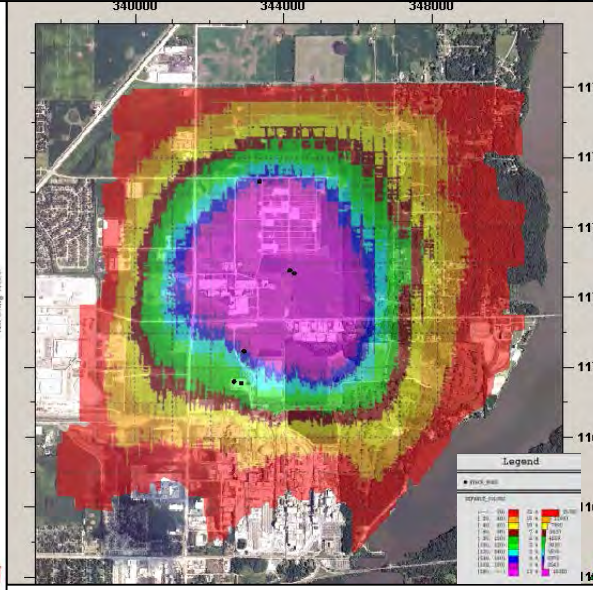
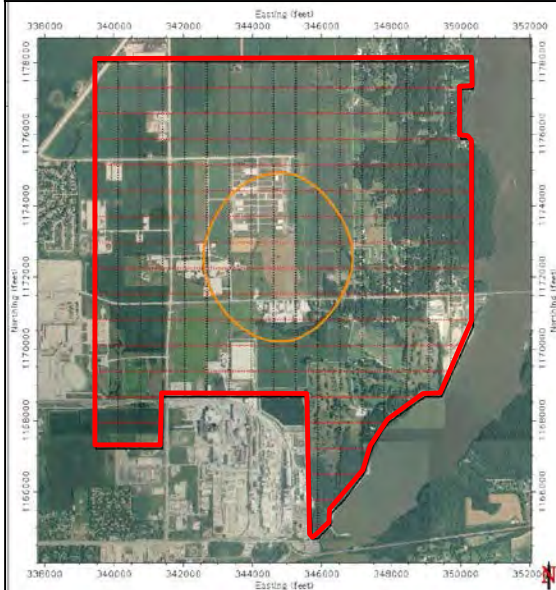
*Injection
Well head*





