CONTRIBUTIONS FROM THE ILLINOIS BASIN – DECATUR PROJECT

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JUNE 2023

Safe and Effective storage:
The pieces Have come together

Barriers (2003)

Obstacles (2009)

Challenges (2011)

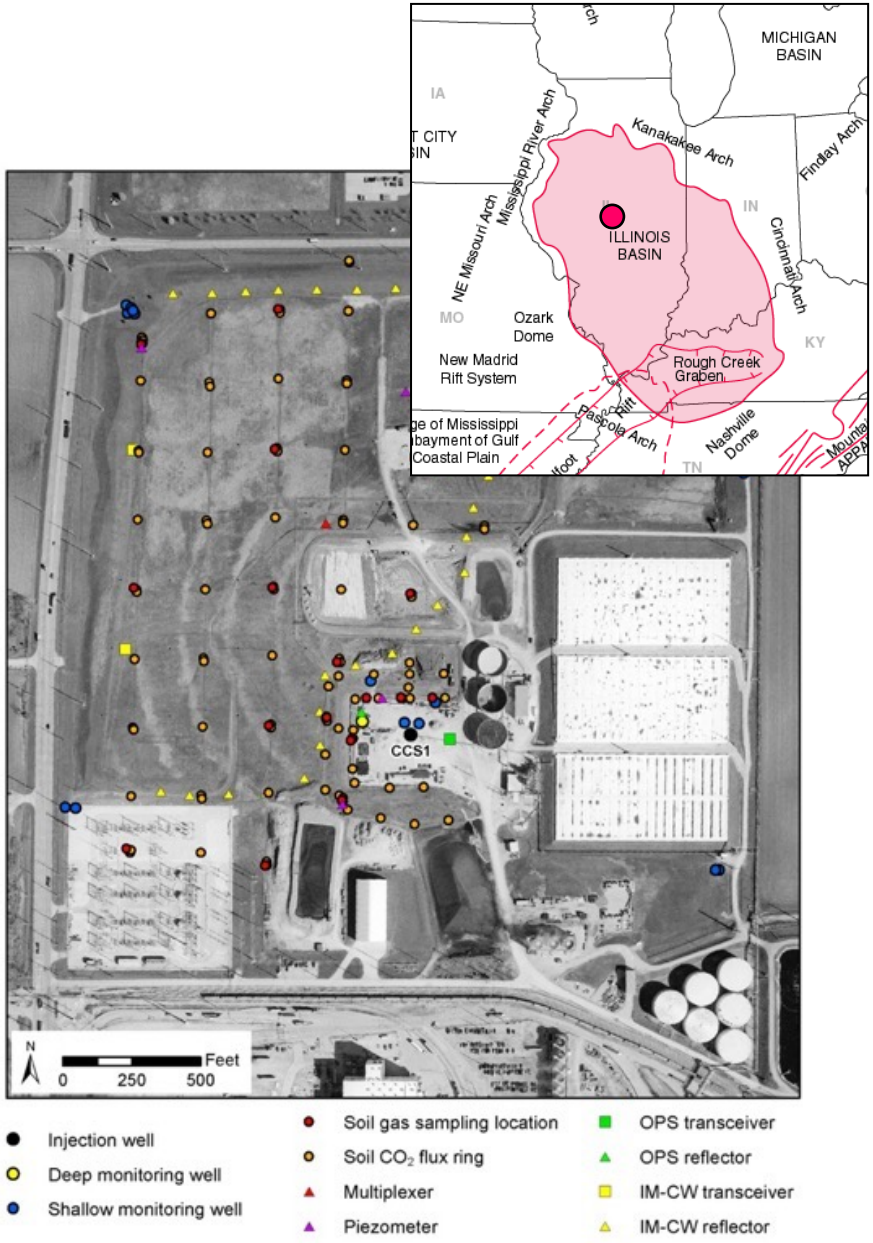
Successes (2015)

Deployment (2017)

Community Impacts (2021)

Illinois Basin – Decatur Project

- Captured, transported, stored, and monitored 1 million tonnes of CO_2 from biofuel production in an onshore Saline Reservoir
- First-of-a-kind monitoring, verification, and accounting program
- Proved storage potential, injectivity, and containment
- Met and exceeded all technical and non-technical challenges
- Successful Class VI permitting
- Conducted microseismic monitoring and interpretation
- Laid foundations for multiple projects
- Build international, national, and regional capacity
- Stakeholder engagement strategy built trusted relationships
- Created comprehensive data set



IBDP by the numbers (IBDP + ICCS):

- 2.5 million stored from **biofuels**
- More than **5,000 meters** of drilled wells
- More than **245 meters** of collected core
- Near-surface groundwater monitoring efforts have resulted in more than **50,000 analyses**
- Basin-scale modeling used **1,020,000 CPU-hours** of XSEDE supercomputing resources.
- More than **1,000 visitors from 29 countries** have been to IBDP and ICCS
- More than **100 people from at least 10 organizations** have worked together to make these projects a success

