

Integrated Midcontinent Stacked Carbon Storage Hub

Project Number DE-FE0029264

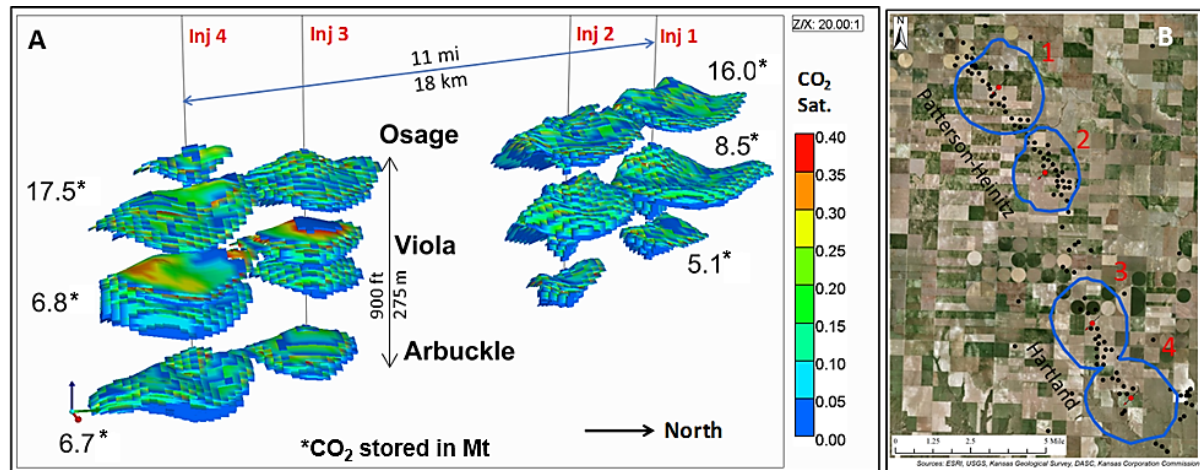
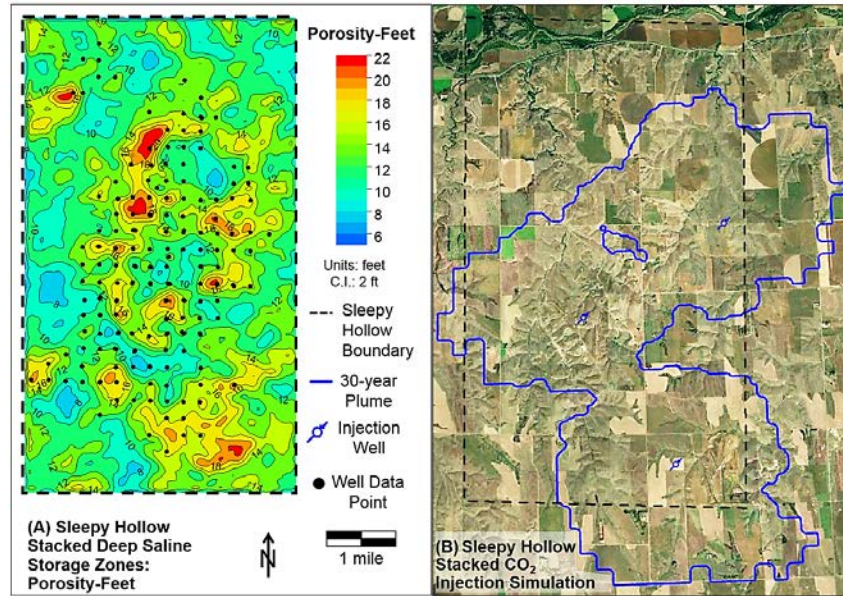


Andrew Duguid, Ph.D., P.E.

