Critical Challenges. Practical Solutions.

Energy & Environmental Research Center (EERC)

North Dakota CarbonSAFE Phase III: Site Characterization and Permitting

(FE0031889)

U.S. Department of Energy

Fossil Energy & Carbon Management / National Energy Technology Laboratory

Carbon Management Research Project Review Meeting

August 29, 2023

Wes Peck

Energy & Environmental Research Center

Project Overview

Objective:

- Perform commercial-scale site characterization and permitting for the geologic storage of nearly 4 million metric tons (Mt) of CO_2 per year.

Funding	DOE	Cost Share	Project Total
Dollars (MM)	$16.97	$7.96	$24.93
Contribution	68%	32%	100%

- Performance dates:
  - BP1: October 2020 - September 2022
  - BP2: October 2022 - September 2023+

PROJECT TUNDRA

Minnkota Power COOPERATIVE
A Touchstone Energy® Cooperative

EERC
UND UNIVERSITY OF NORTH DAKOTA

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

Industrial Commission of North Dakota
Lignite Research, Development and Marketing Program

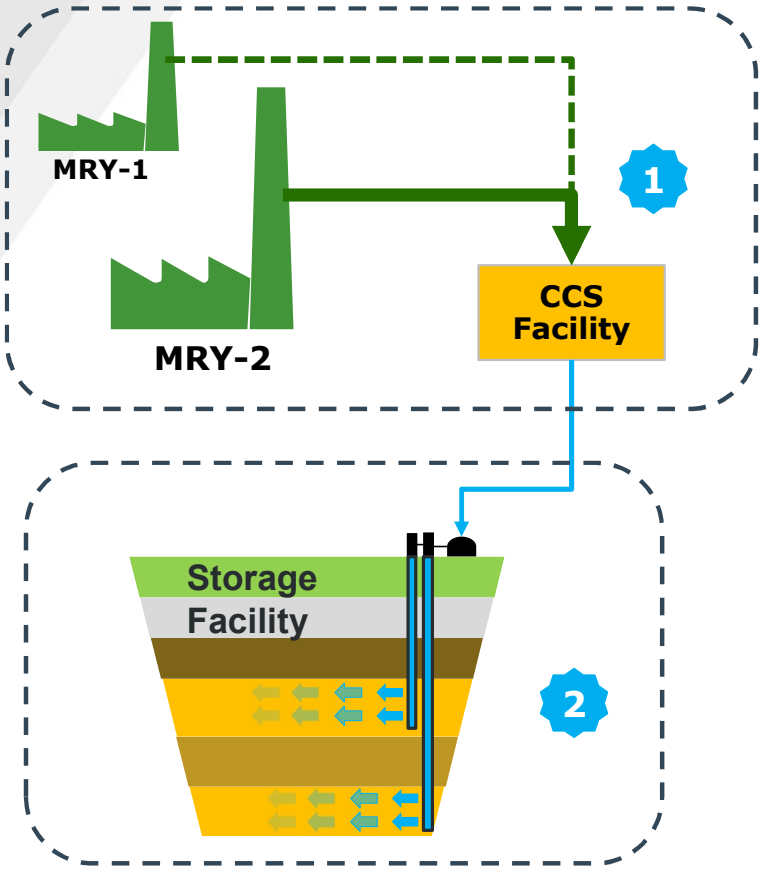
CMG COMPUTER MODELLING GROUP LTD.

Schlumberger

SB Square Butte ELECTRIC COOPERATIVE


GOAL: Accelerate wide-scale deployment of CCUS by assessing and permitting the geologic storage of CO_2 emissions captured from the Milton R. Young Power station.

Project Tundra Overview



Two Projects in One

1. **Divert flue gas then separate CO_2** in a carbon capture system that strips out the CO_2 then liquifies under pressure.

2. **Inject CO_2 into storage formation** over a mile below lignite mine.

No impact on the power plant and no impact on its costs

How Did We Get Here?

