INDUSTRIAL COMMISSION OF NORTH DAKOTA

Doug Burgum
Governor

Drew H. Wrigley
Attorney General

Doug Goehring
Agriculture Commissioner

Friday, July 28, 2023, 9:00 am
Bank of North Dakota 3rd Floor Conference Room or Microsoft Teams
1200 Memorial Highway, Bismarck, ND 58504
Join on your computer or mobile app
Click here to join the meeting
Or call in (audio only)
+1 701-328-0950,,502714424#

I. Joint Meeting of the Industrial Commission and the Bank of North Dakota Advisory Board Regarding Bank of North Dakota Business

A. Introduction of Bank of North Dakota Advisory Board Members – Todd Steinwand, Karl Bollingberg (Attachment 1)
B. Report on Bank of North Dakota Recruitment and Retention Study – Karl Bollingberg
C. Discussion on Role of Advisory Board in Bank of North Dakota Executive Succession Planning – Karl Bollingberg
D. Report on Bank of North Dakota ESG Study – Todd Steinwand (Attachment 2)
E. Presentation of College SAVE Audit Report – December 31, 2022 – Rob Pfennig (Attachment 3)
F. Presentation of Second Quarter 2023 Performance Highlights – Todd Steinwand (Attachment 4)
G. **Consideration for Approval of Amendments to General Loan Policy** (Attachment 5) - Kirby Evanger, Kelvin Hullet
H. Presentation of April 19 and May 17, 2023 Non-confidential Finance and Credit Committee Minutes (Attachment 6)
I. Presentation of April 20, 2023 Non-confidential Audit and Risk Management Committee Minutes (Attachment 7)
J. Presentation of May 18, 2023 Non-confidential Leadership Development and Compensation Committee Minutes (Attachment 8)
K. Presentation of April 20 and May 18, 2023 Non-confidential Advisory Board Committee Minutes (Attachment 9)
L. Other Bank of North Dakota business

Meeting Closed to the Public for Bank of North Dakota Executive Session Pursuant to NDCC 6-09-35, 44-04-18.4, 44-04-19.1 and 44-04-19.2

(approximately 10:00 a.m.)

II. Bank of North Dakota Executive Session

A. Report of one loan application – Craig Hanson (Confidential Attachment 10)
B. Presentation of Non-Accrual Loans Quarterly Report – Kirby Evanger (Confidential Attachment 11)
C. Presentation of Problem Loans – Adversely Classified Quarterly Report – Kirby Evanger (Confidential Attachment 12)
D. Presentation of Loan Charge-Offs and Recoveries Year-to-Date as of June 30, 2023 – Kirby Evanger (Confidential Attachment 13)
E. Presentation of Off-Balance Sheet Risk Quarterly Report – Kirby Evanger (Confidential Attachment 14)
F. May 17, 2023 Confidential Finance and Credit Committee Minutes (Confidential Attachment 15)
G. May 18, 2023 Confidential Advisory Board Committee Minutes (Confidential Attachment 16)
H. Other Bank of North Dakota Confidential Business as defined by NDCC 6-09-35

Meeting Returns to Public Session

(approximately 10:20 a.m.)

III. North Dakota Department of Mineral Resources – Lynn Helms

A. **Consideration of the following cases:**
   i. **Order 32652 for Case 30043** regarding a petition of Foundation Energy Management, LLC for an order to unitize and operate the Camel Hump-Red River Unit located in Golden Valley County, ND (Attachment 17)
   ii. **Order 32653 for Case 30044** regarding a petition of Foundation Energy Management, LLC for an order to determine that the Unit Agreement and Unit Operating Agreement for the Camel Hump-Red River Unit have been signed, ratified, or approved by the required percentage of lessees and royalty owners (Attachment 18)
B. Update on Litigation*:
   i. Case No. 31-2020-CV-0018 - Northern Oil and Gas, Inc. vs. Continental Resources, Inc; Board of University and School Lands and ND Industrial Commission et al – Ordinary High Water Mark challenge

ii. Blue Appaloosa – appeal of Industrial Commission Order 31208
iii. Dominek v Equinor et al – allocation of production from overlapping spacing units
iv. Liberty Resources vs. NDIC et al – appeal of Industrial Commission Order 31792
v. North Dakota Industrial Commission v. U.S. Department of Interior – quarterly lease sales
vi. Northwest Landowners vs. NDIC et al

C. Update on Dakota Access Pipeline Environmental Impact Statement cooperating agency comments
D. Update on EPA Section 111 GHG/Carbon Rule – deadline extension request letter, cooperating agency comments
E. Other Department of Mineral Resources business

* Possible Executive Session under N.D.C.C. 44-04-19.1(9) & 44-04-19.2 for attorney consultation

(approximately 11:00 a.m.)

IV. North Dakota Pipeline Authority – Justin Kringstad

A. Pipeline Authority Midstream Update (Attachment 19)
B. Other Pipeline Authority Business

(approximately 11:30 a.m.)

V. North Dakota Transmission Authority – John Weeda and Claire Vigesaa

A. Report on Midcontinent Independent System Operator (MISO) and Southwest Power Pool (SPP) Resource Adequacy Studies (Attachment 20)
B. **Consideration of authorization to contract with EERC for administrative services related to IIJA Grid Resilience grant** – Reice Haase (Attachment 21)
C. **Consideration of appointment of Claire Vigesaa as Director of the North Dakota Transmission Authority – Karen Tyler** (Attachment 22)
D. Other Transmission Authority Business

(approximately 12:00 p.m.)

VI. North Dakota Oil and Gas Research Program – Reice Haase

A. Presentation of the Oil and Gas Research Program Project Management and Financial Report (Attachment 23)
B. **Consideration of the Oil and Gas Research Council recommendations for Grant Round 58 applications:**
   i. **G-058-01 ONEOK, Inc.: Roughrider Carbon Storage Hub, $525,000** (Attachment 24)
   ii. **G-058-02 Cobra Oil and Gas: Maximizing Production from Residual Oil Zones in Western ND, $2,000,000** (Attachment 25)

iii. **G-058-03 EERC: Bakken Production Optimization Program 4.0, $4,000,000** (Attachment 26)

C. **Consideration of Oil and Gas Research Council recommendations for the following contract:**
   i. **G-050-096 EERC: PCOR Initiative to Accelerate CCUS Deployment – Authorization of next increment of funding in the amount of $500,000** – Charles Gorecki (Attachment 27)

D. Other Oil and Gas Research Program business

(approximately 12:20 p.m.)

VII. Clean Sustainable Energy Program – Reice Haase

A. Presentation of the Clean Sustainable Energy Program Project Management and Financial Report (Attachment 28)

B. **Consideration of the following Grant Round 4 applications:**
   i. **C-04-A Bushel, Inc.: Bushel Farm Traceability Dashboard, $3,500,000 grant** (Attachment 29)
   ii. **C-04-D Minnkota Power Cooperative: Project Tundra, $150,000,000 loan** (Attachment 30)
   iii. **C-04-E Newlight Technologies, Inc.: Project Phoenix, $30,000,000 loan** (Attachment 31)
   iv. **C-04-F Rainbow Energy Center: Lignite Combustion Product Enhancements, $42,500,000 loan** (Attachment 32)
   v. **C-04-G WellSpring Hydro: Unlocking the Full Potential of Produced Water, $5,000,000 grant** (Attachment 33)

C. Other Clean Sustainable Energy Program business

(approximately 12:40 p.m.)

VIII. Lignite Research, Development and Marketing Program – Mike Holms

A. Presentation of the Lignite Research, Development and Marketing Program Project Management and Financial Report – Reice Haase (Attachment 34)

B. **Consideration of Lignite Research Council recommendations for the following contracts:**
   i. **LMFS-22-43 LEC: Enhance, Preserve and Protect the ND Lignite Industry (EPP) – Amendment to increase funding by $204,418 and task changes** (Attachment 35)
   ii. **FY20-91-226 EERC: PCOR Initiative to Accelerate CCUS Deployment - Authorization of next increment of funding in the amount of $500,000** (Attachment 36)

C. Other Lignite Research, Development and Marketing Program Business

(approximately 12:50 p.m.)

IX. North Dakota Mill and Elevator – Karen Tyler

A. Report on Profit Transfer FY 2023 (Attachment 37)

(approximately 12:55 p.m.)

X. Office of the Industrial Commission – Karen Tyler

A. **Consideration of the June 29th, 2023 Industrial Commission meeting minutes** (Attachment 38)
B. Other Office of the Industrial Commission business

(approximately 1:00 p.m.)

XI. Adjournment

Next Meeting – September 7th, 2023
Governor's Conference Room, Bismarck, ND

Bank of North Dakota Advisory Board Members

Karl Bollingberg, *Chair*

Karl Bollingberg has served as loan participation advisor of Alerus Financial in Grand Forks, North Dakota since 2018. In this position, Mr. Bollingberg is responsible for building a specialized line of business for Alerus in North Dakota and across the upper Midwest.

Prior to accepting this position, he served as director of lending from 2016 to 2018, as well as various other roles at Alerus since 1987. Bollingberg worked for U.S. Bank, N.A. from 1985 to 1987.

Known for his community involvement, Bollingberg is active in a number of organizations including board member and past chair for the Regional Economic Development Corporation, board member, vice chair and chair for the Bank of North Dakota Advisory Board, board member and past chair of the Regional Airport Authority, and campaign chairperson for the Community Violence and Intervention Center Shelter Project.

He earned his bachelor's degree in agricultural economics from North Dakota State University and completed the Louisiana State University School of Banking in 2000.

Dennis Johnson, *Vice Chair*

Dennis W. Johnson is vice chair of Bank of North Dakota's Advisory Board and is Chairman and Chief Executive Officer of TMI Corporation. TMI, located in Dickinson, North Dakota, employs about 250 people.

He is a member of the board of directors of MDU Resources Group Incorporated, currently serving as Chair of the Board. In addition to his participation on the Bank of North Dakota Advisory Board, he is a past director of the Federal Reserve Bank of Minneapolis. He twice chaired the Dickinson State University Presidential Search Committee and chaired Governor John Hoeven's transition team in 2000.

Johnson served as President of the Dickinson City Commission from June 2000 through October 2015. He was twice named the Outstanding City Elected Official of the year by the North Dakota League of Cities.

Johnson is a native of Tioga, North Dakota. He is a graduate of North Dakota State University with a Bachelor of Science degree in electrical engineering and a Master of Science degree in industrial engineering. He joined TMI in 1974 as an industrial engineer, becoming President in 1982 and in 1985 majority stockholder, Chairman, and CEO.

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Pat Clement, *Board Member*

Pat Clement retired from BND Coal, Inc. in 2016 after 41 years with the company. As their Secretary-Treasurer, she managed the finance, accounting, purchasing, inventory and information technology departments.

During her years at BNI Coal, they financed millions of dollars in heavy equipment including an 8200 dragline. These transactions were analyzed and either financed through operating leases or capital purchases. Clement was also responsible for the $30 million employee pension fund and the employe health benefit trust fund.

A native of Garrison, North Dakota, Clement earned a degree in Business Education with a concentration in accounting at the University of North Dakota. She extended her education to include more classes in accounting, banking, finance and economics at the University of North Dakota and the University of Mary.

Clement served as a member of the Workforce Safety and Insurance Board for six years, and was a board member of the YMCA Board of Directors. Today, she still serves ands a YMCA Trustee.

Brenda Foster, *Board Member*

Brenda Foster began her banking career in 1981 with First Western Bank & Trust in bookkeeping and continued to prove her value through the years. After a series of promotions, she was named president and chief executive officer in 2016 and chairman of the board in 2017.

A Minot native, she has a Bachelor of Science degree with an emphasis in banking and finance from Minot State University.

Foster is known for her professional and community involvement. She has served on the board of directors for the 9th District Federal Reserve and the North Dakota State Banking Board, the Independent Community Banks of America Policy Development Committee, a board member for the Independent Community Banks of North Dakota, member and past chair of the Minot State University Board of Regents, and Junior Achievement instructor in addition to Bank of North Dakota's Advisory Board.

She has received many honors including 2022 Banker of the Year by BankBeat Magazine, 2021 Independent Community Bankers Distinguished Banker Award and 2020 Top 25 Women in Business by Prairie Business magazine.

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Christie Obenauer, *Board Member*

Christie Huber Obenauer is CEO and President of Union State Bank, Hazen, North Dakota

Obenauer was born and raised in Hazen, North Dakota. After graduating from St. Olaf College in Northfield, Minnesota, she began her banking career at what was then Norwest Bank in Fargo. She worked for a regional bank in the Boise market before moving back to her hometown of Hazen in 2002, where she continued her banking career at her family's community bank, Union State Bank.

Christie is the fourth generation in her family to lead their over 115-year-old institution. She is active in many local, state-level, and regional boards and committees involving banking and business, including the North Dakota Bankers Association, the Bank of North Dakota, Graduate School of Banking – Colorado, American Bankers Association, Sakakawea Medical Center, and Mercer County Community Foundation. She is passionate about community banking, relationships, her community and her state.

Bill Price, *Board Member*

Bill Price is a fourth generation native North Dakota rancher and farmer. He has been the managing partner of Price Cattle Ranch LLP and the managing partner of Missouri River Feeders LLP, a permitted feed yard and diversified farm, for many years.

Price is a board member of Eco Balance Global LLC. He is a founding member and sits on the Board of Governors of Red Trail Energy, which is a 55-million-gallon ethanol plant located in Richardton, ND. Additionally, Price is also one of the founding partners and Governors of North Dakota Sow Center which is a 10,000 head isowean facility.

In addition to being on the Bank of North Dakota Advisory Board, he has served as Chairman for the North Dakota Feeder Council and is a member of the North Dakota Stockmen's Association and National Cattlemen's Beef Association.

Bill was educated in Center, North Dakota and attended college at North Dakota State University.

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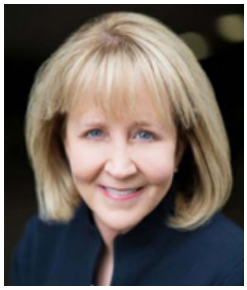


Jean Voorhees, *Board Member*

Jean Voorhees is currently the Head of Global Product Management for Conveying Solutions, Continental AG.

A native of Cavalier, ND, Voorhees holds a bachelor's and master's degree in Agricultural Economics and Agribusiness from North Dakota State University. She has 30+ years of international experience working with leading equipment manufacturers in the agriculture, construction, and mining industries including Bobcat, Caterpillar, and WCCO Belting.

Voorhees has held leadership roles in strategic marketing, product development, sales, and M&A. She is currently the Head of Global Product Management for Conveying Solutions, Continental AG. She has also served on various community and charitable boards.

North Dakota ESG Study Steering Committee

Thursday, July 27, 2023 - 9 a.m.

Meeting Location
Basin Electric 1717 E Interstate Ave, Bismarck, ND
Conference Room - East 4 Wyoming

Virtual Option
Teams Meeting Link

Dial In Number
1-323-406-1564 Conference ID: 251 592 373#

Agenda

- Welcome & Introductions
- Committee Administration
- SWOT Analysis
- Areas of Focus
- Next Steps & Feedback
- Future Meeting Dates

Kick-off Meeting Purpose, Scope & Deliverable

Purpose

The 2023 North Dakota Legislature outlined an ESG study to be completed by June 1, 2024. The focus will be on trends, laws and policies that impact businesses and industries in the state. Primary industries include energy, agriculture, insurance, investments, economic development, contracting and finance.

The Steering Committee represents members of state government, private industry and non-profit organizations that are navigating ESG.

Scope

Steering committee members will share insights to direct the outcome of the ESG study to ensure that industries in North Dakota can capitalize on ESG trends, laws and policies that will strengthen the economy and enhance quality of life for North Dakota citizens, and to mitigate identified risks.

Deliverables

BND will author, in collaboration with stakeholders representing state government, private industry and non-profit organizations, to create a dynamic report outlining industry-specific public policy strategies for immediate and long-term implementation to help the state continue to be a global leader in energy and agriculture.

Terminology

Environmental, Social and Governance (ESG)

ESG is a framework for risk evaluation based on environmental, social and governance practices. ESG metrics are quantitative, long term and can be subject to public disclosure. ESG strategies are complex and require measurable goals, specialized data collection and analysis.

As of now, there is no legal definition of ESG. For continuity when discussing ESG, the steering committee will use the definitions outlined below:

Environmental: The measurement of environmental impact and sustainability of a particular company and industry. Reporting areas include greenhouse gas emissions, material disposal, resource management, efficiency, sustainability practices, and future environmental goals.

Social: How a company interacts with and impacts employees, customers, suppliers, and communities.

Governance: How the company is governed at the top levels. Some areas of interest include executive compensation, corruption, conflicts of interest, and transparency.

Sustainability

Fulfilling the needs of current generations without compromising the needs of future generations, while ensuring a balance between economic growth, environmental stewardship and social well-being.

Ground Rules

There are a few ground rules that we want to adhere to in order to maximize our time together in this hybrid meeting.

Be Here Now

Please do not use electronic devices during the meeting. Keep your camera on throughout the meeting if you are online.

Silence or Absence is Agreement

Your opinion and experiences are important, it is your responsibility to share them with the committee. When silent, it indicates that you will support the topic discussed and that you will not lose any sleep over it.

Consensus means “I can live with it”

Your specialty area may be in conflict with other members of the steering committee. We are NOT defining consensus as everyone’s favorite or top choice;
We are facilitating to a standard that everyone can professionally support. Participants agree they will NOT try to undermine the results after the meeting ends. We strive to build agreement that is robust enough to be considered valid by everyone. No one should lose any sleep over the results. Remember, however, it may not be their ‘favorite’ course of action.

Make Your Thinking Visible

Be specific and objective when communicating. When people are vague other members can make assumptions based on personal opinion or bias. To one person the room may be hot, but to another person the room is cold. Specifically, the room temperature is 72 degrees.

Topic Parking Lot

The time we have together is limited. If a topic needs further focus it will be documented in the Parking Lot. Topics may be explored more in depth at the workgroup level.

Steering Committee Members

Co-Chairs

Charlie Gorecki, *Chief Executive Officer*
Energy & Environmental Research Center (EERC)

Charlie is CEO of the EERC. With 15 years of service to UND, he leads a multidisciplinary science, engineering, and support team of over 270 people who focus on research and development (R&D) leading to demonstration and commercialization of innovative energy and environmental technologies. The EERC, with its long tradition of fossil fuel-related R&D, has broadened its scope to include a wide array of strategic energy and environmental issues. Charlie oversees efforts to address these issues through strategic initiatives focused on clean coal technologies; oil and gas industry technologies; carbon capture, utilization, and storage (CCUS); energy and water sustainability; air toxics and fine particulate control; water management strategies; global climate change; waste utilization, hydrogen technologies; and contaminant cleanup.

Kelvin Hullet, *Senior Vice President of Business Development*
Bank of North Dakota

Kelvin Hullet currently serves as the Senior Vice President of Business Development at the Bank of North Dakota. In his role, Kelvin leads the Bank's oversight of Legislative directed programs, economic development financing and the student loan division. Prior to BND, Kelvin served as the president of the Bismarck-Mandan Chamber for 13 years.

Project Lead

Kayla Ver Helst, Sustainability Officer
Bank of North Dakota

Kayla joined the Bank of North Dakota, the only state-owned bank in the U.S. whose mission is to deliver quality, sound financial services that promote agriculture, commerce and industry. As the bank's first Sustainability Officer, Kayla is leading a diverse team of stakeholders as part of a legislatively directed ESG study to identify trends, laws and policies that impact businesses and industries across the state. When completed, this study will create the foundation for future policy strategies to continue to define North Dakota as a global leader in agriculture and energy. Kayla has over 15 years of experience in various government relations, business development and public affairs roles.

North Dakota State Legislators

Anna S. Novak, *Representative*
R – District 33

Anna was elected as a North Dakota state Representative in 2022 representing District 33. During her first session she served on the Education and Energy and Natural Resources standing committees and is a member of the School Funding Task Force and Water Topics Overview interim committees. She is the co-founder of Faces of North Dakota Coal, which is a grassroots advocacy group to humanize the hardworking people in the coal industry. Anna is a licensed stockbroker and insurance agent at Choice Wealth.

Dale Patten, *Senator*
R – District 26

Dale Patten is presently serving in the North Dakota Legislature as State Senator from District 26. His committees are the Finance and Tax Committee and the Energy and Natural Resources Committee where he presently serves as chair. His interim committee assignments are the Energy Development and Transmission Committee and the State and Tribal Relations Committee where he serves as vice-chair. He also serves as the co-chair of the Clean Sustainable Energy Authority, as well as being a member of the Tax Relief Task Force, the Energy Council, the Lignite Research Council, the ESG Study Steering Committee, the NDSU FARMS Engine Governance Board, High-Level Radioactive Waste Advisory Committee, the NDSU Animal Science Education Foundation and is the Vice Chair of the Mountrail McKenzie Human Service Zone Board. Prior to being elected, Dale was the President at McKenzie County Bank and Market President for Cornerstone Bank.

State Government Elected Representatives

Doug Goehring, *Commissioner*
North Dakota Department of Agriculture

A third-generation farmer, Commissioner Goehring and his son, Dustin, operate a 2,800-acre, no-till farm near Menoken in south central North Dakota where they grow a variety of crops. Beyond his responsibilities to North Dakota's agriculture industry and research, his portfolio as commissioner includes energy, water, trade, business development, tax equalization, and infrastructure.

Jon Godfread, *Commissioner*
North Dakota Insurance Department

Jon was elected North Dakota's 22nd Insurance Commissioner in 2016 and re-elected in 2020. In service to the citizens of North Dakota, he has prioritized consumer advocacy, ensuring North Dakotans are better aware of the services offered by the North Dakota Insurance Department beyond industry regulation. He has also worked to restructure the Insurance Department for efficient and effective use of tax-payer dollars, along with better utilization of staff talents. On a national level, Jon has been an active voice in discussions about insurance regulations including the use of technology, air ambulance service, and health care reinsurance.

Randy Christmann, *Commissioner*
North Dakota Public Service Commission

Randy Christmann was elected to the North Dakota Public Service Commission in November 2012 and re-elected in. He brings to the Commission a background in agriculture, telecommunications, and energy industry background to the Public Service Commission. He has led the effort to implement rules for future decommissioning and reclamation of wind farms and solar farms, serves as a PSC representative on the Lignite Research Council, and serves as a PSC representative for the multi-state Southwest Power Pool. He is the current chair, and his portfolios include Business Operations; Coal mining, reclamation, and abandoned mine lands; Auctioneer and Auction Clerk Licensing; Telecommunications; and SPP/RSC.

Tammy J. Miller, *Lieutenant Governor*
State of North Dakota

Tammy was sworn in as the 39th lieutenant governor of North Dakota on Jan. 3, 2023. She served as chief operating officer in the Governor's Office working with cabinet agencies to enhance citizen focus, drive innovation and improve the delivery of government services. She previously served as CEO of Fargo-based Border States, the sixth-largest electrical distributor in North America.

As lieutenant governor, Tammy serves as president of the state Senate and chairs the Capitol Grounds Planning Commission, North Dakota Trade Office, Task Force for Military Issues in North Dakota, Northern Plains Unmanned Systems Authority, State Investment Board, State Board of Equalization and Early Childhood Council.

Thomas Beadle, *Treasurer*
North Dakota State Treasurer

Treasurer Thomas Beadle was elected in 2020 to serve as North Dakota's 34th State Treasurer. Thomas has a background in commercial real estate investment and brokerage. He previously served as a State Representative for North Dakota's 27th district from 2010-2020, serving on numerous committees, including the Appropriations committee, and focused on expanding our economy, developing our workforce and bringing new technologies to our region.

State Government Appointed Representatives

Claire Vigesaa, *Director*
North Dakota Transmission Authority

Claire serves as Director of the North Dakota Transmission Authority where he monitors electric transmission grid activities and provides support and information to ND Agencies, utilities, and developers with transmission related topics. Prior to state government, Claire's career included working at Verendrye Electric Cooperative, Northern Plains Electric Cooperative, Cass County Electric Cooperative. With those companies, he developed load management programs, served as rate and billing manager, managed public & member relations, key accounts, economic development programs, and served as chief lobbyist. Later in his career he helped a special task force at Tri-State G & T Association in Denver, to facilitate the transfer of 100 kV plus assets from its member systems to the G & T. Claire was named General Manager/CEO of Upper Missouri Power Cooperative and saw the cooperative quadruple electric energy sales, became a transmission owner in MISO and he participated in the submission of transmission assets in the Southwest Power Pool.

Dave Glatt, *Director*
North Dakota Department of Environmental Quality

Dave is the director of DEQ, which implements protective programs and standards to help maintain and improve environmental quality. He has more than 40 years of environmental protection experience serving in leadership roles pertaining to environmental health, waste management, consolidated laboratories, water quality, ground water protection and has overseen EPA Superfund projects. Dave is a member of the Oil and Gas Caucus with the Environmental Council of the States and serves on the Environmental Protection Agency Small Communities Advisory Subcommittee, the International Red River Watershed Board, and the International Souris River Board.

Jan Murtha, *Executive Director*
North Dakota's Retirement and Investment Office (RIO)

Jan serves as the executive director of RIO, which is responsible for the administration of an investment program overseen by the State Investment Board (SIB) and a pension program overseen by the Teachers' Fund for Retirement (TFFR) Board of Trustees. SIB currently has assets under management in excess of $19 billion. Its largest client fund being a sovereign wealth fund known as the Legacy Fund. More than 24,000 educators participate in TFFR's retirement program. The majority are active members employed by public schools and state institutions.

Lynn Helms, *Director*
North Dakota Department of Mineral Resources

Lynn Helms grew up on a cattle ranch in Harding County South Dakota where he learned the benefits of agriculture, prairie ecology, resources, and conservation. His work in the oil industry began as a roughneck working holidays and summers during college and has taken him all over the world. Lynn has served as Director of the Department of Mineral Resources since it was formed in July 2005. Before moving to Bismarck to work in state government, he worked as a production engineer, reservoir engineer, and asset team leader on projects in Abu Dhabi, Alaska, Arkansas, Louisiana, Mississippi, Montana, New Mexico, North Dakota, Texas, and Wyoming.

Reice Haase, *Deputy Director*
North Dakota Industrial Commission

Reice is the Deputy Director of the North Dakota Industrial Commission, which oversees various state agencies and over $250 million in energy research projects. During the course of his career, he has served as an environmental consultant and energy client lead for projects across the upper Midwest and Canada, and most recently served as Senior Policy Advisor to Governor Doug Burgum. His experience includes policy issues related to agriculture, energy, natural resources, tribal affairs, and emergency services. He has also supported private sector clients with Phase I and II Environmental Site Assessments, radioactive materials licensing, Class I, II, and V underground injection well permitting, Natural Resource Damage Assessments, and NEPA projects. He is a member of the Interstate Oil and Gas Compact Commission's Legal and Regulatory Affairs Committee where he served as Chairman from 2021-2023 and is a former North Dakota delegate on the International Lower Pembina River Basin Advisory Board.

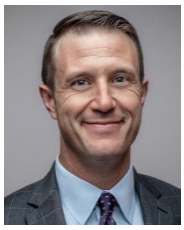
Tom Oakland, *Energy Research & Development Manager*
North Dakota Department of Commerce

In November 2021, Tom began his role as the Energy Research and Development Manager with the North Dakota Department of Commerce. Starting in December 2022, Tom continued to manage energy related economic development with Commerce as the Manager of the newly established Energy and Economic Coordination Office within the Economic Development and Finance Division. Tom is actively working with industry leadership and new and expanding businesses to expand the landscape of North Dakota Energy.

Private Industry Representatives

Ashley Zickefoose, *Director of Environmental, Safety & Health*
ONEOK

Ashley is responsible for the development and implementation of ONEOK's corporate sustainability programs. She has been at ONEOK for 10 years and has held various roles including permitting and compliance for design, construction, and operation of pipelines and natural gas and natural gas liquids processing facilities. Ashley participates in ONEOK's annual United Way Campaign and is a business representative for the Indigenous/Native American Business Resource Group.



Blu Hulsey, *Sr. VP of Environmental, Safety & Health; Gov. & Reg. Affairs*
Continental Resources

Blu is responsible for strategic leadership of corporate HSE and ESG programs along with guiding corporate policy and regulatory initiatives. He is a past Chairman of the North Dakota Petroleum Council and currently serving as the Chairman of The Petroleum Alliance of Oklahoma. He also presently serves as a board member of the Domestic Energy Producers Alliance, Council for a Secure America, and The Oklahoma City National Memorial Museum.

Chris Kunkle, *Director of State Affairs*
Apex Clean Energy

Chris is the Director of State Affairs for Apex Clean Energy, a leading energy company that develops, constructs, and operates utility-scale wind, solar, and battery storage facilities across the country. Chris leads the company's government and regulatory affairs strategy and engagement across the Midwest region. In this role, Chris focuses on state policy and regulatory initiatives that facilitate the development of renewable energy, working with policymakers, energy regulators, and coalition partners to achieve these priorities.

Kathleen Neset, *President/Geologist*
NESET Consulting

Kathy is President of NESET, a company that provides well site geologic/geo-steering and engineering services to the oil industry. She has experienced the cyclical nature of the Bakken and Three Forks formations for more than four decades and has seen the acceleration of technology, which makes her one of the industry's greatest spokespersons to explain hydraulic fracturing. Kathy has served on the ND State Board of Higher Education, ND Petroleum Council Executive Board and as a board member for numerous higher education and community organizations.

Nick Martin, *Director of Strategy & Advocacy*
Xcel Energy

Nick serves as Director of Strategic Outreach & Advocacy for Xcel Energy, leading efforts to promote equity in the clean energy transition, including developing new partnerships with Black, Indigenous and People of Color (BIPOC) communities and Tribal nations; supporting resiliency, clean energy, and electrification projects; and advancing the Company's net zero greenhouse gas vision across electricity, buildings and transportation. He has served as an expert witness in Public Utilities Commission proceedings related to natural gas decarbonization, renewable energy, integrated resource planning, environmental externalities, and performance-based ratemaking.

Stephanie Barth, *Vice President, Chief Accounting Officer & Controller*
MDU Resources Group

Stephanie is the Vice President, Chief Accounting Officer and Controller for MDU Resources Group, Inc. (MDU). In addition to oversight of the company's SEC and Financial Reporting, internal controls, and income tax functions, she serves as the co-chair of MDU's executive sustainability committee, which supports execution of the company's environmental and sustainability strategy and establishes, maintains and enhances the processes, procedures and controls for the company's environmental and sustainability disclosures. Stephanie has been with the MDU family of companies for 27 years and is a CPA.

Todd Brickhouse, *Interim CEO & General Manager*
Basin Electric Power Cooperative

Todd Brickhouse joined Basin Electric Power Cooperative in June 2022 as its Senior Vice President and Chief Financial Officer and was named interim CEO and General Manager in July 2023. He got his start in the utility industry at Old Dominion Electric Cooperative in August 2000 and served as Old Dominion's Vice President and Treasurer from 2010 to 2022. He has extensive experience with raising capital, treasury management, strategic planning, risk management, stakeholder relations, financial reporting, and budgeting. Todd spent his early career in the financial services industry with a background in securities trading, investment banking, and investment management.

Non-Profit Representatives

Jason Bohrer, *President & Chief Economic Officer*
North Dakota Lignite Energy Council

Jason Bohrer's background as an attorney, a communications director for the Idaho Republican Party and as chief of staff to U.S. Rep. Raul Labrador (R-Idaho) provide a diverse skill set in his role as president and chief executive officer of the Lignite Energy Council. He is a graduate of North Dakota State University and earned his law degree from George Mason University. Prior to joining the Lignite Energy Council in 2013, Bohrer worked nine years in Washington, D.C.

Jesse Beckers, *Energy Program Manager*
North Dakota Natural Resources Trust

Jesse's main responsibilities include working with partners in the energy and agricultural livestock industries. Jesse has a graduate and undergraduate degree in natural resources management from North Dakota State University. He develops innovative projects, secures partnerships and funding, and delivers program success through professional presentations & communications. He has experience in grant writing and administration, partnership development, program management and delivery, habitat development, land reclamation, and environmental compliance. Most recently, Jesse manages a terrestrial carbon capture study involving several partners from multiple industries. Before coming to the Trust, Jesse worked as an environmental consultant in the oil and gas industry.

Ron Ness, *President*
North Dakota Petroleum Council

Ron Ness is President of the North Dakota Petroleum Council (NDPC). Over more than a 30-year career, with Ness's leadership and commitment to energy development, North Dakota oil production has increased from just over 80,000 barrels of oil per day to over 1.1 million barrels of oil per day. Ness has been instrumental in driving state energy policy and research including the Legacy Fund, Outdoor Heritage Fund, and the Clean Sustainable Energy Authority. In a position he has held since 1999, his primary function is governmental relations in North Dakota. He serves as the industry spokesperson and manages the association which represents more than 550 companies involved in all aspects of North Dakota's oil and gas industry.

Docket for Hearing
Friday, April 28, 2023
N.D. Oil & Gas Division N.D. Oil & Gas Division 1000 East Calgary Avenue

Case No. 30043, Order No. 32652: In the matter of the petition of Foundation Energy Management, LLC for an order of the Commission providing for the unitized management, operation, and further development of the Camel Hump-Red River Unit, located in Golden Valley County, ND; for approval of the Unit Agreement and the Unit Operating Agreement constituting the plan of unitization for the Camel Hump-Red River Unit; for approval of the plan of operation; for vacation of the applicable spacing order; and for such other and further relief as the Commission deems appropriate.

Docket for Hearing
Friday, April 28, 2023
N.D. Oil & Gas Division N.D. Oil & Gas Division 1000 East Calgary Avenue

Case No. 30044, Order No. 32653: In the matter of the petition of Foundation Energy Management, LLC for an order of the Commission determining that the Unit Agreement and Unit Operating Agreement constituting the plan of unitization for the Camel Hump-Red River Unit, Golden Valley County, ND, has been signed, ratified or approved by lessees and royalty owners owning the required percentage of working interest and royalty interest within said unit.

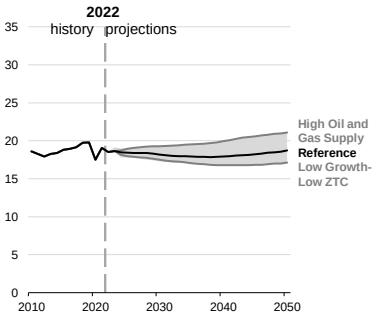
North Dakota Midstream Update

Justin J. Kringstad - North Dakota Pipeline Authority

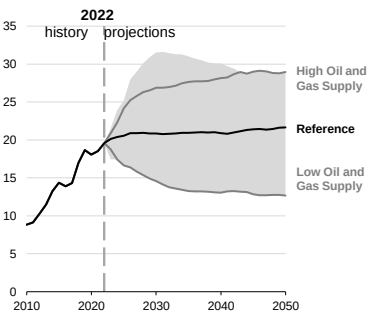
July 21, 2023

In all cases, we project that the United States will remain a net exporter of petroleum products through 2050

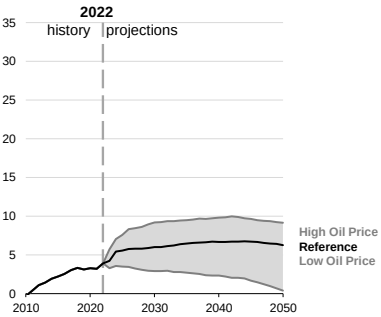
Petroleum and other liquids consumption
million barrels per day



Petroleum and other liquids production
million barrels per day

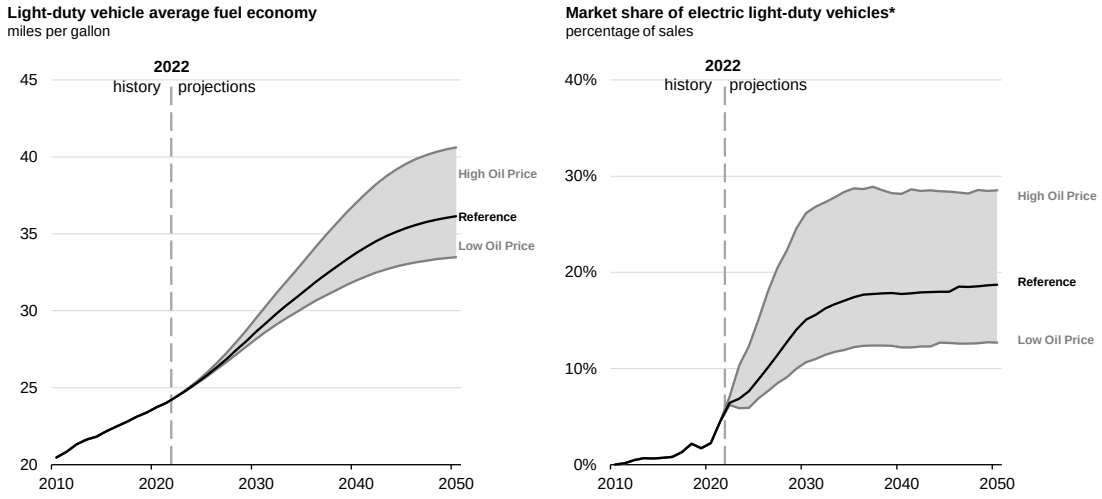


Petroleum products net exports
million barrels per day



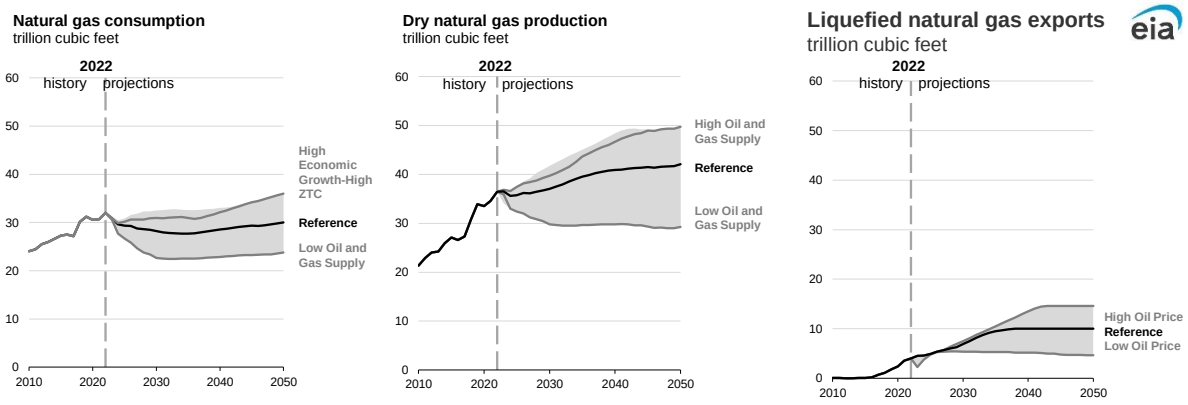
Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: Biofuels are not included in *petroleum and other liquids* production or consumption. Shaded regions represent maximum and minimum values for each projection year across the AEO2023 Reference case and side cases. ZTC=Zero-Carbon Technology Cost

Light-duty vehicle fuel economy and electric vehicle market share increase through 2050 due to rising CAFE Standards and other incentives



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: *Includes battery electric and plug-in hybrid electric vehicles. Shaded regions represent maximum and minimum values for each projection year across the AEO2023 Reference case and side cases.

Liquefied natural gas exports drive production; domestic consumption remains stable



Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: Shaded regions represent maximum and minimum values for each projection year across the AEO2023 Reference case and side cases. ZTC=Zero-Carbon Technology Cost

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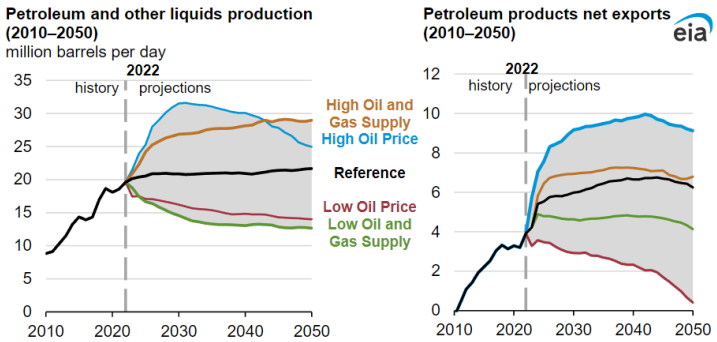
- 2023
  - April
  - March

APRIL 4, 2023

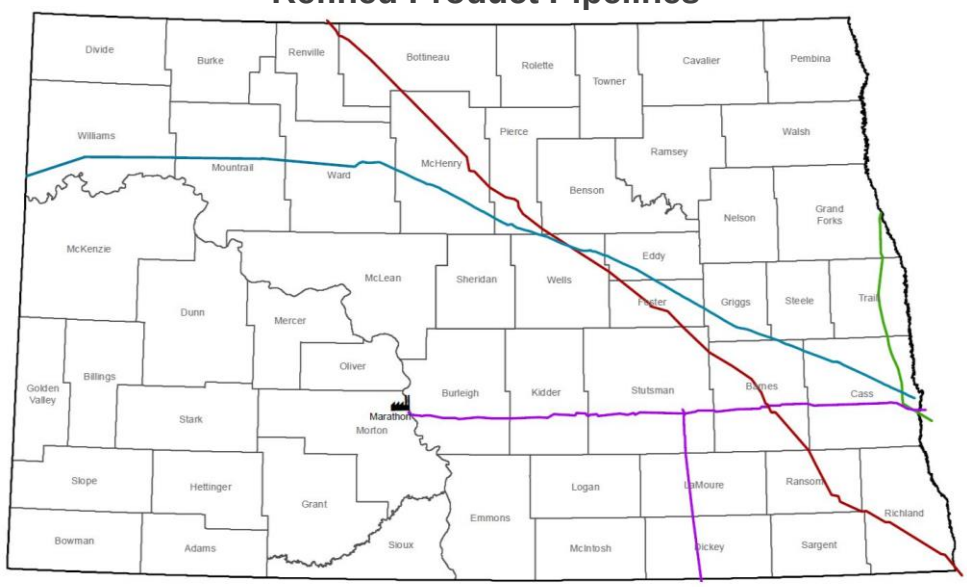
U.S. production of petroleum and other liquids to be driven by international demand



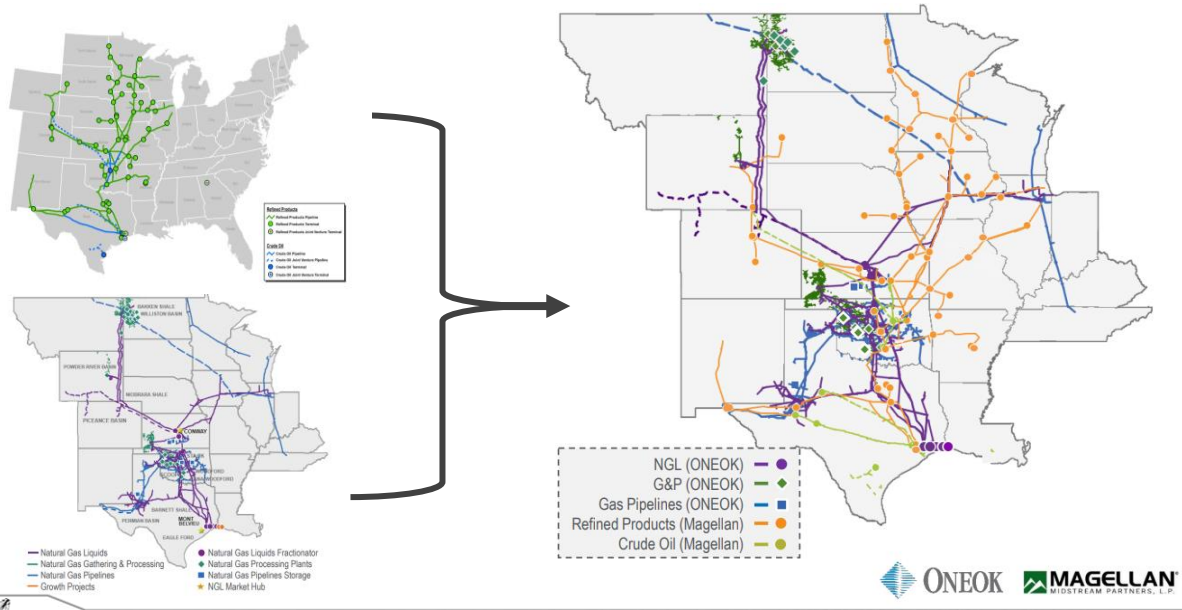
Data source: U.S. Energy Information Administration, *Annual Energy Outlook 2023* (AEO2023)
Note: We do not include biofuels in petroleum and other liquids production. Shaded regions represent maximum and minimum values for each projection year across the AEO2023 Reference case and side cases.

Strong continuing international demand for petroleum and other liquids will sustain U.S. production above 2022 levels through 2050, according to most of the cases we examined in our *Annual Energy Outlook 2023* (AEO2023). We project that the United States will continue to be an integral part of global oil markets and a significant source of supply in these cases, as increased exports of finished products support U.S. production.

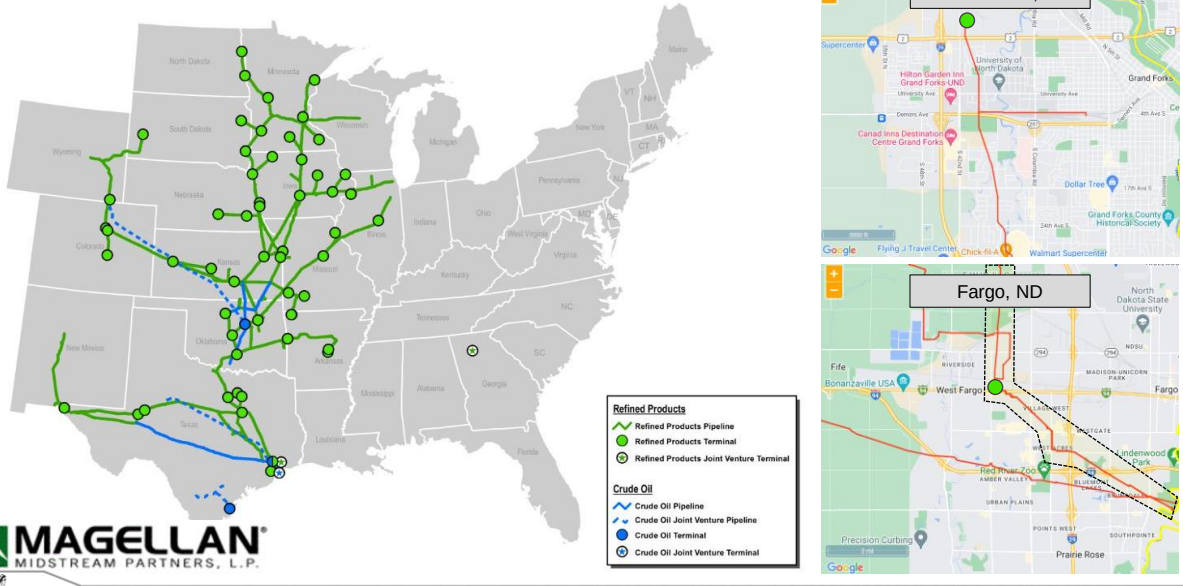
Refined Product Pipelines



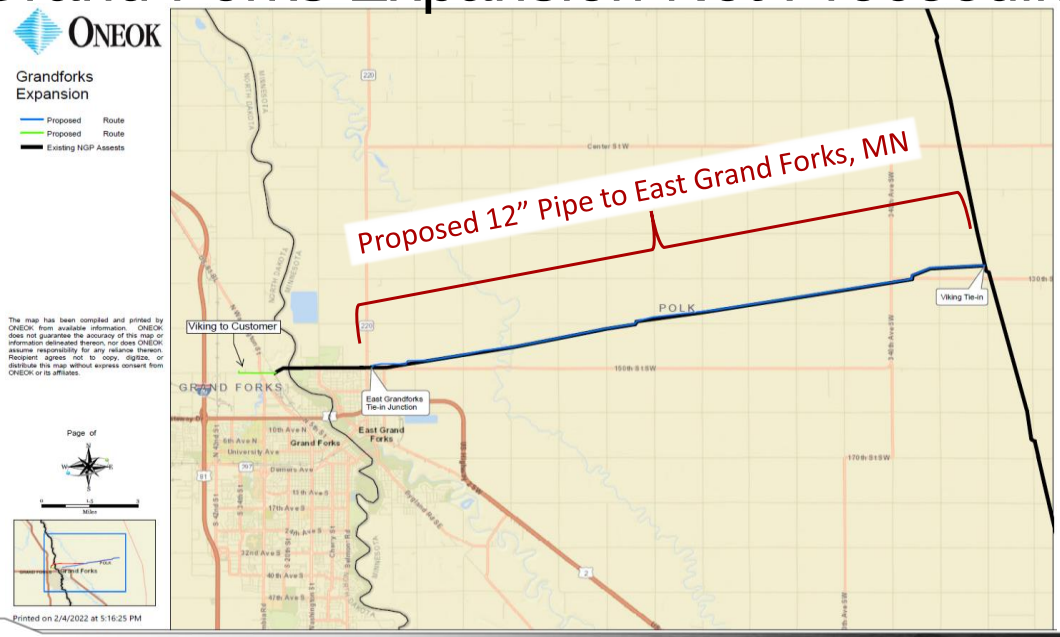
ONEOK to Acquire Magellan: $18.8B



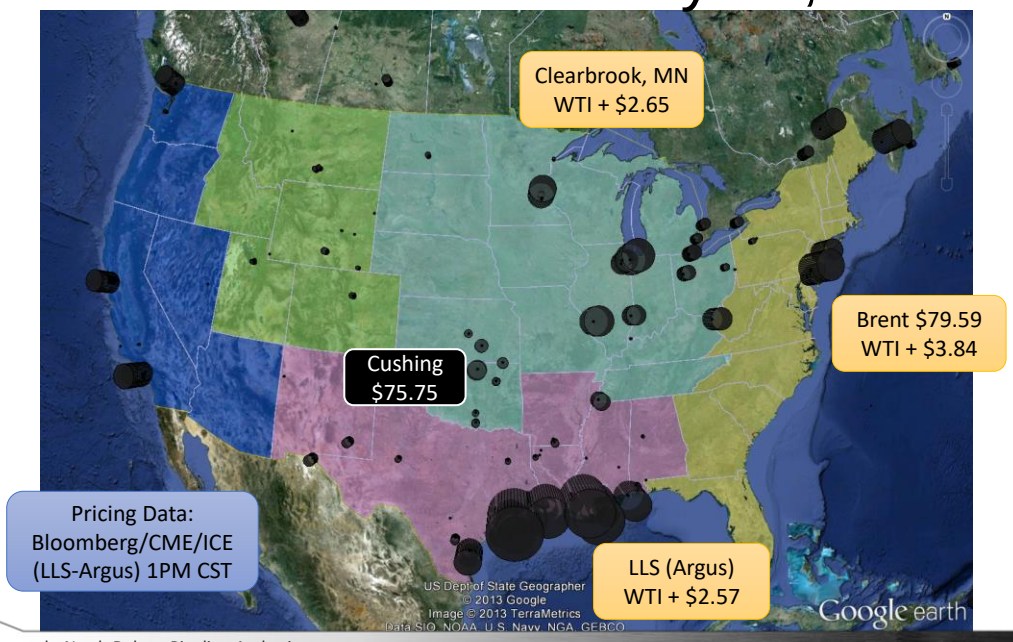
ONEOK to Acquire Magellan: $18.8B



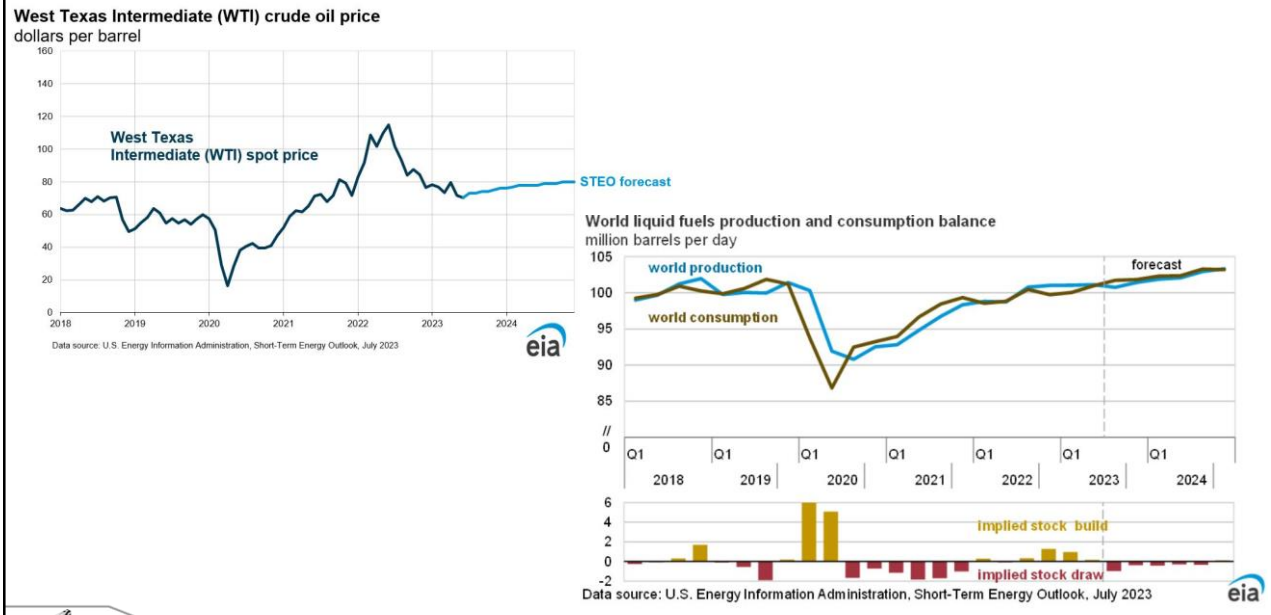
Grand Forks Expansion Not Proceeding



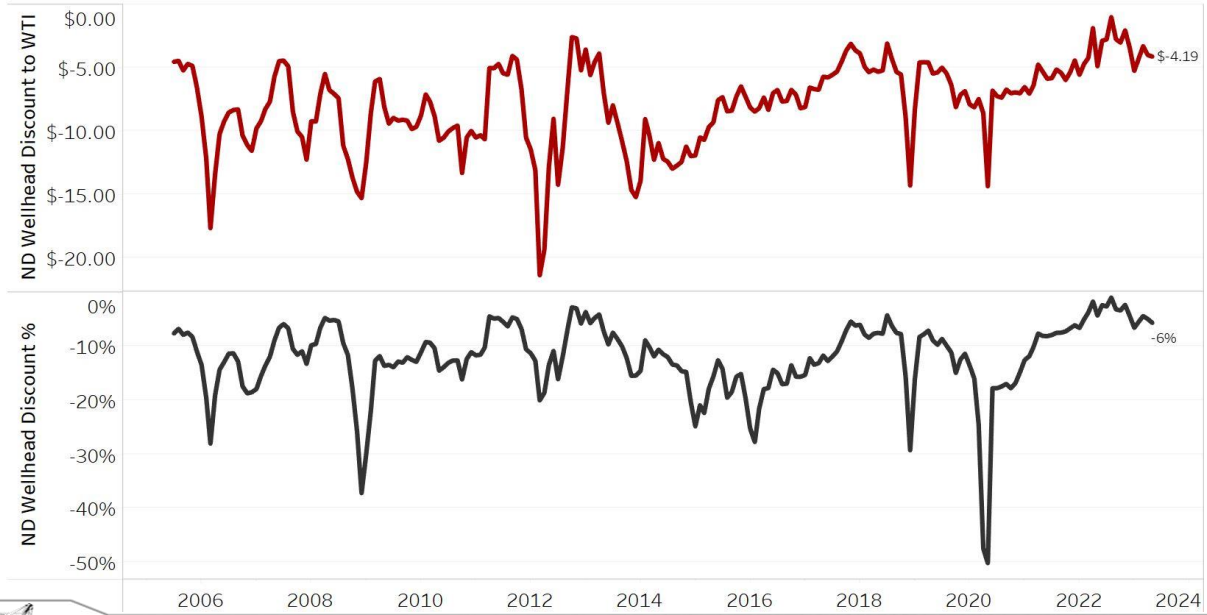
Crude Oil Prices – July 20, 2023



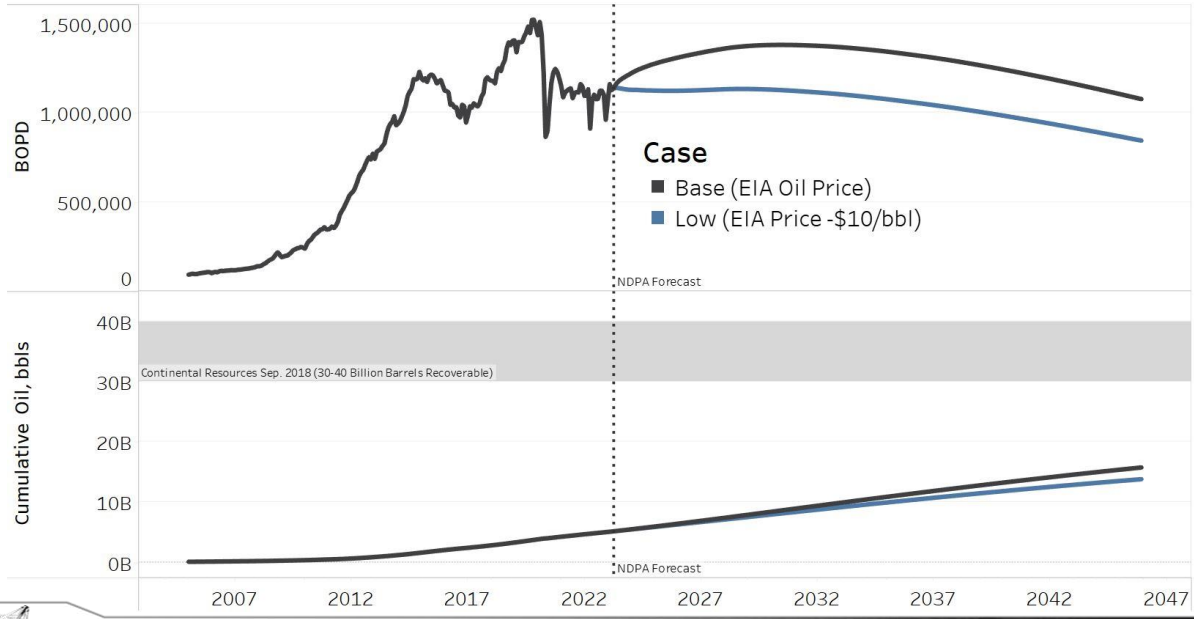
EIA Oil Price Outlook (July 2023)