XSEDE is an NSF-sponsored supercomputer network

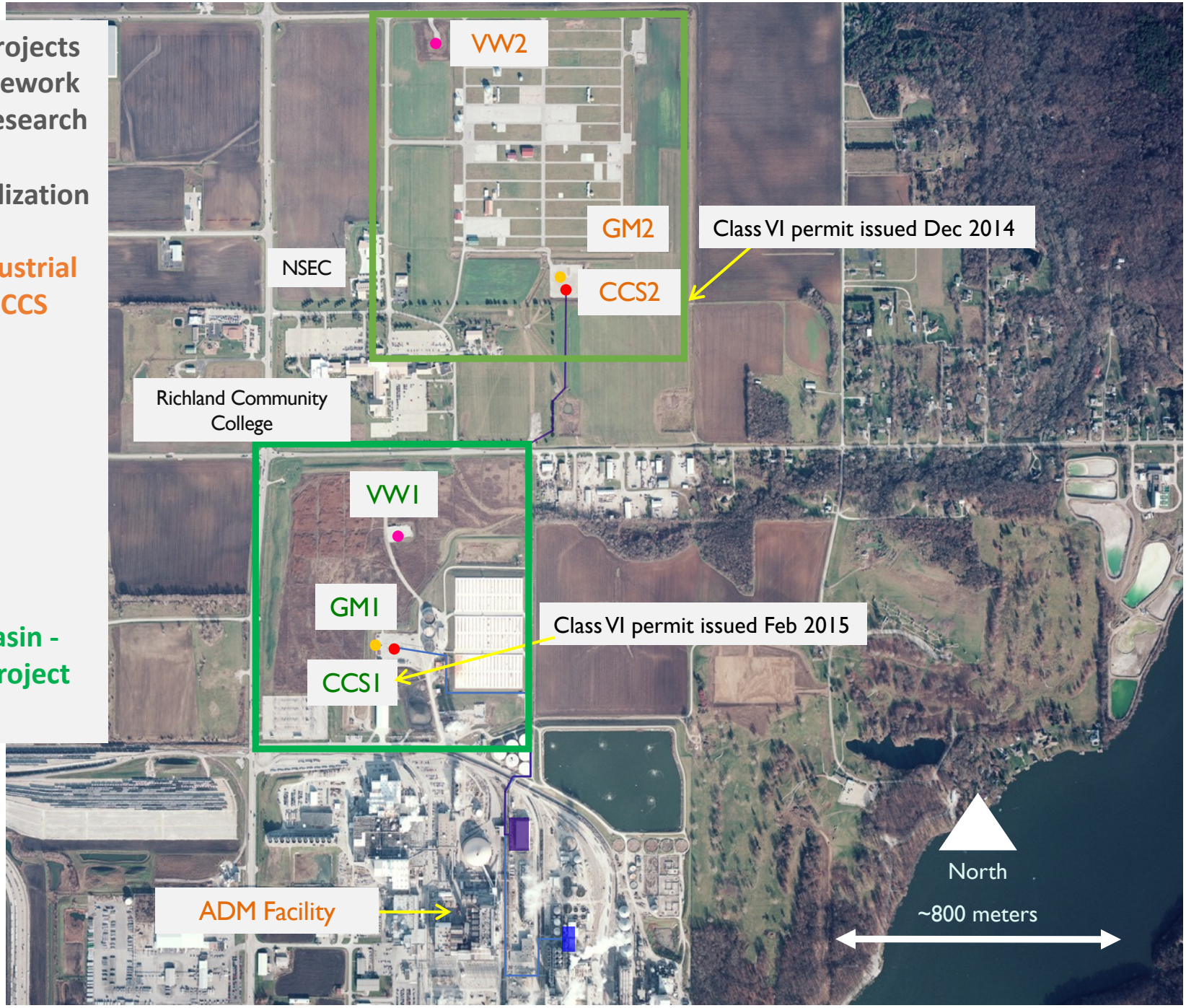
Key Learnings from Illinois Experience

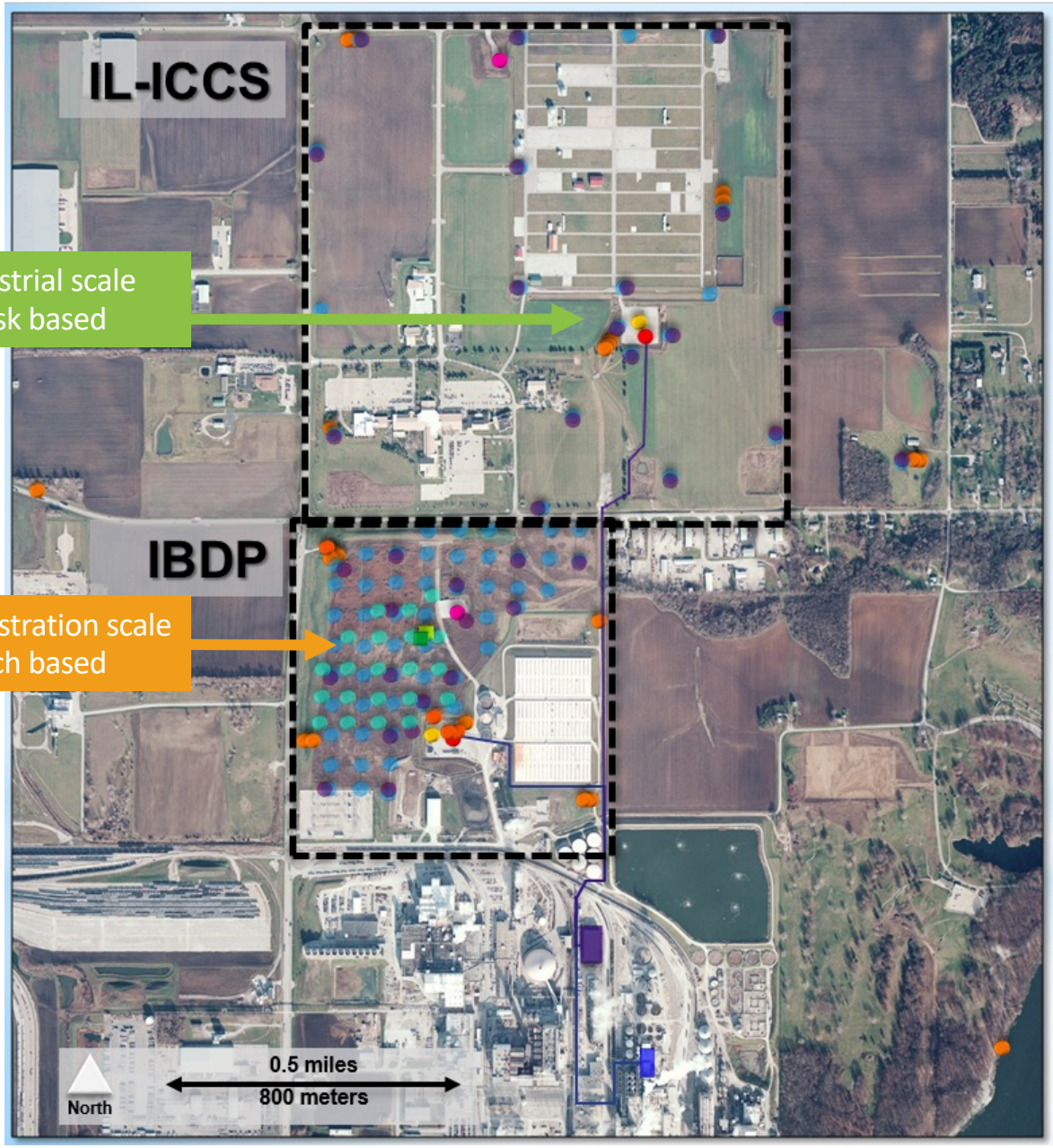
- Storage of carbon dioxide is safe, viable, and important for climate mitigation strategies
- Geology is critical and will always remain key factor
- Baseline environmental assessments are critical
- Simplicity is key success factor
- Regulatory framework is in place to ensure safe storage
- Scientific and engineering require alignment with policy
- Pilot and demonstration projects provide critical insights

Multiple Projects Build Framework for CCUS Research and Commercialization

Illinois Industrial Sources CCS

Illinois Basin - Decatur Project





Monitoring Summary

- Injection wells (2)
- Verification wells (2)
- Geophysical wells (2)
- Compliance wells (4)
- Research wells (24)
- Soil gas points (35)
- Soil flux points (145)
- Eddy covariance station (1)
- Continuous GPS station (1)
- InSAR artificial reflectors (21)

