Oklahoma CUSP Progress

June 21, 2023

Agenda

- Acknowledgement
- Project Overview
- OK Focused Project
- New Optimization Software for CO₂ Transport

Acknowledgement

- Karen Ochie
- Ayomide Hamzat
- Benmadi Milad
- David Nnamdi
- Jamal Daneshfar
- FNU Suriamin
- Sean Yaw
- Hamed Goddusi
- Tom Mueller

- Mike McGinnis
- Saba Tahmassebi
- Lloyd Kirk
- William Lynn
- Carbon Solutions LLC
- LANL
- RZG LLC
- Department of Natural Resources-Osage Nation

Achievements

- CUSP promoted & enabled CCUS dialogues among stakeholders in Oklahoma
- Working closely with an operator for a Class VI application
- Numerous publications (published & pending)
- Three completed MS thesis and a PhD dissertation (ongoing)
- Upgrading SimCCS to include existing pipelines
- Osage CO₂ Storage Hub CarbonSAFE proposal

CUSP – Original Scope of Work

- Focus on collecting, synthesizing, and using existing data sets.
- Data to be incorporated into analytical and optimization models to evaluate CCUS potential and readiness. Goals include:
- State organizations assessing, updating, augmenting, and verifying data used in data analysis and modeling
- Strong emphasis on technology transfer and outreach

OK CCUS Catalog and Scoping Project

Data Catalog (responsive, interactive, evergreen doc)

C	
0	klahoma CCS Data Catalog
	State-level interest in conform capture strategic/imputation (EGS) is not here in the Conformation known in the standard ord and an entering the COS possible strategic and the Conformation (Eds) and the Conformation of the Conformation of the University of Okahoma (200 captors Eds) and the Edshama depath beams in interested in howing an initial bate estimate of COS posterial calculated for deep, saline reservoirs in Okahoma.
oklahoma CCS Data Catalog	The goal of this catalog of accessible information (data) and resources was to complete a cursory analysis of data inventory for a selected region (select counties) in Okiahoma (Xia). The ype of data available, quality and gaps in data were recorded for all data this pertained to calculating CCS.
State-level interest in carbon capture storagh/requestration (CCB) is on the fau- Colantorus a isounder of a aduated of and gas reservoirs. The CCS potential of the same reservoirs as unknown depute having a long history of near-oir studies. The University of distance and the same University of distance and the same University of distance and the same listence of a history on initial State estimate of CCS potential calculated for deep, alter near-over a Oklahrom.	Strang door
The goal of this catalog of accessible information (data) and resources was to complete a cursory analysis of data	www.zenostatis.io
inventory for a selected region (select counties) in Oklahoma (OK). The type of data available, quality and gaps in data were recorded for all data that pertained to	

https://cusp.oucreate.com/catalog

Workflows, Database, and Report for Oklahoma CO₂ Storage Potential Calculations based on the following Methods:

- Generalized Gross
 - Detailed Gross
 - Detailed Net

CO₂ Storage Potential Viewer Application (browser-based, future mobile enabled)

······ @ OK-CCUS-Dashboard_pre-st	ige	•• 8• 0 -• One
OK CUSP CO2 Storage Potential View organg investigation as al November 2021	er.	County County Count Count On Decempoint
Jagasha ke a da katakan Ingga ka da da katakan juunga katakan kata kuda keca Laka Bagastan		
	-	A STREET
+ rus + tus + Hughes Hughes	Constant Rel Descent Second Se	
	Proceedings of the Demonstration of the Control of Cont	
Hughes Hughes	Bits 313 Bits 313 Bits 314 Bits 315 Bits 316	
Hughes Hughes	The part of the theorem is a part of the p	



not public under construction

CUSP-Focused Goals for Oklahoma (2020-2022)

Main goal: Develop a two-step roadmap to help accelerate CCUS deployment in Oklahoma, focusing on a designing and permitting a novel stacked storage CCUS complex:

Field site development: Support operators to develop a plan to submit a Class VI well permit application for a stacked storage CCUS complex