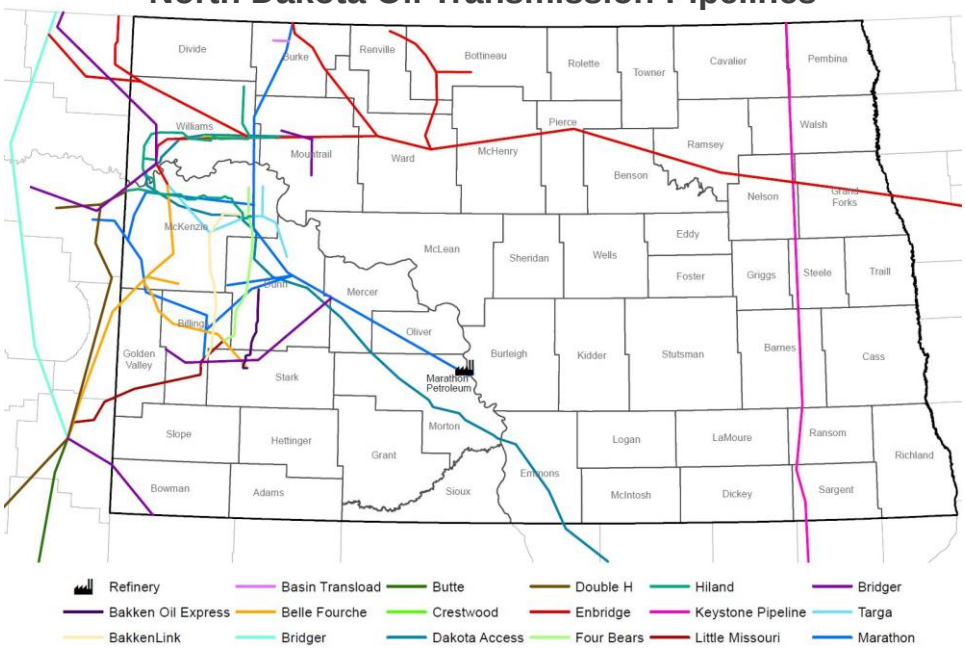
Average North Dakota Oil "Discount" to WTI



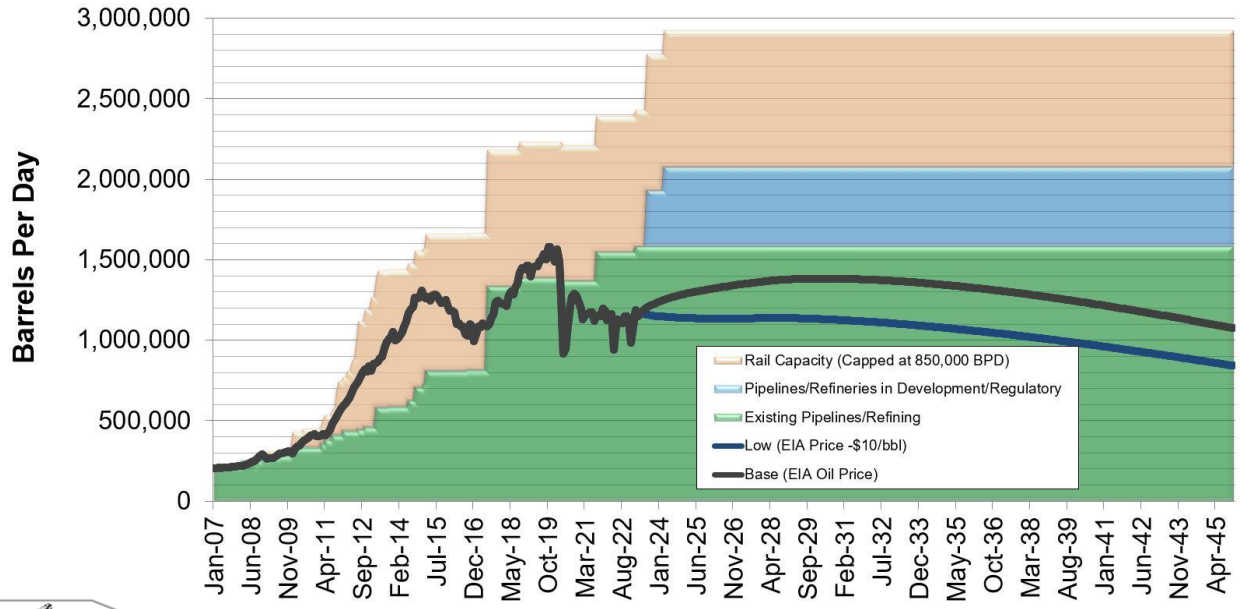
ND Oil Production: EIA Price Deck



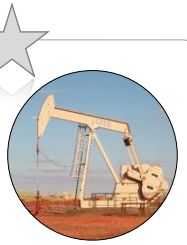
North Dakota Oil Transmission Pipelines



Williston Basin Oil Production & Export Capacity, BOPD



Natural Gas Update



Production

- Technology
- Markets

Gathering

- Capacity
- Connections

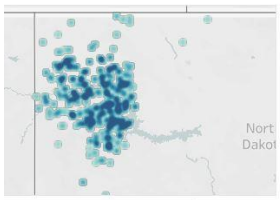
Processing

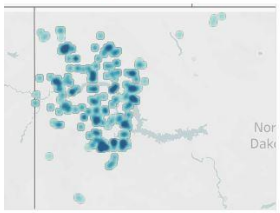
- Capacity
- Location

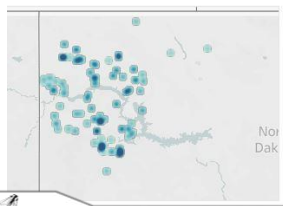
Transmission

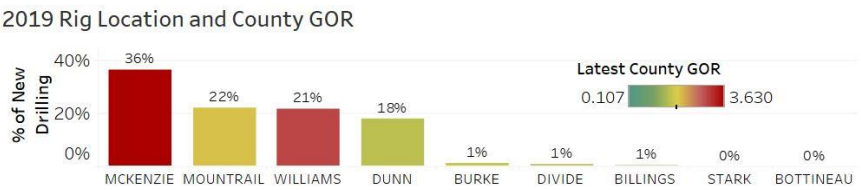
- Dry Gas
- Natural Gas Liquids

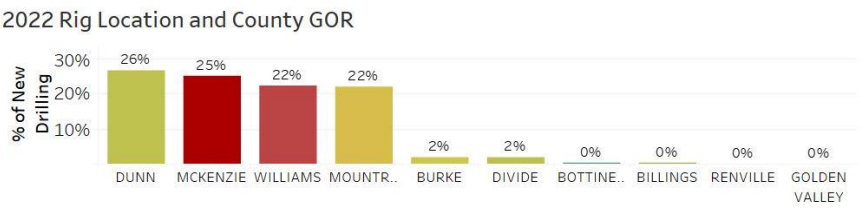
Near-term GOR Influenced by Drilling Location

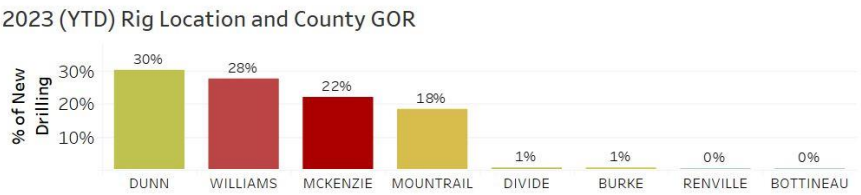






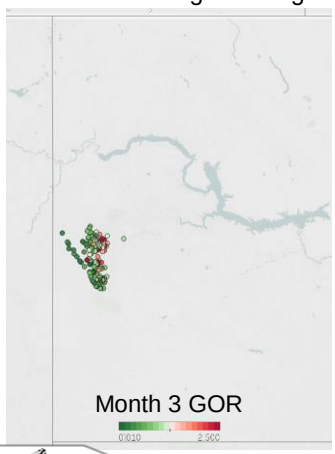


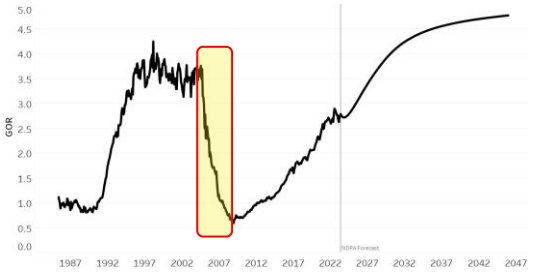




The GOR "Reset" and Forward Expectations

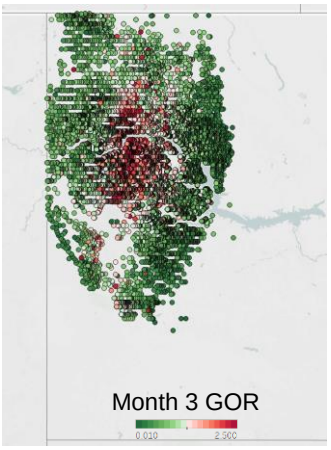
Bakken GOR settles around ~3.6 from 1990's Bakken development in what is now considered "fringe" acreage



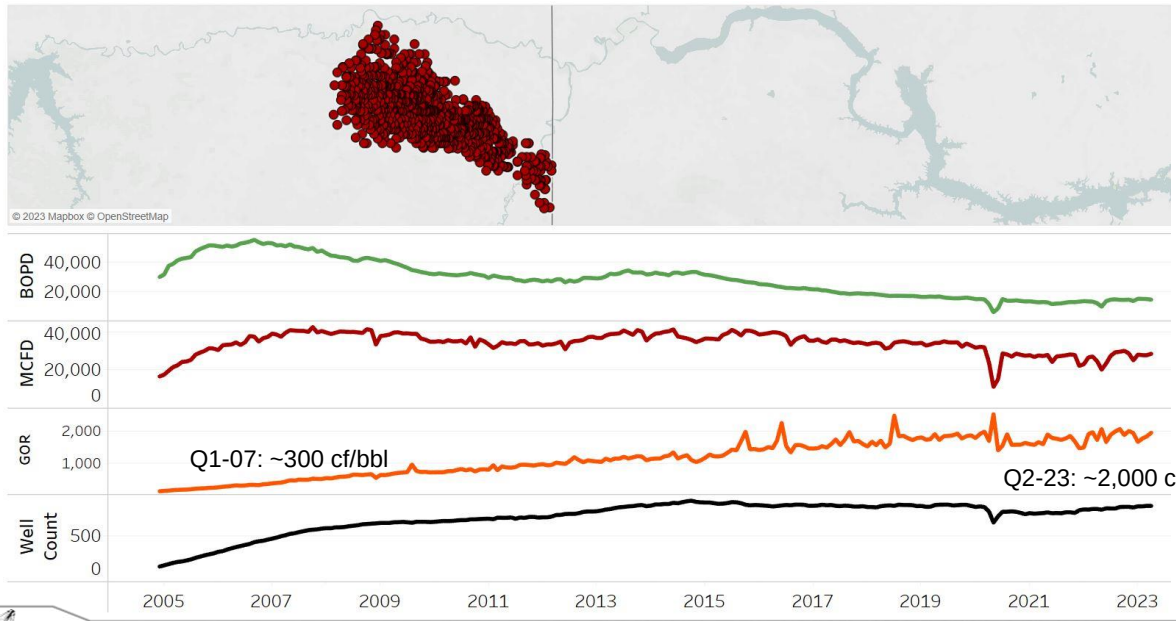


Mid-2000's: Modern Bakken development begins and statewide average GOR is "reset" with large volumes of new gas production

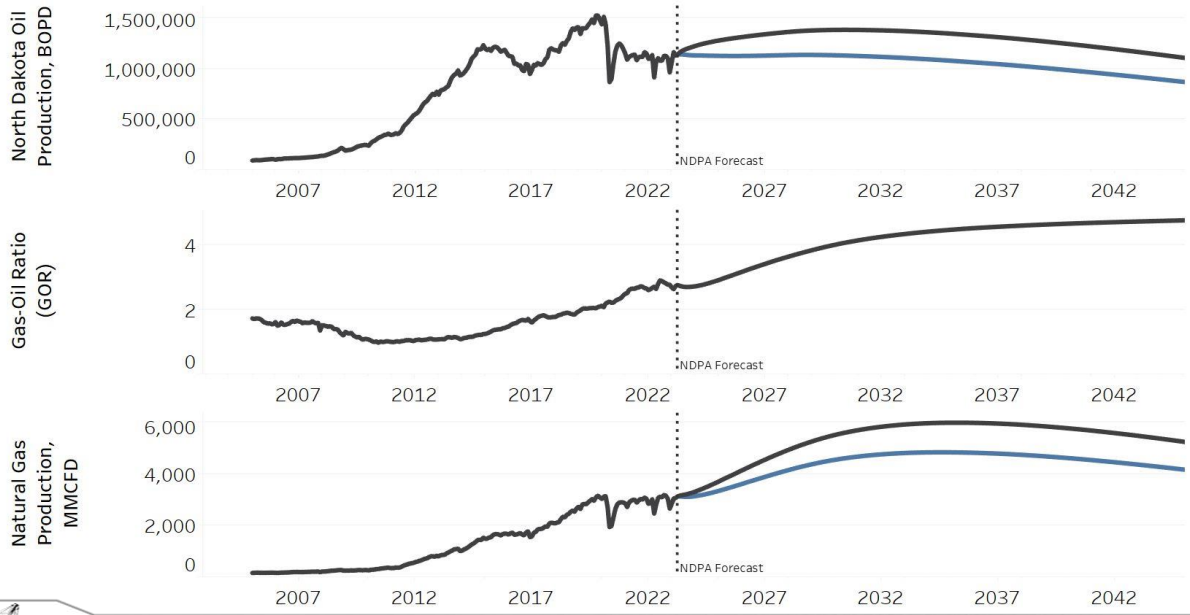
Future GOR will be driven by widespread development including deeper/hotter acreage with higher initial and sustained reservoir GOR



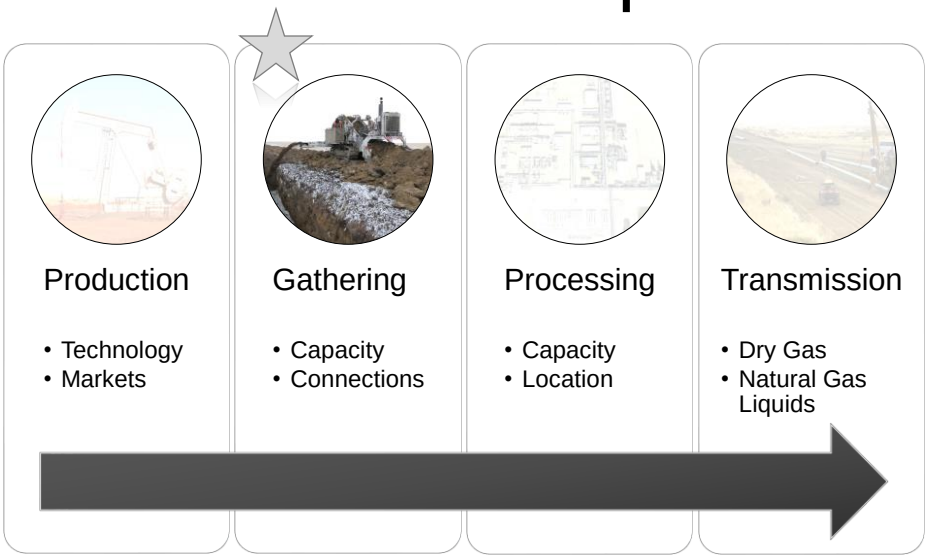
Montana Elm Coulee Gas/Oil Ratios



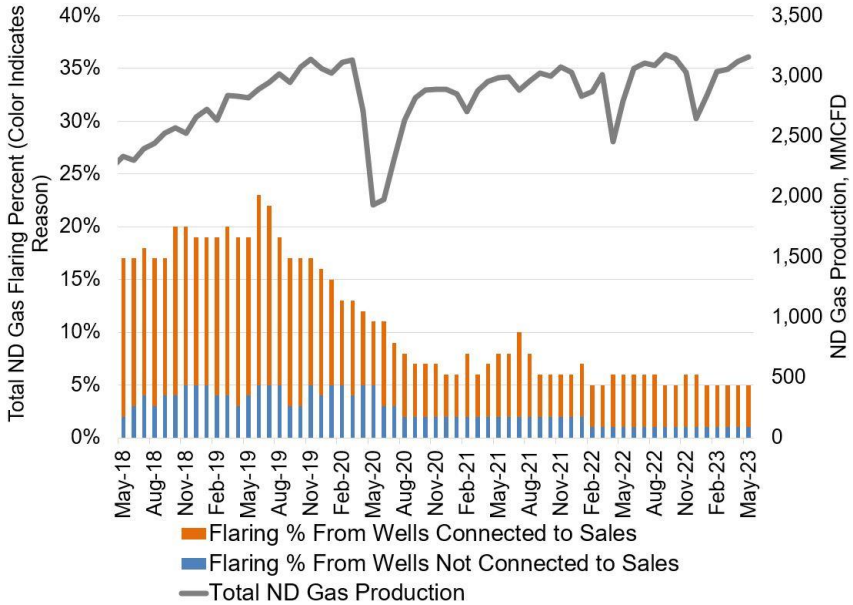
ND Production Forecast: EIA Price Deck



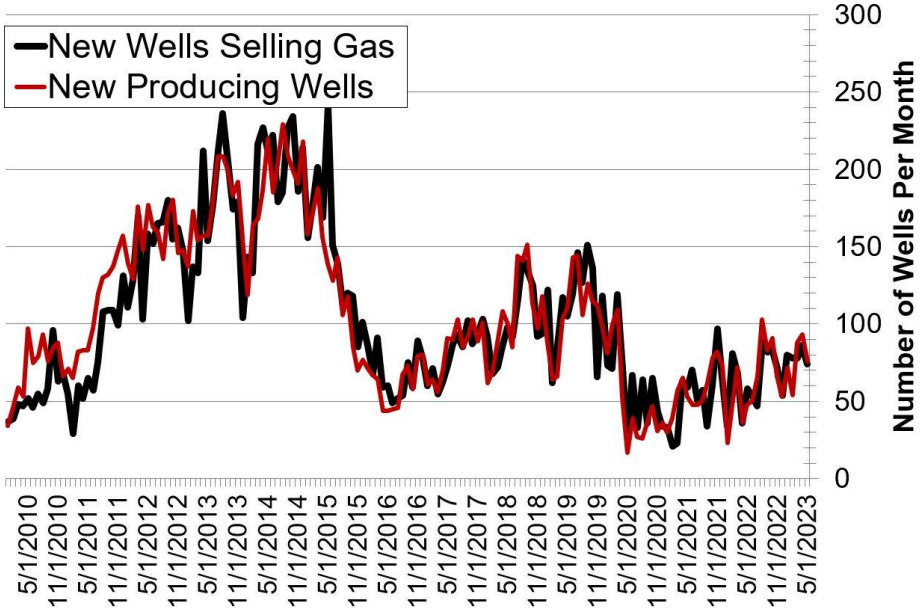
Natural Gas Update



Natural Gas Capture Rates



Natural Gas Gathering Connections Keeping Pace



Natural Gas Update

Production

- Technology
- Markets

Gathering

- Capacity
- Connections

Processing

- Capacity
- Location

Transmission

- Dry Gas
- Natural Gas Liquids

Natural Gas Update

Production

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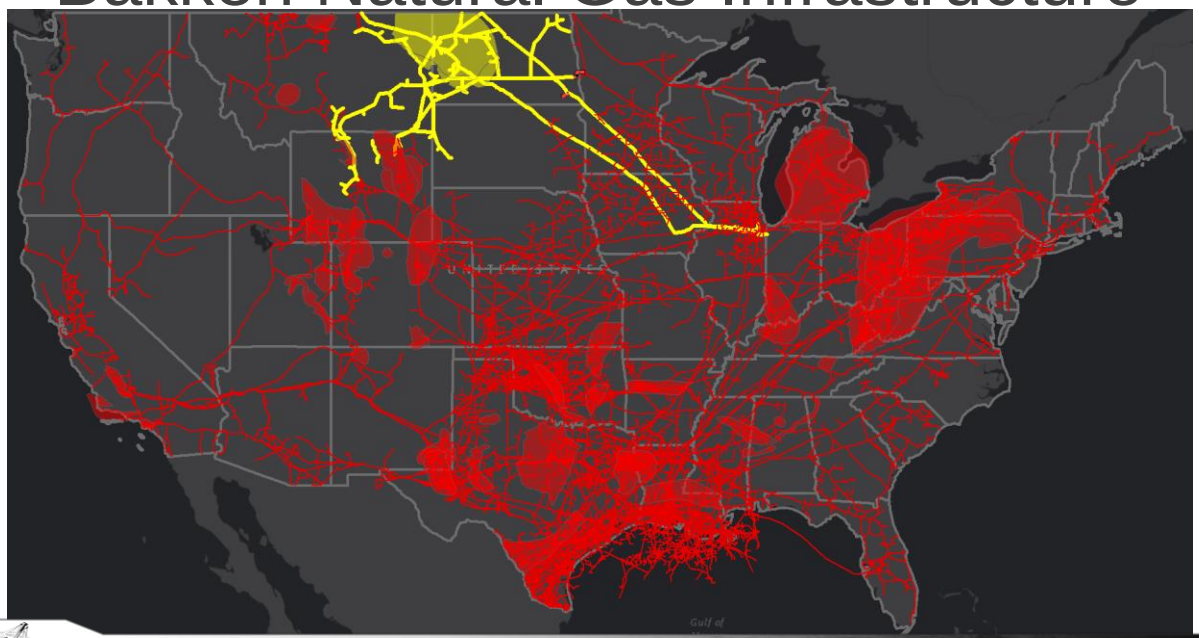
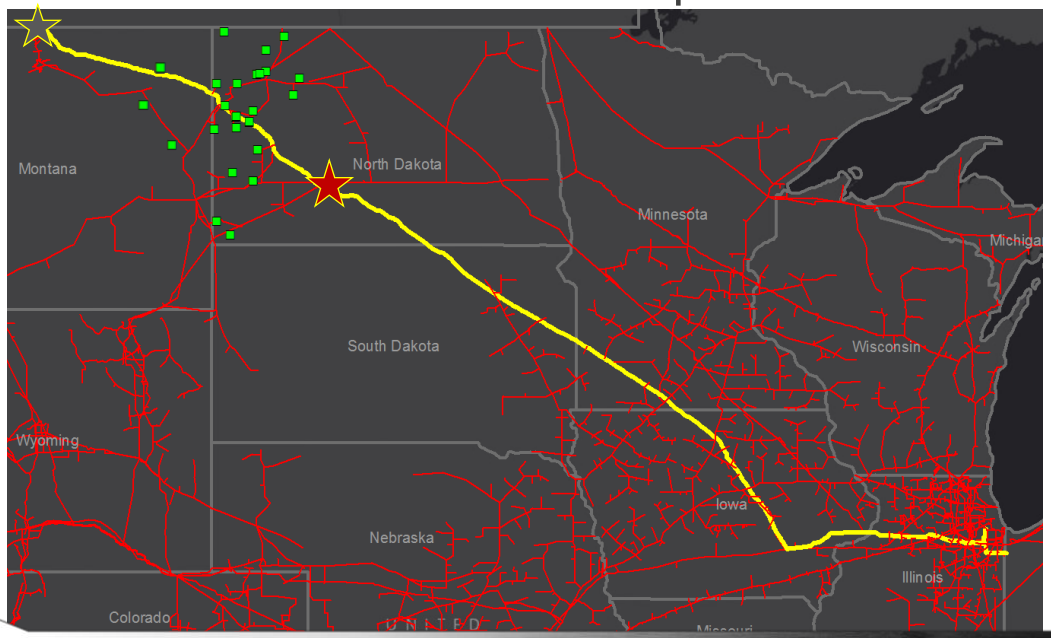
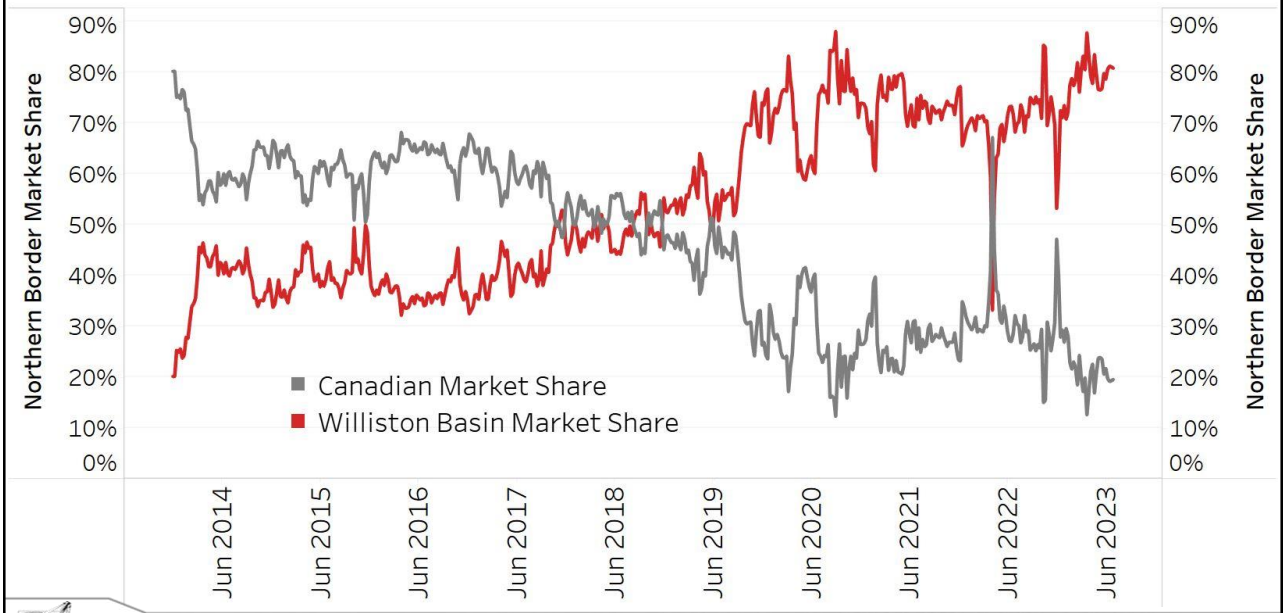
Bakken Natural Gas Infrastructure



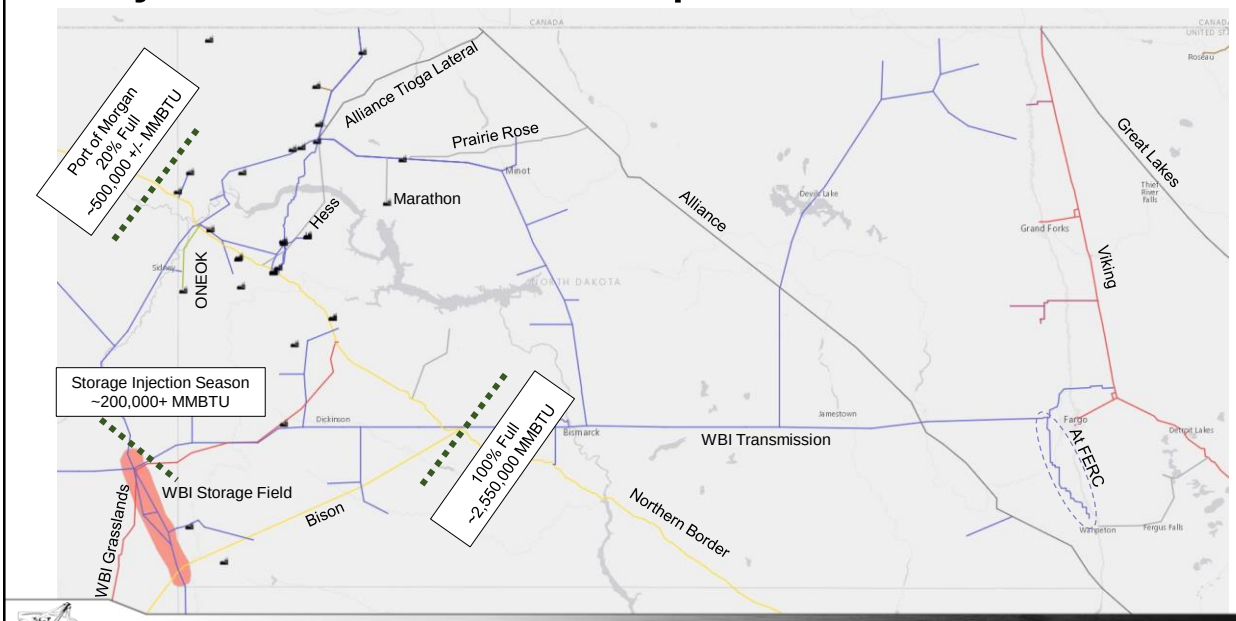
Northern Border Pipeline



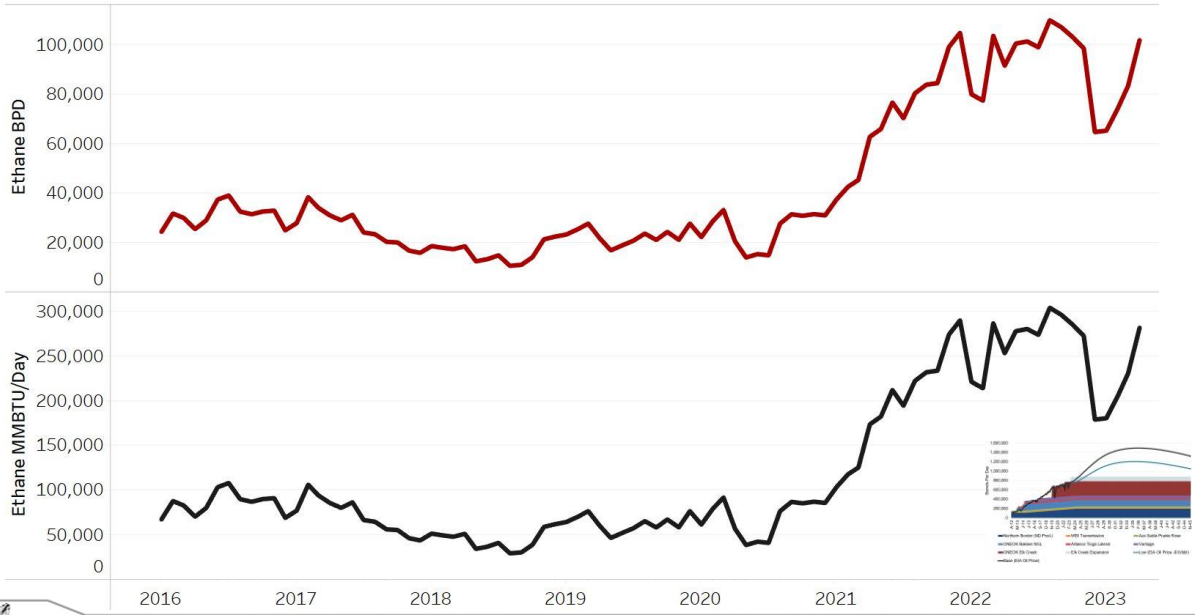
Northern Border Pipeline Market Share



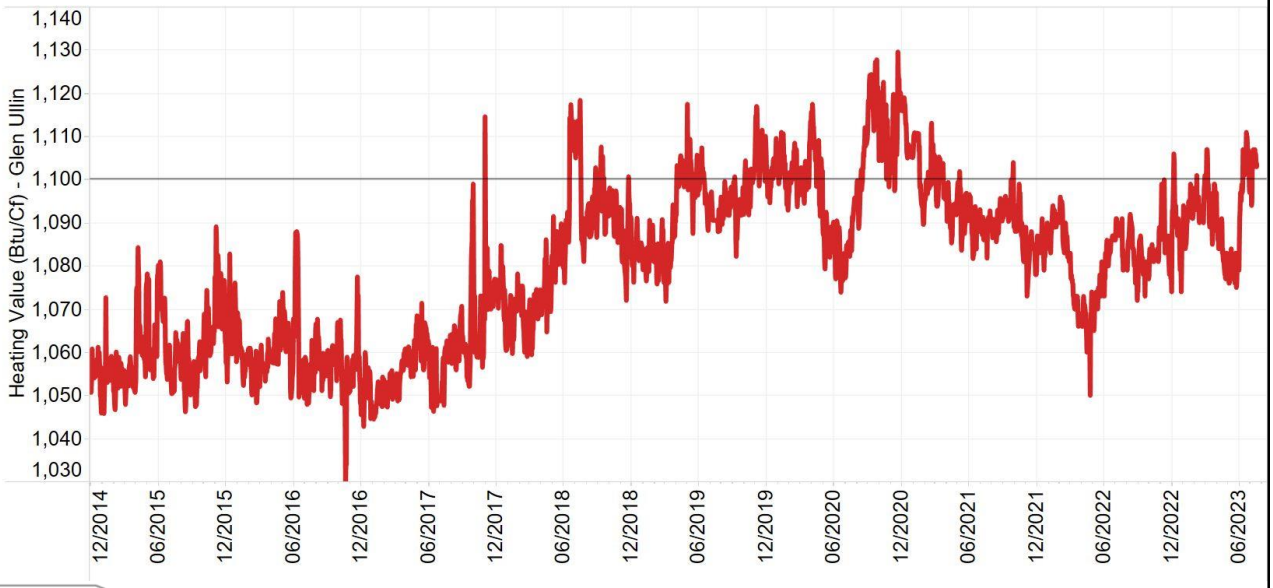
Major Residue Gas Pipeline Infrastructure

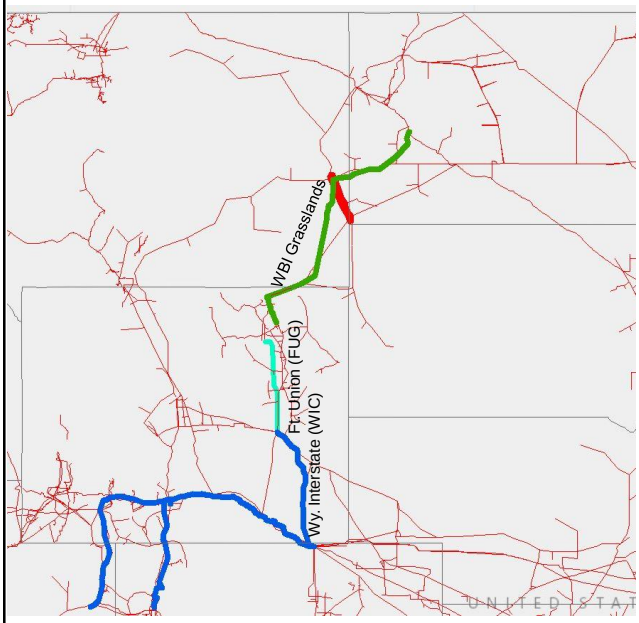


Rockies NGL Pipes Driving Down NB BTU & Market Share



Northern Border BTU at Glen Ullin, ND





WBI Energy – Grasslands South Project

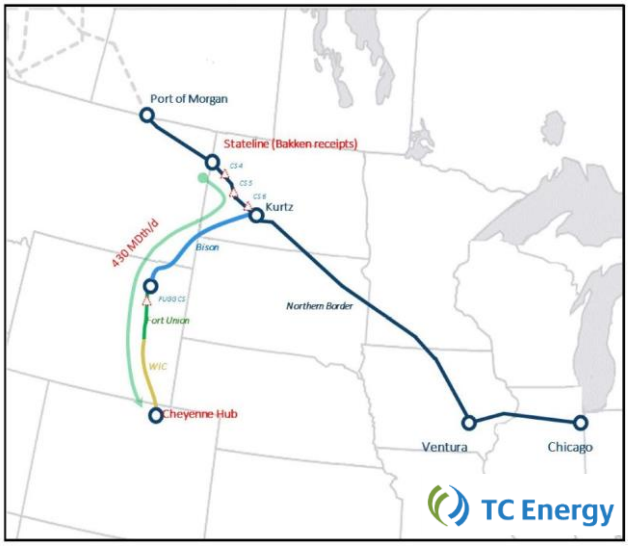
Project Highlights

- Binding open season Jan 10 – Feb 25, 2022
- Repurpose Grasslands Pipeline (16")
- Proposed Capacity 94,000 Dth/Day
- Access to Baker storage field
- Q3 2023 proposed completion
- Seeking commitments 10yrs or Longer
- Fort Union Gas Gathering and Wyoming Interstate Company provide further transport to Cheyenne hub.

Proposed Tariff Rates

- WBI $0.32356/Dth + Fuel/Elec to WIC/FUG Interconnect
- FUG/WIC to Cheyenne $0.2899/Dth + Fuel/Elec

TC Energy / Kinder Morgan: Bakken xPress Project



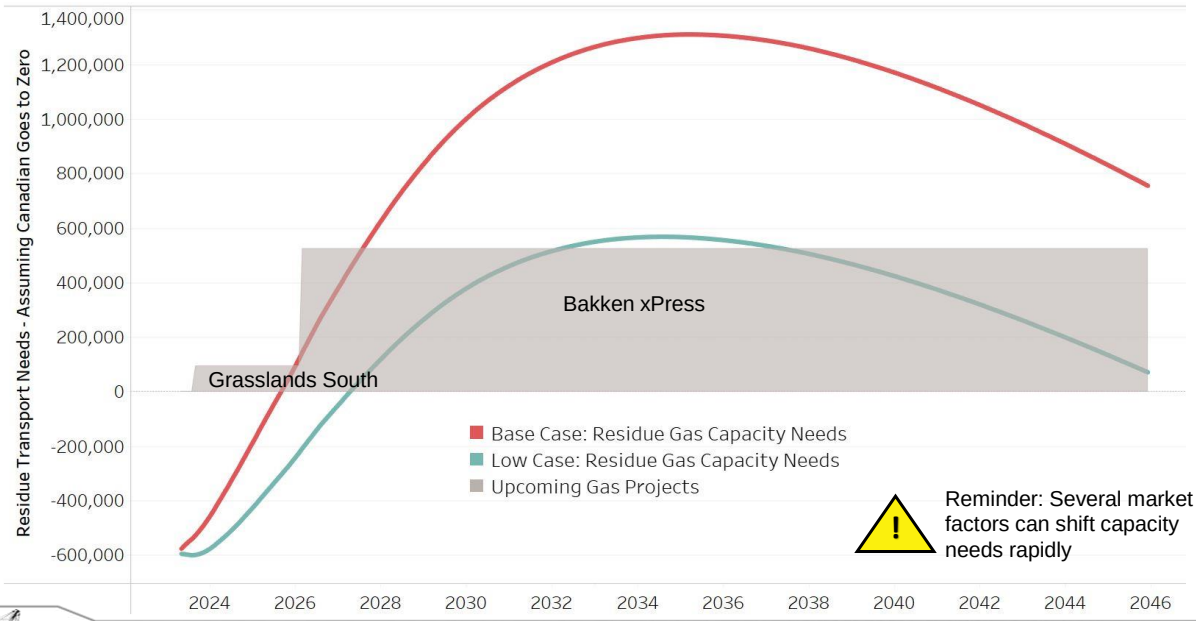
Project Highlights

- Non-binding open season April 4 - May 6, 2022
- Binding Open Season: June 1-30, 2023
- Three compressor upgrades in North Dakota
- Reverse the idle Bison Pipeline (30" – 302 Mile)
- Proposed capacity Up to 430,000 Dth/Day
- March 2026 targeted in-service date
- Fort Union Gas Gathering and Wyoming Interstate Company provide further transport to Cheyenne hub.
- Seeking commitments 10yrs or Longer

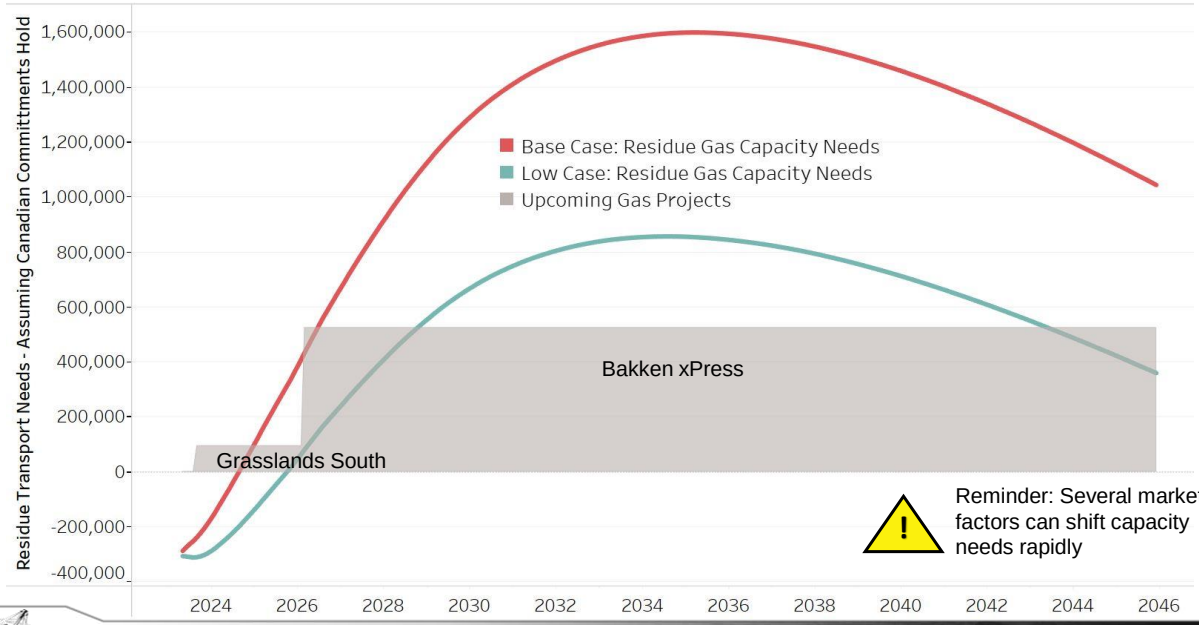
Proposed Tariff Rates

- NBPL/Bison $0.45/Dth + Fuel/Elec to WIC/FUG Interconnect
- WIC/FUG to Cheyenne $0.30/Dth + Fuel/Elec
- Anchor Shipper Minimum: 50,000 Dth/Day

Residue Capacity Needs : **ZERO CANADIAN**



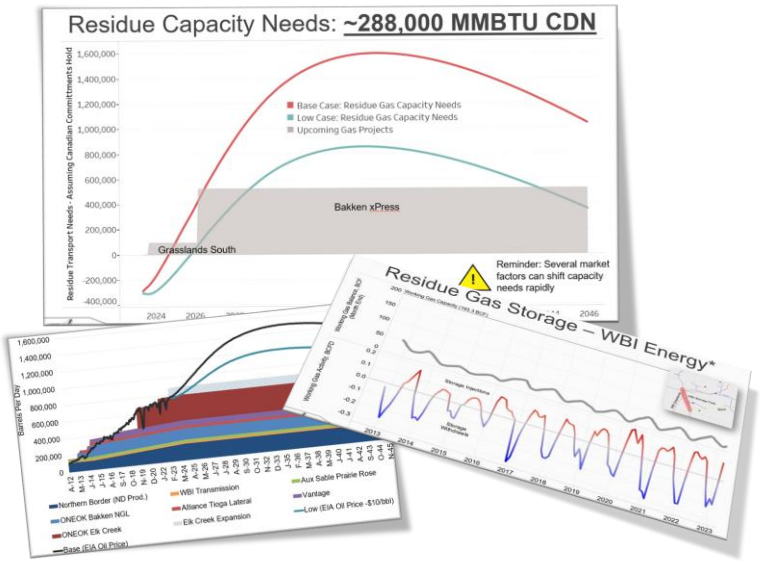
Residue Capacity Needs: **~288,000 MMBTU CDN**



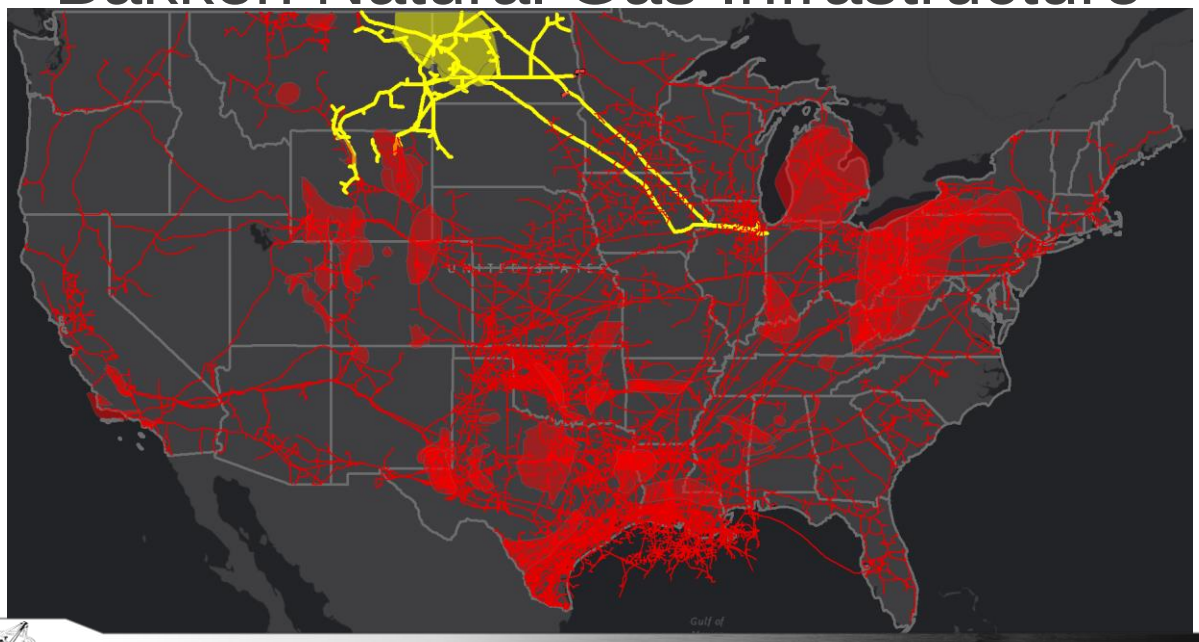
**Assumes BTU of 1,100*

Key Topics Being Watched/Considered

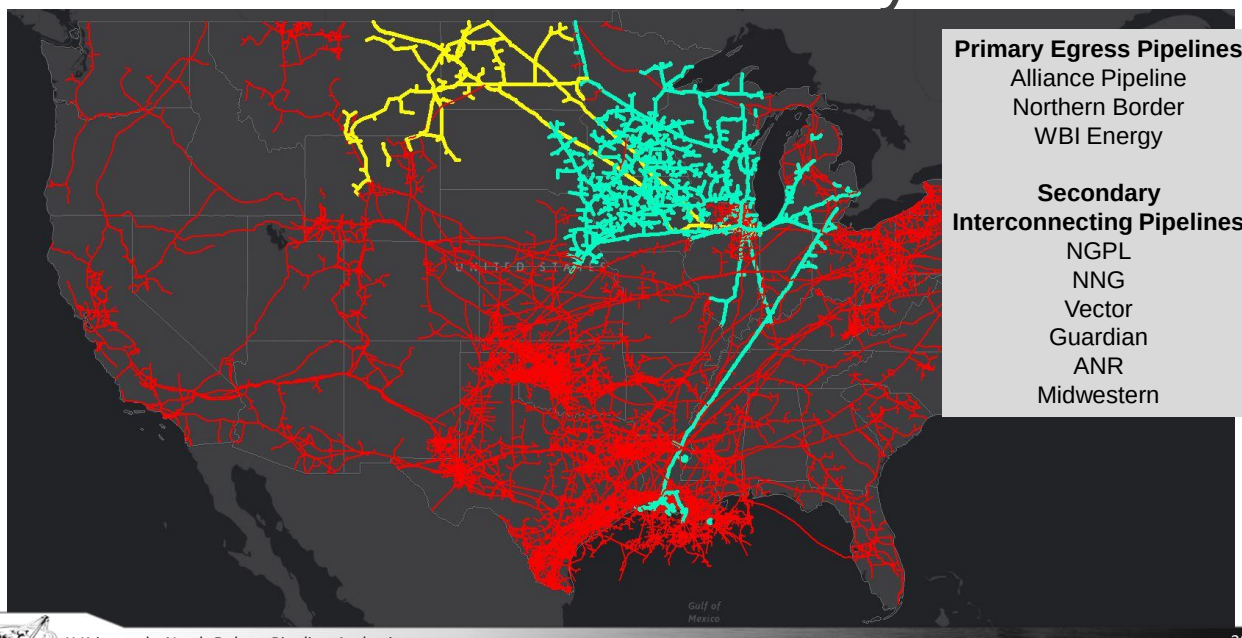
- Currently ~200,000 MMBTU/Day incremental ethane capture. What happens if/when NGL pipes hit capacity or market conditions shift?
- Seasonal storage swings of +/- 200-300,000+ MMBTU/Day. How will total egress impact storage withdrawals?
- What if Port of Morgan "stickiness" is greater than 288,000 MMBTU/Day?
- Could market conditions at Cheyenne attract more competition from Port of Morgan Shippers?
- Will downstream markets desire a Northern Border BTU limit?



