Wyoming CarbonSAFE: Accelerating CCUS Commercialization and Deployment at Dry Fork Station and the Wyoming Integrated Test Center

PROJECT AWARD #: DE-FE0031891

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UNIVERSITY OF WYOMING | School of Energy Resources

THE WORLD NEEDS MORE COWBOYS.

Project Overview

Project Overview: Wyoming CarbonSAFE Phase III

- Dry Fork Station (Basin Electric Power Coop)
- Wyoming Integrated Test Center (WY-ITC)

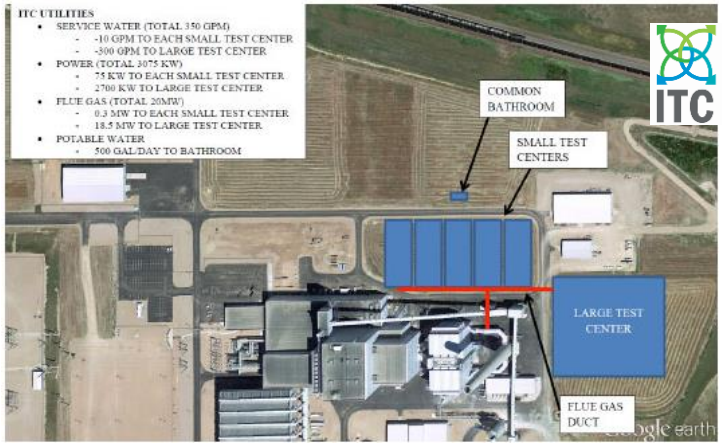
BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

Dry Fork Station

- Built in 2007
- Operating life to 2072
- 385 MW
- 3.3 million tons of CO_2/year

WY-Integrated Test Center (ITC)

- Completed fall 2017
- Test CO_2 capture/CCUS technologies
- $20M public/private investment
- $65M Membrane Technology Research (MTR) Large-scale pilot



WYOMING INTEGRATED TEST CENTER

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Full-Scale FEED of MTR's Capture Process at Dry Fork Station

MTR · BASIN ELECTRIC POWER COOPERATIVE, A Touchstone Energy® Cooperative · Sargent & Lundy · EPRI ELECTRIC POWER RESEARCH INSTITUTE · TRIMERIC CORPORATION · CARBON MANAGEMENT STRATEGIES · NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

Project Participants

ACADEMIC PARTNERS

University of Wyoming

Advanced Resources International

Energy and Environmental Research Center

Los Alamos National Laboratory

CARBON CAPTURE

Membrane technology and Research, Inc. (MTR)

Wyoming Integrated Test Center

INDUSTRIAL PARTNERS

Schlumberger Carbon Services

Denbury Resources

Oxy Low Carbon Ventures

Carbon GeoCapture

Western Fuels Association

PERMITTING, ENVIRONMENTAL AND REGULATORY EXPERTS

Long Reimer Winegar Beppler, LLP

TriHydryo Corporation

Wyoming Energy Authority

Wyoming Department of Environmental Quality (DEQ)

Wyoming Municipal Power Agency

Major Objectives

1. Finalize surface and subsurface characterization activities at DFS

2. Conduct NEPA and environmental analysis

3. Integrate MTR's CO_2 FEED capture assessment

4. Complete Class VI permits to construct for the storage hub

5. Advance commerciality within the Wyoming CarbonSAFE storage hub

Project funding:

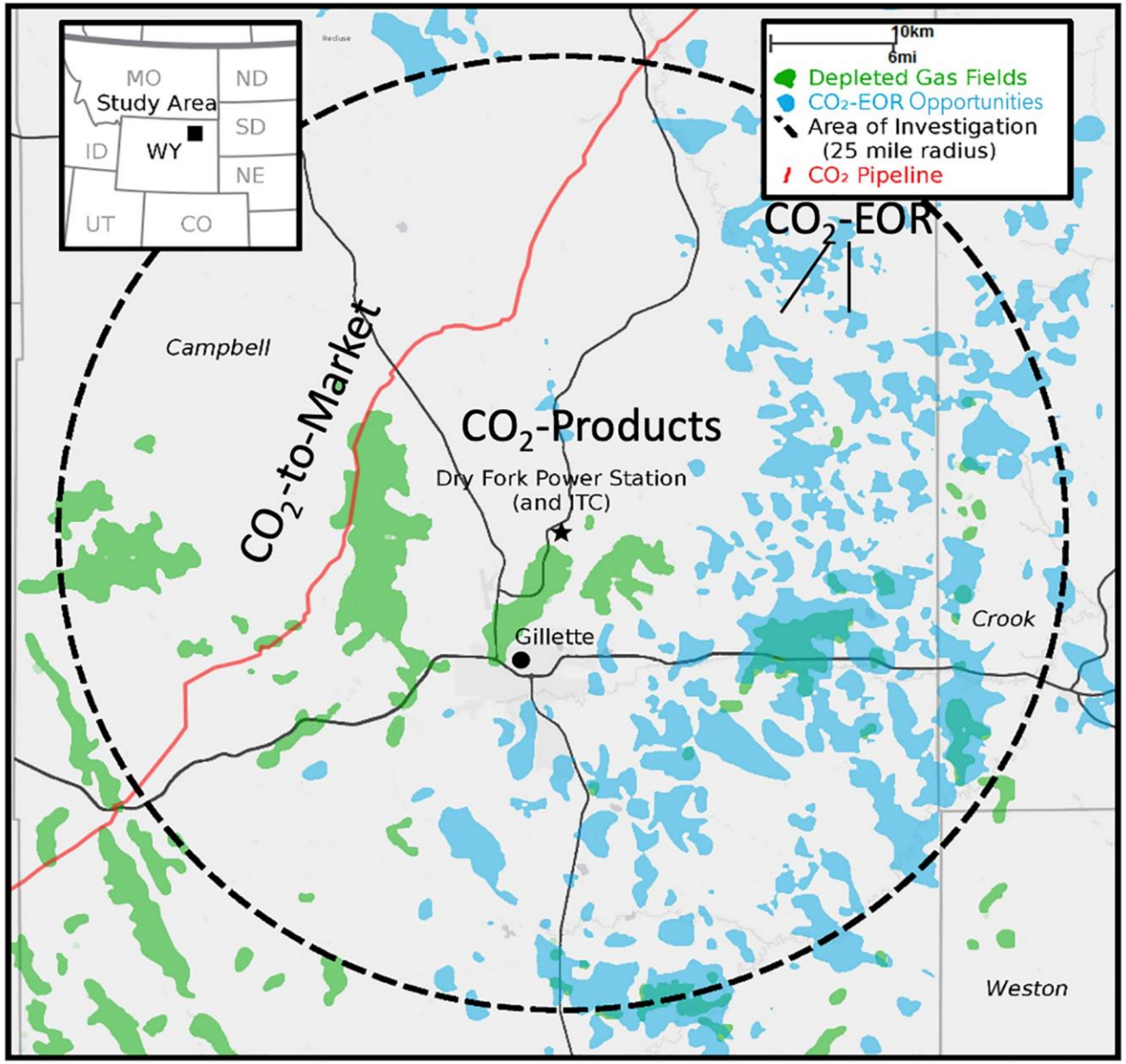
- $15,526,325 (Federal)
- $3,941,389 (Cost share)
- $19,467,714 (Total)

Period of performance: Oct. 2020 to Sept. 2023

Site selection and characterization

Rational for site selection

- CO_2 source with 50 year operational life-span
- Modern coal plant
- Located within Carbon Valley, the site of:
  - Existing intrastate CO_2 transportation network
  - Multiple utilization industries
    - Carbon to products industry
    - CO_2-EOR for carbon utilization
  - Experienced carbon workforce
  - Multiple CO_2 point sources
  - Transportation infrastructure
- Wyoming has
  - CO_2 management legislative framework
  - Class VI primacy
  - Educated and supportive public
  - Known geologic targets

