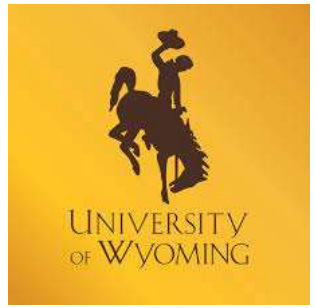
A CUSP Focused Project

Midcon CCS Hub

Franek Hasiuk, PI + Project Partners

ONEOK

Carbon Solutions LLC



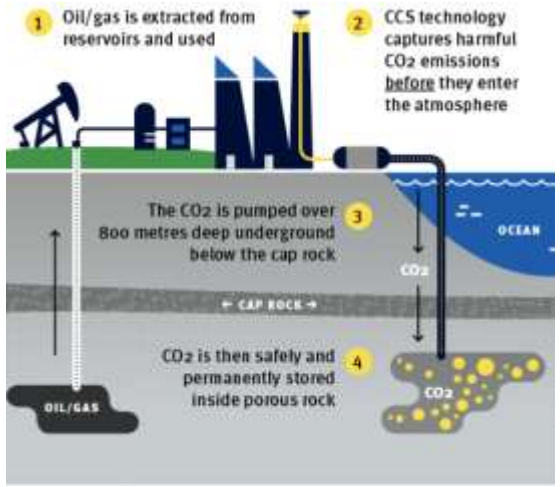
Sandia National Laboratories

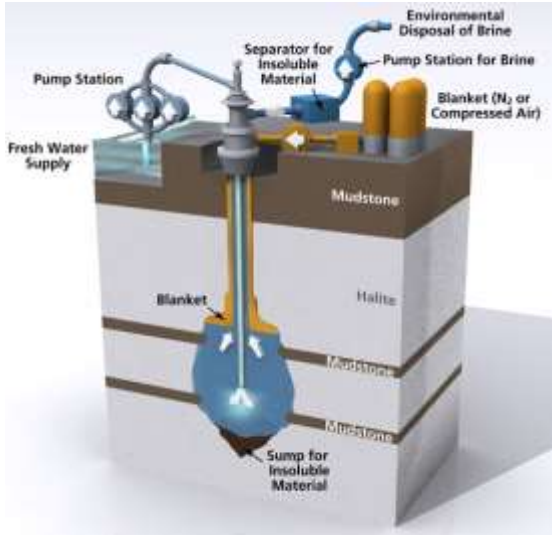
Los Alamos NATIONAL LABORATORY

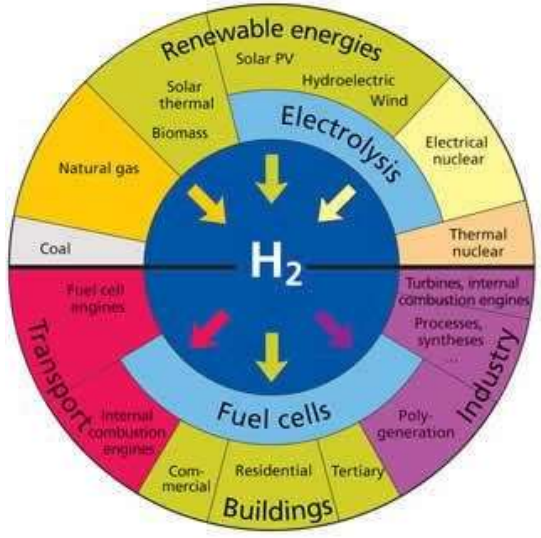
Pacific Northwest NATIONAL LABORATORY

Energy Transition Has Key Technologies

CCUS	Energy Storage	Hydrogen Economy	Critical Minerals
• Gets CO_2 out of the atmosphere • Prolongs investments in current infrastructure	• Manages variable production of power from renewables ***and*** fossil generators • Network benefits	• Can be burned with natural gas • Transport fuel • Industrial uses	• Required for high tech manufacturing (e.g., solar panels, wind turbines, electronics, screens) • Complex to refine







Summary of Our Focused Project

ONEOK has several gas processing plants that emit ~1M tonnes of CO_2 per year and plan to install hydrogen generation facilities that generate another 300k tons per year