July 26, 2018

Outline

- Introduction
- Setting
- Team
- Corridors
- Capture
- Transport
- Storage
- Tasks



Introduction

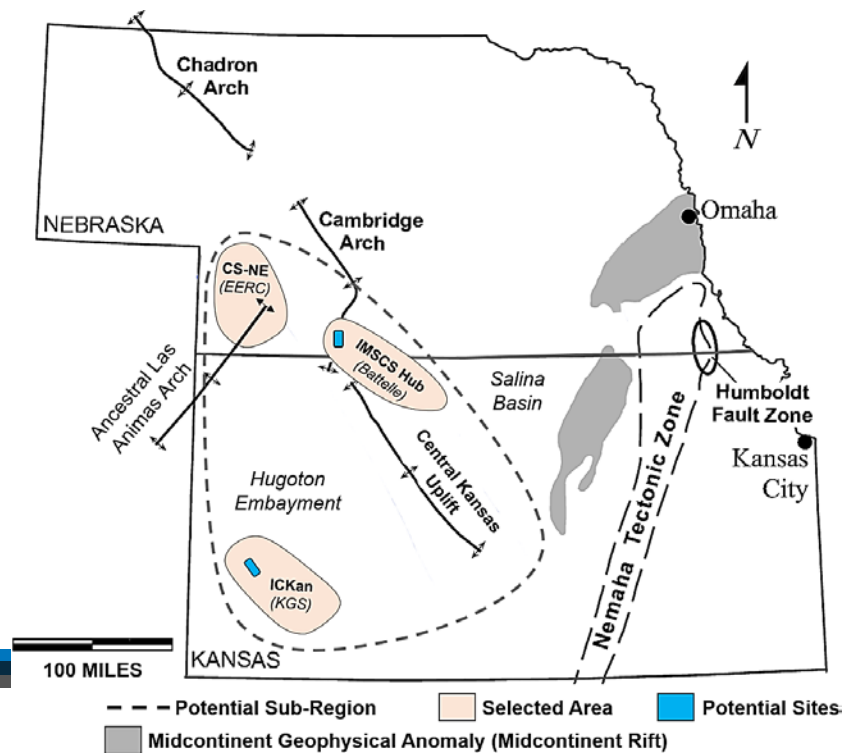
- The Integrated Midcontinent Stacked Carbon Storage Hub will gather CO₂ from eastern and central NE and transport it southwest toward Red Willow County, NE along a CO₂-source collection corridor. The CO₂ will then be piped south into central KS along a stacked storage corridor.
- Objective: Develop a midwestern carbon storage facility having multiple sites with a 50-Mt or greater capacity to safely, permanently, and economically store CO₂ by 2025.
 - Represents an important step forward in storage scale, exceeding the 50 million tonne (Mt) safe storage objective identified in DE-FOA-0001450.

Setting

- Nebraska and Kansas offer multiple near pure sources of CO₂ and multiple opportunities for both saline storage and storage associated with CO₂-EOR.
- The area offers a unique opportunity for early implementation of a CCS hub due to the large concentration of ethanol plants.
 - Nebraska has an ethanol production capacity of over 2 billion gallons per year which presents the opportunity to capture over 6 million tonnes of CO₂ from this source.
 - Implementation of CCS from ethanol production has been demonstrated by the two ADM projects in Decatur, IL.
- Nebraska and Kansas offer regionally continuous storage and caprock formations

Phase 1 Projects Represented

- This proposal is based on the combination of three Phase I CarbonSAFE projects:
 - IMSCS-HUB led by Battelle,
 - The Nebraska Integrated Carbon Capture and Storage Pre-Feasibility Study led by EERC, and the
 - Integrated Carbon Capture and Storage for Kansas (ICKan) led by KGS.