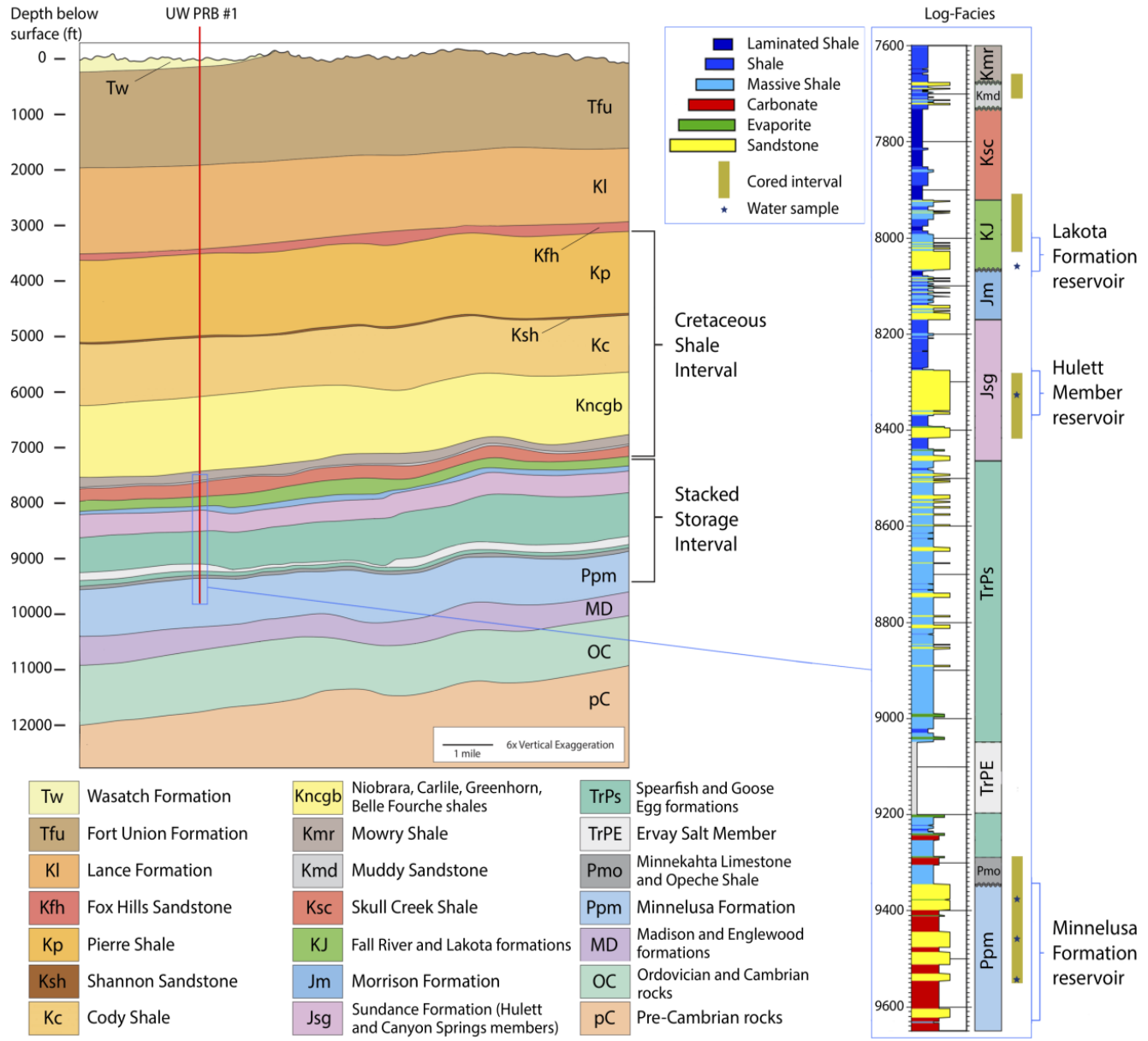


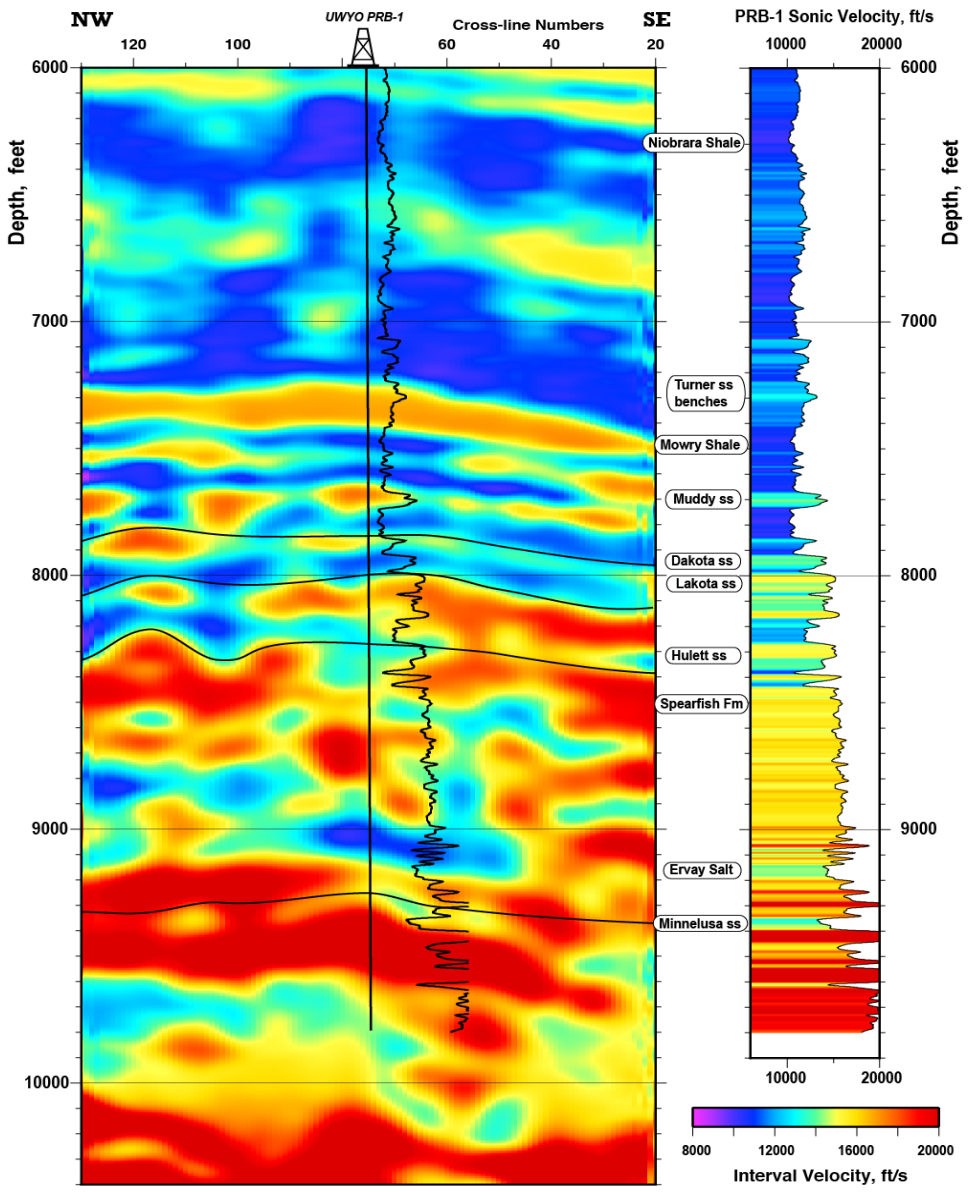
Site Characterization to-date

- One stratigraphic test well completed, one well designed and in-review
- Assessment of core, formation fluid and logs from target injection formations and sealing lithology
- Environmental (EIV) and monitoring assessments (Soil, GW)
- 3D seismic survey
- Storage hub property models and injection feasibility simulations
- Regulatory assessment
- Economic/business case assessments
- Initial risk and MVA assessments

Location	Sundance Stored CO_2, MT	Minnelusa Stored CO_2, MT	Total Stored CO_2, MT
1	2.9	5.4	8.3
2 (UW PRB 1)	0.9	6.8	7.7
3	8.5	9.1	17.6
4	-	-	-
5	0.6	7.5	8.1
6	5.2	6.8	12.0
7	-	-	-
Total	18.1	35.6	53.7