- Identify CO_2 reservoirs for long-term saline storage or EOR around ONEOK natural gas liquids fractionation plants near Bushton, KS, and Medford, OK, as well as several gas processing plants in Oklahoma
  - Develop economic feasibility and business models for the CCUS projects for suitable storage candidates
  - Prepare necessary information and guidance for permitting, monitoring, and verification programs will be prepared for suitable candidates
- Explore feasibility of CO_2 use in unconventional reservoirs in Kansas, Oklahoma, or beyond

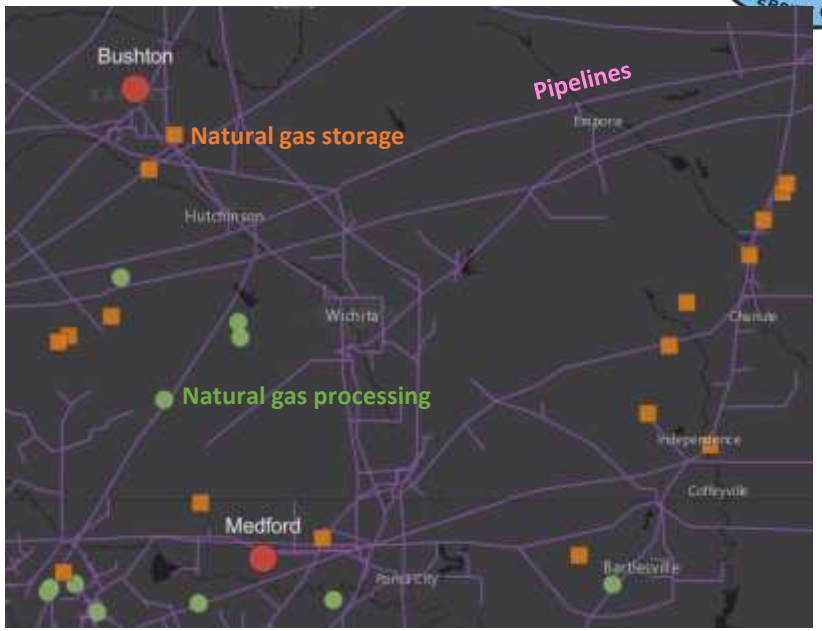
Summary of Our Focused Project

- Review co-utilization of additional gaseous products along with novel CO_2 capture concepts
  - Consider on-site hydrogen generation with CO_2 capture
  - Explore temporary storage of H_2, CO_2, or other gaseous products in salt caverns
- Quantify the feasibility of augmenting ONEOK CO_2 capture systems to ensure sufficient CO_2 volume output to qualify for 45Q tax credits or other incentives
  - Investigate centralized CO_2 capture/processing facility for process units that leverage existing pipeline network

If successful, this study will support a "Hub" concept for ONEOK that will allow for co-utilization of various hydrocarbon and non-hydrocarbon gasses and products

