
EERC
Critical Challenges.
Practical Solutions.

# NORTH DAKOTA INTEGRATED CARBON CAPTURE AND STORAGE COMPLEX FEASIBILITY STUDY

## DE-FE0029488

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Energy & Environmental Research Center

U.S. Department of Energy

National Energy Technology Laboratory

Mastering the Subsurface Through Technology Innovation, Partnerships and Collaboration:
Carbon Storage and Oil and Natural Gas Technologies Review Meeting

August 1–3, 2017

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# PRESENTATION OUTLINE

- Background
- Objectives
- Approach
- Summary

# A KEY GAP

The development of commercial-scale geologic storage sites for $CO_2$ from industrial sources.

# WHAT IS CARBONSAFE?

- An effort to develop an integrated $CO_2$ storage complex ready for operation in the 2025 time frame.
- Development phases:
  - Integrated CCS Pre-Feasibility
  - Storage Complex Feasibility
  - Site Characterization
  - Permitting and Construction

Builds on lessons learned from the Regional Carbon Sequestration Partnerships' large-scale field projects, and aims to instill greater confidence that commercial-scale carbon capture and storage (CCS) projects can be integrated in a technically and economically feasible manner.

# NORTH DAKOTA CARBONSAFE

- Address technical and nontechnical challenges specific to commercial-scale deployment of a $CO_2$ storage project in central North Dakota.
- Long-term goal: develop a certified (permitted) geologic storage opportunity should a business case for $CO_2$ storage emerge.

# EXPECTED OUTCOMES

- 3-D geologic models and dynamic simulations to:
  - Establish areas of review to understand the extent of future monitoring, verification, and accounting (MVA) activities.
  - Determine pore space-leasing requirements and development of business case scenarios.
- Identification of potential technical and nontechnical challenges specific to establishing a qualified commercial-scale $CO_2$ storage site.
- Mitigation strategies to address identified challenges.
- Detailed plans for the Site Characterization phase of CarbonSAFE.

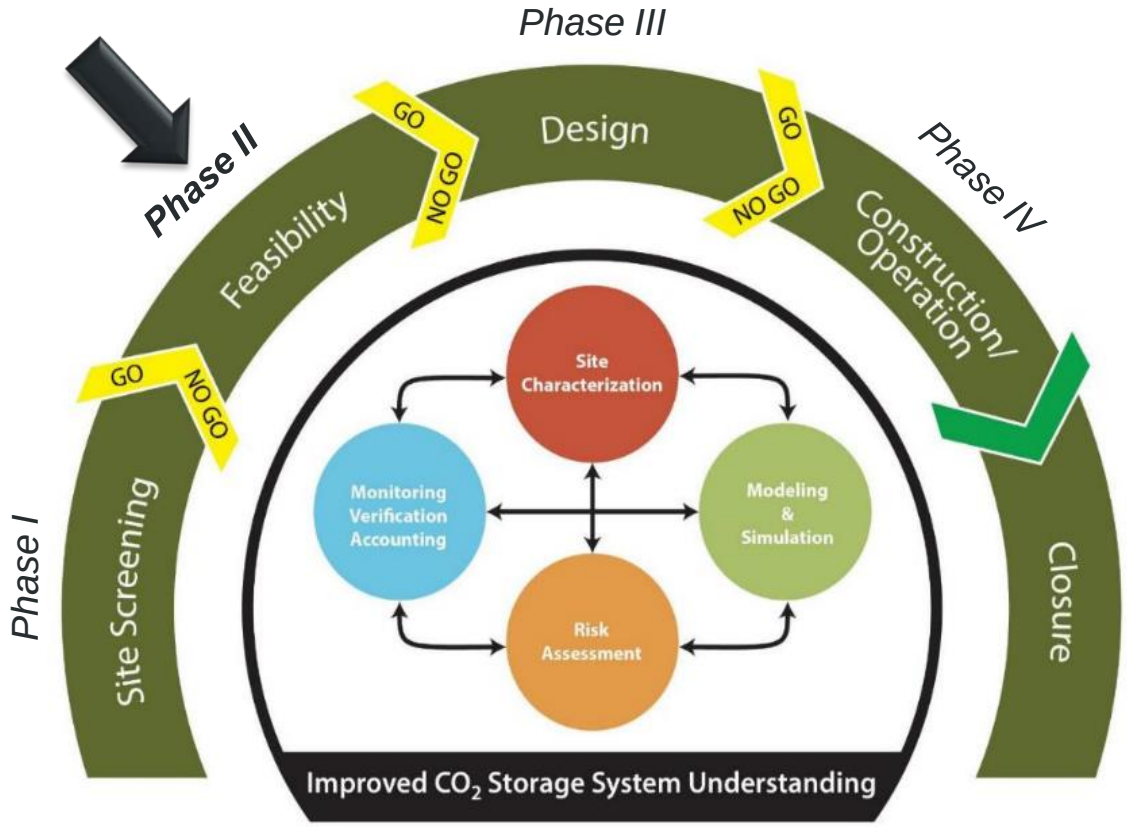
# PROJECT PARTNERS

- U.S. Department of Energy
- NDIC Lignite Research Council
- Basin Electric Power Cooperative
- ALLETE Clean Energy
- Minnkota Power Cooperative
- BNI Energy
- North American Coal
- Prairie Public Television
- Schlumberger Carbon Services
- Computer Modelling Group, Ltd.

# PROJECT OBJECTIVES

- Evaluate two ideal geologic storage complexes located adjacent to separate coal-fired facilities.
  - One has readily available $CO_2$ and an existing $CO_2$ pipeline.
  - The other is associated with a planned integrated $CO_2$ capture and storage project with a time line coincident with the CarbonSAFE Program.
- Gauge public support.
- Conduct a regulatory and economic analysis.