Site Characterization

Seismic Acquisition



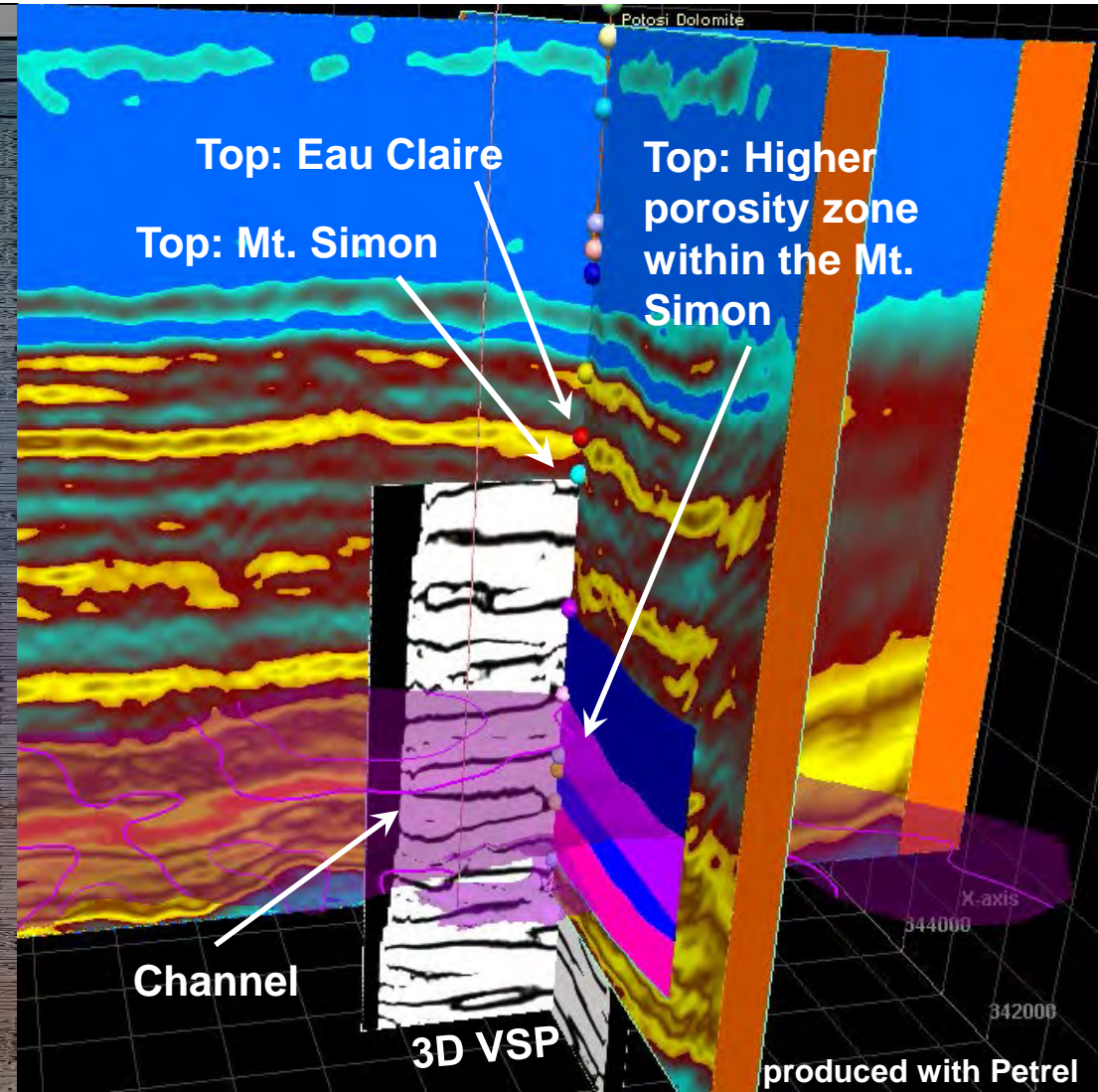


Site Characterization

Evaluation of the Decatur Site

SYSTEM	ROCKS
PENNSYLVANIAN	DEBILIAK
	DEBILIAK
	DEBILIAK
	DEBILIAK
MISSISSIPPIAN	DEBILIAK
	DEBILIAK
	DEBILIAK
	DEBILIAK
DEVONIAN	DEBILIAK
	DEBILIAK
SELENIUM	DEBILIAK
	DEBILIAK
ORDOVICIAN	DEBILIAK
	DEBILIAK
CAMBRIAN	DEBILIAK
	DEBILIAK

- The ADM site has excellent features for CO₂ storage
- High purity source of CO₂
- Thick permeable formation for storage. Porosity <20% and permeability 26 mD
- Formation depth
- Thick seal with no resolvable faulting
- Additional seal formations
- No local penetrations of the primary seal formation
- Low population density