Our Focused Project

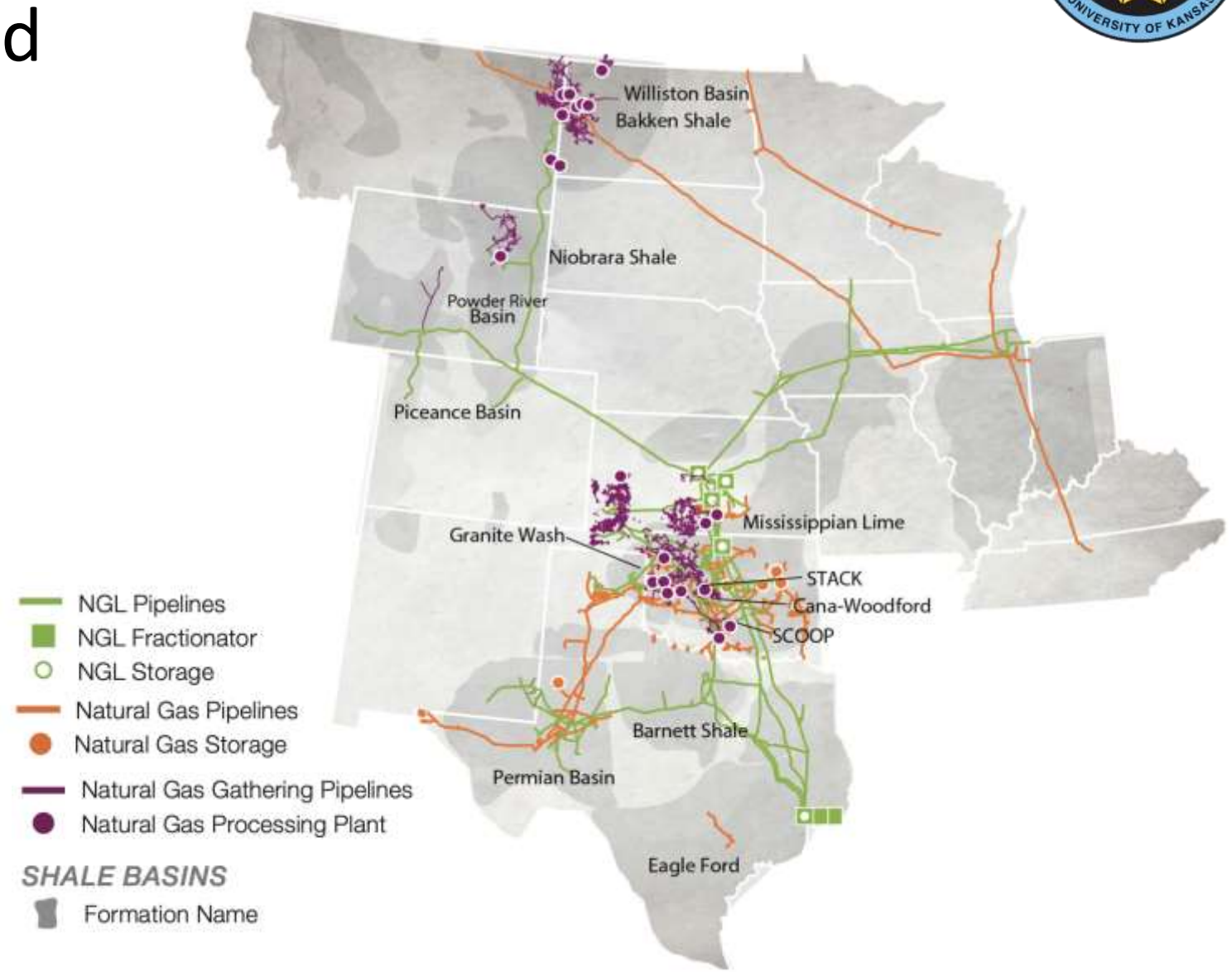
- **CUSP Team:** KGS/KU, OU/OGS, NMT, Sandia, PNNL, LANL, Carbon Solutions, ONEOK
- **Primary goal(s)**
  - Identify saline storage, EOR, and unconventional resources for CCUS
  - Identify salt resources for gas storage
- **Industry Partner:** ONEOK (Midstream Operator)
- **Project duration** (CUSP and beyond)
  - Phase 1: 5/2021–2/2024
  - Phase 2: 2024-2026
  - Phase 3: 2027-2028
- **Anticipated time to storage:** 2 years
- **Anticipated volume/year:** ?