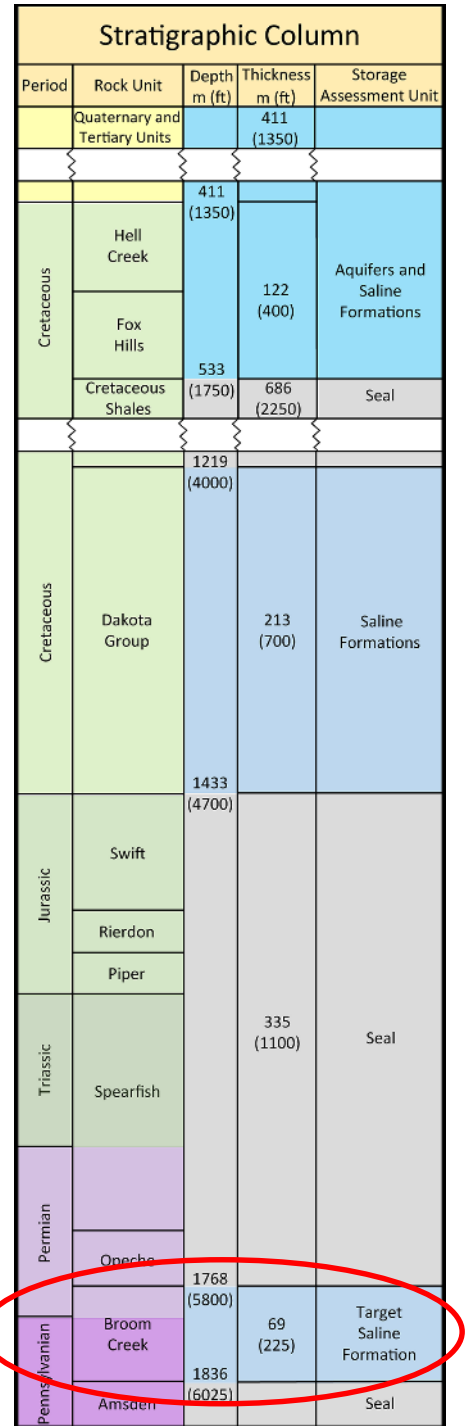
# ESTABLISHED METHODS




- Use the adaptive management approach to project management and execution as developed by the PCOR Partnership.
- Technical elements include:
  - Geologic modeling and reservoir simulation.
  - Risk assessment.
  - MVA.
  - Site characterization activities related to CCS.