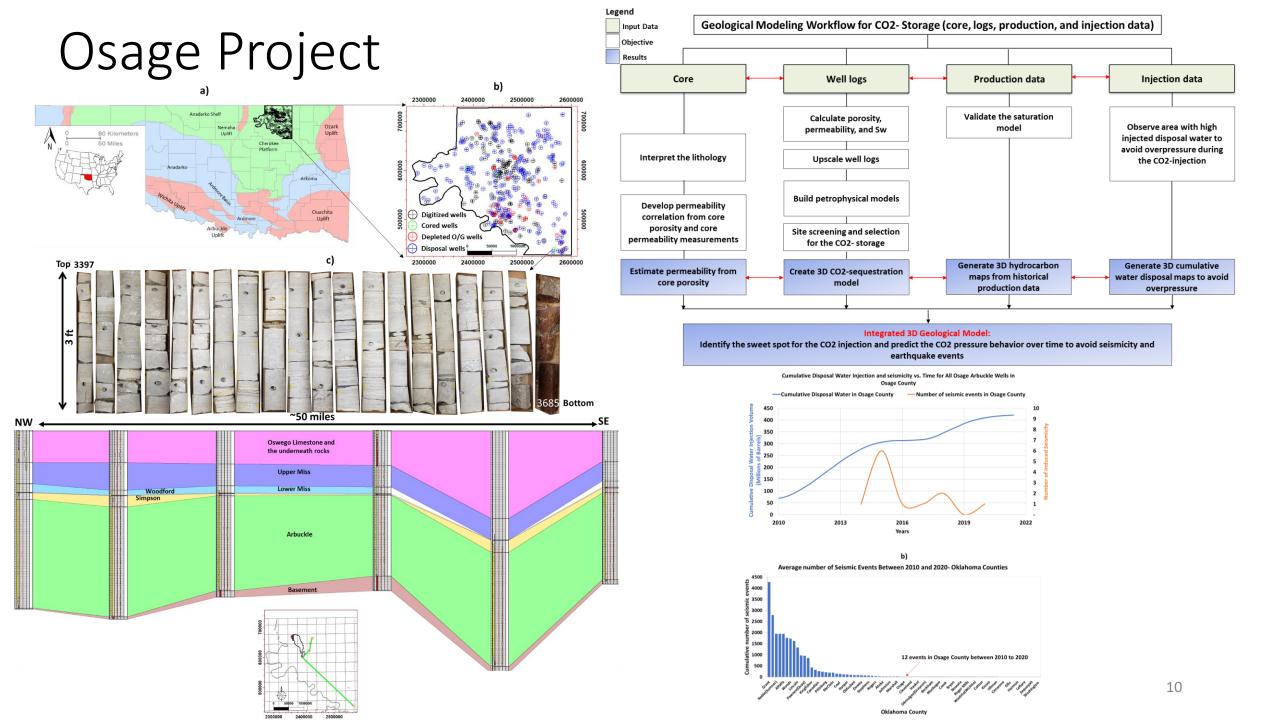
Roadmap: deliver a roadmap for industry, state government, and other stakeholders to jumpstart CCUS development in Oklahoma based on stacked storage.

Deliverables

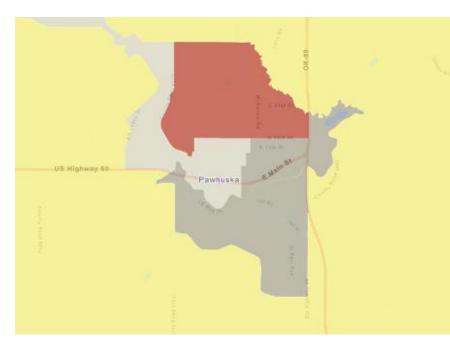
- **Deliverable 1:** A comprehensive economic feasibility of a stacked storage site, combining CO_2 -EOR and CO_2 sequestration operations in the Osage Reservation
- **Deliverable 2:** A representative geological model based on knowledge and understanding of the Arbuckle saline formation in the Osage Reservation
- **Deliverable 3:** The significant outcome of the proposed work, when appropriate, will be disseminated to the public through journal articles, conference papers, and webinars

Project Specific Tasks

- Task 1: A thorough formation evaluation of Arbuckle formation in Osage county
- Task 2: Determine the economic feasibility of a stacked storage site, combining CO₂-EOR and CO₂ sequestration operations using the same surface facility unit in Osage county.
- Task 3: Develop a representative geological model based on knowledge and understanding of the Arbuckle saline formation in Osage county and perform flow simulations of CO₂ plume.
- Task 4: Develop a multi-pathway CCUS roadmap for Oklahoma centered on the stacked storage concept
- Task 5: Evaluation of Environmental and Social Justice parameters in Osage county



