



EERC



UNIVERSITY OF
NORTH DAKOTA



Critical Challenges. Practical Solutions.



Energy & Environmental Research Center (EERC)

SCALING UP TO INDUSTRIAL CCUS

A Regional Perspective

North Dakota, USA

Ground Water Protection Council

2020 Underground Injection Control Conference

San Antonio, TX

February 18, 2020

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A STATE OF ENERGY

Population – ~760,000 (~70,000 square miles)

CO₂ emissions – 34th – ~56 million tonnes per year

Total Energy Production 6th

- Oil – 2nd
- Natural gas – 10th
- Coal – 8th
- Wind – 10th
- Ethanol – 10th

Agricultural products

- 19 – top three



REGIONAL POTENTIAL

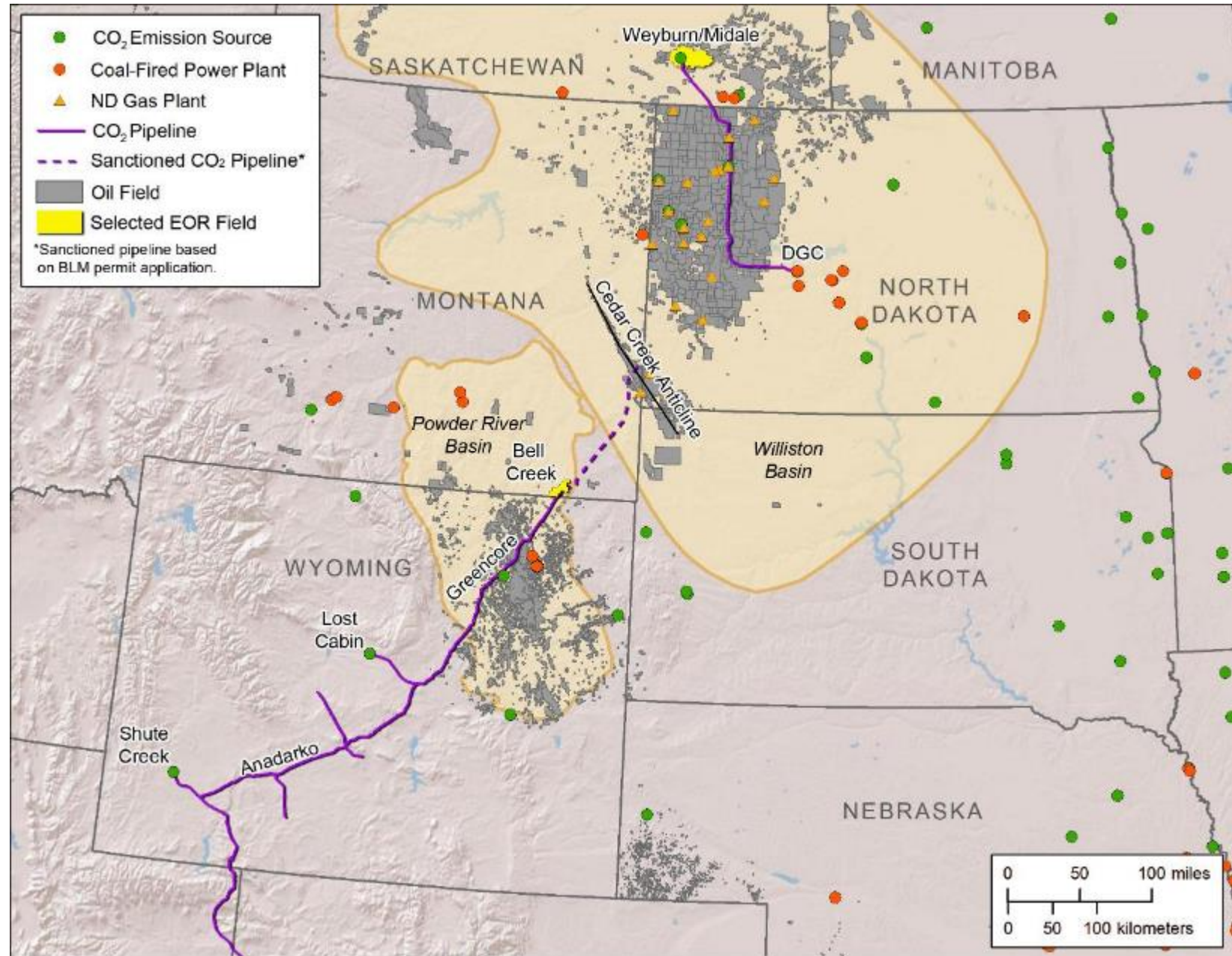
A Prolific Oil-Producing Region in North America