Bakken Natural Gas Infrastructure



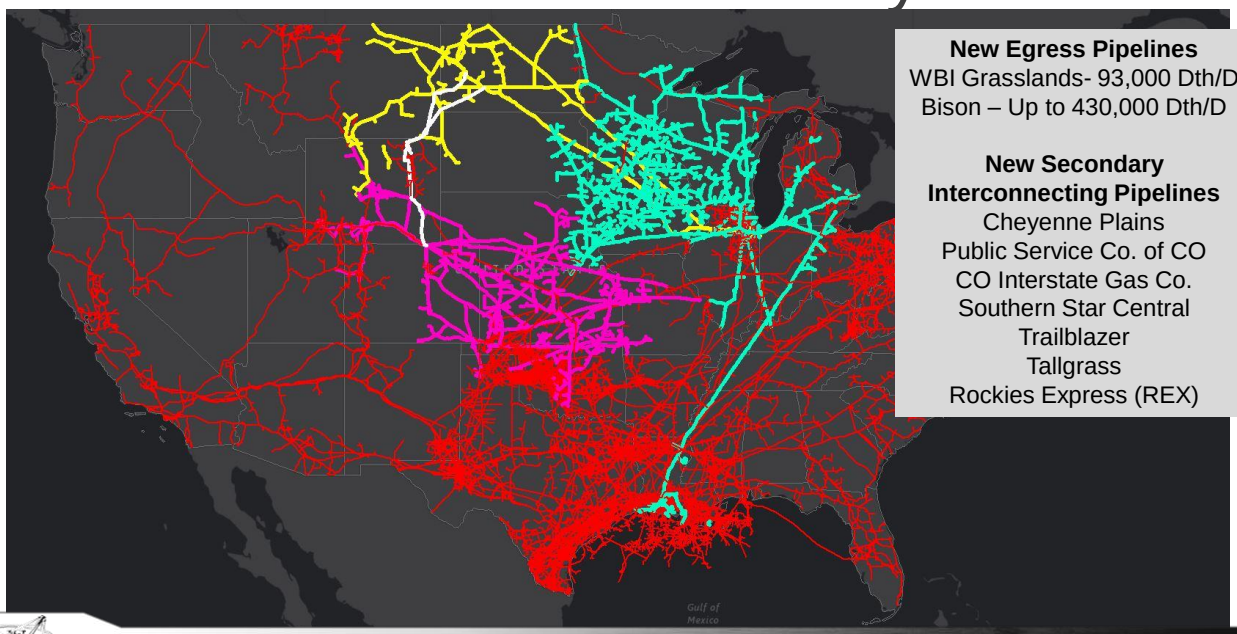
Bakken Market Connectivity - Current



Primary Egress Pipelines
Alliance Pipeline
Northern Border
WBI Energy

Secondary Interconnecting Pipelines
NGPL
NNG
Vector
Guardian
ANR
Midwestern

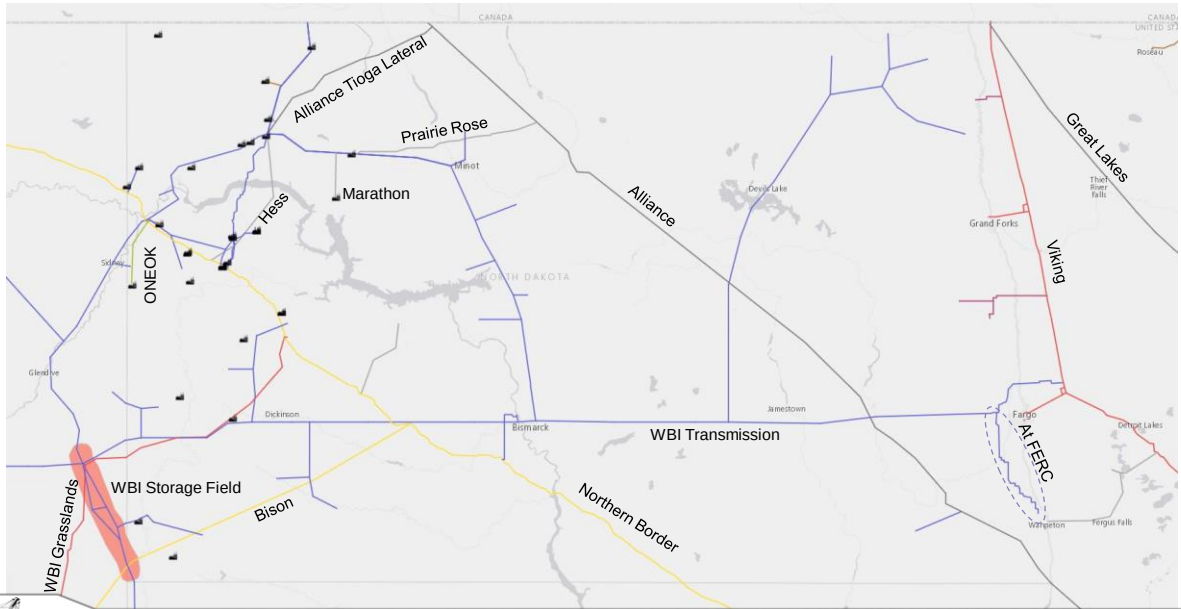
Bakken Market Connectivity – 2024+



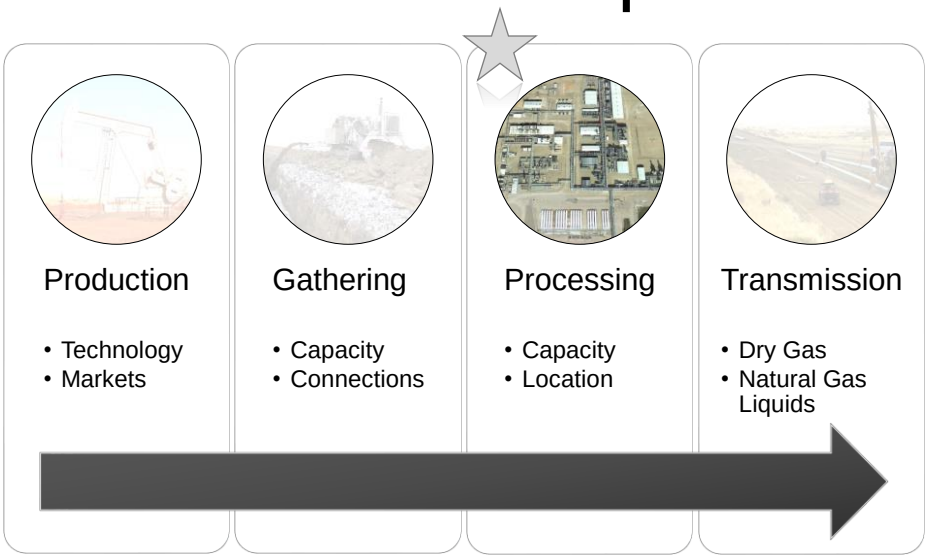
New Egress Pipelines
WBI Grasslands- 93,000 Dth/D
Bison – Up to 430,000 Dth/D

New Secondary Interconnecting Pipelines
Cheyenne Plains
Public Service Co. of CO
CO Interstate Gas Co.
Southern Star Central
Trailblazer
Tallgrass
Rockies Express (REX)

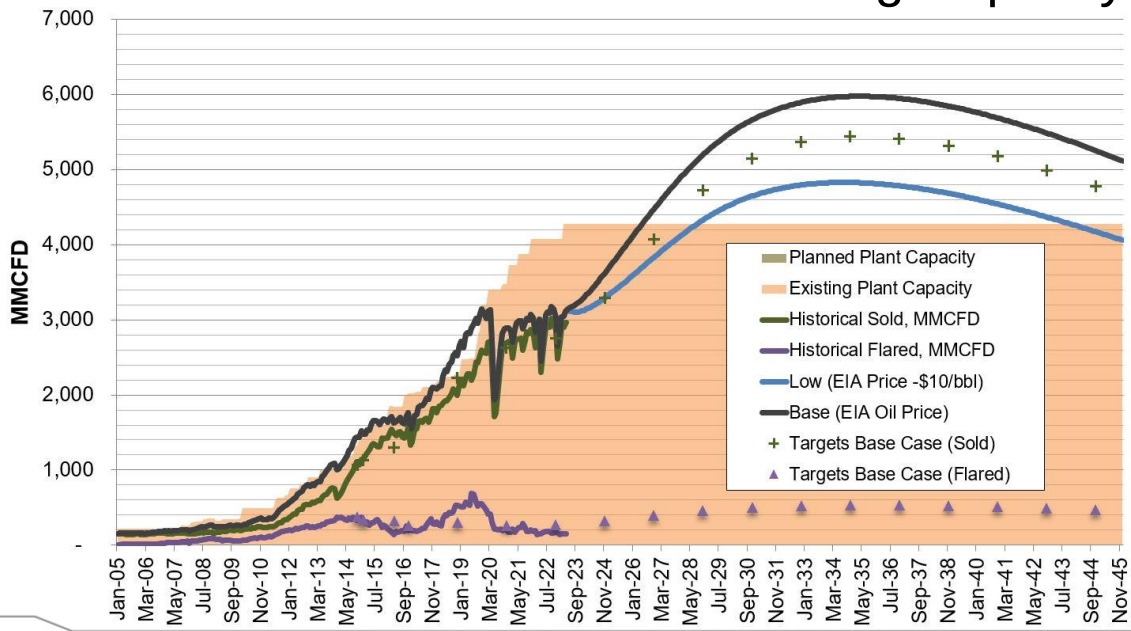
Major Residue Gas Pipeline Infrastructure



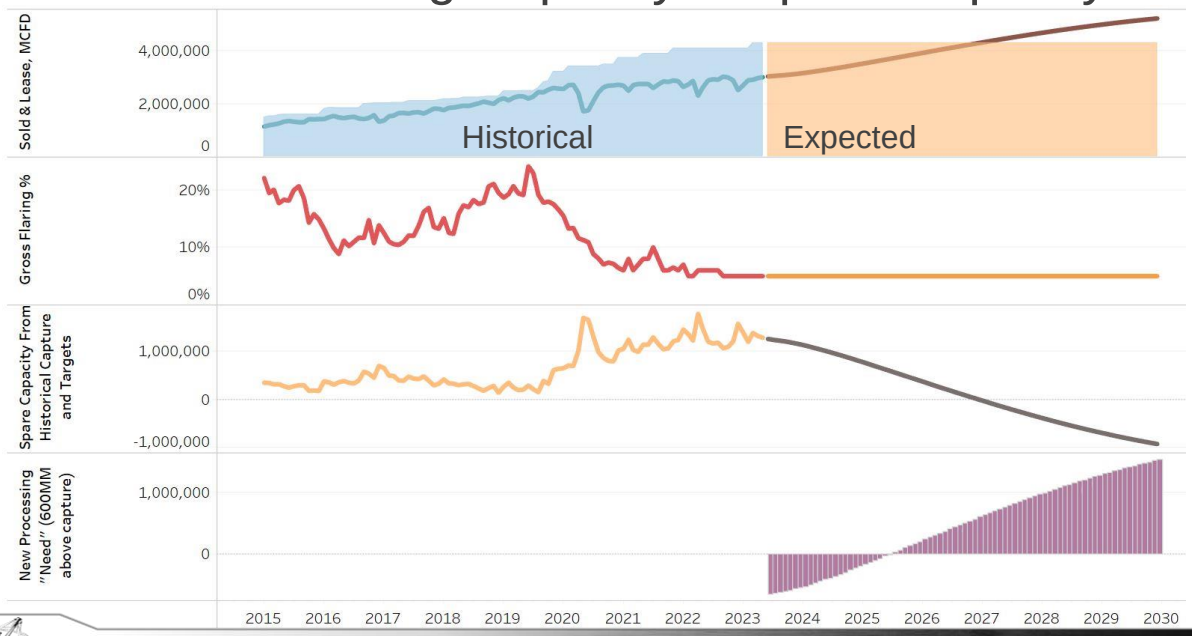
Natural Gas Update



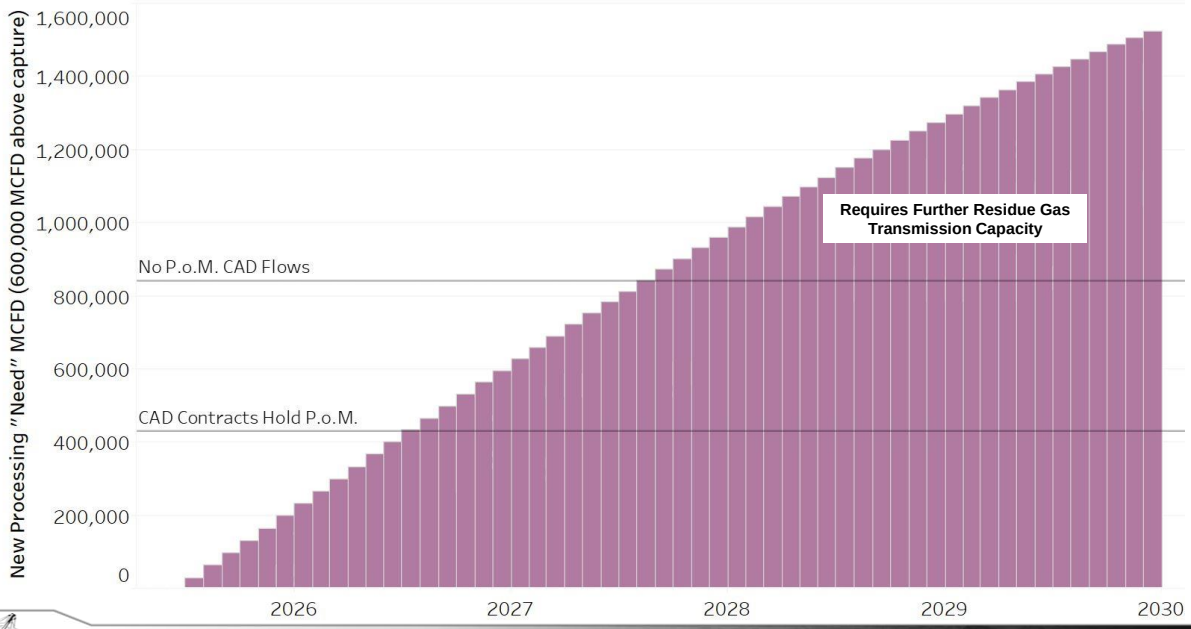
North Dakota Natural Gas Processing Capacity



Gas Processing Capacity & Spare Capacity



Processing Needs* – With New Cheyenne Pipes



Natural Gas Update

Production

- Technology
- Markets

Gathering

- Capacity
- Connections

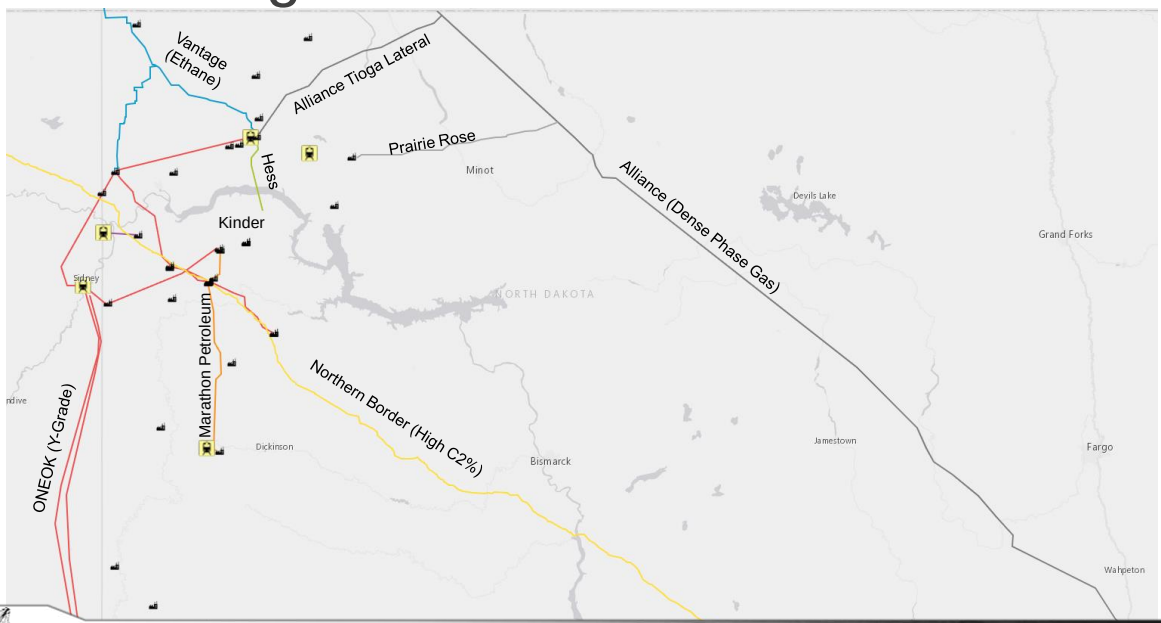
Processing

- Capacity
- Location

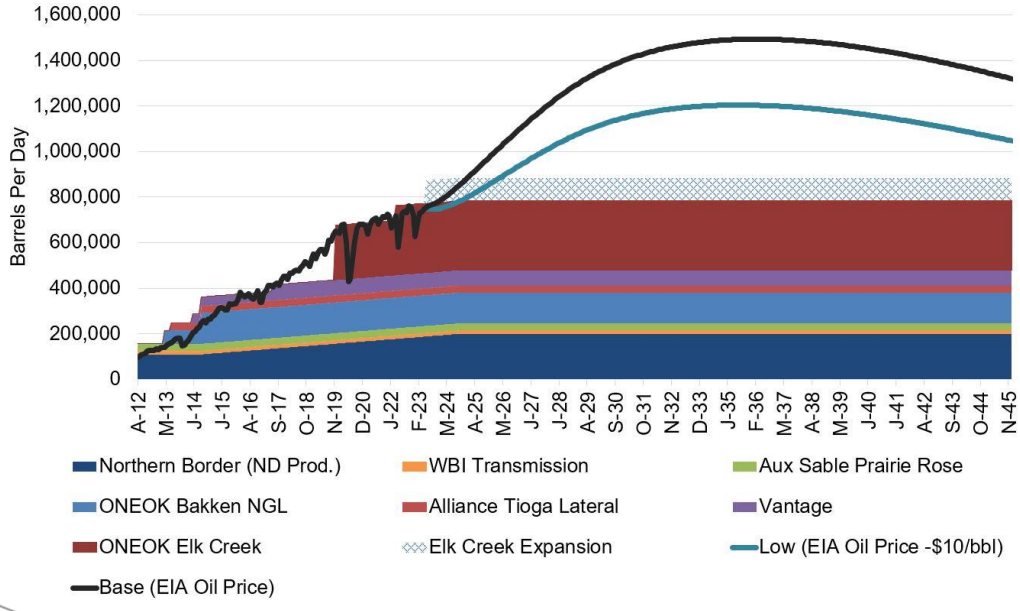
Transmission

- Dry Gas
- Natural Gas Liquids

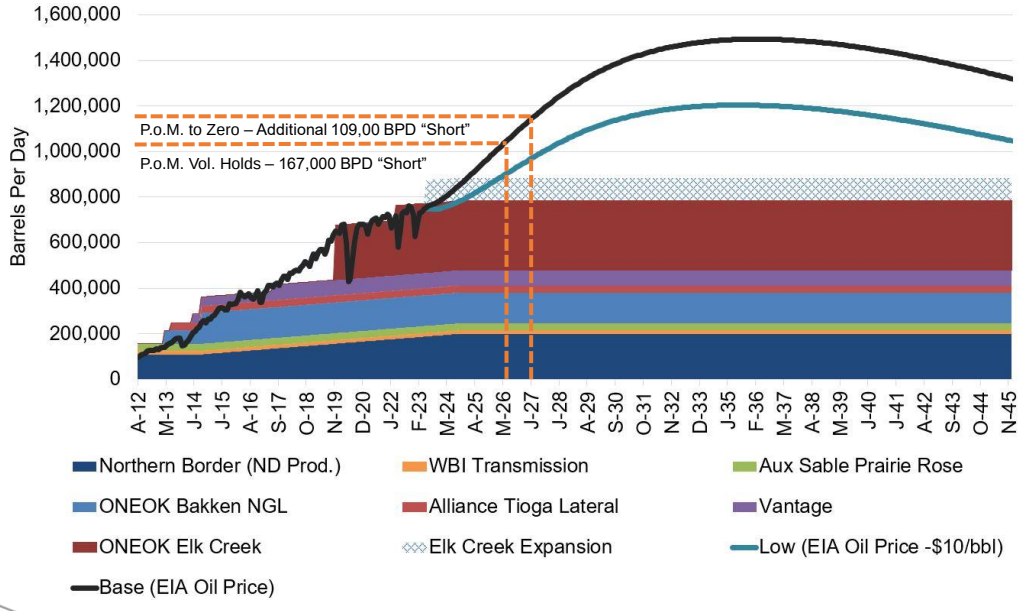
Regional NGL Infrastructure



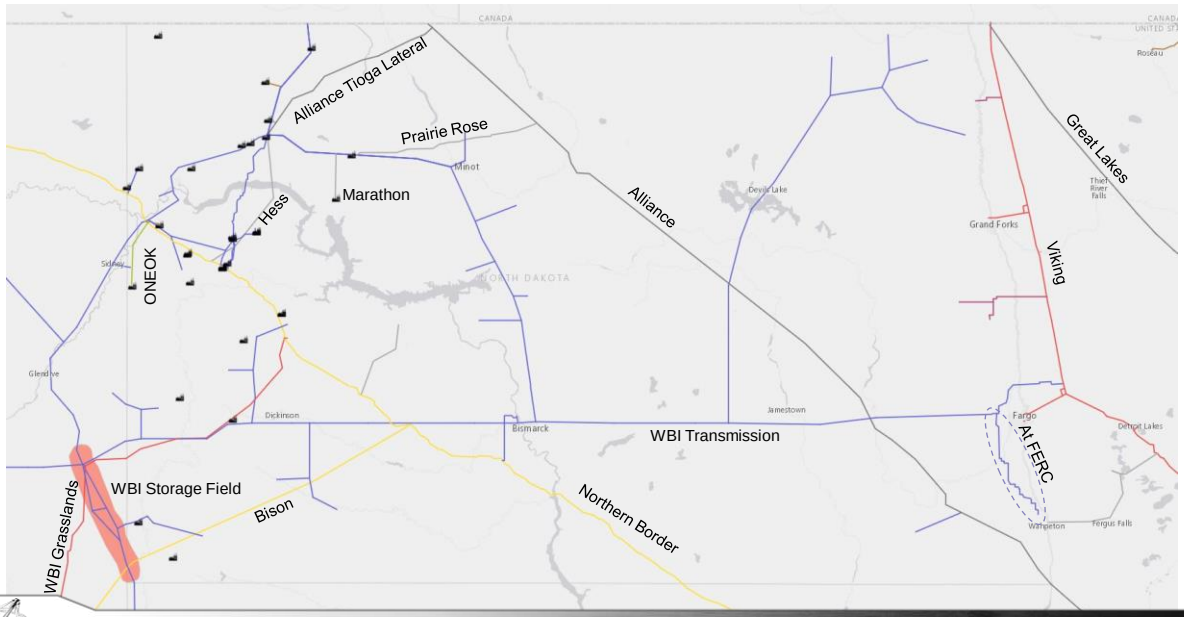
NGL Pipeline Takeaway Options*



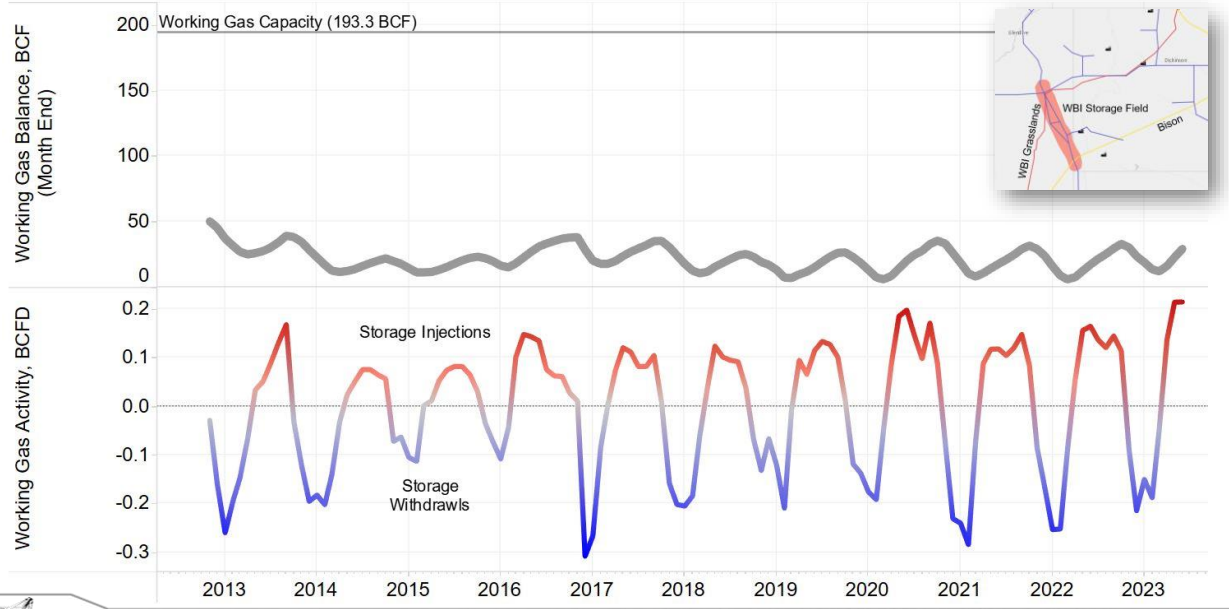
NGL Transport Needs* – With New Cheyenne Pipes



Major Residue Gas Pipeline Infrastructure



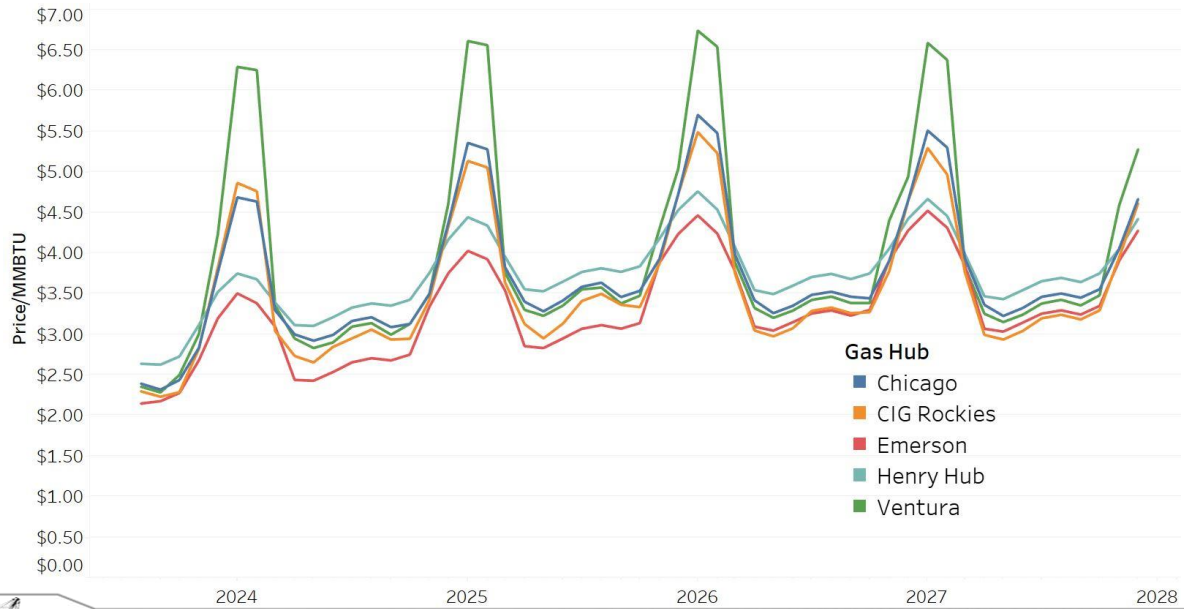
Residue Gas Storage – WBI Energy*



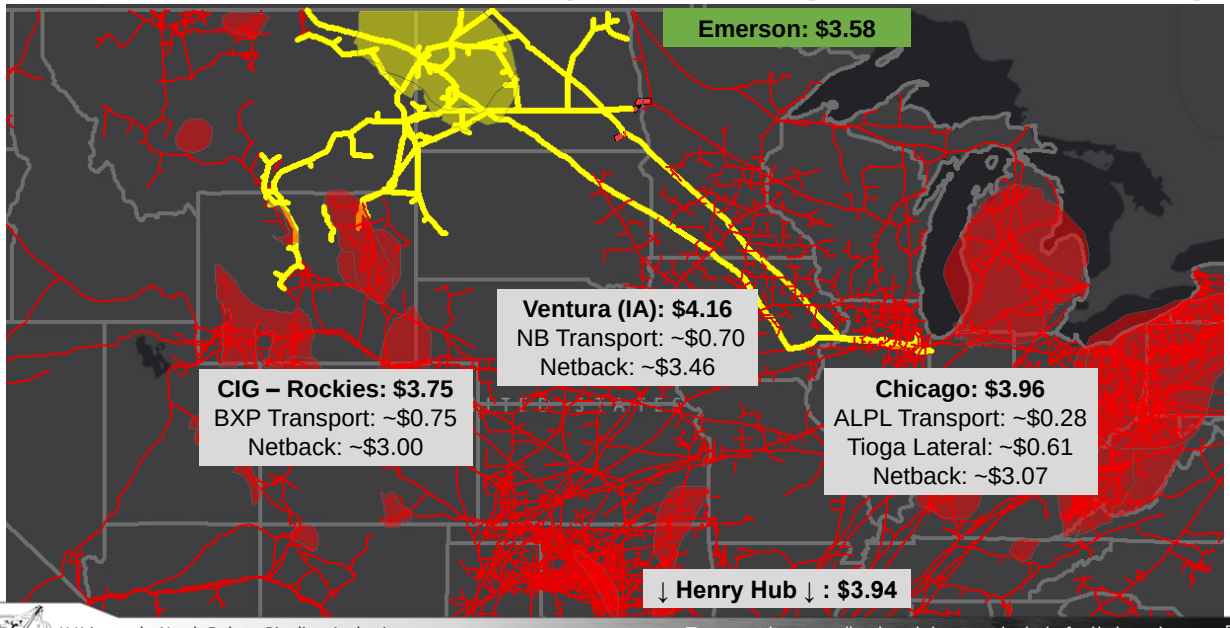
Why is gas expansion to eastern North Dakota so challenging?....

…And why is demand growth so important to the potential project success?

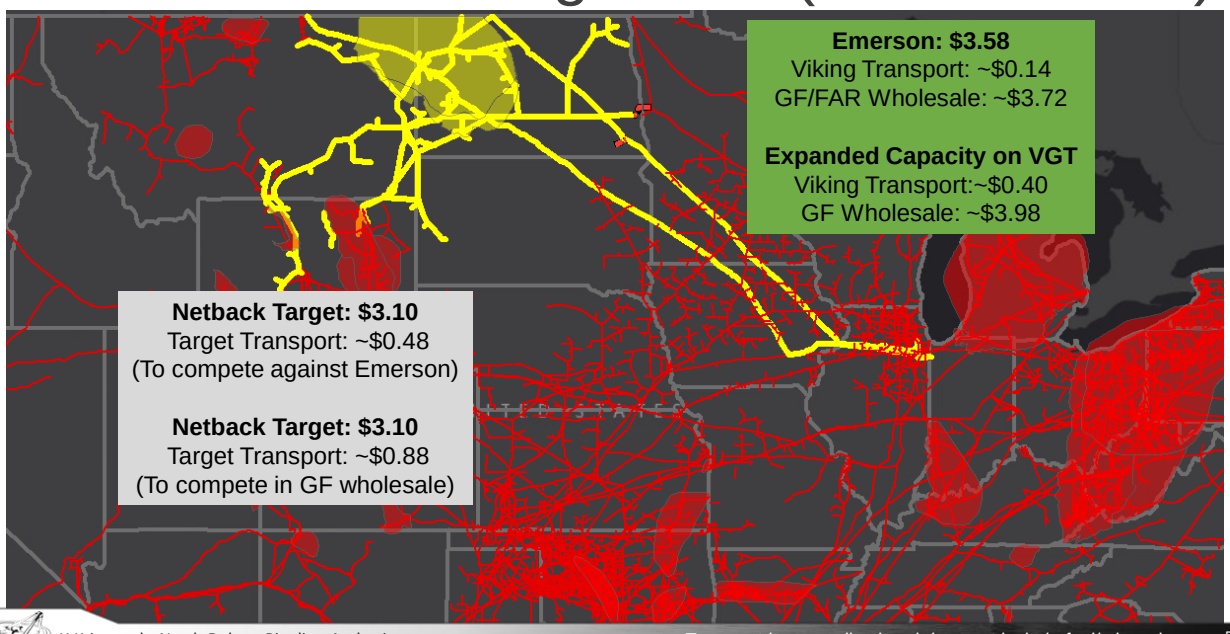
Regional Gas Hub Pricing*



Natural Gas Pricing: 2026 (ICE: 7-18-23)

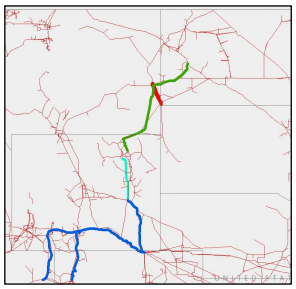


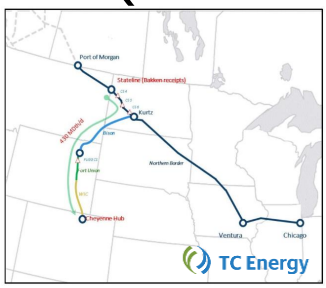
Natural Gas Pricing: 2026 (ICE: 7-18-23)



Value of a Dekatherm (MMBTU)

WBI Grasslands
94,000 Dekatherms
Per Day





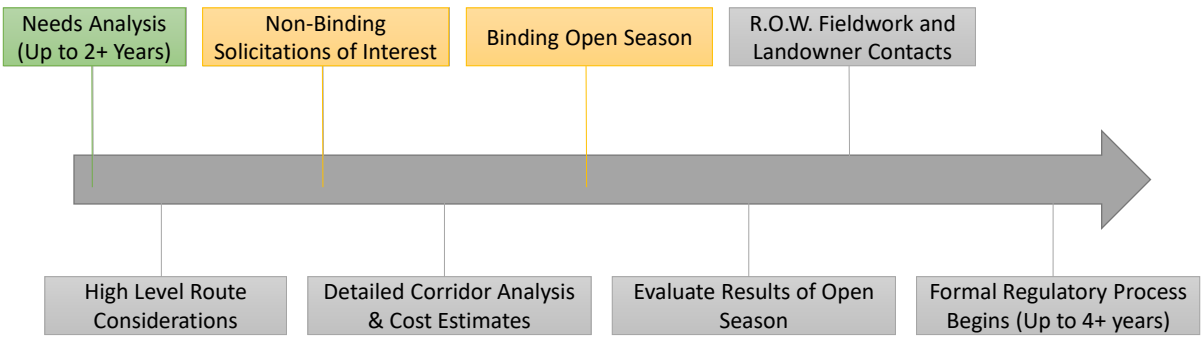
Bison XPress
430,000 Dekatherms
Per Day

Combined Oil and Natural Gas Tax Value

- Combined 524,000 Dekatherms per day of needed gas takeaway capacity
- $3.30* in oil/gas tax value per Dekatherm x 524,000 Dekatherms = $1,745,400 per day
- **<u>$637+ Million</u> per year in oil and natural gas taxes to the State of North Dakota**

*NDPA Estimate From July 2023 NDIC Meeting

Early Stages of Pipeline Development



HB 1014 – NDPA Related Sections

SECTION 18. AMENDMENT. Section 6-09.7-05 of the North Dakota Century Code is amended and reenacted as follows:

6-09.7-05. Establishment and maintenance of adequate guarantee funds - Use of strategic investment and improvements fund.

The Bank of North Dakota shall establish and at all times maintain an adequate guarantee reserve fund in a special account in the Bank. The Bank may request the director of the office of management and budget to transfer funds from the strategic investment and improvements fund created by section 15-08.1-08 to maintain one hundred percent of the guarantee reserve fund balance. Transfers from the strategic investment and improvements fund may not exceed a total of ~~eighty~~one hundred forty million dollars. Moneys in the guarantee reserve fund are available to reimburse lenders, including the Bank, for guaranteed loans in default. The securities in which the moneys in the reserve fund may be invested must meet the same requirements as those authorized for investment under the state investment board. The income from such investments must be made available for the costs of administering the state guarantee loan program and income in excess of that required to pay the cost of administering the program must be deposited in the reserve fund. The amount of reserves for all guaranteed loans must be determined by a formula that will assure, as determined by the Bank, an adequate amount of reserve.

SECTION 30. EFFECTIVE DATE. Section 18 of this Act becomes effective July 1, 2025.

HB 1014 – NDPA Related Sections

SECTION 20. AMENDMENT. Section 54-17.7-01 of the North Dakota Century Code is amended and reenacted as follows:

54-17.7-01. North Dakota pipeline authority - Legislative intent.

There is created the North Dakota pipeline authority, which shall be governed by the industrial commission. It is the intent of the legislative assembly that the pipeline authority consider the operations, finances, and market positions of private entities engaged in pipeline activities while carrying out the purposes of this chapter to avoid competing with private entities to the extent possible.

SECTION 21. AMENDMENT. Subsection 3 of section 54-17.7-04 of the North Dakota Century Code is amended and reenacted as follows:

3. Acquire, purchase, hold, use, lease, license, sell, transfer, and dispose of an undivided or other interest in or the right to capacity in any pipeline system or systems, including interconnection of pipeline systems, within or without the state of North Dakota in order to facilitate the production, transportation, distribution, or delivery of energy-related commodities produced in North Dakota ~~as a purchaser of last resort. The obligation of the state may not exceed ten percent of the pipeline authority's acquisition or purchase of a right to capacity in any pipeline system or systems, or interconnection of pipeline systems, and the state's obligation is limited to the funding available from the oil and gas research fund~~. If the authority acquires, purchases, holds, uses, or leases capacity positions, the authority shall sell, transfer, release, or dispose of the capacity positions at intervals that are no more frequent than monthly and in an amount that is equal to or greater than the market rate, but only if the sale, transfer, release, or disposal of the capacity positions is sufficient to cover the expenses and obligations incurred. The authority's contract obligations for the capacity positions are limited to the capacity rates, charges, and terms.

HB 1014 – NDPA Related Sections

SECTION 22. AMENDMENT. Subsection 4 of section 54-17.7-04 of the North Dakota Century Code is amended and reenacted as follows:

4. Borrow money and issue evidences of indebtedness as provided in this chapter, including borrowing from the Bank of North Dakota.

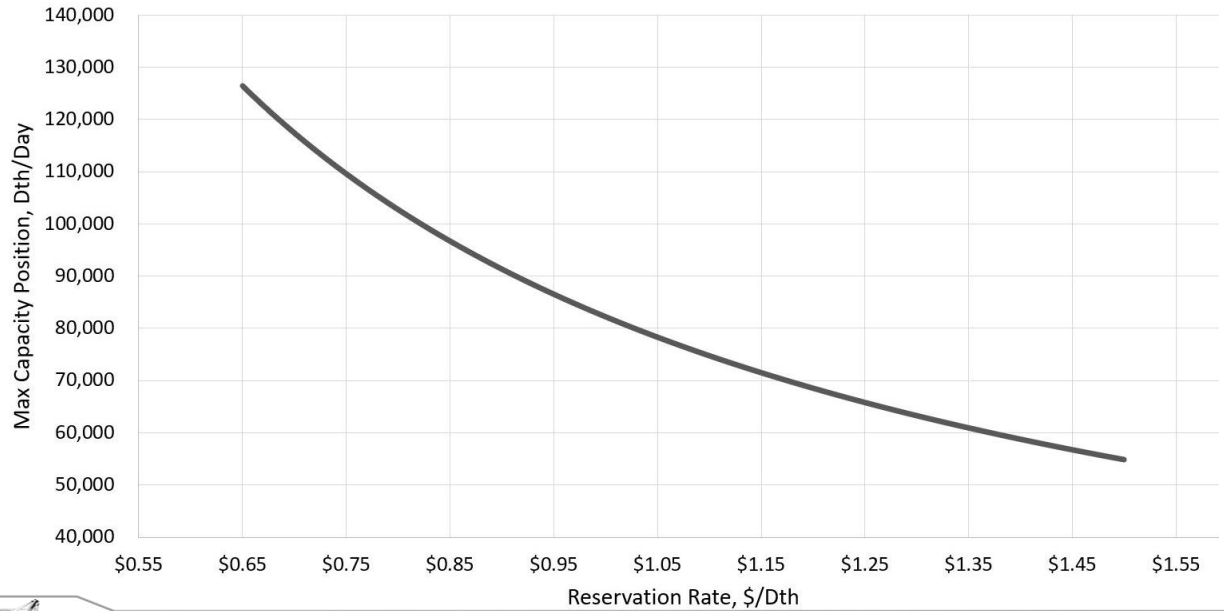
   a. The authority may borrow up to sixty million dollars through a line of credit from the Bank. The interest rate on the line of credit must be the prevailing interest rate charged to North Dakota governmental entities.

   b. The line of credit must be guaranteed by reserves under section 6-09.7-05.

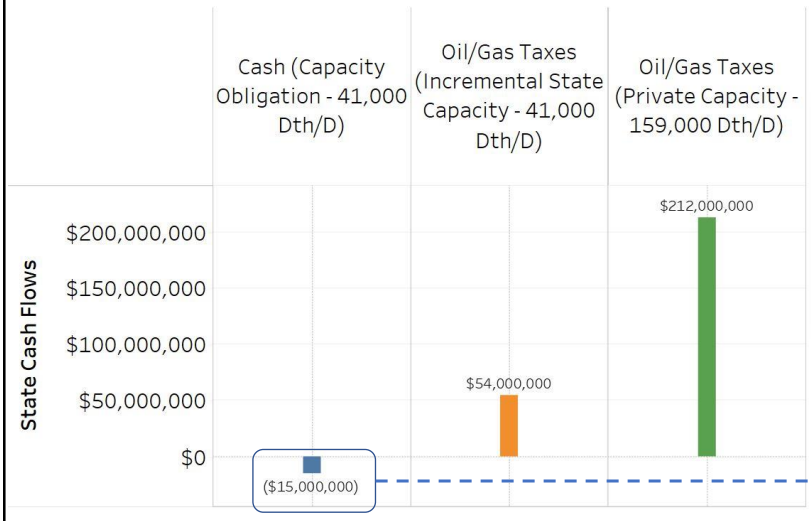
   c. The line of credit may be used to support activities under subsection 3.

   d. The authority shall repay the line of credit from amounts available. If the amounts available on June 30, 2027, are not sufficient to repay the line of credit, the authority shall notify the director of the office of management and budget, and the director of the office of management and budget shall transfer funds from the strategic investment and improvements fund to the Bank for the repayment pursuant to section 6-09.7-05 based on the amount certified by the Bank.

Capacity and Reservation Rate at $30M/Yr



Example Operating Project Cashflows



Hypothetical Project Needs 200,000 Dth/D Capacity Commitment to Move Forward

Options for State Capacity Obligation

- Release (full or partial) to private sector
- Monetize capacity through asset management agreement (AMA)
- Worst case – Continue to pay obligations without recovery or release on 41,000Dth

Contact Information

Justin J. Kringstad, Director
North Dakota Pipeline Authority

600 E. Boulevard Ave. Dept. 405
Bismarck, ND 58505-0840

Phone: (701)220-6227
Fax: (701)328-2820
E-mail: jjkringstad@ndpipelines.com

811 Know what's below. Call before you dig.

Websites:
www.pipeline.nd.gov
www.northdakotapipelines.com

NEW REPORT DEVELOPED FOR NDIC / NDTA / LEC:

Forecasting Resource Adequacy in SPP and MISO Power Pools Through 2035

NDIC Briefing July 28, 2023

John Weeda and Claire Vigesaa, NDTA

Report by:

Isaac Orr, Mitch Rolling and Brent Bennet

Funded by:

The ND Enhance, Preserve and Protect Program

AMERICAN EXPERIMENT NORTH DAKOTA

Life:Powered

Lignite Energy Council

Objectives: Model Resource Adequacy and Cost in MISO and SPP Under Two Scenarios

Step 1: Develop Reasonable Accreditation Values for Wind and Solar

a. 2018-2022 hourly dataset
   i. Peak load availability.
   ii. Net peak load availability.

Step 2: Reference Scenario

- SPP/EIA planned additions (2.9 GW Gas, 1.4 GW Wind, 740 MW Solar, 60 MW Battery Storage) and retirements (2.9 GW Coal, 2.4 GW Gas, 40 MW Other) by 2035.
- Replace rest with modeled wind (15.7 GW), solar (23.2 GW), and four-hour storage (9.8 GW)
- Peak load and net load.

Step 3: Ozone Transport Rule (OTR) and Coal Combustion Residual (CCR) Scenario

- Loss of 22 GW of coal and 6.3 GW of gas by 2035.
- Replace with natural gas (2.9 GW), wind (69.7 GW), solar (101.7 GW), and four-hour storage (29.9 GW).
- Peak load and net load.

Falling Reserve Margins in SPP

- In 2022 SPP expected to see its reserve margin fall from 22 percent to 13.6 percent by planning year 2027, approaching the then-planning reserve margin of 12 percent.
- SPP has since updated its planning reserve margin to 15 percent.

Figure 2: SPP BA Area Planning Reserve Margin Summary

Wind and Solar ELCC Methodology Reversed At FERC

- SPP had planned to base wind and solar accreditation on their effective load carrying capacities (ELCC).
- After initially being approved by FERC, the Commission reversed its decision arguing all generators should be required to undergo an ELCC analysis, not just wind and solar.
- FERC Commissioners also disagreed on whether SPP had failed to define seasonal net peak load.
- This leaves the accreditation of wind and solar in limbo as SPP continues to go through the FERC rehearing process.

FERC reverses its approval of SPP's capacity accreditation plan for wind, solar resources

Published March 7, 2023

Ethan Howland
Senior Reporter

Laurent Fady via Getty Images

SPP's 2022 Capacity Accreditation

- SPP's 2022 UCAP mix was:
  - 46.3 percent natural gas
  - 35 percent coal
  - 7 percent wind
  - 5.4 percent hydro
  - 3 percent nuclear
  - 2.6 percent petroleum
  - 0.3 percent other
  - 0.2 percent solar

- This mix will change rapidly moving forward based on planned retirements and Environmental Protection Agency (EPA) regulations.

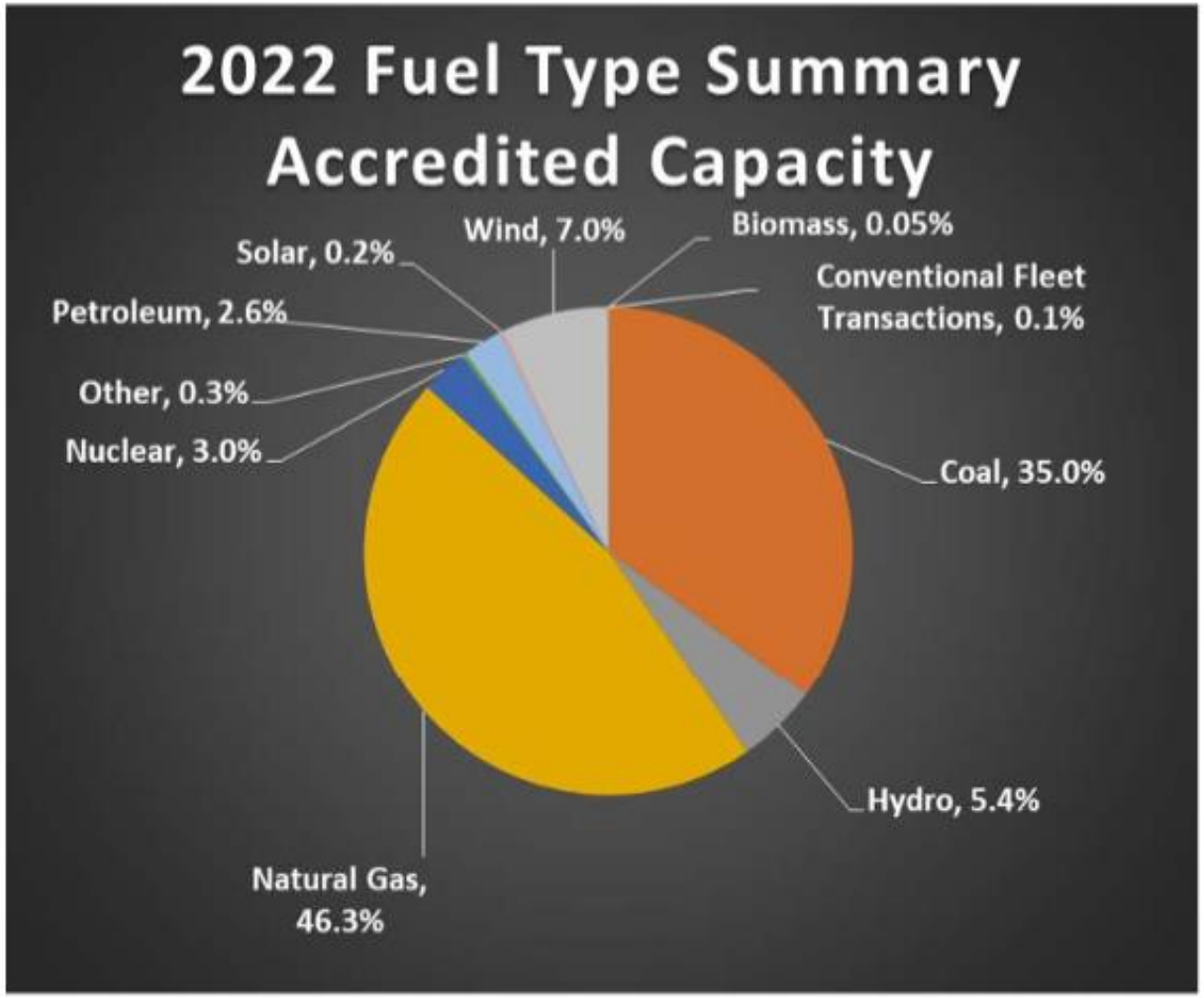
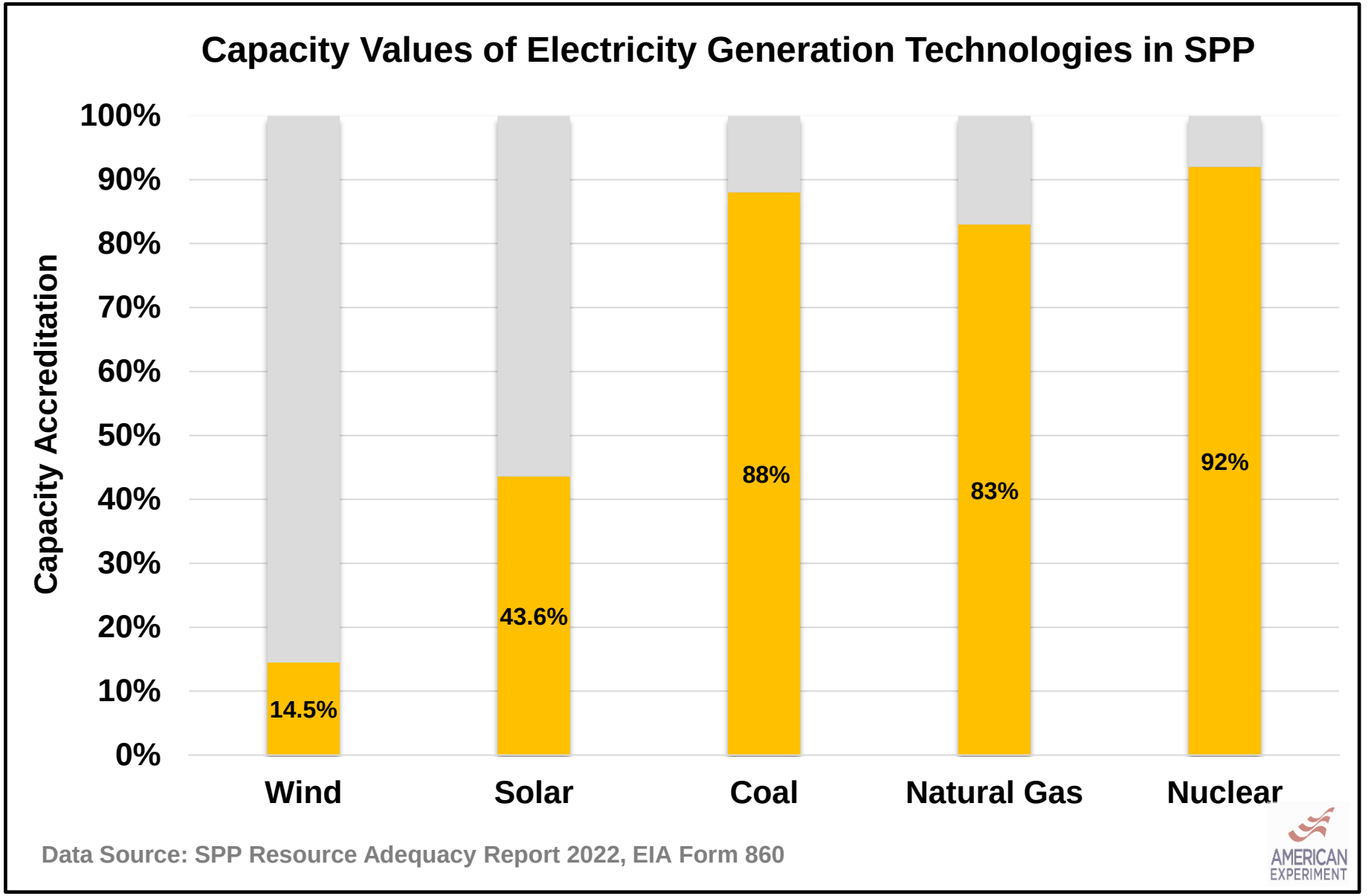


Figure 7: 2022 Summer Season Fuel Type Summary

SPP's 2022 Capacity Accreditation by Resource

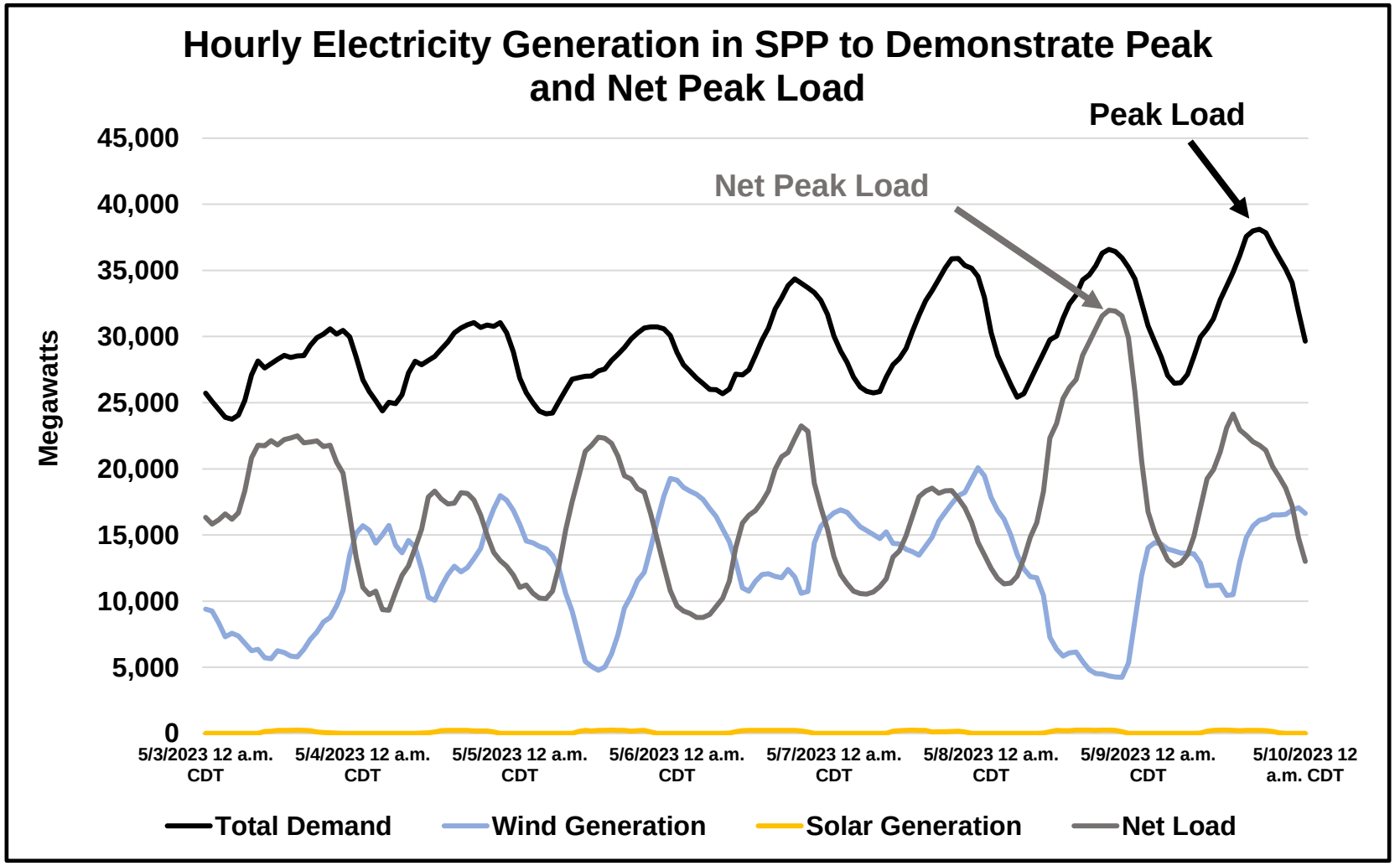
- Technologies are given different accreditation values based on their reliability during times of peak electricity demand.
- Nuclear, coal, and natural gas get the highest accreditation values.
- Wind and solar get much lower accreditation values.



Methodology- Developing a Standardized Capacity Accreditation for Renewable Resources

Assess wind and solar variability during peak load and net peak load hours

- **Peak Load:** The hours with the highest electricity demand.
- **Net peak load:** Gross demand minus wind and solar generation, which allows us to assess the highest demand hours where wind and solar output is the lowest. This is the standard new wind and solar resources should be judged by going forward.



Methodology- Developing a Standardized Capacity Accreditation for Renewable Resources in SPP

- SPP results utilizing this method
- Used the last 4 years of data from EIA Hourly Grid Monitor and Form 923. Peak and net peak occurred on July 19, 2022, and August 6, 2019, respectively.
- Highest Certainty Deliverability (HCD) to assess wind and solar accreditation.
  - Sample size of 2,000 hours for wind & solar of the highest peak & net peak hours across 4 years.
  - Took the mean of the lowest 25 percent of wind and solar output during those hours to come up with our accredited capacity values for peak and net peak.
- Using this methodology, we developed peak capacity and net peak capacity values for wind and solar.

	Peak Accreditation	Net Peak Accreditation
Wind	11.8%	7.5%
Solar	16.4%	20.4%

How does the ND Study's HCD Approach Differ from SPP's Proposed New Seasonal ELCC Approach?

- HCD peak accreditation values for wind and solar are consistent with SPP's ELCC values (summer and winter for wind, winter for solar).
- HCD net peak accreditation values for wind and solar are lower than SPP's ELCC values.

<u>HCD approach is valuable for a few reasons</u>:

- As more wind & solar are added to the grid, net peak will become more challenging than peak load demand.
- HCD manages the downside of wind & solar at net peak compared to ELCC and is more empirical than the options MISO is considering as they move away from ELCC to a Direct-LOL accreditation approach.