Societal Impacts of CCUS Projects in Osage Project



Unemployment

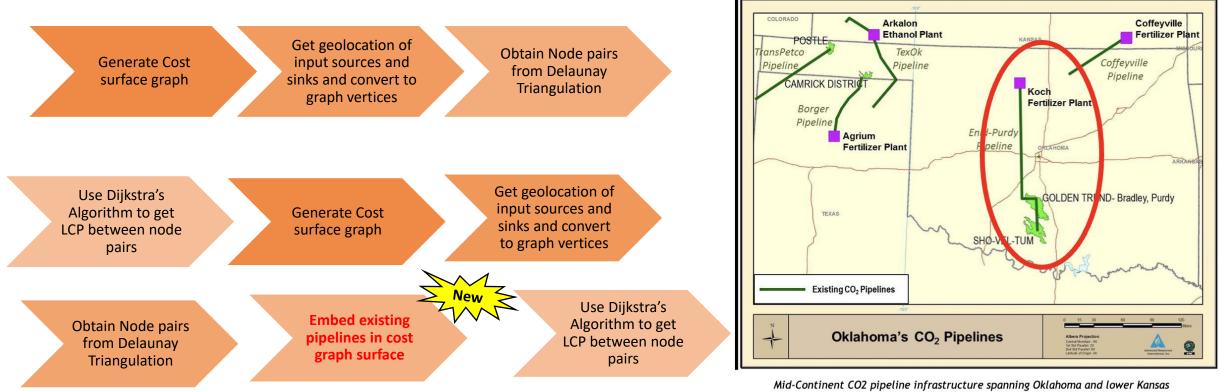
Sample of EJ Indicators for Pawhuska (darker colors mean higher than the national average)



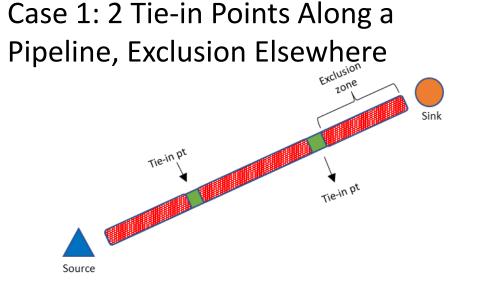
Motivations for Upgrading SimCCS

- There are a few available solutions for network optimization of CO2 pipelines:
 - ✓ **GETCO** (Gale et. al., 2001)
 - ✓ SimCCS (Middleton et. al., 2009)
 - ✓ JRC InfraCCS (Morbee et. al., 2011)
 - ✓ SiMCCS^{2.0}
 - ✓ SimCCS ^{Pro}
- Limitation of SiMCCS:
 - \checkmark Limited to suggesting new pipeline construction routes
 - $\checkmark\,$ Cannot accommodate existing pipelines in alternate route generation
 - ✓ Cannot limit flow capacity of existing pipelines to user specifications
 - ✓ Cannot allow user specified transport costs along existing pipelines

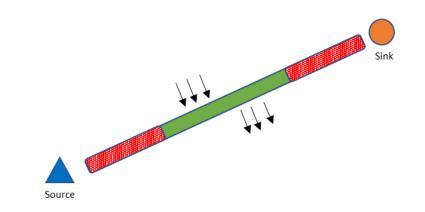
New Software Workflow



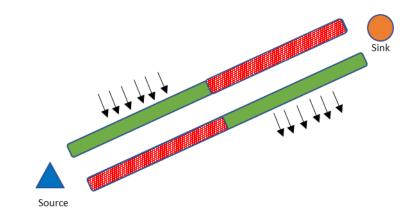
(Callahan et al., 2014)



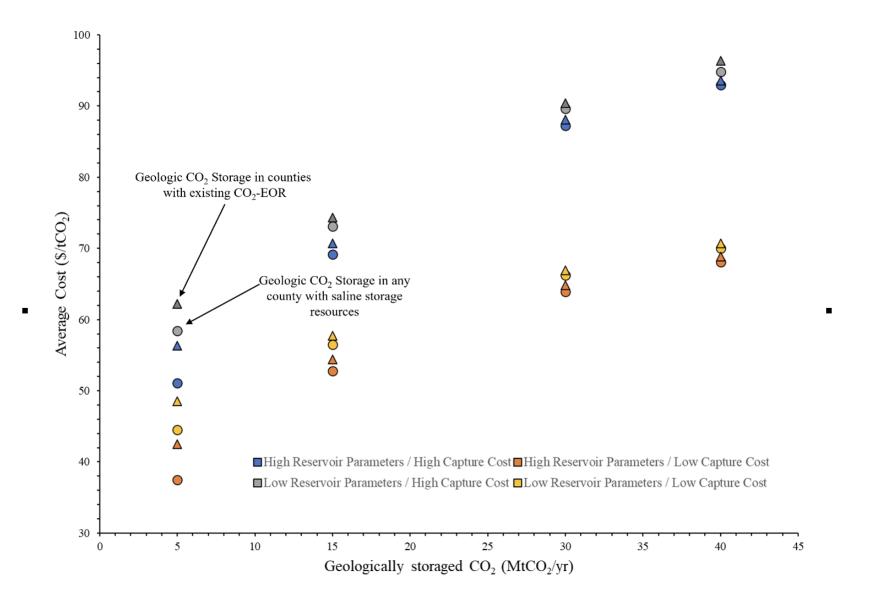
Case 2: 2 Tie-in Points With Exclusion At Ends