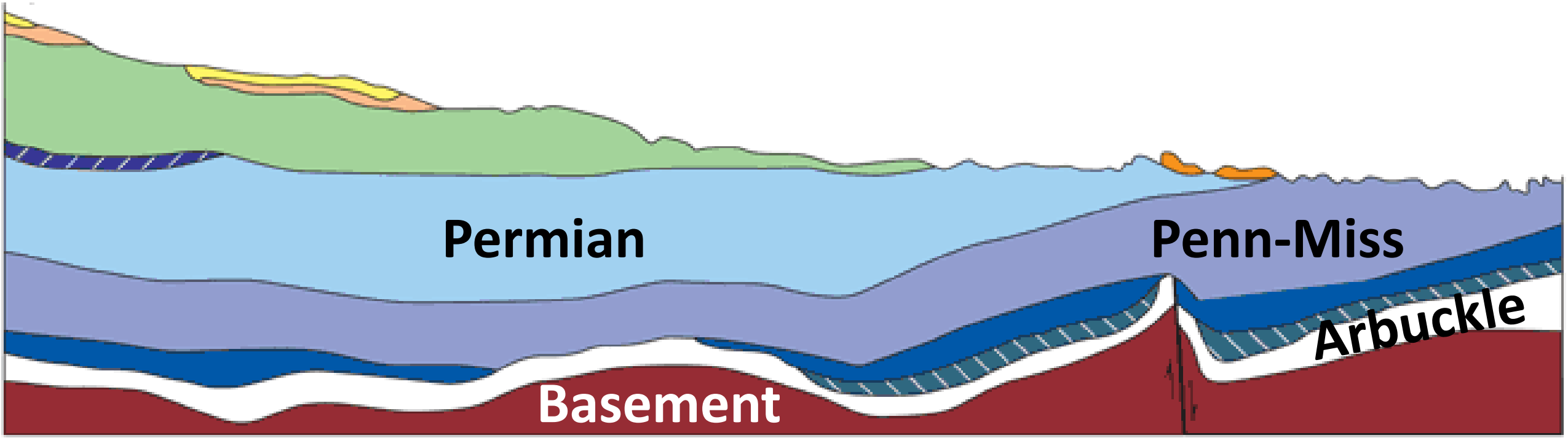
Task	Task Name	Task Assignments	22			23				24
			Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1
1	Technical Review	**KGS**, CS, Sandia, ONEOK								
2	Digital Database Build	**KGS**, CS, ONEOK								
3	Reservoir Studies	**KGS**, CS, LANL								
4	Dynamic Simulations	**KGS**, PNNL, LANL								
5	Infrastructure Network Assessment	CS, Sandia								
6	UIC Class VI Preparations	**KGS**, ONEOK								
7	UIC Class VI Support	**KGS**, ONEOK, PNNL, LANL								
8	45Q Preparations	NMT, **KGS**, ONEOK								
9	MVA Program	KU Geology, **KGS**, LANL								
10	Risk Assessment	PNNL, LANL, **KGS**, Sandia								
11	Project Management	**KGS**, ONEOK								

ONEOK is a Midstream Operator

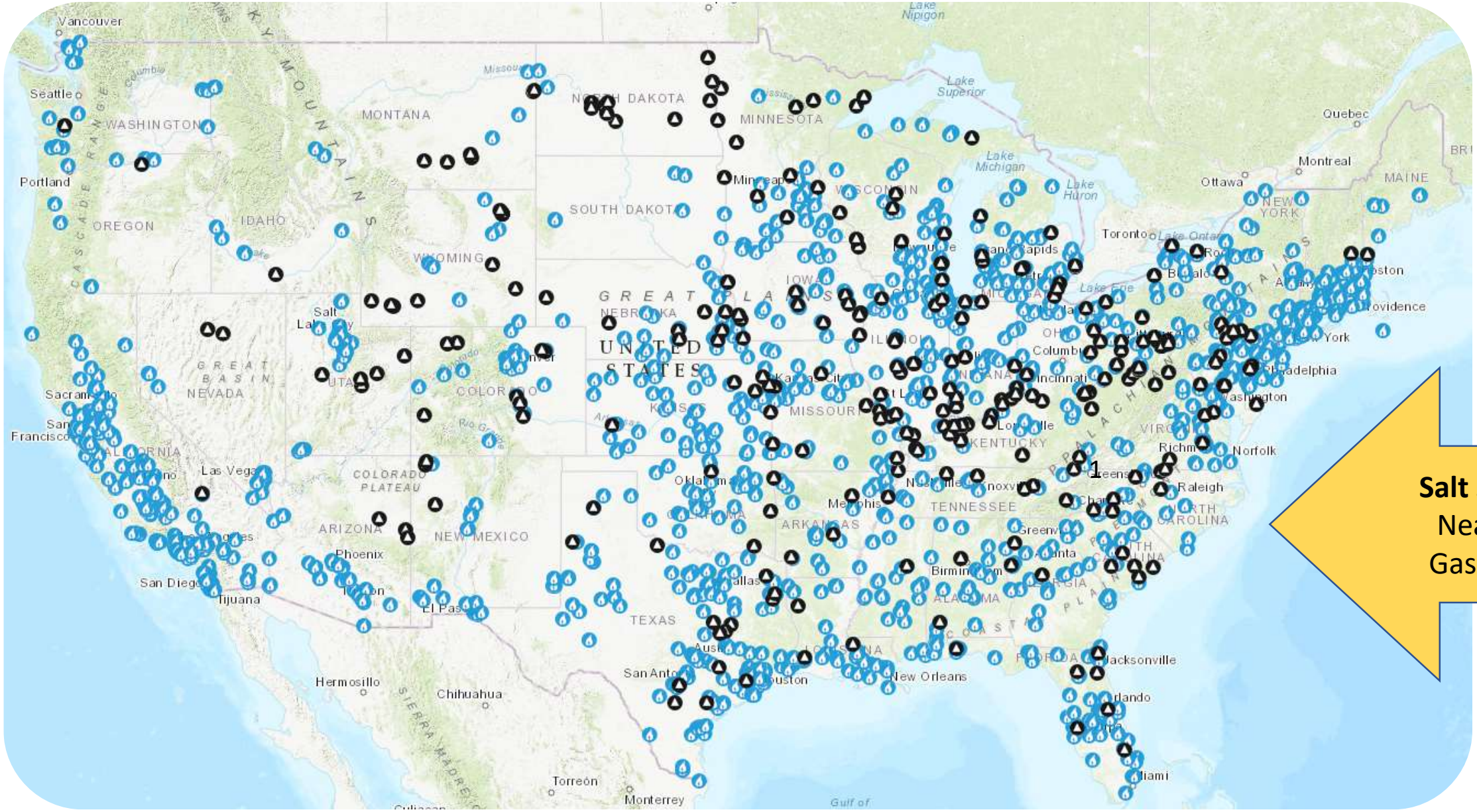
- 37,000 miles of NGL and natural gas pipelines
- 55 bcf of natural gas storage capacity
- 840,000 bpd of NGL fractionation capacity