Site Characterization to-date

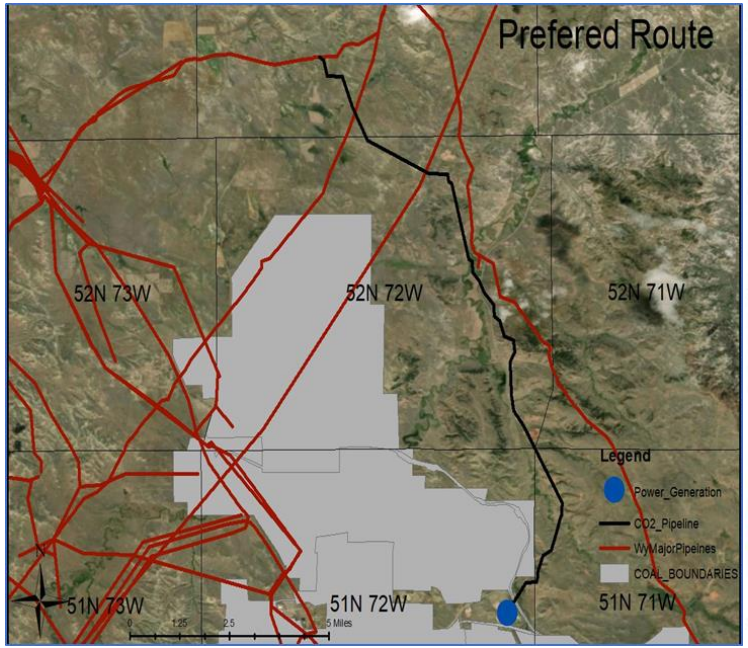


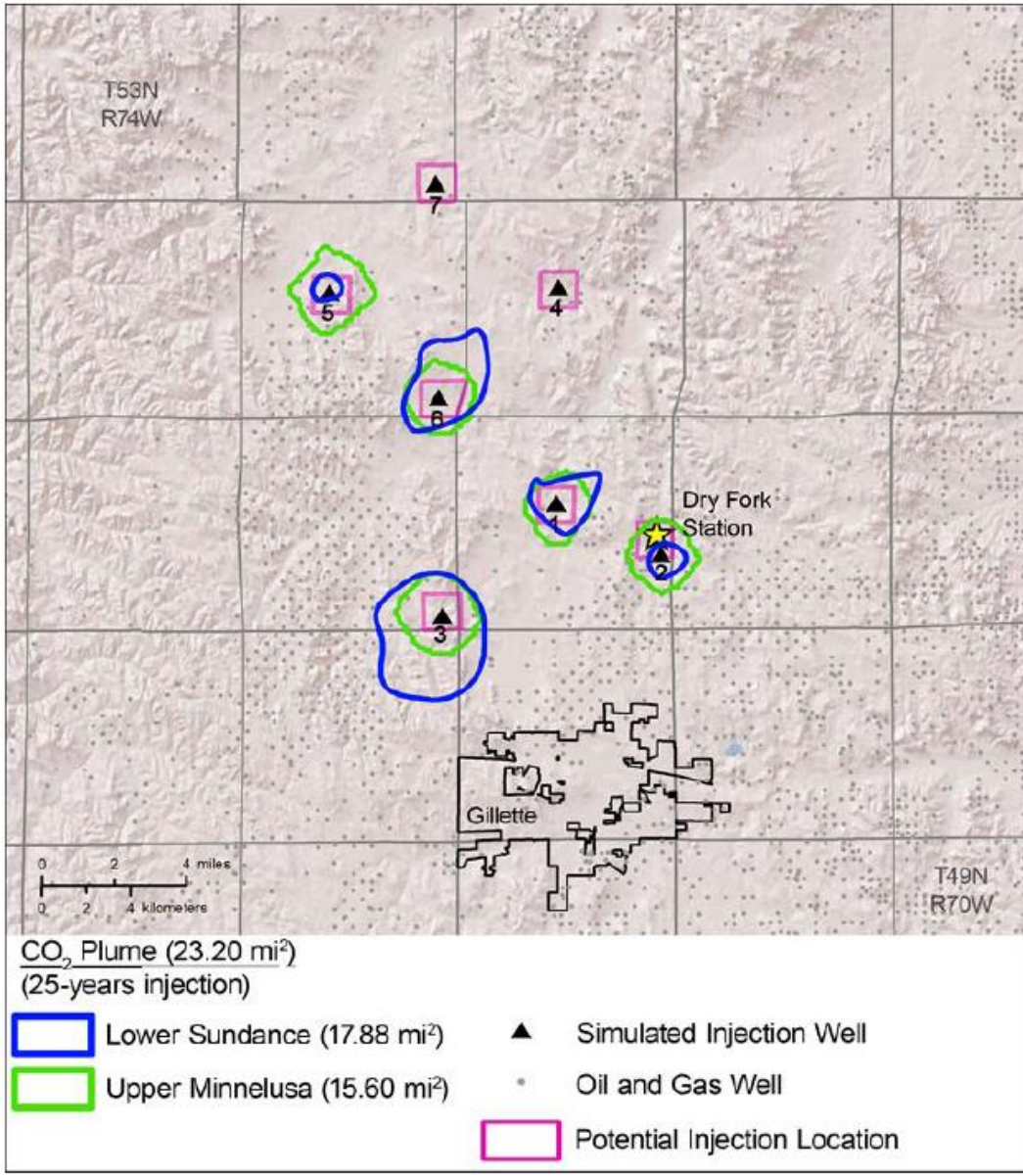


Site Characterization to-date

Legal, public and regulatory analysis

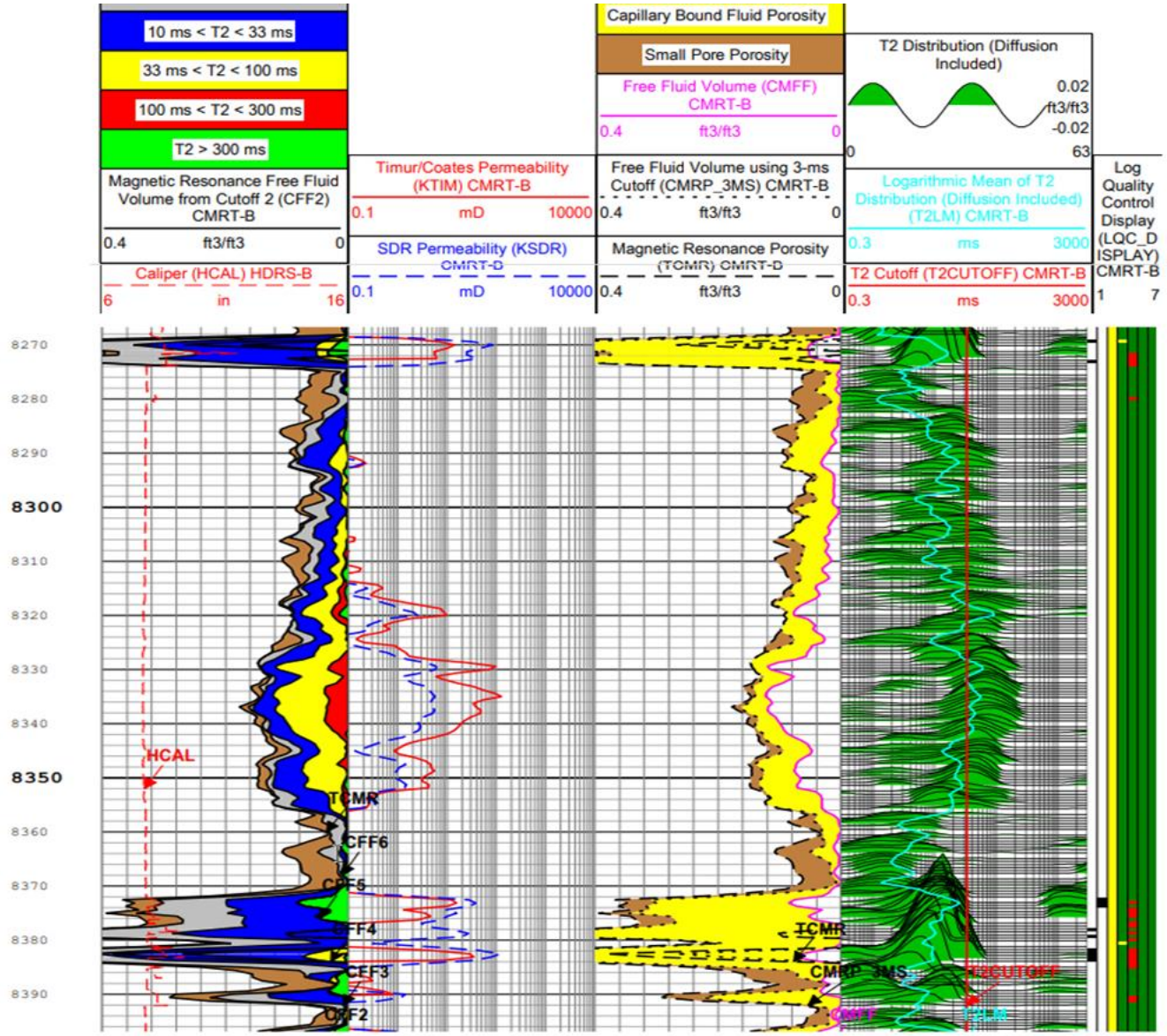
- Class VI permitting analysis
- Preliminary title abstract for pore space ownership
- Impacts of anticipated Federal and State regulations
- Model project and business agreements
- Potential business agreements
- Integrated pipeline networks
- Initiated public outreach





Advantages

- Modern, relatively-young CO_2 source
- Supportive industry partners
- Existing capture technology programs/projects
- Proximity to CO_2 infrastructure
- Existing CO_2 management industry
- Robust regional subsurface data (proven injectio targets and confining potential)
- Stacked storage lessons footprint
- Minimal surface structures/large land holdings
- Supportive regulatory framework



Technical Approach

Technical Approach

Technical Approach for Site Characterization and Commercialization of the Wyoming CarbonSAFE Storage Hub

