



# Lignite Research Program Update and Strategies

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WDEA – Watford City

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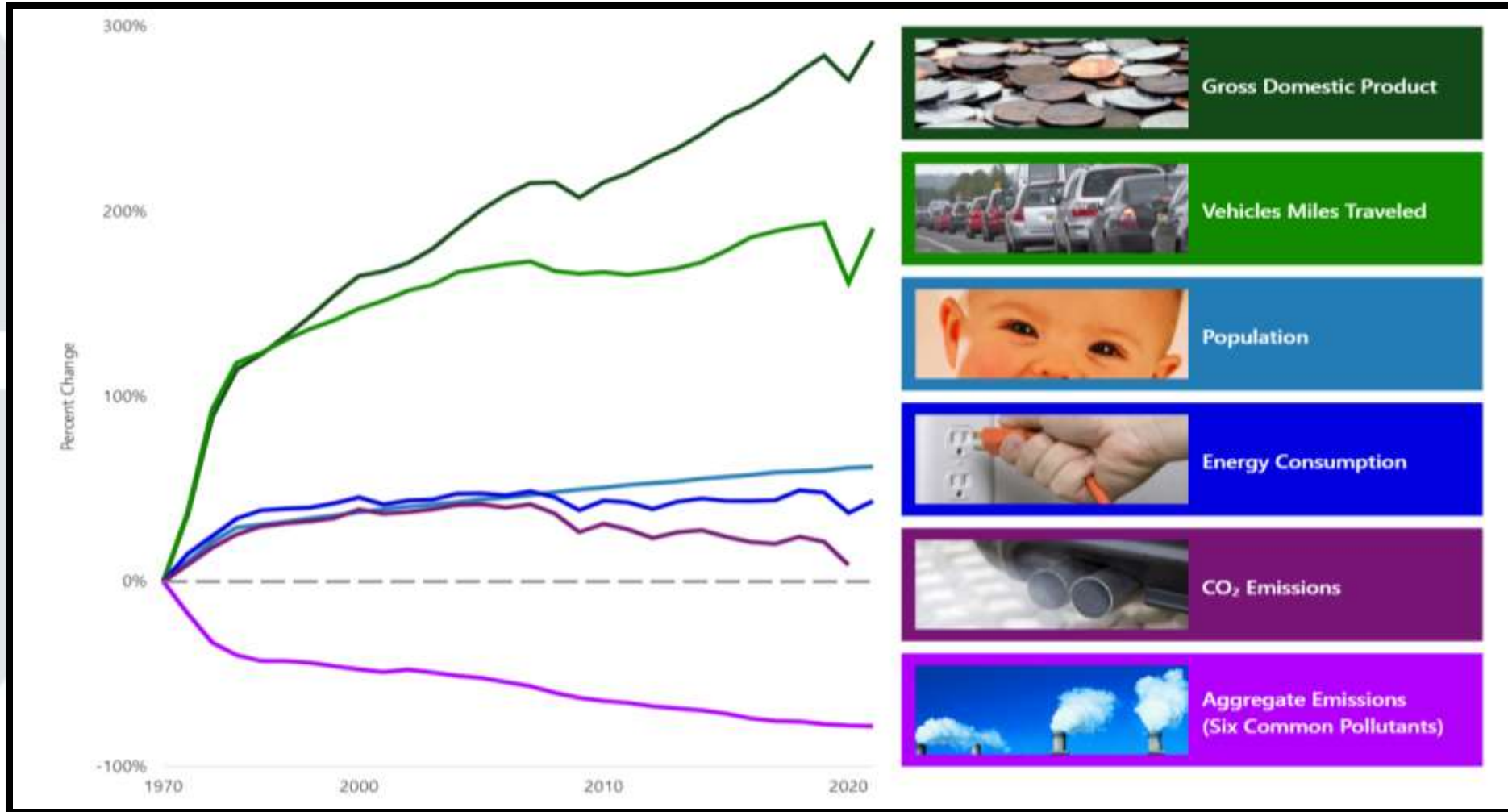