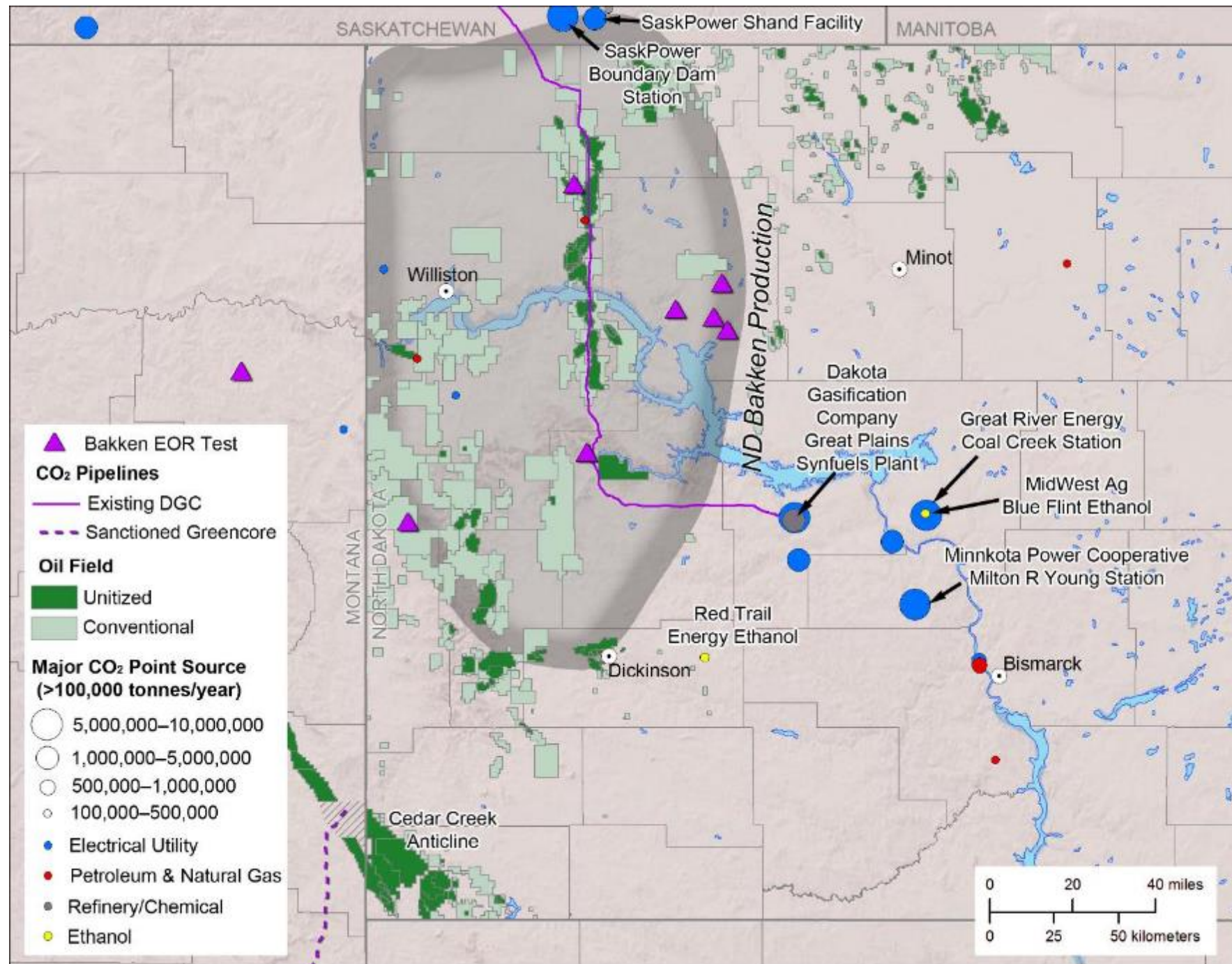
- Conventional
- Unconventional
- Stacked horizons
- Residual oil zones (ROZs)?

Abundant Anthropogenic CO₂
Sources Proximal to Enhanced
Oil Recovery (EOR) and Storage
Opportunities

Growing CO₂ Transportation
Network

Massive CO₂ Storage Potential in
Deep Saline Formations





ENORMOUS EOR OPPORTUNITY

86 conventional unitized fields:

- 280 million to 630 million bbl of incremental oil
- 47 million to 283 million metric tons of CO₂ needed

200+ conventional fields

- >1 Bbbl of incremental oil
- >358 million metric tons of CO₂ needed

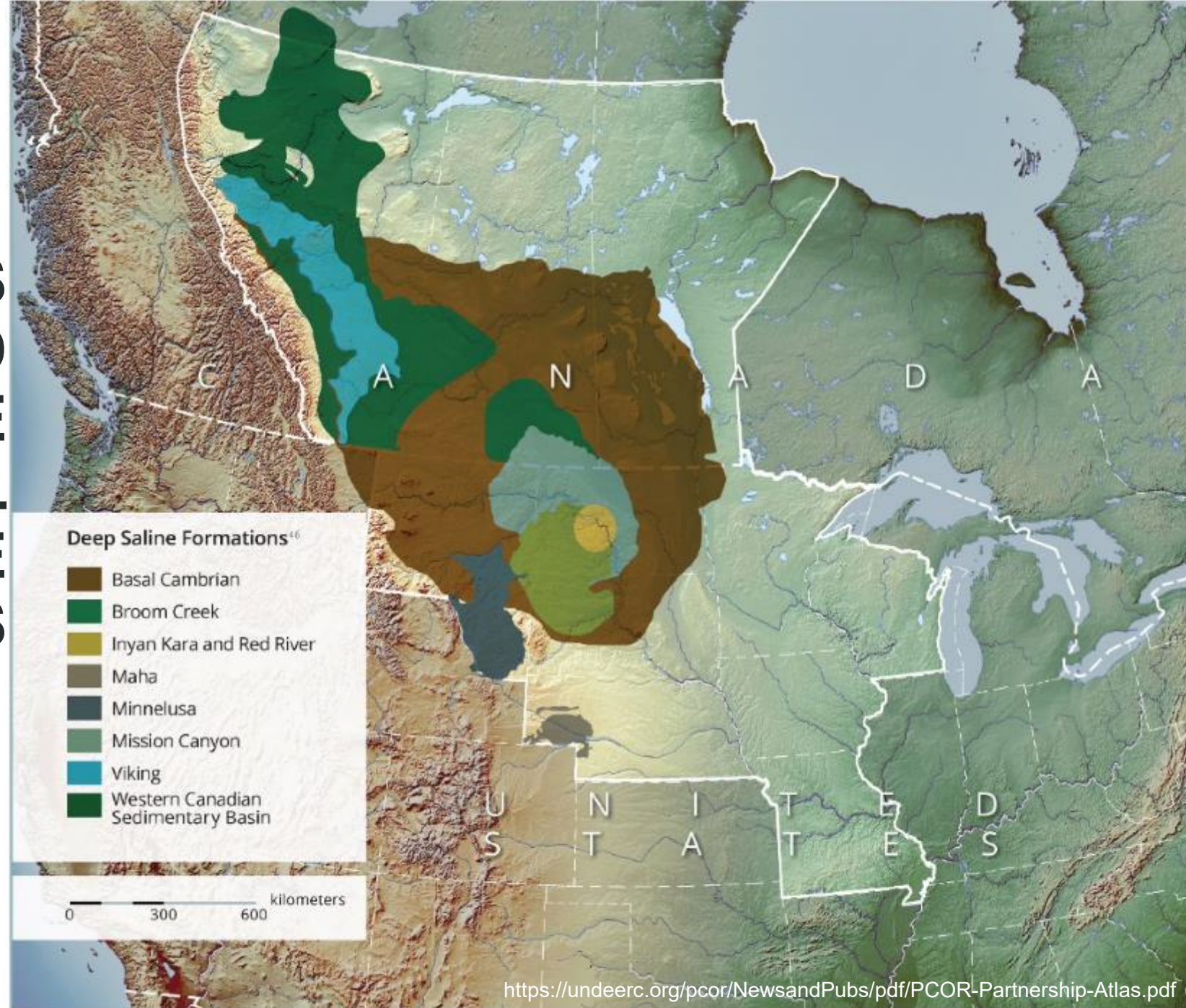
Conventional + Bakken Petroleum System:

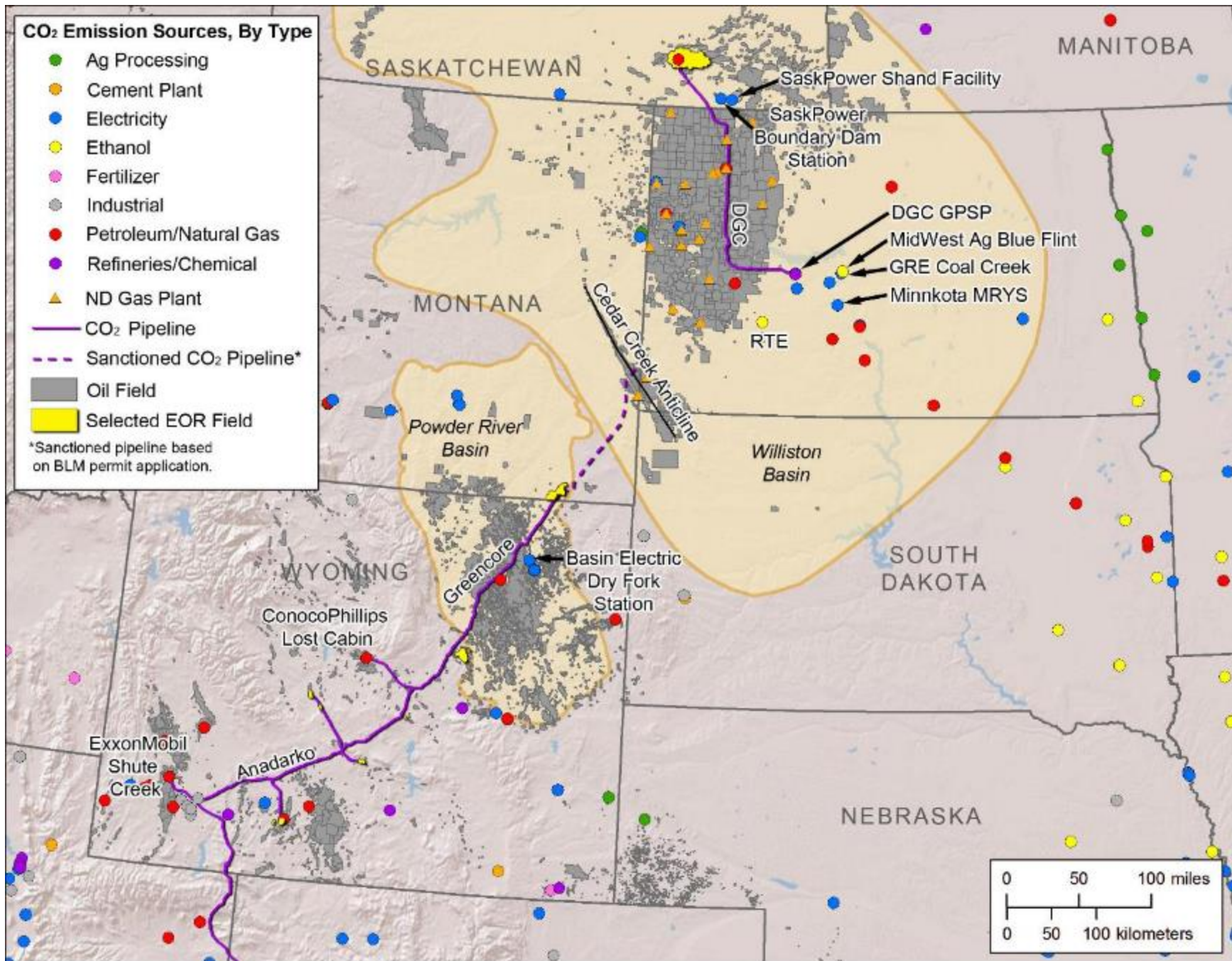
- 4 Bbbl–7.6 Bbbl of incremental oil
 - 2 Btons–3.8 Btons of CO₂ needed
- ...or more

ENORMOUS DEDICATED STORAGE POTENTIAL IN DEEP SALINE FORMATIONS

*More than 330 GT of
storage potential,*

100+ billion tonnes in ND alone.