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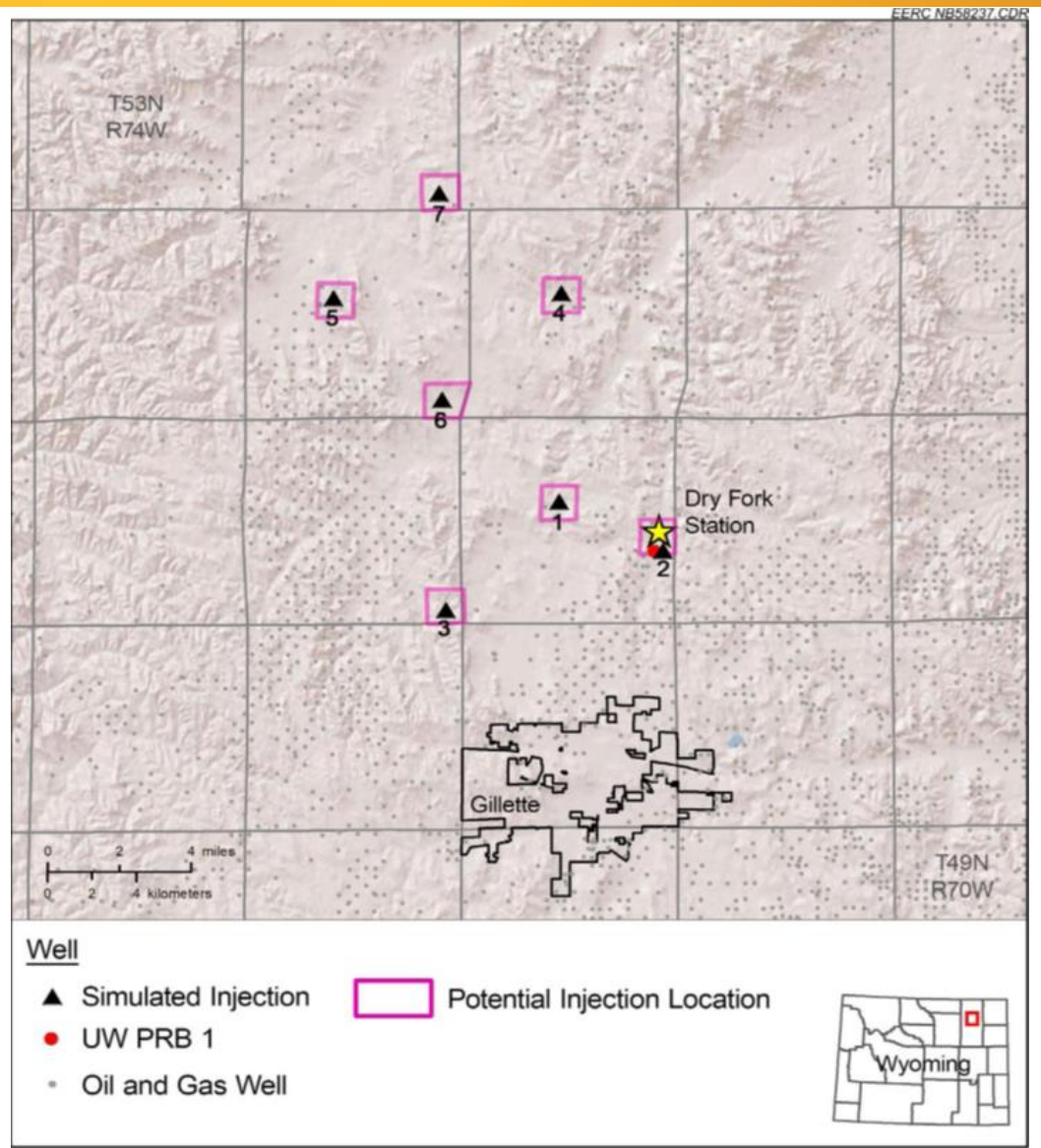
- Characterize seven sites within the storage hub
- Full injection/permitting completion of the DFS site
  - 2 wells for optimal stacked storage, reservoir testing, interference tests, subsurface data gap completion
  - Wells completed to Class VI standards
- Develop and complete Class VI permits for all sites
- Develop business and commercial strategies for the storage hub
- Environmental assessment (NEPA demands and baseline conditions)
- Integrate MTR's capture assessment into commercial plan
- Finalize site risk and MVA
- Develop greater regional capacity than the program requires



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Schedule/milestones/success criteria

Key milestones

Milestone Title & Description	Completion Date
Finalize initial environmental assessment	3/30/2021
Initiate drilling of UW PRB#2	9/30/2021
Update models with seismic and field data	1/1/2022
Initiate Class VI applications	11/1/2020
Submittal of Class VI permits	9/30/2022
Complete risk assessment	1/31/2023
Public Outreach meeting	9/1/2021
Identification of potential business partners	1/31/2023

Success criteria

EIV identifies site(s) issues
CO_2 capture study is not completed
Submitting and receiving applications to initiate drilling
Obtaining access agreements
Drilling UW PRB#2
Complete subsurface field testing and monitoring

Project risks and mitigation strategies

Perceived Risk	Mitigation/Response Strategy
Financial Risks:	
Drilling expenses	Rates are subject to the market price of oil. If rates increase, the co-PIs will look for ways to absorb costs in other areas of the project.
Cost/Schedule Risks:	
Project timeline	The Project timeline was developed based on the experienced gained form previous projects of this scale and will communicate regularly with the DOE program Manager.
Technical/Scope Risks:	
NEPA assessments	UW will select an environmental consultant with a proven record of accomplishment of EIVs.
Drilling and field operations	Challenges will be addressed through the team's prior experience with drilling operations and the selection of experienced contractors and commercial technologies.
Data collection	The team has extensive experience performing fieldwork in the PRB and has successfully collected the necessary data
Subsurface modeling	CEGR, EERC and ARI have extensive experience with the industry-standard software packages that will be used
Class VI well permitting	WYDEQ has received Class VI primacy and the Project team has collaborated closely with WYDEQ on permitting strategies
CO_2 source commitment	As demonstrated by the CO_2 source commitment letters, BEPC (source) and MTR (capture) can provide the CO_2 for successful implementation of future phases.
Management, Planning and Oversight Risks:	
Project Management	Risks are negligible due to the team's collective experience in projects of this type.
ES&H Risks:	
Operations	All physical activities, including drilling, will be overseen in compliance with applicable laws.
External Factor Risks:	
Site access	The drilling site is on land owned by partner BEPC, which mitigates these concerns.
Pore space ownership	Risk will be addressed by WY law, which defines pore space ownership; minimization of project impacts; and project siting to focus impacts on land owned by team members. Risks are at medium due to the first-of-its-kind program.
Public acceptance	The Project team will continue to implement the outreach strategy deployed during Phases I & II.
Resource availability	Resource availability risks include access to a drilling site, equipment and skilled labor. These are negligible as BEPC will construct the drilling site and the PRB has a skilled workforce.