- CarbonSAFE Jump Start—Leveraged existing:
  - Partnerships
  - Expertise
  - Methods
  - Regional characterization

Phase I: Integrated CCS Pre-Feasibility
18-month initiative

- Formation of a team; development of a feasibility plan; and high-level technical evaluation of the sub-basin and potential CO_2 sources
- Thirteen projects funded

Phase II: Storage Complex Feasibility
2–year initiative

- Data collection; geologic analysis; analysis of contractual and regulatory requirements; subsurface modeling; risk assessment; evaluate monitoring requirements; and public outreach
- Six projects funded

Phase III: Site Characterization and CO_2 Capture Assessment
3-year initiative

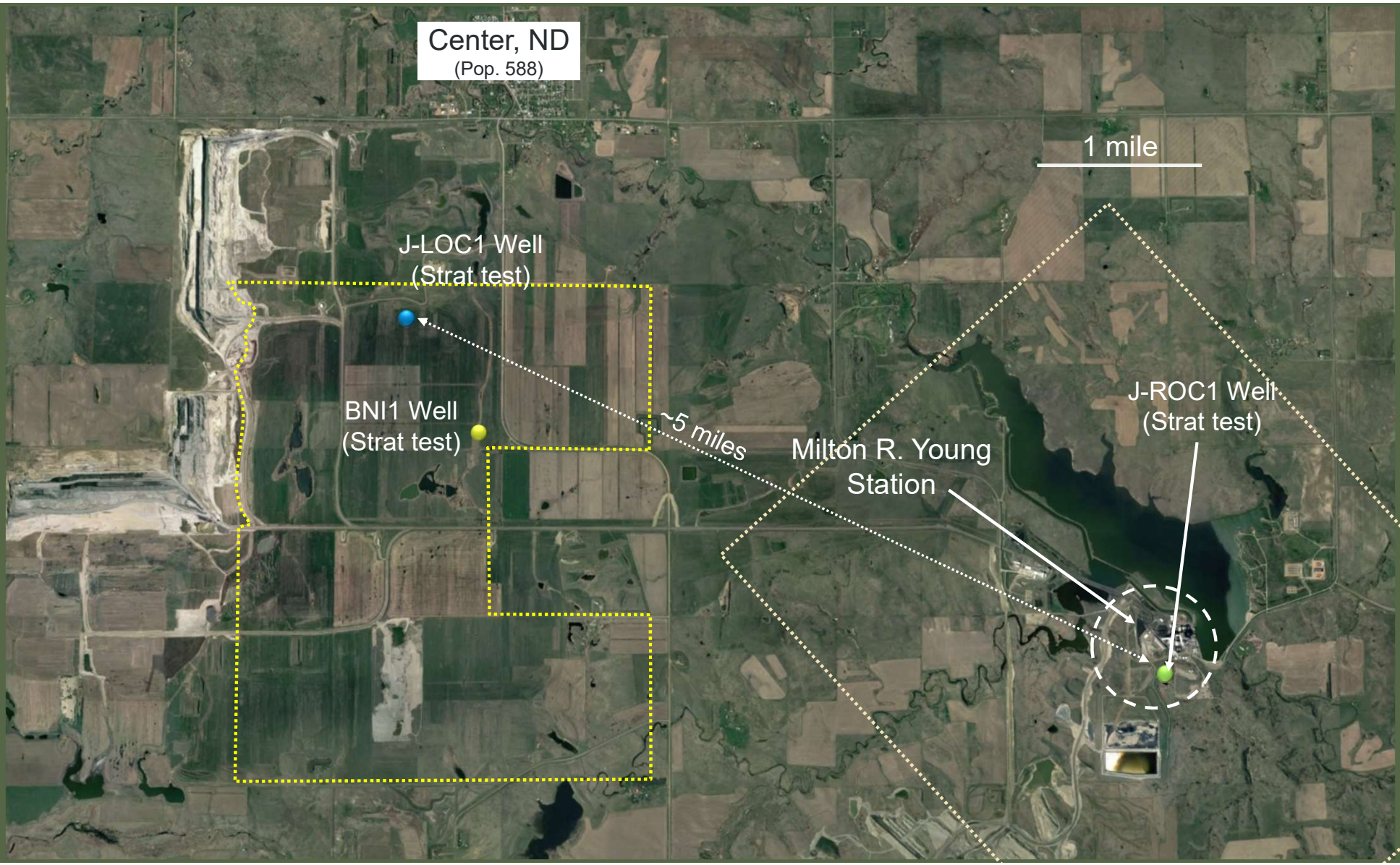
- Detailed site characterization; obtain Underground Injection Control (UIC) Class VI Permit to construct; CO_2 Capture Assessment; NEPA approvals
- Five projects funded