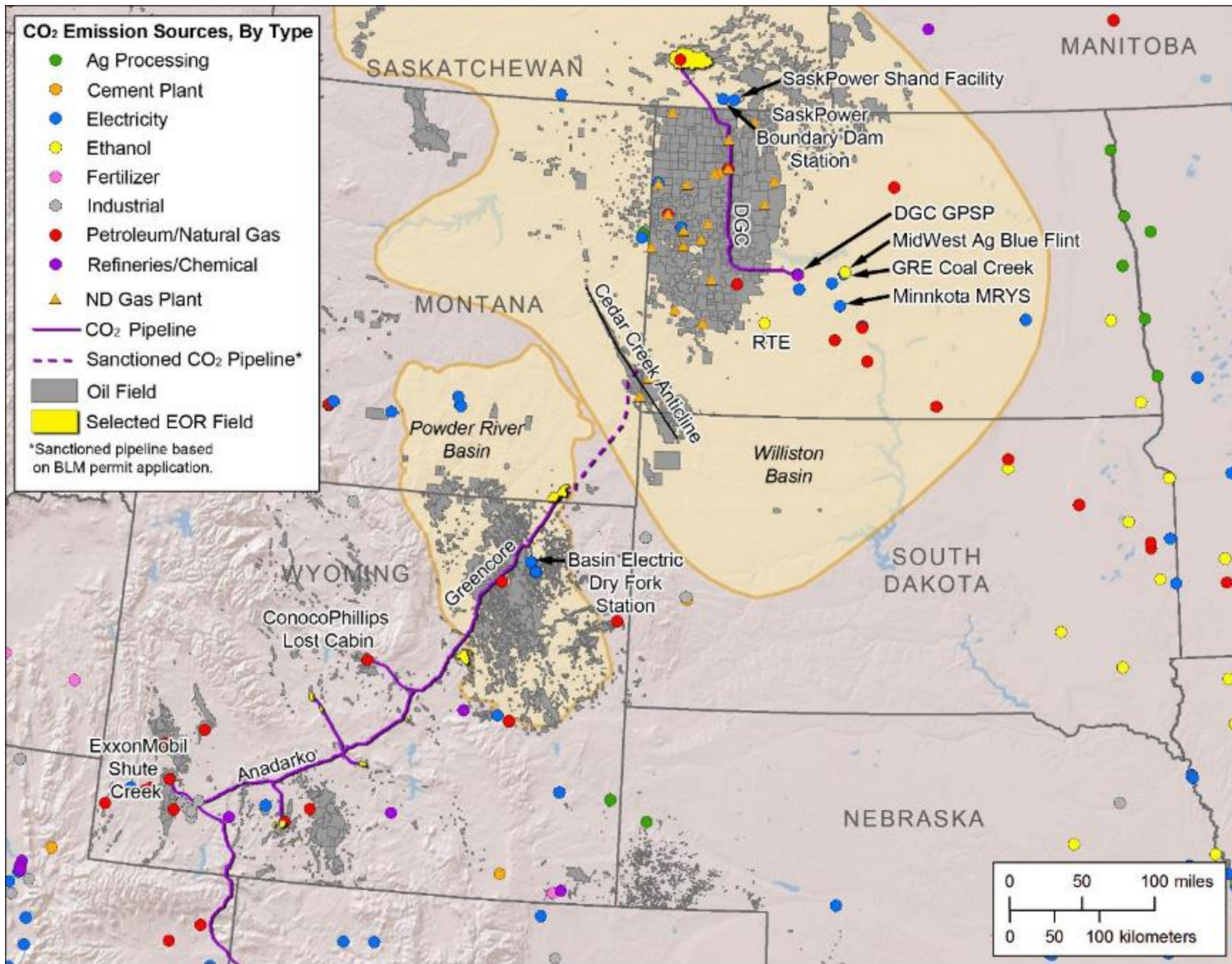




Commercial Industrial CCUS Projects

- Basin Electric Power Cooperative, Dakota Gasification Company Great Plains Synfuels (commercial)
- Basin Electric Power Cooperative Urea Process Liquefaction Plant (commercial)
- SaskPower Boundary Dam Carbon Capture Project (commercial)
- Exxon Mobil Shute Creek Natural Gas Processing (commercial)
- ConocoPhillips Lost Cabin Natural Gas Processing (commercial)
- Shell Quest CCS Facility* (commercial) – Alberta, Canada

*not pictured.



Announced Industrial CCUS Projects

- Red Trail Energy – **Richardton Ethanol Facility** (precommercial/FEED)
- Minnkota Power Cooperative **Project Tundra** – Milton R. Young Station (precommercial/FEED)
- Basin Electric Power Cooperative Dry Fork Station (precommercialization/FEED)
- Great River Energy **CCS²** - Coal Creek Station (feasibility)
- Midwest AgEnergy – Blue Flint Ethanol Facility (feasibility)
- SaskPower Shand Power Station (feasibility)

CO₂ Transportation Network

DGC line (commercial)

- 205-mile 14" - 12"

Greencore Pipeline (commercial)

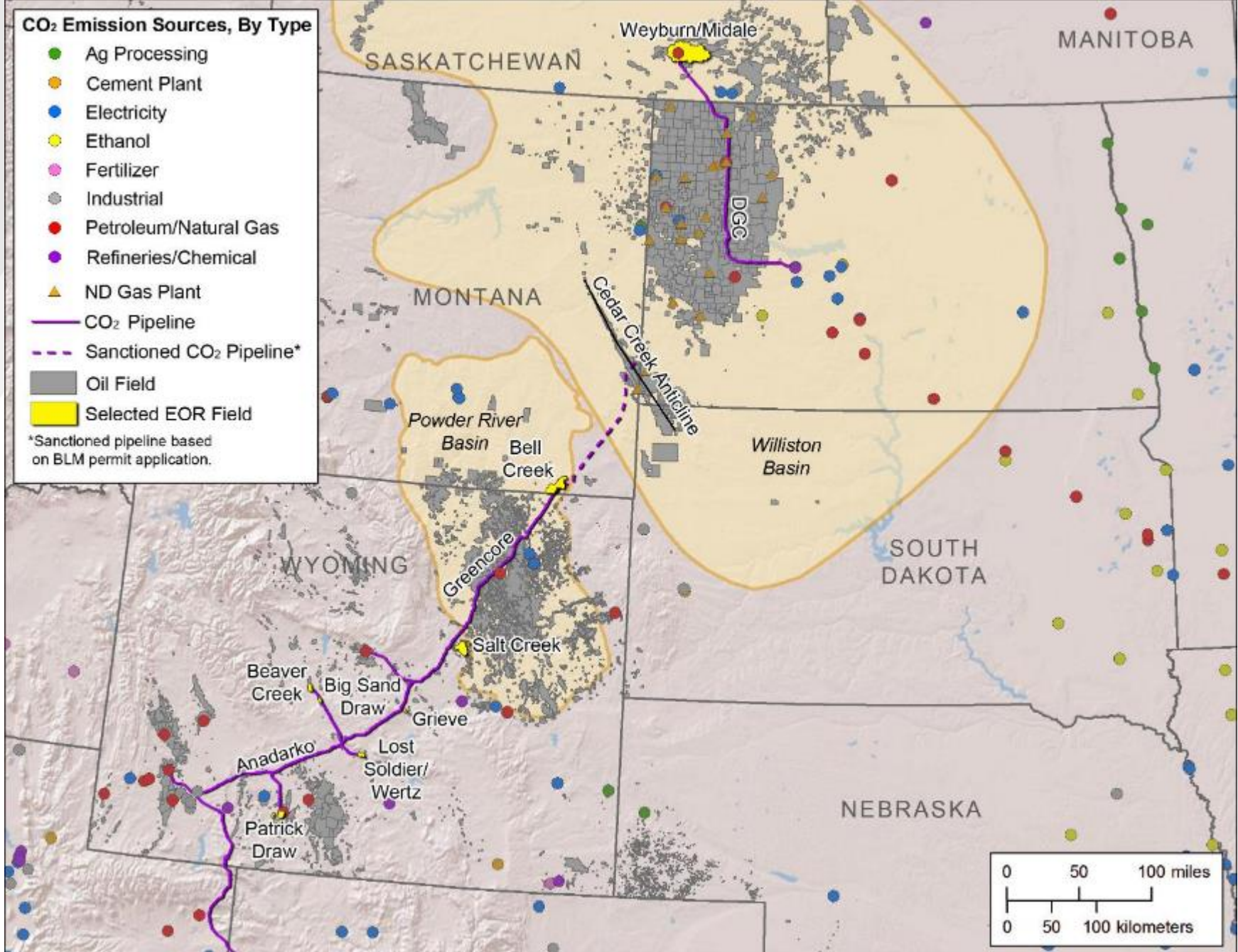
- 232-mile long 20"
- (725 MMscf/day)
- Anadarko CO₂ pipeline interconnect