SPP APPROACH

Table 1. Summer Wind ELCC Tier Result

2022 Allocated ELCC Summer Wind by Tier (MW)			
	TIER 1	TIER 2	TIER 3
Tier ELCC (MW)	2,952	404	1,978
Tier Nameplate (MW)	13,211	2,808	16,448
Tier ELCC (%)	22%	14%	12%

Table 2. Winter Wind ELCC Tier Result

2022 Allocated ELCC Winter Wind by Tier (MW)			
	TIER 1	TIER 2	TIER 3
Tier ELCC (MW)	2,949	654	2,083
Tier Nameplate (MW)	11,745	4,274	16,448
Tier ELCC (%)	25%	15%	13%

Table 3. Summer Solar ELCC Tier Result

2022 Summer ELCC Solar			
	TIER 1	TIER 2	TIER 3
Tier ELCC (MW)	181	0	202
Tier Nameplate (MW)	235	0	327
Tier ELCC (%)	77%	0%	62%

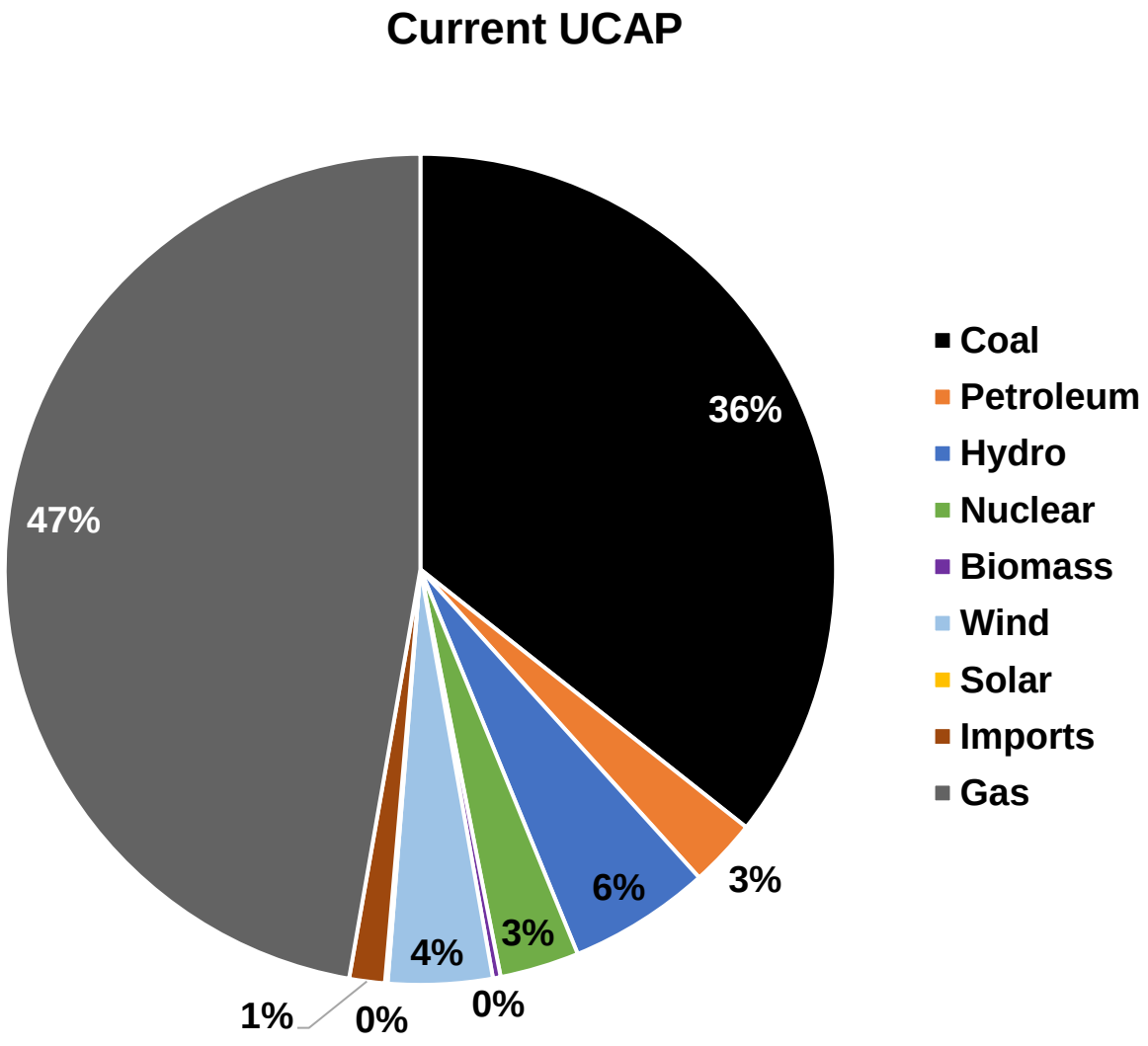
Table 4. Winter Solar ELCC Tier Result

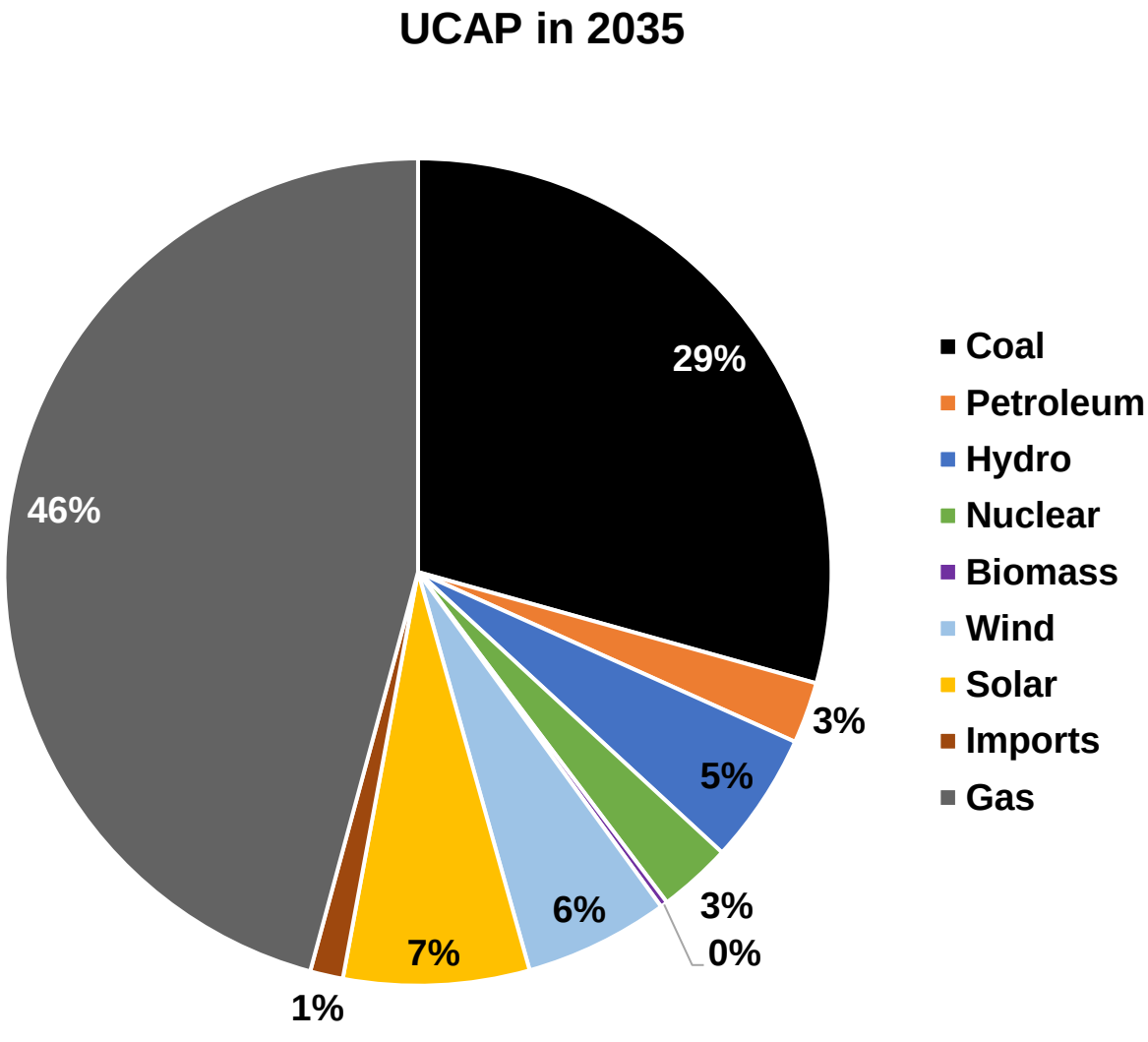
2022 ELCC Winter Solar			
	TIER 1	TIER 2	TIER 3
Tier ELCC (MW)	87	0	86
Tier Nameplate (MW)	235	0	327
Tier ELCC (%)	37%	0%	26%

HCD ALTERNATIVE APPROACH

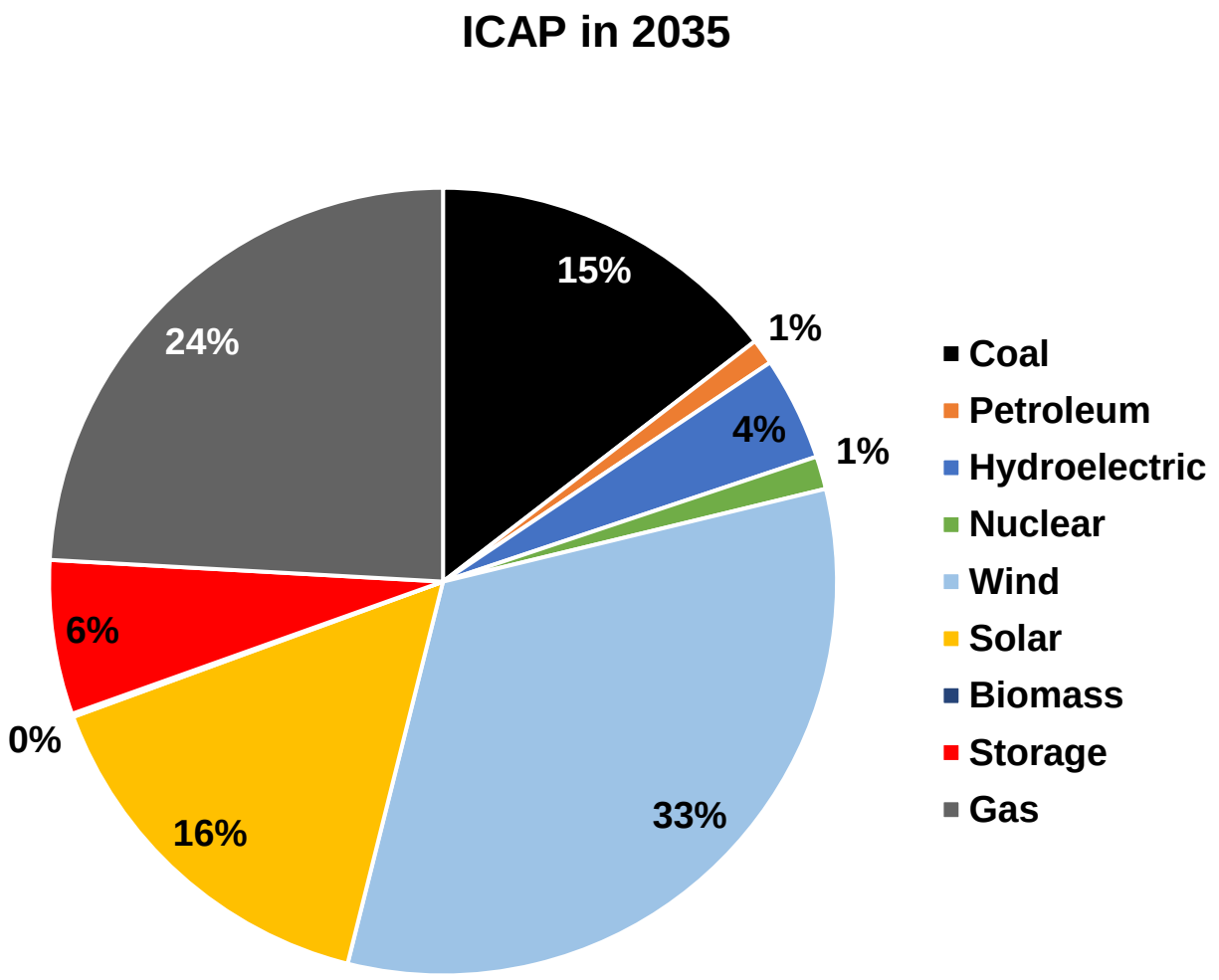
Highest Certainty Deliverability	Peak Accreditation	Net Peak Accreditation
Wind	11.8%	7.5%
Solar	16.4%	20.4%
Reserve Margin	12.0%	12.0%

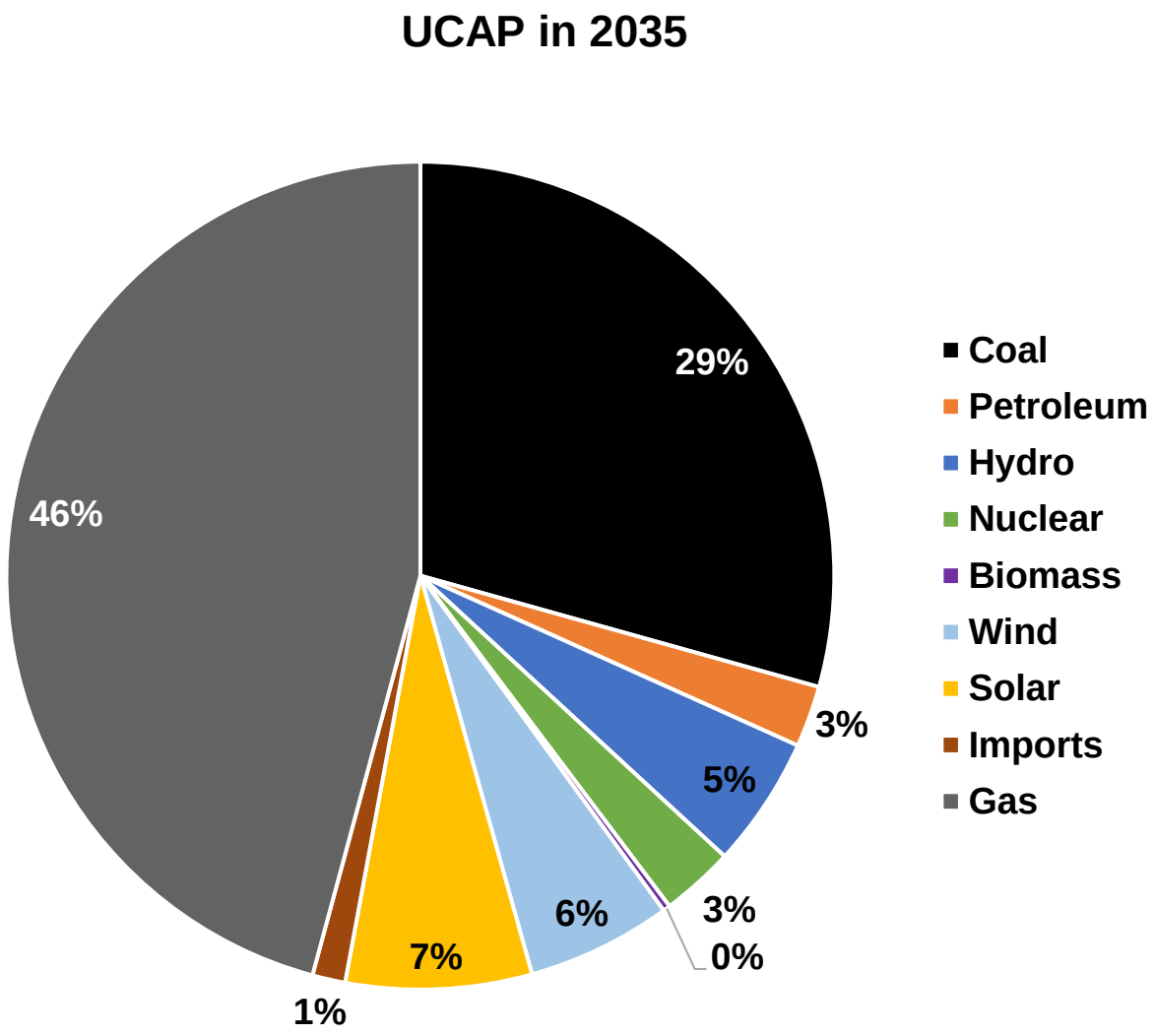
Reference Scenario: Current SPP UCAP Mix vs. 2035



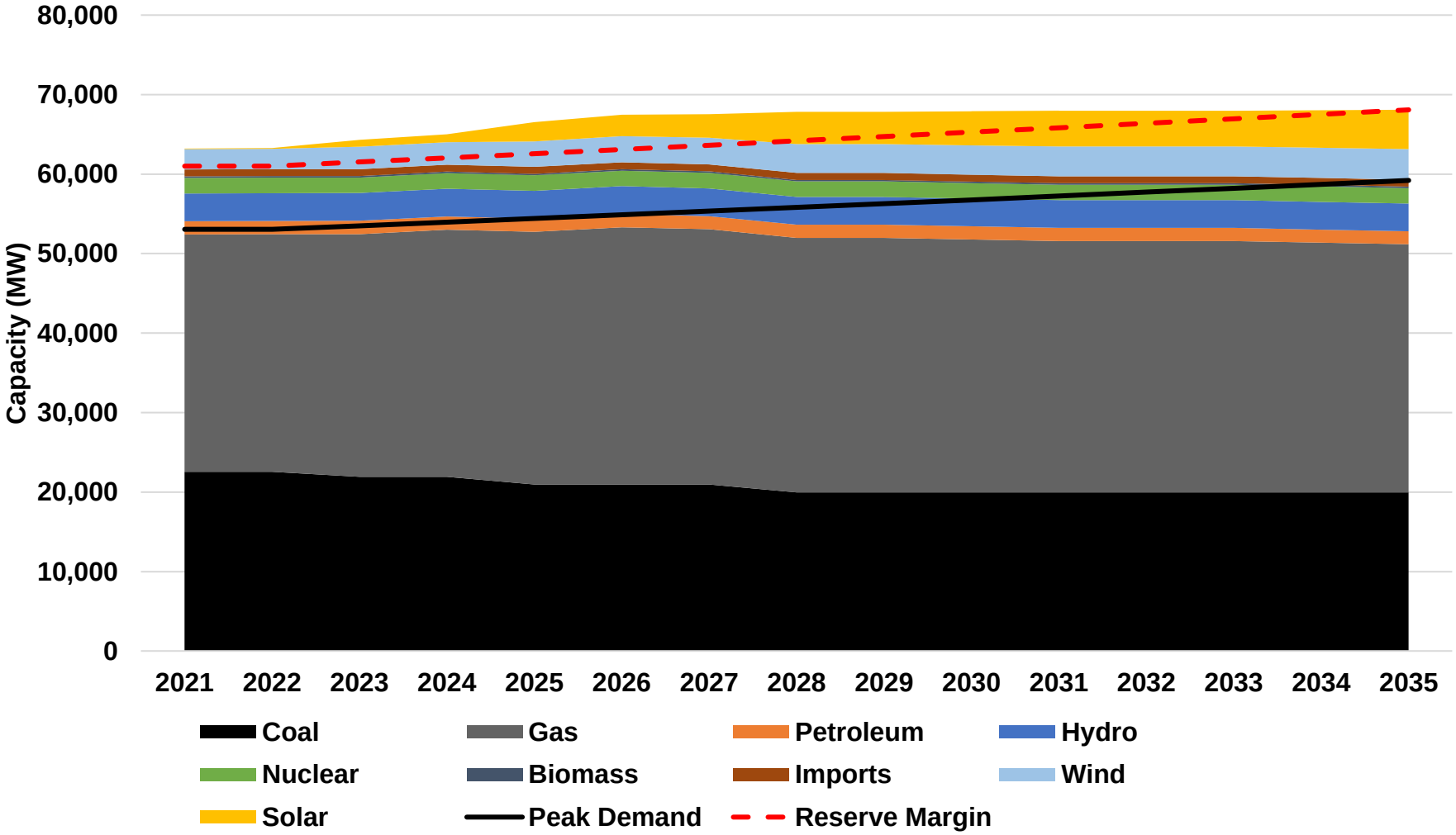


Reference Scenario: 2035 SPP ICAP vs. UCAP





Even With No EPA impact, SPP Relying Upon Weather & Imports for Reserve at SPP



Year	Reserve Margin
2022	19%
2023	20%
2024	21%
2025	22%
2026	23%
2027	22%
2028	22%
2029	20%
2030	20%
2031	19%
2032	18%
2033	17%
2034	16%
2035	15%

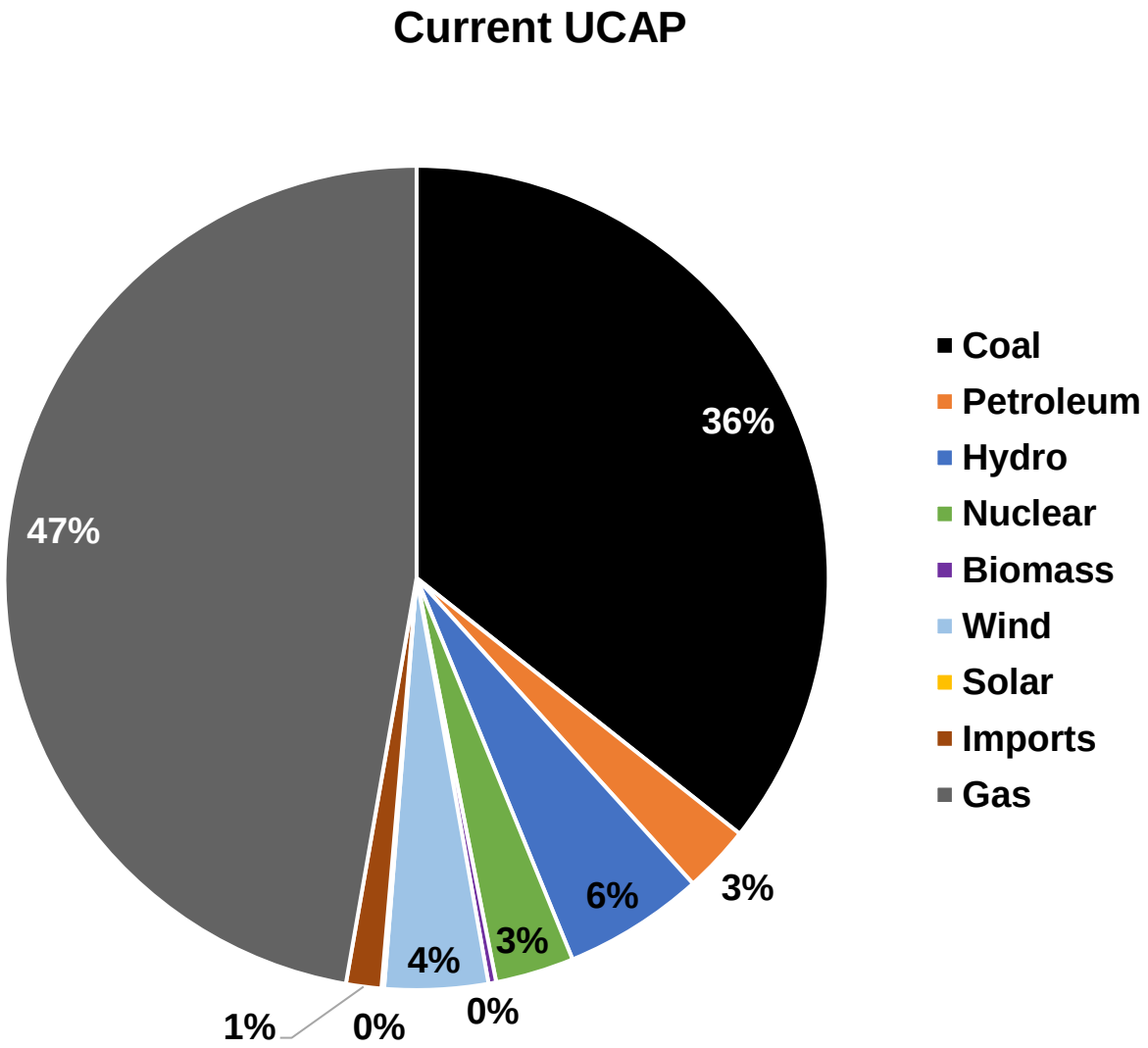
Estimated firm capacity using net peak load capacity accreditation values for wind (7.5%) and solar (20.4%), 92% for nuclear, 88% for coal, 83% for natural gas, and 90% for other thermal generators.

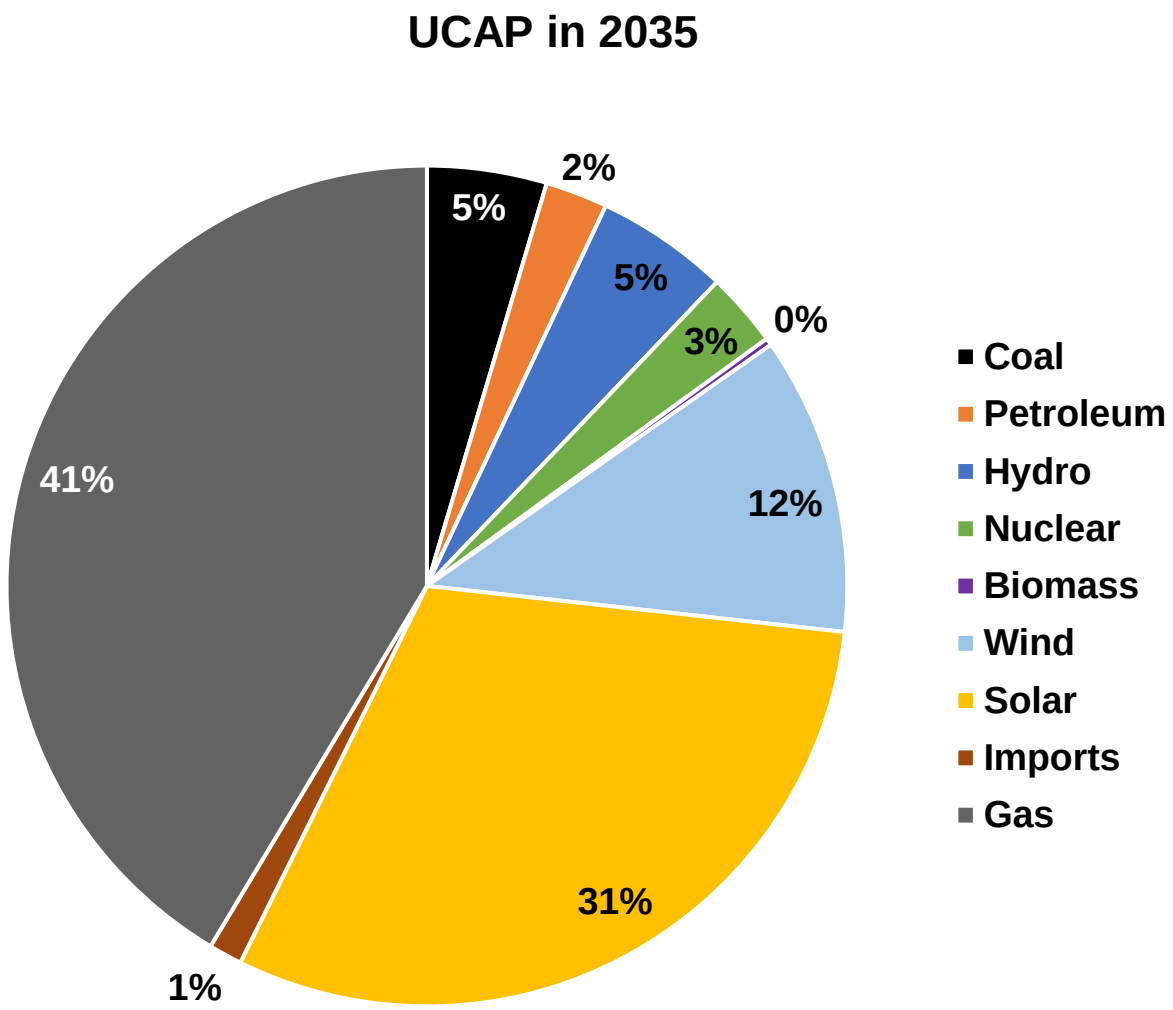
Ozone Transport Rule (OTR) and Coal Combustion and Residual (CCR) Scenario at SPP

Ozone Transport Rule (OTR) and Coal Combustion Residual (CCR) Scenario

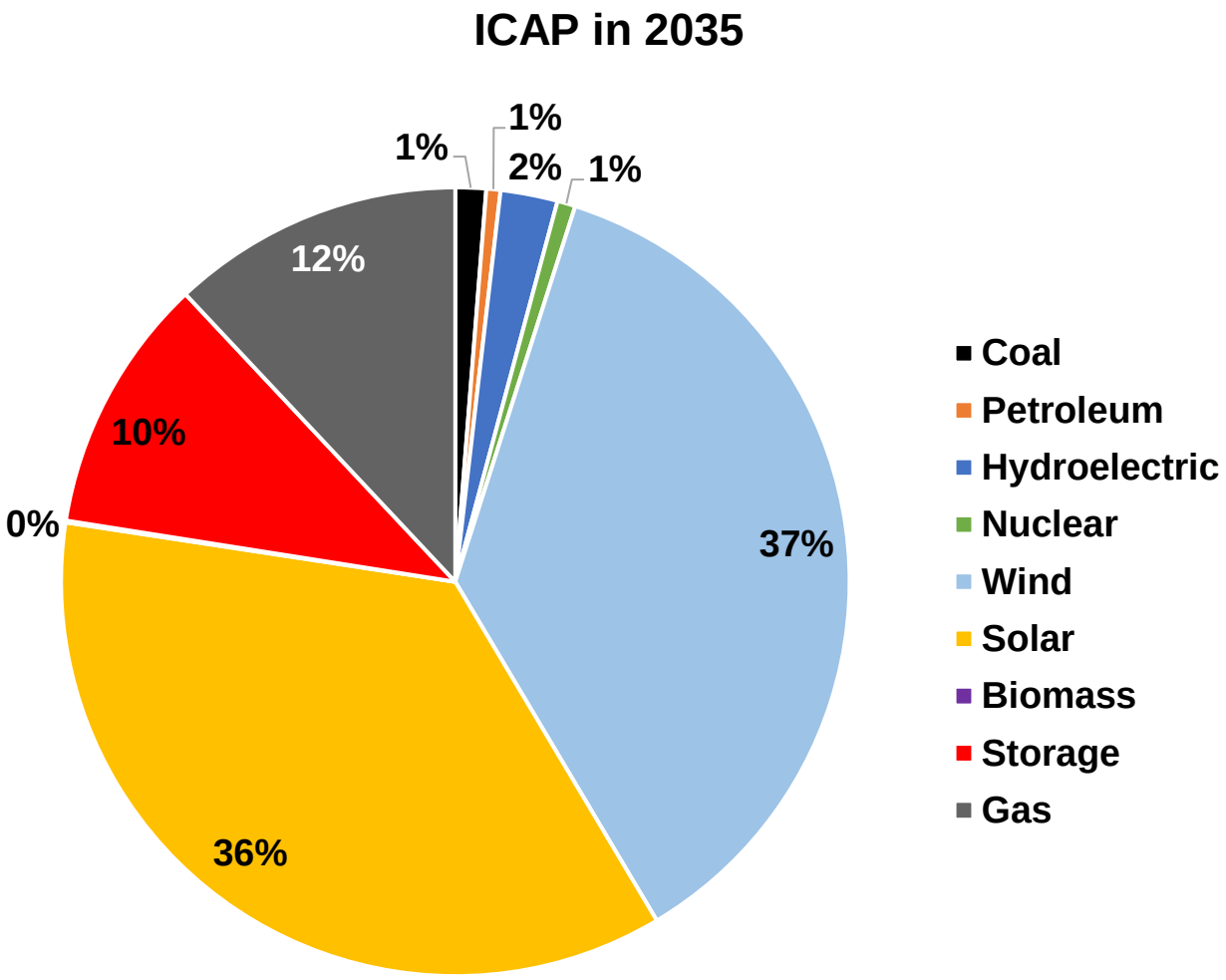
- Assumes all of the closures in the reference scenario will occur.
- Increases closures due to OTR and CCR rules.
- The CCR rule is less impactful in SPP than in MISO, so the analysis combines both rules into one scenario.
- The ORT & CCR scenario experiences a loss of 22 GW of coal and 6.3 GW of gas by 2035.
- This capacity will be replaced with natural gas (2.4 GW), wind (65 GW), solar (94.7 GW), and four-hour storage (32.4 GW).

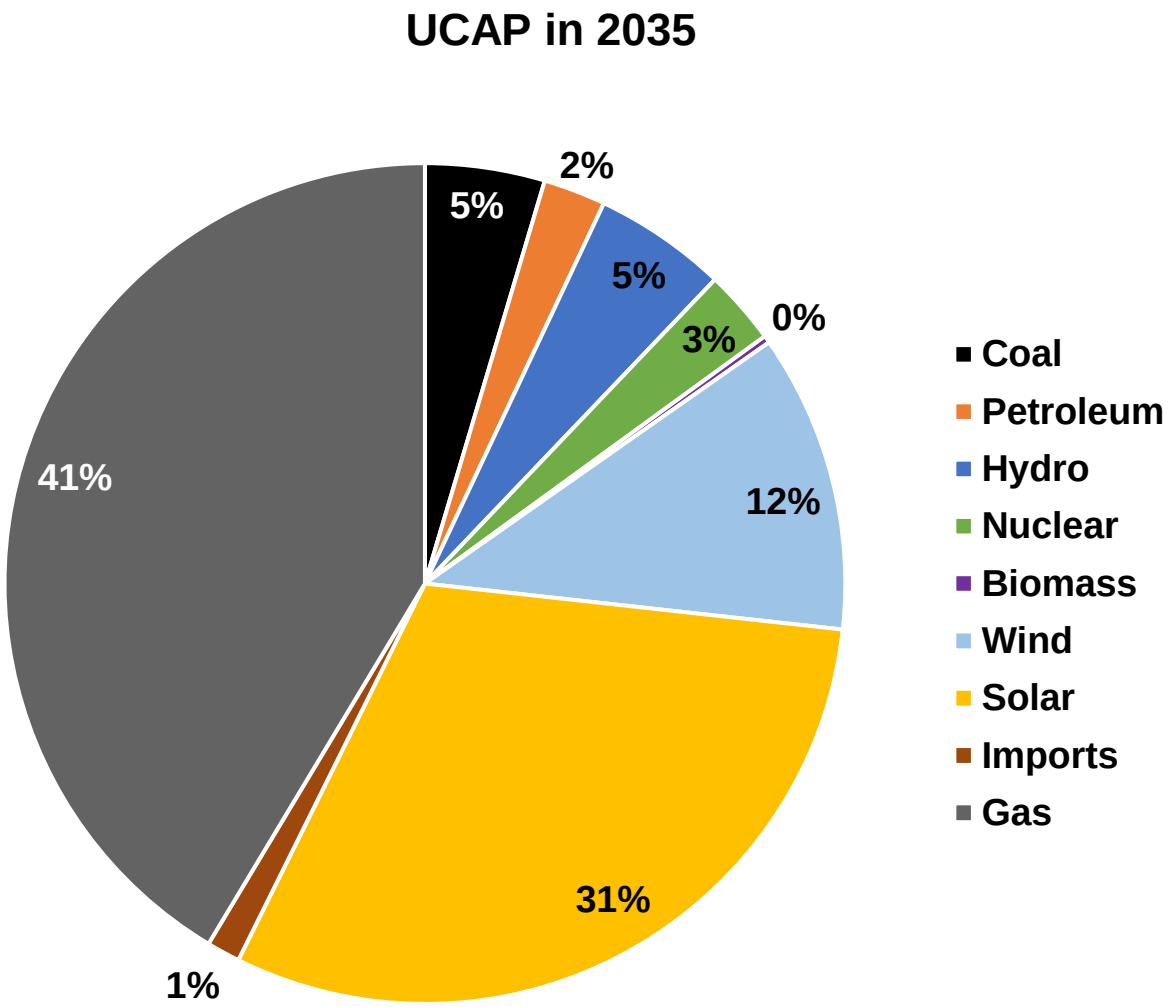
OTR & CCR Scenario: Current SPP UCAP Mix vs. 2035



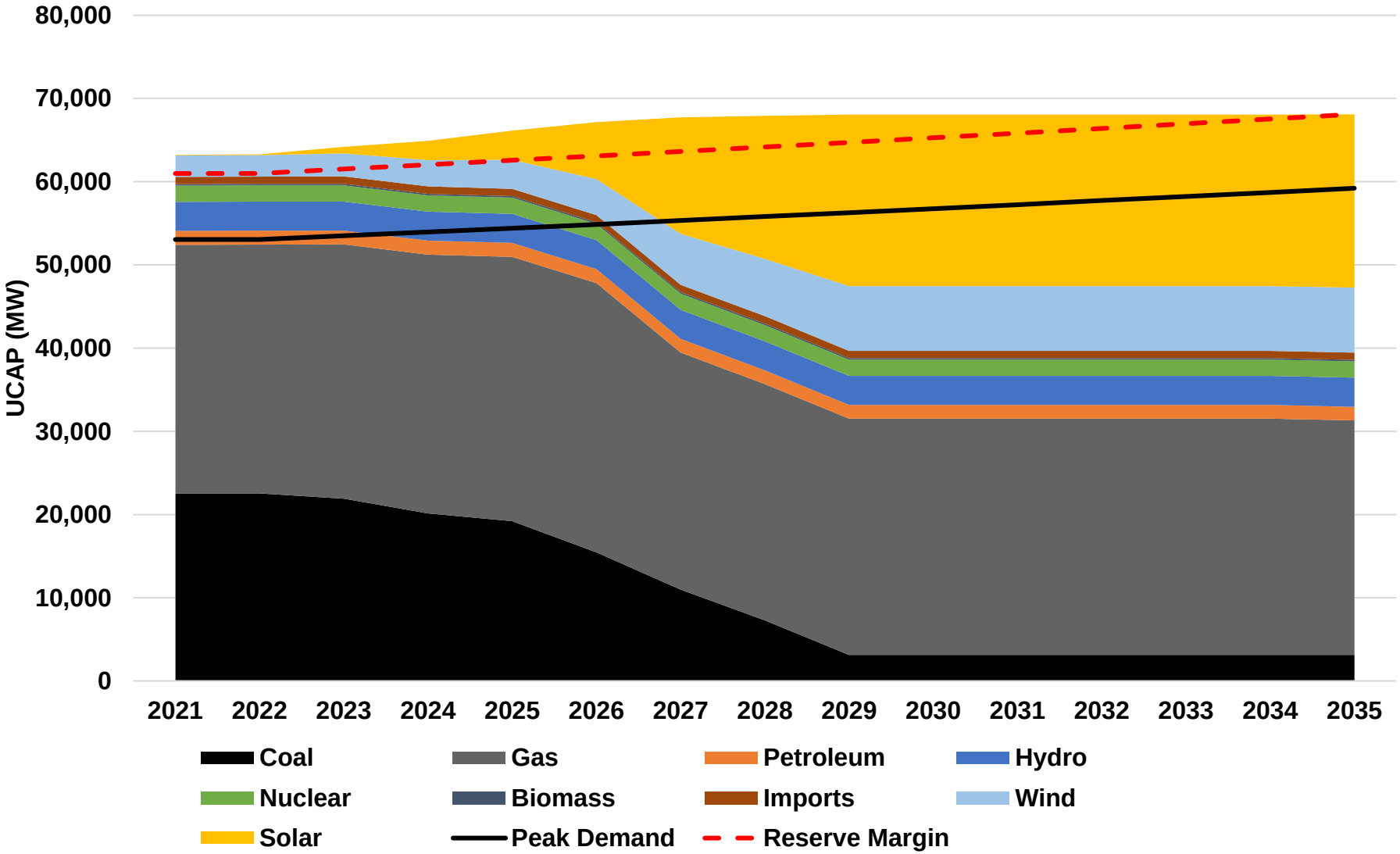


OTR & CCR Scenario: Current SPP UCAP Mix vs. 2035





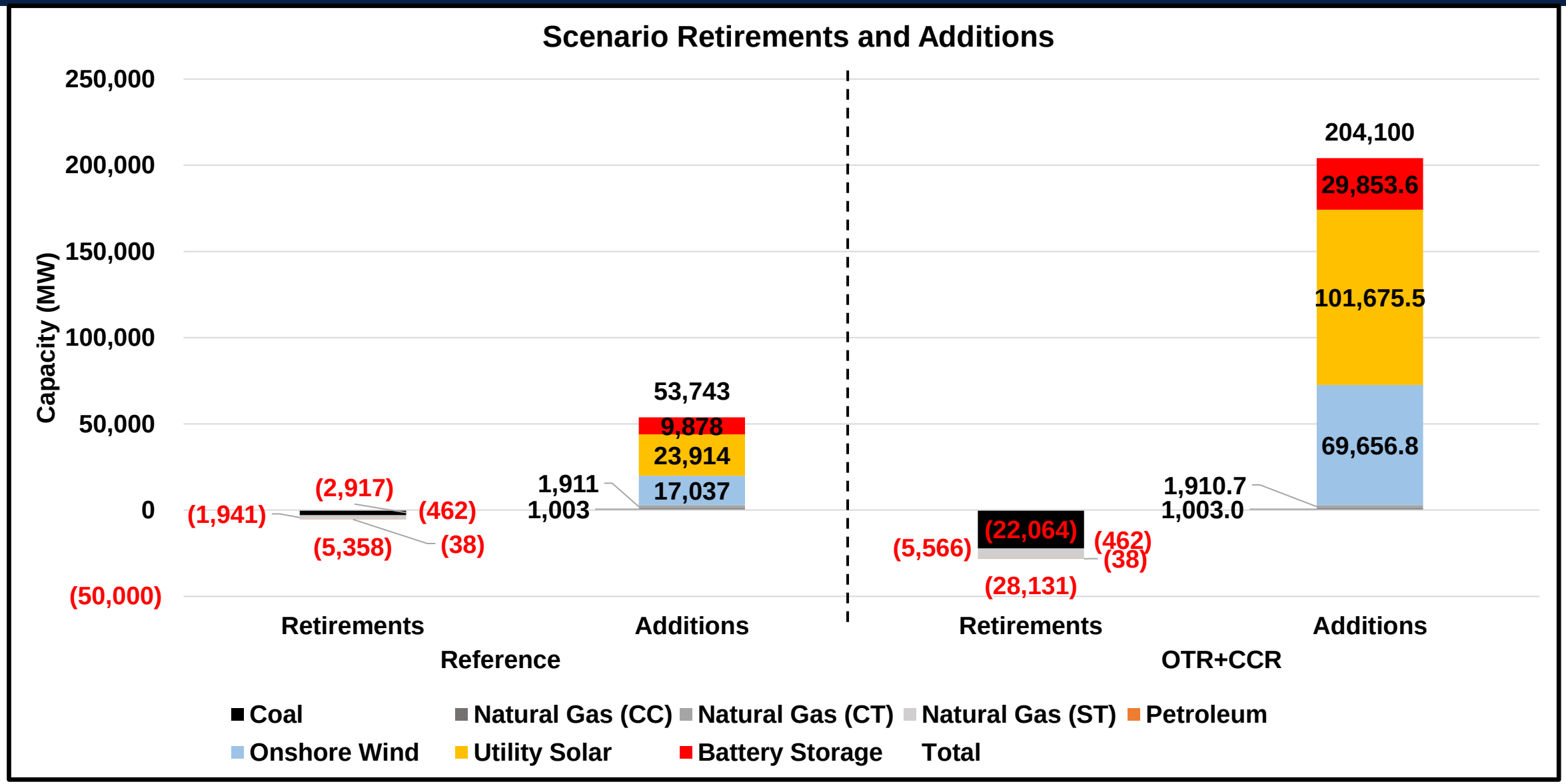
OTR & CCR SPP Scenario: Capacity Shortfall Risk



Year	Reserve Margin
2022	19%
2023	20%
2024	20%
2025	21%
2026	22%
2027	21%
2028	20%
2029	19%
2030	18%
2031	18%
2032	17%
2033	16%
2034	16%
2035	15%

Estimated firm capacity using net peak load capacity accreditation values for wind (7.5%) and solar (20.4%), 92% for nuclear, 88% for coal, 83% for natural gas, and 90% for other thermal generators. Under this scenario, SPP is dependent on intermittent resources to meet peak load by 2026.

In Summary: If EPA Rules Force Early Retirements of SPP Resources by 2035



Methodology- Cost at SPP

Assessment of the retail cost of replacing existing coal and natural gas resources with planned natural gas, wind, solar, and battery storage capacity.

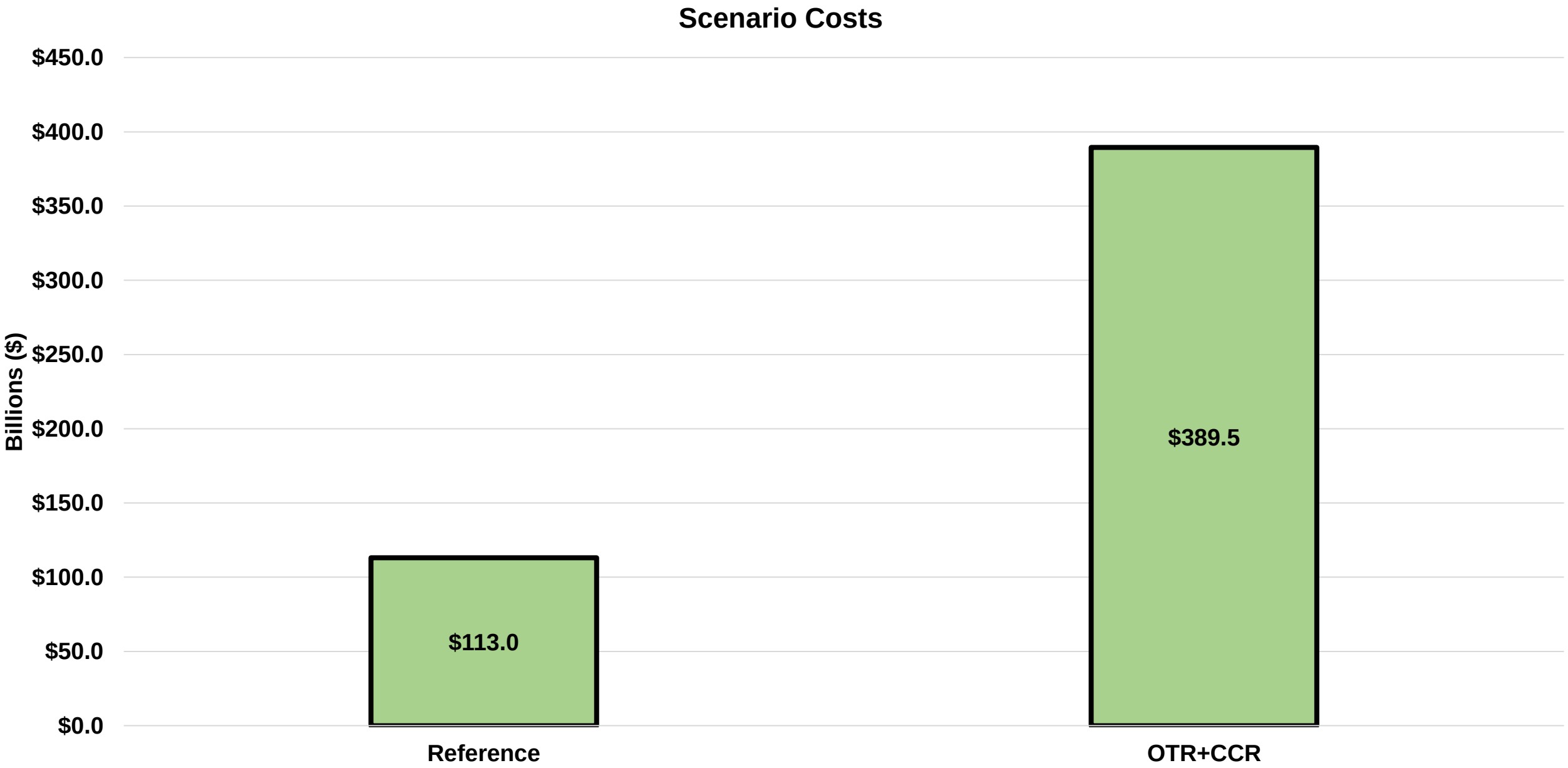
- SPP Interconnect queue data were used to input 2.9 GW of new natural gas to replace retiring coal and gas facilities.
- Wind, solar, and 4-hour battery storage capacities were determined based on a cost-optimized model.

Assumptions include:

- Capital costs based on weighted average of SPP regions in EIA's Assumptions to the Electricity Market Module.
- Rate of return assumption of 9.88 percent with debt/equity split of 47.06/52.94 based on the rate of return and debt/equity split of the six-largest investor-owned utilities in SPP.
- Property tax costs of 1.3 percent of the rate base.
- Transmission costs in accordance with NREL's estimates for achieving 80 percent wind and solar and average cost of active projects at the point of interconnect, which is about $48,000 per MW of wind and solar installed.
- New natural gas fuel cost of $4.49 per MMBtu.

Capital Costs:
https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf

SPP Costs for Each Scenario Through 2035



Conclusions in SPP

1. Our findings represent a best-case scenario for reliability due to our HCD accreditation standard.

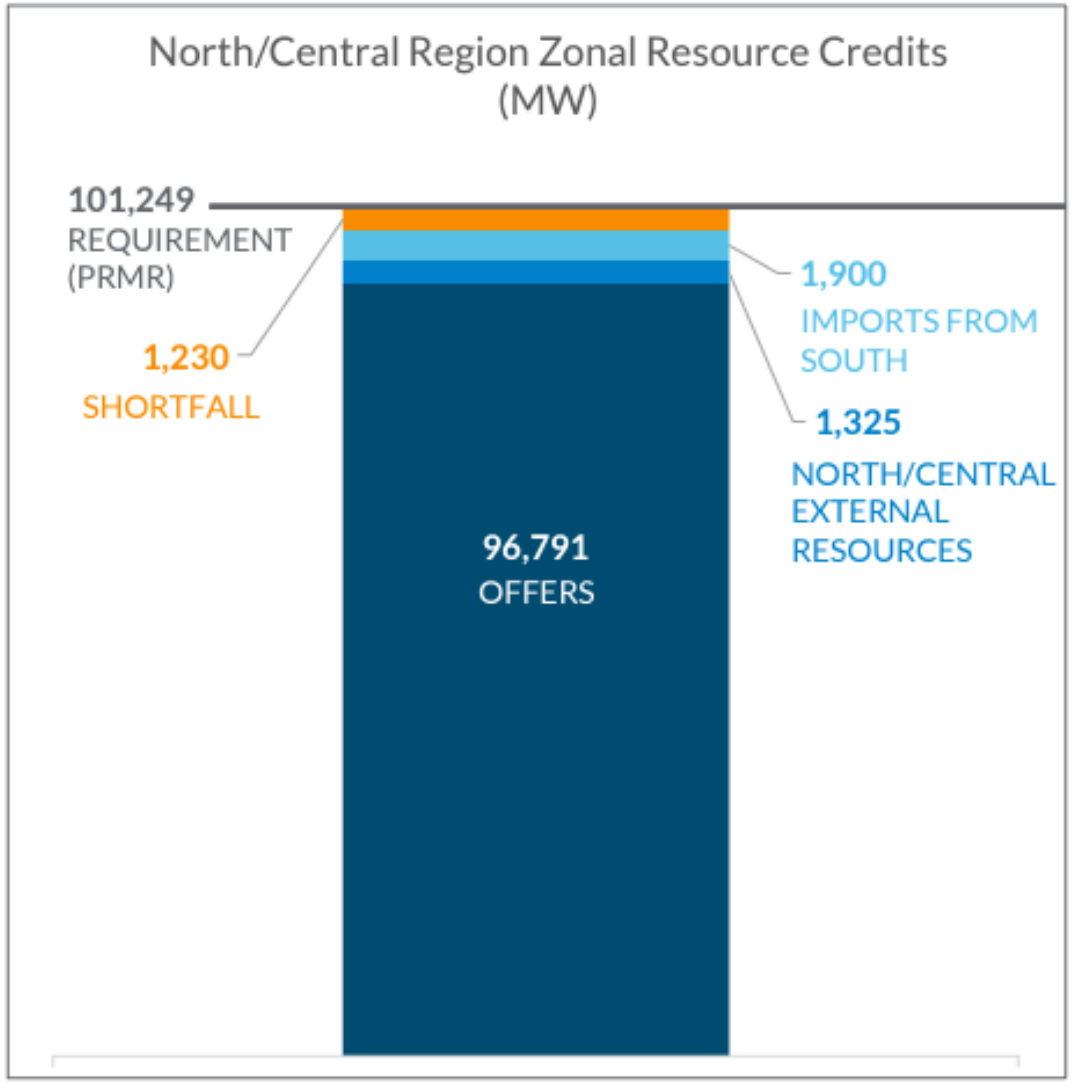
2. Different standards, such as seasonal accreditation ELCC being explored by SPP, will produce varying levels of reliability that must be examined in light of these results.

3. Costs were relatively modest due to the large amount of thermal capacity remaining on the SPP system through 2035, but costs increase substantially as more thermal retirements occur and Load Responsible Entities (LREs) attempt to replace this lost generation with wind, solar, and battery storage.

4. Policymakers must understand the challenges regarding reliability, resiliency and affordability that are growing every year.

How do the Rules Affect MISO Resource Adequacy?

- MISO resource adequacy is challenged by a changing energy mix.
  - MISO had a 1,200 MW capacity shortfall from the Planning Reserve Margin (PRM) in the summer of 2022.
  - Max Gen Declarations have become more common over the last six years.
- Planned retirements and additions show a continued decline in thermal generation and an increase in weather-dependent renewables.
- Given these trends, there is critical need to assess short term reliability risks to the MISO region.
- MISO capacity auction results released in May 2023 went back to low prices ($10)



MISO's 2022 Capacity Accreditation

- MISO's current UCAP mix is:
  - 41 percent natural gas
  - 30 percent coal
  - 8 percent nuclear
  - 5 percent hydro
  - 3 percent oil
  - 3 percent wind
  - 2 percent solar
  - 2 percent misc.

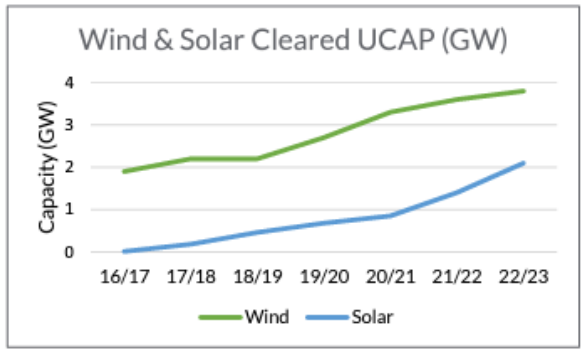
- UCAP is based on MISO's cleared capacity at auction, which is capacity that MISO can reliably call upon and is less than total installed capacity on MISO's grid.

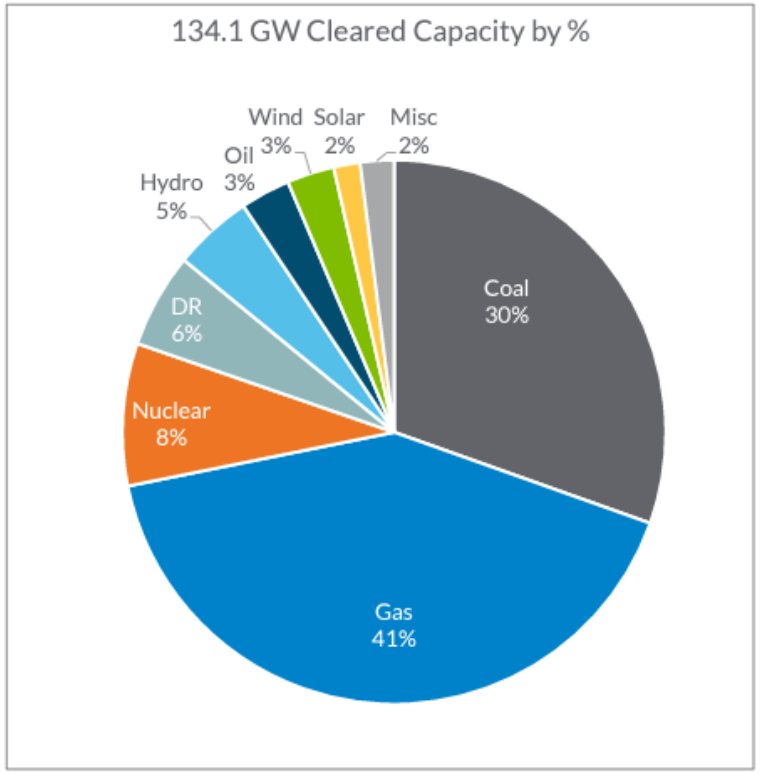
- This mix will change rapidly moving forward.

Although conventional generation still provides the majority of capacity, wind and solar continue to grow

- 2.1 GW of solar cleared this year's auction—an increase of 48% from Planning Year 2021-22 (1.4 GW)

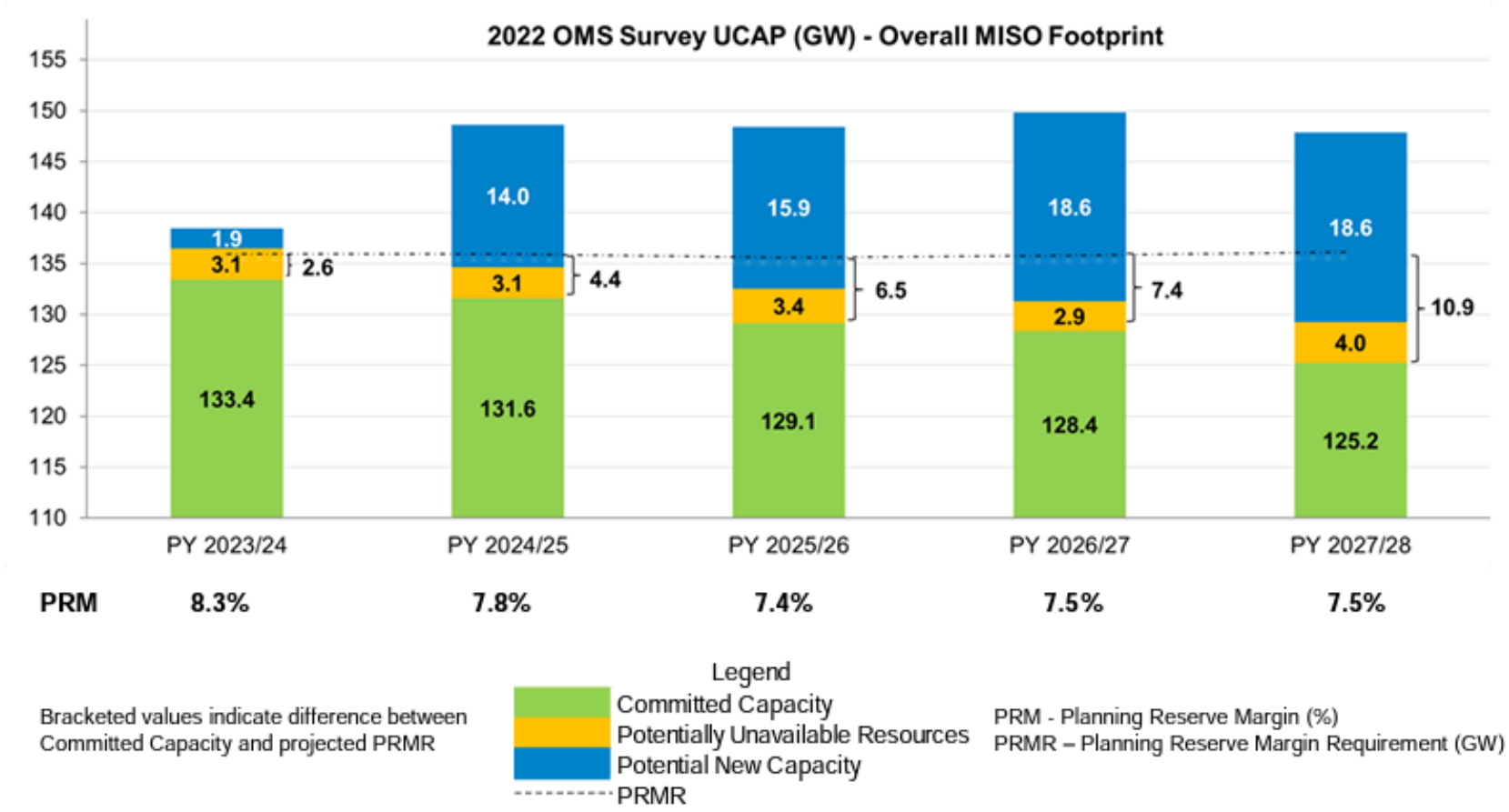
- Similarly, 3.8 GW of wind cleared this year, an increase of 5% compared to last year. (3.6 GW)





Capacity Shortfalls Could Grow Over Time

- The 1,200 MW capacity shortfall in 2022 could grow to 2,600 MW in 2023, increasing the risk of power outages.
- By 2027/2028, the shortfall could reach 10,900 MW if new capacity does not come online.



MISO Recently (since study completion) Updated Accreditation Values for Wind and Solar

- The previous slides may ***overstate*** the amount of UCAP on the system due to MISOs prior capacity accreditation method for wind and solar.
- Wind was assumed to produce 15.5% of potential output during peak hours and new solar was expected to produce 50% for the first year in operation.
- However, wind and solar routinely underperform accreditation causing “Phantom Firm” resources to potentially enter into capacity auctions and the PRM capacity stack.
- MISO is moving toward seasonal accreditation to more accurately accredit wind and solar, but this may or may not solve the problem as rising penetrations of intermittent resources make ***net*** peak loads a larger concern.
- Net peak is gross demand minus wind and solar generation, which allows us to assess the highest demand hours where wind and solar output is the lowest. This is the standard new wind and solar resources should be judged by going forward.

Methodology - Developing a Standardized Capacity Accreditation for Renewable Resources

Assess wind and solar variability during peak load and net peak load hours.

- Used the last 4 years of data from EIA Hourly Grid Monitor and Form 923. Peak and net peak occurred on July 19, 2019, and August 25, 2021, respectively.
- Mean of Lowest Quartile (MLQ) to assess wind and solar accreditation.
  - Sample size of 2000 hours for wind & solar of the highest peak & net peak hours across 4 years.
  - Took the mean of the lowest 25 percent of wind and solar output during those hours to come up with our accredited capacity values for peak and net peak.
- Using this methodology, we developed peak capacity and net peak capacity values for wind and solar.

	Peak Accreditation	Net Peak Accreditation
Wind	7.1%	5.8%
Solar	12.4%	12.0%

How does the ND Study's MLQ Approach Differ from MISO's New Seasonal Accreditation Approach?

- MLQ accreditation values for wind are consistent with MISO's F1-25 values.
- MLQ accreditation values for solar are lower than MISO's F1-25 values but higher than their F1-2039 values.

MLQ approach is valuable for a few reasons:

- MLQ provides consistent metrics for evaluating wind & solar that are independent of future modeling & not linked to significant adjustment of seasonal reserve margins.
- As more wind & solar are added to the grid, net peak will become more challenging than peak load demand.
- MLQ manages the downside of wind & solar at net peak compared to ELCC and is more empirical than the options MISO is considering as they move away from ELCC to a Direct-LOL accreditation approach.