Phase III:

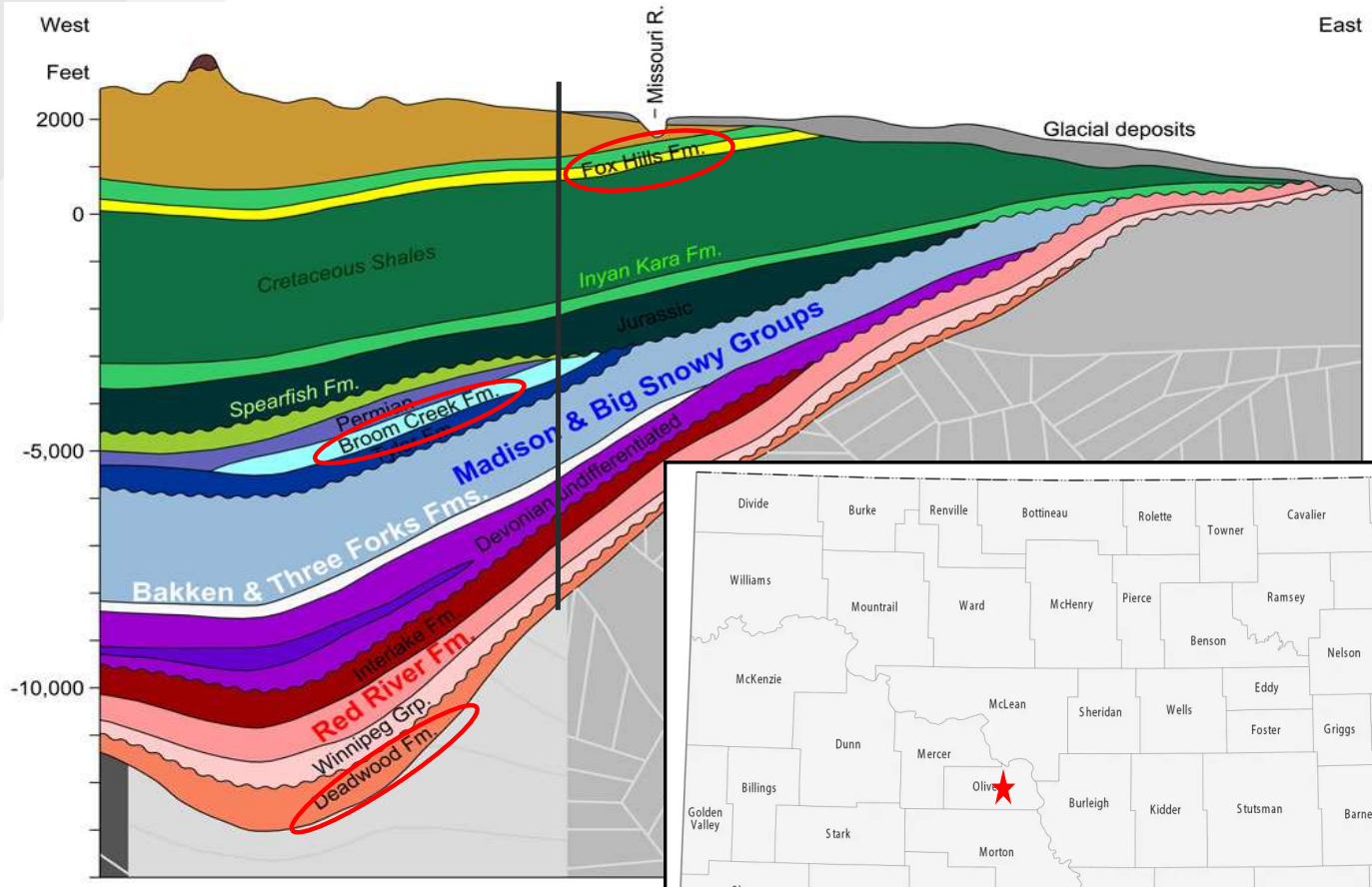
Pre-award 5/1/2020 → J-LOC1 5/14/2020 → J-ROC1 9/8/2020 → Award - BP1 10/1/2020