Team

ADM

ARI

Battelle

Berexco

**Conservation and Survey
Division, SNR, UNL**

DGR&M

**Energy and Environment
Research Center**

Great Plains Energy

Great Plains Institute

**Improved Hydrocarbon
Recovery**

Kansas Geologic Survey

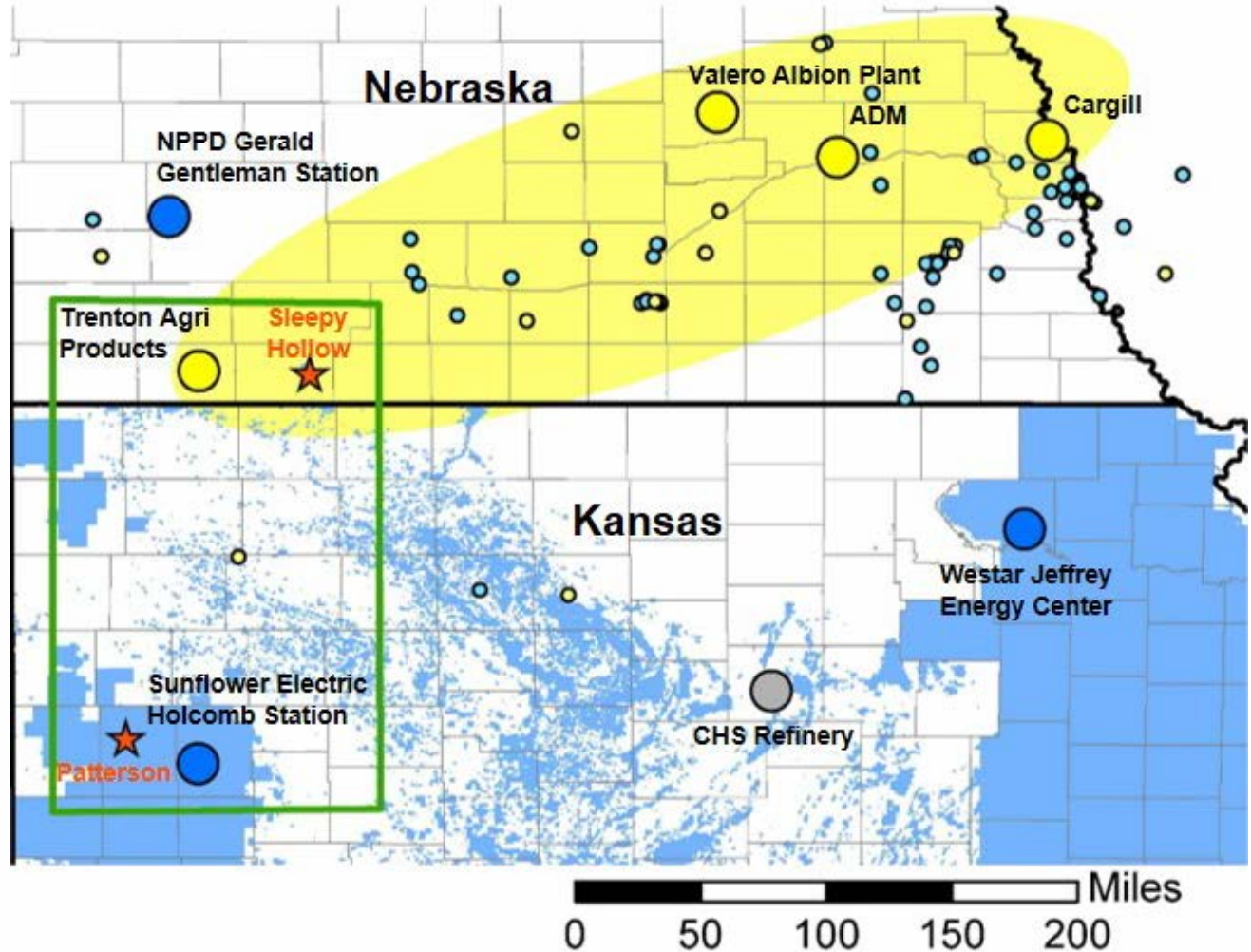
LANL

**Loudon Technical
Services**

PNNL

Schlumberger

Project Area



Legend

- Participating Power Plant
- Participating Ethanol Facility
- Other Participating Source
- Other Ethanol Facility
- Other Sources
- Yellow shaded area: Ethanol Source Corridor
- Green outlined area: Stacked Storage Corridor
- ★ Study Area
- Blue shaded area: Oil Resource/Stacked Storage Resource
- Black line: State Line
- Grey line: County Line