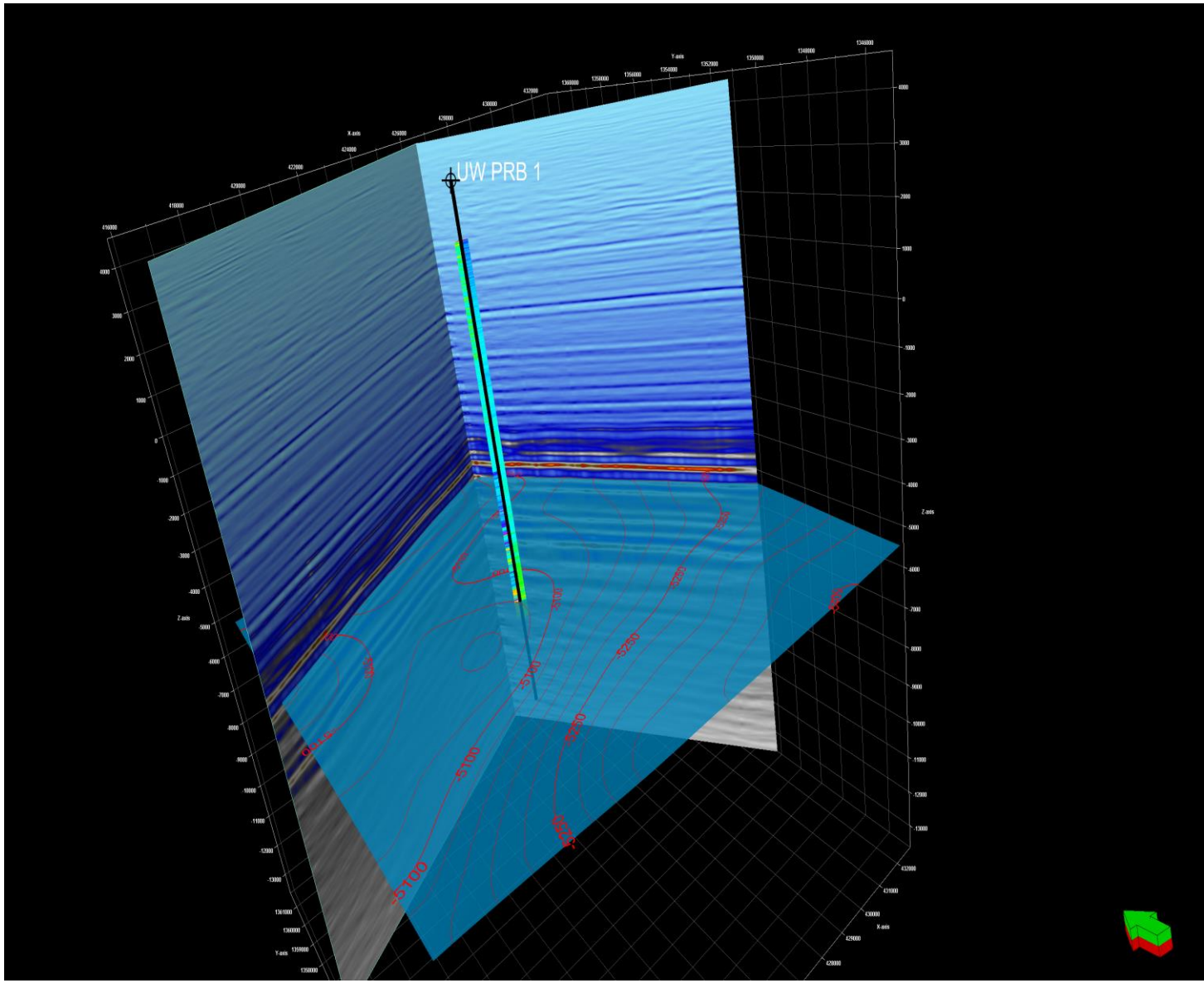
Status Update

Progress and Current Status

Finalize surface and subsurface characterization activities

- One well drilled, sampled and analyzed
- 3D seismic survey acquired
- Second well designed, testing and completion programs verified
- Initial permits acquired for completion of both wells
- Feasibility models (full scale and site specific) completed and tested, populated with Phase II data
- Formation fluid characterized and modeled for reactivity
- Data incorporation for Machine Learning
- NRAP IAM being built

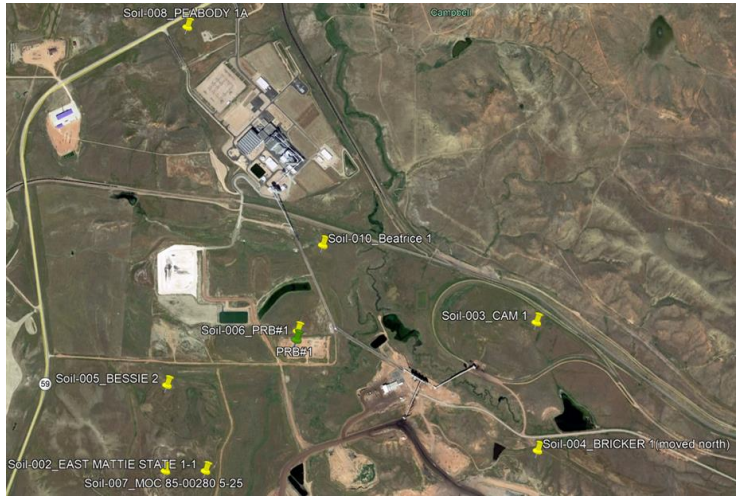
SmartTensors

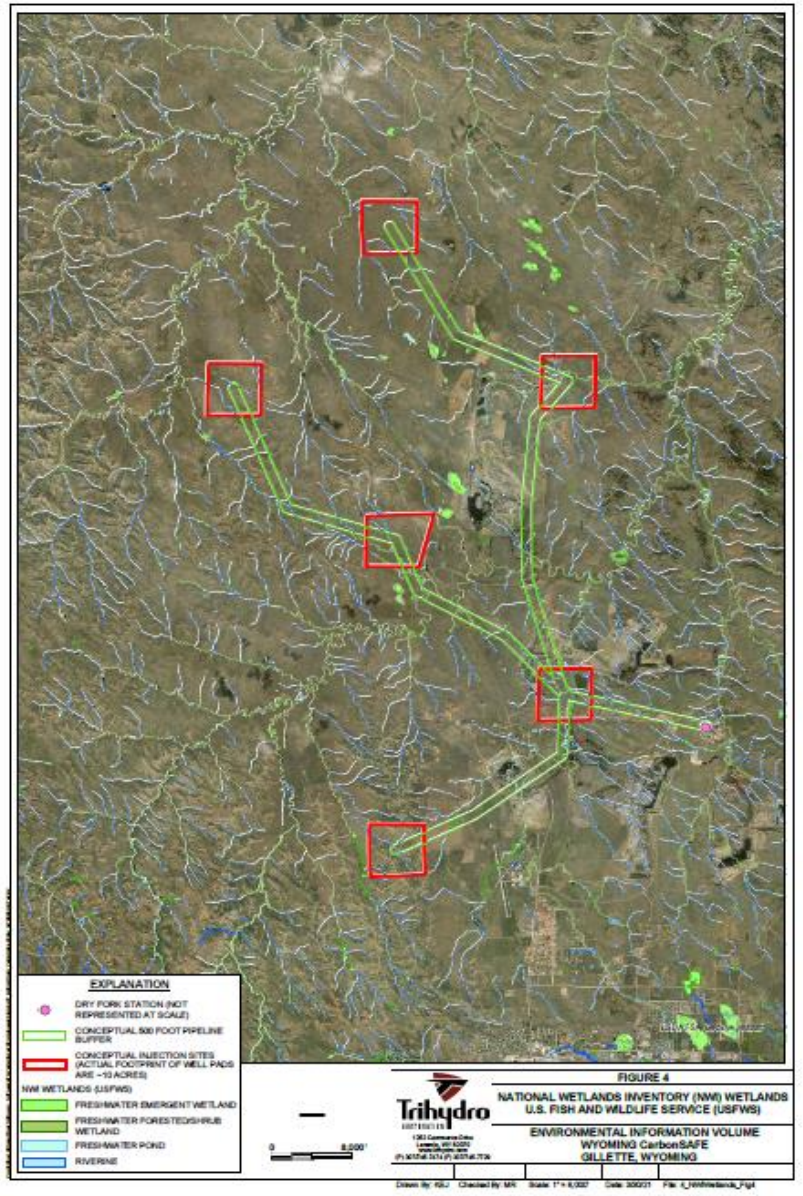


Progress and Current Status

Conduct NEPA and environmental analysis

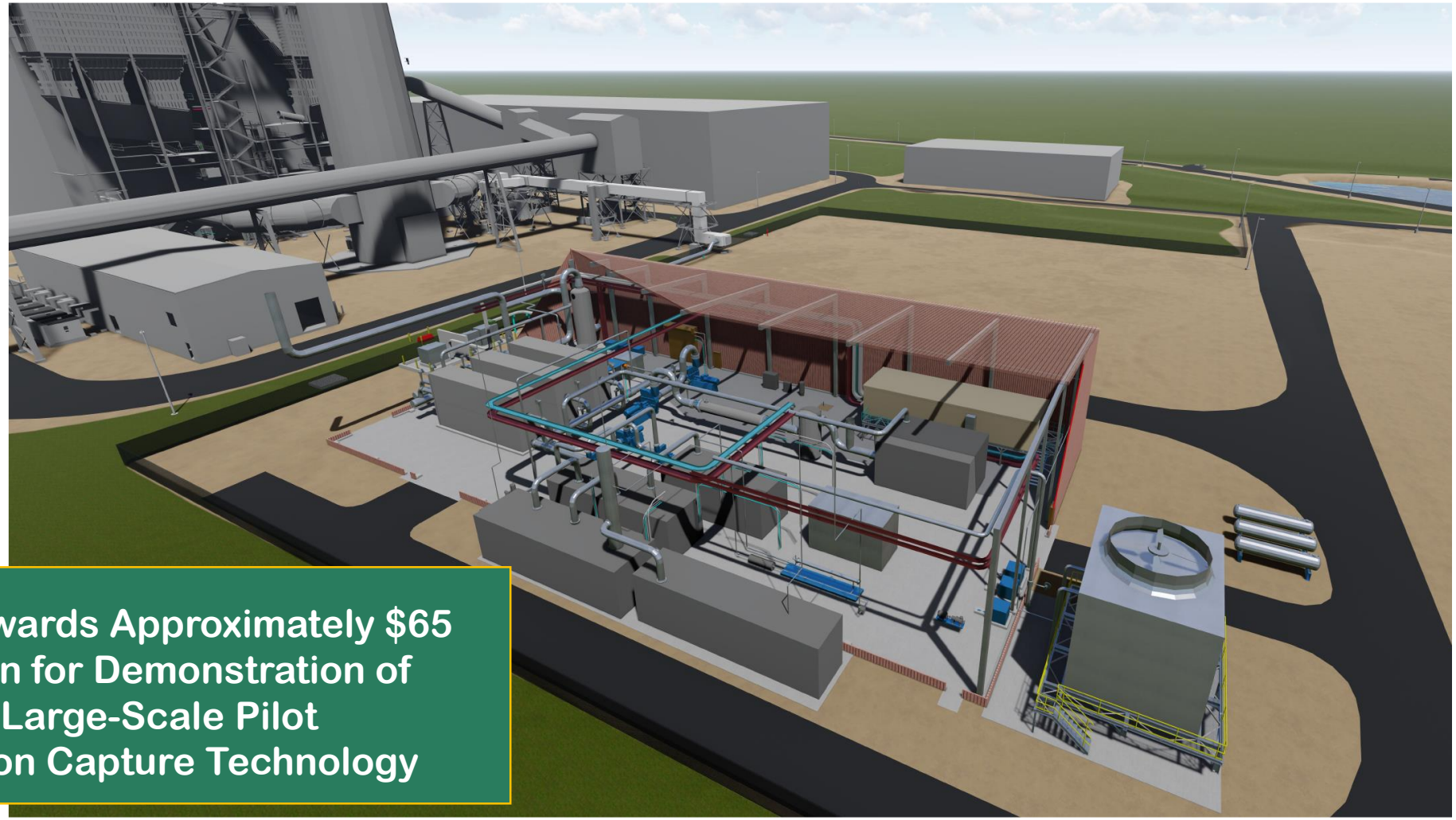
- A Environmental Information Volume has been completed and reviewed
  - Incorporated MTR's capture design, and potential storage sites
  - Evaluated ownership, mineral estates, wetlands, vegetation and wildlife resources, atmospheric impacts, existing structures, soils/surficial geology, historic and cultural resources, potential wastes, land cover, health and safety factors, and compliance issues
- Baseline environmental monitoring stations/sampling is underway
  - Set eight soil gas sensors within the DFS storage site
  - Sampling local/regional groundwater monitoring wells
  - Designed a passive seismic study (acquisition Fall 2021)