Bridging Activity

- **CSND Phase II – ended March 31, 2020**
- **CSND Phase III – started one month later!**


Center, ND
(Pop. 588)
1 mile
J-LOC1 Well
(Strat test)
BNI1 Well
(Strat test)
~5 miles
Milton R. Young
Station
J-ROC1 Well
(Strat test)

Project Location



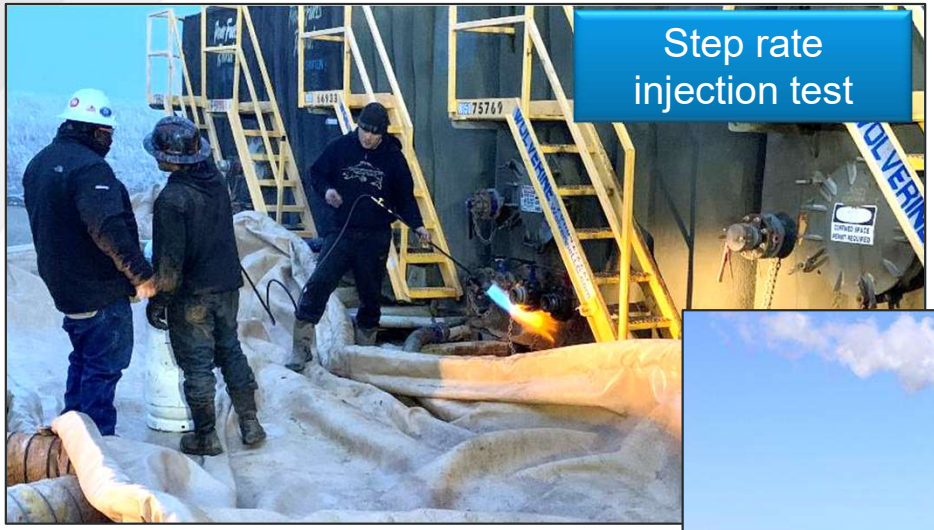
Broom Creek Measured Values
Depth: ~4900 ft
Porosity (%): 2 – 27
Permeability (mD): 0.06 – 2690

Black Island/Deadwood Measured Values
Depth: ~9400 ft
Porosity (%): 3.4 – 15
Permeability (mD): 0.03 – 2060

Phase III Technical Approach: Address the Needs of the Permit!

Major NDIC Permitting Requirements	Major Proposed Characterization Activities											
	Core	Logging	Downhole Testing	Lab Testing	Modeling	Simulation	Seismic	Collection	Baseline	Sampling	New Fox Hills Wells	
Determine Plume Extent	X	X	X	X	X	X	X					
Determine Pore Space Amalgamation	X	X	X		X	X	X					
Geologic Properties of Injection and Confining Zones	X	X	X	X								
Regional Faulting Assessment	X						X					
Potential for Seismic Activity			X		X		X					
Geologic Maps and Cross Sections		X			X		X				X	
Geomechanics of Confining Zones(s)		X	X	X	X							
Identify and Characterize Secondary Confining Zones		X	X		X		X					
Determine Area of Review		X	X	X	X	X	X	X	X			
Baseline Geochemical Data	X			X				X	X			
Baseline Water and Soil Data				X				X	X			