Geologic cross-section shows reservoirs



Salt is Key to Storage



Salt Supports Near-Term Gas Storage

Data: EIA

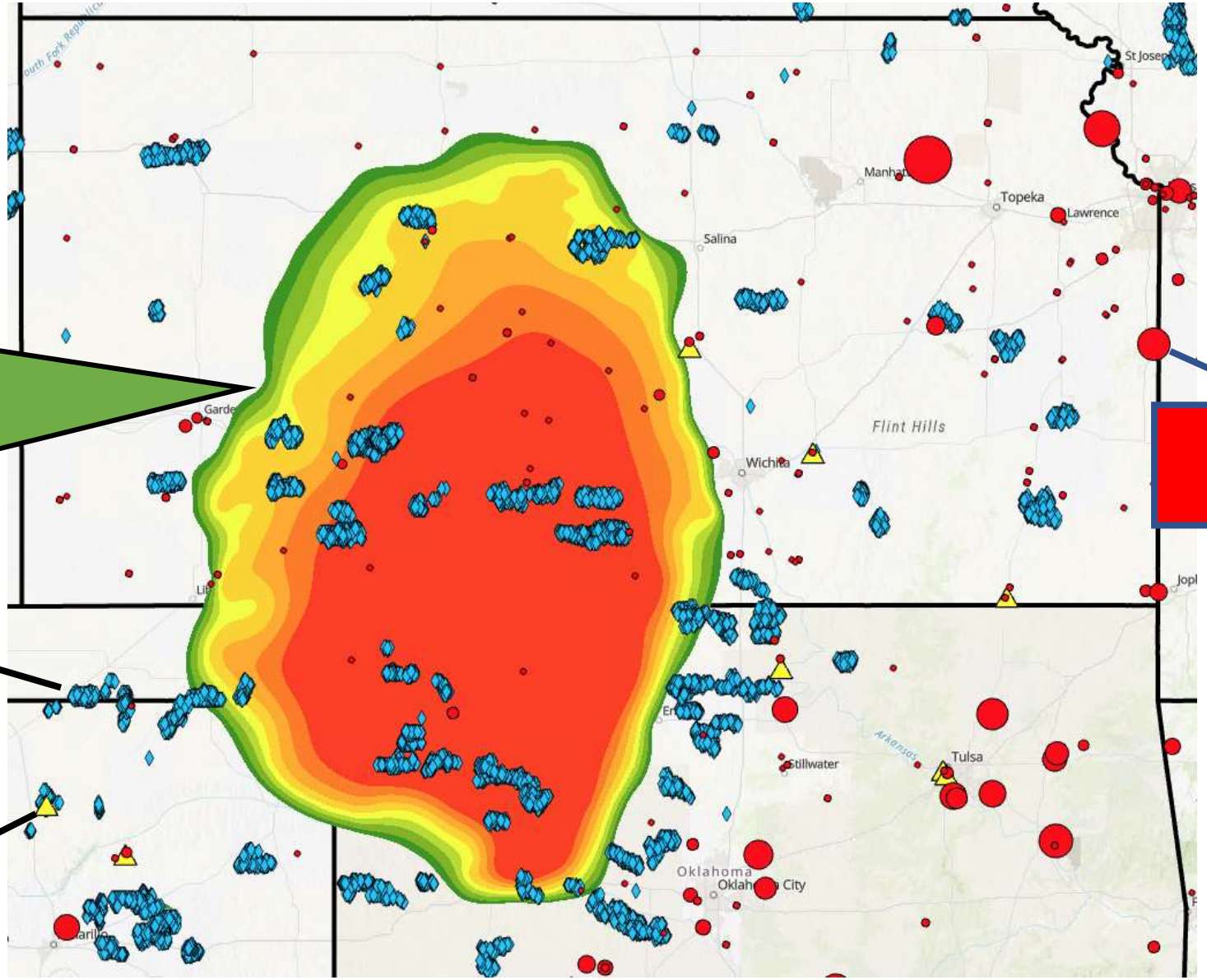
Geography of Salt in Kansas & Oklahoma

Hutchinson Salt Bed Thickness (ft)

- <= 50
- <= 100
- <= 150