# Topics of Presentation

## Lignite Research Program Overview

- Current Project Portfolio
  - Carbon Management
  - Emerging Markets
- Enhance Preserve and Protect Project
  - New Proposal
  - Planned and Current White Papers
- Q&A and Discussion of Strategy / Path Forward

# Comparison of Growth Areas & Declining Emissions 1970-2021



EPA Air Trends (U.S.) - <https://gispub.epa.gov/air/trendsreport/2022/#growth>

# Lignite Research Program Historical Challenges Met



Basin Electric Antelope Valley Station  
and DGC Synfuels Plant  
[www.dakotagas.com](http://www.dakotagas.com)

## *To highlight a few...*

- Thriving with high-sodium coal
- Optimized operations and cleanability
- Support of only U.S. coal-to-synfuels plant
- DGC added urea to product suite
- Lignite mining, use, and reclamation advances through data, instrumentation & controls
- **Spiritwood – industrial complex**
- DryFining – coal upgrading
- **Meeting regulations for primary pollutants**
- Addressed control of nitrogen and sulfur emissions
- Mercury costs reduced by more than 20X

# Lignite Industry Technology Roadmap



Support continued options to enhance performance of the existing fleet



Invest in transformational research (Next generation of Lignite conversion systems that integrate CO<sub>2</sub> capture)



Focus on Carbon Capture Utilization & Storage (CCUS)



Leverage International R&D breakthroughs



Renewed Focus

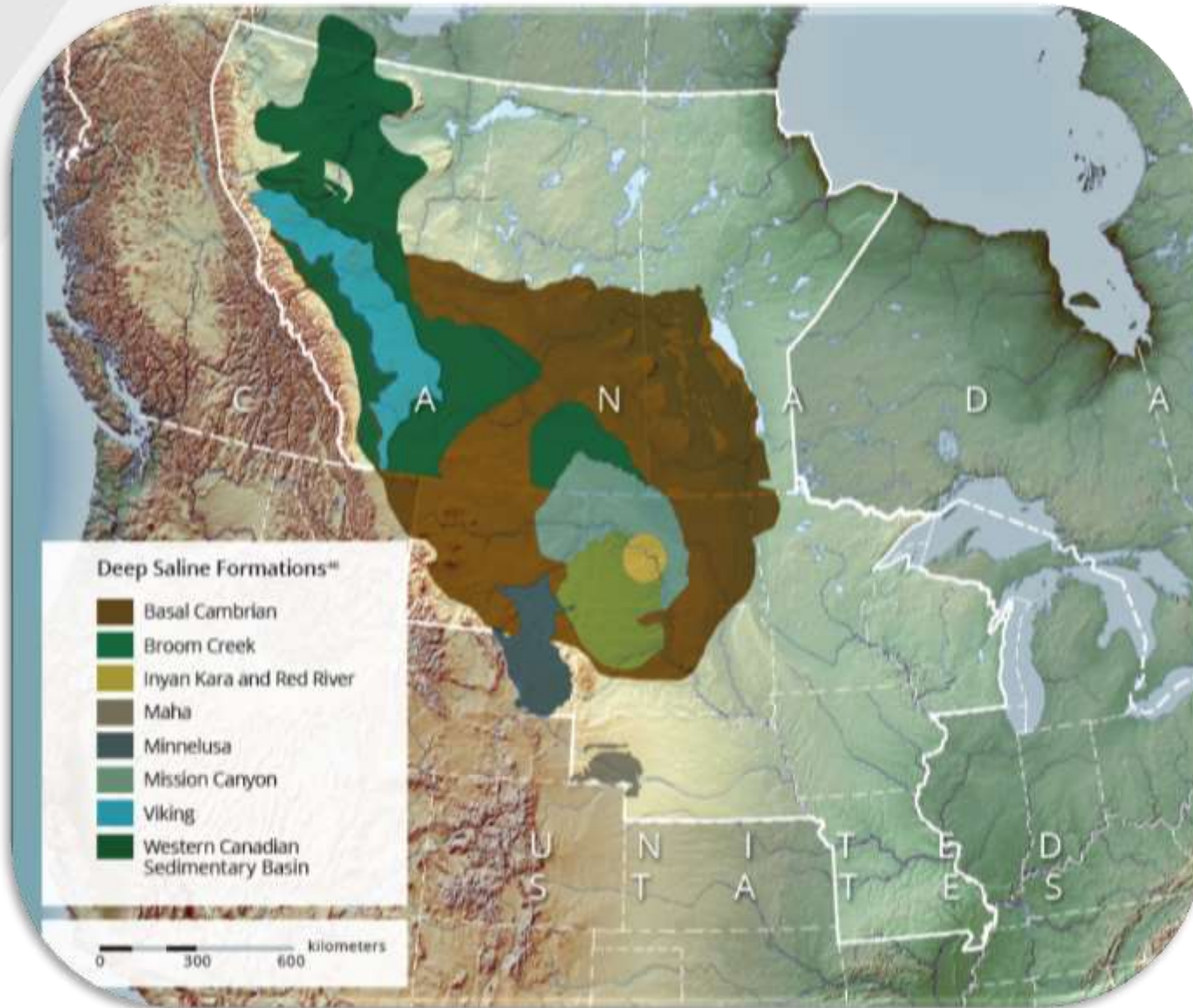
Additional value propositions for lignite  
Polygeneration opportunities