Greencore Pipeline Expansion (sanctioned)

- 110-mile expansion to Baker, MT, and Cedar Creek Anticline

North Dakota Industrial Sources Line(s) (conceptual)

DGC Food-Grade Truck Facility (commercial)



INCENTIVES

West Coast LCFS Markets

- Credits trading up to \$213 per ton.
- Stacked with 45Q

45Q Tax Credits

- Projects beginning construction before January 1, 2024, can claim credits for 12 years after operations begin.
- Tax credits claimed by the taxpayer capturing the emissions or transferred to operators of CO₂ EOR projects.
- Tax credit for CO₂ stored in a qualified EOR project (10-year ramp up to a maximum of \$35/tonne in 2026).
- Tax credit for CO₂ stored in a saline formation (10-year ramp-up to a maximum of \$50/tonne in 2026).

North Dakota CCUS Incentives

- Coal conversion tax: tax reduction with CO₂ capture (up to 50%)

- No sales tax on capture-related infrastructure
- No sales tax on CO₂ sold for EOR

- No sales tax on construction of pipeline.
- Property tax-exempt for 10 years (equipment)

- No sales tax on CO₂ EOR infrastructure
- 0% extraction tax for 20 years for tertiary incremental recovery
- Production tax still applies



A RESOURCE MANAGEMENT PHILOSOPHY

Mission to promote and prudently develop North Dakota's oil, gas, fossil, and renewable energy resources.

“Public interest to promote geologic storage of carbon dioxide...”

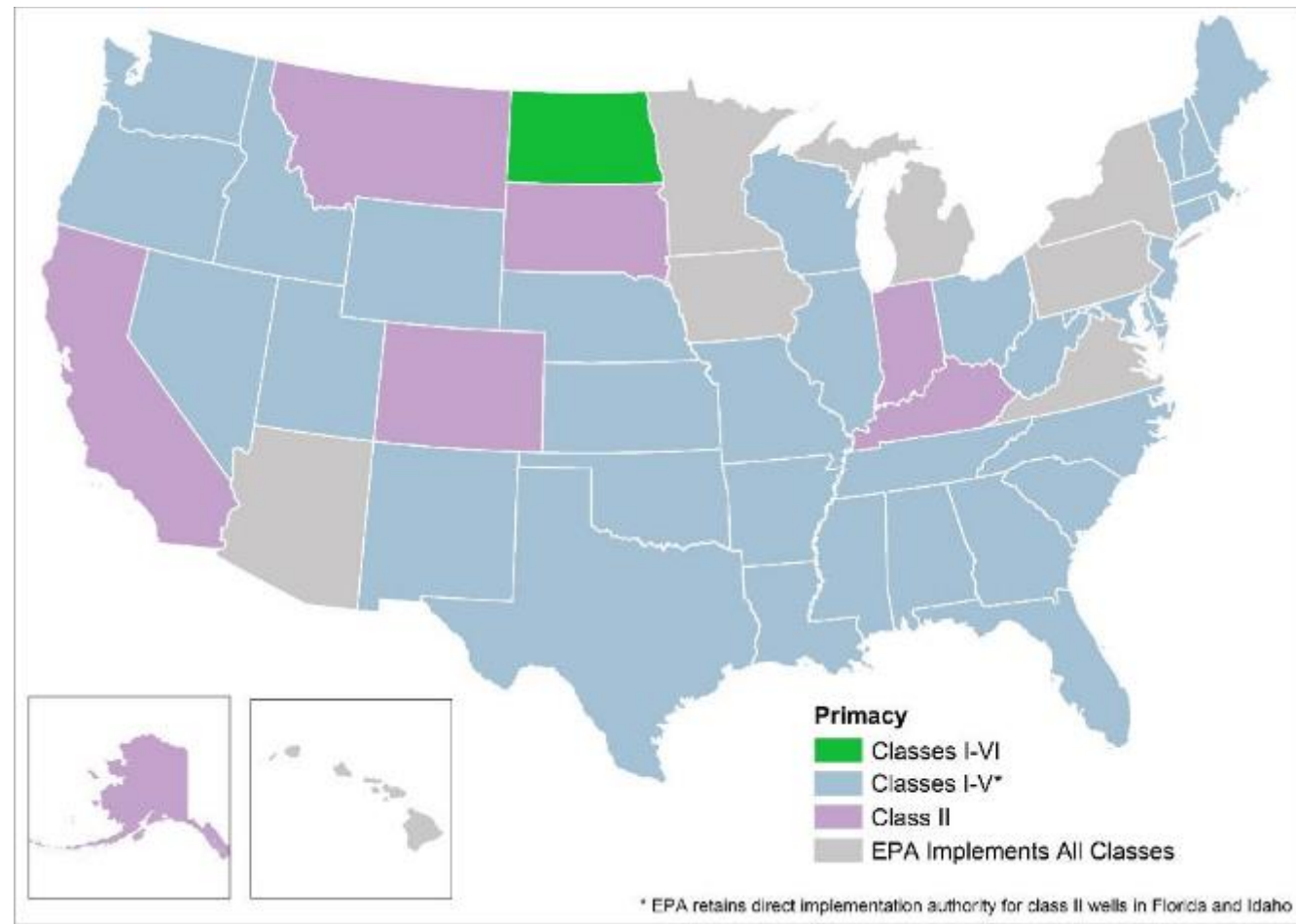
Carbon capture, utilization, and storage (CCUS) is a key to leveraging a tremendous endowment of fossil energy to provide secure, reliable, affordable, safe, clean energy.