- <= 200
- <= 250
- <= 300
- <= 350
- <= 400

Wind Turbines

Refineries



Fossil Power Plants

Why Here? *Location, Location, Location*

Business Location

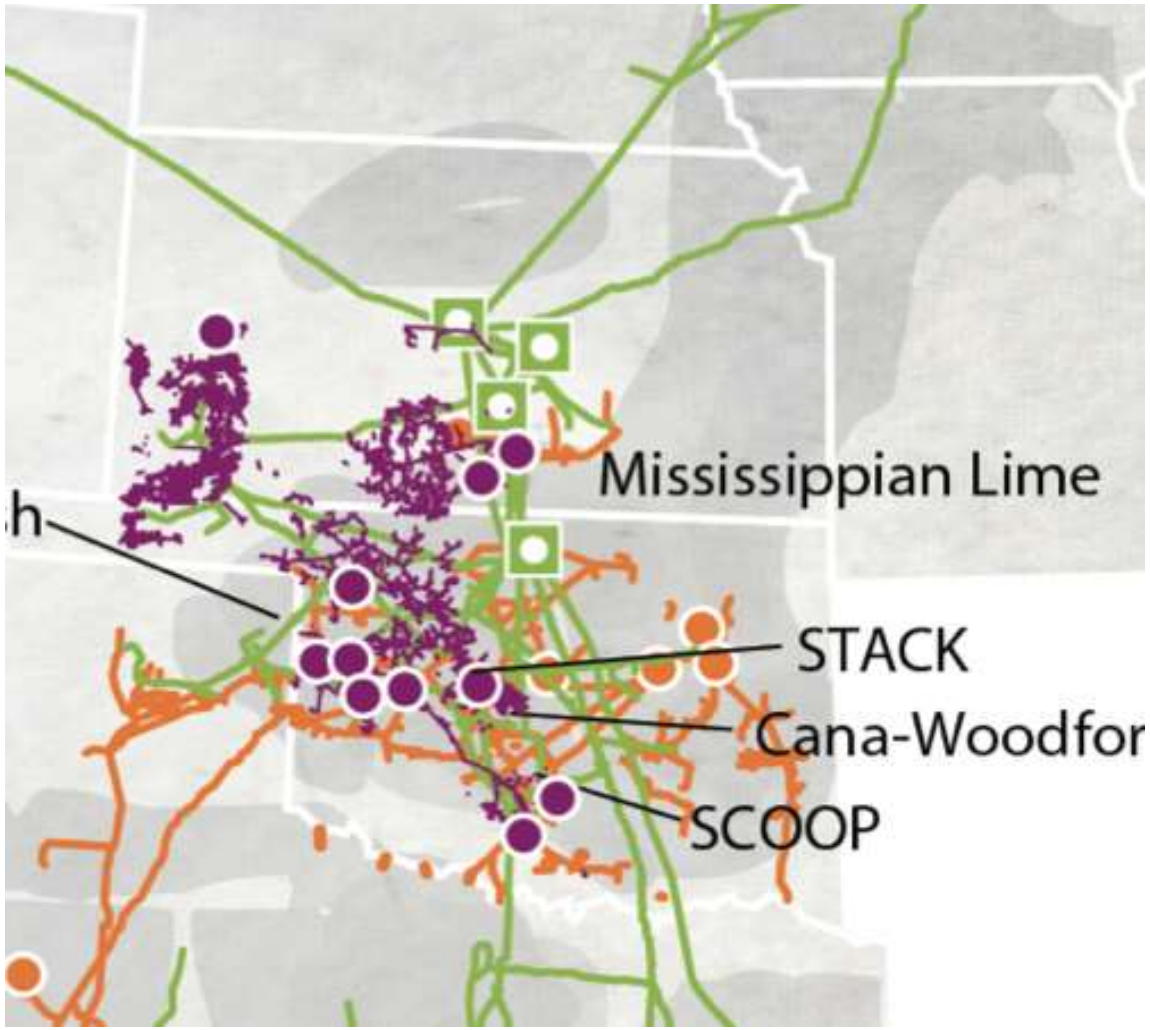
- Significant investments in infrastructure and people