# Carbon Capture, Utilization and Storage (CCUS)



Graphic from EERC PCOR Program

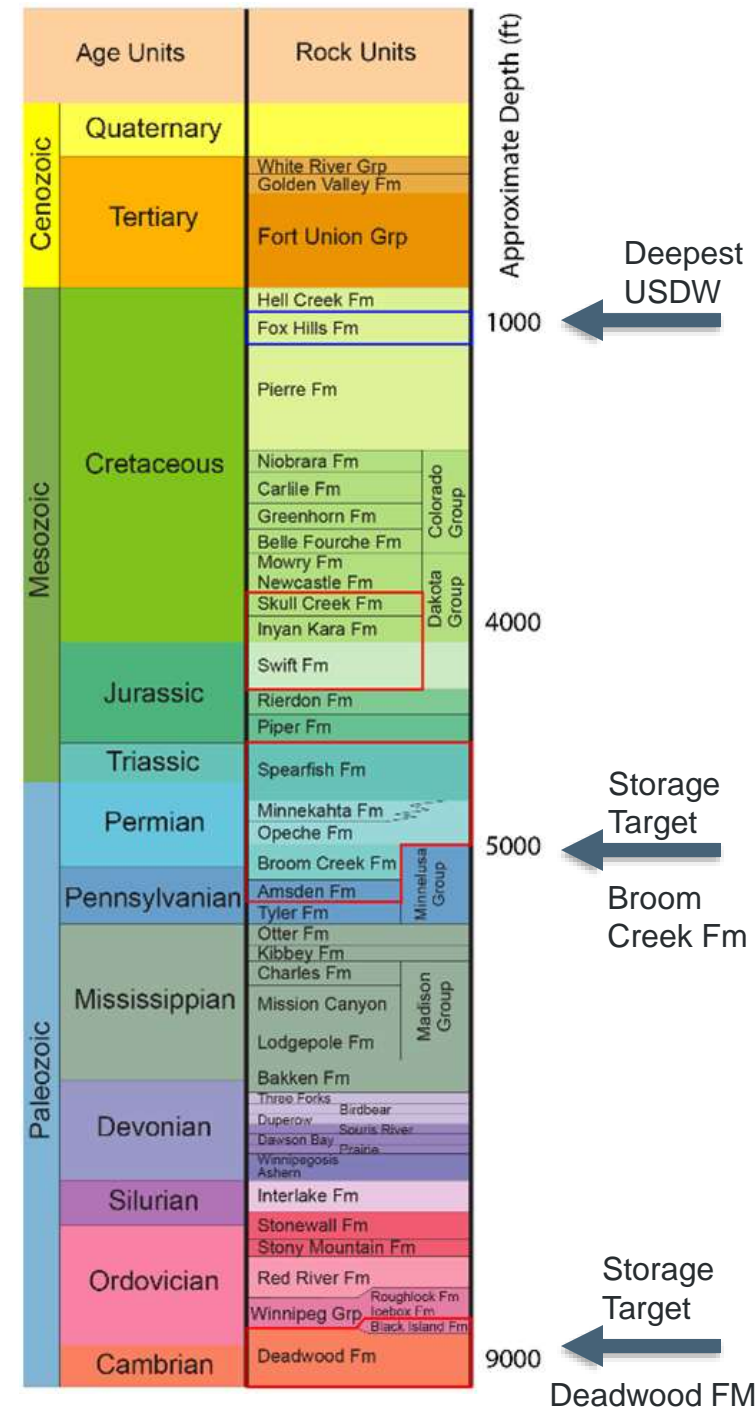