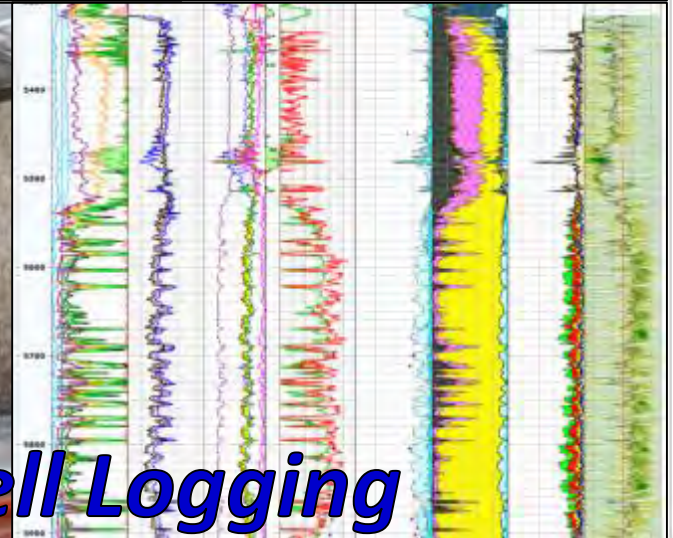
Test Well Construction



Deep Monitoring & Geophysical Wells



Coring and Well Logging



Core Samples and Well Logging

Core Analysis Results

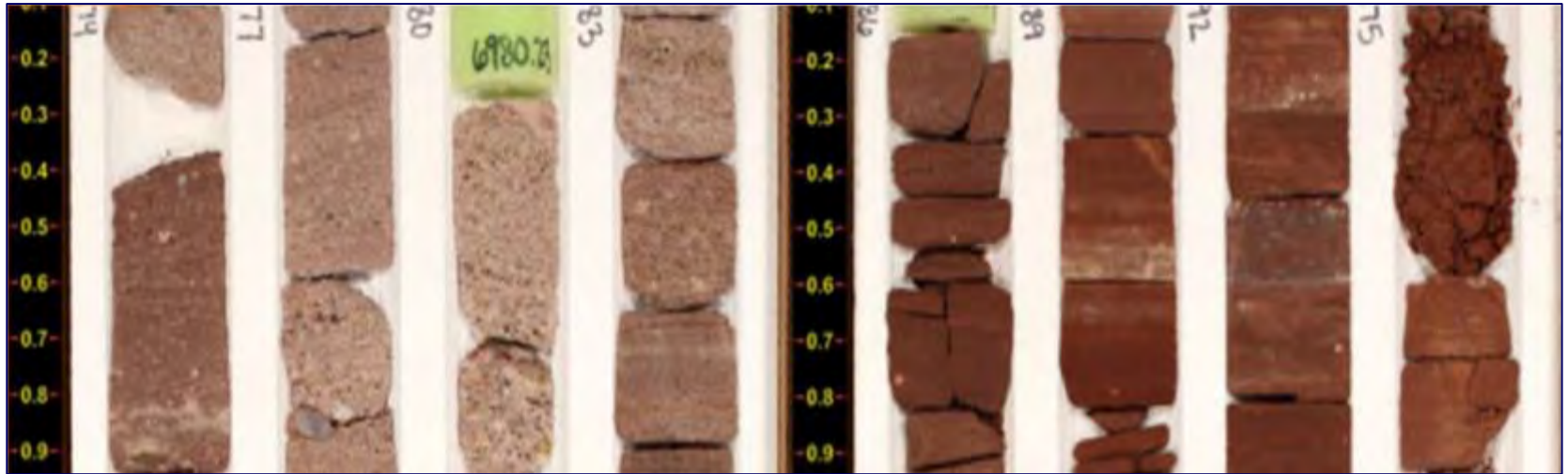
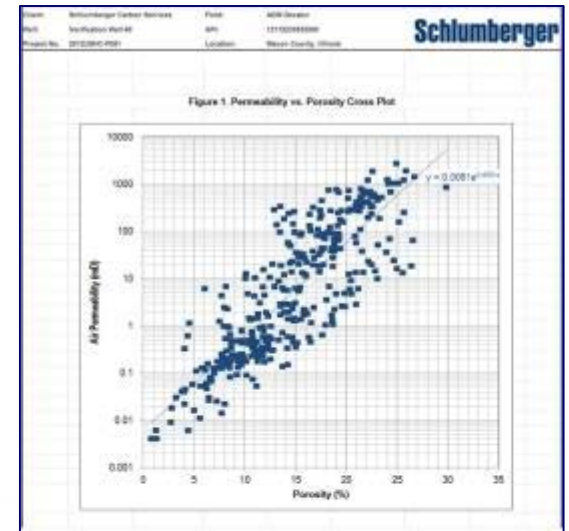


TABLE 1. SUMMARY OF WHOLE ROCK MINERALOGY BY X-RAY DIFFRACTION (% BY WEIGHT)