Corridors

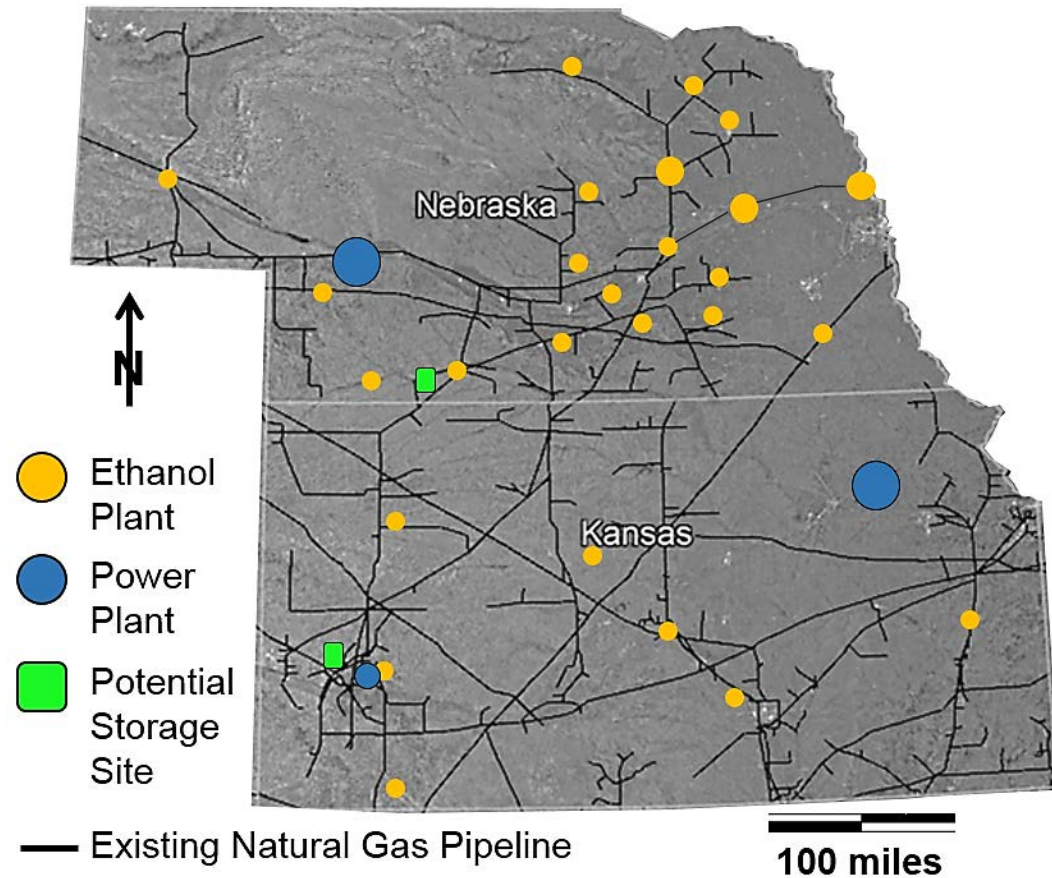
- Source Corridor (Initially Ethanol Derived CO₂)
 - Run from the Cargill ethanol plant at Blair, NE to SW NE
 - Optimize maximize the number of sources/amount of CO₂ to develop market and infrastructure for CCUS
 - 16 Ethanol plants in the corridor with annual emissions of 5 Mt
 - Bring in electric utility generated CO₂ as capture comes on line. Existing market from ethanol derived CO₂ will provide certainty that a utilization market and storage market exist for electric utilities
 - 5 other participating sources (4 electric utility and 1 refinery) with 20 Mt annual emissions
- Stacked Storage Corridor
 - Run from SW NE southeast into SW KS
 - Saline storage and CO₂ EOR
 - Co-locate infrastructure for Saline and CO₂ EOR.

Capture: CO₂ Sources

Ethanol Source	Annual CO ₂ Emissions (t)	CO ₂ Source	Annual CO ₂ Emissions (t)
ADM	1,164,813	Holcomb Station	1,726,751
Cargill Corn Milling	592,278	Westar JEC	10,848,198
Valero Renewables	366,648	CHS Refinery	613,756
Trenton Agri Products	112,815	NPPD GGS	7,499,834
AGP Soy/Corn Processing	159,232	Kansas City Board of Public Utilities	1,184,453
Pacific Ethanol (3 plants)	1,130,968		
Green Plains (5 plants)	1,119,687		
Chief Ethanol Fuels (2 plants)	338,444		
Bridgeport Ethanol	47,856		
Total	5,032,741		20,146,241

Transport: Rights of Way

- Ethanol plants in the region use natural gas as a fuel for processing corn.
- Natural gas pipelines run to every ethanol plant in Nebraska and Kansas.
- These pipelines occur within 3 miles of each potential site in Nebraska and Kansas.