MISO APPROACH

Seasonal Solar Accreditation				
	PY23-24	F1-25	F1-39	Reserve Margin
Winter		1%	1%	25.50%
Spring		35%	2%	24.50%
Summer	45%	43%	3%	7.40%
Fall		6%	5%	14.90%

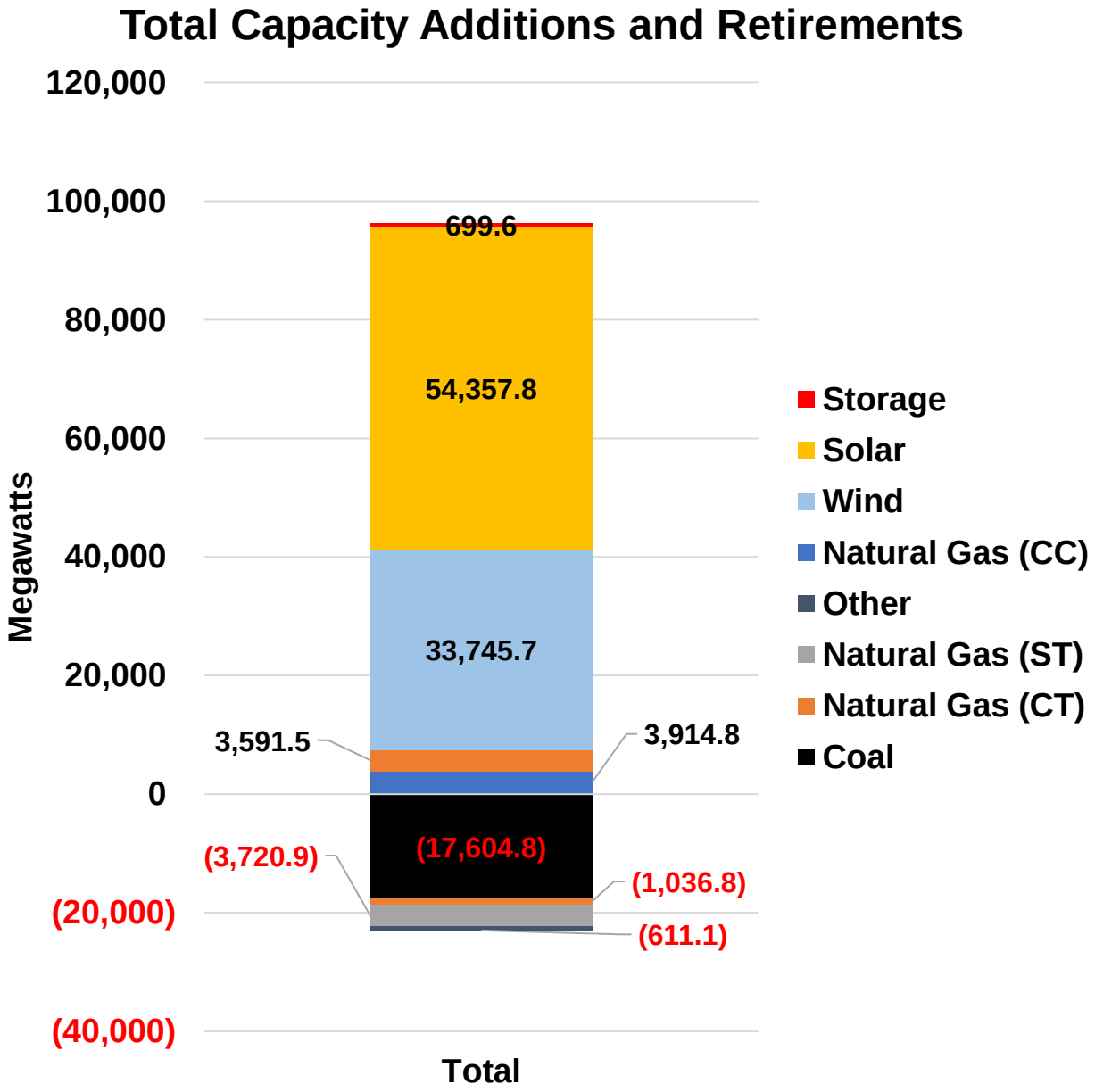
Seasonal Wind Accreditation				
	PY23-24	F1-25	F1-39	Reserve Margin
Winter		15%	10%	25.50%
Spring		13%	20%	24.50%
Summer	10%	7%	11%	7.40%
Fall		7%	12%	14.90%

MLQ ALTERNATIVE APPROACH

Mean of Lowest Quartile	Peak Accreditation	Net Peak Accreditation
Wind	7.10%	5.80%
Solar	12.40%	12.00%
Reserve Margin	15.50%	15.50%

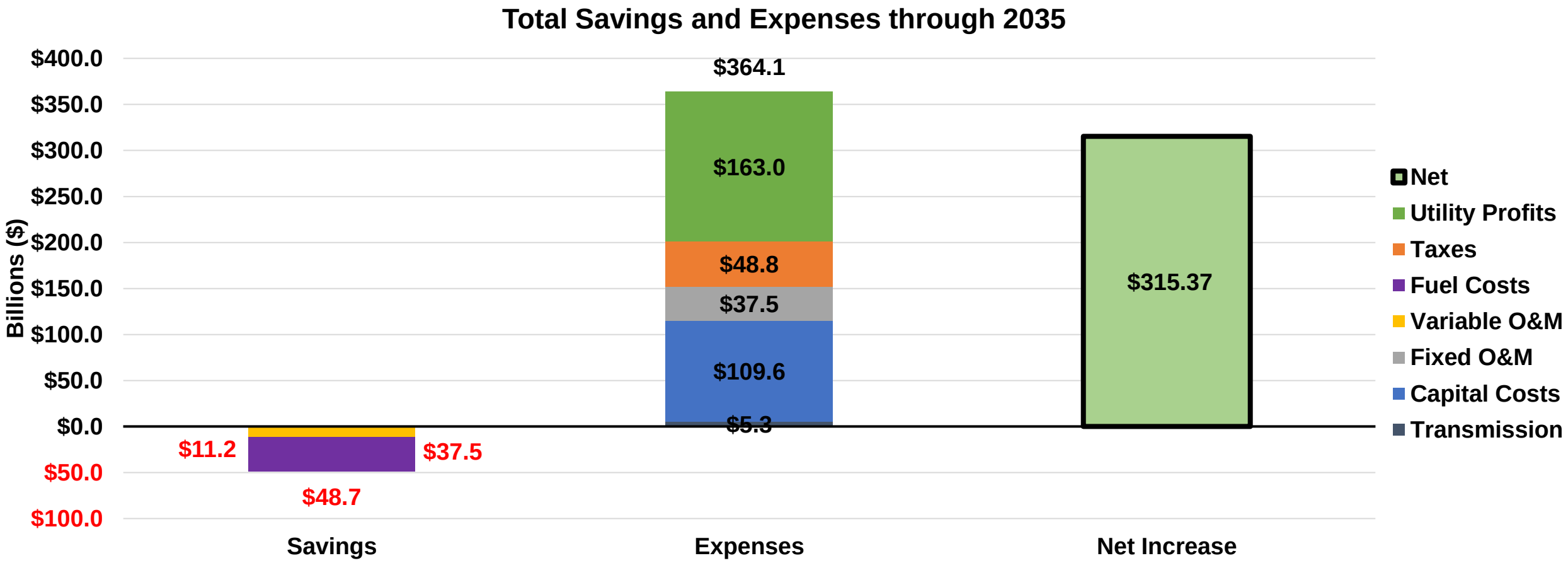
MISO Reference Scenario

- Investigates resource adequacy in MISO by only looking at announced plant retirements and additions.
- It does not include EPA regulation impacts.
- MISO would
  - Retire 17.6 GW of coal.
  - 4.8 GW of natural gas.
  - 600 MW of “other.”
  - Add 7.5 GW of natural gas.
  - 33.7 GW of wind.
  - 54.4 GW solar.
  - and 700 GW storage.

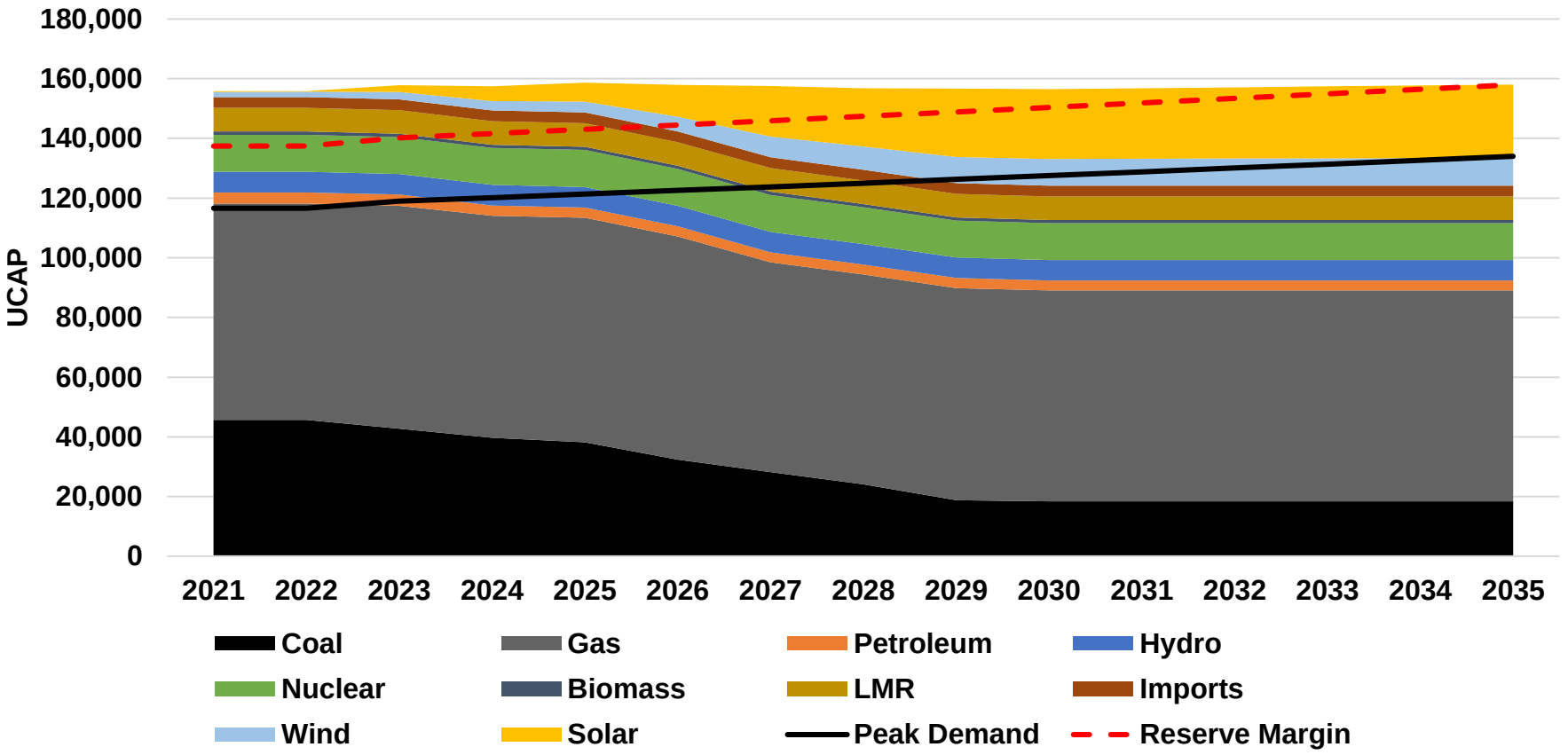


MISO Cost of Reference Scenario

The total additional cost to ratepayers in the Reference Scenario would be $315.4 billion through 2035 using net peak accreditation for wind and solar.



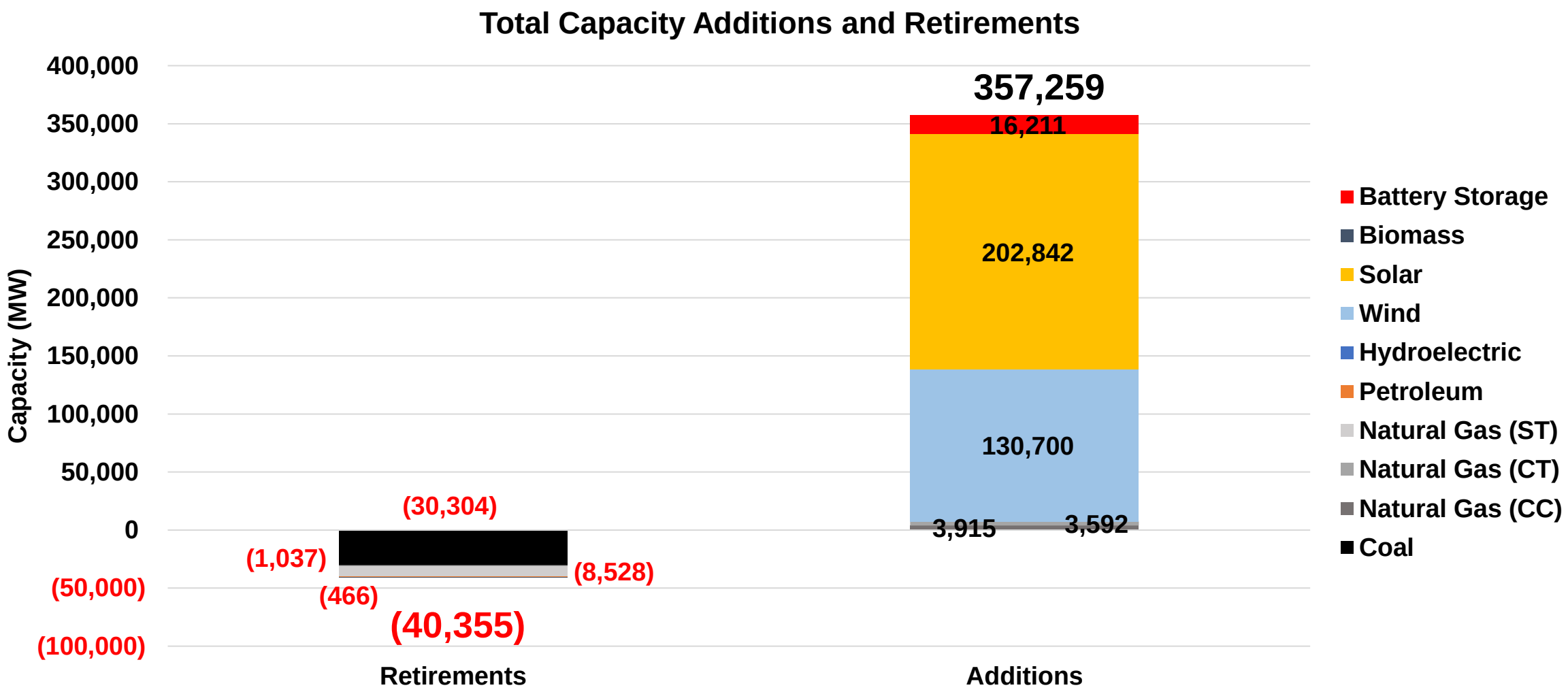
OTR Scenario: Capacity Shortfall Risk



Year	Reserve Margin
2022	34%
2023	33%
2024	31%
2025	31%
2026	**29%**
2027	**27%**
2028	**25%**
2029	**24%**
2030	**23%**
2031	**22%**
2032	**21%**
2033	**20%**
2034	**19%**
2035	**18%**

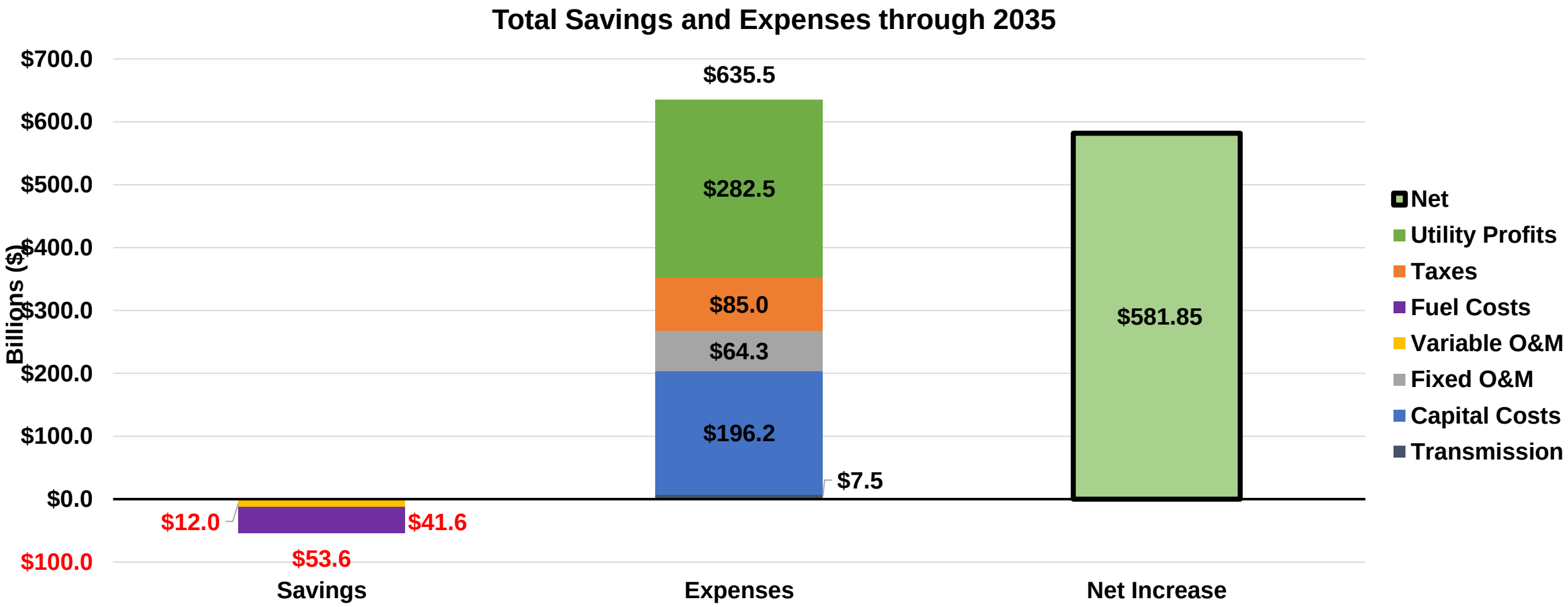
Estimated firm capacity using net peak load capacity accreditation values for wind (5.8%) and solar (12%), 95% for nuclear, and 90% for other thermal generators. Different than MISO cleared UCAP (unforced [accredited] capacity). Under this scenario, MISO dependent on intermittent resources to meet peak load.

OTR Scenario: Retirements and Additions



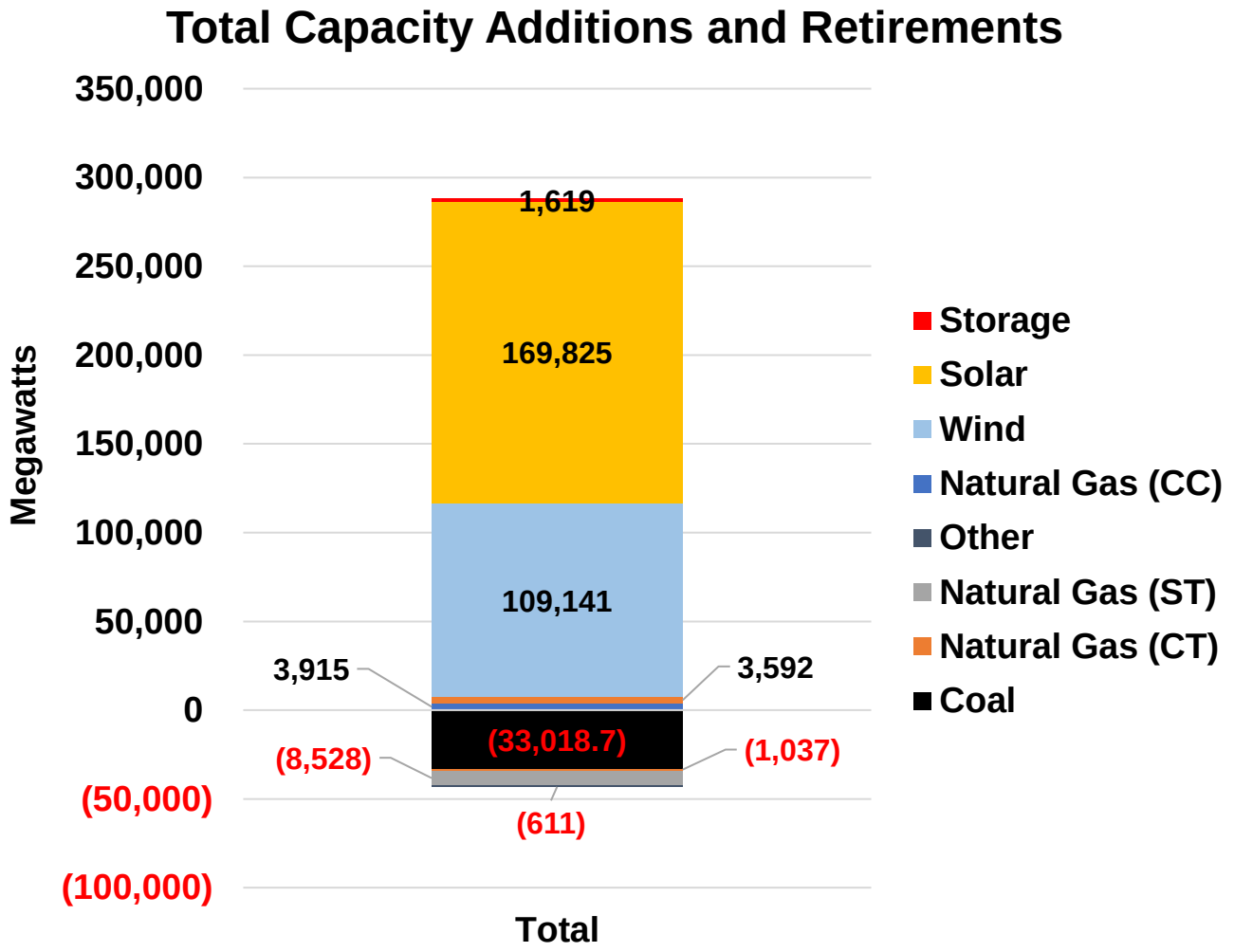
OTR Scenario Costs

The total additional cost to ratepayers in the OTR Scenario would be $581.85 billion through 2035.

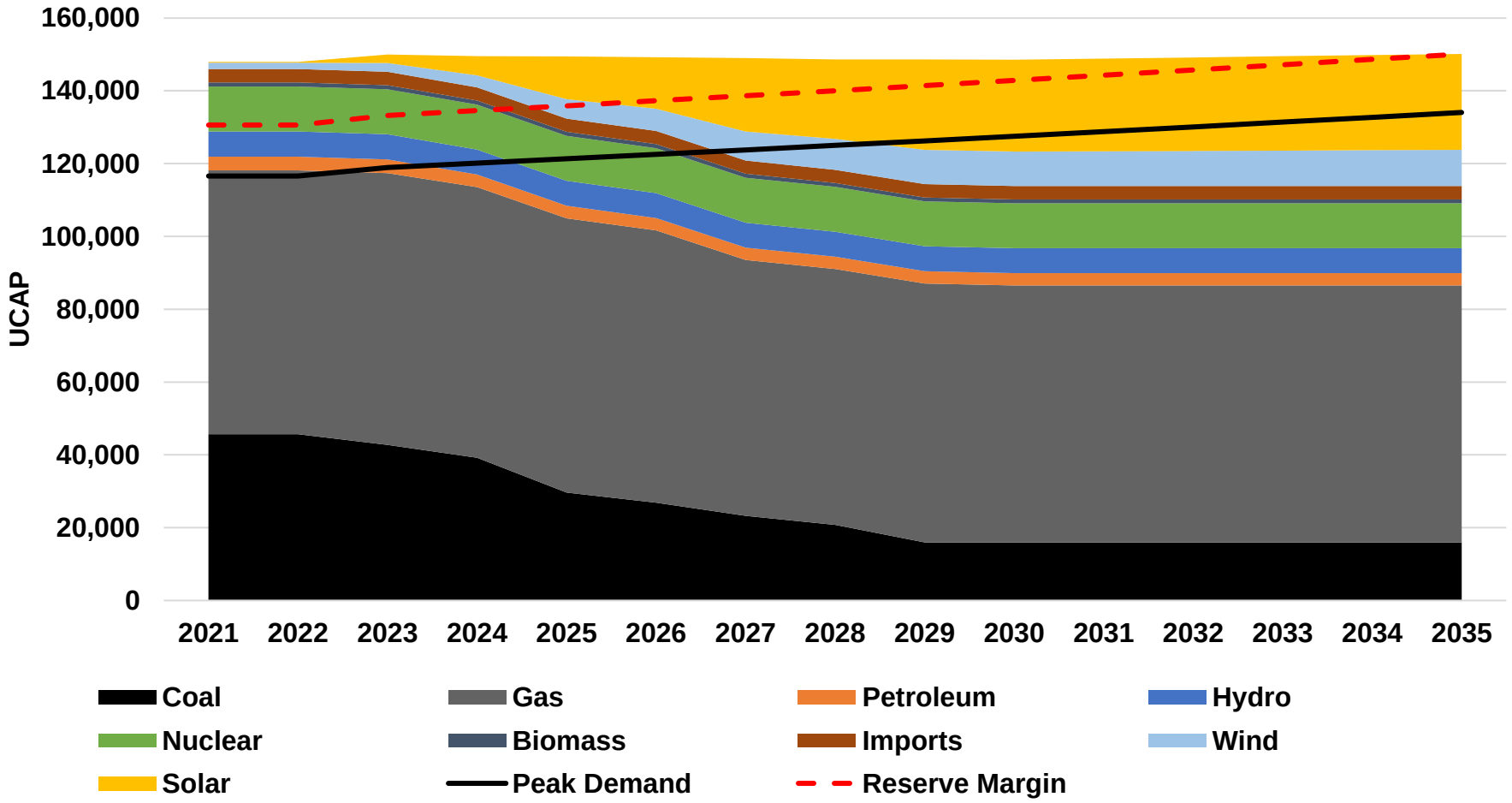


CCR Scenario: Retirements and Additions

- Investigates resource adequacy in MISO resulting from OTR and the CCR implementation.
- MISO would
  - Retire 33 GW of coal.
  - 9.5 GW of natural gas.
  - 611 MW of “other.”
  - Add 7.5 GW of natural gas.
  - 109 GW of wind.
  - 170 GW solar.
  - And 1.6 GW storage.



OTR + CCR Scenario: Capacity Shortfall Risk

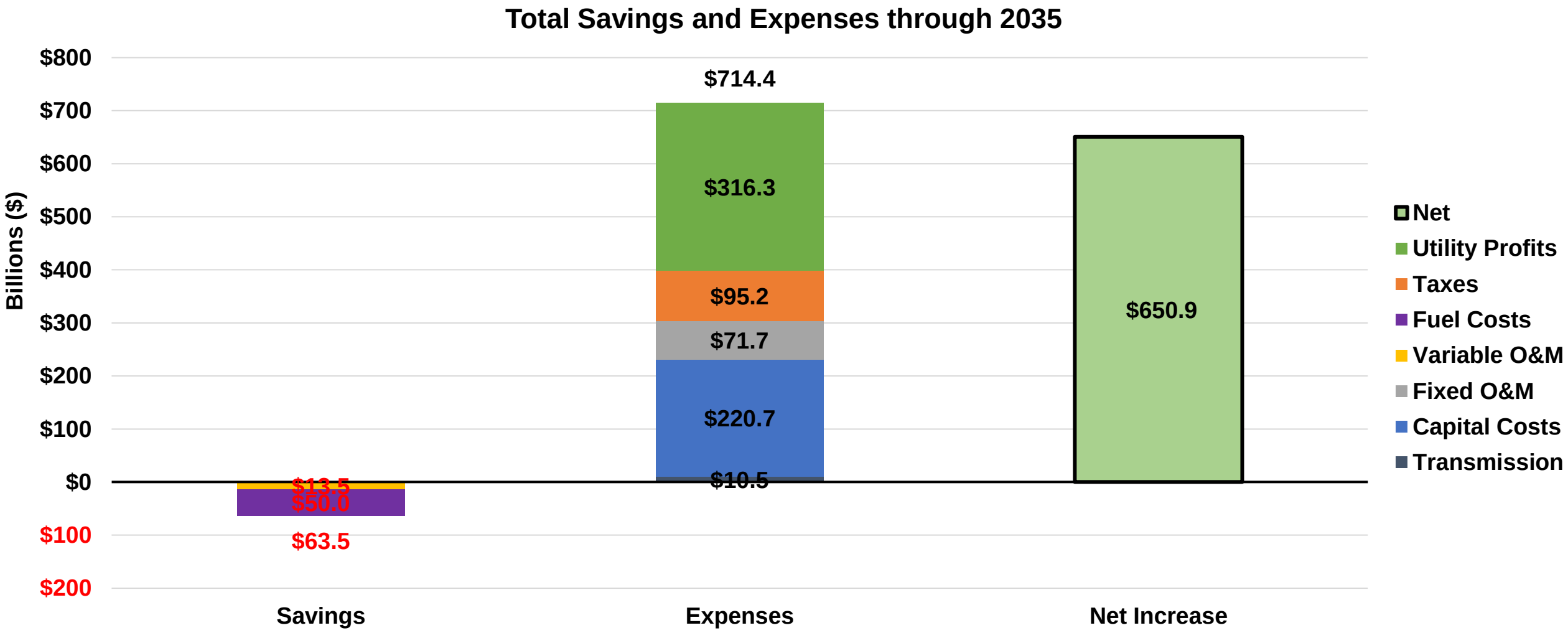


Year	Reserve Margin
2022	34%
2023	33%
2024	31%
2025	30%
2026	28%
2027	27%
2028	25%
2029	24%
2030	23%
2031	22%
2032	21%
2033	20%
2034	19%
2035	18%

Estimated firm capacity using net peak load capacity accreditation values for wind (5.8%) and solar (12%), 95% for nuclear, and 90% for other thermal generators. Different than MISO cleared UCAP (unforced [accredited] capacity). Under this scenario, MISO would be dependent on intermittent resources to meet peak load.

OTR+CCR Scenario Cost

The total additional cost to ratepayers in the CCR Scenario would be $651 billion through 2035.



MISO Conclusions

1. Our findings represent a best-case scenario for reliability due to our HCD accreditation standard, which is more stringent than MISO's prior accreditation process and could enhance their recently-adopted Seasonal Accreditation Construct (SAC).

2. Different standards, such as seasonal accreditation being explored by MISO, will produce varying levels of reliability that must be examined in light of these results.

3. Costs were relatively modest due to the large amount of thermal capacity remaining on the MISO system through 2035, but costs increase substantially as more thermal retirements occur and Load Serving Entities (LSEs) attempt to replace this lost generation with wind, solar, and battery storage.

4. Policymakers must understand the challenges regarding reliability, resiliency and affordability that are growing every year.

North Dakota Industrial Commission

Doug Burgum	Drew H. Wrigley	Doug Goehring
Governor	Attorney General	Agriculture Commissioner

MEMORANDUM

TO: Doug Burgum, Governor and Chair
Drew Wrigley, Attorney General
Doug Goehring, Agriculture Commissioner

FR: Reice Haase, Deputy Executive Director

DT: July 28, 2023

RE: Contract for Administrative Services Related to IIJA Grid Resilience Grant

On May 23, 2023, the U.S. Department of Energy (DOE) announced that North Dakota joined three other states and two tribal nations in receiving the first Grid Resilience State and Tribal Formula Grants under the Infrastructure Investment and Jobs Act (IIJA). North Dakota was awarded $7.5 million, which will be administered by the North Dakota Industrial Commission through the Transmission Authority. During the 2023 legislative session, the North Dakota Legislature appropriated a $1.1 million state match, leading to a total amount of $8.6 million available for the 2023-2025 biennium.

DOE requires the Commission to complete a Project Management Plan, Demographic Report, regular Quarterly Reports, and several other reports prior to dispersing the funds. The rules of the IIJA grant program allow the Commission to use up to 5% of the funds to contract for administrative services. The Commission had previously contracted with the State Energy Research Center (SERC) for the purpose of applying for the grant dollars. SERC staff have indicated that they are prepared to continue offering administrative services to the Commission.

Therefore, I recommend that the Commission approves the contracting with the State Energy Research Center (SERC) for the purpose of providing administrative services related to the IIJA Grid Resilience Formula Grant, not to exceed $430,000 during the 2023-2025 biennium, and direct the Office of the Industrial Commission to enter into such a contract with SERC.

State Capitol 14th Floor
600 E. Boulevard Ave.
Bismarck ND 58505-0840

Karen Tyler, Interim Executive Director
Reice Haase, Deputy Executive Director

Phone | 701-328-3722
Email | ndicinfo@nd.gov
Website | ndic.nd.gov

North Dakota
Industrial Commission

Doug Burgum
Governor

Drew H. Wrigley
Attorney General

Doug Goehring
Agriculture Commissioner

MEMORANDUM

TO: Doug Burgum, Governor and Chair
Drew Wrigley, Attorney General
Doug Goehring, Agriculture Commissioner

FR: Karen Tyler, Interim Executive Director

DT: July 28, 2023

RE: Contract for Transmission Authority Executive Director

During the 68th Legislative Session, the legislature appropriated $300,000 from the General Fund to the Commission to contract directly for the Transmission Authority Executive Director position in the 2023-2025 biennium. This funding resides in the administrative office budget, which will facilitate and manage the contract on behalf of the Commission. The shift of the funding source for this contract to General Fund dollars from lignite grant dollars was driven by the evolution of the role of the Authority and its growing workload involving non-lignite energy sources, and the change was supported by relevant stakeholders.

At the April 25th, 2023 Industrial Commission meeting, Mr. John Weeda announced his intent to retire from the Transmission Authority Executive Director role.

A public solicitation for applications for the contract for the role of Transmission Authority Executive Director has been completed, and I am pleased to recommend awarding the contract to Mr. Claire Vigesaa, who has been serving in the role of Deputy Director to Mr. Weeda.

Claire has a decades-long and diverse career in the energy industry which included management roles at Northern Plains Electric in Carrington, Cass County Electric in Fargo and at Tri-State Generation and Transmission Association in Denver prior to his eleven years as General Manager at Upper Missouri Power Cooperative. He was also involved with both the Mid-Continent Independent System Operator (MISO) and Southwest Power Pool (SPP) in his management role at Upper Missouri Power Cooperative, building relationships that will be of great value in the role of Transmission Authority Executive Director.

Claire has served on several industry boards and committees including the Western States Power Corporation board of directors, Midwest Electric Consumers Association board of directors, and the National Touchstone Energy Committee. He was involved in the development of several value added ag processing projects including Dakota Growers Pasta in Carrington and the High Value Irrigated Task Force which culminated in the construction of the Cavendish Potato processing facility near Jamestown. He also served on other economic development corporation boards including President of the Carrington Economic Development Corporation and on the executive board of the Greater Fargo Moorhead Economic Development Corporation.

Claire's technical expertise, executive experience, and stakeholder relationships position him to be an impactful leader for the North Dakota Transmission Authority.

Therefore, I recommend that the Commission appoint Mr. Claire Vigesaa as Director of the North Dakota Transmission Authority, effective August 1, 2023, and direct the Interim Executive Director to execute a contract with Mr. Vigesaa for services in the role of Transmission Authority Executive Director during the 2023-2025 biennium.

Historical information prepared by Deputy Director Reice Haase regarding the staffing and funding of the Transmission Authority is attached hereto:

The North Dakota Transmission Authority was created in 2005, with the original purpose of serving as a catalyst for developing transmission in North Dakota, offering alternate sources of financing, fostering the development of transmission corridors, and to be a builder of last resort if the private sector was unable to construct needed infrastructure. Since its creation, the role and workload of the Authority has continued to grow.

At its inception, the Industrial Commission contracted with two consultants to assist with the implementation of the legislation. The consultants were hired using Lignite Vision 21 Program grant dollars, which, over time, continued to pay for contracting costs for the Transmission Authority. The Lignite Vision 21 Program later evolved into the Enhance, Preserve and Protect project (EPP), which remains an active project of the Lignite Research Program today.

The Commission appointed its first Transmission Authority Director on October 19, 2006 when it accepted the recommendation of the Lignite Vision 21 Program and the Lignite Energy Council and named Sandi Tabor as acting director. The Commission directed Karlene Fine and Ms. Tabor to conduct a search for a permanent director. Concluding the search, the Commission determined that Ms. Tabor should remain acting director.

Since that time, the Commission had typically appointed a Transmission Authority Director based on the recommendations of Karlene Fine and the Lignite Energy Council. This position was structured as an independent contractor, with a contract executed through the Lignite Energy Council:

- Sandi Tabor as Acting Director from 2006 – 2013 based on Lignite Vision 21 and LEC recommendations
- Curtis Jabs as Acting Director from 2013 – 2014 based on Karlene Fine and Sandi Tabor recommendations
- Andrea Stromberg as Director from 2014 – 2015 based on Karlene Fine and LEC recommendations
- Tyler Hamman as Director from 2015 – 2017 based on Karlene Fine and LEC recommendations
- John Weeda as Director from 2018 – Present based on Karlene Fine and LEC

OIL AND GAS RESEARCH PROGRAM PROJECT MANAGEMENT REPORT

Reice Haase, Deputy Executive Director, NDIC

July 21, 2023

NORTH Dakota

Be Legendary.™

ACTIVE PROJECTS

22
Active Projects

$22.6 Million
Paid To Date

$41.8 Million
Awarded Dollars

$19.2 Million
Outstanding Committed Dollars

$2.8 Million
Uncommitted Cash Available

Oil and Gas Research Program (247)
Financial Statement - Cash Balance
2021-2023
21-Jul-23

		Cash Balance	
July 1, 2021 Beginning Balance	$16,283,145.53		
Oil and Gas Tax Revenues through April 30, 2023		$14,500,000.00	
Transfer from the SIIF Fund		$9,500,000.00	
Interest/Other Income through April 30, 2023		$61,871.38	
Total Revenues		$24,061,871.38	
Expenditures through April 30, 2023			
Transfer to the Pipeline Authority Fund		$600,000.00	
Salt Cavern Study (Legislative Directed) (Contract 104)		$9,614,160.74	
Underground Storage (Legislative Directed) (Contract 92)		$763,600.00	
Legislative Directed Studies (Contracts 101 & 105)		$443,962.29	
Oil and Gas Research Projects		$3,707,410.66	
Oil and Gas Education Projects		$562,405.59	
Oil and Gas Education College of Petroleum Engineering		$2,191,761.78	
Administrative Expenditures through April 30, 2023		$102,353.35	
Total Expenditures		$17,985,654.41	
Cash Balance as of April 30, 2023			$22,359,362.50
Outstanding Research Contract Commitments/Emerging Issues	9,953,316.10		
Outstanding Contracted Legislative Directed Cavern Study	$3,372,039.26		
Outstanding Contracted Legislative Directed Studies	$590,862.38		
Outstanding Education Contract Commitments	$1,783,967.70		
Outstanding Petroleum Engineering Oil & Gas Research	$3,576,238.22		
Outstanding Pipeline Authority Commitment	$0.00		
Estimated Administrative Expenses for 2021-2023 Biennium	$197,646.65		
		19,474,070.31	
Non-Committed Cash Funding			**$2,885,292.19**
Estimated Revenues for 2021-2023 Biennium			
Oil and Gas Tax Revenues	$14,500,000.00		
SIIF Fund	$9,500,000.00		
Interest & Other Income	$25,000.00		
		$24,025,000.00	

2021-2023	Budgeted	Committed	Balance
Administration	$300,000.00	$300,000.00	$0.00
Pipeline Authority Transfer	$600,000.00	$600,000.00	$0.00
Legislative Directive Cavern Study	$9,500,000.00	$12,986,200.00	($3,486,200.00)
Legislative Directed Studies	$4,300,196.00	$1,798,424.67	$2,501,771.33
Petroleum Engineering Oil & Gas Research	$5,768,000.00	$5,768,000.00	$0.00
Oil and Gas Education Projects	$2,667,678.00	$2,346,373.29	$321,304.71
Oil and Gas Research Projects	$17,172,271.00	$13,660,726.76	$3,511,544.24
	$40,308,145.00	$37,459,724.72	$2,848,420.28

Contract #	Project Name	Company	Total Project Cost	Original Commitment	Spent to Date	Balance
G-25-55	Effects of Oil and Gas Development on Mule Deer Populations in Western North Dakota	ND Game and Fish Department	658,747.00	329,374.00	303,000.00	26,374.00
G-45-86	Unitized Legacy Oil Fields: Prototypes for Revitalizing Conventional Oil Fields in North Dakota	Eagle Energy Partners Tundra (EEP Tundra, LLC)	6,000,000.00	3,000,000.00	203,772.82	2,796,227.18
G-46-88	intelligent Pipeline Integrity Program (iPIPE)	Hess Corporation/Stat Oil ASA, Midstream Partners	3,714,000.00	2,600,000.00	2,140,000.00	460,000.00
G-47-90	History of the North Dakota Oil and Natural Gas Industry Project	ND Petroleum Council	607,000.00	295,500.00	54,000.00	241,500.00
G-49-92	Underground Storage of Produced Natural Gas-Conceptual Evaluation and Pilot Project(s) (HB 1014)	Energy & Environmental Research Center (EERC)	12,000,000.00	3,500,000.00	3,076,600.00	423,400.00
G-49-93	AUG Field Trip - Promoting Student Interest in Geology and Geological Engineering	Association of UND Geologists	10,600.00	5,300.00	2,650.00	2,650.00
G-49-94	Weather Information System to Effectively Reduce Oilfield Delays and Disruption (WISE Roads)	Western Dakota Energy Association	625,000.00	310,000.00	163,125.63	146,874.37
G-50-96	PCOR Initiative to Accelerate CCUS Deployment	Energy & Environmental Research Center (EERC)	18,752,874.00	2,000,000.00	640,342.14	1,359,657.86
G-50-97	Improving EOR Performance Through Data Analytics and Next-Generation Controllable Completions	Energy & Environmental Research Center (EERC)	10,000,000.00	500,000.00	94,930.07	405,069.93
G-51-98	Bakken Production Optimization Program 3.0	Energy & Environmental Research Center (EERC)	12,000,000.00	6,000,000.00	3,201,577.45	2,798,422.55
G-51-100	NDIC Funding to Support Research of Petroleum Engineering Program at University of North Dakota	Petroleum Engineering Program, University of North Dakota (UND)	7,712,150.00	2,788,000.00	2,191,761.78	596,238.22
G-52-102	North Dakota Petroleum Foundation Outreach and Education Program	ND Petroleum Foundation	2,025,000.00	1,012,500.00	454,807.30	557,692.70
G-53-103	Creedence Energy Services EOR Biosurfactant Applications	Creedence Energy Services/Locus Bio-Energy	622,288.00	205,750.00	-	205,750.00
G-54-104	Field Study to Determine the Feasibility of Developing Salt Caverns for Hydrocarbon Storage in Western North Dakota	Energy & Environmental Research Center (EERC)	10,000,000.00	12,986,200.00	9,614,160.74	3,372,039.26
G-54-105	Hydrogen Energy Development for North Dakota	Energy & Environmental Research Center (EERC)	500,000.00	500,000.00	332,537.62	167,462.38
G-55-106	Development of Formulations for the Removal of Scale from Oil and Gas Wells in the Williston Basin	University of North Dakota (UND)	1,603,163.00	451,427.00	-	451,427.00
G-55-107	UND's Department of Petroleum Engineering Oil and Gas Research	UND Petroleum Engineering	6,613,930.00	2,980,000.00	-	2,980,000.00
G-55-108	iPIPE 2.0	Energy & Environmental Research Center (EERC)	1,450,000.00	400,000.00	70,663.93	329,336.07
G-55-109	Advances In Impacts Recovery From Electrokinetic Soil Remediation	Stealth Energy Services/NDSU/EOG/Oasis	547,660.00	265,000.00	-	265,000.00
G-55-110	Well Site Thief Hatch Methane Detectors	Vareberg Engineering, Ltd./Blue Rock Solutions, LLC	582,000.00	266,000.00	56,822.86	209,177.14
G-56-111	Agricultural Carbon Capture in Western North Dakota	ND Natural Resources Trust	1,051,000.00	500,000.00	-	500,000.00
G-57-112	North Dakota Petroleum Foundation Outreach and Education Program	North Dakota Petroleum Foundation	1,574,250.00	982,125.00	-	982,125.00
			98,649,662.00	**41,877,176.00**	**22,600,752.34**	**19,276,423.66**

2023-2025 BIENNIUM:

Appropriated Income:

$20.5 million

Natural Gas Capture Commitment:

$3 million

Grant Management and Digitization Costs:

$250,000

Pipeline Authority and Administration Costs:

$900,000

Pipeline Leak Detection Commitment:

$3 million

CO2 Utilization Commitment:

$100,000

Total All Commitments:

$7.25 million

Estimated Uncommitted Funds Available for 2023-2025:

$13.25 million

Oil and Gas Research Program

Grant Round 58 Applications (July 21, 2023)

Grant #	Application Title	Applicant	Principal Investigator	Funding Requested	Recommended Funding	Total Project Costs	Duration	OGRC Vote
G-058-01	Roughrider Carbon Storage Hub	ONEOK, Inc.	Chad Schneeberger	$1,050,000	$525,000	$16,550,000	2 Years	4-2
G-058-02	Maximizing Production from Residual Oil Zones in Western ND	Cobra Oil and Gas	Kyle Gardner	$2,000,000	$2,000,000	$4,000,000	2 Years	6-0
G-058-03	Bakken Production Optimization Program 4.0	EERC	James A. Sorenson	$6,000,000	$4,000,000	$12,000,000	3 Years	6-0
	Total being considered			**$9,050,000**	**$6,525,000**	**$32,550,000**		

Remaining 2021-2023 Uncommitted Cash:	$2,885,292.19
+ Estimated 2023-2025 Uncommitted Cash:	$13,500,000.00
- Grant Round 58 Recommendation:	$6,525,000
= Estimated Remaining 2023-2025:	**$9,860,292.19**

DIRECTOR'S COMMENTS
G-058-01
Roughrider Carbon Storage Hub
Submitted by: ONEOK, Inc.
Principal Investigator: Chad Schneeberger
Request for: $1,050,000
Total Project Costs: $16,550,000
Duration: 2 years

Description of the Project:

The objectives of the Roughrider Carbon Storage Hub are to accelerate wide-scale deployment of carbon capture, utilization, and storage (CCUS) by assessing and verifying the feasibility of using stacked storage complexes in McKenzie County, North Dakota, for the safe and cost-effective commercial-scale storage of anthropogenic CO2 emissions captured from ONEOK and Cerilon (planned) hydrocarbon-processing facilities in northwestern North Dakota. Through the execution of the scope of work, the prospective CO2 storage resource of the area of interest in McKenzie County will be advanced to a contingent storage resource as classified under the Society of Petroleum Engineers CO2 Storage Resources Management System (SRMS). In addition, the proposed project will complete a thorough feasibility study for both technical and economic viability as well as develop and implement region-specific plans to engage communities and stakeholders. This project will provide new information to enable operators, investors, regulators, and other stakeholders to make informed decisions regarding potential CO2 storage resource in the central portion of the Williston Basin.

Technical Reviewers' Recommendations: 3 Fund

Director's Recommendation: Recommend funding in the amount of $525,000

Conflicts of Interest: None

Vote: 4 yes; 2 nay, 1 absent and not voting

ONEOK

June 1, 2023

Mr. Reice Haase
Deputy Director
North Dakota Industrial Commission
State Capitol 14th Floor
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: Proposal Entitled "Roughrider Carbon Storage Hub" in Response to the North Dakota Industrial Commission Oil and Gas Research Program Solicitation

ONEOK, Inc., is pleased to propose a research project designed to encourage and promote the use of new technologies that have a positive economic and environmental impact on oil and gas exploration, production, and processing in North Dakota. The ONEOK team has been involved with North Dakota's oil and gas industry for the past 35 years. We see the proposed research of evaluating a prospective CO_2 storage hub as an opportunity to not only address the objectives of the Oil and Gas Research Program (OGRP) but also advance Governor Burgum's goal of a carbon-neutral North Dakota. The proposed research will lay the technical groundwork that informs investment decisions and prudent development strategies for natural gas-processing operators seeking to produce low-carbon product.

ONEOK believes the potential long-lasting economic and technological benefits of the proposed project far exceed the requested investment from the OGRP, and ONEOK is prepared to complement U.S. Department of Energy (DOE) and OGRP funding with in-kind cost share to pay for the balance of the project's estimated costs.

ONEOK is confident that its commitment to provide professional and financial resources, as well as providing our project partner, the Energy & Environmental Research Center (EERC), with the necessary access to information, field infrastructure, operational and technical support, and other such items as necessary, will accomplish the proposed research project and bring tremendous value to OGRP and state of North Dakota. Enclosed please find an original and one copy of the subject proposal. A check for $100 will be delivered to the NDIC office. If you have any questions, please contact me by telephone at (918) 732-1476.

Sincerely,

Chad Schneeberger
Director, Renewable Project Development
ONEOK, Inc.

ONEOK, Inc.
100 West Fifth Street
Tulsa, OK 74103
www.oneok.com

Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: Roughrider Carbon Storage Hub

Applicant: ONEOK, Inc.

Principal Investigator: Chad Schneeberger

Date of Application: June 1, 2023

Amount of Request: $1,050,000

Total Amount of Proposed Project: approximately $16,550,000

Duration of Project: 24 months

Point of Contact (POC): Chad Schneeberger

POC Telephone: (918) 732-1476

POC E-Mail Address:

chad.schneeberger@oneok.com

POC Address: ONEOK, Inc., 100 West 5th Street, Tulsa, OK 74103

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ABSTRACT

Objective: The objectives of the Roughrider Carbon Storage Hub are to accelerate wide-scale deployment of carbon capture, utilization, and storage (CCUS) by assessing and verifying the feasibility of using stacked storage complexes in McKenzie County, North Dakota, for the safe and cost-effective commercial-scale (i.e., ≥50 Mt within 30 years) storage of anthropogenic CO_2 emissions captured from ONEOK and Cerilon (planned) hydrocarbon-processing facilities in northwestern North Dakota. Through the execution of the scope of work, the prospective CO_2 storage resource of the area of interest in McKenzie County will be advanced to a contingent storage resource as classified under the Society of Petroleum Engineers CO_2 Storage Resources Management System (SRMS). In addition, the proposed project will complete a thorough feasibility study for both technical and economic viability as well as develop and implement region-specific plans to engage communities and stakeholders.

Expected Results: This project will provide new information to enable operators, investors, regulators, and other stakeholders to make informed decisions regarding potential CO_2 storage resource in the central portion of the Williston Basin. The stratigraphic test well planned for this project will be drilled near the depocenter of the Williston Basin and will extend to the base of the stratigraphic section (i.e., to the Precambrian surface).

Duration: 24 months (full project duration)

Total Project Cost: The total cost of the project is estimated at $16,550,000. The amount requested from the Oil and Gas Research Program (OGRP) is $1,050,000. The U.S. Department of Energy (DOE) is contributing $9,000,000 through a recent award (currently in negotiation) to the Energy & Environmental Research Center (EERC) at the University of North Dakota from the CarbonSAFE Initiative. If OGRP grants the requested funds ($1,050,000), ONEOK's in-kind cost share is estimated to be $6,500,000.

Participants: ONEOK, the EERC, and Neset Consulting Service (Neset). Letters of support from the EERC, Neset, and others can be found in Appendix A.

PROJECT DESCRIPTION

Objective: The Roughrider Carbon Storage Hub (DE-FOA-0002610 Carbon Storage Assurance Facility Enterprise [CarbonSAFE] Phase II – Storage Complex Feasibility) is a recently awarded 2-year project to determine the feasibility of developing a commercial-scale carbon dioxide (CO_2) geologic storage project (Appendix B). This feasibility study will investigate the safe, permanent, and economical storage of 50+ million metric tons of CO_2 captured from several gas-processing plants owned and operated by project partner, ONEOK, Inc., and a planned gas-to-liquids (GTL) plant by Cerilon.

This CO_2 storage hub scenario includes aspects that make it a highly qualified candidate for a feasibility study with a notably reduced project risk profile: 1) a project partner with a committed goal to reduce greenhouse gas (GHG) emissions associated with North Dakota oil and gas production; 2) prior subsurface data analysis results supporting a stacked storage scenario with adequate CO_2 storage resource; 3) commitment from local, regional, and state-level stakeholders; and 4) a state with Class VI primacy. Potential also exists for expansion/flexibility to include additional CO_2 sources. In aggregate, these project characteristics combined with the Energy & Environmental Research Center's (EERC's) extensive experience with carbon capture, utilization, and storage (CCUS) through the Plains CO_2 Reduction (PCOR) Partnership Program and previous CarbonSAFE efforts (Phases II and III) make our scenario a viable CCUS stacked storage system that can realistically be constructed and permitted for operation. The project risk profile is reduced by the existence of established and tested pore space ownership legislation and the long-term liability policy of the state of North Dakota. North Dakota is one of two states with underground injection control (UIC) Class VI well primacy. This status has proven to be a strong driver for the growth of CCUS project planning in the state, as is public acceptance of the four EERC-led Class VI permits now approved.

Previous subsurface data analysis by both the PCOR Partnership and a specific investigation sponsored by ONEOK identified the Inyan Kara, Broom Creek, Mission Canyon, and Deadwood Formations as potential secure CO_2 storage horizons in the area of interest (AOI). Data analysis and

modeling results indicate the prospective CO_2 storage resource potential of these formations in the AOI to be nearly 200 Mt in a 36-square-mile area (one township). In addition, the proposed approach leverages economies of scale and the potential for efficiency and optimization through the grouping of natural gas-processing facilities, a proposed GTL plant, and an existing pipeline right of way (ROW). This synergy facilitates success of the project.

The discrete geologic data sets derived from the proposed activities will enable the development of comprehensive 3D geocellular models with reduced uncertainty compared to earlier basin-scale evaluations. These models will be used in dynamic simulation activities to accurately determine the area of review (AOR) extent associated with CO_2 and pressure plume development. Understanding the potential extent of the CO_2 and pressure plumes will provide a foundation for understanding the magnitude of future pore space-leasing requirements and monitoring, verification, and accounting activities.

Methodology: The proposed scope of work is based on sound scientific and engineering principles, as evidenced by the EERC's record of conducting similar assessments in central North Dakota, resulting in four approved CO_2 storage facility permits. In addition, the project team has decades of experience managing field activities, successful major construction projects, and operation of gas-processing facilities, all of which require understanding and application of scientific and engineering principles. The proposed tasks will leverage the existing experience, knowledge, lessons learned, and relationships within the project team to characterize a storage complex with the potential to securely store 50 Mt of anthropogenic CO_2. Collected and interpreted data, as well as execution of societal considerations and impacts assessments and plans, will build a foundation upon which future decisions can be made regarding the implementation of commercial-scale CCUS operations in McKenzie County. The tasks are designed to systematically identify and address both technical and nontechnical challenges; collaborate with team members and key stakeholders to provide solutions and paths toward commercialization; and communicate results to the state of North Dakota, local communities, the U.S. Department of Energy (DOE), and other stakeholders.

Task 1.0 – Project Management: This task includes the activities for managing project tasks, milestones, and deliverables and ensuring coordination and planning of the project with the North Dakota Industrial Commission (NDIC), DOE, and other project participants. This includes briefings, as requested, and routinely scheduled conference calls. A final topical report summarizing key results and recommendations from this feasibility study will be completed. In addition, the EERC will ensure compliance with all technical briefing and presentation requirements, including but not limited to NDIC and DOE program peer review meetings.

Task 2.0 – Societal Considerations and Impacts Assessment and Plans: Through a social characterization analysis, activities within this task will, from the standpoint of the project and associated goals, identity communities and stakeholders to determine effective ways to engage and build relationships with those audiences, listen to their needs and concerns, and develop meaningful outcomes for those stakeholders. This work will include developing messaging goals and content, selecting methods for engaging stakeholders (e.g., media campaigns, open houses, etc.). strategies for incorporating stakeholder feedback, and materials development.

Task 3.0 – Storage Complex Characterization: This task covers all the activity required to characterize up to four prospective CO_2 storage complexes (stratigraphic zones) within the AOI of the proposed project. This effort includes updates to existing geologic and hydrogeologic evaluations based on new data from existing geologic resources; the collection of new data in the form of collection and analysis of new core, subsurface fluid samples, and well logs; and the acquisition and reprocessing of existing seismic surveys. Significant activity in this task is to locate, permit, and drill a geologic characterization well (stratigraphic test well) in the study area. This well will be drilled on private land, 4-inch core will be taken from the cap rock and reservoir sections of up to four stratigraphic pairs, and a comprehensive logging suite will be collected from the well. Once sampling and logging processes are completed, this well will be plugged and abandoned according to procedures established by NDIC. Data acquired and analyzed during this task will be used in the development of Task 4.0 – Geologic Modeling and Simulation.

Task 4.0 – Geologic Modeling and Simulation: The geologic site characterization data (logs, core analysis, and seismic) will be integrated into geocellular models that account for the properties of the study areas, which comprise the injection horizons and overlying sealing formations that serve as barriers to prevent out-of-zone migration. The geologic models will provide the foundation for dynamic simulations of potential injection scenarios. Dynamic simulations are required to predict how CO_2 and its associated pressure plume would be distributed in the study areas and the effectiveness of the sealing formation at the site during the carbon capture and storage (CCS) time frame. Simulation results will provide key design and operational parameters for 1) the injection well and infrastructure; 2) a technical risk assessment; 3) AOR determination; 4) monitoring, reporting, and verification (MRV) planning; and 5) installation expenditures.

Task 5.0 – Technical and Economic Analysis: This task will be conducted to evaluate the technical and economic feasibility of the proposed CO_2 storage project, including various project options such as adjacent and distributive (collection and pipelining of CO_2 streams to a central location) storage potentials. The expansion of conceptual pipeline designs leveraging the existing ROWs and the experience of ONEOK in the operating conditions that include the design, construction, operation, and access of pipelines will be used. This task will include examining more specific economic needs and the incentives in place or additional CO_2 volumes required to make the proposed scenarios economically feasible for the project partners.