Public accustomed to energy industry and the role it plays.



UNDERGROUND INJECTION CONTROL

NORTH DAKOTA'S GOT CLASS! I, II, III, IV, V, AND VI



Class I	Class II	Class III	Class IV	Class V	Class VI
ND Dept of Health	NDIC Oil & Gas Division	ND Geological Survey	ND Dept of Health	ND Dept of Health	NDIC Oil & Gas Division
Hazardous and nonhazardous fluids (industrial and municipal wastes).	Brines and other fluids associated with oil and gas production.	Fluids associated with solution mining of minerals.	Hazardous or radioactive wastes. This class is banned by EPA.	Nonhazardous fluids into or above a USDW and are typically shallow.	Injection of carbon dioxide for long-term storage.

PRUUDENT REGULATIONS THAT ENABEL CCUS

Codified in North Dakota Law



CHAPTER 38-22 CARBON DIOXIDE UNDERGROUND STORAGE

38-22-01. Policy. It is in the **public interest** to promote the **geologic storage of carbon dioxide**. Doing so **will benefit the state** and the global environment by reducing greenhouse gas emissions. Doing so will help ensure the viability of the state's coal and power industries, to the **economic benefit** of North Dakota and its citizens. Further, geologic storage of carbon dioxide, a potentially **valuable commodity**, may allow for its ready availability if needed for commercial, industrial, or other uses, including enhanced recovery of oil, gas, and other minerals. Geologic storage, however, to be practical and effective **requires cooperative use** of surface and subsurface property interests and the collaboration of property owners. Obtaining **consent from all owners may not be feasible**, requiring **procedures that promote, in a manner fair to all interests**, cooperative management, thereby **ensuring the maximum use of natural resources**.

Carbon dioxide storage facility administrative fund (\$0.01/ton): administrative costs associated with regulating storage facilities.

Carbon dioxide storage facility trust fund (\$0.07/ton): cost of long-term monitoring.

Certificate of Project Completion – Release of Bond – Transfer of Title and Custody

ANCILLARY REGULATORY MECHANISMS FACILITATE INDUSTRIAL CCUS

State issues certificate of project completion (all criteria met – at least 10 years postinjection)

- Releases responsibility, regulatory requirements, and bonds
- Transfer of title and custody to storage facility and stored CO₂ state
- State oversees/responsible for monitoring and managing the storage facility until such time as federal government assumes responsibility (assures site access/confidence)

State retains all authority to regulate future mineral and UIC activities

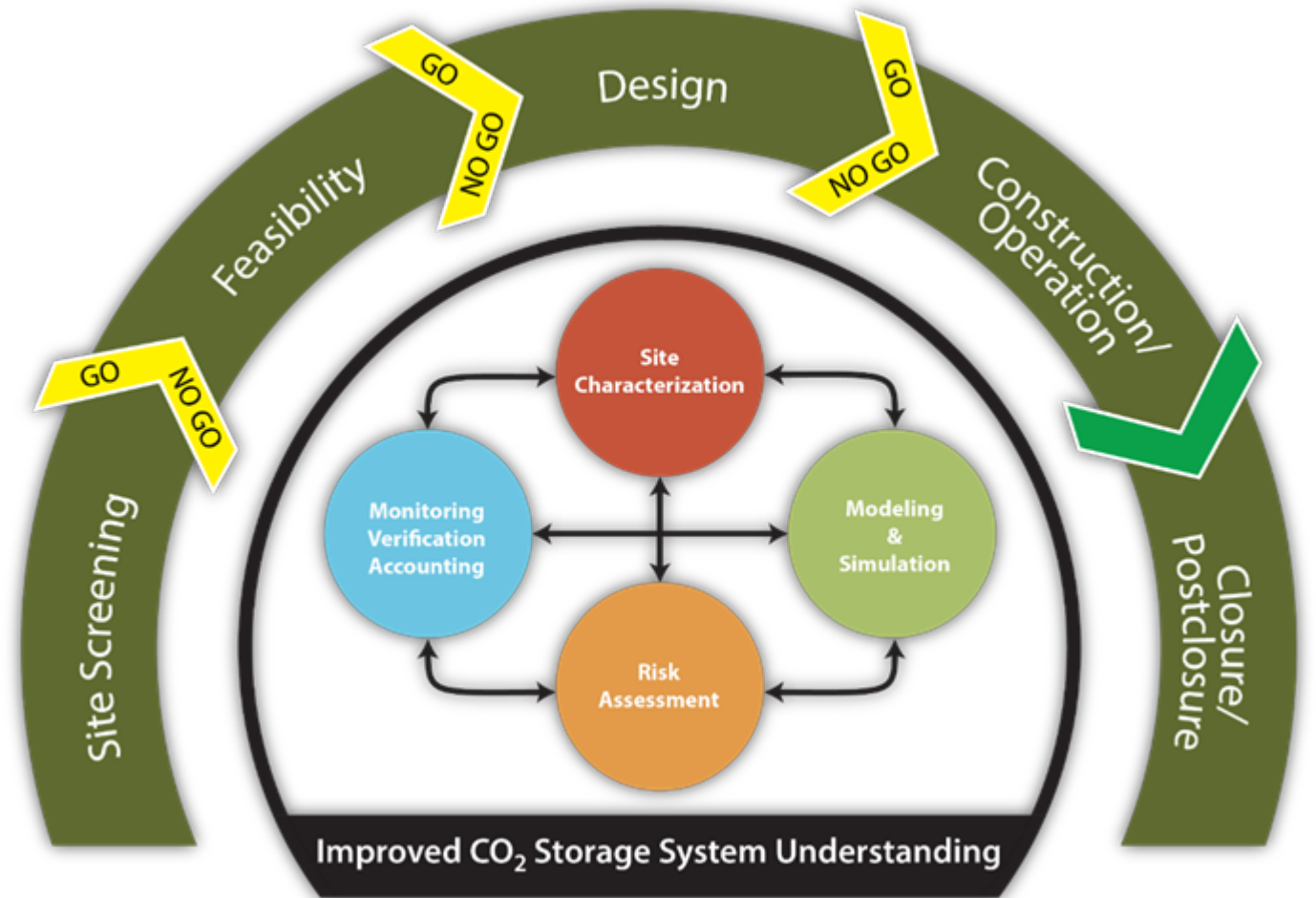
- protection from recapture of incentives.