Progress and Current Status

Integrate MTR's CO_2 FEED capture assessment



DOE Awards Approximately $65 Million for Demonstration of Large-Scale Pilot Carbon Capture Technology

NATIONAL ENERGY TECHNOLOGY LABORATORY

DE-FE0031587

ITC WYOMING INTEGRATED TEST CENTER

MTR

Sargent & Lundy

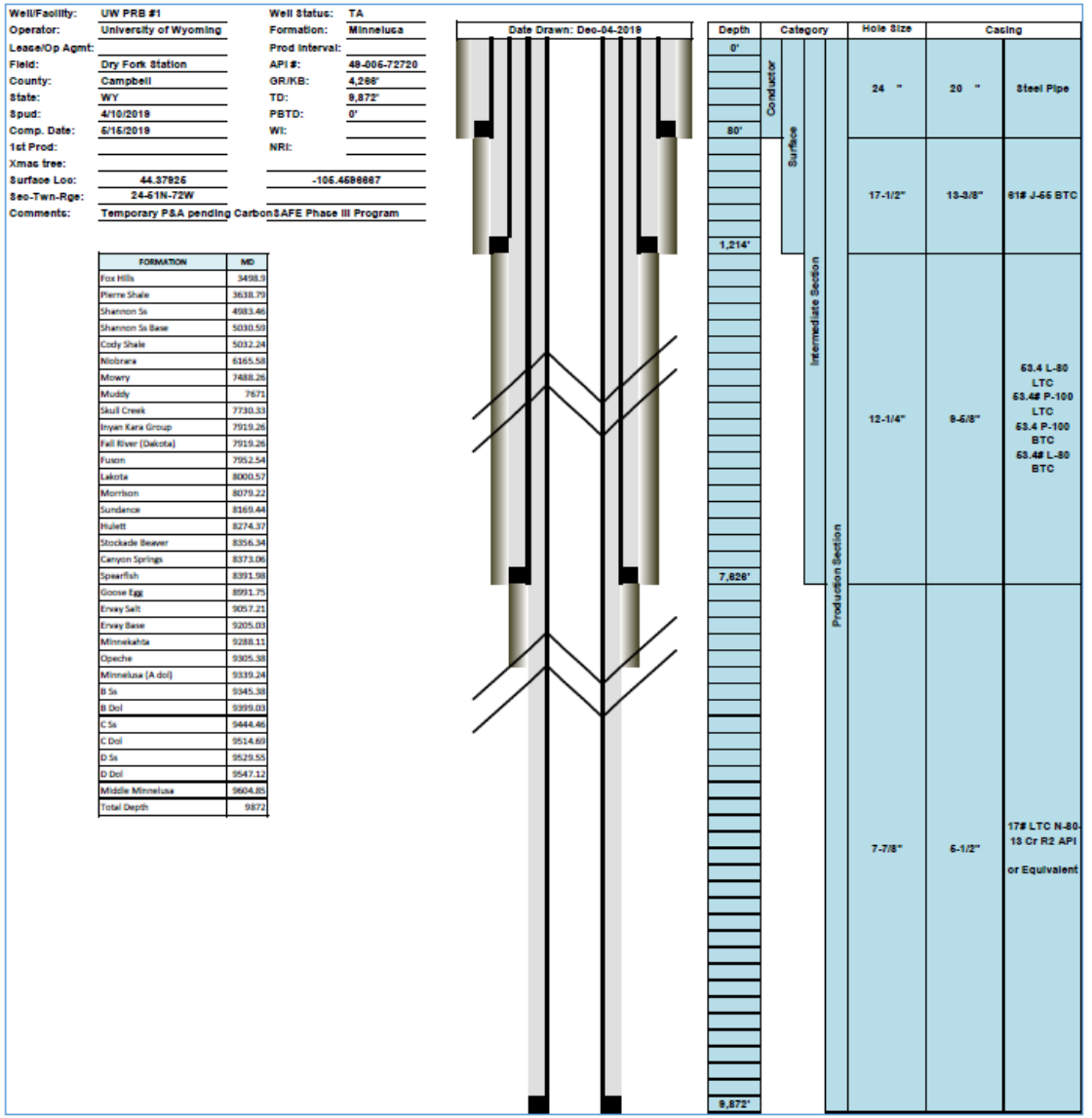
TRIMERIC CORPORATION

MTR

Progress and Current Status

Complete Class VI permits for the storage hub

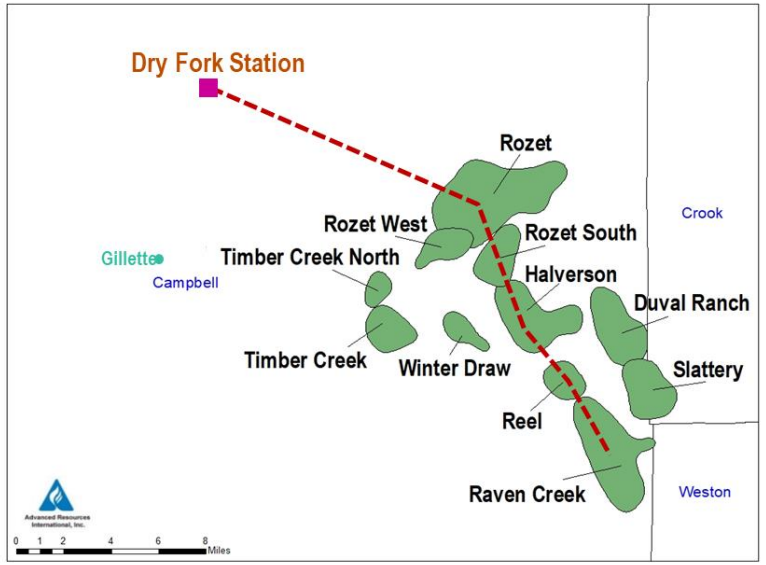
- Initial permit applications (Class I) for both wells have been submitted and reviewed by the DEQ
- Class VI standard well completion diagrams submitted and reviewed
- Wyoming CarbonSAFE Risk Register has been drafted, research/data gaps identified
- Awaiting data, interpretations and updated modeling post completion and testing of UW PRB#2



Progress and Current Status

Advance commerciality within the Wyoming CarbonSAFE storage hub

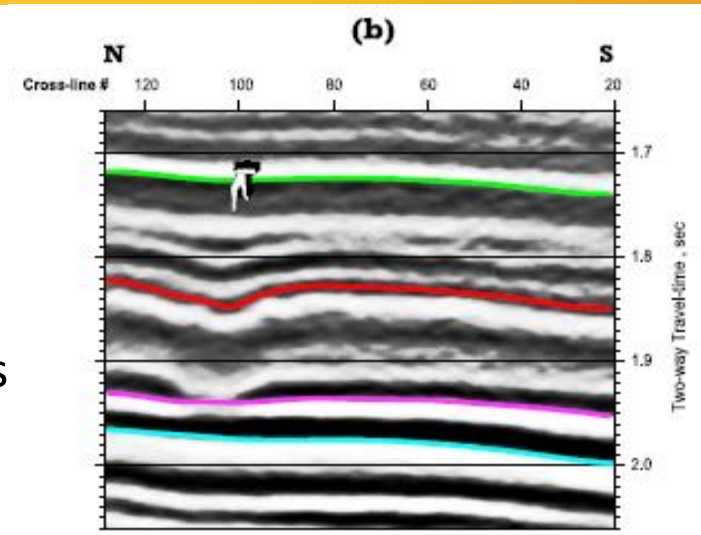
- Initiated public outreach strategy
- Finalized sight access agreements
- Developed infrastructure right-of-ways and working with commercial CO_2 transportation partners
- Developed model business agreements to assess operational models
- Developed utilization business models
- Developed an economic model that incorporates tax credits, operational lifecycle, capex/opex, etc. and assesses the impact to local communities
- Advancing synergistic opportunities with capture, utilization and governmental industries