IBDP Monitoring Summary

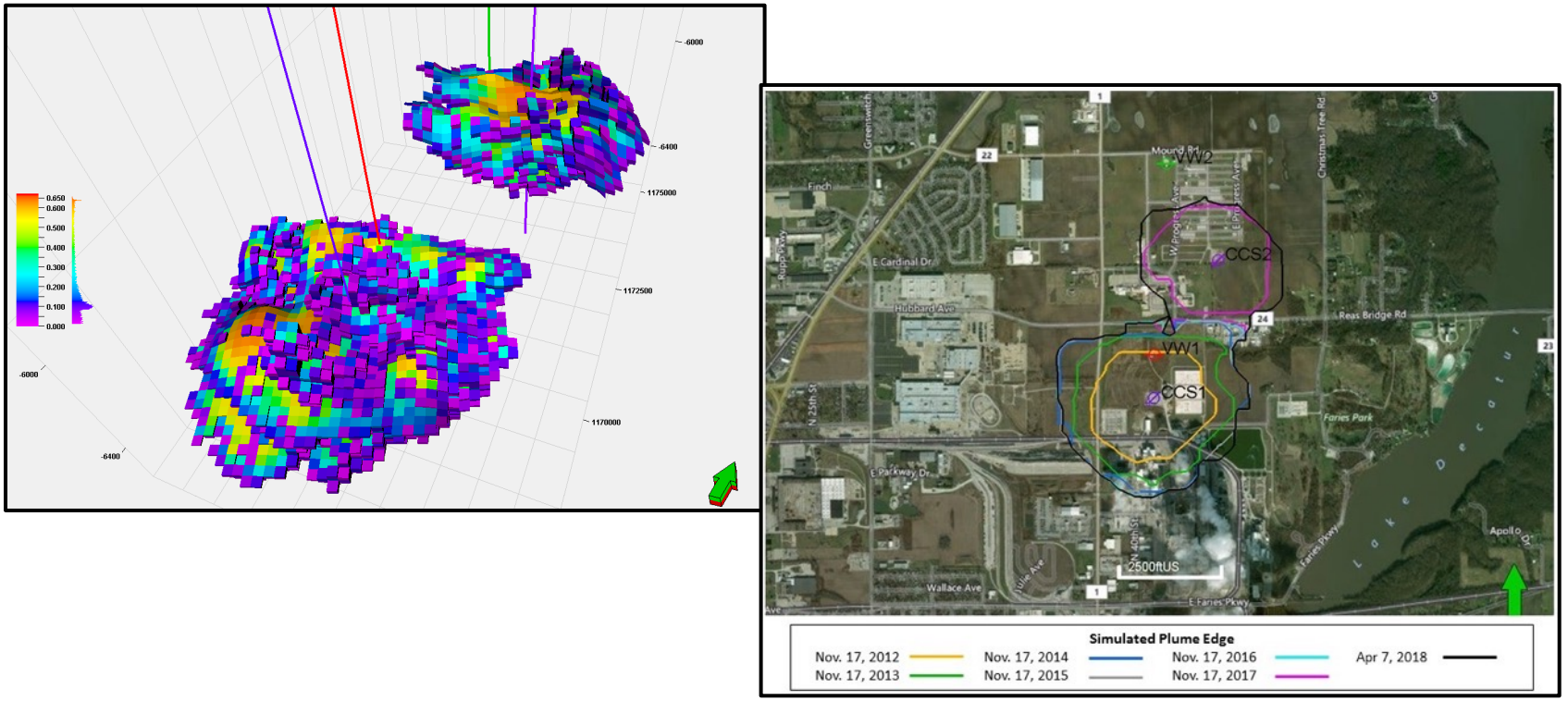
	Monitoring Activity	Freq.	Pre-injection			Injection				Post-Injection					
			2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Surface	Aerial imagery	SA		x	x	x	x	x	x	x	x	x	x	x	x
	Eddy covariance	C					x	x	x						
	Soil flux - network*	W-Q		x	x	x	x	x	x	x					
	Soil flux - multiplexer*	C			x	x	x	x	x	x					
	Tunable diode laser- single path	C					x	x							
	Tunable diode laser- multi path *	C								x					
	InSAR *	BW				x	x								
	Continuous GPS *	C					x	x	x						
Near-Surface	Soil gas sampling	Q-A				x	x	x	x	x	x				
	Shallow groundwater sampling	M-Q-SA		x	x	x	x	x	x	x	x	x	x	x	x→
	Shallow electrical earth resistivity *	A	x	x	x										
Subsurface	Pressure/temp. - VW1 and CCS1	C				x	x	x	x	x	x	x	x	x	x→
	Pulsed neutron (CCS1, VW1, GM1)	Q-A		x		x	x	x	x	x			x		x→
	Deep fluid sampling (VW1)	SA				x	x	x	x	x		x	x	x	
	Passive seismic monitoring (GM1)	C			x	x	x	x	x	x	x	x	x	x	x→
	Seismic/3D VSP imaging	SA-A			x	x	x	x	x	x					x→
	Mechanical integrity (CCS1, VW1)	A			x	x	x	x	x	x					x

Abbreviations: C = Continuous, W = Weekly, BW = Biweekly, M = Monthly, Q = Quarterly, SA = Semi-Annually, A = Annually,

x = planned, not permit required; * = experimental technique or deployment; x = planned, permit required;

x→ = permit activity required beyond 2020; yellow box highlights decrease in monitoring activity during PISC phase