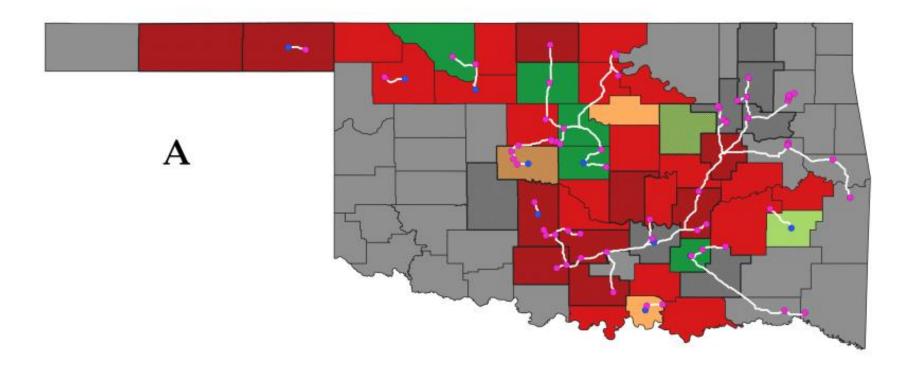


Case 3: Single Tie-in Point with All Exclusion But Source/Sink Case 4: Single Tie-in Point With Exclusion Before/After

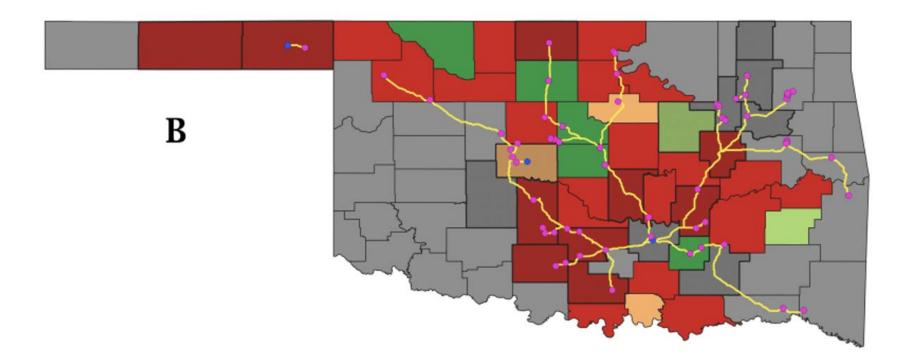


Thank You!



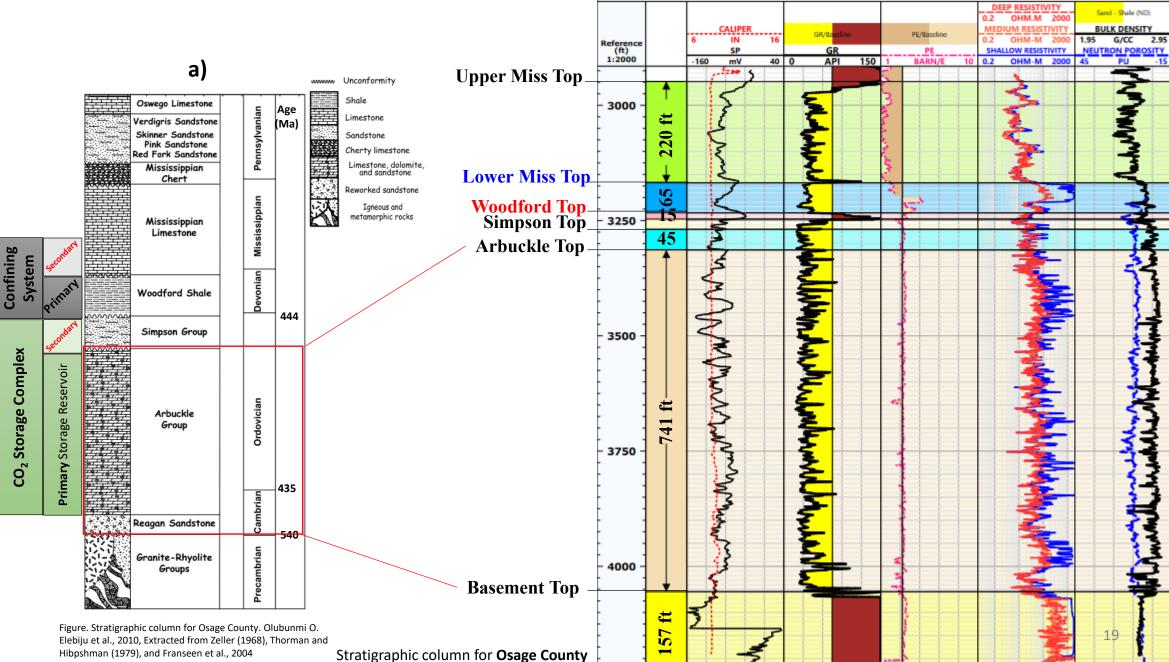








Geological Setting—Type Log



b)