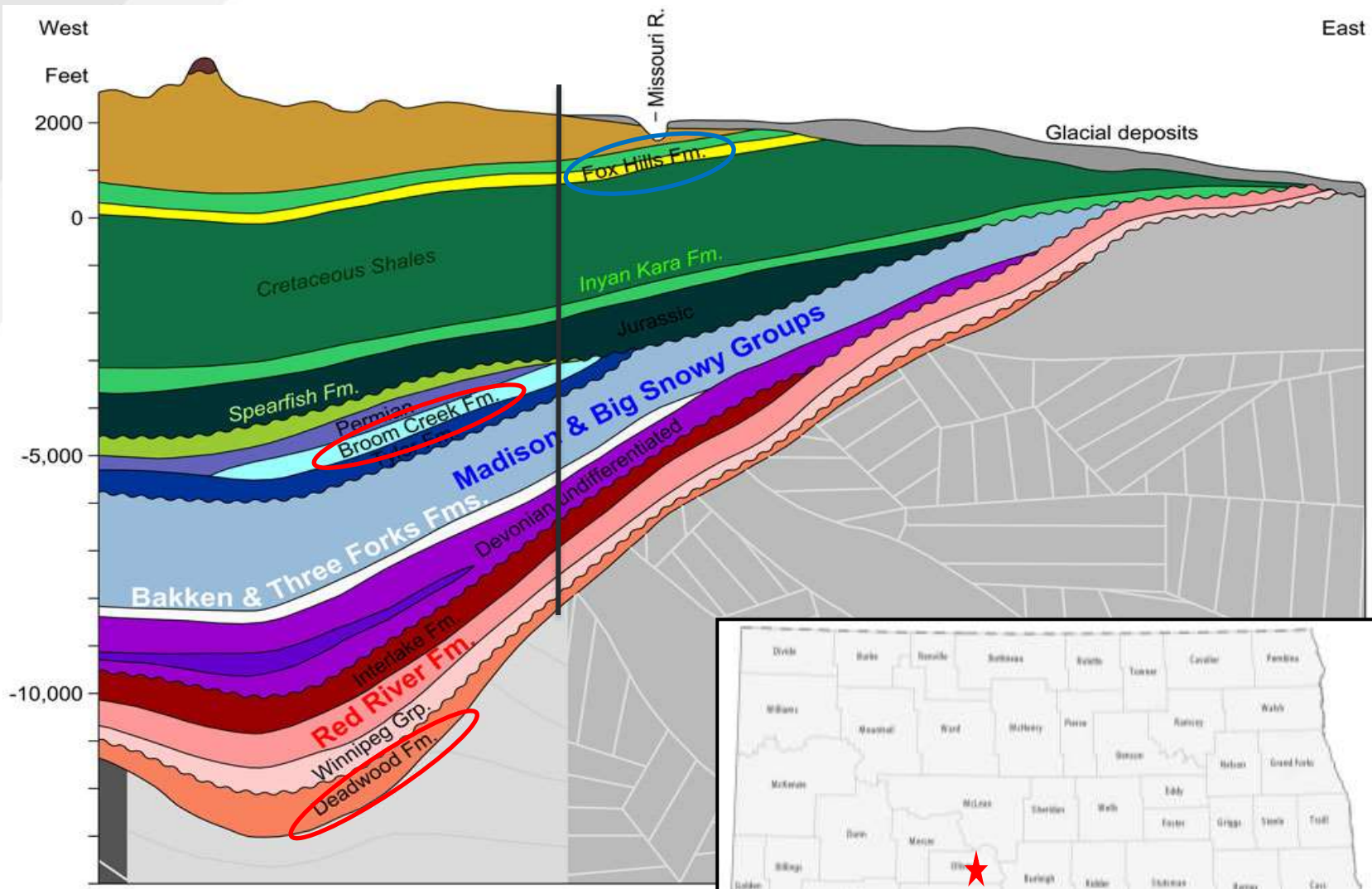
# CO<sub>2</sub> Storage Resource in the PCOR Partnership Region