State issued determination of storage (facilitate trading and incentive programs)

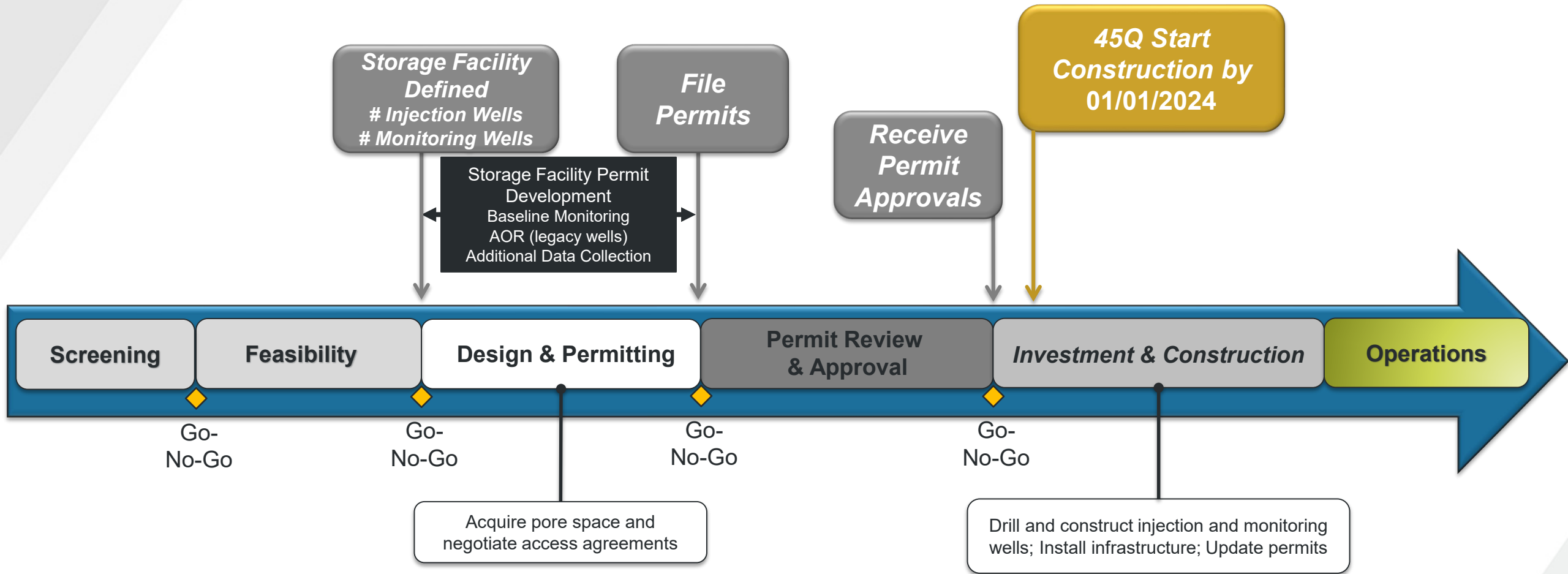


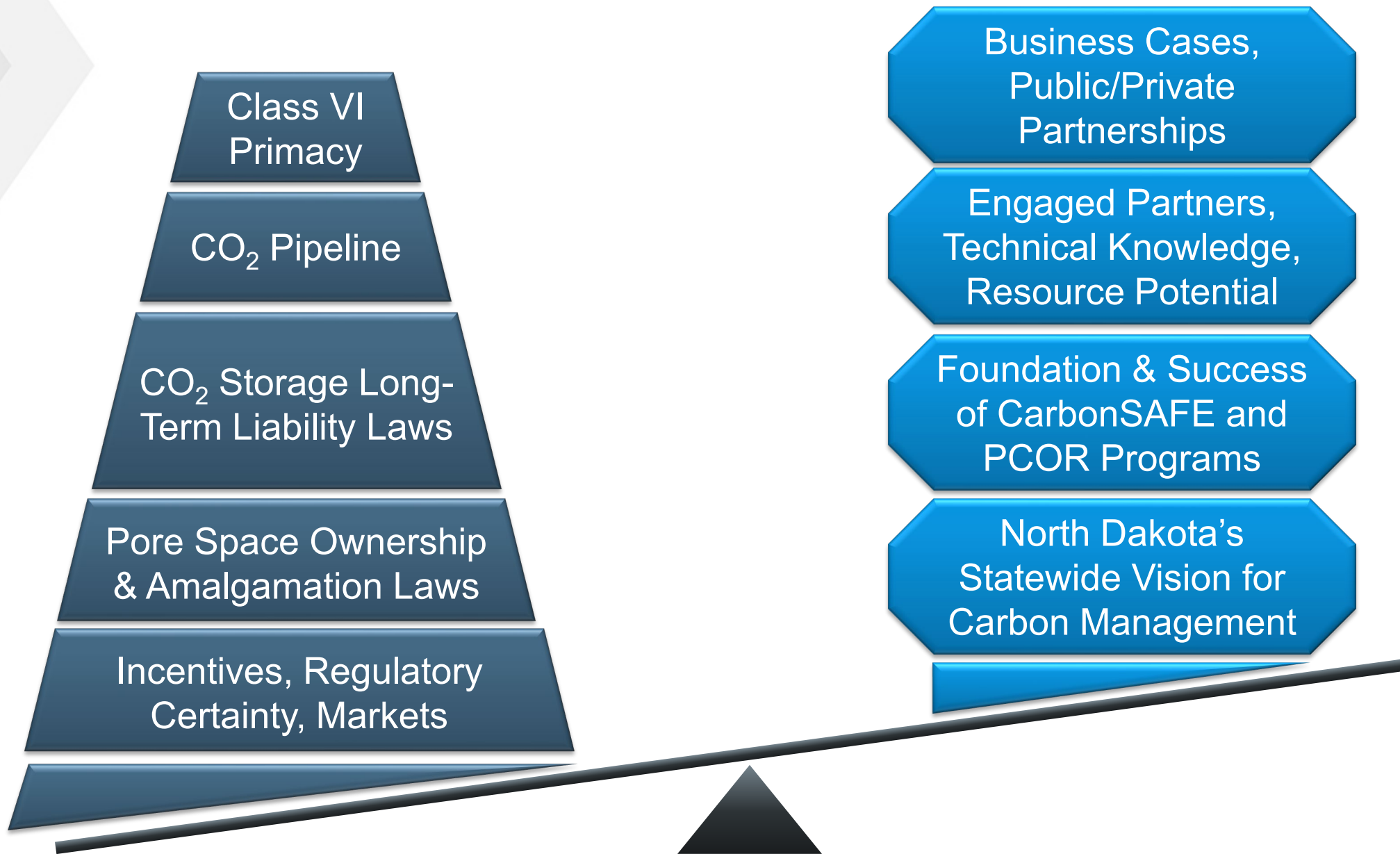
INTEGRATED ADAPTIVE MANAGEMENT APPROACH TO PROJECT IMPLEMENTATION

- Staged approach to manage uncertainty and inform investment strategy
- Implementation can be accelerated
 - More investment needed at lower levels of confidence
 - Balance financial and technical risk
 - ◆ Site qualification
 - ◆ Permitting
 - ◆ Investment
 - ◆ 45Q start of construction



GENERALIZED TIMELINE AND MAJOR MILESTONES





DRIVERS FOR INDUSTRIAL CCUS



OBSTACLES FOR INDUSTRIAL CCUS





QUESTIONS & DISCUSSION