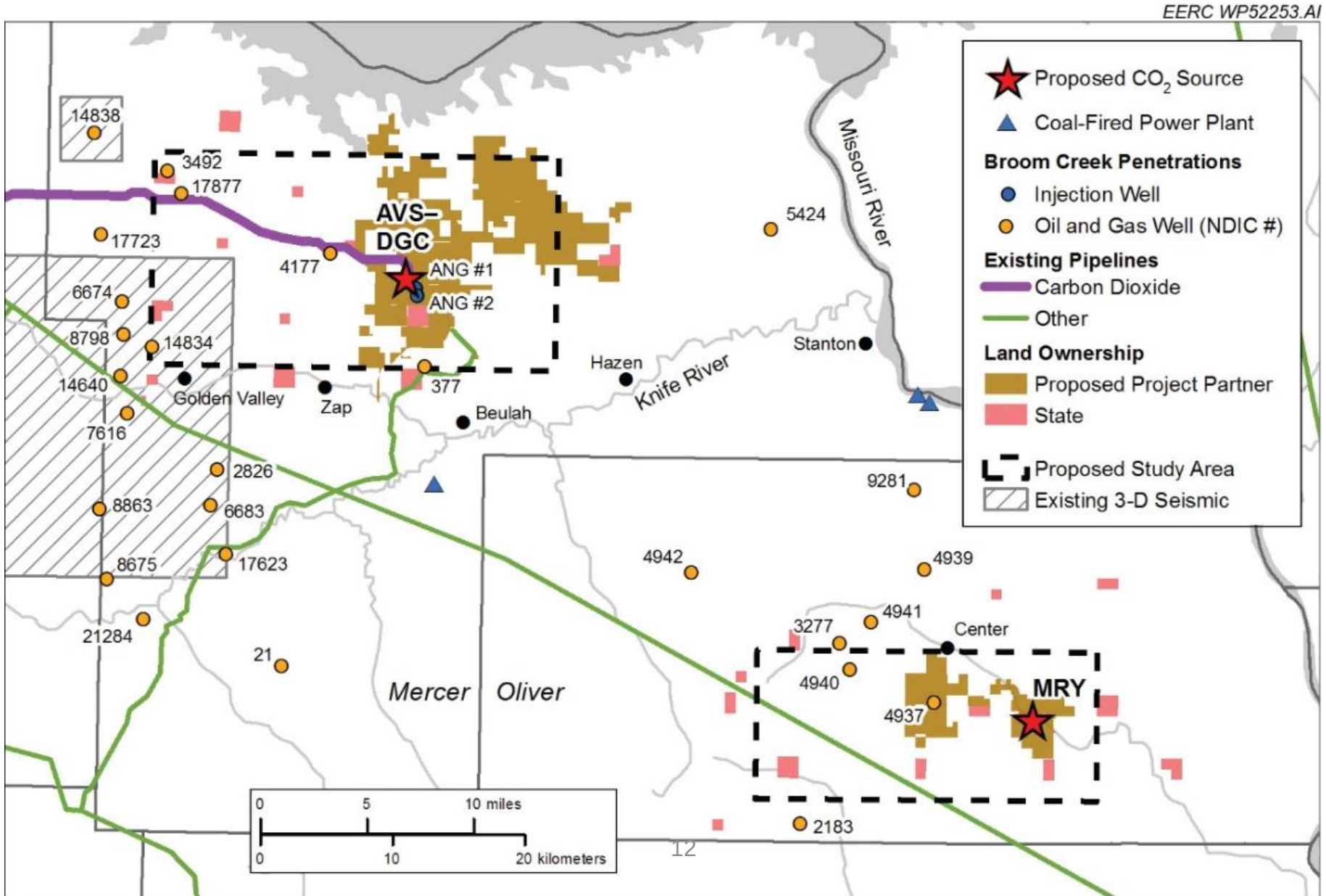
# AREAS OF INVESTIGATION

- Two areas of investigation:
  - Vicinity of the Antelope Valley Station (AVS) (north of Beulah, ND)
  - Vicinity of the Milton R. Young Station (MRY) (near Center, ND)
- Evaluate the saline Broom Creek Formation.
  - ~5800 ft deep
  - ~7 times saltier than the ocean
  - Not a petroleum reservoir
  - Used for wastewater disposal at the Great Plains Synfuels Plant
- The storage site would accommodate $CO_2$ not sold for $CO_2$ enhanced oil recovery.




Target Horizon:
Broom Creek Formation

# PROJECT AREA AND SUBSURFACE GEOLOGY



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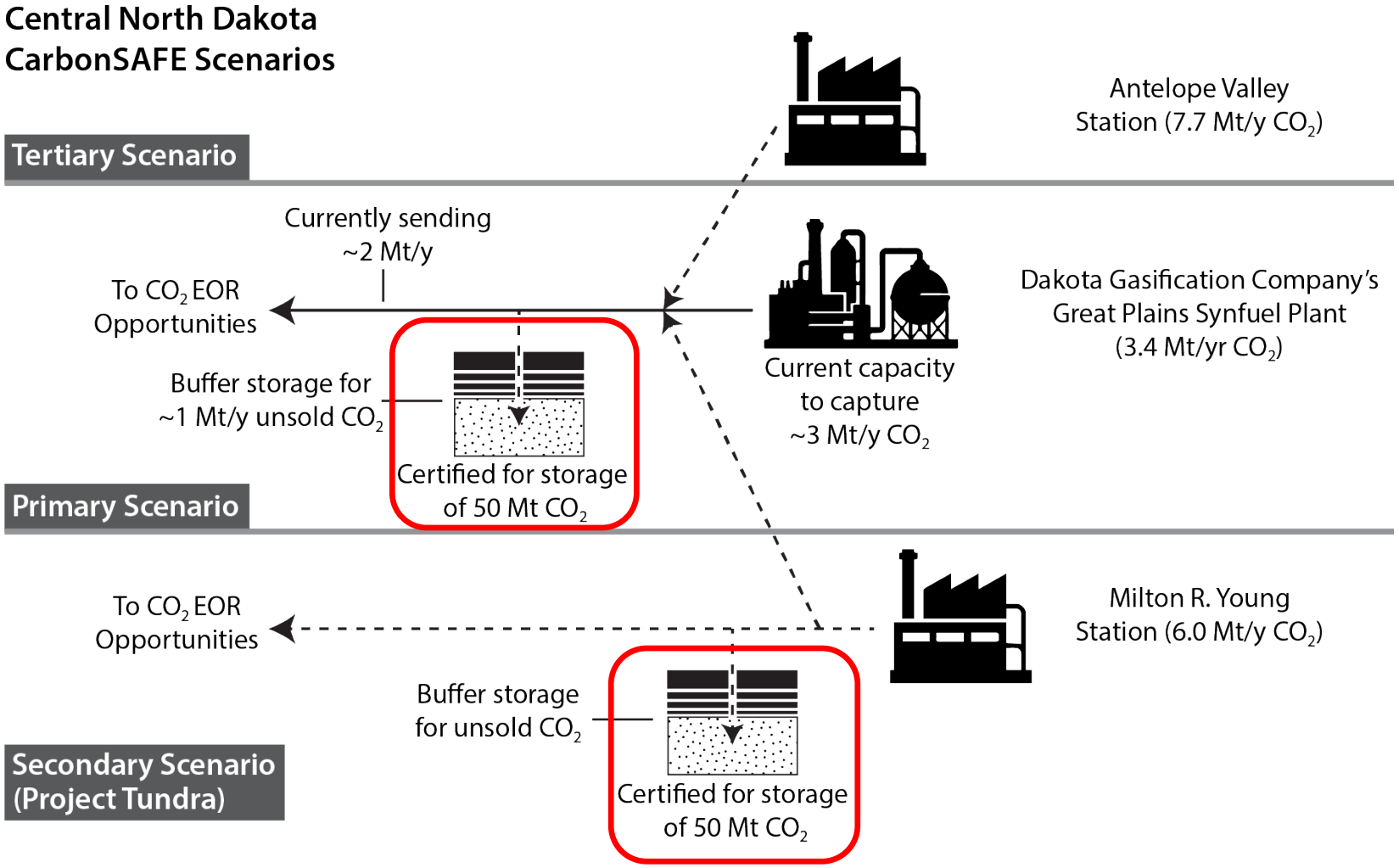
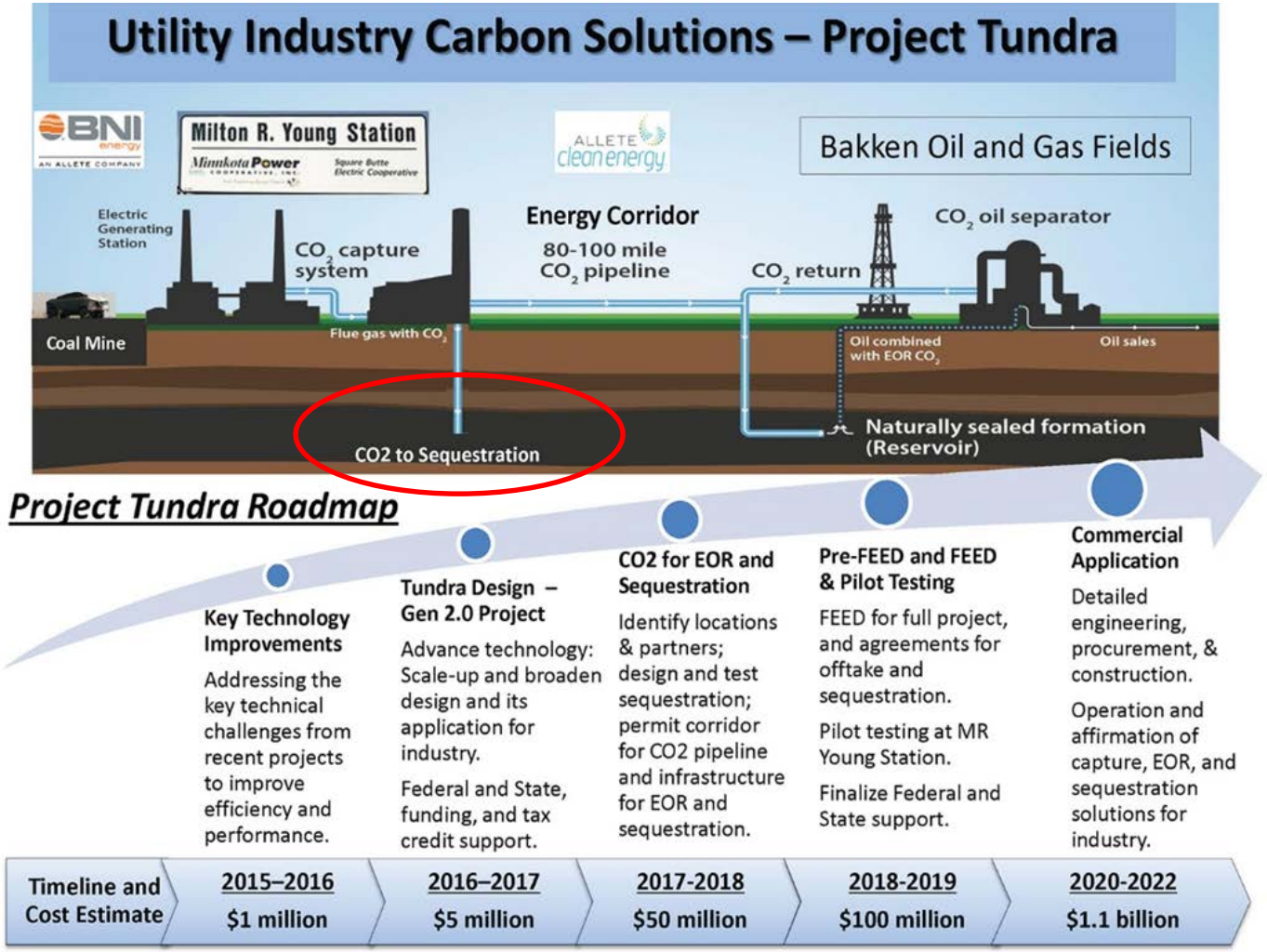
# NORTH DAKOTA CARBONSAFE $CO_2$ SOURCE OPTIONS