Several deep saline formations throughout the PCOR region have been evaluated for CO<sub>2</sub> storage.

North Dakota formations have the ability to store between 76 billion and 252 billion tonnes of CO<sub>2</sub>.

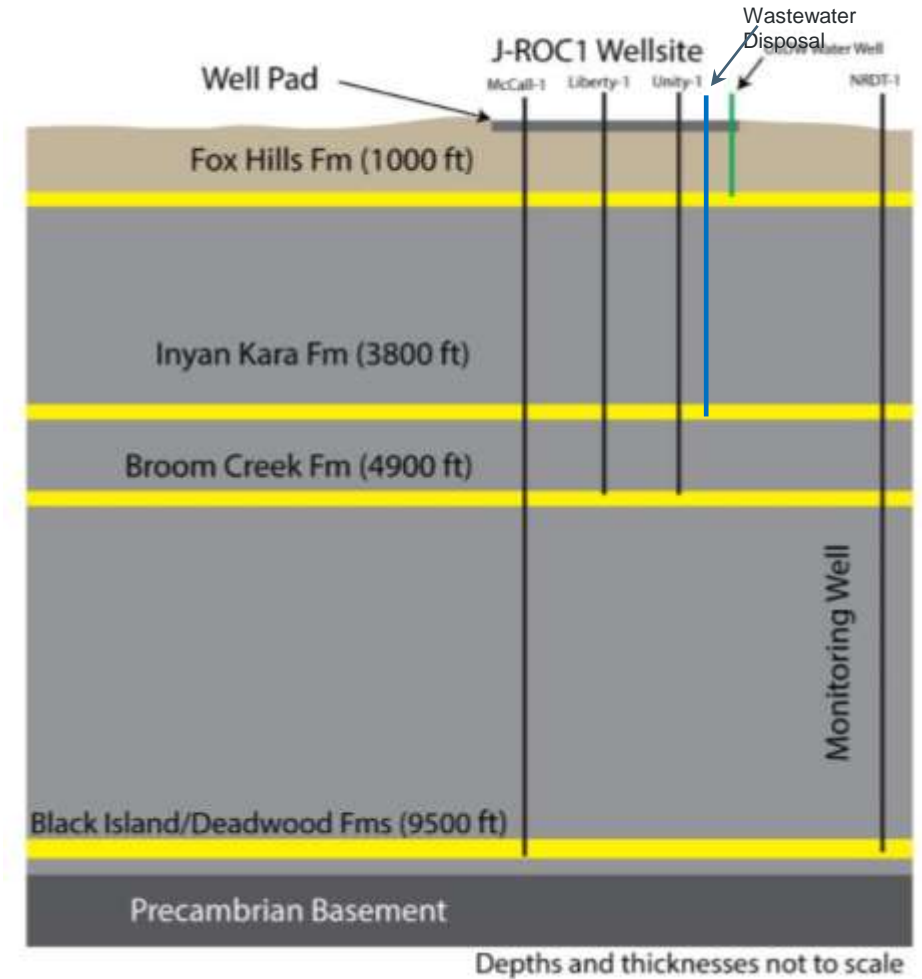
# Project Tundra Location





# Carbon Management Projects – Recent

- Tundra
  - FEED
    - ◆ Two injection wells into the Broom Creek Formation can inject 4 million tonnes CO<sub>2</sub>/year for at least 20 years.
    - ◆ One injection well into the Black Island/Deadwood interval (contingency target up to 1 million tonnes CO<sub>2</sub>/year).
- One monitoring well that extends to the Black Island/Deadwood (NRDT-1).
- USDW monitoring well in the Fox Hills Formation.
- One Class I wastewater disposal well into the Inyan Kara Formation.