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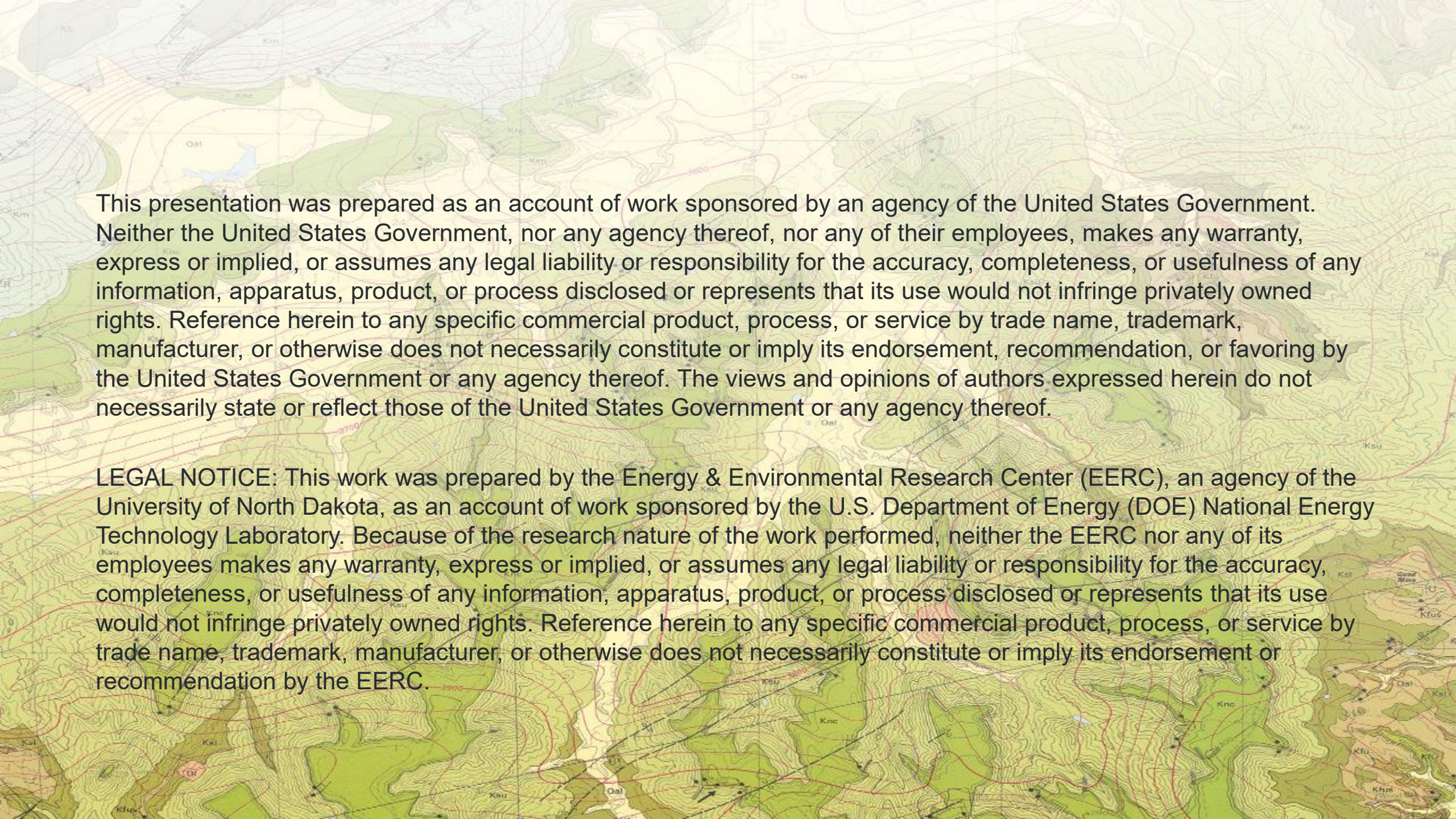
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A wide-angle photograph of a university campus at sunset. The sun is low on the horizon, casting a warm glow over the scene. In the foreground, there are trees with yellowing leaves. In the background, there are several large, multi-story brick buildings and a parking lot filled with cars.

THANK YOU

Critical Challenges. Practical Solutions.

A topographic map of a mountainous region, likely in the western United States, showing contour lines, roads, and a river. The map is overlaid with a semi-transparent text box.

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