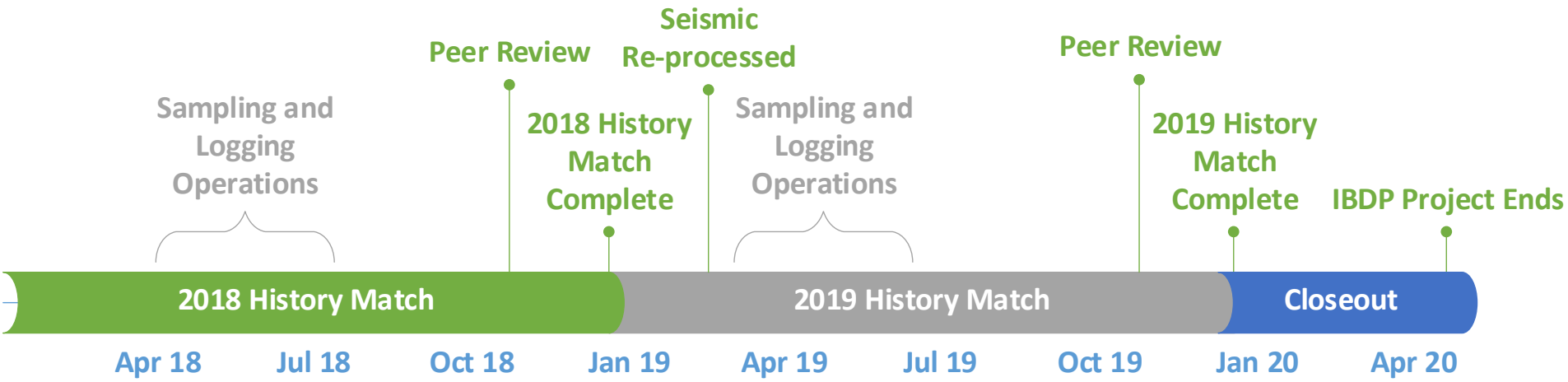
Plume Distribution of IBDP and ICCS

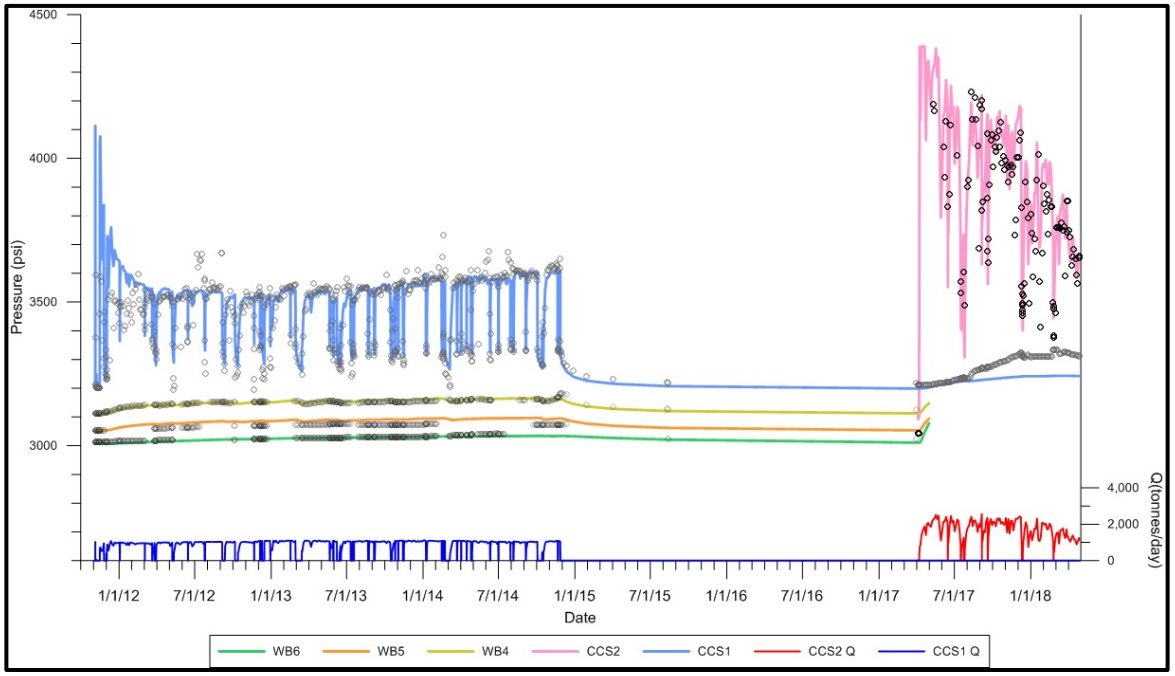


3D simulated CO_2 plume distribution on Apr. 7, 2018. Vertical exaggeration is 5x.