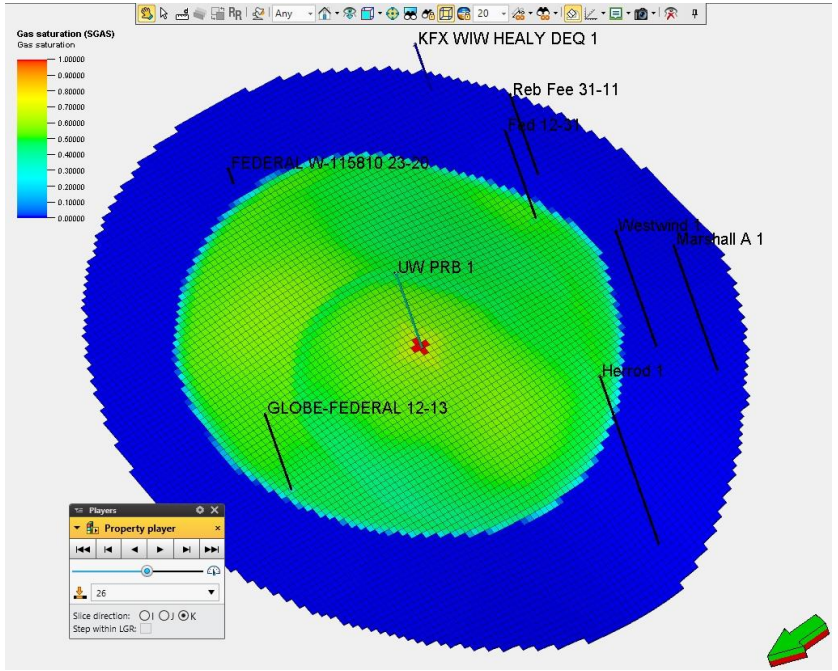


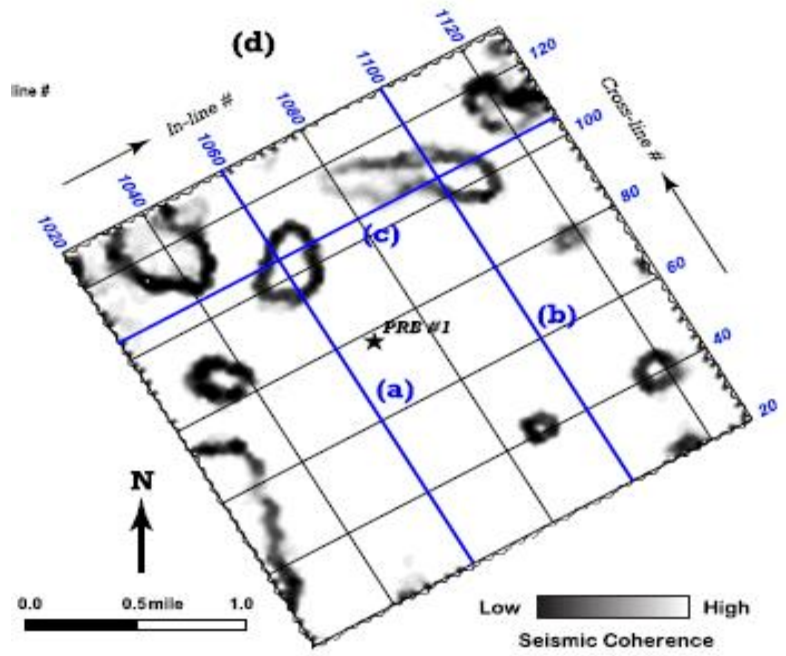
Progress and Current Status

Gaps/challenges/hurdles

- Finalizing site risk characterization
- Risk register assessment using Wyoming's matrix
- Class VI well completion materials
- Scale of boundaries/compartmentalization (if existent) within reservoirs
- "First" of its kind project







Summary

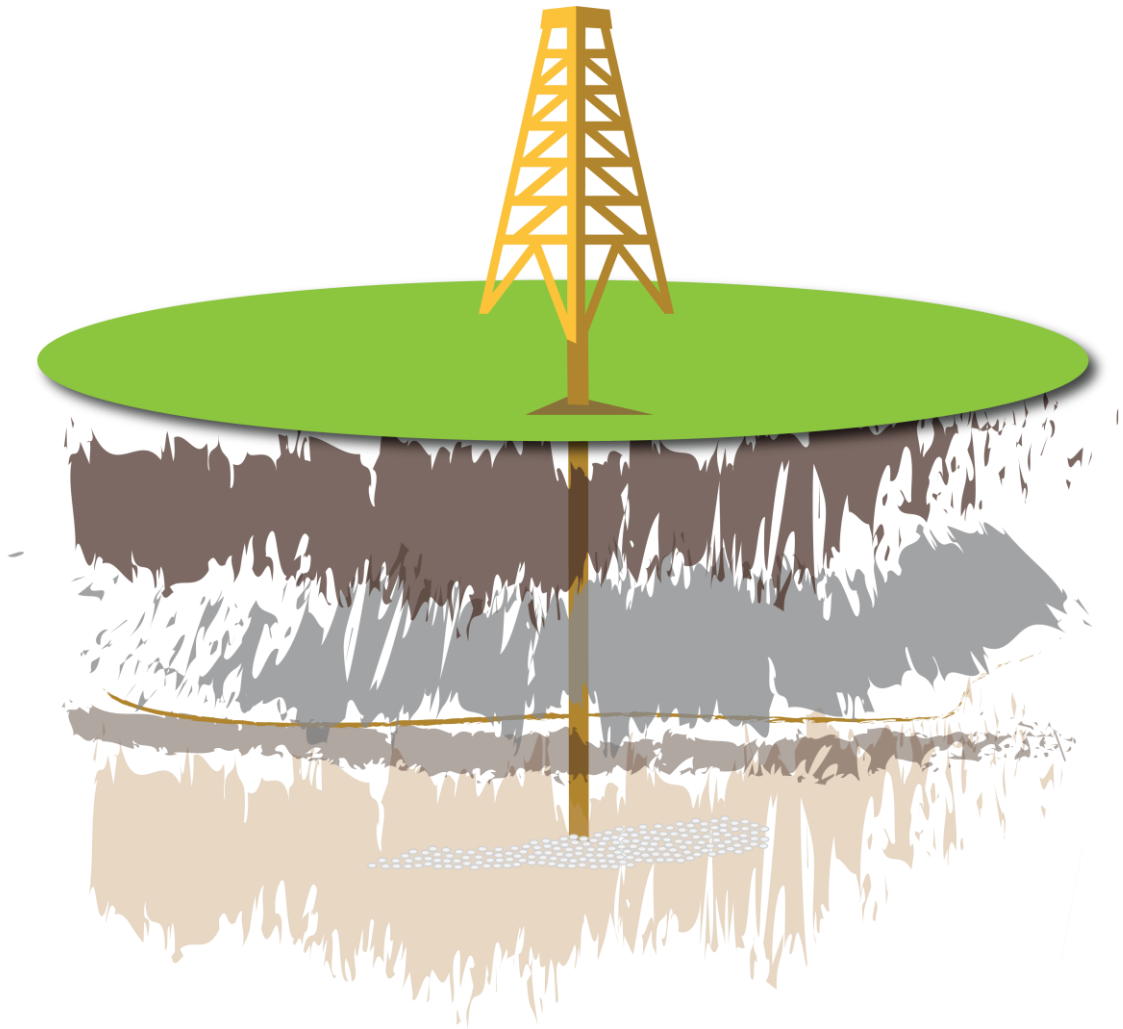
- ✓ Wyoming CarbonSAFE envisions the successful and timely completion of all Phase 3 objectives, and is on track to deliver the same

- ✓ Site Selection & Characterization: (1) the site possesses numerous favorable technical, infrastructure and geologic attributes based on existing conditions/data and work conducted in prior project phases; (2) additional site characterization work will be conducted in Phase III, with additional subsurface data from a new well (UW PRB#2) and well testing between it and the existing well (UW PRB #1); and (3) existing legal, regulatory and public acceptance analyses will be advanced in Phase III