# PROJECT TUNDRA: A NICE FIT



# GEOLOGIC CHARACTERIZATION

- Two new stratigraphic test wells:
  - Drill, core, log, plug, and abandon.
  - ~3 weeks for each well.
  - Not intended/designed as future injection (Class VI) or monitoring wells:
    - Class VI well prohibitively expensive.
    - Monitoring well would need to be left open indefinitely (regulatory challenge/risk; more costly).
- Broom Creek (target) and Opeche Formations (seal).
- Advanced modern geophysical logging in each well.
- Reprocessing of legacy 3-D seismic from area west of AVS/Dakota Gasification Company.
- New 2-D seismic near MRY.

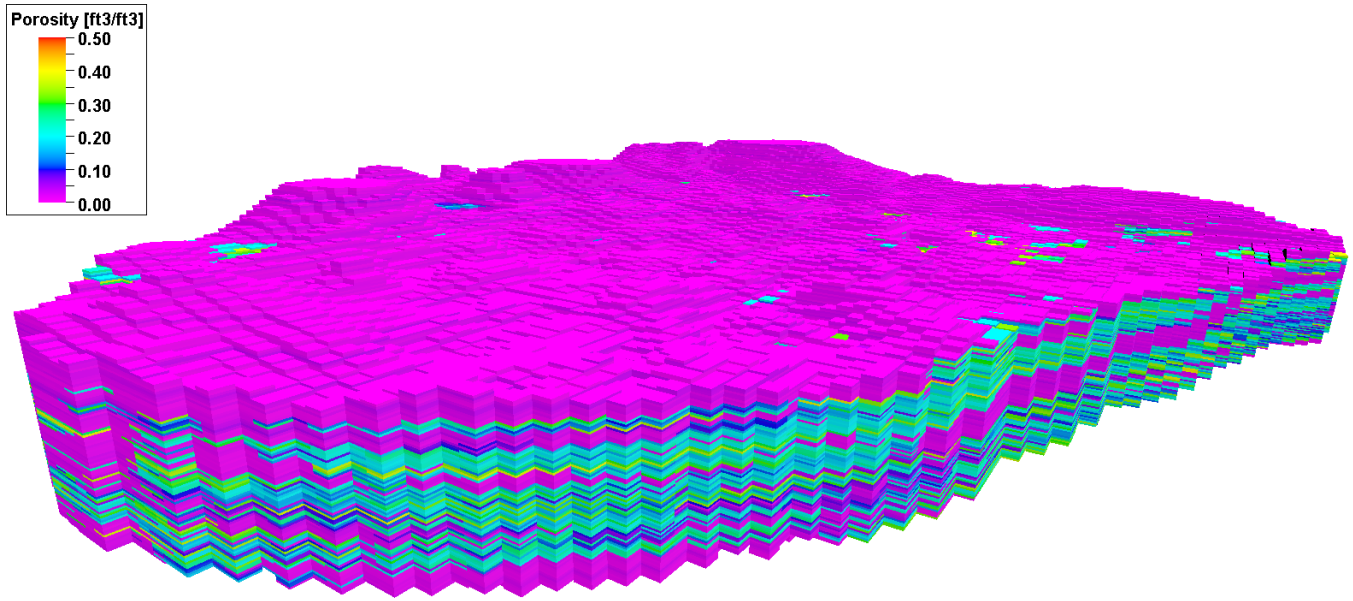
# STORAGE COMPLEX CHARACTERIZATION

*Includes all activities to characterize the Broom Creek (reservoir unit) and overlying Opeche Formations (sealing unit) within the project study areas.*