# Lignite Research Program Carbon Management Projects



## **PCOR Initiative to Accelerate CCUS Deployment**

This project provides a continuation of the PCOR program to help address challenges and opportunities for commercial CCUS in the region.

Lead: Kevin Connors, EERC (UND)



## **Project Tundra**

Front End Engineering and Design (FEED) study for carbon capture utilization and storage at the Milton R. Young Station.

Lead: Gerry Pfau, Minnkota Power

Final report under review and includes associated Carbon SAFE storage evaluation.



## **Project Tundra CREST Study**

Construction readiness evaluation that also includes evaluation of opportunities to improve the process economics and operation.

Lead: Craig Bleth, Minnkota Power



## **Preliminary Front End Engineering and Design (pre-FEED)**

Study for a full-scale carbon dioxide capture system at Coal Creek Station (CCS2) – Initial investigation of the potential for CCUS at Coal Creek through a pre-FEED study and includes investigation of the storage geology.

Lead: John Bauer, Rainbow Energy – Completed FEED study is ongoing under the CSEA Program

# Lignite Research Program

## Rare Earth Elements and Critical Minerals

**Rare Earth Element Extraction and Concentration at Pilot-Scale from North Dakota Coal-Related Feedstocks – Phase 3** – Directed at demonstrating novel technology for rare earth element recovery from North Dakota lignite coal feedstocks at the pilot scale. Lead: Nolan Theaker, UND Institute for Energy Studies

**North Dakota Rare Earth and Critical Element Resource Evaluation** – This project targets a better understanding of the North Dakota rare earth element and critical mineral resource. Lead: Steven Benson, MTI

**Williston Basin CORE-CM Initiative** – Focused on the expansion and transformation of coal and coal-based resource utilization within the Williston Basin to produce Rare Earth Elements, Critical Minerals and Non-fuel Carbon Products. Lead: John Kay, EERC

**Production of Germanium and Gallium Concentrates for Industrial Processes** – Targets Germanium and Gallium removal and concentration, integrated into the UND IES REE recovery process. Lead: Steven Benson, MTI

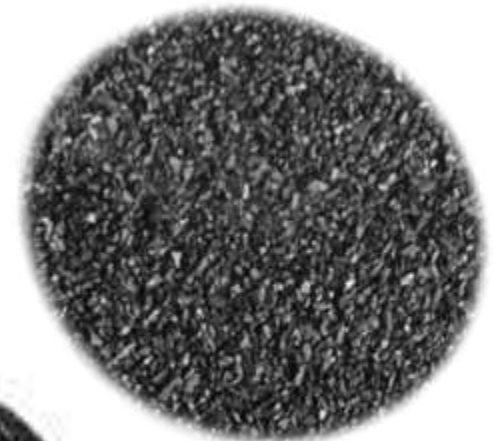
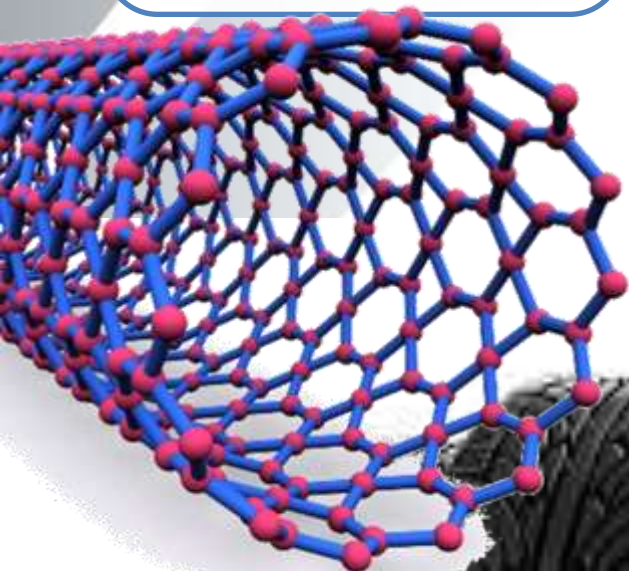
# Lignite Research Program Carbon Materials