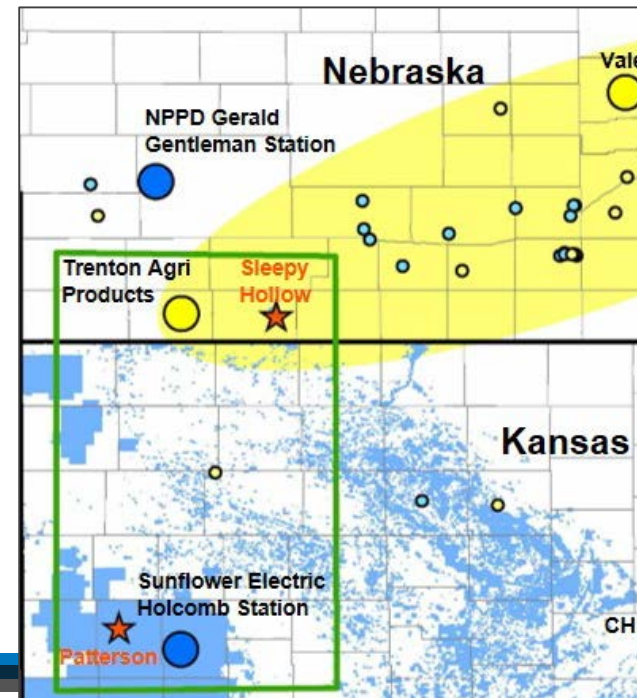
Storage: Geology

STRATIGRAPHY*					
Era	Period	Southwest Nebraska		Southwest Kansas	
Paleozoic	Permian	Nippewalla	caprock	Nippewalla	caprock
		Sumner		Sumner	
		Chase		Chase	
	Pennsylvanian	Council Grove	caprock	Council Grove	gas-bearing
		Admire		Admire	
		Wabaunsee	deep saline	Wabaunsee	baffle and deep saline
		Shawnee		Shawnee	
		Douglas		Douglas	
		Lansing-Kansas City	oil-bearing	Lansing-Kansas City	oil-bearing
		Pleasanton	deep saline	Pleasanton	baffle and deep saline
		Marmaton		Marmaton	
		Cherokee		Cherokee	
		basal sandstone	oil-bearing	Atoka	caprock
	Mississippian			Morrow	oil-bearing
				Chester	oil-bearing
				Meramec	baffle
				Osage	deep saline
				Kinderhook	baffle
	Devonian				
	Silurian				
Ordovician			Viola	deep saline	
			Simpson		
			Arbuckle		
Cambrian			Reagan	bottom barrier	
Precambrian		crystalline basement			

* formal lithostratigraphic group and stage names used unless otherwise noted; not to scale

LEGEND:

-  shale + limestone
-  shale + sandstone + limestone
-  shale + limestone ± evaporite
-  shale + sandstone
-  limestone ± shale
-  sandstone + limestone ± shale
-  sandstone
-  dolomite
-  igneous and metamorphic rocks
-  major unconformity