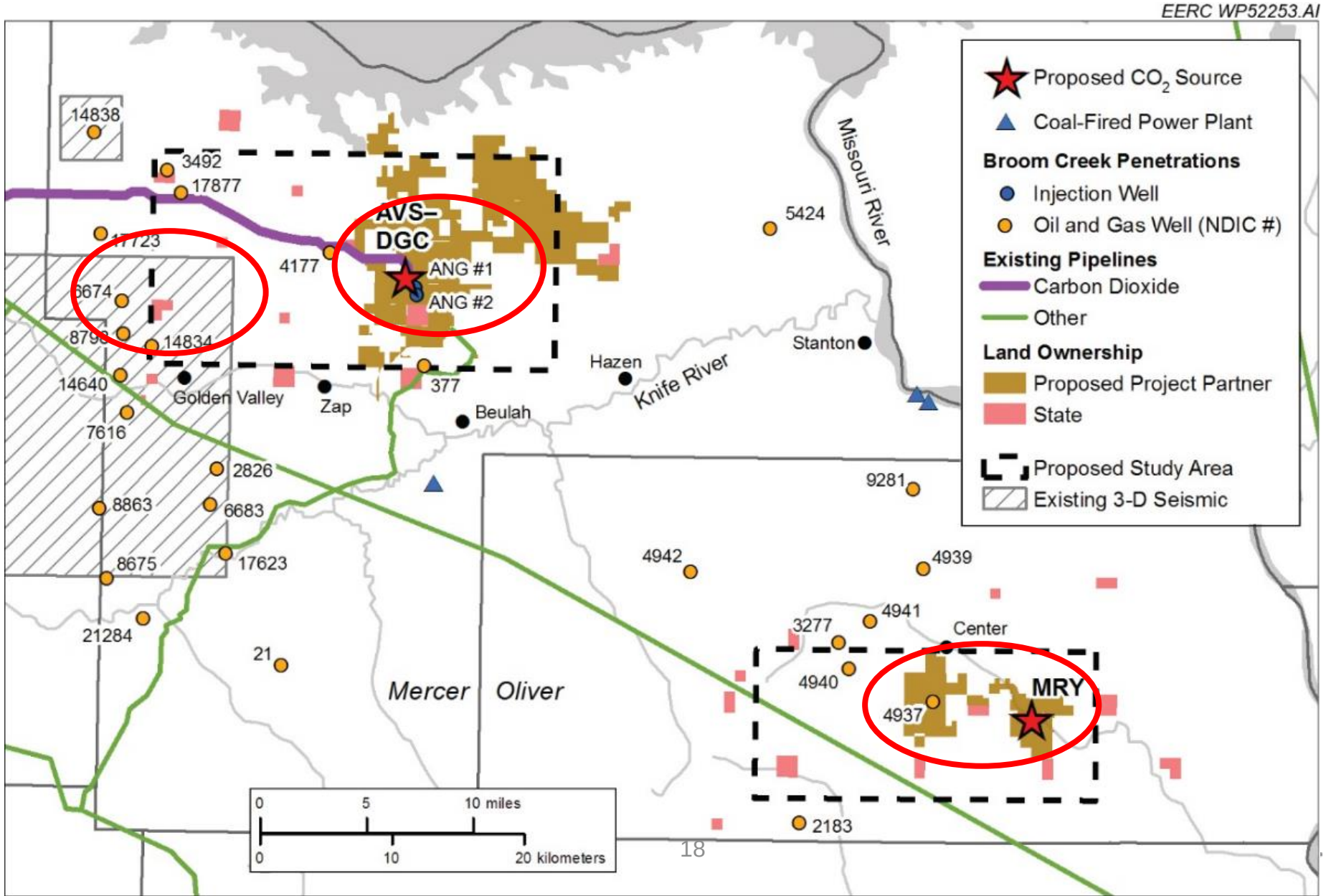
- Existing data acquisition and analysis
- Geologic characterization wells
- Core analysis and testing
- Seismic data collection, reprocessing, and interpretation

# GEOLOGIC MODELING AND SIMULATION

*Site characterization data will be integrated into geologic models which comprise the injection horizon and overlying sealing formation. These models provide the foundation for dynamic simulations of potential injection scenarios.*



# MODELING AREAS



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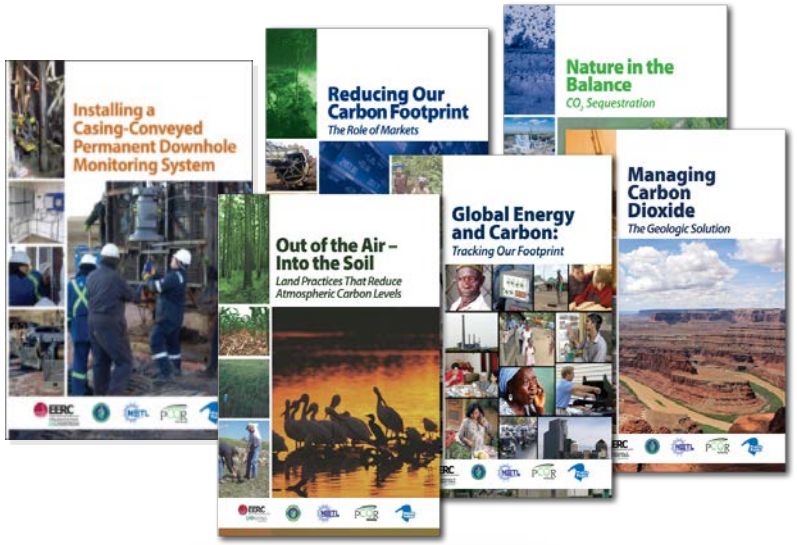
# OUTREACH