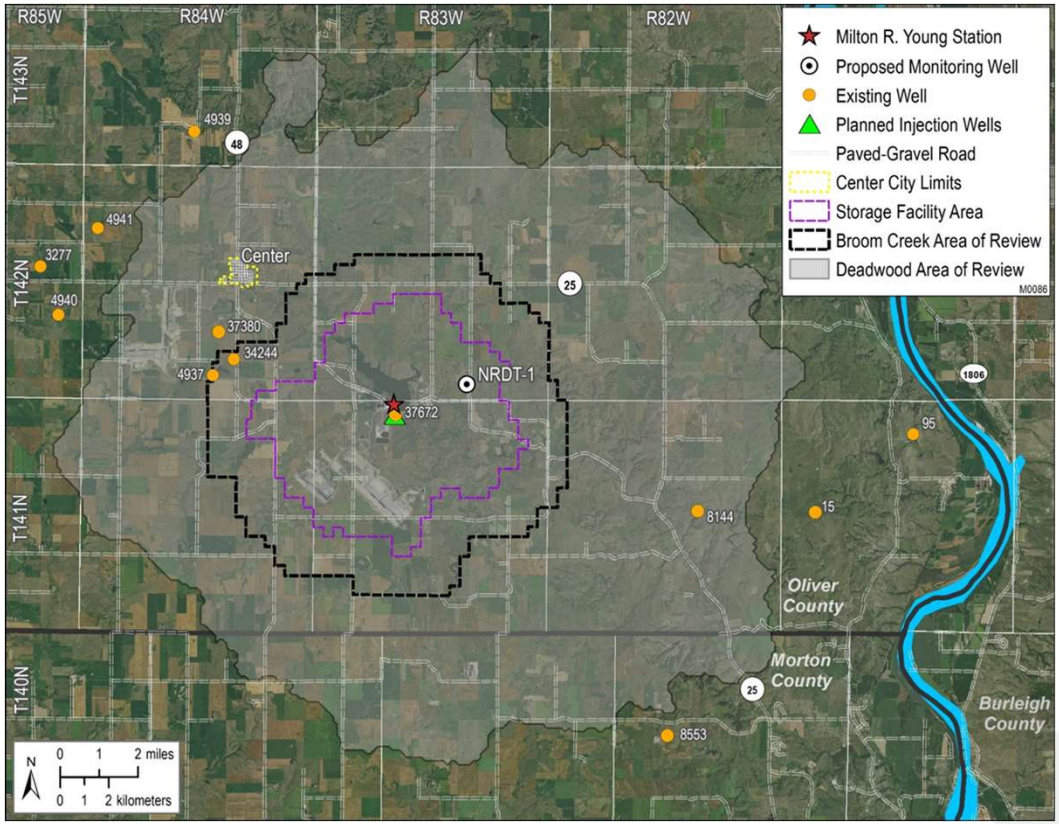
Data Collection



Pore Space and Area of Review

- Pore Space Access:
  - ~50 parcels of land
  - ~60 different landowners
  - >95% voluntary enrollment

- Area of Review (AOR) – risk-based approach for over-pressured formations (Broom Creek Formation)