Task 6.0 – Site Development Plan: This task will create a detailed plan to develop a subsequent complete site characterization effort to support a potential future UIC Class VI permitting process for a potential future commercial CCUS facility. This plan will be based on the results of the other project tasks and will include a geologic characterization strategy for the potential injection site(s), a CO_2 management strategy for acquiring and transporting CO_2 to the injection site, and a risk assessment to identify project risks and provide mitigation strategies. The site development plan will be developed under applicable North Dakota Administrative Code sections.

Anticipated Results: This project will facilitate CCUS deployment and infrastructure development in an area of North Dakota that has had minimal exploration for CO_2 storage resource by reducing uncertainties and providing solutions to technical and nontechnical challenges. The results of the proposed work will enable the development of environmentally sound, low-carbon-intensity natural gas processing and utilization by providing essential technical and economic information regarding the various components of the CCUS value chain (i.e., CO_2 capture, transport, storage). Data collected from the stratigraphic test well (e.g., core, geophysical logs, fluid samples) that is planned to extend to the Precambrian basement will provide new insight into the nature of the deep subsurface in the McKenzie County portion of the Williston Basin. In addition to supporting the assessment of storage resource potential, these data will provide new information on potential underdeveloped hydrocarbon plays and geothermal resources.

Facilities: Most of the data collection and manipulation, reservoir characterization, modeling, laboratory analysis, facilities assessment, and product development work will be conducted at EERC facilities in Grand Forks, North Dakota. Modeling hardware at the EERC includes a high-performance computer cluster dedicated to advanced reservoir modeling and simulations. The EERC uses industry-standard modeling and simulation software and has staff proficient in their use. EERC facilities include several laboratories and personnel with more than two decades of experience conducting standard and advanced core and fluid studies, including geomechanical, petrographic, geochemical, exposure, and flow-through studies. The EERC has x-ray diffraction (XRD), x-ray fluorescence (XRF), and scanning electron microscopy systems, as well as the ability to conduct wet-chemistry and trace elemental analyses. The EERC's staff encompass geology, chemistry, physics, and engineering disciplines.

Resources: Project partners, the EERC and ONEOK, conducted an initial screening study of northwestern North Dakota using publicly available legacy well data. The screening study area included the AOI for this project in central McKenzie County, North Dakota. The NDIC Oil and Gas Division provides online access to all geophysical logs related to deep well drilling in North Dakota. These data will be used, along with new data collected as part of this research effort, to construct 3D geocellular models of the targeted

CO_2 storage complexes. Legacy 3D data available in the project area will be purchased from a data exchange company. The legacy 3D data will be reprocessed with modern processing techniques and will be interpreted at the EERC for the purpose of extending the point characterization data collected at the test well laterally for several miles to evaluate the structural and stratigraphic continuity of the target geologic horizons.

Techniques to Be Used, Their Availability and Capability: Industry-standard geologic characterization and reservoir engineering practices will be employed. Static and dynamic modeling activities will be conducted on computer hardware and software currently existing at the EERC. All personnel, equipment, space, and software to conduct the laboratory and modeling activities will be available throughout the duration of the project.

Environmental and Economic Impacts While Project Is Under Way: Most of the project will be conducted at the EERC. Fieldwork focused on the drilling of a stratigraphic test well, core collection, and well logging will be conducted following industry-standard practices on an existing well pad; thus minimal environmental impact is expected over the 2-year period of performance.

Ultimate Technological and Economic Impacts: ONEOK's midstream assets in North Dakota include over 12,000 miles of natural gas-gathering pipelines, over 300 miles of natural gas liquid pipelines, and six processing facilities with the capacity to process and treat almost 2 billion cubic feet per day of natural gas. This natural gas network employs approximately 485 personnel. As a midstream service provider experienced in the gathering, transportation, storage, and distribution of natural gas, ONEOK is well-positioned to provide similar CO_2-related services for companies in need of a CO_2 storage solution.

As the Williston Basin continues to mature, natural gas production will continue to grow with increasing gas-to-oil ratios, which will result in more demand for natural gas processing. Achieving a goal of net carbon neutrality for the state will require the capture and geologic storage of CO_2. This scenario will retain and even increase quality jobs, and as gas production volumes increase and processing capacity is developed to accommodate that growth, additional sources of CO_2 emissions will need to be captured,

transported, and stored, thereby creating additional high-quality, good-paying jobs and a lower-carbon-intensity oil and gas industry in North Dakota.

The EERC and ONEOK are currently working with Cerilon, which is developing a state-of-the-art GTL facility in northwestern North Dakota to produce low-carbon liquid transportation fuels. Cerilon is including CO_2 capture technologies in its engineering designs for the facility, and ONEOK is assisting by studying CO_2 gathering, transportation, and storage alternatives. Cerilon expects to employ 77 people at the time of operations, which will be new high-quality jobs in the project area. The development of a CO_2 storage hub in northwestern North Dakota would create an opportunity to aggregate and store CO_2 emissions from several sources across multiple industries, thereby potentially saving and generating hundreds of quality jobs. It would also reduce CO_2 emissions that are projected to increase in the area over time while facilitating increased production of oil and gas resources vital to energy security.

Why the Project Is Needed: Currently there are no permitted CO_2 storage facilities in the major oil-producing counties of northwestern North Dakota (McKenzie, Mountrail, Billings, Williams, Burke Counties). The proposed Roughrider Carbon Storage Hub project will provide infrastructure to safely, efficiently, and cost-effectively store CO_2 generated in the major oil-producing counties of North Dakota that would otherwise contribute to increased concentrations of CO_2 in the atmosphere. ONEOK has analyzed CO_2 sources in the project area and determined that there are over 2.2 Mt of CO_2 produced each year by industries such as natural gas gathering, processing, and transportation; power generation; and ethanol production. ONEOK anticipates continued growth in these industries in future years, which will increase the volume of CO_2 produced. Cerilon, which is supportive of this project, plans to develop a GTL facility in the area that is expected to produce between 1.2 and 4.0 Mt of CO_2 each year. Like ONEOK, many of the companies operating assets in northwestern North Dakota have environmental and sustainability goals to reduce their GHG emissions in the coming years, and CO_2 capture, transportation, and storage are expected to further the goal of reducing these emissions. A viable CO_2 storage hub will be critical to managing CO_2 emissions from natural gas processing and use in North Dakota and is essential to achieving Governor Burgum's challenge of a carbon-neutral North Dakota by 2030.

Funding through DOE will help offset the development costs of CO_2 storage projects, and incentives such as 45Q will provide tax credits that make CO_2 capture, transportation, and storage economically viable. The project team believes that as more CCS projects are developed, the costs of the technologies employed will continue to fall and projects such as this will become more economically attractive.

STANDARDS OF SUCCESS

Success will be measured according to the timely achievement of project milestones and the development of deliverables. Several success criteria have been developed to help track the progress of the project and to indicate the successful completion of project objectives. For example, the successful completion of Milestone (M) 2 (stratigraphic well drilling) will allow the core to be available for analysis and testing, and data from the interpretation and analysis of core samples will provide site-specific data to the geologic model. The successful completion of a first geologic model will allow for the initiation of dynamic simulation (M6) as well as critical input to the site characterization plan; the successful completion of the technical and feasibility review and assessment (D7) will allow for the team to confirm and validate the subsequent risk assessment, monitoring and mitigation strategies. The successful completion of M10 will allow the project team to identify and evaluate project risks and complete the site development plan (Deliverable [D] 9).

The development of a CO_2 storage hub in northwestern North Dakota would create an opportunity to aggregate and store CO_2 emissions from several sources across multiple industries, thereby potentially saving and generating hundreds of quality jobs. It would also reduce CO_2 emissions that are projected to increase in the area over time while facilitating increased production of oil and gas resources vital to energy security. The results of this project will facilitate environmentally sound exploration and production methods and technologies to develop the state's oil and gas resources and support research and educational activities concerning the oil and gas exploration, production, and processing industry. The project will also provide the foundation for future commercial gas storage (CH_4, H_2, CO_2) development in western North Dakota. The educational contribution of the project will be fulfilled by conference presentations and publications, which may include presentations at the Williston Basin Petroleum

Conference, public reporting, and engagement with the North Dakota Petroleum Council's outreach and education program. ONEOK and the EERC will work closely with NDIC through project meetings and quarterly reporting to ensure project quality and timeliness.

BACKGROUND/QUALIFICATIONS

Wesley Peck, EERC Assistant Director for Subsurface Strategies, will be the project manager and principal investigator (PI) on the DOE-funded project. Other key personnel include Mr. Chad Schneeberger, ONEOK Renewable Project Development Director, who will serve as a project advisor and direct and coordinate efforts by ONEOK to assist in project activities and provide land and data access. Mr. Schneeberger will work closely with the EERC team to ensure project team members have the appropriate resources/information and that ONEOK meets internal deliverables for the proposed project. Mr. Schneeberger has over 25 years of experience in midstream operations. Resumes of key personnel are provided in Appendix C.

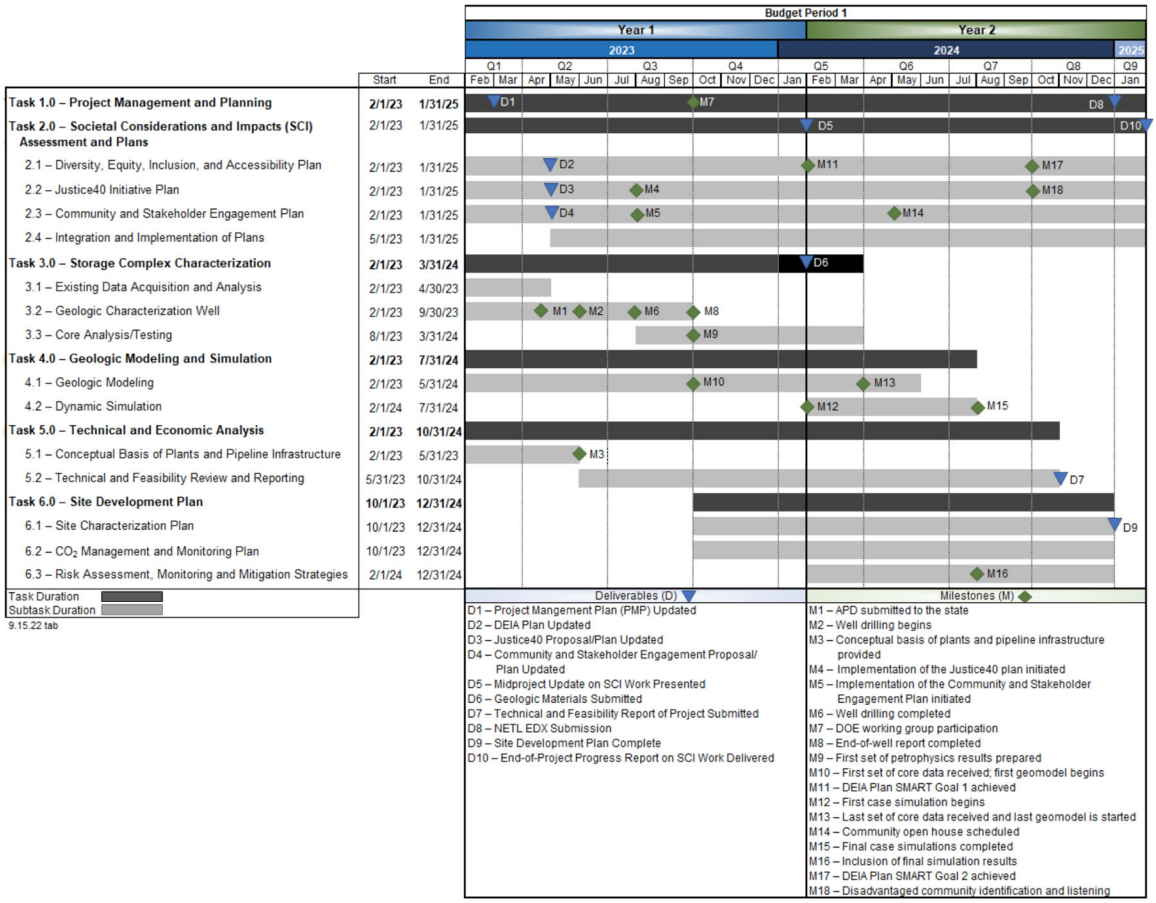
The EERC is a high-tech, nonprofit branch of UND that operates like a business and is dedicated to moving applied research into the commercial marketplace. The EERC, practicing under a long-standing philosophy of collaboration and an interdisciplinary approach, brings a specialized technical group focusing on the design and implementation of new approaches to the exploration, development, and production of oil and gas. Previous EERC carbon storage projects have focused on characterizing storage resources in North Dakota, developing advanced methods for monitoring injected CO_2, and developing CO_2 storage facility permits under the North Dakota Class VI well-permitting program. Neset Consulting Services (Neset) has overseen the drilling, core collection, and geophysical logging of hundreds of wells in North Dakota, including stratigraphic test wells for CO_2 storage resource evaluations.

MANAGEMENT

The EERC will lead the project with support from project partners, ONEOK and Neset. SLB (formerly Schlumberger Technology Corporation) and Computer Modelling Group Ltd. (CMG) will provide the industry-standard software packages needed to execute the proposed scope of work. Each of the proposed tasks will be led by qualified individuals from the EERC who will work with the project partners as

appropriate to accomplish task goals and corresponding project goals. Deliverables and milestones will be incorporated into a contractual agreement to ensure the project is being carried out on schedule and in a manner that best ensures the objectives will be met. Progress reports will be prepared quarterly (due 30 days at the end of each calendar quarter) and will serve to evaluate the project for budget, schedule, and technical achievement. The evaluation points (i.e., deliverables and milestones) are identified in the following Gantt chart. The actual dates will be adjusted when the final contract with DOE is in place.

TIMETABLE



BUDGET

The overall estimated cost for the 2-year project is $16,550,000 (Appendix B). DOE is contributing $9,000,000 in funding support through the CarbonSAFE Initiative. This proposal requests $1,050,000 from NDIC through its Oil and Gas Research Program (OGRP), and ONEOK anticipates providing an

estimated $6,500,000 in 15 cofounding for the remainder of the project cost. The ONEOK and NDIC contributions will support the drilling and testing of the stratigraphic test well. Operating costs not directly associated with the costs of the project are not shown. Successful achievement of all of the project's objectives is dependent upon timely completion of each proposed component of the project. The knowledge that will be generated by successful completion of the proposed activities is necessary to build and maintain momentum for possible future deployment of commercial-scale CCS in McKenzie County. Lower-than-requested funding levels could result in significant delays to execution of the proposed activities. Current federal tax incentives for CCS have a limited time frame during which they will be available, and delays in developing the necessary data required to determine the viability of McKenzie County will delay commercialization and adversely impact the business model.

Total Project Expense	NDIC's Share	Applicant's Share (cash)	DOE's Share
$16,550,000	$1,050,000 (6%)	$6,500,000 (39%)	$9,000,000 (55%)

TAX LIABILITY

ONEOK, Inc., a leading midstream service provider and one of the nation's premier natural gas liquids systems, connecting NGL supply in the Rocky Mountain, Mid-Continent and Permian regions with key market centers and an extensive network of natural gas gathering, processing, storage and transportation assets is current with all tax filings and liabilities in the state of North Dakota.

CONFIDENTIAL INFORMATION

Although there is no confidential information included in the proposal, there is a reasonable expectation that confidential information will be involved in, or created during, the execution of the project. In such cases, confidential information will be withheld from public disclosure. However, the intent is to make as much information publicly available as possible while protecting the interests of ONEOK.

PATENTS/RIGHTS TO TECHNICAL DATA

Patents or rights do not apply to this proposal.

STATUS OF ONGOING PROJECTS (IF ANY)

ONEOK has not previously requested or received OGRP funding.

APPENDIX A

LETTERS OF SUPPORT

Energy & Environmental Research Center
15 North 23rd Street, Stop 9018 • Grand Forks, ND 58202-9018 • P. 701.777.5000 • F. 701.777.5181
www.undeerc.org

May 31, 2023

Mr. Chad Schneeberger
ONEOK Renewable Project Development Director
ONEOK, Inc.
100 West 5th Street
Tulsa, OK 74103

Dear Mr. Schneeberger:

Subject: OGRP Proposal Entitled "Roughrider Carbon Storage Hub"

The Energy & Environmental Research Center (EERC) is excited to support ONEOK in its proposal to the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) entitled "Roughrider Carbon Storage Hub." The proposed scope of work directly aligns with the NDIC OGRP mission to *promote the growth of the oil and gas industry through research and education* and the EERC's vision *to lead the world in developing solutions to energy and environmental challenges through innovative science and engineering*.

As you know, the U.S. Department of Energy (DOE) recently announced the EERC as the recipient of a $9 million award to investigate the feasibility of developing a CO_2 storage hub in western North Dakota. Through the proposed research effort, the EERC will work closely with ONEOK to evaluate a prospective CO_2 storage hub as an opportunity to not only address the objectives of OGRP and DOE but also make major strides toward achieving Governor Burgum's goal of a carbon-neutral North Dakota. The proposed research will lay the technical groundwork to inform investment decisions and prudent development strategies for natural-gas processing operators seeking to produce a low-carbon product.

We believe that the proposed research's potential long-lasting economic and technological benefits far exceed the requested investment from NDIC OGRP, and the EERC is prepared to leverage our experience and provide the necessary technical resources to ensure the successful execution and fulfillment of reporting requirements for the research activities. We look forward to collaborating with ONEOK and NDIC on this exciting effort. If you have any questions, please contact me by phone at (701) 777-5472 or by email at jhamling@undeerc.org.

Best regards,

DocuSigned by:
6AD3DF00E40048F...
John A. Hamling
VP for Strategic Partnerships

Approved by:

DocuSigned by:
29499751F2B84D7...
Charles D. Gorecki, CEO
Energy & Environmental Research Center

JAH/rlo

KELLY ARMSTRONG
AT-LARGE, NORTH DAKOTA

ENERGY AND COMMERCE COMMITTEE
CONSUMER PROTECTION AND COMMERCE
ENERGY

Congress of the United States
House of Representatives
Washington, DC 20515

WASHINGTON OFFICE:
1740 LONGWORTH HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-2611

DISTRICT OFFICES:
3217 FIECHTNER DR., SUITE B
FARGO, ND 58103
PHONE: (701) 353-6665

U.S. FEDERAL BUILDING
220 E ROSSER AVE., ROOM 228
BISMARCK, ND 58501
(701) 354-6700

ARMSTRONG.HOUSE.GOV

July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

I write to express my support for the Energy & Environmental Research Center's (EERC) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity, DE-FOA-0002610.

I am a champion of North Dakota's vibrant energy resources and those enterprises that responsibly produce and develop these assets. I am particularly proud of my frequent opportunities to highlight the ongoing leadership of the EERC in formulating an economically viable reduced carbon future for our nation and world.

The EERC's proposed efforts will examine the potential development of a world-class and world-scale carbon storage enterprise in North Dakota. I am confident that this initiative will further propel North Dakota's leadership in the pursuit of long-term energy solutions.

I strongly support the EERC's efforts, which will lead to exciting opportunities for the state of North Dakota and the nation.

Sincerely,

Kelly Armstrong
Member of Congress

NORTH Dakota | Governor Doug Burgum

Be Legendary.™

July 21, 2022

National Energy Technology Lab
U.S. Department of Energy
Morgantown Campus
3610 Collins Ferry Road
P.O Box 880
Morgantown, WV 26507-0880

Subject: Support for EERC CarbonSAFE Proposal Titled "Roughrider Carbon Storage Hub"

To whom it may concern:

Please accept this letter of support for the Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity, DE-FOA-0002610.

Among my duties as governor of North Dakota is to chair the North Dakota Industrial Commission, which is the primary regulator of North Dakota's vast subsurface mineral resources. North Dakota has a long history of responsible development and environmental stewardship. The EERC has had a long-term commitment to making geologic sequestration of CO_2 a viable option in our quest to make North Dakota carbon neutral by 2030 through innovation.

North Dakota's energy industries are global leaders in energy development and production, implementing long-term strategies that provide meaningful and abundant contributions to our nation's energy needs. This includes fossil fuels as well as renewable resources. The project proposed by the EERC will facilitate continual environmental progress in the utilization of our state's abundant natural resources by investigating the feasibility of developing an integrated carbon storage complex.

We strongly support the efforts of the EERC and look forward to the exciting opportunities this work will bring to the state of North Dakota and our country in resolving our energy challenges.

Regards,

Doug Burgum
Governor

COMPUTER MODELLING GROUP LTD.
3710 33rd Street NW ▪ Calgary, AB, T2L 2M1 ▪ Canada
Tel: +1.403.531.1300 ▪ Fax: +1.403.289.8502
cmgl@cmgl.ca ▪ www.cmgl.ca

September 13, 2022

Mr. Wesley Peck
Assistant Director for Subsurface Strategies
Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Peck:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

I am writing to confirm Computer Modelling Group Ltd.'s (CMG's) commitment to partner with the team being assembled by the Energy & Environmental Research Center (EERC) in response to The U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity
DE-FOA-0002610.

CMG is focused on providing practical solutions for modeling and simulation of oil and gas and CO2 storage opportunities and as such, we are very supportive of projects that will enable the continued use of our nation's energy resources in an environmentally responsible manner. The results of the project will provide the natural gas industry with data and knowledge critical to implementing commercial-scale CO_2 storage.

As indicated in the subject proposal, CMG is committed to provide reservoir simulation software licenses and technical support for the duration of 18 months. We will provide three licenses each of GEM MAX and CMOST, plus one license of WINPROP. The total value of this contribution is shown below

Software Type (Number of Licenses)	GEM MAX (3), WINPROP (1), CMOST (3), BUILDER (4), RESULTS (4)
Total License Fees (18 mo.)	**$747,150**
Amount to Be Paid by EERC (BUILDER, RESULTS) (18 mo.)	**$124,800**
Total Contribution (18 mo.)	**$747,150**

We welcome this opportunity to collaborate with the EERC and the rest of the team on addressing the critical challenges associated with the development of a commercial-scale CO_2 storage site.

Sincerely,
Computer Modelling Group Ltd.

Sandra Balic
Vice President, Finance & CFO

KEVIN CRAMER
NORTH DAKOTA

SUITE 330
HART BUILDING
WASHINGTON, DC 20510
202–224–2043

United States Senate

COMMITTEES
ARMED SERVICES
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VETERANS' AFFAIRS

July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

I am writing to express my support for the University of North Dakota Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity, DE-FOA-0002610.

As you know, I have been persistent in my support for our state's all-the-above energy industry and for the world-class energy research across multiple disciplines undertaken by the EERC. I introduced and worked on multiple pieces of legislation to encourage research, development, and implementation of carbon capture, utilization, and storage (CCUS) technologies.

North Dakota is among the nation's premier states in energy production and environmental conservation. I am a proponent of an all-the-above strategy for the development and production of all of the state's energy resources—conventional and renewable—and believe North Dakota's energy research and policies should serve as a model for the rest of the country. The EERC's proposed efforts will fast-track the development of an integrated carbon storage complex in North Dakota, which will lead to an expansion of the opportunities for our state's and nation's energy industries.

I am a strong advocate of the work being done at the EERC and remain supportive and committed to the opportunities being pursued, including proposals like the geologic carbon storage project, and the promise they provide for the state of North Dakota and the nation.

Sincerely,

Kevin Cramer

Kevin Cramer
United States Senator

JOHN HOEVEN
NORTH DAKOTA
338 RUSSELL SENATE OFFICE BUILDING
TELEPHONE: (202) 224-2551
FAX: (202) 224-7999
hoeven.senate.gov

United States Senate

WASHINGTON, DC 20510

COMMITTEES:
AGRICULTURE
APPROPRIATIONS
ENERGY AND NATURAL RESOURCES
INDIAN AFFAIRS

July 20, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

RE: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

Dear John:

I am writing to express my support for the Energy & Environmental Research Center's (EERC's) efforts to secure funding through the U.S. Department of Energy's CarbonSAFE Phase II – Storage Complex Feasibility funding opportunity (DE-FOA-0002610).

After nearly 15 years of effort, we have placed North Dakota at the forefront of energy development. Our state not only serves as an energy powerhouse for our nation, but we are also leading the way in innovative new technologies, like carbon capture, utilization and storage (CCUS), which will empower the United States to continue utilizing all of our abundant energy resources with better environmental stewardship. In particular, we:

- Developed and passed through the North Dakota legislature, a regulatory framework for long-term carbon sequestration in the state.
- Established trust funds for state oversight and for long-term liability.
- Secured approval from the Environmental Protection Agency to give North Dakota regulatory primacy over Class VI wells.

These are among the critical elements that set our state apart in making geologic sequestration a reality, and the EERC has been a central player throughout these efforts. Now under this proposal, the EERC is seeking to investigate the feasibility of housing an integrated carbon storage hub in North Dakota. Such a facility would be an important resource in accelerating the implementation of CCUS in our state, while supporting the energy security of our nation.

Accordingly, I hope this application receives favorable consideration. Thank you for your continued work toward these important goals, and feel free to contact my office should you need any further assistance.

Sincerely,

John Hoeven

John Hoeven
U.S. Senator

July 15, 2022

INDUSTRIAL COMMISSION OF NORTH DAKOTA

Doug Burgum
Governor

Drew H. Wrigley
Attorney General

Doug Goehring
Agriculture Commissioner

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

The North Dakota Industrial Commission (NDIC) Clean Sustainable Energy Authority (CSEA) is pleased to support the Energy & Environmental Research Center's (EERC's) proposed project to investigate the geologic storage of CO_2 in western North Dakota in response to CarbonSAFE Phase II – Storage Complex Feasibility DE-FOA-0002610.

The purpose of CSEA is to support research, development, and technological advancements through partnerships and financial support for the large-scale development and commercialization of projects, processes, activities, and technologies that reduce environmental impacts and increase sustainability of energy production and delivery. The U.S. Department of Energy's interest in carbon capture aligns with the goals and objectives of CSEA.

North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all the state's energy resources—traditional and emerging—to meet the nation's growing energy demand in an environmentally responsible manner. The project proposed by the EERC will investigate the feasibility of a commercial storage complex hub in North Dakota, leading to expanded opportunities for the state's energy industries. If the proposed project is awarded, CSEA may be able to provide additional funding opportunities in the form of grants and/or loans to support future developmental work.

We look forward to working with the EERC team on this important project.

Sincerely,

Alan Anderson
Director

Karlene Fine, Executive Director and Secretary
State Capitol, 14th Floor - 600 E Boulevard Ave Dept 405 - Bismarck, ND 58505-0840
E-Mail: kfine@nd.gov
Phone: (701) 328-3722
www.nd.gov

NORTH Dakota | Mineral Resources
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July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

The North Dakota Industrial Commission's (NDIC's) Department of Mineral Resources (DMR) is pleased to provide the Energy & Environmental Research Center (EERC) with this letter of support for the proposed studies to investigate a commercial-scale geologic carbon storage hub in western North Dakota in response to the U.S. Department of Energy's CarbonSAFE Funding Opportunity DE-FOA-0002610.

As you know, North Dakota is one of the nation's largest providers of energy. Because energy production is such a vital part of the North Dakota economy, we are very supportive of the development of technologies that will enable the continued use of our energy resources in an environmentally responsible manner.

We are particularly excited about the proposed CarbonSAFE opportunity because it will help support the natural gas-processing facilities in western North Dakota. If successfully funded, the EERC's CarbonSAFE project will characterize storage sites in North Dakota to help qualify a portion of our vast CO2 storage potential. The results of the project will provide the natural gas industry with data and knowledge critical to implementing commercial-scale CO2 storage in deep saline formations across the state.

Should the feasibility study be funded, we understand the EERC is planning to permit and drill one stratigraphic test well under NDIC guidelines. As the state regulator for underground injection control (UIC) Class VI storage permits, to support this effort, NDIC DMR is prepared to work with the EERC to ensure all required documents are submitted with the permit applications and that they are reviewed and approved in a timely manner.

In closing, we look forward to working with the EERC and proposal team on this important project. We wish you the best in your efforts to secure this funding opportunity.

Sincerely,

Lynn D. Helms
Director

Bruce E. Hicks
ASSISTANT DIRECTOR
OIL AND GAS DIVISION

Lynn D. Helms
DIRECTOR
DEPT. OF MINERAL RESOURCES

Edward C. Murphy
STATE GEOLOGIST
GEOLOGICAL SURVEY

600 E Boulevard Ave – Dept 405 | Bismarck, ND 58505-0840 | PHONE: 701-328-8020 | FAX: 701-328-8022 | dmr.nd.gov

INDUSTRIAL COMMISSION OF NORTH DAKOTA

OIL AND GAS RESEARCH PROGRAM

Brent Brannan, Director
E-Mail: brentbrannan@gmail.com

Governor
Doug Burgum
Attorney General
Drew Wrigley
Agriculture Commissioner
Doug Goehring

July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear John:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

The North Dakota Industrial Commission's (NDIC's) Oil and Gas Research Program (OGRP) is pleased to support the Energy & Environmental Research Center (EERC) proposed project to investigate the geologic storage of CO_2 in western North Dakota in response to U.S. Department of Energy (DOE) CarbonSAFE Phase II – Storage Complex Feasibility Funding Opportunity Announcement DE-FOA-0002610.

One of the functions of OGRP is to promote efficient, economical, and environmentally sound exploration, development, and use of North Dakota's oil and gas resources; preserve and create jobs involved in the exploration, production, and utilization of North Dakota's oil and gas resources; and ensure economic stability, growth, and opportunity in the oil and gas industry. DOE's interest in carbon capture for the purpose of developing net-carbon-negative generation technologies aligns well with the goals and objectives of OGRP.

North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all of the state's energy resources—traditional and emerging—to meet the nation's growing energy demand in an environmentally responsible manner. The project proposed by the EERC will investigate the feasibility of a commercial CO_2 storage hub in North Dakota, leading to expanded opportunities for the state's energy industries.

We look forward to working with the EERC team on this important project.

Sincerely,

Brent Brannan

NORTH DAKOTA
PETROLEUM
COUNCIL

100 West Broadway, Ste. 200 | P.O. Box 1395 | Bismarck, ND 58501-1395
701.223.6380 | ndpc@ndoil.org | www.NDOil.org

July 21, 2022

Mr. John A. Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

Dear Mr. Harju:

The North Dakota Petroleum Council (NDPC) is pleased to submit this letter of support for the team being assembled by the Energy & Environmental Research Center (EERC) to investigate the geologic storage of CO_2 in western North Dakota in response to CarbonSAFE Phase II – Storage Complex Feasibility DE-FOA-0002610.

Established in 1952, the NDPC is a trade association that represents more than 600 companies involved in all aspects of the oil and gas industry, including oil and gas production, refining, pipeline, transportation, mineral leasing, consulting, legal work, and oil field service activities in North Dakota, South Dakota, and the Rocky Mountain Region.

Part of NDPC's mission is to promote and enhance the discovery, development, production, transportation, refining, conservation, and marketing of oil and gas in our region as well as promote opportunities for open discussion, lawful interchange of information, and education concerning the petroleum industry. We support the important work being done by the EERC and believe there is great potential in this research.

We strongly encourage consideration of the EERC proposal and look forward to the results of this important project.

Sincerely,

Ron Ness

Ron Ness
President
North Dakota Petroleum Council

NESET

6844 Highway 40, Tioga, ND 58852 701-664-1492

September 13, 2022

Mr. Wesley D. Peck
Assistant Director for Subsurface Strategies
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Peck:

Subject: Support for EERC CarbonSAFE Proposal Entitled "Roughrider Carbon Storage Hub"

NESET is pleased to partner with the Energy & Environmental Research Center to support the investigation of a commercial-scale geologic storage hub for CO_2 in northwestern North Dakota in response to the U.S. Department of Energy's CarbonSAFE Funding Opportunity DE-FOA-0002610. The past 70 years has proven that the Williston Basin possesses a vast amount of energy potential. The petroleum resource of the Williston Basin continues to provide our society with energy needed to fuel our economy. We are honored to support and assist in the project in the following capacity.

NESET will work as a subcontractor to the EERC and serve as the General Contractor during the well drilling and core collection portion of the project. Activities will include planning and development of procedures with the EERC, Gantt chart development, AFE development, competitive bidding process, vendor selection in conjunction with the EERC, vendor management, development, and management of master service agreements (MSAs) with all vendors, payment to all vendors, daily activity reporting, daily cost reporting, and invoice development for the EERC. NESET has successfully operated in the Williston Basin from its headquarters in Tioga, ND, for 40 years, providing a wide range of drilling, production, and geological services to over 170 oil and gas companies. Operating on as many as 99 rigs simultaneously during the height of the latest Bakken boom, NESET has successfully contributed to the completion of over 7750 wells in the Williston Basin. NESET is well positioned to meet or exceed every requirement in this contract.

NESET will also provide advice and support to the societal considerations and impacts task. The company philosophy includes investment in education, job retention, and the community. A certified woman-owned business, NESET maintains a current WBENC (Women's Business Enterprise National Council) certification. NESET proactively invests in mentoring young STEM professionals, especially women, has integrated community service into the work life of its employees, and encourages "giving back," examples of which are our on-premises childcare facility and serving on governing boards spanning the North Dakota Petroleum Council, the State

Board of Higher Education, regional foundations, and local charitable and religious organizations.

We wish the EERC the best of luck in this project. NESET fully supports the important work being done with CCUS in North Dakota.

Sincerely,

Kathleen Neset

Kathleen Neset
President, Geologist

Schlumberger

Letter of Commitment

September 14, 2022

Mr. Wesley Peck
Assistant Director for Subsurface Strategies
Energy and Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND. 58202-9018

Dear Mr. Peck

This letter confirms our commitment in supporting the Energy and Environmental Research Center's Proposal No. 2022-0174 to the U.S. Department of Energy' CarbonSAFE Program (DE-FOA-0002610) entitled "Roughrider Carbon Storage Hub" to investigate carbon storage in central North Dakota.

Schlumberger is a recognized leader in modeling complex geologic systems, reservoir evaluations, and the management of CO_2, with decades of experience in field testing for the oil and gas industry. As such, Schlumberger is focused on providing practical solutions for the characterization, modeling, and simulation of oil, gas, and saline reservoirs to assist in answering challenging questions associated with the identification of suitable targets for CO_2 injection, reservoir behaviors in response to injection, and the long-term fate of the injected fluid. Schlumberger's technology expertise coupled with the EERC's research capabilities and wealth of knowledge regarding geologic analysis and characterization, 3D geocellular modeling, and geologic storage of CO_2 creates an ideal method to conduct the proposed feasibility assessment of an integrated Carbon Capture Storage project in North Dakota.

Schlumberger and EERC have a strong track record of collaboration through technical data gathering, analysis, modeling, field service work, and consulting. Schlumberger will continue to offer our software package licensing through the University Donation Program and will support graduate and undergraduate students as they carry out research on such projects.

We welcome the opportunity to partner with and support the EERC and University of North Dakota in researching the feasibility of developing a commercial-scale CO_2 storage site in the great state of North Dakota.

Sincerely,

Erik Borchardt

Erik Borchardt
Business Development Manager -Reservoir Performance/New Energy
303-241-0815
eborchardt@slb.com

WESTERN DAKOTA ENERGY ASSOCIATION

July 17, 2022

Mr. Wesley D. Peck
Assistant Director for Subsurface Strategies
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Peck:

Subject: Support for EERC CarbonSAFE Proposal Entitled Roughrider Carbon Storage Hub

The Western Dakota Energy Association is a membership organization comprised of the cities, counties and school districts in the energy-producing region of western North Dakota. WDEA is pleased to provide the Energy & Environmental Research Center (EERC) with this letter of support for the proposed studies to investigate a commercial-scale geologic carbon storage hub in western North Dakota in response to the U.S. Department of Energy's CarbonSAFE Funding Opportunity DE-FOA-0002610.

WDEA's advocacy goals include ensuring a solid economic future for our communities, strong infrastructure which promotes safety for our citizens, and sensible management of our natural resources to ensure their viability for generations to come.

North Dakota is at the forefront of energy development and production, investigating long-term strategies that incorporate all the state's energy resources—traditional and emerging—to meet the nation's growing energy demand in an environmentally responsible manner. The project proposed by the EERC will investigate the feasibility of a commercial storage complex hub in North Dakota, leading to expanded opportunities for the state's energy industries, its communities and its citizens.

We look forward to working with the EERC team on this important project.

Sincerely,

Geoff Simon
Executive Director

Western Dakota Energy Association
1661 Capitol Way, Bismarck ND 58501
www.ndenergy.org • 701-527-1832

APPENDIX B

ADDITIONAL SUPPORTIVE DOCUMENTATION

PROJECT NARRATIVE

Proposed Project Title:	Roughrider Carbon Storage Hub
Funding Opportunity Number:	DE-FOA-0002610 Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Phase II – Storage Complex Feasibility
Area of Interest 1:	Single- or Multi-Source (Hub) Onshore Storage Facilities
Name and Address of Applicant:	Energy & Environmental Research Center (EERC) University of North Dakota (UND) 15 North 23rd Street, Stop 9018 Grand Forks, ND 58202-9018
Team Member Organizations:	UND EERC ONEOK Neset Consulting Service
Technical Point of Contact:	Wesley D. Peck Phone: (701) 777-5195 Fax: (701) 777-5181 Email: wpeck@undeerc.org
Business Point of Contact:	Sheryl A. Eicholtz-Landis Phone: (701) 777-5124 Fax: (701) 777-5181 Email: slandis@undeerc.org
Federal Share of Costs:	$9,000,000
Nonfederal Share of Costs:	$7,550,000
Date of Application:	September 15, 2022

TABLE OF CONTENTS

INTRODUCTION

The proposed Roughrider Carbon Storage Hub scenario in northwestern North Dakota will store CO_2 captured from several gas-processing plants owned and operated by project partner ONEOK, Inc., and a planned gas-to-liquids (GTL) plant by Cerilon (Figure 1). This feasibility study will evaluate the aggregation of CO_2 captured from seven sources for injection into geologic storage complexes in a stacked storage configuration. The hub scenario includes several aspects that make it a highly qualified candidate for a feasibility study with a notably reduced project risk profile. These include 1) a project partner with a committed goal to reduce greenhouse gas (GHG) emissions; 2) prior subsurface data analysis results supporting a stacked storage scenario with adequate CO_2 storage volume; 3) commitment from local, regional, and state-level stakeholders, and 4) a state with Class VI primacy. In addition, there is potential for expansion/flexibility to include additional CO_2 sources (including direct air capture). In aggregate, these project characteristics combined with the Energy & Environmental Research Center's (EERC's) extensive experience with carbon capture, utilization, and storage (CCUS) through the Plains CO_2 Reduction (PCOR) Partnership Program Initiative and previous Carbon Storage Assurance Facility Enterprise (CarbonSAFE) efforts (Phases II and III) make our scenario a viable CCUS stacked storage system that can be realistically constructed and permitted for operation. Collectively, this CarbonSAFE Phase II proposal efficiently and effectively meets the goals and objectives of the overall U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) CarbonSAFE Initiative.

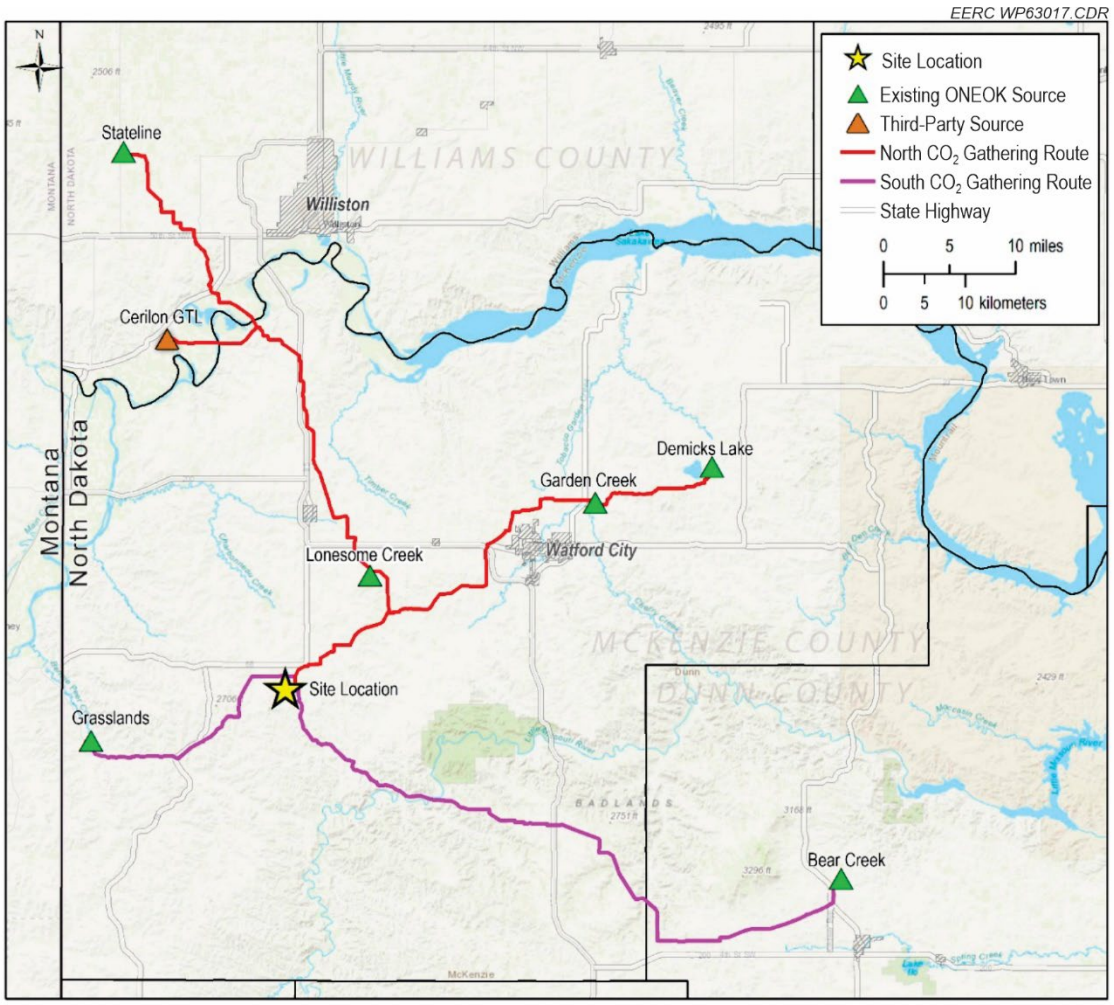

Figure 1. Proposed CarbonSAFE Roughrider Carbon Storage Hub scenario envisioned for northwestern North Dakota. Notional pipeline routes are depicted.

PROJECT OBJECTIVES

The proposed project objectives are to accelerate wide-scale deployment of CCUS by assessing and verifying the feasibility of using stacked storage complexes in northwestern North Dakota for the safe and cost-effective commercial-scale (i.e., ≥ 50 MMt within 30 years) storage of anthropogenic CO_2 emissions captured from ONEOK and Cerilon facilities in northwestern North Dakota. Through the execution of the proposed scope of work, the prospective storage resource of the area of interest (AOI) will be advanced to contingent storage resource as classified under the Society of Petroleum Engineers CO_2 Storage Resources Management System (SRMS). In addition, the proposed Phase II project will complete a rigorous feasibility study for both technical and economic viability as well as identify societal considerations and impacts of the proposed research, including impacts on disadvantaged communities and subpopulations, to develop and implement regional-specific plans to engage communities and stakeholders.

MERIT REVIEW CRITERIA (MRC)

MRC1: Project Readiness

MRC1a–1e

MRC1 is addressed fully in the separate CarbonSAFE Phase II Project Readiness document, providing evidence of a well-developed storage complex prefeasibility evaluation supporting potential for commercial storage as well as evidence of suitable CO_2 sources that will use the storage resource.

MRC1 Subsection	Location in Project Readiness Document
MRC1a	Section 1.0 Northwestern North Dakota Scenario Analysis
MRC1b	Section 2.0 Technical Subbasinal Evaluation
MRC1c	Section 3.0 Regional Analysis
MRC1d	Section 4.0 CO_2 Technical Analysis
MRC1e	Section 5.0 Stakeholder Analysis
MRC1f	Section 4.4 Pipeline ROW Analysis

MRC2: Scientific and Technical Merit

MRC 2a – Thoroughness of Proposed Project with FOA and AOI Research Objectives

The objectives and tasks in the statement of project objectives (SOPO) address the overarching goals of the FOA and each of the prescribed key activities. The proposed work will accelerate wide-scale deployment of CCUS by assessing and verifying a safe and cost-effective commercial-scale storage site for anthropogenic CO_2 emissions captured from ONEOK and Cerilon facilities in northwestern North Dakota. The team will acquire, analyze, and interpret geologic information to investigate the feasibility of a storage complex in the region to demonstrate storage resources for commercial volumes of CO_2 (50 MMt within 30 years). Through the execution of the proposed scope of work, the prospective storage resource of the AOI will be advanced to contingent storage resource as classified under the Society of Petroleum Engineers CO_2 SRMS (Storage Resources Management System).

MRC2b – Feasibility of the Proposed Concept, Based on Sound Scientific and Engineering Principles

The proposed scope of work is based on sound scientific and engineering principles, as evidenced by the EERC's record of conducting similar assessments in central North Dakota, resulting in three approved CO_2 storage facility permits and one pending approval. In addition, the project team has decades of experience managing field activities, successful major construction projects, and operation of gas-

processing facilities, all which require understanding and application of scientific and engineering principles.

MRC3: Technical Approach and Understanding

MRC3a – Adequacy and Feasibility of Approach to FOA and AOI Objectives
Each task in the SOPO is essential for addressing the primary objective of accelerating wide-scale deployment of CCUS.

The proposed tasks will leverage the existing experience, knowledge, lessons learned, and relationships within the project team to characterize a storage complex with the potential to securely store 50 MMt of anthropogenic CO_2. Collected and interpreted data, as well as execution of societal considerations and impacts (SCI) assessments and plans, will build a foundation upon which a successful application could be subsequently submitted for CarbonSAFE Phase III: Site Characterization and Permitting. The tasks are designed to systematically identify and address both technical and nontechnical challenges; collaborate with team members and key stakeholders to provide solutions and paths toward commercialization; and communicate results to DOE, the communities, and other stakeholders.

Task 1, a project management and planning activity, will span the duration of the project and ensure that all subsequent tasks and activities are completed according to the specified timelines and that DOE-compliant reporting occurs. Task 2 – SCI Assessment and Plans consists of the development and implementation of the Societal Considerations and Impacts package that will address Community and Stakeholder Engagement, DEIA (diversity, equity, inclusion, and accessibility), and energy and environmental justice through the Justice40 Initiative. Faculty from the UND Nistler College of Business & Public Administration will assist with implementation of the SCI plans. Task 3 – Storage Complex Characterization comprises all of the activity required to perform geologic characterization of the planned storage targets and their overlying sealing formations. Task 4 – Geologic Modeling and Simulation encompasses the effort to integrate data into a geocellular model of the study area, which provides the foundation for dynamic simulations of potential injection scenarios. Task 5 – Technical and Economic Analysis includes an evaluation of the entire proposed CO_2 storage hub, including options to address potential challenges as well as a complete design study for the CO_2 transport. Task 6 – Site Development Plan comprises the creation of 1) a detailed plan for development of a subsequent complete site-characterization effort for the potential injection site, 2) a CO_2 management strategy for acquiring and transporting CO_2 to the injection site, and 3) a risk assessment to identify project risks and provide mitigation strategies.

Collectively, the activities embraced by these tasks will facilitate wide-scale CCUS deployment and infrastructure development by reducing uncertainties and providing solutions to technical and nontechnical challenges. Results of the proposed work will enable development of environmentally sound, low-emission natural gas processing and utilization by providing essential technical and economic information regarding the various components of the CCUS value chain (i.e., CO_2 capture, transport, storage).

MRC3b – Feasibility, Rationale, and Completeness of SOPO
The proposed project is scheduled to take 24 months with the six-task structure presented in the SOPO. The objectives and tasks in the SOPO further address the overarching goals of the FOA and each of the prescribed Phase II: Storage Complex Feasibility research objectives. In summary, the proposed work will define and assess a storage complex through data collection; geologic analysis; identification of contractual and regulatory requirements and development of plans to satisfy them; subsurface modeling to support geologic characterization, risk assessment, and monitoring; and public engagement as well as

complete a feasibility study for both technical and economic viability. More detail is provided in the SOPO section of this project narrative document.

MRC3c – Adequacy and Completeness of the Project Management Plan
The project management plan (PMP) describes the elements necessary to successfully manage the proposed work and establishes timelines and deliverables for achieving the project objectives. The deliverables, milestones, success criteria, cost profile, and schedule are based on the proposed task structure detailed in the SOPO and portrayed in the PMP. The milestones and success criteria provide discrete points documenting successful progress toward attainment of the project's goals, as described in the SOPO and PMP. In addition to delineating a spend plan of DOE and cost-share funds by fiscal year for the EERC, a project funding profile by budget period (BP) is provided. A Gantt chart in the PMP outlines the project schedule by task and subtask, as described in the SOPO, including the deliverables from the SOPO and the milestones from the PMP. The risk management plan identifies potential project risks and mitigation strategies that will be employed to address those risks.

The reader is directed to the PMP (PMP.pdf).

MRC4: Technical and Management Capabilities, Facilities, and Resources

MRC4a – Adequacy of Preexisting Wells and Equipment/Facilities
Preexisting wells near the location for the proposed stratigraphic test well will be reviewed for integration into the geologic models to be built in the course of the proposed project. Any preexisting equipment or facilities will be reviewed for repurposing and/or replacement as required to meet the requirements of this project. The selected site location has a preexisting well pad ideal for the proposed project efforts.

MRC4b – Preexisting Data Availability and Usage
Project partners EERC and ONEOK conducted an initial screening study of northwestern North Dakota using publicly available legacy well data. The screening study area included the AOI for this project in central McKenzie County, North Dakota. The Oil and Gas Division of the North Dakota Industrial Commission (NDIC) provides online access to all geophysical logs related to deep well drilling in North Dakota. These data will be used, along with new data collected as part of this research effort, to construct 3D geocellular models of the targeted CO_2 storage complexes.

Legacy 3D data available in the project area will be purchased from a data exchange company. The legacy 3D data will be reprocessed with modern processing techniques and will be interpreted at the EERC for the purpose of extending the point characterization data collected at the test well laterally for several miles to evaluate the structural and stratigraphic continuity of the target geologic horizons.

MRC4c – Evidence of Interest/Commitment from Relevant Parties
The partners that have provided letters of commitment/support for this effort are committed fully within their individual scopes and spheres of influence to move CCUS forward in a manner that is economically attractive and publicly acceptable. Regarding cost-share commitment, ONEOK has committed to drilling a dedicated stratigraphic test well valued at over $9,000,000 which will comprise in-kind support for the project. This notable contribution speaks to the seriousness of ONEOK's intent to support the goal of the DOE CarbonSAFE Program. ONEOK's and other letters of commitment are included as separate attachments with this proposal package.

MRC4d – Availability of the Project Team and Subcontractors to Perform the Project
The proposed team has committed to the project and has ensured the availability of the key personnel for the time frame of this project.

MRC4e – Degree of Evidence of Organizations and Individuals Credentials, Experience, and Capabilities

The organization of the project team is described in the PMP. The EERC will lead the project with support from project partners ONEOK and Neset Consulting Service (NESET). Schlumberger Technology Corporation (Schlumberger) and Computer Modelling Group Ltd. (CMG) will provide the industry-standard software packages needed to execute the proposed scope of work. Each of the proposed tasks will be led by qualified individuals from the EERC who will work with the project partners as appropriate to accomplish task goals and corresponding project goals. The principal investigator (PI) and lead for Task 1 is Mr. Wesley Peck, EERC Assistant Director for Subsurface Strategies. In this role, Mr. Peck will handle project management, planning, and reporting activities. He will ensure successful completion of the project on schedule and budget, coordinate and direct subcontractor activities, and ensure transfer of data and products to the DOE NETL Energy Data eXchange (EDX). Mr. Peck will also lead efforts to complete required National Environmental Policy Act (NEPA) documentation. Mr. Peck has served as PI on several DOE projects at the EERC, including both a Phase II and Phase III project (ongoing) within the DOE CarbonSAFE program. Mr. Peck has broad expertise in CO_2 geologic storage, including geologic site characterization. Mr. Peck served as the task lead for the regional characterization effort of the PCOR Partnership Program, one of seven regional partnerships established under the DOE NETL Regional Carbon Sequestration Partnerships (RCSP) Initiative in 2003. Mr. Peck is very familiar with the geology of the key formations and will help guide characterization efforts.

Task 2.0 will be led by Ms. Charlene Crocker, EERC Senior Research Scientist and Outreach Team Lead, who will be responsible for implementing and refining the plans laid out in Task 2.0. Ms. Crocker has nearly 20 years of experience developing and implementing CCUS outreach. She currently serves as the task lead on outreach for the current North Dakota CarbonSAFE Phase III project, has served as the task lead on the Red Trail Energy Ethanol CCUS project, and was a team member for the outreach and education task under the PCOR Partnership. As the coordinator of the EERC's Energy Hawks Program, a multidisciplinary summer internship focused on understanding the impacts of and adding value to North Dakota's energy landscape, Ms. Crocker mentors multicultural graduate and undergraduate students studying at six of North Dakota's colleges and universities. Outreach programs Ms. Crocker has developed have focused on fossil energy transformations, CO_2 emissions, critical minerals, water quality and use, and fish consumption advisories and include general public, K–12, and post-secondary education, and documentary development, writing, and production.

Task 3.0 will be led by Mr. Ryan Klapperich, EERC Principal Geoscientist, responsible for overseeing all aspects of the storage complex characterization effort. Mr. Klapperich has expertise in CO_2 storage, geologic site characterization, monitoring program assessments, design and implementation of near-surface monitoring programs, and interpretation of monitoring data. Mr. Klapperich is actively involved in several site characterization and CO_2-monitoring activities at the EERC, including leading the characterization tasks on the North Dakota CarbonSAFE Phase II and III projects. Mr. Klapperich serves as Co-PI on the Brine Extraction and Storage Test (BEST) project, which is demonstrating the use of active reservoir management (ARM) techniques to improve reservoir storage potential in saline formations with CO_2 storage potential. Mr. Klapperich previously served as Co-PI on a project principally funded by the IEA Greenhouse Gas R&D Programme (IEAGHG) focused on understanding the use of ARM schemes to enhance CO_2 storage and reduce monitoring, verification, and accounting (MVA) costs.

Task 4.0 will be led by Dr. Matthew Burton-Kelly, EERC Senior Geologist, who will be responsible for geologic modeling and simulation. Dr. Burton-Kelly has expertise and experience in well log, core, and thin-section petrophysical analysis; CO_2 storage efficiency; data science; stratigraphy, paleogeography, and geologic characterization; geocellular reservoir modeling; and geologic storage of CO_2. He is currently involved in multiple DOE-funded projects. Previously, Dr. Burton-Kelly led the development and publication of a new method to delineate area of review for CO_2 storage projects as part of the PCOR

Partnership Initiative and led development and simulation of an ensemble of geologic models to support DOE's Science-Informed Machine Learning for Accelerating Real-Time Decisions in Subsurface Applications (SMART) Initiative. Dr. Burton-Kelly has also contributed to multiple storage facility permit applications for commercial geologic storage of CO_2 in the state of North Dakota.

Task 5.0 will be led by Mr. Mike Warmack, EERC Principal Oil and Gas Facilities Engineer, who will be responsible for leading the technical and economic analysis. Mr. Warmack supports the planning, design, and selection of materials/treatment programs; costing, reporting, and/or upgrade/retrofit efforts related to production facility optimization for unconventional oil plays; injection, production, and recycle infrastructure associated with enhanced oil recovery (EOR)/incremental oil recovery (IOR) in conventional and unconventional oil and gas plays; infrastructure associated with capture and injection of CO_2 for geologic storage; and other emerging challenges associated with oil and gas injection/production processes. Mr. Warmack has more than 38 years of experience in production, operations, facilities design and installation, chemical treatment and optimization, and hands-on experience in multiple engineering disciplines.

The lead of Task 6.0 will be Mr. Barry Botnen, EERC Senior Hydrogeologist, who will be responsible for the overall site development plan. He currently supports multiple projects evaluating the feasibility and implementation of CCUS technologies for both dedicated and associated CO_2 storage. Most recently, Mr. Botnen has been working to develop and implement MVA concepts for large-scale (>1 MMt/yr) CO_2 storage and EOR operations. Mr. Botnen has over 20 years of experience in CO_2 storage, contaminated site assessment, contaminant release investigation, remedial design/action, wetlands identification/ delineation, biota studies, and the stewardship of contaminated nuclear sites.

Mr. Chad Schneeberger, ONEOK Renewable Project Development Director, will serve as a project advisor and direct and coordinate efforts by ONEOK to assist in project activities and provide land and data access. Mr. Schneeberger will work closely with the EERC team to ensure project team members have the appropriate resources/information and that ONEOK meets internal deliverables for the proposed project. Mr. Schneeberger has over 25 years' experience in midstream operations.

Mr. James Randall, ONEOK Director for Commercial Development and Renewable Energy Ventures, will serve as project advisor. Mr. Randall currently leads the Economic Planning and Projects Analysis teams at ONEOK and supports development opportunities to identify and evaluate strategic investment opportunities in renewable energy technologies and future growth platforms.

Mr. Scott Porter, ONEOK Manager of Mechanical Integrity and Reliability, will serve as project advisor. Mr. Porter has extensive experience in investigation, policy, and risk management.