Plains CO2 Reduction (PCOR) Partnership
Practical, Environmentally Sound CO2 Sequestration
PARTNERS ONLY
KIDS
EDUCATORS
CONTACT US
search
PCOR Partnership
ATLAS
Resources
Up-to-date news and free information
About the Partnership
Climate, CO2, Sequestration
Regional Storage Potential
CO2 Sequestration Projects
Technical Publications
Resources
Documentaries
Video Clip Library
FAQs
Links
Household Carbon Footprint
Zama
Fort Nelson
Quest
Basal Cambrian
Weyburn-Midale
Boundary Dam
Aquistore
Lignite
Northwest McGregor
Bell Creek
Terrestrial
The PCOR Partnership
Through the PCOR Partnership, over 100 stakeholders collaborate to help make safe, practical carbon capture, utilization, and storage (CCUS) projects a reality.
FEATURED DOCUMENTARY:
Global Carbon and Energy
2016 PCOR PARTNERSHIP ANNUAL MEMBERSHIP MEETING & WORKSHOP
Fact Sheets
Watch Videos
CCS Basics
Let's Get Technical


GEOPHYSICS
tional Methods


Installing a Casing-Conveyed Permanent Downhole Monitoring System
Reducing Our Carbon Footprint
The Role of Markets
Nature in the Balance
CO2 Sequestration
Out of the Air – Into the Soil
Land Practices That Reduce Atmospheric Carbon Levels
Global Energy and Carbon:
Tracking Our Footprint
Managing Carbon Dioxide
The Geologic Solution


Fact Sheet
Geologic Storage of Sour CO2 from a Natural Gas-Processing Plant – A Proposed Commercial Demonstration
Fact Sheet
Carbon Management Planning Prospectus
Fact Sheet
Geologic Storage of Sour CO2 from a Natural Gas-Processing Plant – A Proposed Commercial Demonstration

# PUBLIC OUTREACH

*Initiate public outreach to gauge local public acceptance of a potential $CO_2$ storage project.*

- Formation of outreach advisory group.
- Hold stakeholder meetings (regional officials, landowners, energy industry representatives).
- Hold four open house meetings (two early and two later).
- Develop outreach and media information kits.
- Develop an updated public outreach plan for future CarbonSAFE phases.

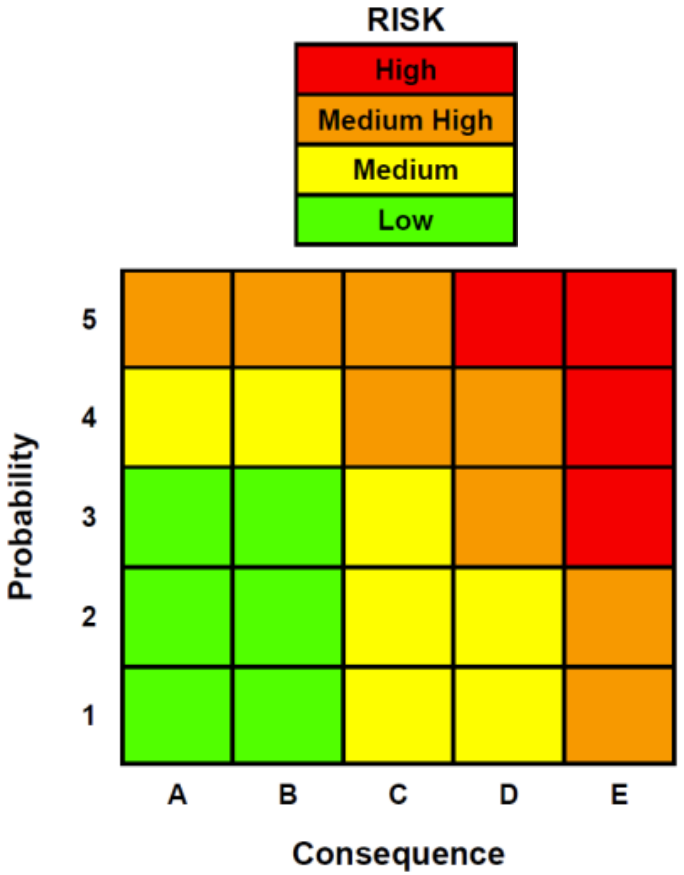
# REGULATORY AND ECONOMIC ANALYSIS

- Evaluate the permitting requirements needed for future implementation of EPA UIC Class VI injection wells.
- Investigate site access agreement options, pore space acquisition, and short-term project liability along with a cost model.
- Examine specific economic needs and the incentives in place to make the proposed scenarios economically feasible for the project partners.