Proprietary. Not for release without attribution

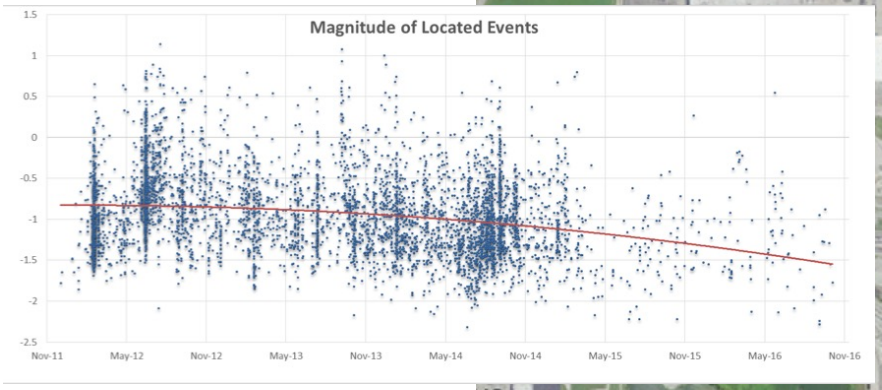
Modeling and History Matching

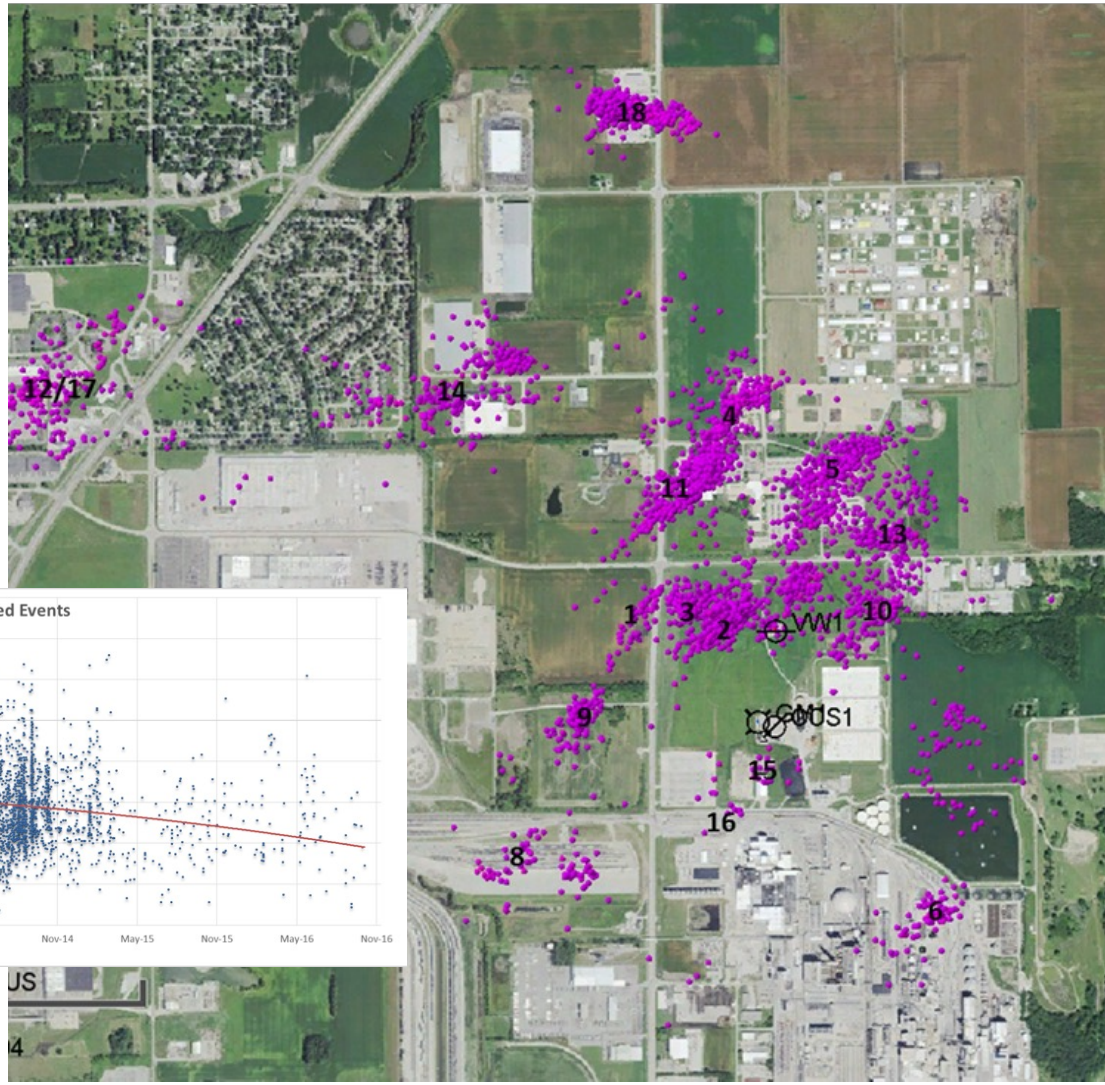




Passive Seismic (Microseismic) Monitoring

- Location critical to understanding reservoir response
- Relation of clusters to *pressure front* and *basement characteristics*
- 5 surface seismometers also used





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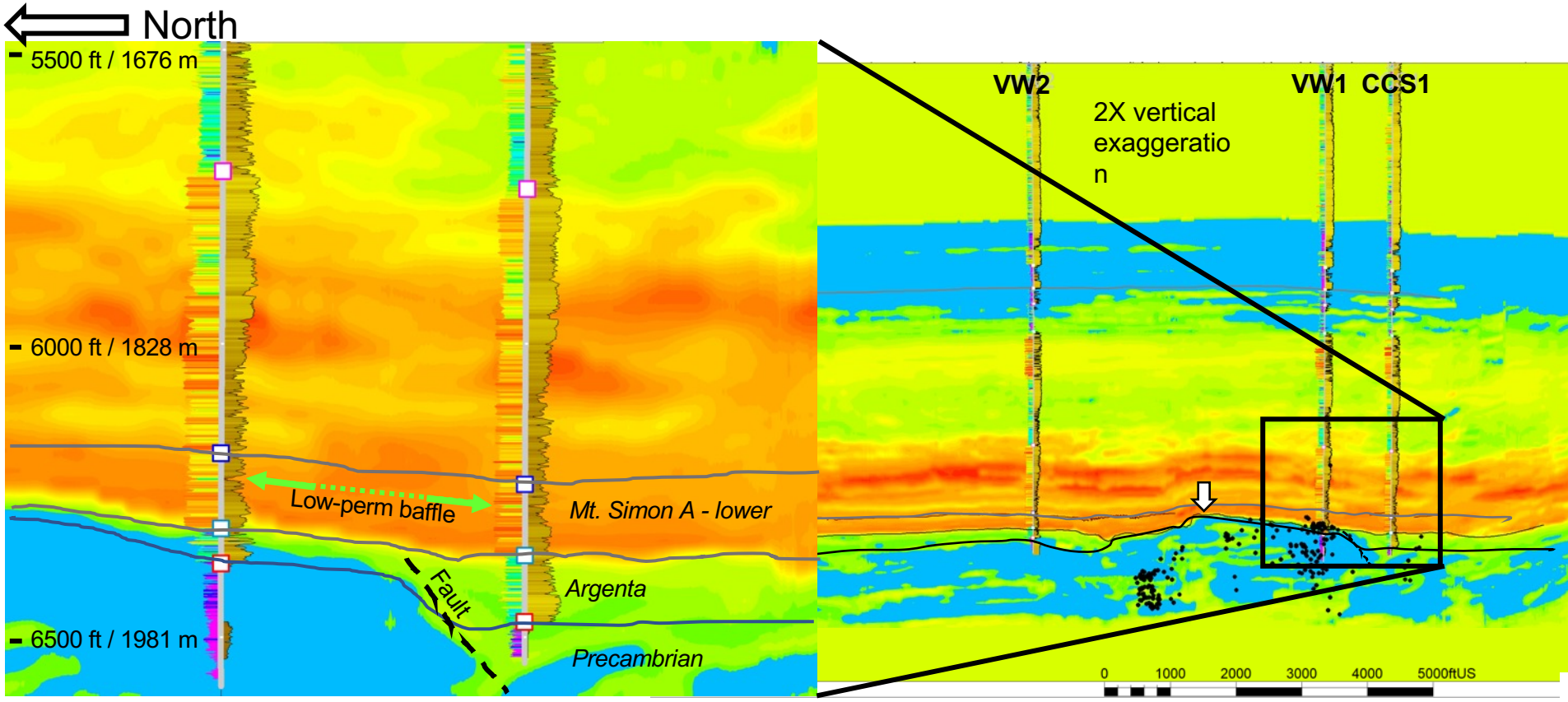
Refection Seismic Porosity Inversion

Wells and seismic events projected onto the cross section from up to 200 ft.