- ✓ Technical Approach for Phase III: (1) characterize 7 sites within the storage hub; (2) drill/re-enter two test wells, both completed/re-completed to Class VI construction standards; (3) prepare Class VI permits to construct for a full project; (4) further advance business and commercial strategies for the storage hub; (5) satisfy all NEPA requirements of Phase III; (6) integrate MTR's capture assessment into the commercial plan; (7) finalize site risk and MVA; and (8) develop greater regional capacity than the CarbonSAFE program requires

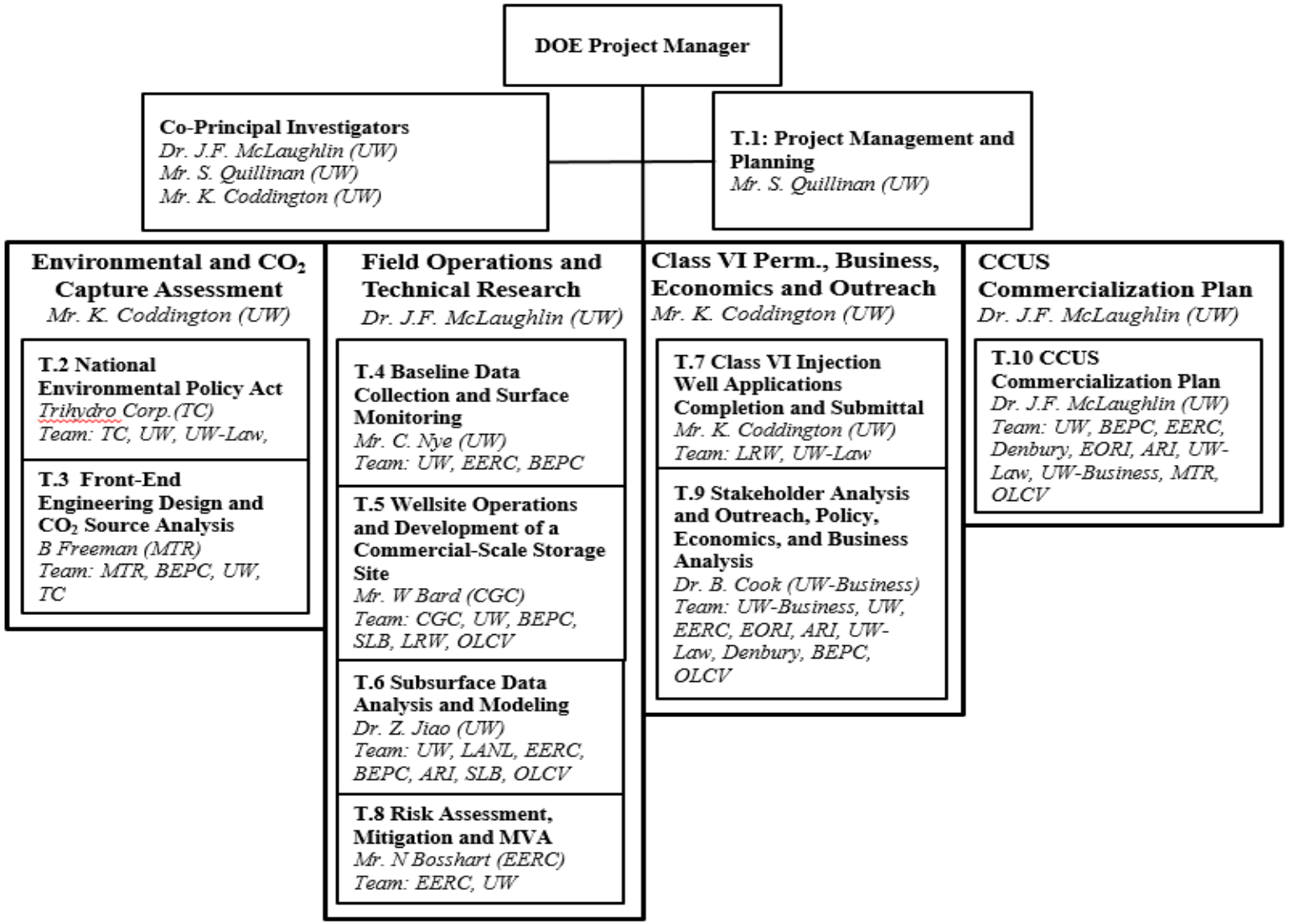
- ✓ Project on track to satisfy milestones and success criteria, and is assessing/managing project risks and mitigation strategies

Questions?



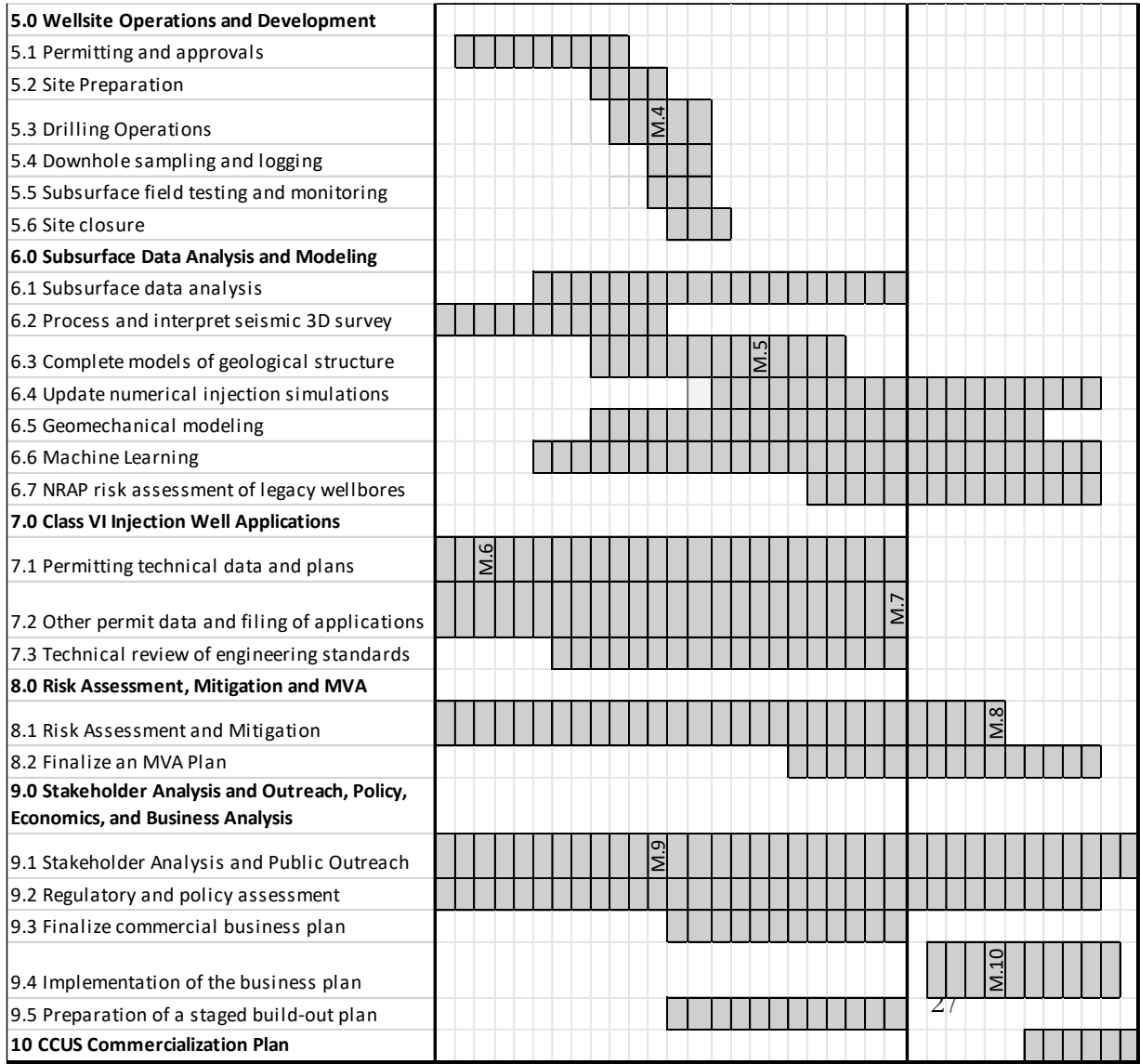
Appendix

Organization Chart



Gantt Chart

	Year 1				Year 2				Year 3			
	Budget Period I								Budget Period II			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
1.0 Project Management and Planning												
1.1 Project Management Plan	M.1											
1.2 Data Management Plan												
1.3 Technology Maturation Plan												
2.0 National Environmental Policy Act												
2.1 Preparation and Submission for NEPA for CO2 Capture												
2.2 Preparation of EIV	M.2											
2.3 Preparation and Submission of NEPA for CO2 storage												
3.0 FEED and CO2 Capture Analysis												
3.1 Summary of the FEED CO2 capture												
3.2 Assessment of DE-FOA-0002058												
4.0 Baseline Data Collection Monitoring												
4.1 Establish microseismicity baselines												
4.2 Establish monitoring baselines			M.3									



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