# SITE DEVELOPMENT PLAN

*Create a detailed plan for development of an injection site within the storage complex in Phase III of CarbonSAFE.*

- Site characterization plan
- $CO_2$ management strategy
- Risk assessment and mitigation strategies

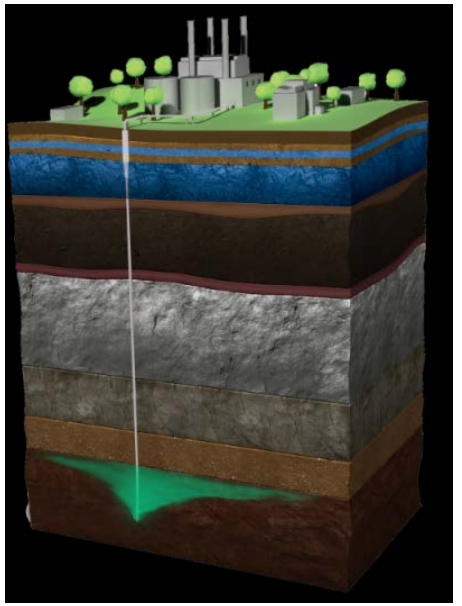


# NRAP VALIDATION

*Validate select tool(s) developed through DOE's National Risk Assessment Partnership.*

- Validation will entail comparing outputs from the NRAP tools against commercial software packages.
- Reservoir Evaluation Visualization (REV), Natural Seal ROM (NSealR), and Wellbore Leakage Analysis Tool (WLAT) are likely NRAP tool options for validation with the data generated in the project.

NRAP
National Risk Assessment Partnership



# SYNERGY OPPORTUNITIES

- Targeting the same formations being investigated in the ND BEST project.
- Providing pore space amalgamation and management analogies for other CarbonSAFE projects.
- Providing another practical example of assessing commercial-scale geologic storage for $CO_2$.
- Providing another case study for NRAP tool validation.

# PROJECT SUMMARY

- The EERC project team's accumulated experience will ensure both the technical and nontechnical challenges associated with establishing the feasibility of a commercial-scale geologic $CO_2$ storage complex in North Dakota are successfully addressed.
- Known potential risks can be successfully managed.
- Deliverables and milestones have been planned to document and track progress as well as disseminate results.
- The results derived from implementation of the project will provide a significant contribution to DOE's Carbon Storage Program goals.

# ACKNOWLEDGMENT

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## Disclaimer

# CONTACT INFORMATION

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# THANK YOU!

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# APPENDIX

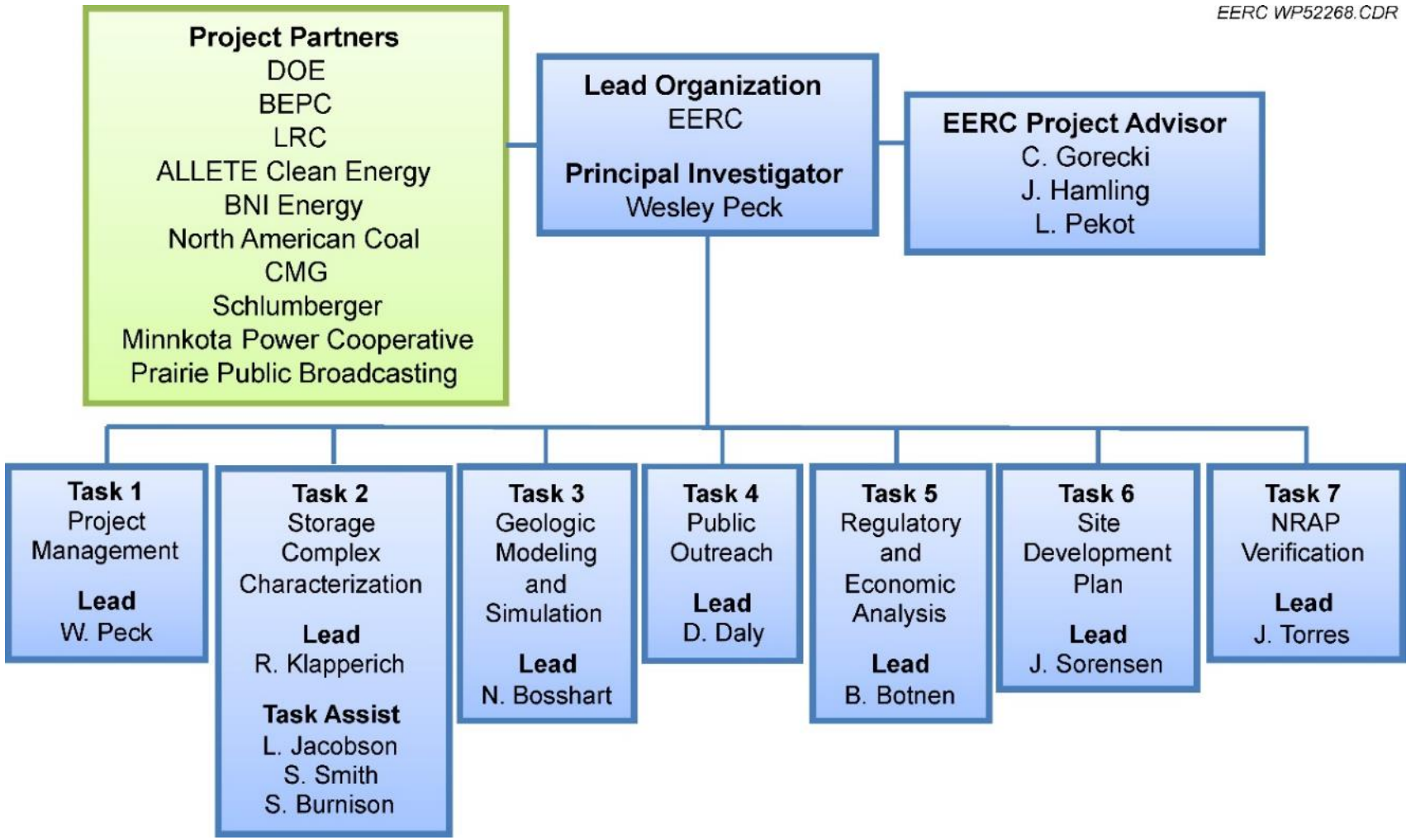
# BENEFIT TO THE PROGRAM

- Address the technical and nontechnical challenges associated with establishing the feasibility of a commercial-scale (50+ Mt) geologic storage complex for $CO_2$.
- Validate technologies that improve reservoir storage efficiency, ensure containment effectiveness, and/or ensure storage permanence by generating fundamental geologic data from characterizing the Broom Creek Formation.
- Address the ability to predict $CO_2$ storage capacity in geologic formations to within ±30% by integrating characterization data into geocellular and dynamic reservoir models.
- Produce information for the development of DOE's series of commercial-scale best practice manuals.
- Evaluate/validate risk assessment tools developed by NRAP.