**Laboratory-Scale Coal-Derived Graphene Process** – Development of a technological process for converting North Dakota Lignite into high-value solid carbon products such as graphene. Lead: Alexander Azenkeng, EERC (UND)

**Advanced Processing of Coal and Coal Waste to Produce Graphite for Fast-Charging Lithium-Ion Batteries** – Follow on EERC project, Alexander Azenkeng.

**Lignite Derived Carbon Materials for Lithium-Ion Battery Anodes** – Develop and demonstrate an economic process for production of advanced composite anode materials for lithium-ion batteries using lignite. Lead: Xiaodong Hou, UND Institute for Energy Studies

**ND Lignite Coal-Based Pitch for Production of High Value Carbon Products** – Use of Lignite to produce coal pitch for use in carbon materials such as graphene, asphalt, tires, ... Lead: David Berry, AmeriCarbon Products, LLC.



# Lignite Research Program Building Materials Projects

Semplastics EHC LLC



Artist's conception of coal building proof-of-concept design by CART

**Systematically Applied Research to Develop High Value Products from Coal –** Development of new improved building materials out of lignite-based resources.

Lead: Bill Easter, Semplastics

**Incorporation of Coal and Coal Waste Into High-Value Materials –** Follow-on of Semplastics project for development of new improved building materials out of lignite-based resources. Leading toward a demonstration structure.

Lead: Bill Easter, Semplastics

**Development of Novel Sintered Coal Building Materials –** Microbeam Technologies Incorporated (MTI) approach to making building materials from coal Feedstocks.

Lead: Matt Fuka, MTI

# Strategic Studies

Regional Haze Studies –  
MTI, AECOM, &  
Troutman Pepper

MISO and SPP Impacts  
and Strategies

NDGS Evaluation of REE  
Resource in ND

Evaluation of Demand  
Growth / Update 2023  
- Barr

Forecast of EV Impacts  
on regional demand  
and the grid

Next Generation Lignite  
Power Options

NDSU Economic Impact  
(2022) – Public Affairs

Others to be identified  
jointly between  
industry and the  
Industrial Commission

Regional Economic  
Impact of CCUS (TBD)

Evaluation of ESG  
Impacts on Lignite  
(TBD)

Coal to Hydrogen  
(TBD)



# Strategic Study - EPP

The Unquestionable Success of the Petra Nova  
Carbon Capture Utilization & Storage (CCUS)  
Demonstration Project

10/16/2022



# Petra Nova CCUS White Paper (Preliminary Findings)

- Petra Nova is an oil company that performed a CCS demonstration.
- The demonstration was a success in terms of schedule, budget, meeting guarantees, and with lower emissions and water use than expected.
- The decision to suspend operation was because the oil company was not profitable during the time of depressed oil prices.
- The project was not designed with a geologic storage backup option and there was no 45Q credit available to generate revenues outside of oil sales.



# Petra Nova CCUS White Paper (Preliminary Findings)

- The Petra Nova project was on time, under budget, and achieved nearly all its central demonstration objectives.
- Despite the use of partial information by CCS opponents to argue failure, the project results tell a story of success.