Geological Location

- Significant salt presence
- Deep enough reservoirs

Geographic Location

- Middle of Lower 48
- Lower climate risk



No strangers to hard work!

Kansas

AD ASTRA PER ASPERA

Kansas

Oklahoma

Midcon CCS Hub

What questions do ***you*** have?

Geological & Engineering Tasks

- **Task 1 – Technical Review (KGS, OU/OGS, Carbon Solutions, Sandia, ONEOK)**
  - Determine quantity, type, and quality of the legacy data relevant to geologic, infrastructure, and risk assessment, as well as economic modeling activities…including available well, well test, core, pressure, and temperature data
- **Task 2 – Digital Database Build (KGS, OGS, Carbon Solutions, ONEOK)**
  - Create databases region for the use by geologic modeling (e.g., Petrel), pipeline routing (SimCCS), NRAP Tools (risk assessment), and others
- **Task 3 – Reservoir Studies (KGS, OGS, Carbon Solutions, LANL)**
  - Generating draft maps to define saline storage and EOR prospects. Subject to data availability, this work will include structure, isopach, and porosity maps for seal and reservoir horizons of interest to qualitatively assess potential for CO_2 injection.
  - Evaluate existing injection pressures and rates to determine suitability for saline storage or EOR
  - Perform geomechanical analysis, seal assessment, structural model creation/analysis, and stress regime assessment to identify potential risks associated with geomechanical hazards
  - Assess well integrity and seal penetrations to support seal assessment
  - Assess the thickness distribution of salt beds in Kansas and Oklahoma
- **Task 4 – Dynamic Simulation (WYO, PNNL, LANL)**
  - Evaluate current operations within existing fields to determine active wells, potential business entry opportunities and potential CO_2 project risks related to subsurface geology, ongoing operations, or surface activities.

Class VI & 45Q Tasks

- **Task 5 – Class VI Preparations (KGS, OGS, ONEOK)**
  - Meet with EPA to prepare for Class VI permit application; consultant on necessary data and analysis submissions before the application
  - Meet with external teams that have experience in applying for a Class VI permit
- **Task 7 – UIC Class VI Support (KGS, OGS, ONEOK, PNNL, LANL)**
  - Facilitate the flow of information between an applicant and US EPA Team
  - Answer Requests for Additional Information tables or documents and prepare additional reports
- **Task 8 – 45Q Preparations (NMT, KGS, ONEOK)**
  - Facilitate necessary US IRS 45Q compliance documentation

Operations Tasks

- **Task 8 – Infrastructure Network Assessment (Carbon Solutions, Sandia)**
  - Assess operational limitations to developing a CO_2 injection project.
  - Model pipeline corridor and survey site access and surface facilities
  - Define equipment, surface facilities, and subsurface vessels that would be required to execute the chosen design
- **Task Task 9 – Monitoring, Verification, and Accounting Program (KU Geology, KGS, LANL)**
  - Install and monitor seismometer network
  - survey surface and shallow well geochemistry
  - Assess pore-pressure and other secondary means of AoR monitoring
- **Task 10 – Risk Assessment (PNNL, LANL, KGS, Sandia)**
  - Prepare a ranked matrix of key risk factors for each seal and reservoir addressing key (sub)surface issues that could affect injection viability
  - Perform induced seismicity and potential leakage risk analysis using NRAP tools, and develop strategies for risk mitigation