Sample ID	Depth (ft)	Silicates			Carbonates				Other			TOTAL NON-CLAY	Clays					TOTAL CLAY	GRAND TOTAL
		QUARTZ	K-FELDSPAR	PLAGIOCLASE	CALCITE	SIDERITE	ANKERITE/FE-DOLOMITE	DOLOMITE	PYRITE	FLUORAPATITE	HEMATITE		SMECTITE	ILLITE/SMECTITE (I/S)	ILLITE + MICA	KAOLINITE	CHLORITE		
4-4 XRD	6766.50	70	17	4	0	1	1	0	2	0	1	96	0	4	0	0	0	4	100
5-48 XRD	6877.75	63	22	4	0	1	0	1	1	1	0	93	0	1	6	1	0	8	100
6-2 XRD	6890.75	73	10	8	2	0	1	0	0	0	1	95	0	0	0	0	5	5	100
9-1 XRD	6981.30	79	6	4	0	0	0	1	0	0	1	92	0	2	3	0	3	8	100
9-2 XRD	7002.20	79	10	5	0	0	1	1	0	0	1	97	0	0	3	0	0	3	100





VW2: Petrophysical Analysis and Completion Plan



Middle Mt Simon

CCS2 inject interval

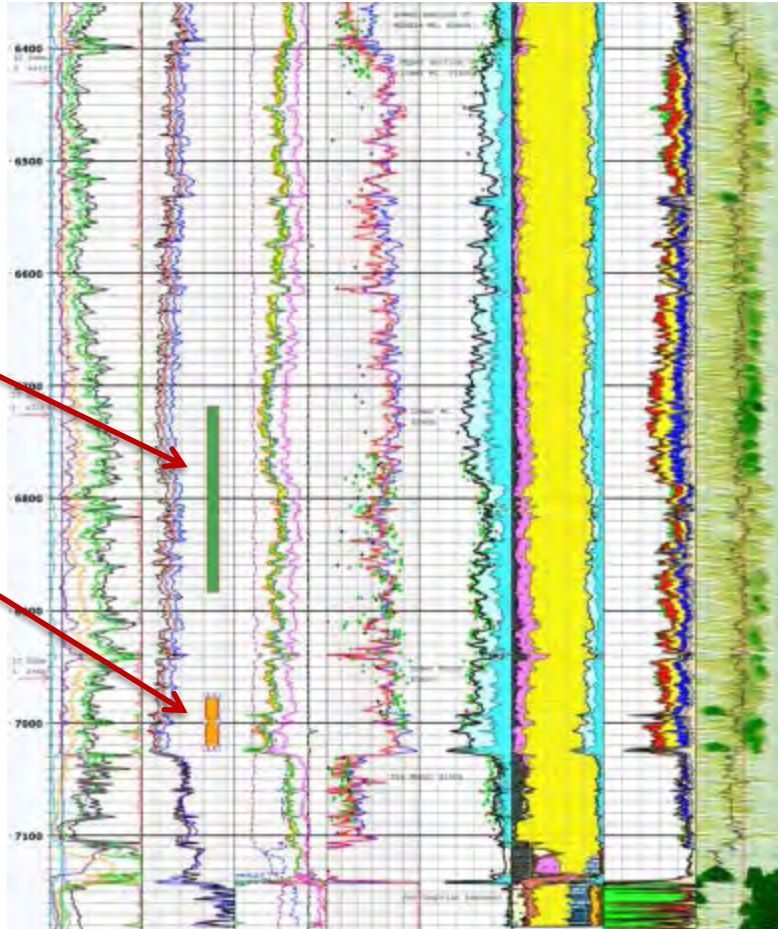
CCS1 inject interval

Lower Mt Simon

Pre Mt Simon

Weathered PC

PC



Resistivity Porosity Permeability Porosity Lithology Pore Size NMR T2

Compared to Petrophysical Analysis

- Zones of Interest
- Mount Simon
 - (Upper, Middle, Lower)
- Pre Mount Simon
 - Weathered Pre Cambrian
 - Pre Cambrian Basement
- IC zones 1,2,3 in lower Mt Simon
- IC zones 4,5 in upper Mt Simon