# Some of the Petra Nova CCS Project Myths Versus the Facts



- *Petra Nova did not achieve its target of 90% capture*
  - **The system averaged 92.4% capture over the full 3 years.**
- *The mothballing of Petra Nova highlights the financial risks that others will face*
  - **The only thing that is highlighted is the risk of relying on a volatile commodity market.**
- *Petra Nova is indefinitely mothballed.*
  - **There was a recent announcement by JX Nippon Oil & Gas Exploration to buy an additional 50% stake and operations are expected to restart very soon.**
- *Capacity, Costs ...*



# Resilience of the Electric Grid in North Dakota

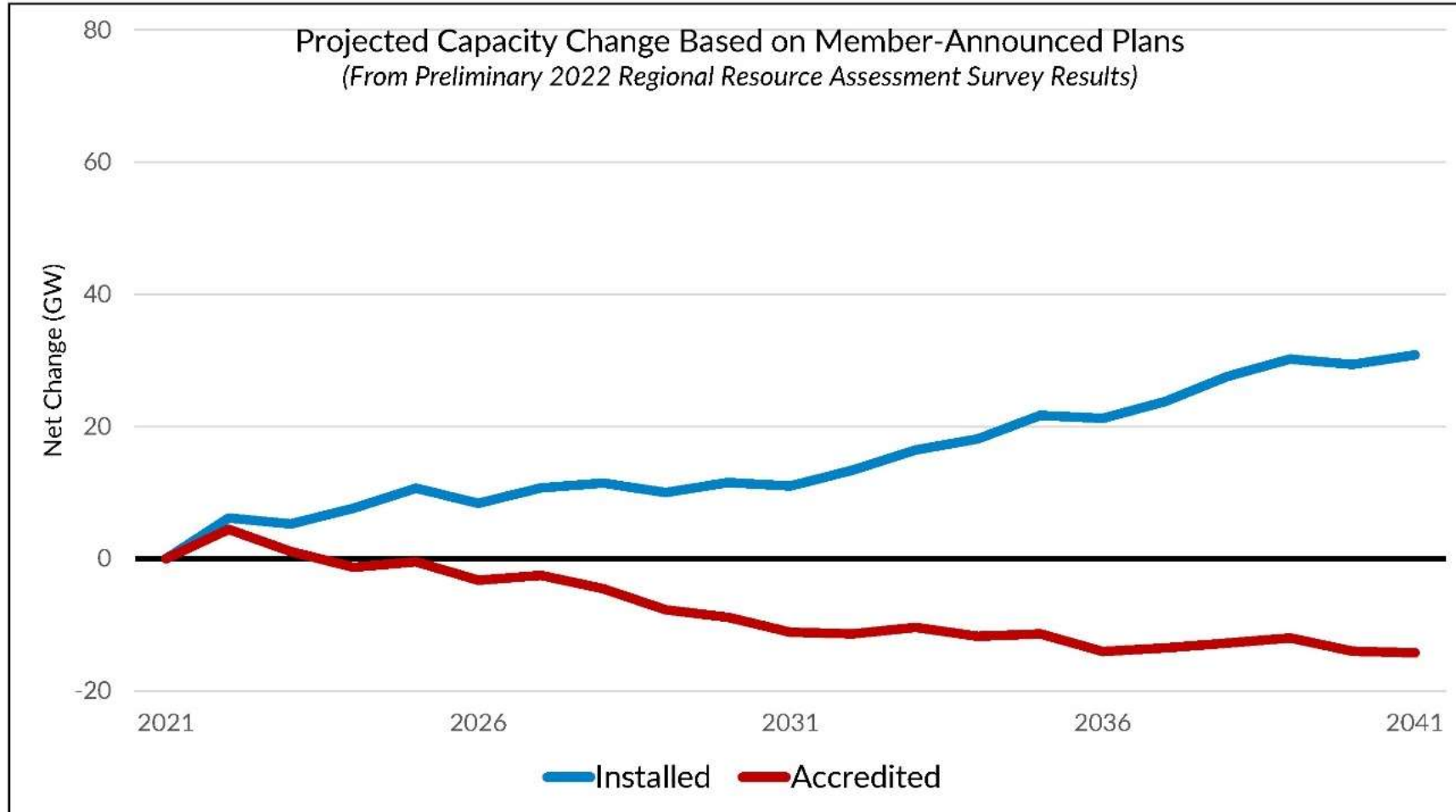


John Weeda & Claire Vigesaa

North Dakota

Transmission Authority

## ...accredited capacity is declining due to the rapid pace of retirements of controllable resources





# Questions & Strategy Discussion