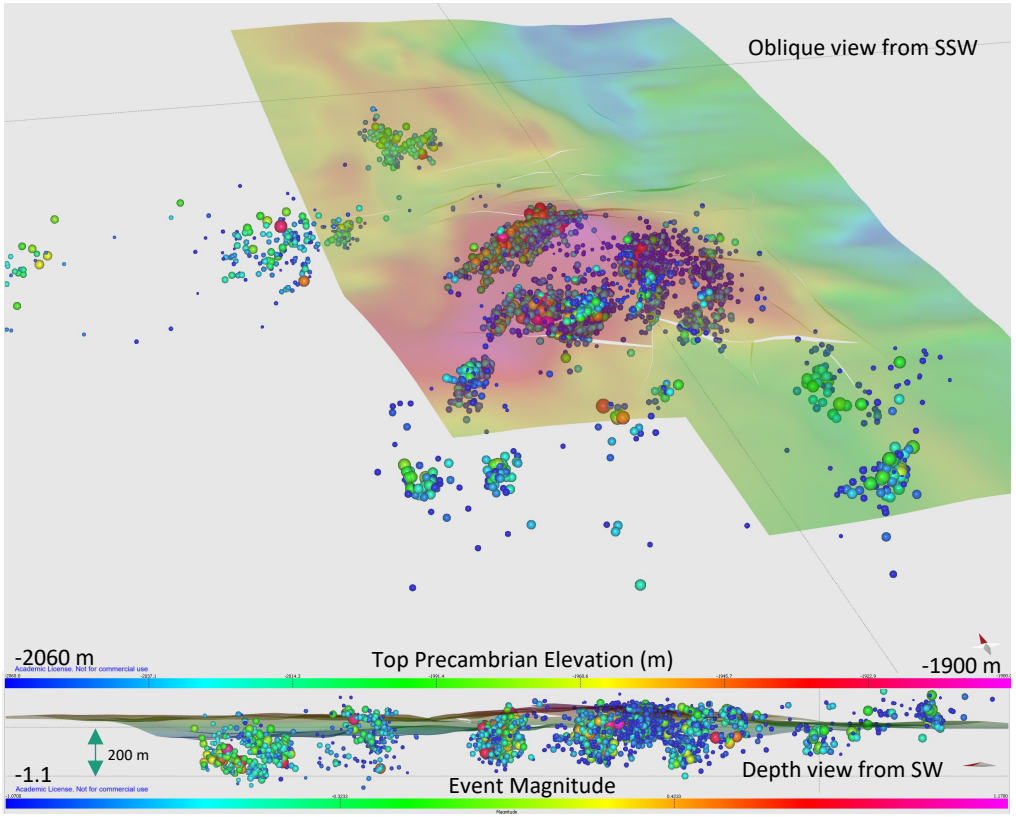


Response of Precambrian Basement

More than 90% of the induced seismicity occurs in the basement below the reservoir.

The <u>below</u> the reservoir response shows:

- Significant induced microseismicity during CCS1 injection
- Seismic activity diminished to low level after injection stopped
- Seismic activity has not increased during CCS2 injection
- Fluid/pressure pathway to basement likely includes faults



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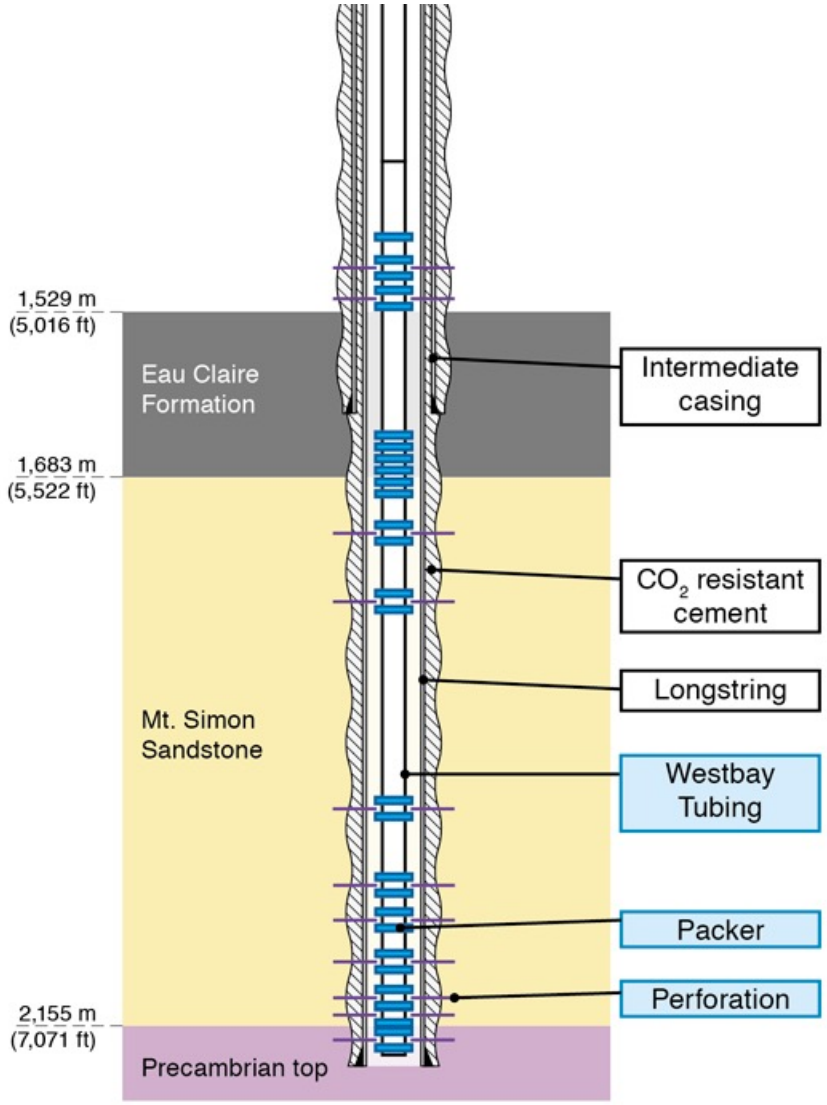
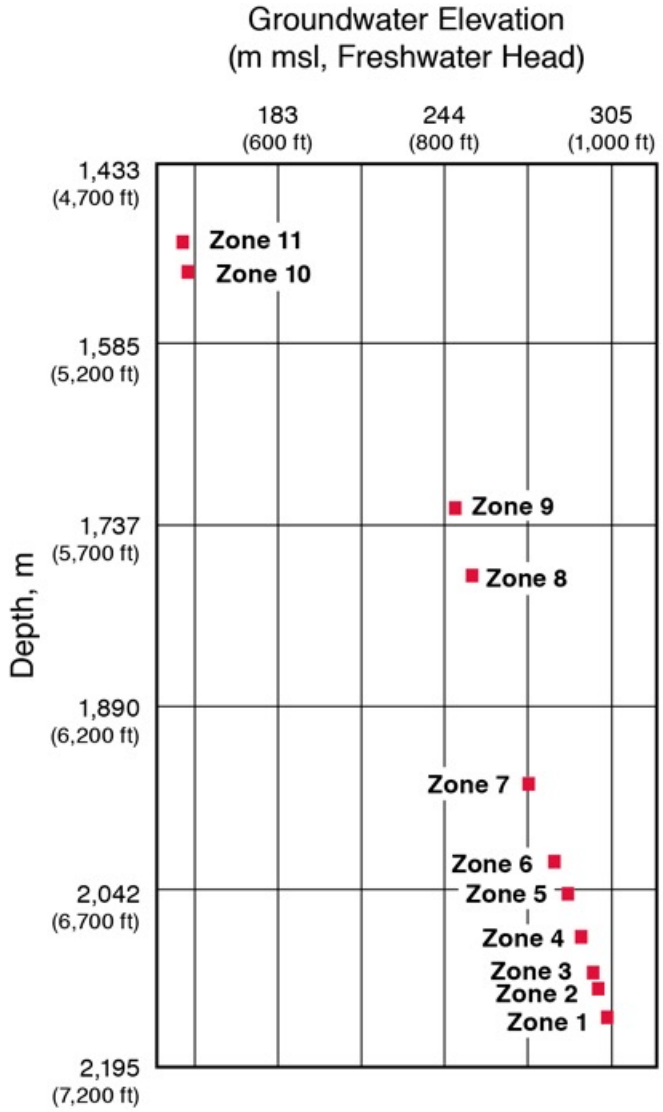
VW1 Westbay Completion