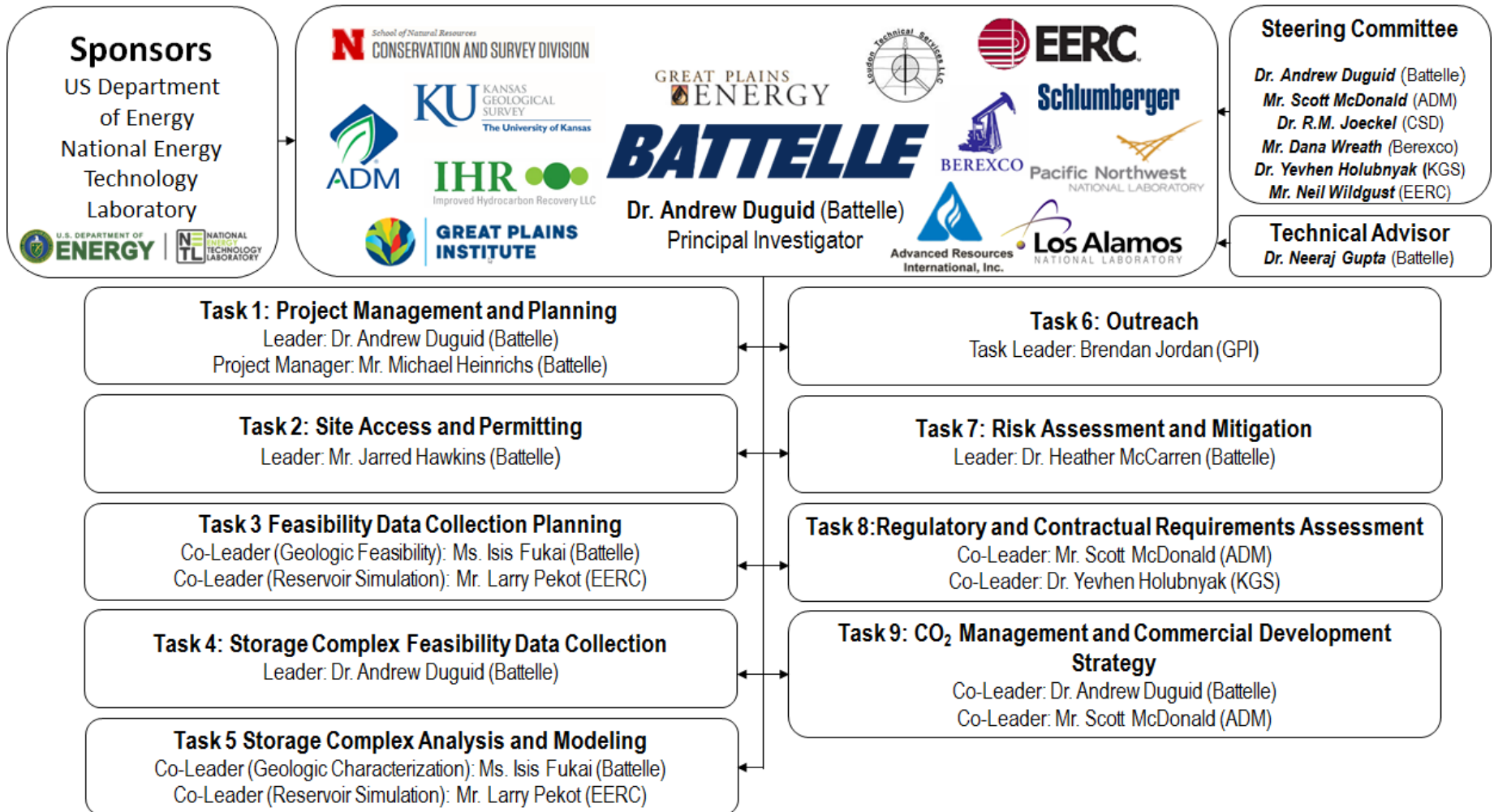


Storage: Capacity

- The DOE-NETL volumetric methodology for deep saline formations was used to calculate the prospective storage resource of the deep saline storage zones at each potential site (DOE-NETL, 2010; Goodman et al., 2011, 2016).

Selected Area	Deep Saline Storage Zone	Prospective Storage Resource (Mt)		
		P ₁₀	P ₅₀	P ₉₀
SW Kansas (Patterson)	Osage	12.3	24.6	49.0
	Viola	9.9	16.7	28.1
	Arbuckle	7.8	19.2	47.5
	Total	30.0	60.4	124.6
SW-Central Nebraska (Sleepy Hollow)	Wabaunsee	14.0	27.7	48.9
	Topeka	5.9	11.0	17.2
	Deer Creek-Oread	5.7	11.7	23.3
	Lansing-Kansas City A	2.5	7.0	13.9
	Lansing-Kansas City D-F	16.4	25.9	37.4
	Pleasanton-Marmaton	5.2	10.7	19.0
	Total	49.7	94.0	159.6

Project Tasks



Thank You

Andrew Duguid Ph.D., P.E.

Battelle
505 King Avenue
Columbus, OH 43201

Cell: +1 614-561-4468
Email: duguid@battelle.org