Public Hearing

Combined applications were **1200+ pages**

Over 7 hours of testimony and responding to public comments

First coal-fired power plant permitted to store CO_2

CarbonSAFE North Dakota Storage Facility Permits – Approved January 21, 2022

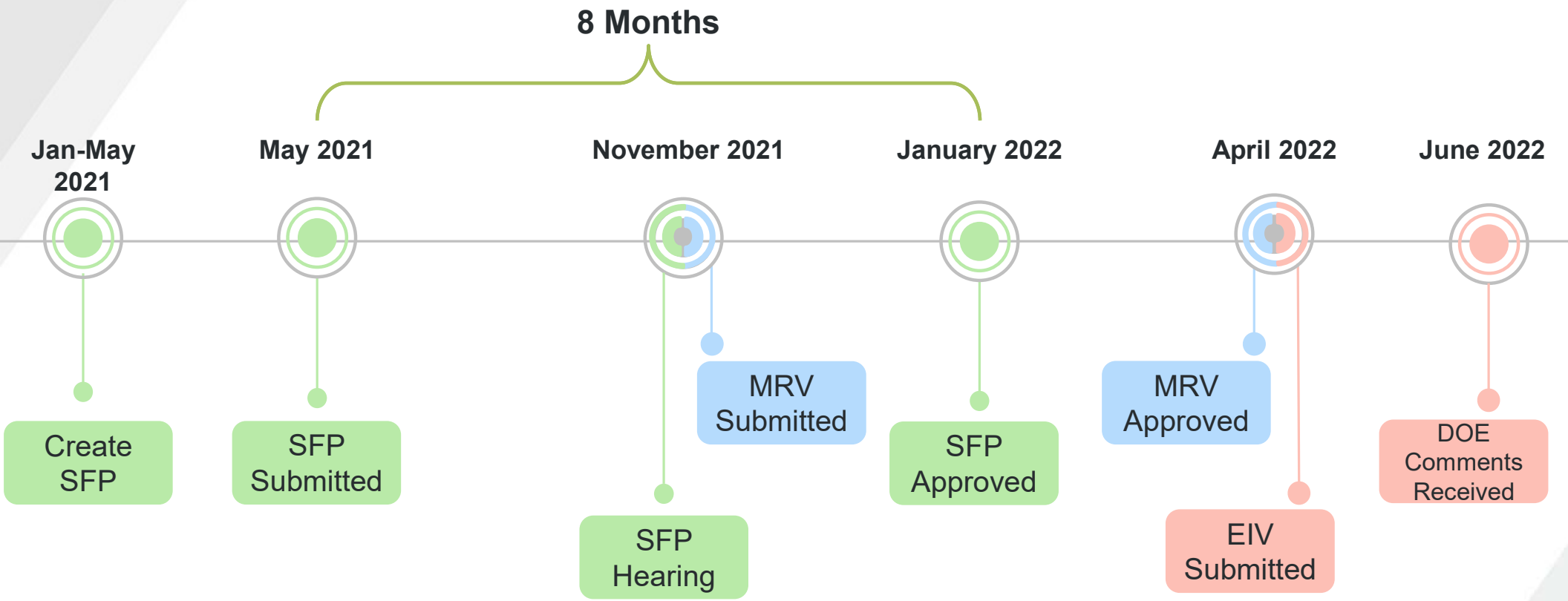
MRV Plan Development and Approval

- Develop an EPA-compliant MRV plan to meet the requirements of the IRS 45Q tax incentive program.
- The MRV plan is founded on the storage facility permit application “testing and monitoring plan” and complements the ND Class VI UIC reporting requirements.

MRV plan submitted November 2021.

MRV plan approved April 2022.

Timeline


8 Months
Jan-May 2021
May 2021
November 2021
January 2022
April 2022
June 2022
Create SFP
SFP Submitted
SFP Hearing
MRV Submitted
SFP Approved
MRV Approved
EIV Submitted
DOE Comments Received

EIV Submitted and Approved

Environmental Assessment (EA)

- Draft EA approved August 9, 2023
- Published for public comment
- On schedule for late November approval

Lessons Learned

- Injection tests are worth it.
- Scenario iteration takes time—every answer generates more questions.
- Pore space acquisition takes more time than you'd think.
- Working in a state with Class VI primacy—priceless.
- Great partners make a difference!

Where Are We Today

- NDIC administrative orders signed for two SFPs
- Received approval for Class VI injection wells
- MRV plan approved
- Pending approval of the Environmental Assessment
- Community Benefit Plan add-on

- Future activity:
  - Install injection wells and monitoring well
  - File for permit to inject when CO_2 is available.

For More Information

www.dmr.nd.gov/dmr/oilgas/ClassVI

CO2 Storage Facility Permit Requests:

- **Applicant:** Dakota Gasification Company
  - NDIC Case No. 29450 - Draft permit, fact sheet, and storage facility permit application

CO2 Storage Facility Permits Issued:

- **Applicant:** Minnkota Power Cooperative, Inc.
  - Order 31583 – Minnkota Power Cooperative – Geologic storage of carbon dioxide, Broom Creek Formation, Oliver County
  - Order 31584 – Minnkota Power Cooperative – Amalgamation of storage reservoir pore spacing, Broom Creek Formation, Oliver County
  - Order 31585 – Minnkota Power Cooperative – Determination of financial responsibility for geologic storage of carbon dioxide, Broom Creek Formation, Oliver County
  - Order 31586 – Minnkota Power Cooperative – Geologic storage of carbon dioxide, Deadwood Formation, Oliver County
  - Order 31587 – Minnkota Power Cooperative – Amalgamation of storage reservoir pore spacing, Deadwood Formation, Oliver County
  - Order 31588 – Minnkota Power Cooperative – Determination of financial responsibility for geologic storage of carbon dioxide, Deadwood Formation, Oliver County
  - NDIC Case No. 29029 - Draft permit, fact sheet, and storage facility permit application
  - NDIC Case No. 29032 - Draft permit, fact sheet, and storage facility permit application

- **Applicant:** Red Trail Energy LLC
  - Order 31453 – Geological storage of carbon dioxide from Red Trail Energy
  - Order 31454 – Amalgamation of the storage reservoir pore space/Red Trail Energy
  - Order 31455 – Determination of financial responsibility/Red Trail Energy
  - NDIC Case No. 28848 - Draft Permit, fact sheet, and storage facility permit application

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