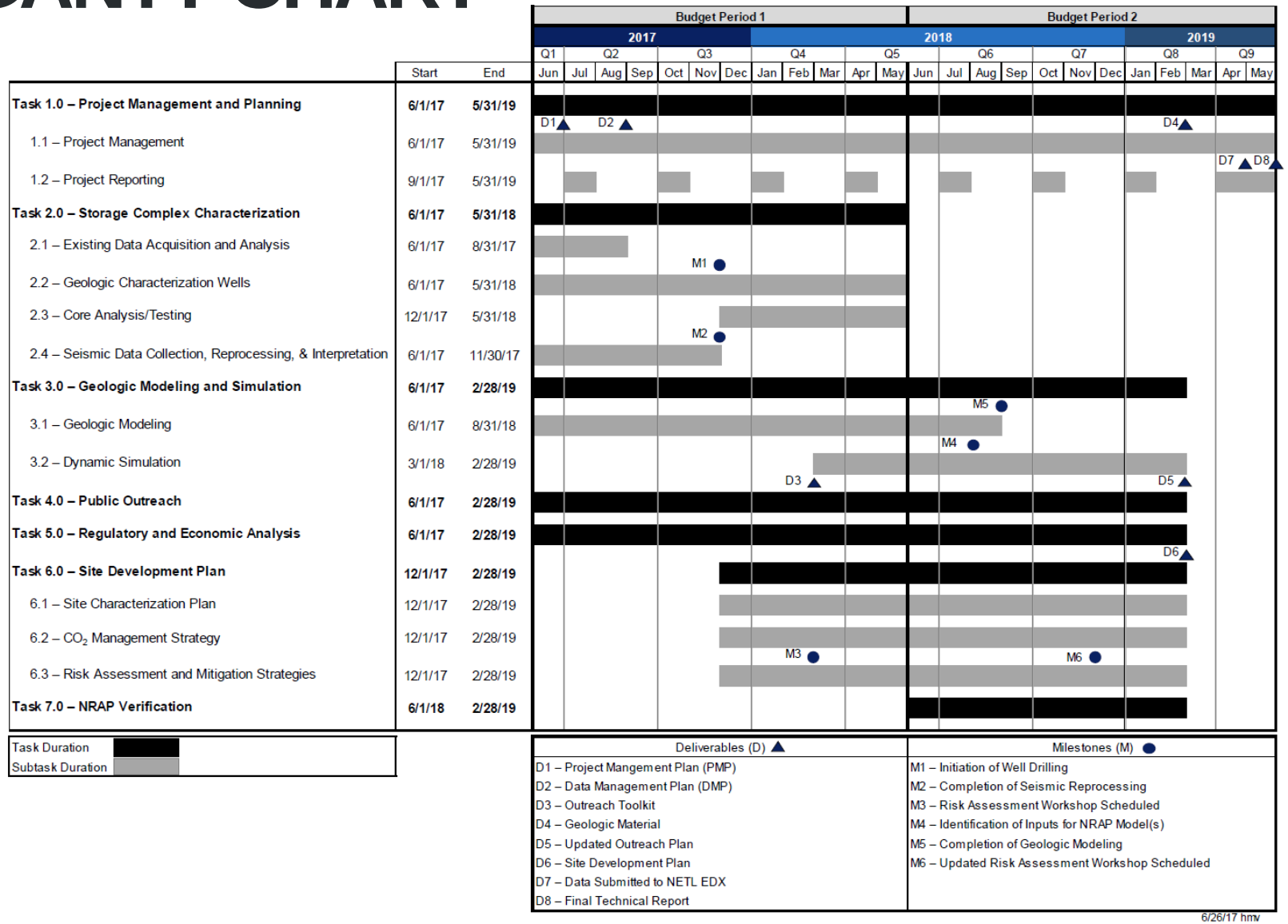
# PROJECT OVERVIEW – GOALS AND OBJECTIVES

- Goal: Determine the feasibility of developing a commercial-scale $CO_2$ geologic storage complex able to store 50+ million metric tons of $CO_2$ in central North Dakota safely, permanently, and economically.
- Objectives:
  - Evaluate two project study areas, each with ideal geologic storage complexes located adjacent to separate coal-fired facilities.
    - The site near the AVS/DGC facility site has readily available $CO_2$ and an existing $CO_2$ pipeline.
    - The site near the MRY facility is associated with a planned integrated $CO_2$ capture and storage project with a time line coincident with the DOE CarbonSAFE Program.
    - Each site is bolstered by existing North Dakota pore space ownership and long-term liability laws.

# ORGANIZATION CHART



# GANTT CHART




**Deliverables**

D1 – Project Management Plan (PMP)
D2 – Data Management Plan (DMP)
D3 – Outreach Toolkit
D4 – Geologic Material
D5 – Updated Outreach Plan
D6 – Site Development Plan
D7 – Data Submitted to NETL EDX
D8 – Final Technical Report

**Milestones**

M1 – Initiation of Well Drilling
M2 – Completion of Seismic Reprocessing
M3 – Risk Assessment Workshop Scheduled
M4 – Identification of Inputs for NRAP Model(s)
M5 – Completion of Geologic Modeling
M6 – Updated Risk Assessment Workshop Scheduled

Gantt chart as originally proposed. Dates will be adjusted in accordance with the actual start date.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