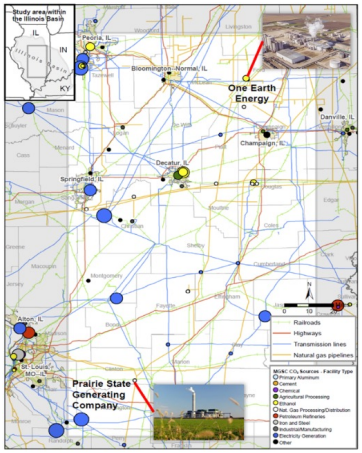
Recompletion of VW1 Monitoring Well

- Option 1 – Retain Westbay
- Option 2 – Schlumberger IntelliZone
- Option 3 – Baker Hughes Intelligent
- Option 4 – Drill new well

Two Fluid Sampling and Four Pressure Zones

Illinois Leader in Carbon Storage Research and Deployment

CarbonSAFE Phase 3, 3.5, 4



CarbonSAFE Illinois

ILLINOIS Industrial Carbon Capture & Storage

ILLINOIS Illinois State Geological Survey PRAIRIE RESEARCH INSTITUTE

FutureGen 1

IBDP:

1 Mt stored

FutureGen 2

IL-ICCS:

3 - 5.5 MT

Industry Site - active

CarbonSAFE Illinois:

Phase 1

CarbonSAFE

Phase 2s

>50 MT Feasibility

CarbonSAFE

Phase 3s

Injection Permitting

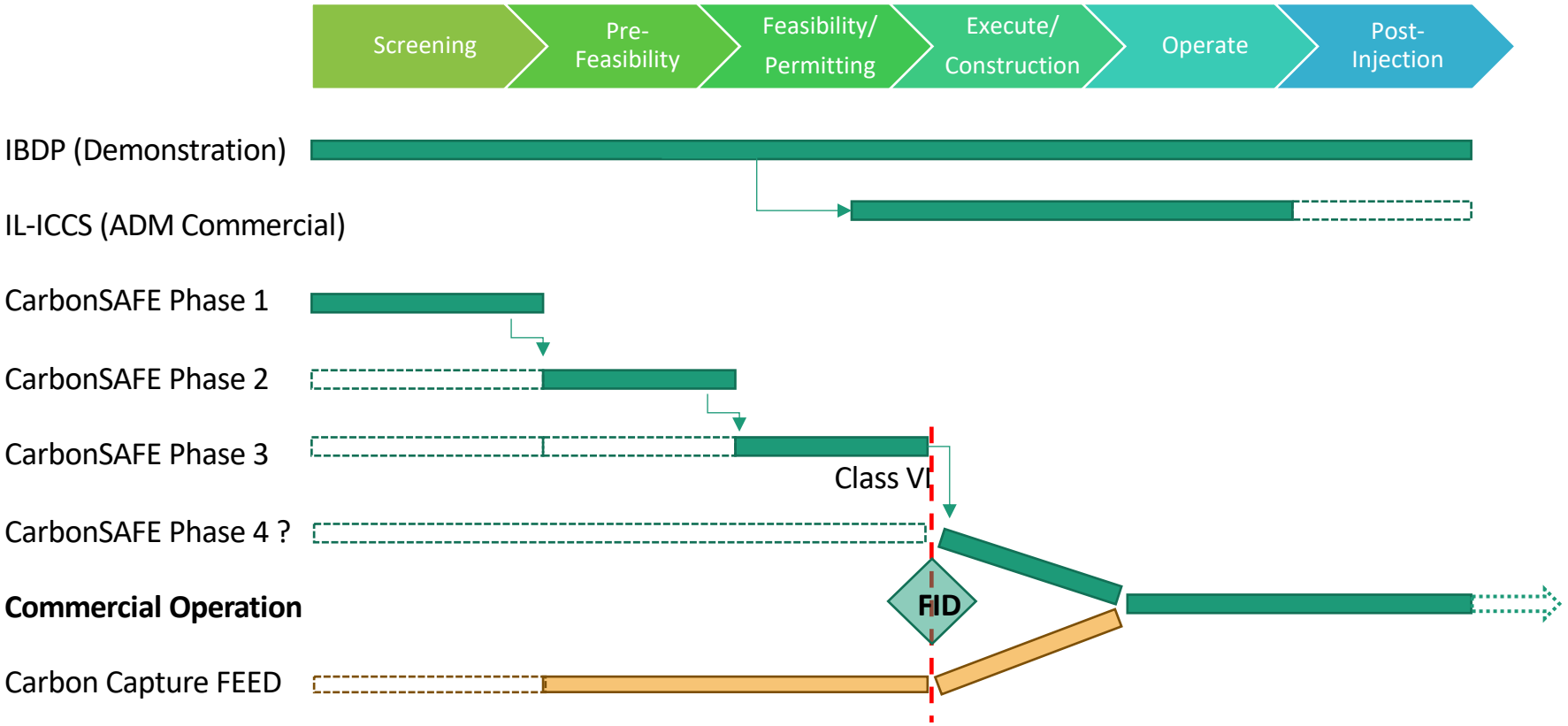
MGSC

U.S. DEPARTMENT OF ENERGY | NATIONAL ENERGY TECHNOLOGY LABORATORY

MRCI Midwest Regional Carbon Initiative

2000's

2020's



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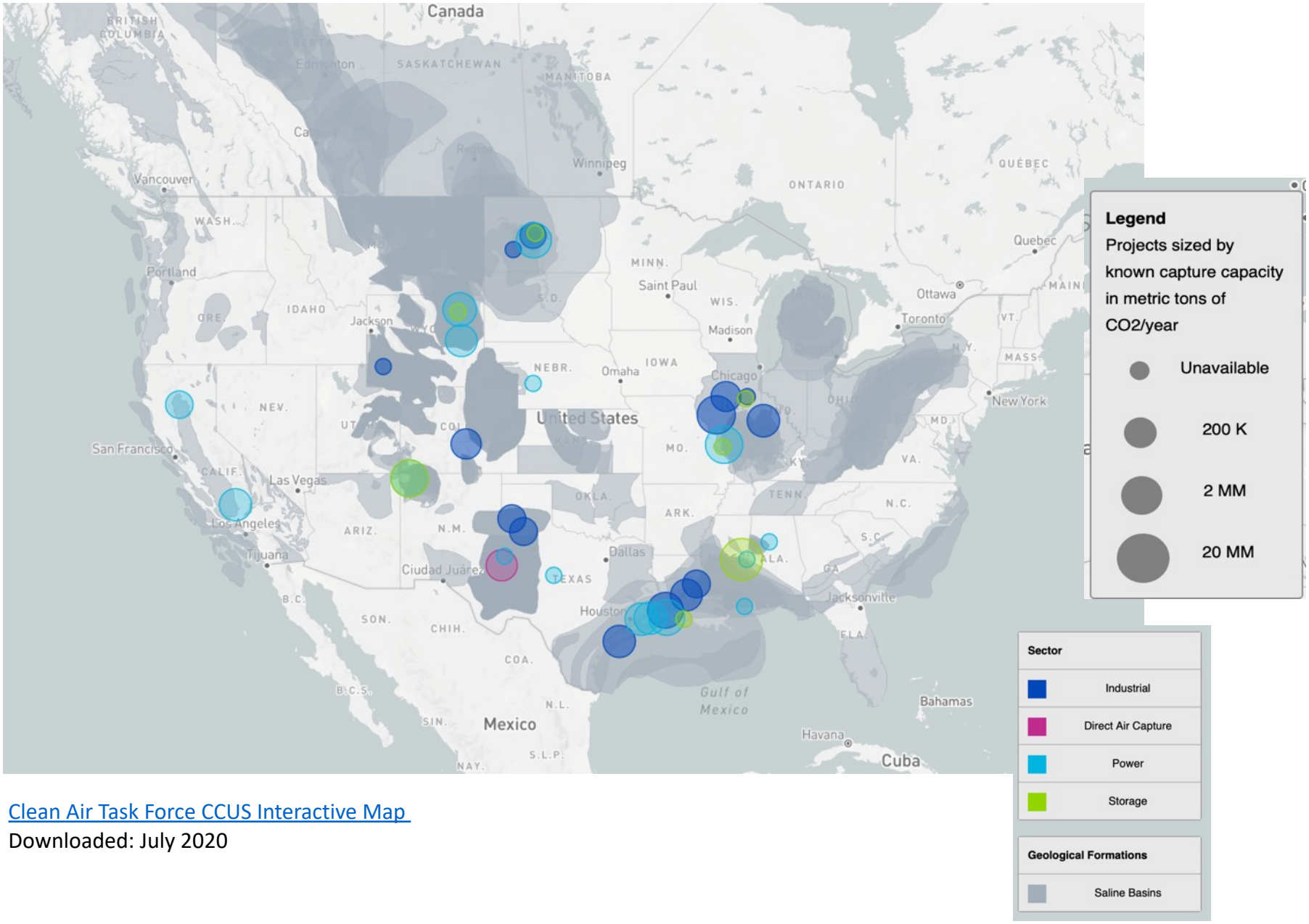

[Clean Air Task Force CCUS Interactive Map]

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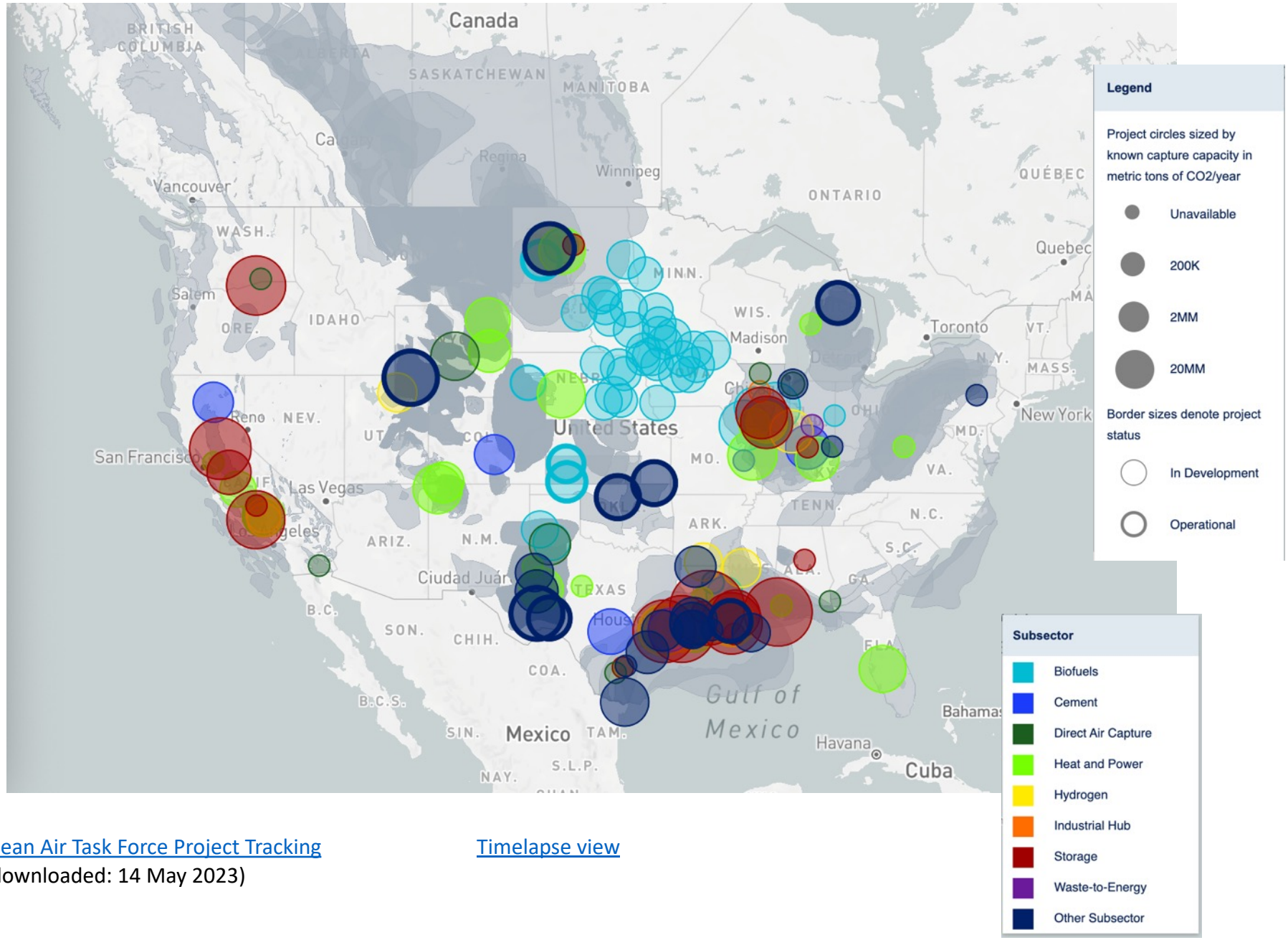

[Clean Air Task Force Project Tracking]

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[Timelapse view]