The EERC has demonstrated the needed experience and capabilities to lead and carry out the proposed project through a wide variety of previous work. As a culminating effort of nearly 20 years of CCUS research through the EERC-led PCOR Partnership of the DOE RCSP Initiative,[1] the Bell Creek demonstration project deployed a research-monitoring program to better understand incidental CO_2 storage associated with a commercial EOR project. The program successfully integrated operations data with commercial and emerging monitoring techniques. In addition, the EERC published best practices manuals (BPMs) for the assessment of storage projects, which incorporate 1) site characterization, 2) modeling and simulation, 3) MVA, and 4) risk assessment.[1] The PCOR Partnership successfully demonstrated these technical elements across a variety of pilot- and commercial-scale projects, with the

[1] Hamling, J.A., Glazewski, K.A., Leroux, K.M., Kalenze, N.S., Bosshart, N.W., Burnison, S.A., Klapperich, R.J., Stepan, D.J., Gorecki, C.D., and Richards, T.L., 2017, Monitoring 3.2 million tonnes of CO_2 at the Bell Creek Oil Field: Energy Procedia, v. 114, p. 5553–5561.

aim of improving the efficiency of storage operations, reducing associated costs, and lowering risk profiles.[1,2]

The PCOR Partnership is succeeded by the recently awarded PCOR Partnership Initiative, also led by the EERC. The PCOR Partnership Initiative is fostering the development of infrastructure and accelerated deployment of CCUS in the northwestern quadrant of North America, comprising 13 U.S. states and four Canadian provinces. The PCOR Partnership Initiative utilizes the network of organizations from current and past initiatives in the region to address the critical challenges for expanding CCUS technology in the region.

MRC4f – Discussion of Previous and Current CCS Projects of Proposed Partners

The research, field experience, and partnership investment that has been built through the PCOR Partnership and PCOR Partnership Initiative enables the EERC to confidently propose the Roughrider Storage Hub program. As stated above, the PCOR Partnership Program has covered all aspects of developing CO_2 storage projects and has led directly to developing new carbon capture and storage (CCS) storage programs in the region. For example, the EERC assessed the technical and economic feasibility of integrating CCUS with ethanol production in western North Dakota (Leroux and others, 2018).[3] The EERC worked with Red Trail Energy to develop a CCS Program and obtain Class VI permitting documents for a CO_2 storage project and assisted with implementing the project, which became operational in June of 2022 (Red Trail Energy, 2022).[4] Red Trail's Class VI permit was the first issued by the State of North Dakota and the second issued in the United States.

The EERC previously led the North Dakota CarbonSAFE Phase II project involving multiple project partners, including Minnkota Power Cooperative, BNI Coal, North American Coal, ALLETE Clean Energy, Schlumberger, and CMG. The EERC and these partners have successfully conducted a variety of geologic characterization, data acquisition, laboratory testing, sample evaluation, storage operations planning, and outreach activities for the Phase II project. The EERC, Minnkota, and BNI then successfully transitioned to the North Dakota CarbonSAFE Phase III Program, which selected a storage site, completed full characterization of the site, and acquired a Class VI storage facility permit from the State of North Dakota.[5,6] Minnkota's Class VI storage facility permit was the second issued by the State of North Dakota and among the first such permits issued in the country.

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[2] Azzolina, N.A., Torres, J.A., Chimote, S.A., Pekot, L.J., Livers-Douglas, A.J., Kovacevich, J.T., Burton-Kelly, M.E., Dotzenrod, N.W., Bosshart, N.W., Dalkhaa, C., Ayash, S.C., Li, C., Nakles, D.V., Gorecki, C.D., and Vettleson, H.M., 2018, Development of intelligent monitoring system (IMS) modules for the Aquistore CO_2 storage project: Deliverable D5 final technical report for U.S. Department of Energy National Energy Technology Laboratory Cooperative Agreement No. DE-FE0026516, EERC Publication 2018-EERC-11-19, Grand Forks, North Dakota, Energy & Environmental Research Center, November.

[3] Leroux, K.M., Ayash, S.C., Klapperich, R.J., Jensen, M.D., Kalenze, N.S., Azzolina, N.A., Bosshart, N.W., Torres Rivero, J.A., Jacobson, L.J., Stevens, B.G., Nakles, D.V., Jiang, T., Oster, B.S., Feole, I.K., Fiala, N.J., Schlasner, S.M., Doll, T.E., Wilson, W.I., Gorecki, C.D., Pekot, L.J., Hamling, J.A., Burnison, S.A., Smith, S.A., Botnen, B.W., Foerster, C.L., Piggott, B., and Vance, A.E., 2018, Integrating carbon capture and storage with ethanol production for potential economic benefit: Presented at the 14th International Conference on Greenhouse Gas Control Technologies, GHGT-14, Melbourne, Australia, October 21–25.

[4] Red Trail Energy LLC, 2022, Red Tail Energy begins carbon capture and storage: Published in Carbon Capture Magazine, July 19. https://carboncapturemagazine.com/articles/284/red-trail-energy-begins-carbon-capture-and-storage (accessed August 2022).

[5] Minnkota Power Cooperative, 2022, Minnkota receives CO_2 storage permit from NDIC: press release Jan 21, www.projecttundrand.com/post/minnkota-receives-co2-storage-permit-from-ndic (accessed August 2022,).

[6] Clark, K., 2022, Minnkota Power, Summit Carbon Solutions launch CO_2 storage partnership: Power Engineering, April 29. www.power-eng.com/emissions/minnkota-power-summit-carbon-solutions-launch-co2-storage-partnership/ (accessed August 2022).

The EERC is also working with Summit Carbon Solutions, a Minnkota partner that previously explored potential CO_2 storage options in central North Dakota. Through this agreement, Summit receives access to Minnkota's currently permitted storage resource of 100 million tons while Summit and the EERC work to characterize and acquire Class VI permits for an additional estimated 100 million tons.[6] These Class VI permits are currently under development. The SASSA (scalable, automated, sparse seismic array) project, being conducted at the Bell Creek oil field, is demonstrating and validating two new geophysical technologies that provide a low impact means of detecting CO_2. These technologies require minimal processing, can be designed to operate remotely and/or autonomously, and provide actionable data in a near-real-time manner to inform operational decisions.[7] The EERC-led Intelligent Monitoring System $(IMS)^2$ project integrated continuous and periodic monitoring data sets from the Aquistore site in Saskatchewan with an automated history-matching process that could ultimately allow a commercial storage site operator to monitor, respond to, and predict storage performance of a site with minimal user input. Experience from these projects will inform proposed efforts to apply machine learning (ML) to commercial CCUS projects.

The EERC is also currently serving as the Task 4 lead for DOE's SMART Initiative. Task 4 focuses on applying ML for accurate, timely forecasts for geologic CO_2 storage via real-time measurement integration. As the task lead organization, the EERC is managing a team of seven national laboratories and five universities and cross-cutting teams that interact with the other four SMART Initiative tasks.

The EERC and ONEOK have a solid relationship built upon past projects including the initial site screening done for this effort, as well as collaboration on the PCOR Partnership Initiative and a DOE-funded project examining improving production in conventional oil fields through the use of mixed CO_2 and rich gas EOR practices. The CO_2 and rich gas project includes project partners ONEOK, Denbury Resources, Schlumberger, and CMG. ONEOK and the EERC endeavor to continue future work together on this project and others.

ONEOK, NESET, and Cerilon are active members of the PCOR Partnership (i.e., one of the five DOE regional partnership initiatives). In addition, ONEOK and Cerilon have worked separately with the EERC on regional CO_2 site-screening efforts (i.e., prefeasibility). The EERC and NESET are currently partnered on efforts funded by the state of North Dakota to characterize the potential to develop underground storage of natural gas and related gases in subsurface salt formations.

MRC5: Societal Considerations and Impacts/Economic Revitalization and Job Creation Questionnaire

MRC5a–d – Social Considerations and Impacts (SCI)

Quality (MRC5a), Support (MRC5b), SCI Team and Resources (MRC5c), Integration (MRC5d), Influence (MRC5e)

The research, experience, and partnership investment that have been built through the PCOR Partnership, PCOR Partnership Initiative, and prior CarbonSAFE efforts enable the EERC to confidently propose the Roughrider Storage Hub Program. The commitment and experience needed to develop and implement an SCI package consisting of individual plans and development proposals specifically to address the topics of Community and Stakeholder Engagement, Justice40 Initiative, and DEIA are described in the proposal package DEIA plan, J40 Plan, and CSEP documents.

[7] Burnison, S.A., Livers-Douglas, A.J., Salako, O., Hamling, J.A., and Gorecki, C.D., 2016, Design and implementation of a scalable, automated, semi-permanent seismic array for detecting CO_2 extent during geologic CO_2 injection: Presented at the 13th International Conference on Greenhouse Gas Control Technologies (GHGT-13), Lausanne, Switzerland, November 14–18, 2016.

The attached SCI documents detail the specifics set forth to plan, develop goals, and implement strategies to advance goals through SMART objectives and milestones and ongoing evaluation.

As the PMP indicates, Task 2 is dedicated to SCI activities, deliverables, and milestones. While each plan in the SCI package will center on its own unique focus, all three plans are components of the overarching SCI package and will be integrated and implemented concurrently. Integrated throughout all plans in the SCI package is providing all project team members the tools and training needed to carry out SCI-related activity as appropriate to their roles and responsibilities in the project.

Above and Beyond the Requirements for Compliance (MRC5f), Previous Efforts/Lessons Learned (MRC5g)
Given their extensive experience working in North Dakota on CCS projects, pipeline rights-of-way (ROWs), and regional hydrocarbon development, project partners EERC, ONEOK, and NESET know that the success of energy projects depends on relationship building and partnerships with communities and stakeholders. This is done through engagement early and through all project phases, transparent and trustworthy actions, and commitment and investment in the project communities. Experience from the work described in MRC4f has shown the positive results and successful outcomes of engaging communities and key stakeholders early and often. The project partners are active in promoting STEM (science, technology, engineering, and math) education, demonstrating DEIA principles, providing monetary support, and encouraging sweat equity.

MRC5a–d – Economic Revitalization and Job Creation Questionnaire

Future Activity That Creates or Retains High-Quality, Good-Paying Jobs.
ONEOK's midstream assets in North Dakota include over 12,000 miles of natural gas-gathering pipelines, over 300 miles of natural gas liquid pipelines, and six processing facilities with the capacity to process and treat almost 2 billion cubic feet per day of natural gas. This natural gas network employs approximately 485 personnel. As a midstream service provider experienced in the gathering, transportation, storage, and distribution of natural gas, ONEOK is well positioned to provide similar CO_2-related services for companies in need of a CO_2 storage solution.

As the Williston Basin continues to mature, natural gas production will continue to grow with increasing gas-to-oil ratios that will result in more demand for natural gas processing. This scenario will retain quality jobs, and as volumes increase and processing capacity is developed to accommodate that growth, additional sources of CO_2 emissions will need to be captured, transported, and stored, thereby creating additional high-quality, good-paying jobs.

The EERC and ONEOK are currently working with Cerilon, which is developing a state-of-the-art GTL facility in northwestern North Dakota to produce low-carbon liquid transportation fuels. Cerilon is already including CO_2 capture technologies in its engineering designs for the facility, and ONEOK is assisting by studying CO_2 gathering, transportation, and storage alternatives. Cerilon expects to employ 77 people at the time of operations, which will be new, high-quality jobs in the project area.

Development of a CO_2 storage hub in northwestern North Dakota would create an opportunity to aggregate and store CO_2 emissions from several sources across multiple industries, thereby potentially saving and generating hundreds of quality jobs. It would also reduce CO_2 emissions that are projected to increase in the area over time while facilitating increased production of oil and gas resources vital to energy security.

Future Activity That Supports Workforce Development.
Finding creative solutions to improve the environmental effects of the oil and gas and coal industries in North Dakota not only creates energy sustainability for our nation but also assists in employment retention as well as workforce development. Work described in Task 2.0 specifically aims to educate and engage job seekers and K–12 educators and students to encourage energy literacy and interest in STEM careers as specified in the plans described in the attached DEIA plan, J40 Plan, and CSEP (community and stakeholder engagement plan) documents.

Future Activity That Provides Workforce Opportunities in Disadvantaged or Energy Communities.
Communities surrounding the project area include rural, disadvantaged populations, and tribal areas. Building infrastructure via the development of a regional geologic CO_2 storage hub to protect the region's oil, gas, and coal industries would help retain jobs that would otherwise be displaced and create opportunity for new quality jobs that would positively impact disadvantaged communities and tribal populations.

Recruitment and Training Objectives.
Attracting and retaining employees who value diverse background, ideas, and opinions has long been a cornerstone of both the EERC and ONEOK cultures. This commitment strengthens the companies and supports the communities relying on the companies and their employment opportunities.

STATEMENT OF PROJECT OBJECTIVES
Roughrider Carbon Storage Hub

A. OBJECTIVES
The objective of this project is to determine the feasibility of developing a commercial-scale CO_2 geologic stacked storage complex able to store 50+ million metric tons of CO_2 in northwestern North Dakota safely, permanently, and economically. This objective is being met through the evaluation of a CO_2 storage complex in northwestern North Dakota suitable for storing CO_2 aggregated from multiple sources in a stacked storage configuration. CO_2 will be captured from several gas-processing plants in the area owned and operated by the project partner and a planned gas-to-liquids (GTL) plant in the project area. This effort is bolstered by progressive North Dakota pore space ownership and long-term liability laws, North Dakota primacy of the U.S. Environmental Protection Agency's (EPA's) Class VI CO_2 injection regulations, and commitment from local, regional, and state-level stakeholders. These elements, in combination with a motivated, experienced team, create an ideal synergistic scenario for ensuring success of the Carbon Storage Assurance Facility Enterprise (CarbonSAFE) Initiative and promoting national energy security through North Dakota's statewide vision for carbon management. The details of this scenario evaluation are described in the CarbonSAFE Phase II Project Readiness document.

B. SCOPE OF WORK
The objectives of the project will be achieved through the six tasks described in Section C. Task 1.0, a project management, planning, and reporting activity, will span the duration of the project and ensure that all subsequent tasks and activities are completed according to the specified timelines and that U.S. Department of Energy (DOE)-compliant reporting occurs. Task 2.0 includes societal considerations and impacts assessment and plans that incorporate plans for diversity, equity, inclusion, and accessibility; Justice40 (J40) Initiative; and community and stakeholder engagement. Task 3.0 will include activities required to characterize the storage complex within the study areas of the proposed project, including the permitting and drilling of a new geologic characterization well. Task 4.0 will integrate the data collected from Task 3.0 into the construction of geologic models that accurately represent the stacked storage opportunity in the study area. These models will also serve as the foundation for dynamic simulations, which will be used to define the boundaries of a 50-million-metric-ton CO_2 plume at that site for the

purposes of developing permitting, MVA (monitoring, verification, and accounting), risk assessment, and outreach plans. Task 5.0 will include a technical and economic analysis of the project. Task 6.0 will highlight the site characterization plans of the project to support the underground injection control (UIC) Class VI permitting process and will assess regulatory requirements necessary to move forward with future phases of the project, with a specific focus on permits required by the State of North Dakota and EPA UIC rules.

C. TASKS TO BE PERFORMED

Task 1.0 – Project Management

The recipient shall manage and direct the project in accordance with a project management plan (PMP) to meet all technical, schedule, and budget objectives and requirements. The recipient will coordinate activities in order to effectively accomplish the work. The recipient will ensure that project plans, results, and decisions are appropriately documented and project reporting and briefing requirements are satisfied.

The recipient shall update the PMP 30 days after award and as necessary throughout the project to accurately reflect the current status of the project. Examples of when it may be appropriate to update the PMP include 1) project management policy and procedural changes; 2) changes to the technical, cost, and/or schedule baseline for the project; 3) significant changes in scope, methods, or approaches; or 4) as otherwise required to ensure that the plan is the appropriate governing document for the work required to accomplish the project objectives.

Management of project risks will occur in accordance with the risk management methodology delineated in the PMP in order to identify, assess, monitor, and mitigate technical uncertainties as well as schedule, budgetary, and environmental risks associated with all aspects of the project. The results and status of the risk management process will be presented during project reviews and in quarterly progress reports with emphasis placed on the medium- and high-risk items.

The recipient shall participate in cross-project working groups once the working groups are established by the National Energy Technology Laboratory (NETL).

This task includes the necessary activities for managing project activities and ensuring coordination and planning of the project with NETL and other project participants. This includes briefings, as requested, along with routinely scheduled conference calls and regular email updates. This also includes, but is not limited to, the submission and approval of required National Environmental Policy Act (NEPA) documentation. The project is restricted from taking any action using federal funds that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to DOE providing a final NEPA decision regarding the project.

Reports will be prepared and submitted in accordance with the Federal Assistance Reporting Checklist, DOE F4600.2. A final topical report summarizing key results and recommendations from this feasibility study will be completed. In addition, the EERC will ensure compliance with all technical briefing and presentation requirements, including but not limited to DOE program peer review meetings.

The EERC will work with NETL project officers annually to assess if there are data that should be submitted to Energy Data eXchange (EDX) (D8) and identify the proper file formats prior to submission. Select data generated by this project will be submitted to EDX, including but not limited to 1) data sets and files, 2) metadata, 3) software/tools, and 4) articles developed as part of this project.

Task 2.0 – Societal Considerations and Impacts Assessment and Plans
The recipient is also required to implement the project in accordance with the Diversity, Equity, Inclusion, and Accessibility (DEIA) Plan provided in the application and the development of the Justice40 Plan (J40P), and the Community and Stakeholder Engagement Plan (CSEP) based on the development proposals provided in the application. It is expected that these plans will be updated within 90 days of award and provided to the NETL Project Manager. In addition, it is expected that key milestones associated with these plans will be incorporated into the milestone log as part of the overall PMP and that there will be at least one milestone a year associated with each plan. The quarterly progress reports and the final technical reports shall include updates on the progress and challenges throughout the course of the award.

Through a social characterization analysis that looks at the history and context of the region, this task's activities will identity communities and stakeholders—including diverse and disadvantaged subgroups—determine effective ways to engage and build relationships with those audiences, listen to their needs and concerns, and develop meaningful outcomes for those stakeholders. The analysis will inform an iterative process of plan development, implementation, and evaluation for three audience-specific plans, each corresponding to its own subtask. A societal considerations and impacts (SCI) advisory group comprising representatives of project partners and key stakeholders will be formed to provide guidance and feedback for all SCI activities. The exact roles and responsibilities of the group will be specified in the CSEP under Subtask 2.3. A SCI Mid-Project Update (D5) will include implementation status for all the plans, and updated plans will be submitted at the end of the project as part of a publicly available End-of-Project Progress Report on SCI work (D9).

Subtask 2.1 – Diversity, Equity, Inclusion, and Accessibility Plan
The DEIA Plan included with this proposal describes the actions that will be implemented throughout the project to foster a welcoming and inclusive environment; support people from groups traditionally underrepresented in STEM and/or applicable workforces; advance equity; and encourage the inclusion of individuals from these groups in future phases of the project. The DEIA Plan will be updated according to DOE comment (D2), which may include new impacts, metrics, or ways of processing information. Through feedback on plan implementation, new knowledge, and lessons learned, continual evaluation and updates to the DEIA Plan will occur throughout the life of project.

Subtask 2.2 – Justice40 Initiative Plan
The J40P Development Proposal included with this proposal will be implemented to create a J40P. Consisting of two-parts, Part 1 will begin with an in-depth Energy and Environmental Justice Assessment (EEJ Assessment) that will assess the project benefits and impacts. Learnings from the EEJ Assessment will be used to inform and develop Part 2, the Justice40 Implementation Strategy section that will explain actions the project team will take to maximize benefits and minimize negative impacts in areas related to energy and environmental justice. the content of the J40P, including background, milestones and timeline, assessment of risks and barriers and resource summary. DOE's proposal evaluation, which may include new impacts, metrics, or ways of processing information, will be incorporated to create an initial J40P (D3) that outlines concrete steps the project will take to implement EEJ efforts. Through feedback on plan implementation, regular evaluation, new knowledge, and lessons learned, the J40P will be viewed as a living document with continual updates being incorporated throughout the life of project.

Subtask 2.3 – Community and Stakeholder Engagement Plan
The CSEP Development Proposal included with this proposal will be implemented to create a CSEP. This work will include in-depth social characterization of the project area in the context of the greater region; identification of audiences, including communities with environmental justice concerns, disadvantaged communities, and tribes; developing messaging goals and content; selecting methods for engaging stakeholders (e.g., media campaigns, one-on-one contact, listening sessions, open houses, etc.); strategies

for incorporating stakeholder feedback; materials development; developing a timeline for implementation of the plan; and creating a system for tracking engagement outcomes and gauging impact. The draft CSEP will be submitted to DOE for review and comment (D4). Through feedback on plan implementation, new knowledge, and lessons learned, continual evaluation and updates to the CSEP will occur throughout the life of the project.

Subtask 2.4 – Integration and Implementation of Plans

The plans discussed in Subtasks 2.1–2.3 each have a unique community or stakeholder focus but are all components of the overarching SCI package and will be implemented concurrently. This approach will not only maximize efficiency and use of materials and resources, but also provide consistent trustworthy messaging to enhance existing community relationships and foster new ones. For example, one SCI advisory group member may focus on environmental justice while another aims to build relationships that help broaden the appeal of STEM. A project webpage hosted on the EERC website will be developed and will incorporate principles of DEIA and environmental justice, while providing information on project objectives, status, fact sheets, project partners, and contact information.

While the specific SCI activities will be determined by the needs of the communities and stakeholders in the greater project area and outlined in the Subtask 2.1–2.3 plans, implementation will likely include the following:

- Project team training on SCI elements and tracking procedures.
- Tracking SCI activities and audience feedback regarding outreach products, engagement activities, communication, and interactions.
- SCI Tool Kit – Development of materials to support public outreach efforts, including at least 2 fact sheets 3 posters, and a general project slide presentation for community events.
- Media Kit – Development of a background document, press releases, frequently asked questions, and the packaging of those materials with items from the information tool kit for print and electronic media.
- Meetings and other communication to inform, educate, and engage state, county, local, and tribal officials, regional opinion leaders, landowners, and other stakeholders.
- Educational Outreach – Periodic educational sessions geared to students and teachers in local schools and educational meetings and events.
- Community/Stakeholder Open House – Community meeting in McKenzie County tied to major project milestones and hosted by the project team.
- Community Listening Sessions – Opportunities for community members to learn about the project, ask questions, express their opinions, share concerns, and give feedback.
- Stakeholder opinion survey developed to collect feedback from engagement participants or to gauge stakeholder knowledge of, interest in, or comfort with concepts related to energy and CCS.

Task 3.0 – Storage Complex Characterization

This task conducts all the activity required to characterize up to four prospective CO_2 storage complexes within the area of interest (AOI) of the proposed project. This effort includes updates to existing geologic and hydrogeologic evaluations based on new data from existing geologic resources; the collection of new data in the form of analysis of new core, subsurface fluid samples, and well logs; and the acquisition and reprocessing of existing seismic surveys. Data acquired and analyzed during this task will be used in the development of Task 4.0 – Geologic Modeling and Simulation.

Subtask 3.1 – Existing Data Acquisition and Analysis

The prospective CO_2 storage complexes in the AOI will be evaluated to determine formation characteristics (such as porosity, permeability, injectivity, mineralogy, fluid composition, geochemical

conditions stratigraphy, cap rock integrity, etc.) within the project study areas. Existing data from offset wells will be compiled and digitized (as necessary) in preparation for use in Task 4.0 activities. Additionally, data sets that may be purchased from private entities will be identified and assessed for potential inclusion in Phase III activities.

This subtask will also acquire new or updated data sets that relate to land surface use and ownership within the study areas to identify pore space owners, geopolitical characterization, environmentally sensitive areas, and various ROWs (including pipelines). This information will be used to identify conflicts or opportunities for project development within the study areas and will be incorporated into Tasks 4.0–6.0.

Subtask 3.2 – Geologic Characterization Well

Activities in this subtask will locate, permit, and drill a geologic characterization well (stratigraphic test well) in the study area. This well will be drilled on private land, 4-inch core will be taken from the cap rock and reservoir sections of up to four stratigraphic pairs, and a comprehensive logging suite will be collected from the well. The well-logging suite will be analyzed to understand the distribution of petrophysical and lithologic properties throughout the characterization well for incorporation into Task 4.0. Once sampling and logging processes are completed, this well will be plugged and abandoned according to procedures established by the North Dakota Industrial Commission (NDIC).

Subtask 3.3 – Core Analysis/Testing

This subtask includes testing and analysis of core and fluid samples collected in Subtask 3.2. A suite of petrographic, petrophysical, geomechanical, and geochemical analyses will be performed on core samples to better understand factors that influence the long-term containment of CO_2, to aid in the calibration and correlation of well logs, and to improve the accuracy of geologic and simulation models. Specific analytical techniques (e.g., thin-section analysis, x-ray diffraction, x-ray fluorescence, scanning electron microscopy, steady-state relative permeability, helium porosimetry, and capillary pressure testing) will provide direct insight regarding the pore size distribution of the target reservoir and cap rock, potential for two-phase flow in a system dominated by high-salinity brine, zones of heterogeneity within the reservoir, and major and minor mineral phases. Geomechanical studies conducted in this task will focus on mechanical strength testing and will be interpreted to determine the maximum injection integrity of the cap rock. This work will be performed by the EERC's Applied Geology Laboratory.

Core and other geologic samples obtained during the project will be provided to NETL for inclusion in its core repository (D6 – Geologic Materials Submission). North Dakota law requires, at a minimum, half of the collected core be delivered without charge to the state geologist.

Task 4.0 – Geologic Modeling and Simulation

The geologic site characterization data (logs, core analysis, and seismic) will be integrated into geocellular models that account for the properties of the study areas, which comprises the injection horizon(s) and overlying sealing formation(s) that serve as barriers to prevent out-of-zone migration. The geologic models will provide the foundation for dynamic simulations of potential injection scenarios. Dynamic simulations are required to predict how CO_2 and its associated pressure plume would be distributed in the study areas and the effectiveness of the sealing formation at the site during the carbon capture, utilization, and storage (CCUS) time frame. Simulation results will provide key design and operational parameters for 1) the injection well and infrastructure; 2) a technical risk assessment; 3) area of review (AOR) determination; 4) monitoring, reporting, and verification (MRV) planning; and 5) installation expenditures.

Subtask 4.1 – Geologic Modeling

The proposed stacked storage horizons will be evaluated in this subtask through detailed reservoir modeling efforts using Schlumberger's Petrel geologic modeling software. The models will integrate the known and acquired geologic, structural, and fluid data of the study area (for both the reservoir and confining zones) that were collected and analyzed in Task 3.0. These models may be used to assess seal effectiveness in CO_2 containment, CO_2 density under reservoir conditions, CO_2 storage resource, total and effective pore volume, both lateral and vertical geologic heterogeneity (as interpreted from 2D and/or 3D seismic data sets), and AOR for regions likely to experience CO_2 saturation during injections resulting in 50+ million metric tons of CO_2. The geologic model will also provide the foundation for dynamic simulation of potential injection scenarios (Subtask 4.2).

Subtask 4.2 – Dynamic Simulation

Activities in this subtask will focus on dynamic simulations to determine the potential distribution and extent of a 50-million-metric-ton CO_2 plume injected over a 30-year time frame. These simulations will be based on the geologic assessments of the stacked storage reservoirs conducted in previous tasks. Simulation models will be developed using Computer Modelling Group Ltd.'s (CMG's) GEM dynamic simulation module. Injectivity of the stacked storage complexes will be assessed to confirm potential for injection of 50+ million metric tons of CO_2 at the project site into the minimum number of injection wells and develop the smallest footprint. Development of the plume will be tracked throughout various simulations of the 30-year injection period to determine AOR and CO_2 plume extents through time. Simulations will also evaluate potential for conflicts with existing subsurface injection or production operations, although these are anticipated to be minimal based on current understanding of regional activities.

Task 5.0 – Technical and Economic Analysis

This task will be conducted to evaluate the technical and economic feasibility of the proposed CO_2 storage project, including various project options such as adjacent and distributive (collection and pipelining of CO_2 streams to a central location) storage potentials. The expansion of conceptual pipeline designs leveraging the existing ROWs and the experience in the operating conditions that include the design, construction, operation, and access of pipelines of the project partner will be utilized. This task will include examining more specific economic needs and the incentives in place or additional CO_2 volumes required to make the proposed scenarios economically feasible for the project partners. Local, state, and federal incentives will be evaluated for their potential contribution to offsetting project costs. These activities will form the basis for detailing the cost and likely performance of the proposed geologic storage system that would have a capacity to store 50 million metric tons of CO_2 or more and could receive and store that amount in 30 years or less.

A feasibility report (D7) will provide a summary of the geology and risks associated with the potential storage site. It will address the regulatory, legislative, technical, public policy, commercial, financial, etc., challenges specific to this proposed project, and it will include a strategy that would enable an integrated capture and storage project to be economically feasible and publicly acceptable.

Work in this task will also form a conceptual-level design study to evaluate the technical and economic feasibility of CO_2 transportation for the storage hub and will be included.

Subtask 5.1 – Conceptual Basis of Plants and Pipeline Infrastructure

After a detailed review based on the selection of the project partner's plants, a conceptual pipeline design will be made based on the plant volume and utilizing the project partner's ROW corridors to transport the captured CO_2 to a central injection site. The design of the system will highlight the project partner's experience with securing ROWs and interacting with landowners in the area. While the project partner

has a multitude of ROWs secured in the project area, new ROWs will be required. Any new ROWs will be secured based on the project partner's experience in the project area.

Subtask 5.2 – Technical and Feasibility Review and Reporting
Based on the conceptual design realized from Subtask 5.1, a technical and feasibility study will be provided. An economic analysis reflecting the cost of the capture, transportation, and injection of the CO_2 from the project partner's plants will be provided. The technical and feasibility study for this project will reflect any incentives available to the project. Additionally, any identifiable alternative available to this project will be highlighted and incorporated into the report.

Task 6.0 – Site Development Plan
This task will create a detailed plan (D9) for development of a subsequent complete site characterization effort to support UIC Class VI permitting process (i.e., Phase III of CarbonSAFE). This plan will be based upon the results of the other project tasks. It will include a site characterization plan for the potential injection site(s), a CO_2 management strategy for acquiring and transporting CO_2 to the injection site, and a risk assessment to identify project risks and provide mitigation strategies.

Subtask 6.1 – Site Characterization Plan
A detailed plan for a complete site characterization phase will be completed for characterizing and testing an injection site to reduce uncertainty in the subsurface and to address regulatory requirements specific to developing a Class VI-qualified site and other stakeholder requirements. These data can define MVA needs and improve CO_2 storage performance forecasts. Characterization and testing, required for the approval of any Class VI wells and/or certification of associated CO_2 storage credits, may include collecting data related to the storage capacity of the chosen formations, determining the ability of the sealing formation to prevent migration from the storage complex, defining injection performance, and inspecting the mechanical integrity of the wellbore. The plan will thus provide for geologic core collection, downhole wellbore geophysical testing, laboratory testing of both rock and fluid samples as deemed appropriate and include a subject matter expert (SME) review of materials to be used in the infrastructure both on the surface and within the injection wells.

An assessment will also be made of local, state, and federal permits that may be needed for future installation of the injection site. This assessment will include data needs and potential timelines for acquisition of these permits to understand the potential permitting process needed for future CarbonSAFE phases. The site characterization plan will be developed pursuant to North Dakota Administrative Code (NDAC) Sections 43-05-01-05 §1b(3) and 43-05-01-05.1 §2a in anticipation of future phases.

Subtask 6.2 – CO_2 Management and Monitoring Plan
The EERC will develop a preliminary CO_2 management plan focused on providing a reliable supply of captured CO_2 to the proposed carbon storage hub. The goal is to ensure that one or more reliable source(s) of CO_2 are accessible to the project. Sources that are both currently available and those that may be available by the projected start of injection operations (in the 2025 time frame) will be considered. The CO_2 management plan will account for known and expected variances for the selected sources in the variables known to impact gathering and transportation infrastructure, such as CO_2 quality, quantity, composition, pressure, temperature, water content, and/or rate of delivery. The management plan will show how these sources can be combined and delivered to the proposed injection site developed in Subtask 6.1. In addition, an evaluation of pipeline needs and how they could vary under a range of CO_2 source options will be performed.

Subtask 6.3 – Risk Assessment, Monitoring, and Mitigation Strategies
This subtask will conduct a preliminary risk assessment with mitigation plans for the entire CO_2 transport and storage project. The risk assessment process includes 1) risk identification, 2) risk analysis, 3) risk

evaluation, and 4) risk treatment. Risk identification will be conducted to identify both technical and nontechnical risks that would prevent potential candidate storage reservoirs within the study areas from serving as commercial storage sites. Quantitative assessments of each identified risk will be made by assessing and scoring the probability that a risk event will occur and the impact that will result if it does occur. For technical risks, the project team will assess probability scores by incorporating the most current site characterization data and available modeling and simulation results. Risk evaluation will include an uncertainty assessment to evaluate the variability in the risk probability and impact scores from the risk analysis. The uncertainty assessment will be used to develop representative most likely and maximum (worst-case) scores. Outliers, or unusually low or high scores, will trigger follow-up evaluation. The project team will define risk rank thresholds to identify high-ranking risks that warrant treatment or further analysis.

Once the risk assessment has been completed, a risk treatment strategy will be formulated. Risk treatment includes several different strategies for negative risks, including avoidance, transfer, mitigation, and acceptance, and for positive risks, including exploitation, sharing, enhancing, and acceptance. A risk mitigation plan will be developed should any of these risks materialize. Communication is necessary during every step of the risk assessment process to assure stakeholders that the risks are being regularly monitored and effectively managed at all stages of the project.

D. DELIVERABLES

The periodic and final reports shall be submitted in accordance with the "Federal Assistance Reporting Checklist" and the instructions accompanying the checklist. In addition to the reports specified in the "Federal Assistance Reporting Checklist," the Recipient must provide the following to the NETL Project Manager (identified in Block 15 of the Assistance Agreement as the Program Manager)**.**

A catalog of geologic materials/samples collected under the project must be developed and maintained throughout the project. Throughout the life of the project, the Recipient must provide to DOE physical access to available materials/samples upon request ensuring this request does not impede ongoing or planned investigations. If the Recipient does not wish to retain the materials/samples, then the Recipient must offer DOE the opportunity to obtain possession of available materials/samples before the materials/samples are disposed.

The following guidance applies to all tasks performed under this FOA:

- In accordance with Executive and DOE Orders, any data products generated as a result of federally funded research and development shall be provided to NETL for inclusion in the Energy Data eXchange (EDX), https://edx.netl.doe.gov/. The data owner should work with its NETL/FECM Federal Project Manager annually to assess if there is data that should be submitted to EDX and identify the proper file formats prior to submission.
- Data products resulting from federally funded research and development include but are not limited to software code, tools, applications, webpages, portfolios, images, videos, and datasets.
- All final data products shall be submitted to EDX by the project Principal Investigator (PI)/performer one (1) month prior to the end date of the project. Note, EDX offers the contributor the option to request a delay in release to the public for any given contribution. Thus, if there are compelling reasons to delay release (e.g., patent application pending, publication pending, etc.), such requests can be easily accommodated but all agreed to data products still should be submitted by the Project PI/performer to EDX and that contribution process used to request the delay.
- EDX supports a wide variety of file types and formats including 1) data, 2) metadata, 3) software/tools, and 4) articles (provided that there is an accompanying Government use license). A partial list of file formats accepted by EDX is provided below, however, EDX is designed for

flexibility and accepts all types of file formats. Please contact EDXsupport@netl.doe.gov for any questions regarding file types and formats.

- EDX uses federation and web services to elevate visibility for publicly approved assets in the system, including connections with DOE's OSTI systems, Data.gov and Re3Data. This ensures compliance with federal requirements, while raising visibility for researcher's published data products to promote discoverability and reuse.
- It is strongly encouraged that all published research products obtain an OSTI Digital Object Identifier (DOI) to ensure more visibility in other search repositories (i.e., osti.gov, data.gov, Google Scholar, etc.). EDX has a custom-built API within the standard contribution workflow that allows contributors the option for obtaining an OSTI DOI by completing just a few additional fields.
- If there are questions about contributions to EDX, Project PIs should work with their Federal Project Manager. EDX help information is also available at https://edx.netl.doe.gov/about or edxsupport@netl.doe.gov.

Common Data Product Submission Formats: ASC, AmiraMesh, AVI, CAD, CSV, DAT, DBF, DOC, DSV, DWG, GIF, HDF, HTML, JPEG2000, JPG, MOV, MPEG4, MSH/CAS/DAT, NetCDF, PDF, PNG, PostScript, PPT, RTF, Surface, TAB, TIFF, TIFF Stacks, TXT, XLS, XML, Xradio, ZIP, and others.
Geographic Formats: APR, DBF, DEM, DLG, DRG, DXF, E00, ECW, GDB, GeoPDF, GeoTIFF, GML, GPX, GRID, IMG, KML, KMZ, MDB, MrSID, SHP, and others.

A full list of proposed deliverables is included in Table 1.

Table 1. Proposed Project Deliverables

Task/Subtask No.	Deliverable Title	Due Date
1.1	Project Management Plan	Update due 30 days after award. Revisions to the PMP shall be submitted as requested by the NETL Project Manager.
2.1	Diversity, Equity, Inclusion, and Accessibility Plan	Update due 90 days after award. Revisions shall be submitted as required by the NETL Project Manager.
2.2	Justice40 Plan	Update due 90 days after award. Revisions shall be submitted as required by the NETL Project Manager.
2.3	Community Engagement and Stakeholder Plan	Update due 90 days after award. Revisions shall be submitted as required by the NETL Project Manager.
2.0	Midproject Update on SCI Work Presented	An update on all SCI work will be presented midproject.
3.0	Geologic Materials Submission	Annually
5.2	Technical and Feasibility Report	A technical and feasibility report will be submitted at the completion of Task 5.0
1.0	NETL EDX Submissions	Annually
6.0	Site Development Plan	A site development plan will be submitted at the completion of Task 6.0.
2.0	End-of-Project Progress Report on SCI Work Delivered	An end-of-project progress report on SCI work will be delivered at the end of the project.

E. BRIEFINGS/TECHNICAL PRESENTATIONS
The Recipient shall prepare detailed briefings for presentation to the NETL Project Manager at their facility located in Pittsburgh, PA, Morgantown, WV, Albany, OR, or via WebEx. The Recipient shall make a presentation to the NETL Project Manager at a project kickoff meeting held within ninety (90) days of the project start date. At a minimum, two annual briefings shall also be given by the Recipient: 1) to explain the plans, progress, and results of the technical effort and 2) a separate, annual, peer review meeting. A final project briefing at the close of the project shall also be given.

At least one presentation will be given by a member of the project team at a national or international conference during the project. The specific conference(s) will be selected based on conversations with the DOE Project Officer.

>>END OF SOPO<<

RELEVANCE OUTCOMES/IMPACTS
The proposed Roughrider Carbon Storage Hub Project will provide infrastructure to safely, efficiently, and cost-effectively store CO_2 that would otherwise contribute to increased concentrations of CO_2 in the atmosphere.

ONEOK has analyzed CO_2 sources in the project area and determined that there are over 2,200,000 metric tons of CO_2 produced each year by industries such as natural gas gathering, processing, and transportation; power generation; and ethanol production. ONEOK anticipates continued growth in these industries in future years which will increase the volume of CO_2 produced. Cerilon, which is supportive of this project, plans to develop a GTL facility in the area that is expected to produce between 1,200,000 and 4,000,000 metric tons of CO_2 each year. Like ONEOK, many of the companies operating assets in northwestern North Dakota have environmental and sustainability goals to reduce their GHG emissions in the coming years, and CO_2 capture, transportation, and storage is expected to be one of the primary contributors to reducing these emissions.

Funding through DOE will help offset the development costs of CO_2 storage projects, and incentives such as the 45Q will provide tax credits that make CO_2 capture, transportation, and storage economically viable. The project team believes that as more carbon capture and storage projects are developed, the costs of the technologies employed will continue to fall and projects such as this will become more economically attractive.

Members of the project team have a strong record of commitment to environmental protections, environmental justice, community engagement, and DEIA. The plans and plan development proposals provided as a part of this application have been developed to address the considerations provided by the FOA. Continuous improvement on these programs are core values for project participants, and as outlined in the application material, it is the intent of the project to meet DOE's goals to advance these programs throughout the life of the project.

ROLES OF PARTICIPANTS
The project team comprises the EERC, ONEOK, NESET, Schlumberger, and CMG. The EERC will be the prime recipient, lead all tasks as described in the SOPO, and work closely with partners to ensure that objectives are met according to the established criteria and timelines. Mr. Wesley Peck will serve as the PI and Task 1.0 lead and will focus on the overall success of the project by providing management and leadership to all research activities, ensuring that the project is carried out within budget, schedule, and scope. The EERC will hold regular meetings with the project team and advisors to ensure the project is conducted in accordance with the statement of project objectives and project management plan. The EERC will keep all partners informed of project progress, coordinate activities, and be responsible for the timely submission of all project deliverables and transfer of data and products to the team.

ONEOK will secure site access to the project field location as well as provide cash and in-kind cost share for the drilling of the stratigraphic test well (Task 3.0) and provide source CO_2 data from its select locations for the technical and economic analysis (Task 5.0) and site development plan (Task 6.0). ONEOK will also bring its expertise and insight into midstream natural gas industry to other project activities, including risk assessment, community and stakeholder engagement, and economic evaluations. ONEOK has long-standing DEIA values and community investment and will contribute to Task 2.0 activities.

Cerilon is actively planning to develop a GTL facility in the area that is expected to produce between 1,800,000 and 4,000,000 metric tons of CO_2 each year. Cerilon is supportive of this project and has committed to provide technical and economic information for its GTL facility and evaluate the viability of storing CO_2 at the proposed storage hub. A letter of support/commitment is attached.

NESET is a wellsite services provider that was founded in North Dakota in 1980 and provides wellsite geology and mudlogging services across North Dakota, Montana, Wyoming, and South Dakota. Their crews are educated, trained, and skilled geo-steering wellsite geologists and mudloggers. They provide on-site technical geologic data to the operator and other stakeholder teams using the latest technology available. NESET has extensive experience and knowledge of the geology of Williston Basin and the drilling conditions that will be encountered during the proposed project. A certified woman-owned-business, NESET is committed to DEIA, environmental justice, education, and community engagement. A letter of support is included in the proposal package.

Schlumberger is a leading service provider for the oil and gas industry and has been a pioneer in addressing the challenges of safely, reliably, and efficiently storing CO_2 in the subsurface using proven technologies. Schlumberger has committed to provide critical software licenses and support to conduct the geocellular modeling activities.

CMG's focus is on providing the best modeling and simulation software for subsurface characterization to address the challenging questions associated with the long-term fate of CO_2 and other fluids injected into the reservoir. CMG will support the project by providing reservoir simulation software licenses and technical support.

Table 2 summarizes the roles of key personnel.

Table 2. Key Personnel Roles

Key Personnel	Role(s)
Wesley Peck (EERC)	PI; Task 1.0 lead
Charlene Crocker (EERC)	Task 2.0 lead
Ryan Klapperich (EERC)	Task 3.0 lead
Matt Burton-Kelly (EERC)	Task 4.0 lead
Michael Warmack (EERC)	Task 5.0 lead
Barry Botnen (EERC)	Task 6.0 lead
Chad Schneeberger (ONEOK)	Project Advisor

MULTIPLE PRINCIPAL INVESTIGATORS

The proposed project will not have multiple PIs. Mr. Wesley Peck, EERC, will be the sole PI.

FACILITIES AND OTHER RESOURCES

The EERC research complex comprises 254,000 square feet of laboratories, fabrication facilities, technology demonstration facilities, and offices. The EERC has established working relationships with

over 1300 clients, including federal and state agencies, universities, energy exploration and production companies, utilities, research and development firms, equipment vendors, architecture and engineering firms, chemical companies, and other organizations in all 50 states and 53 countries.

The EERC houses eight analytical laboratories dedicated to research focused on coal combustion and utilization, coal by-product utilization, water resource characterization, conventional and unconventional petroleum resources, alternative fuels, environmental chemistry, and CCUS.

The Williston Basin has a history of hydrocarbon production dating back to 1892. As a result of a long history of production, extensive oil and gas data sets are available. Most notably, data sets are publicly available for free from NDIC which the EERC regularly accesses and utilizes for oil- and gas-related projects, with data from over 30,000 wells. These data sets consist of both spatial and tabular databases. Other available data (for free and/or purchase) include seismic surveys (2D and 3D), geophysical well logs, core data, water quality data, groundwater well locations and water salinity.

The North Dakota Geological Survey's Wilson M. Laird Core and Sample Library is located less than 1 mile from the EERC as both facilities are part of the University of North Dakota campus. The climate-controlled facility currently houses over 375,000 feet of core and 30,000 boxes of drill cuttings obtained from oil and gas wells which represents about 75% of the cores cut in the North Dakota portion of the Williston Basin and about 95% of the samples collected. This includes the few remaining samples of Broom Creek Formation core currently available. Use of the facility is free of charge.

The EERC also has access to a library of geologic models within the North Dakota portion of the Williston Basin because of a history of creating geologic models for DOE and internationally funded projects. These basin- and subscale models include structural surfaces, isopachs, and petrophysical properties. Properties within the models have been derived from previous log analysis and core measurements and distributed via geostatistical methods.

The EERC has extensive modeling and simulation capabilities, including multiple high-end workstation computers and a dedicated high-performance parallel computing cluster. The cluster comprises eight computing nodes consisting of 232 total cores available for modeling and simulation usage. All the nodes/threads share a network-based power vault with a massive file server. Additionally, the project team has access to industry-level geologic modeling and simulation software and database capabilities for managing data that will be collected and generated during the project.

Finally, the EERC has also obtained a letter of support from the field site landowner that will allow necessary access for drilling of the stratigraphic test well.

EQUIPMENT

EERC Laboratories

The EERC has laboratory equipment directly applicable to conducting the proposed work. The EERC has equipment for analyzing the field-based fluid and gas samples and to conduct the laboratory testing of rock core materials outlined in the scope of work (Table 3).

Table 3. Existing Equipment in EERC Laboratories Applicable to Proposed Work

Equipment	Capability
High-Pressure Flow-Through System	Relative permeability with ability to flow CO_2, rich gas, and brines at elevated pressure and temperature; hysteresis measurements, helium porosimeter.
Gas Chromatography (GC)–Mass Spectrometry (MS)	Organic compound identification.
Bruker AXS D8 ADVANCE X-Ray Diffractometer	X-ray diffraction with diffraction pattern matching software for identification and quantification of major and minor minerals, clay types, and noncrystalline materials.
Rigaku ZSX PRIMUS II X-Ray Fluorescence System	Wavelength-dispersive x-ray system for semiquantitative identification of atomic elements present within a sample, used in conjunction with other techniques to identify mineralogy and composition of a sample.
JEOL 5800 Series Scanning Electron Microscopes (SEM)	Microscopic imaging and chemical analysis of samples to identify and characterize both the material composition (mineralogy) and physical structure of a sample (mineral distribution and diagenetic relationships), porosity characterization.
Nikon Binocular Optical Microscopes	Thin-section analysis of core samples to determine depositional features, mineral composition, and porosity characterization.
Perkin Elmer Optima 2100 Inductively Coupled Plasma Optical Emission Spectrometer	Identification and quantification of cations and other trace metals in water samples.
Dionex ICS3000 Ion Chromatograph	Identification and quantification of anion species in water samples.
Shimadzu TOC-L TOC Analyzer	Identification and quantification of dissolved and total organic and inorganic carbon species in water samples.
General Wet Chemistry Laboratory	Equipment and materials necessary to evaluate water sample characteristics, composition, total dissolved solids, and trace minerals and metals.

Computing

The EERC has extensive modeling and simulation capabilities, including multiple high-end workstation computers and a dedicated high-performance parallel computing cluster. The cluster comprises eight computing nodes consisting of 232 total cores available for modeling and simulation usage. All the nodes/threads share a network-based power vault with a massive file server. Additionally, the project team has access to industry-level geologic modeling and simulation software. A computer workstation will be purchased to augment the EERC's modeling and simulation capabilities to address the requirements of the proposed scope of work.

Fieldwork

The EERC has the necessary personal protection equipment (PPE) and equipment to oversee the collection of core samples and water samples in the project area.

IDENTIFICATION OF POTENTIAL CONFLICTS OF INTEREST OR BIAS IN SELECTION OF REVIEWERS

WESLEY D. PECK

Collaborators and Coeditors
Bangsund, D., North Dakota State University
Boeshans, W., Summit Carbon Solutions
Brennan, S.T., United States Geological Survey (USGS)
Bromhal, G.S., Predictive Geosciences Division, U.S. Department of Energy National Energy Technology Laboratory (NETL)
Dilmore, R.M., Predictive Geosciences Division, NETL
Goodman, A.L., NETL
Grant, T.C., NETL
Guthrie, G.D., NETL
Holmes, M.J., Lignite Energy Council
Karacan, C.O., USGS
Levine, J.S., NETL
Melzer, L.S., Melzer Consulting
Mikula, S., Minnkota
Morgan, D.J., NETL
Myshakin, E.M., NETL
Nordeng, S., UND Geology
Rodosta, T.D., NETL
Sanguinito, S., NETL
Singh, H., NETL
Warwick, P.D., USGS

Graduate and Postdoctoral Advisors and Advisees
None.

IDENTIFICATION OF POTENTIAL CONFLICTS OF INTEREST OR BIAS IN SELECTION OF REVIEWERS

CHARLENE R. CROCKER

Collaborators and Coeditors
Harris, J., III, Prairie Public Broadcasting
Garske, A., Prairie Public Broadcasting
Gravel, B., Prairie Public Broadcasting
Hanson, S., University of North Dakota College of Business Administration

Graduate and Postdoctoral Advisors and Advisees
None.

IDENTIFICATION OF POTENTIAL CONFLICTS OF INTEREST OR BIAS IN SELECTION OF REVIEWERS

RYAN J. KLAPPERICH

Collaborators and Coeditors

Dilmore, R., U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL)
Locke, R.A., Illinois State Geologic Survey
McCling, T.L., Idaho National Laboratory
McNemar, A.T., DOE NETL
Piggott, B., Trimeric Corporation
Schwartz, B., Penn State University
Siefert, N., DOE NETL
Thomas, R. Burt, DOE NETL
Vance, A.E., Trimeric Corporation
Van Voorhees, R., BCLP Law

Graduate and Postdoctoral Advisors and Advisees

None.

IDENTIFICATION OF POTENTIAL CONFLICTS OF INTEREST OR BIAS IN SELECTION OF REVIEWERS

DR. MATTHEW E. BURTON-KELLY

Collaborators and Coeditors
Balajii, K., EERC former student employee
Bangsund, D., North Dakota State University
Brennan, S., U.S. Geological Survey
Bromhal, G., U.S. Department of Energy National Energy Technology Laboratory
Cook, B., Enhanced Oil Recovery Institute/University of Wyoming
Dilmore, R., U.S. Department of Energy National Energy Technology Laboratory
Duguid, A., Advanced Resources International
Frailey, S., Illinois State Geological Survey, University of Illinois, Urbana, Champaign
Freeman, P., U.S. Geological Survey
Fu, P., Atmospheric, Earth, and Energy Division, Lawrence Livermore National Laboratory
Goodman, A., U.S. Department of Energy National Energy Technology Laboratory
Grant, T., U.S. Department of Energy National Energy Technology Laboratory
Hamon, F., Total E&P Research and Technology
Heinrichs, M., Battelle Memorial Institute
Ju, X., Atmospheric, Earth, and Energy Division, Lawrence Livermore National Laboratory
Karacan, C., U.S. Geological Survey
Kong, L., Department of Petroleum Engineering, School of Earth Resources, China University of Geosciences
Lu, D., Computational Sciences and Engineering Division, Oak Ridge National Laboratory
Morgan, D., U.S. Department of Energy National Energy Technology Laboratory
Morris, J., Atmospheric, Earth, and Energy Division, Lawrence Livermore National Laboratory
Myshakin, E.M., U.S. Department of Energy National Energy Technology Laboratory/Leidos Research Support Team
Painter, S., Environmental Sciences Division, Oak Ridge National Laboratory
Pawar, R., Earth and Environmental Sciences Division, Los Alamos National Laboratory
Sanguinito, S., U.S. Department of Energy National Energy Technology Laboratory/Leidos Research Support Team
Scharenberg, M., Battelle Memorial Institute
Sherman, C., Atmospheric, Earth, and Energy Division, Lawrence Livermore National Laboratory
Singh, H., U.S. Department of Energy National Energy Technology Laboratory
Smith, V., Battelle Memorial Institute
Tang, H., Atmospheric, Earth, and Energy Division, Lawrence Livermore National Laboratory
Torres, J., Adera Soutenir les acteurs de l'innovation
Walker, J., Battelle Memorial Institute
Warwick, P., U.S. Geological Survey
Zhang, J., Center for Applied Scientific Computing, Lawrence Livermore National Laboratory

Graduate and Postdoctoral Advisors and Advisees
None.

IDENTIFICATION OF POTENTIAL CONFLICTS OF INTEREST OR BIAS IN SELECTION OF REVIEWERS

MICHAEL P. WARMACK

Collaborators and Coeditors
Lagorin, W.A., Resolute Engineering, Tulsa, OK
Craig, Dr. B.D., Stress Engineering, Houston, TX
Piggott, B., Trimeric Corporation, Buda, TX

Graduate and Postdoctoral Advisors and Advisees
None.

IDENTIFICATION OF POTENTIAL CONFLICTS OF INTEREST OR BIAS IN SELECTION OF REVIEWERS

BARRY W. BOTNEN

Collaborators and Coeditors
Hopfauf, S., Minnkota Power Cooperative
Keller, A., Minnkota Power Cooperative
Mikula, S., Minnkota Power Cooperative

Graduate and Postdoctoral Advisors and Advisees
None.

IDENTIFICATION OF POTENTIAL CONFLICTS OF INTEREST OR BIAS IN SELECTION OF REVIEWERS

CHAD SCHNEEBERGER

Collaborators and Coeditors
None.

Graduate and Postdoctoral Advisors and Advisees
None.

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PROJECT MANAGEMENT PLAN

for

ROUGHRIDER CARBON STORAGE HUB

DATE PREPARED
September 15, 2022

SUBMITTED BY
Energy & Environmental Research Center (EERC)
University of North Dakota (UND)
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

PRINCIPAL INVESTIGATOR
Wesley D. Peck
Phone: (701) 777-5195
Email: wpeck@undeerc.org

SUBMITTED TO
U.S. Department of Energy
National Energy Technology Laboratory

TABLE OF CONTENTS

A. EXECUTIVE SUMMARY

The proposed project objectives are to accelerate wide-scale deployment of carbon capture, utilization, and storage (CCUS) by assessing and verifying the feasibility of using stacked storage complexes in northwestern North Dakota for the safe and cost-effective commercial-scale (i.e., ≥50 MMt within 30 years) storage of anthropogenic CO_2 emissions captured from ONEOK and Cerilon facilities in northwestern North Dakota. Through the execution of the proposed scope of work, the prospective storage resource of the area of interest (AOI) will be advanced to contingent storage resource as classified under the Society of Petroleum Engineers CO_2 Storage Resources Management System. In addition, the proposed Phase II project will complete a rigorous feasibility study for both technical and economic viability as well as identify societal considerations and impacts of the proposed project, including impacts on disadvantaged communities and subpopulations, to develop and implement region-specific plans to engage communities and stakeholders.

B. PROJECT ORGANIZATION AND STRUCTURE

Organizational Chart

Figure 1 shows the project organizational chart.

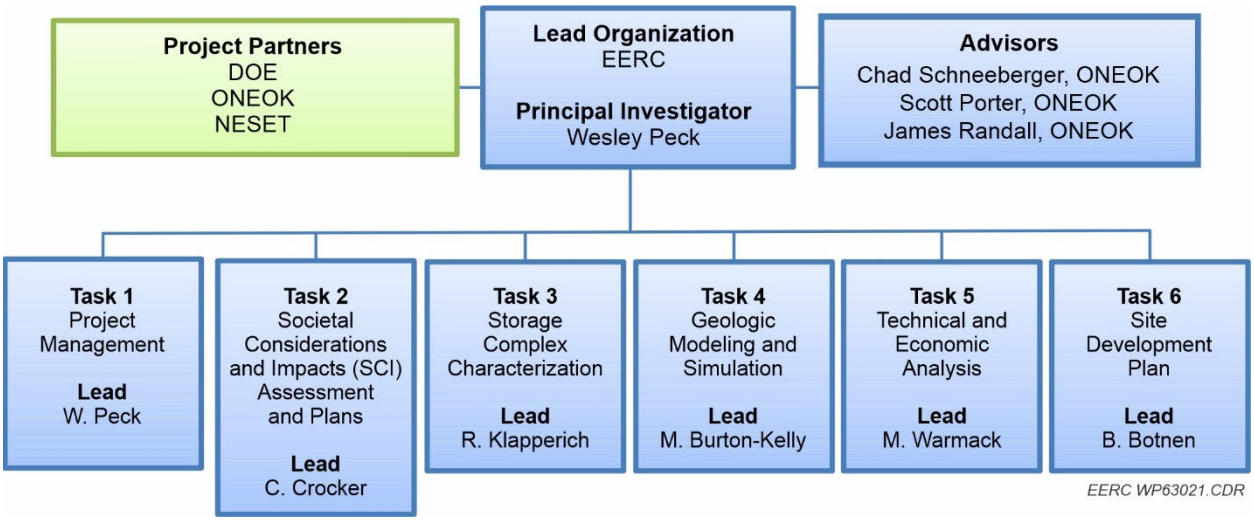


Figure 1. Project organizational chart.

Roles and Responsibilities of Participants

The project team comprises the University of North Dakota (UND) Energy & Environmental Research Center (EERC), ONEOK, Neset Consulting Service (NESET), Schlumberger, and Computer Modelling Group Ltd. (CMG). The EERC will be the prime recipient, lead all tasks as described in the statement of project objectives (SOPO), and work closely with partners to ensure that objectives are met according to the established criteria and timelines. Mr. Wesley Peck will serve as the principal investigator (PI) and Task 1.0 lead and will focus on the overall success of the project by providing management and leadership to all research activities, ensuring that the project is carried out within budget, schedule, and scope. The EERC will hold regular meetings with the project team and advisors to ensure the project is conducted in accordance with the SOPO and this project management plan (PMP). The EERC will keep all partners informed of project progress, coordinate activities, and be responsible for the timely submission of all project deliverables and transfer of data and products to the team. Faculty from the UND Nistler College of Business & Public Administration will assist with implementation of the SCI plans (Task 2.0).

ONEOK will secure site access to the project field location as well as provide cash and in-kind cost share for the drilling of the stratigraphic test well (Task 3.0) and provide source CO_2 data from its select locations for the technical and economic analysis (Task 5.0) and site development plan (Task 6.0). ONEOK will also bring its expertise and insight on the midstream natural gas industry to other project activities, including risk assessment, community and stakeholder engagement, and economic evaluations. ONEOK has long-standing diversity, equity, inclusion, and accessibility (DEIA) values and community investment and will contribute to Task 2.0 activities.

NESET is a wellsite services provider that was founded in North Dakota in 1980 and provides wellsite geology and mudlogging services across North Dakota, Montana, Wyoming, and South Dakota. Its crews are educated, trained, and skilled geosteering wellsite geologists and mudloggers who provide on-site technical geological data to the operator and other stakeholder teams using the latest technology available. NESET has extensive experience and knowledge of the geology of the Williston Basin and the drilling conditions that will be encountered during the proposed project. A certified woman-owned business, through WBENC (Women's Business Enterprise National Council), NESET will also bring its experience in and commitment to community engagement and education and DEIA values and practices to the societal considerations and impacts effort (Task 2.0).

Schlumberger is a leading service provider for the oil and gas industry and has been a pioneer in addressing the challenges of safely, reliably, and efficiently storing CO_2 in the subsurface using proven technologies. Schlumberger has committed to provide critical software licenses and support to conduct the geocellular modeling activities.

CMG's focus is on providing the best modeling and simulation software for subsurface characterization to address the challenging questions associated with the long-term fate of CO_2 and other fluids injected into the reservoir. CMG will support the project by providing reservoir simulation software licenses and technical support.

Cerilon is actively planning to develop a gas-to-liquids (GTL) facility in the area that is expected to produce between 1,200,000 and 4,000,000 metric tons of CO_2 each year. Cerilon is supportive of this project and has committed to providing technical and economic information for its GTL facility and evaluate the viability of storing CO_2 at the proposed storage hub. A letter of support is attached.

Decision-Making and Communication Strategy

Since the majority of the activities outlined in this proposal will occur at EERC facilities, recurring project update meetings will be scheduled and held at regular intervals to ensure that project team members are progressing toward the project's objectives. Decisions affecting the project scope, cost, and

schedule will be executed by Mr. Peck in coordination with task leads as well as the input of key technical scientific and engineering personnel and project advisors. Decisions and communications requiring the input of subcontractors (Schlumberger), especially during well-drilling activities, will occur through regular phone calls, e-mail correspondence, conference calls, Webinar presentations and, when necessary, in-person meetings hosted either at the EERC or external offices. Representatives from the U.S. Department of Energy (DOE) National Energy Technology Laboratory (NETL) will be invited to participate in key update and decision-making conference calls and meetings and will also receive regular quarterly reports detailing progress, accomplishments, challenges, and any variance from the project objectives. Any significant variance in schedule, budget, or scope will be discussed with the DOE project officer for approval.

The EERC will prepare detailed briefings for presentation to the project officer at DOE NETL facilities located in Pittsburgh, Pennsylvania, or Morgantown, West Virginia. The EERC will give a presentation to the NETL project officer at a project kickoff meeting held within 90 days of the project start date. At a minimum, annual briefings will also be given by the EERC to explain the plans, progress, and results of the technical effort. Subsequent review and update briefings will be provided to the project officer on a periodic basis as requested by the project officer or as warranted by project developments. Finally, a project briefing at the close of the project will also be given at DOE NETL facilities in Pittsburgh, Pennsylvania, or Morgantown, West Virginia. During this meeting, the overall results of the project, as presented in the final project report, will be presented to the DOE project officer and other interested DOE staff. Presentations will also be given by a member of the project team at one national or international conference during the project. The specific conference will be selected based on conversations with the DOE project officer.

Management Capabilities

As shown in Figure 1, the PI and lead for Task 1.0 is Mr. Wesley Peck, Principal Geologist and Geosciences Group Lead at the EERC. As such, Mr. Peck will handle the project management, planning, and reporting activities. He will ensure successful completion of the project on schedule and budget, coordinate and direct consultant activities, and ensure transfer of data and products to DOE NETL's Energy Data eXchange (EDX). In addition to having served as the PI/project manager on several DOE projects at the EERC, Mr. Peck serves as the task lead for the regional characterization effort of the Plains CO_2 Reduction (PCOR) Partnership Program, one of seven regional partnerships established under the DOE NETL Regional Carbon Sequestration Partnerships (RCSP) Initiative in 2003. He is a coauthor of a PCOR Partnership topical report that examined the potential for geologic storage of CO_2 in the Lower Cretaceous system of the Williston Basin, which includes the formation that will serve as the test reservoir for the recently awarded BEST (brine extraction and storage test) project. As such, Mr. Peck is very familiar with the geology of the key formations that will be used for the project and will provide guidance with respect to their characterization.

Task 2.0 will be led by Charlene Crocker, EERC Senior Research Scientist and Outreach Team Lead, who will be responsible for updating and implementing the societal considerations and implication (SCI) plans. Ms. Crocker has been a member of North Dakota CarbonSAFE (Storage Assurance Facility Enterprise) Phases II and III teams since its inception in June 2017, developing outreach materials, working with the Outreach Advisory Board, and providing input and guidance to the project timelines, budgets, and objectives. She has served as an Outreach Team member for the PCOR Partnership Program since its inception in 2003 and was the associate producer and cowriter for seven carbon capture and storage (CCS)-related public television documentaries.

Task 3.0 will be led by Mr. Ryan Klapperich, EERC Senior Hydrogeologist, who will be responsible for overseeing all aspects of the storage complex characterization effort. Mr. Klapperich has expertise in CO_2 EOR (enhanced oil recovery) and storage, including geologic site characterization, monitoring program assessments, design and implementation of near-surface monitoring programs, and interpretation of

monitoring data. Mr. Klapperich is actively involved in many site characterization and CO_2-monitoring activities at the EERC. He has served as the Co-PI on a project principally funded by the IEA Greenhouse Gas R&D Programme (IEAGHG) focused on understanding the use of active reservoir management (ARM) schemes to enhance CO_2 storage and reduce monitoring, verification, and accounting (MVA) costs. Mr. Klapperich currently serves as the Co-PI on the recently awarded BEST project which will demonstrate the use of ARM techniques to improve reservoir storage potential in saline formations with CO_2 storage potential. Mr. Klapperich also currently serves as the task lead for the PCOR Partnership's Water Working Group, a working group comprising members of DOE's RCSP Program focused on developing an understanding and solutions for issues at the nexus of CCS and water.

Task 4.0 will be led by Dr. Matthew Burton-Kelly, EERC Senior Geologist and Geomodeling Team Lead, who will be responsible for geologic modeling and simulation. Dr. Burton-Kelly has expertise and experience in well log, core, and thin-section petrophysical analysis; geologic characterization and data management; geostatistical applications; geocellular reservoir modeling; EOR utilizing CO_2; and geologic storage of CO_2. He is currently involved in multiple DOE-funded projects involving modeling and numerical simulation efforts aimed at increasing our understanding of CO_2 storage, residual oil zones, and CO_2 EOR; CO_2 storage efficiency, brine extraction for reservoir pressure management, risks associated with CO_2 storage, and management of these risks through existing and novel MVA activities; and determining the long-term fate of injected CO_2. He is a member of the American Institute of Professional Geologists and the Geological Society of America.

Mr. Michael Warmack, EERC Principal Oil and Gas Facilities Engineer, will lead Task 5.0 with the technical and economic analysis. He serves on EERC project teams and works with EERC clients to improve the development and production of domestic energy. Mr. Warmack supports the planning, design, selection of materials/treatment programs, costing, reporting, and/or upgrade/retrofit efforts related to production facilities optimization for unconventional oil plays; injection, production, and recycle infrastructure associated with EOR/incremental oil recovery (IOR) in conventional and unconventional oil and gas plays; infrastructure associated with capture and injection of CO_2 for geologic storage; and other emerging challenges associated with oil and gas injection/production processes. Mr. Warmack has more than 38 years of experience in production, operations, facilities design and installation, chemical treatment and optimization, and hands-on experience in multiple engineering disciplines. He holds a B.S. degree in Chemical and Petroleum Refining Engineering from the Colorado School of Mines. Prior to his position at the EERC, Mr. Warmack worked for Denbury Resources, most recently as a Facilities and Optimization Engineer at the Delhi EOR Unit.

The lead of Task 6.0 will be Mr. Barry Botnen, EERC Hydrogeologist, who will lead the overall site development plan. Mr. Botnen is a task lead on the current North Dakota CarbonSAFE Phase III project. He currently supports multiple activities for the PCOR Partnership Program. Most recently, Mr. Botnen has been working to develop and implement MVA concepts for large-scale (>1 million tons per year) CO_2 storage and EOR operations. Mr. Botnen also served as the task lead for the Terrestrial Field Validation Test portion of the PCOR Partnership. Mr. Botnen has over 20 years of experience in CO_2 sequestration/storage, contaminated site assessment, contaminant release investigation, remedial design/action, wetlands identification/delineation, biota studies, and the stewardship of contaminated nuclear sites.

Mr. Chad Schneeberger, ONEOK Renewable Project Development Director, will serve as a project advisor and direct and coordinate efforts by ONEOK to assist in project activities and provide land and data access. Mr. Schneeberger will work closely with the EERC team to ensure project team members have the appropriate resources/information and that ONEOK meets internal deliverables for the proposed project. Mr. Schneeberger has over 25 years' experience in midstream operations.

Mr. James Randall, ONEOK Director for Commercial Development and Renewable Energy Ventures, will serve as project advisor. Mr. Randall currently leads the Economic Planning and Projects Analysis teams at ONEOK and supports development opportunities to identify and evaluate strategic investment opportunities in renewable energy technologies and future growth platforms. Mr. Scott Porter, ONEOK Manager of Mechanical Integrity and Reliability, will serve as project advisor. Mr. Porter has extensive experience in investigation, policy, and risk management.

C. RISK MANAGEMENT PLAN

The EERC has integrated risk management practices throughout all aspects of the PCOR Partnership Program and has developed an AMA that ensures successful project implementation while remaining flexible to each project's unique attributes. To aid in the selection of specific reservoirs for commercial storage within the CO_2 study areas, the EERC will implement its risk assessment process, which includes 1) risk identification, 2) risk analysis, 3) risk evaluation, and 4) risk treatment. A preliminary analysis of the potential risks associated with the proposed scope of work did not identify situations or events that have a high likelihood of significantly impacting the success of the project. An ALARA (as low as reasonably achievable) approach is being used to adopt mitigation strategies for risks identified through the risk management plan. Our initial assessment of the technical; resource; environmental, health, and safety (EHS); site access; pore space ownership; and management risks that have the potential to impede project progress is summarized below.

Table 1. Perceived Risks and Mitigation Strategies

Perceived Risk	Risk Rating			Mitigation/Response Strategy
	Prob-ability	Impact	Overall	
	(Low, Medium, High)			
Financial Risks				
Lack of Cost Share	Low	High	Low	The EERC has an existing relationship with project partner ONEOK on multiple projects, including the PCOR Partnership, and ONEOK is very committed to provide cost share on the project.
Cost/Schedule Risks				
Inability to Maintain Schedule of Tasks	Low	Medium	Low	The six project tasks are mainly independent of one another so work can occur concurrently, minimizing risk of schedule delays.
Budget Insufficient to Complete Project	Low	High	Low	The PI will work with task leads to ensure priority is given to schedule and use of allocated hours. Hours and schedule will be tracked using the EERC's internal project cost-tracking system.
Insufficient Data Availability	Low	High	Low	The EERC has a technical team with extensive experience performing fieldwork across North Dakota, including through an initial screening with ONEOK in the proposed project area.
Technical/Scope Risks				
Lack of Technical Expertise	Low	Medium	Low	The EERC and ONEOK are a multidisciplinary team with many years of experience and will leverage established relationships to obtain any unforeseen technical expertise that is not currently accounted for.
CO_2 Sources Inadequate	Low	High	Low	ONEOK will generate sources of CO_2 from its multiple gas-processing facilities in the region with a capacity of 1.8 Bscfd of raw natural gas inlet. Cerilon's new GTL facility will produce up to 1.8 MMt of CO_2/yr, with a proposed second phase nearly doubling the amount to 4 MMt CO_2. Additionally, the region has other CO_2 sources that can be

Continued . . .

Table 1. Perceived Risks and Mitigation Strategies (continued)

Perceived Risk	Risk Rating			Mitigation/Response Strategy
	Prob-ability	Impact	Overall	
	(Low, Medium, High)			
Technical/Scope Risks (continued)				
				considered to ensure a minimum of 50 MMt of CO_2 in a 30-year period.
Management, Planning, and Oversight Risks				
Lack of Resource Availability	Low	High	Low	The EERC is committed to providing the necessary personnel and software resources to carry out project activities. The EERC has long-standing relationships with CMG and Schlumberger and has used their software on multiple projects.
Poor Communication Leads to Schedule or Cost Overruns	Low	High	Medium	Regular update meetings will be held with the project team to ensure objectives are being pursued and that activities are focused on completing the project milestones. External project partners and other stakeholders will be included as needed. The planned schedule and budget will be periodically reviewed to ensure there are no deviations. Communication regarding progress, including any potential deviations from the planned schedule or budget, will occur with the DOE Project Manager via phone calls, e-mail, and quarterly reports.
Loss of PI, Task Lead, or Key Researcher(s) to Health Matters or Attrition	Low	High	Low	Project goals, milestones, and schedule will be communicated to task leads and all researchers regularly. Additionally, a research manager will assist the PI and project team with all matters of the project and will provide continuance should a loss occur.
ES&H Risks				
Fieldwork-Based Injuries (e.g., coring, drilling, logging, and sampling)	Low	High	Low	EERC personnel have completed all safety training and exercised journey management practices to deployment and will participate in on-site safety meetings prior to fieldwork. Personal protective equipment will be standard practice and worn for all field activities, including fire-resistant out covering, hardhat, safety glasses, and steel-toed boots.
Office-Based Computer Work Injuries	Low	Low	Low	Safe office practices will be employed, such as proper ergonomics.
External Factor Risks				
Lack of Site Access for Fieldwork	Low	High	Low	The EERC has obtained a commitment letter from the landowner and will negotiate through ONEOK to obtain site access.
Weather Incidents Delay Fieldwork	Low	Medium	Medium	The EERC will conduct well-drilling fieldwork in late spring 2023 to alleviate significant weather delays to on-site work due to harsh winter conditions.

D. MILESTONE LOG

Table 2. Project Milestones

Task/ Subtask	Milestone Title	Planned Completion Date	Verification Method
3.2	M1 – APD (application of permit to drill) submitted to the state	4/22/23	Reported in subsequent quarterly report.
3.2	M2 – Well drilling initiated	5/31/23	Reported in subsequent quarterly report.
5.1	M3 – Conceptual basis of plants and pipeline infrastructure provided	5/31/23	Reported in subsequent quarterly report
2.2	M4 – Implementation of the Justice40 plan initiated	7/31/23	Reported in subsequent quarterly report.
2.3	M5 – Implementation of the community and stakeholder engagement plan initiated	7/31/23	Reported in subsequent quarterly report.
3.2	M6 – Well drilling completed	7/31/23	Reported in subsequent quarterly report.
1.0	M7 – DOE working group participation initiated	9/30/23	Reported in subsequent quarterly report.
3.2	M8 – End of well report completed	9/30/23	Reported in subsequent quarterly report.
3.3	M9 – First set of petrophysics results prepared	9/30/23	Reported in subsequent quarterly report.
4.1	M10 – First set of core data received; first geomodel initiated	9/30/23	Reported in subsequent quarterly report.
2.1	M11 – DEIA plan SMART Goal 1 achieved	1/31/24	Reported in subsequent quarterly report.
4.2	M12 – First case simulation initiated	1/31/24	Reported in subsequent quarterly report.
4.1	M13 – Last set of core data received and last geomodel initiated	3/31/24	Reported in subsequent quarterly report.
2.3	M14 – Community open house scheduled	4/30/24	Reported in subsequent quarterly report.
4.2	M15 – Final case simulations completed	7/31/24	Reported in subsequent quarterly report.
6.3	M16 – Inclusion of final simulation results	7/31/24	Reported in subsequent quarterly report.
2.1	M17 – DEIA plan SMART Goal 2 achieved	9/30/24	Reported in subsequent quarterly report.
2.2	M18 – Disadvantaged community identification and listening session scheduled	9/30/24	Reported in subsequent quarterly report.

E. COSTING PROFILE

Table 3. Spend Plan by Fiscal Year

	FY2023		FY2024		FY2025		Total	
	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share
Applicant	$4,737,643	$5,033,333	$3,875,164	$2,516,667	$387,193	–	$9,000,000	$7,550,000
Total	$4,737,643	$5,033,333	$3,875,164	$2,516,667	$387,193	–	$9,000,000	$7,550,000

Table 4. Spend Plan – Expenditure of Task Funds by Fiscal Year

	FY2023		FY2024		FY2025		Total	
	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share
Task 1	$233,618	–	$350,427	–	$116,809	–	$700,854	–
Task 2	$253,670	–	$380,505	–	$126,835	–	$761,010	–
Task 3	$3,416,735	$5,033,333	$1,708,368	$2,516,667	–	–	$5,125,103	$7,550,000
Task 4	$730,557	–	$913,196	–	–	–	$1,643,753	–
Task 5	$103,063	–	$154,594	–	$51,531	–	$309,188	–
Task 6	–	–	$368,074	–	$92,018	–	$460,092	–
Total	$4,737,643	$5,033,333	$3,875,164	$2,516,667	$387,193	–	$9,000,000	$7,550,000

F. PROJECT TIMELINE

See Figure 2 for the proposed project timeline.

G. SUCCESS CRITERIA

This project has one budget period (BP) that corresponds to several project milestones. Several success criteria have been developed to help track the progress of the project and to indicate the successful completion of project objectives.

- Task 2.0 – Societal Considerations and Impacts. The successful initiation of M4 (Subtask 2.2) and M5 (Subtask 2.3) will empower project team members to build and strengthen community and stakeholder relationships while providing consistent messaging and mechanisms to incorporate feedback into future planning and messaging and relationship building.
- Subtask 3.2 – Geologic Characterization Well. The successful completion of M2 (well drilling) in this subtask will allow core collected from the stratigraphic test well to be available for analysis and testing (Subtask 3.3), and data from the interpretation and analysis of core samples will provide site-specific data to the geologic model (Subtask 4.1).
- Subtask 4.1 – Geologic Modeling. The successful completion of a first geologic model will allow for the initiation of dynamic simulation (Subtask 4.2, M6) as well as critical input to the site characterization plan (Subtask 6.1).
- Subtask 5.2 – Technical and Feasibility Review and Reporting. The successful completion of the technical and feasibility review and assessment (D7) will allow for the team to confirm and validate the subsequent risk assessment, monitoring and mitigation strategies.
- Subtask 6.3 – Risk Assessment, Monitoring and Mitigation Strategies. The successful completion of M10 will allow for the identification and evaluation of project risks by the full project team and the completion of the site development plan (D9).

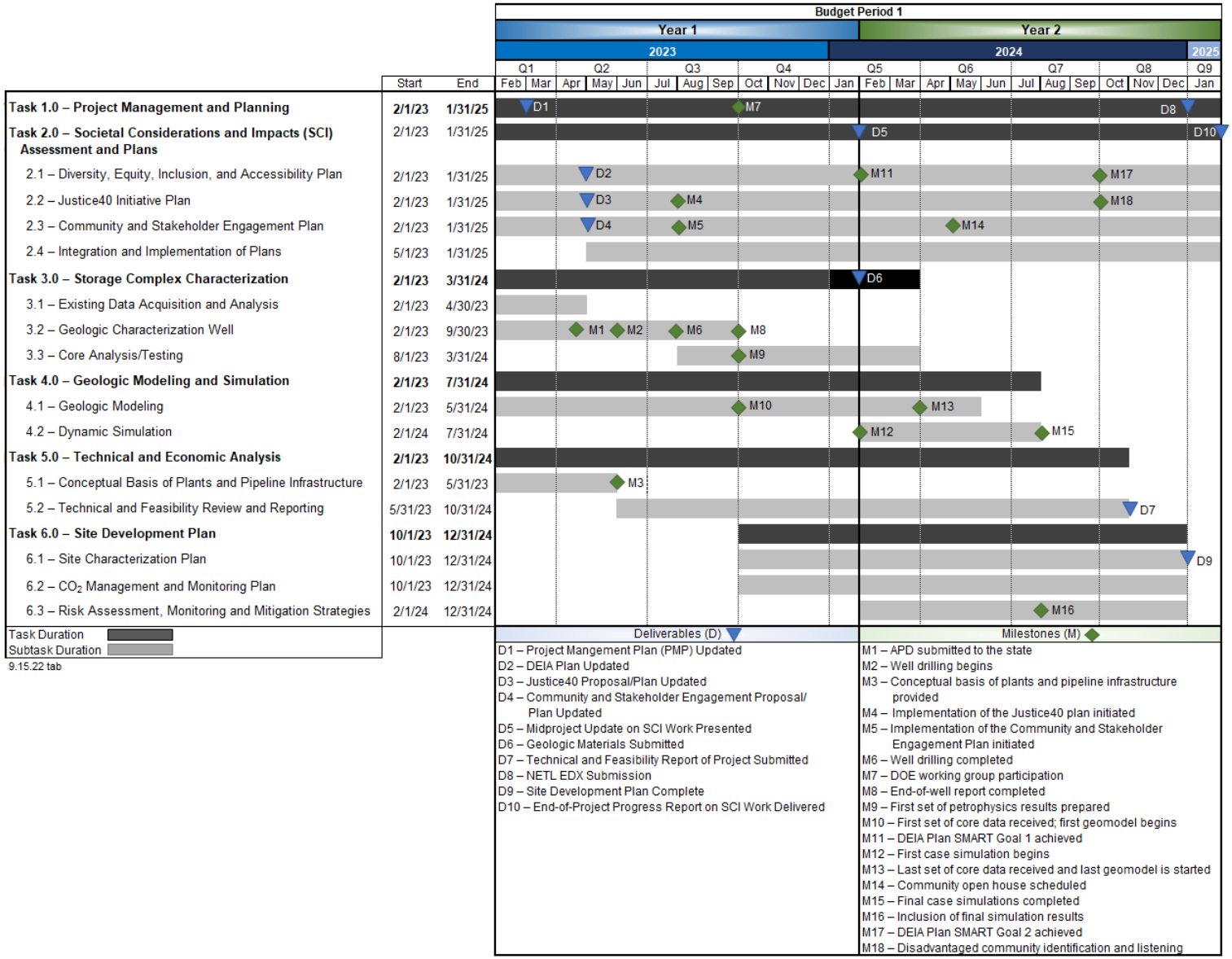


Figure 2. Proposed project timeline. Milestones for the project can be found in Table 2.

APPENDIX C

RESUMES OF KEY PERSONNEL

CHAD SCHNEEBERGER

Tulsa, OK · 580-761-3557
Chad.Schneeberger@oneok.com

Experienced leader with over 25 years of experience in midstream operations. Proven ability to build and lead teams of people to manage compliance, engineering, measurement and other operations support functions. Able to develop and execute greenfield and brownfield projects to manage volume and commercial growth on midstream assets. Placing an emphasis on the analysis of data to develop Key Performance Indicators that help improve asset and people performance.

EXPERIENCE

2007 – PRESENT

ONEOK, INC.

Renewable Project Development Director – research renewable technologies and market opportunities and identify and recommend project investments.
Gas Measurement Director – direct data processing, asset balancing and engineering support to ensure accurate L&U for natural gas gathering and transmission operations.
Environmental Director – oversee environmental team responsible for permitting and programs to improve operations compliance for midstream natural gas assets.
Engineering Director – direct team of engineers and construction managers responsible for the execution of large capital projects and operation support projects for operations

2005 – 2007

INVISTA S.A.R.L

Global Compliance Manager - responsible for transportation compliance with national and international regulations for all modes of transportation for over 45 domestic and international facilities.

1995 – 2005

KOCH PIPELINE COMPANY

Compliance Manager – responsible for environmental, safety and health, PSM, DOT and Coast Guard compliance programs for operating segment.
Operations Supervisor – responsible for daily operations of crude oil gathering and trucking, natural gas liquids gathering, natural gas gathering and processing operations and terminal operations.
Operations Engineer – responsible for engineering and project management for crude oil gathering and trucking operations.

EDUCATION

DECEMBER 1994

BS MECHANICAL ENGINEERING, OKLAHOMA STATE UNIVERSITY

SKILLS

- Employee selection and development
- Compliance management programs
- Diverse operations knowledge
- Customer service
- Team building
- Strategy and initiative development
- Project management & execution
- Cost effectiveness
- ESH management
- Creative problem solving

WESLEY D. PECK
Assistant Director for Subsurface Strategies
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5195, wpeck@undeerc.org

Principal Areas of Expertise

Mr. Peck's principal areas of interest and expertise include geology, geologic storage of CO_2, CO_2 enhanced oil recovery (EOR), and geographic information systems (GIS).

Education and Training

M.S., Geology, University of North Dakota, 1992. Thesis: The Stratigraphy and Sedimentology of the Sentinel Butte Formation (Paleocene) in South-Central Williams County, North Dakota.
B.S., Earth Science, North Dakota State University, 1987.

Research and Professional Experience

2020–Present: Assistant Director for Subsurface Strategies, EERC, UND. Mr. Peck leads efforts in subsurface resource development with emphasis on Williston and Powder River Basins. Serves as principal investigator (PI) on multiyear U.S. Department of Energy (DOE)-sponsored North Dakota CarbonSAFE Phase III Characterization and Permitting project. Served as task lead and PI for regional geologic characterization component of Plains CO_2 Reduction Partnership (PCOR) Partnership Program, focused on CO_2 storage in central North America. Led full-CO_2-chain techno-economic investigation in North Dakota linking lignite mining and electric generation to CO_2 EOR. Expertise includes geology, geologic storage of CO_2, CO_2 enhanced oil recovery (EOR), and geographic information systems (GIS).

2015–2019: Principal Geologist, EERC, UND. Mr. Peck was involved in subsurface resource development with an emphasis on the Williston and Powder River Basins. He served as PI on the multiyear DOE-sponsored North Dakota CarbonSAFE feasibility project. He also served as task lead and PI of the regional geologic characterization component of the PCOR Partnership Program. Mr. Peck recently led a full-CO_2-chain techno-economic investigation in North Dakota linking lignite mining and electric generation to CO_2 EOR.

2011–2015: Research Manager, EERC, UND. Mr. Peck's responsibilities include overseeing a staff of geologists and GIS specialists involved with oil and gas research activities in the Williston Basin as well as regional geologic characterization activities associated with the PCOR Partnership.

1991–2011: Research Scientist, EERC, UND. Mr. Peck oversaw major GIS activities at the EERC, served as task leader for the regional characterization component of the PCOR Partnership, and wrote reports and proposals.

1989–1991: Graduate Research Assistant, EERC, UND. Mr. Peck acquired and managed geologic data related to Cretaceous and Tertiary geology of the Williston Basin. He also assisted in the collection of Cretaceous and Tertiary fossils and stratigraphic information in western North Dakota and eastern Montana.

Publications

Mr. Peck has authored and coauthored numerous professional publications.

JAMES A. SORENSEN
Director of Subsurface Research and Development
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5287, jsorensen@undeerc.org

Principal Areas of Expertise
Mr. Sorensen's primary areas of interest and expertise are enhanced oil recovery (EOR) in unconventional tight oil formations, CO_2 utilization and storage in geologic formations, and tight oil resource assessment and development.

Education and Training
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1991.

Research and Professional Experience
October 2019–Present: Director of Subsurface Research and Development, EERC, UND. Mr. Sorensen is responsible for developing and managing programs and projects focused on conventional, unconventional, and enhanced oil and gas production; the geological storage of CO_2; geothermal; and other energy and environmental research.

July 2018–September 2019: Assistant Director for Subsurface Strategies, EERC, UND. Mr. Sorensen developed business opportunities, provided technical support and guidance regarding emerging areas of research, and served as a principal investigator and task manager for projects related to the sequestration of CO_2 in geologic media and the sustainable development of tight oil resources.

1999–July 2018: Principal Geologist, EERC, UND. Mr. Sorensen served as manager and co-principal investigator for programs to develop strategies for CO_2 utilization and storage. He also led research focused on enhanced oil recovery (EOR) in the Bakken.

1997–1999: Program Manager, EERC, UND. Mr. Sorensen managed projects focused on produced water management and environmental fate of natural gas-processing chemicals.

1993–1997: Geologist, EERC, UND. Mr. Sorensen conducted field-based hydrogeologic investigations focused on natural gas production sites.

1991–1993: Research Specialist, EERC, UND. Mr. Sorensen assembled and maintained comprehensive databases related to oil and gas drilling, production, and waste management.

Professional Activities
Member, Society of Petroleum Engineers

Publications
Mr. Sorensen has coauthored nearly 200 publications.

DR. JOHN A. HARJU
Vice President for Strategic Partnerships
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5157, jharju@undeerc.org

Principal Areas of Expertise

Dr. Harju's principal areas of interest and expertise include carbon sequestration, enhanced oil recovery, unconventional oil and gas development, waste management, geochemistry, technology development, hydrology, and analytical chemistry, especially as applied to the upstream oil and gas industry.

Education and Training

Ph.D., Petroleum Engineering, University of North Dakota, 2022.
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1986.

Research and Professional Experience

2002–Present: EERC, UND.
July 2015–Present: Vice President for Strategic Partnerships. Dr. Harju leads efforts to build and grow dynamic working relationships with industry, government, and research entities globally in support of the EERC's mission to provide practical, pioneering solutions to the world's energy and environmental challenges. He represents the EERC regionally, nationally, and internationally in advancing its core research priorities: coal utilization and emissions, carbon management, oil and gas, alternative fuels and renewable energy, and energy–water.

2003–June 2015: Associate Director for Research. Dr. Harju led a team of scientists and engineers building industry–government–academic partnerships to carry out research, development, demonstration, and commercialization of energy and environmental technologies.

2002–2003: Senior Research Advisor. Dr. Harju developed, marketed, managed, and disseminated research programs focused on the environmental and health effects of power and natural resource production, contaminant cleanup, water management, and analytical techniques.

2017–Present: Adjunct Lecturer, Department of Petroleum Engineering, UND.

1999–2002: Vice President, Crystal Solutions, LLC, Laramie, WY. Dr. Harju's firm was involved in commercial E&P produced water management, regulatory permitting and compliance, and environmental impact monitoring and analysis.

1997–2002: Gas Research Institute (GRI) (now Gas Technology Institute [GTI]), Chicago, IL.

2000–2002: Principal Scientist, Produced Water Management. Dr. Harju developed and deployed produced water management technologies and methodologies for cost-effective and environmentally responsible management of oil and gas produced water.

1998–2000: Program Team Leader, Soil, Water, and Waste. Dr. Harju managed projects and programs related to the development of environmental technologies and informational products related to the North American oil and gas industry; formulated RFPs, reviewed proposals, and formulated contracts; performed technology transfer activities; and supervised staff and contractors. He served as Manager of the Environmentally Acceptable Endpoints project, a multiyear program focused on rigorous determination of appropriate cleanup levels for hydrocarbons and other energy-derived contaminants in soils. He led GRI/GTI involvement with industry environmental consortia and organizations, such as PERF, SPE, AGA, IPEC, and API.

1997–1998: Principal Technology Manager (1997–1998) and Associate Technology Manager (1997), Soil and Water Quality.

1988–1996: EERC, UND.
1994–1996: Senior Research Manager, Oil and Gas Group. Dr. Harju served as:
- Program Manager for assessment of the environmental transport and fate of oil- and gas-derived contaminants, focused on mercury and sweetening and dehydration processes.
- Project Manager for field demonstration of innovative produced water treatment technology using freeze crystallization and evaporation at oil and gas industry site.
- Program Manager for environmental transport and fate assessment of MEA and its degradation compounds at Canadian sour gas-processing site.
- Program Manager for demonstration of unique design for oil and gas surface impoundments.
- Director of the National Mine Land Reclamation Center for the Western Region.
- Co-PI on project exploring feasibility of underground coal gasification in southern Thailand.
- Consultant to an International Atomic Energy Agency program entitled "Solid Wastes and Disposal Methods Associated with Electricity Generation Fuel Chains."

1988–1994: Research Manager (1994), Hydrogeologist (1990–1994), Research Specialist (1989–1990), and Laboratory Technician (1988–1989).

Professional Activities
Member, National Coal Council (appointed 2018)
Member, National Petroleum Council (appointed 2010)
Member, Mainstream Investors, LLC, Board of Governors (2014–present)
Member, DOE Unconventional Resources Technology Advisory Committee (2012–2014)
Member, Interstate Oil and Gas Compact Commission (appointed 2010)
Member, Rocky Mountain Association of Geologists

Publications
Dr. Harju has authored or coauthored more than 100 professional publications and nearly 300 technical presentations.

DIRECTOR'S COMMENTS
G-058-02
Maximizing Production from Residual Oil Zones in Western ND
Submitted by: Cobra Oil & Gas
Principal Investigator: Kyle Gardner
Request for: $2,000,000
Total Project Costs: $4,000,000
Duration: 2 years

Description of the Project:

Cobra Oil & Gas Corporation (Cobra) is seeking funding for a research project to further investigate methods and strategies to maximize oil recovery within Madison oil fields in western North Dakota. The objective of the project is to use new and existing reservoir characterization and laboratory analytical data coupled with state-of-the-art static and dynamic computer modeling to design and implement pilot-scale field injection tests for developing and optimizing production strategies within residual oil zones (ROZs) of the Madison Group's Mission Canyon Formation. The development and implementation of production strategies for North Dakota's ROZ formations would create jobs, increase oil and gas investments, revitalize North Dakota's legacy fields, and increase state tax revenue. Expected results include a series of field-tested operational and completion parameters for increasing production in the Mission Canyon ROZs. These parameters can be implemented to increase oil production in depleted or existing plays, enabling production of previously uneconomical oil resources in North Dakota.

Technical Reviewers' Recommendations: 3 Fund

Director's Recommendation: Recommend funding in the amount of $2,000,000

Conflicts of Interest: None

Vote: 6 yes; 0 nay, 1 absent and not voting

COBRA
OIL & GAS CORPORATION

Mailing Address
P.O. Box 8206
Wichita Falls, Texas 76307-8206
Telephone (940) 716-5100
www.cobraogc.com

June 1, 2023

Mr. Reice Haase
Deputy Executive Director
ATTN: Oil and Gas Research Program
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: Proposal Entitled "Maximizing Production from Residual Oil Zones in Western North Dakota"

Cobra Oil & Gas Corporation (Cobra) is pleased to submit the subject proposal to the Oil and Gas Research Program. This proposal will further investigate methods and strategies to maximize oil recovery within Madison oil fields in western North Dakota. The project will use new and existing reservoir characterization and laboratory analytical data coupled with static and dynamic computer modeling to design and implement pilot-scale field injection tests that will develop and optimize production strategies for residual oil zones in the Madison Group's Mission Canyon Formation.

Please find attached the $100 application fee. Cobra is committed to completing the project as described in this proposal. If you have any questions, please contact me by telephone at (940) 716-5100 or by email at kgardner@cobraogc.com.

Sincerely,

Kyle Gardner
Vice President – Engineering
Cobra Oil & Gas Corporation

KG/rlo

Attachments

Oil and Gas Research Program

North Dakota

Industrial Commission

COBRA OIL & GAS CORPORATION

Application

Project Title: Maximizing Production from Residual Oil Zones in Western North Dakota

Applicant: Cobra Oil & Gas Corporation

Principal Investigator: Kyle Gardner

Date of Application: June 1, 2023

Amount of Request: $2,000,000

Total Amount of Proposed Project: $4,000,000

Duration of Project: 2 years

Point of Contact (POC): Kyle Gardner

POC Telephone: (940) 716-5100

POC Email Address: kgardner@cobraogc.com

POC Address: PO Box 8206
Wichita Falls, TX 76307

TABLE OF CONTENTS

ABSTRACT

Objective: Cobra Oil & Gas Corporation (Cobra) is seeking funding for a research project to further investigate methods and strategies to maximize oil recovery within Madison oil fields in western North Dakota. The objective of the project is to use new and existing reservoir characterization and laboratory analytical data coupled with state-of-the-art static and dynamic computer modeling to design and implement pilot-scale field injection tests for developing and optimizing production strategies within residual oil zones (ROZs) of the Madison Group's Mission Canyon Formation. The development and implementation of production strategies for North Dakota's ROZ formations would create jobs, increase oil and gas investments, revitalize North Dakota's legacy fields, and increase state tax revenue.

Expected Results: Expected results include a series of field-tested operational and completion parameters for increasing production in the Mission Canyon ROZs. These parameters can be implemented to increase oil production in depleted or existing plays, enabling production of previously uneconomical oil resources in North Dakota.

Duration: The anticipated project duration is 24 months (September 1, 2023, to August 31, 2025).

Total Project Cost: The total project cost is $4,000,000. Cobra is requesting $2,000,000 from the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program. Cobra is providing $2,000,000.

Participants: Cobra Oil & Gas Corporation and the Energy & Environmental Research Center at the University of North Dakota.

PROJECT DESCRIPTION

The Madison Group in North Dakota is a mature play that has produced nearly 1 billion barrels (Bbbl) of oil from ~6000 wells. Other parts of the Madison Group (i.e., Mission Canyon Formation) have been bypassed historically because of higher water saturations. Total oil-in-place reserves for the formation are estimated up to 500 million barrels (Burton-Kelly and others, 2018). These fields and depleted Mission Canyon Fields exhibit properties and behavior similar to residual oil zones (ROZs) that contain remnants of oil stranded within sections of rock and require unique production strategies and/or enhanced oil recovery (EOR) methods to produce the trapped oil. In recent efforts, considerable volumes of oil have been produced from ROZs through CO_2 injection into or depressurization within ROZs (Harouaka and others, 2014; Melzer and Trentham, 2015).

Since 2018, Cobra Oil & Gas Corporation (Cobra) has been the operator of a Mission Canyon Field (the project field) in Renville County, North Dakota, that has allowed for implementation and evaluation of oil production strategies from reservoir zones with high water saturation. Cobra has successfully increased oil production, reservoir deliverability, and oil cut in 16 wells in the project field's depressurizing and acidized simulation experiment. Since 2018, gross production in the project field is up ~250% because of these efforts. Larger acidized stimulations of the reservoir should provide higher production rates which, in turn, should increase oil production. Additionally, previous studies have demonstrated the potential of EOR as a viable method to significantly increase oil production out of the Mission Canyon Formation throughout North Dakota (Dotzenrod and others, 2017; Burton-Kelly and others, 2018). Burton-Kelly and others (2018) estimated that CO_2 EOR could generate an additional 60–90 million barrels of oil in North Dakota's Mission Canyon Formation.

Objectives: Cobra is seeking to further investigate methods and strategies to maximize oil recovery within Mission Canyon Fields in western North Dakota. Example strategies may include further depressurizing experiments of the ROZ to lower the reservoir pressure within a radius around the wellbore and/or CO_2 injection into the ROZ. To test these and other possible operation and completion strategies, Cobra will

subcontract with the Energy & Environmental Research Center (EERC) at the University of North Dakota (UND) to evaluate existing data from the project field. The EERC has previous experience evaluating the impact of EOR on ROZs in the Williston Basin (Dotzenrod and others, 2017; Burton-Kelly and others, 2018). The data will be utilized to generate a geologic model and perform numerical dynamic simulation to evaluate production and EOR strategies to maximize production from the Mission Canyon ROZs. Cobra will validate the simulation results by applying select production strategies in the project field. The objective of the project is to use new and existing reservoir characterization and laboratory analytical data coupled with state-of-the-art static and dynamic computer modeling to design and implement pilot-scale field injection tests for developing and optimizing production strategies within ROZs of the Mission Canyon Formation. The goal of the pilot tests is to determine the viability of production and EOR strategies developed through numerical simulation for stimulating oil production in the Mission Canyon Formation.

Methodology: This project will incorporate data gathering and processing, laboratory analysis, modeling/ simulation, and field testing to determine optimized operations and completion strategies for production from the selected Mission Canyon ROZ. The work will be conducted in four tasks leading to the successful completion of the stated project goal. Tasks 1–3 will be led by the EERC, which has demonstrated experience in each of the tasks. The EERC's letter of support is found in Appendix A. Task 4 will be led by Cobra. Specific activities under each task will be conducted and are defined in the following.

Task 1 – Data Assembly

The EERC will work with Cobra on software procurement, data assembly, and data audit tasks to identify data necessary for Tasks 2 and 3 and other data gaps. Activities in this task include a core description workshop for the selected field to determine the need for additional core analyses from existing core, collection of public and Cobra-released well data (e.g., well logs, core analysis, production data, fluid

characterization, well histories), and review of assembled data for gap analysis. Results will include maps, statistics, and summary PowerPoint slides for input data to be used in other tasks.

Task 2 – Reservoir Characterization

The EERC will collaborate with Cobra to create a field-scale geologic model for the targeted ROZ. This will include petrophysical evaluations and stratigraphic correlation leveraging existing core data and geophysical well logs. Petrophysical interpretations will be used to populate the geologic model of the selected field with applicable properties (e.g., lithofacies, porosity, permeability, and water and oil saturations). Petrophysical property uncertainty analyses will be conducted to create a suite of geologic models available for numerical simulation history-matching and sensitivity analyses for validation against historic field production. Results will include maps, well interpretations, summaries of created models and uncertainty analysis, and a knowledge gap assessment with data collection recommendations.

Task 3 – Numerical Simulation for Production Optimization

The EERC will coordinate with Cobra to evaluate strategies to optimize production from the potential ROZ for the selected field using numerical simulation. EERC-proposed activities will include the creation of a fluid model based on available pressure, volume, temperature (PVT) data for the reservoir; calibration of the Task 2 geologic models through a history-matching process using historic operational data for the selected field; and conducting predictive simulations designed to improve oil production from the field. Working with Cobra, the EERC will develop a case matrix of strategic scenarios for numerical evaluation. Suggested scenarios include evaluating production changes from recompletion and operational changes and evaluating responses from EOR methods (e.g., carbon dioxide injection). A sensitivity analysis will be conducted to inform plans to optimize potential ROZ development and support field development. Results from this task will include predicted incremental oil production and associated pressure response for the cases investigated and learnings from the sensitivity analysis, including a recommended optimization strategy.

Task 4 – Data Collection and Field Testing

To facilitate Tasks 2 and 3, additional data collection is required to fill knowledge gaps. Activities for this task will be discussed and designed based on Cobra's planned operations. Activities for this task could include:

- Well testing and assessment of operational changes to existing wells.
- PVT tests to characterize oil behavior.
- Cased hole well log data collection to determine current reservoir fluid saturations.
- Additional testing of existing cores (e.g., routine core analysis, x-ray fluorescence, x-ray diffraction, scanning electron microscopy, mercury injection capillary pressure).
- Recompletion of a well to validate select forward modeling result scenarios.
- Well acidized stimulation.

Anticipated Results: The anticipated results of this project will be field-validated operational and completion strategies for optimizing oil production from the Mission Canyon Formation. Although the work will focus on the project field operated by Cobra, the learnings from this project will establish baseline operational strategies for oil production from the resource-rich ROZs of the Mission Canyon throughout the Williston Basin. Identification of strategies to produce economic volumes of oil from North Dakota's vast Mission Canyon play will have significant economic and social benefit to the state, municipalities, citizens, and industry.

Facilities and Resources: This project is highly enabled by the operational knowledge and existing field facilities provided by Cobra. Cobra brings operated wells, tank batteries, gathering systems, previously recorded data and results, well records, and technical project field knowledge to the proposed research project. Within the project field, Cobra operates 31 producing wells (28 vertical, three horizontal) and 12 water injection/disposal wells. All wells Cobra operates in the project field are completed in the referenced Mission Canyon subinterval. At the time of this application, Cobra does not propose to drill any new wells within the project field. With respect to institutional knowledge and production expertise,

Cobra offers over 100 years of total engineering experience and over 50 years of geological experience from its North Dakota technical team. Among technical team capabilities are advanced petrophysics, reservoir engineering, operations engineering, drilling engineering, advanced geophysics, and 8 years of detailed team research of the Mission Canyon Formation. Cobra also offers robust field supervision with over 100 years of experience in direct oversight of the project field. Cobra field employee experience includes North Dakota operations, facilities construction, digital analytics, completions supervision, downhole fishing, and lease operations. In addition to employee expertise, Cobra offers use of software subscriptions for DrillingInfo, PRAMS, PHDWin, Petra, and Kingdom for the research project. In field equipment, Cobra can provide well-testing operations, remote production monitoring, and Echometer equipment for dynamometers and fluid levels.

Project partner EERC employs a multidisciplinary staff of about 270 employees and has 254,000 square feet of state-of-the-art offices, laboratories, and technology demonstration facilities. EERC engineering and scientific research staff members are equipped with state-of-the-art analytical, modeling, and engineering facilities. The EERC has extensive geologic modeling and reservoir simulation capabilities, including multiple high-end workstation computers and a dedicated high-performance parallel computing cluster. The project team has access to commercial-grade software for use in geologic modeling, process modeling, and numerical simulation and database capabilities for managing data that will be collected and generated during the project. The EERC has designed and implemented field activities that include the drilling of stratigraphic test wells, collection of core samples, industry-standard and advanced downhole geophysical logging, and downhole pressure and temperature monitoring. EERC laboratory facilities will be utilized through this effort for routine and advanced core analysis, including petrophysical, petrographic, geochemical, and geomechanical rock analysis.

Techniques to Be Used, Their Availability, and Capability: Core-based lithofacies and fracture studies will be conducted on slabbed existing core housed at the Wilson M. Laird Core and Sample Library in Grand Forks, North Dakota. Selected core-based analytical activities will be conducted at the EERC using currently available optical microscopes, porosity testing equipment, and relative permeability testing

equipment. Static and dynamic modeling activities will be conducted using industry standard software on computer hardware currently existing at the EERC.

Field efforts will take place at a Cobra-operated Mission Canyon Field in Renville County, North Dakota. Cobra has successfully increased oil production, reservoir deliverability, and oil cut in 16 wells in the project field's depressurizing experiment. Of the 31 producing wells, none has been fracture-stimulated to increase reservoir deliverability, only acidized. Larger acidized stimulations of the reservoir should provide higher production rates which, in turn, should increase oil production.

Environmental and Economic Impacts While Project Is Underway: No significant environmental or economic impacts are anticipated above and beyond normal operations of oil and gas wells because of these proposed activities. Cobra has upgraded remote monitoring equipment on facilities for production fluid levels and emergency shut-offs.

Ultimate Technological and Economic Impacts: This proposal supports the possibility of widespread potential of ROZs throughout the Madison Group's Mission Canyon Formation in the Williston Basin. This research builds on established ROZ projects currently underway in other basins, specifically the redevelopment of the San Andres Formation of the Permian Basin. Like the San Andres Formation, the Madison Group has widespread predictability from a geologic and reservoir standpoint. Research suggests that ROZ potential exists in any county in North Dakota where Madison Group production exists. With this vast geographic area, the ultimate reserves of North Dakota's ROZs could be estimated in the millions of recoverable barrels.

This project will seek to exploit existing oil play infrastructure in the western part of the state to revitalize the Mission Canyon play. Over 15,000 Bakken wells penetrate through the Madison Group, which creates opportunities to repurpose obsolete or underutilized Bakken well infrastructure to support Mission Canyon production.

Why the Project Is Needed: Maximizing productivity of the Madison system and prolonging productive life of the play ensures the continued long-term economic growth from a proven prolific oil reservoir in North Dakota. Optimizing operational and EOR strategies for legacy fields of the Madison system allows for bypassed pay zones to be accessed and produced. The high water cut of the Madison system requires an innovative approach for recovery, and the proposed research activities are necessary to expand the critical knowledge base regarding production and EOR strategies to maximize oil production from the formation. The results of the project will provide industry and the state of North Dakota with a foundation for developing a pathway to improve Mission Canyon oil recovery efficiently and economically. Previous tests by Cobra have proven the viability of certain production strategies to improve Mission Canyon oil recovery. The results of this project will significantly expand and demonstrate the current understanding of completion and production optimization strategies that can be applied to Madison Fields throughout North Dakota. Additionally, recompleting wells within the Madison may be a way to extend the life of existing Bakken infrastructure previously deemed unprofitable.

STANDARDS OF SUCCESS

Success will be measured according to the timely achievement of project milestones and development of deliverables that meet the goal of the project. The value to North Dakota is improved understanding of the Mission Canyon Formation with respect to future EOR and potentially improved oil production from the Mission Canyon Formation. Results may directly influence industry practices and lead to improved oil recovery that could increase job opportunities and increase income revenue for North Dakota and its citizens. In the 4.5-year span of Cobra redeveloping the project field's ROZ potential, gross production revenue, production tax revenue, royalty revenue, and gross lease operating expenses are up ~270%. In the project field, company and contracted employment is up 400%. The majority of mineral owners, service providers, and all of the company employees are citizens of North Dakota. Continuing to grow in these categories with increased understanding and predictability in an expedited manner will define project success.

BACKGROUND/QUALIFICATIONS

Summary of Prior Work: Immediately after acquiring the project field in 2018, Cobra began strictly monitoring the backside fluid level of each producing well. Cobra recognized high standing fluid levels throughout the project field, with some wells maintaining fluid levels almost to the surface. Typically, if artificial lift is running at capacity and a column of backside fluid exists, then the formation can deliver more fluid. Cobra recognized a small variance between the fluid levels of static wells to producing wells, which is indicative of a high deliverability reservoir. With this information, Cobra began to upgrade artificial lift capacity to draw down the reservoir. As artificial lift capacity was upgraded, Cobra began to convert the method of artificial lift to the progressive cavity pump (PCP). All the initial wells Cobra monitored in the project field were completed only in the uppermost portion of the Mission Canyon subinterval's pay section. Interestingly, as Cobra began to pump the well's fluid levels down, oil cut slowly began to increase as more total barrels per day were produced. As fluid levels began to fall, Cobra needed to increase formation deliverability to accommodate the upgraded artificial lift. By knowing the petrophysical consistencies of the Mission Canyon subinterval, examining the consistent oil saturations from core analysis, and having comparable core measured porosity and permeability values throughout the gross section, Cobra increased deliverability by recompleting the gross Mission Canyon subinterval in each well. As Cobra began recompleting each well in the entire Mission Canyon subinterval, backside fluid levels again increased, and oil cuts increased or stayed the same. It is notable that oil cuts did not decrease after the basal portions of the Mission Canyon subinterval were recompleted. Cobra had identified the project field as a Type II ROZ reservoir and believes the increased oil cut coupled with increased daily production being produced from deep in the rock section proves depressurization of the ROZs.

Experience and Qualifications: Cobra is a privately held independent oil and gas company based in Wichita Falls, Texas, that has been in business for approximately 50 years. Cobra has a legacy of using cutting-edge geologic, geophysical, and engineering technologies for exploration discoveries and

operational advancements. Cobra has operated wells in 14 different states and internationally since the company was formed. In 2015, Cobra entered the Williston Basin as a North Dakota Mission Canyon Formation operator of a legacy waterflood. Cobra began extensive research regarding the reservoir characteristics of the Madison Group's Mission Canyon Formation, with emphasis on the hydrodynamic effects of the tilted accumulations in the Billings County area. With proven success in the Mission Canyon Formation, Cobra expanded its asset position in 2018 and now operates in ten different counties of North Dakota. Cobra operates wells that produce exclusively from 12 different conventional formations of the Williston Basin. Cobra's Williston Basin focus for enhancing well productivity revolves around petrophysical and geological evaluation of pipe pay of conventional formations and stressing of fundamental operating techniques. Cobra employs a technical staff of three full-time geologists and five full-time engineers.

The EERC is a high-tech, nonprofit branch of UND, exclusively conducting applied research for a multinational client base. Through 70+ years of collaborating with industry and government on hydrogen technology development, the EERC is globally recognized for its role in advancing commercial deployment of technologies for producing, purifying, and utilizing hydrogen from coal, natural gas, and renewables. The EERC-housed research initiatives focus on techno-economic studies, technology development, and pilot- and demonstration-scale testing.

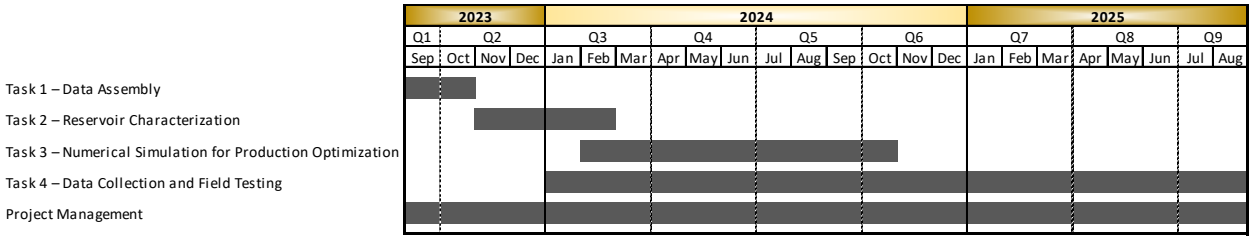
Personnel: Mr. Kyle Gardner, Cobra Vice President of Engineering, will serve as Project Manager and lead Cobra activities. Mr. Gardner will be supported by Mr. Josh Aaron and Mr. Bud Dillard, Cobra Geologists. Mr. Matthew Belobraydic, EERC Assistant Director, Geosciences, will oversee the entire project. Mr. Belobraydic will have project support from Remington Leger, EERC Senior Geoscientist, and Dr. Lu Jin, EERC Distinguished Reservoir Engineer. Project advisors from the EERC include John Harju, EERC Vice President for Strategic Partnerships; James Sorensen, EERC Director of Subsurface R&D; and Bethany Kurz, EERC Director of Analytical Solutions. Resumes of key personnel are included in Appendix B.

PROJECT MANAGEMENT

Overall management and reporting of the project will be handled by subcontractor EERC in close partnership with Cobra. Mr. Kyle Gardner will lead Cobra activities. Mr. Matthew Belobraydic will oversee the entire project. Mr. Belobraydic will be assisted in management of project activities by the EERC leadership team. The EERC manages over 200 contracts a year, with a total of more than 1300 clients in 53 countries. Systems are in place to ensure that projects are managed within budget, schedule, and scope. Mr. Belobraydic will be responsible for project coordination, guidance, and supervision to ensure consistent progress and adherence to budget and schedule constraints. Quarterly reports will be submitted to the North Dakota Industrial Commission (NDIC) 30 days after the end of each calendar quarter to provide timely highlights of ongoing research activities. A final report will be provided to legislative management, NDIC, and the Oil and Gas Research Council summarizing the results of the study.

TIMETABLE

This effort is proposed as a 24-month project beginning September 1, 2023, and ending August 31, 2025.



BUDGET

The total estimated cost for the proposed scope of work is $4,000,000. The request from OGRP is $2,000,000. Cobra will provide $2,000,000 in cash cost share toward the project. The budget provided in the table was developed based on estimates to perform the proposed scope of work and experience with similar projects. Undesignated third-party laboratory costs are set aside for potential sampling of existing core or other logging expenses based on project needs as work progresses.

Project Associated Expense	NDIC Share	Cobra Share (cash)	Total Project
Labor – Engineering and Field	$250,000	$355,000	$605,000
Facilities, Equipment, Gathering		$365,000	$365,000
Stimulation	$350,000	$700,000	$1,050,000
Well Service Rigs	$200,000	$225,000	$425,000
Downhole Production Equipment	$200,000	$350,000	$550,000
Travel		$5,000	$5,000
Subcontractor – EERC	$894,120		$894,120
Undesignated Third-Party Laboratory	$105,880		$105,880
Total Project Cost	$2,000,000	$2,000,000	$4,000,000

AFFIDAVIT OF TAX LIABILITY

Cobra Oil & Gas Corporation has no outstanding tax liability to the State of North Dakota nor any of its political subdivisions.

CONFIDENTIAL INFORMATION

There is no confidential information included in this proposal.

PATENTS/RIGHTS TO TECHNICAL DATA

No patentable technologies are expected to be created during this work.

STATUS OF ONGOING PROJECTS

Cobra has not been awarded previous funding by NDIC.

APPENDIX A

ENERGY & ENVIRONMENTAL RESEARCH CENTER LETTER OF SUPPORT

EERC
Energy & Environmental Research Center
15 North 23rd Street, Stop 9018 • Grand Forks, ND 58202-9018 • P. 701.777.5000 • F. 701.777.5181
www.undeerc.org

May 19, 2023

Mr. Kyle Gardner
Vice President – Engineering
Cobra Oil & Gas Corporation
PO Box 8206
Wichita Falls, TX 76307

Dear Mr. Gardner:

Subject: EERC Proposal No. 2023-0157 Entitled "Maximizing Production from Residual Oil Zones in Western North Dakota"

The Energy & Environmental Research Center (EERC) is pleased to provide the attached proposal outlining the scope of work (SOW) and associated cost to investigate methods and strategies to maximize recovery within potential residual oil zones in the Mission Canyon fields.

The estimated project cost is $894,120. Expenses will be invoiced monthly on a cost-reimbursable basis. Initiation of the proposed work is contingent upon the execution of a mutually negotiated agreement between our organizations.

If you have any questions concerning this proposal, please feel free to contact me by phone at (701) 777-5030 or by email at mbelobraydic@undeerc.org.

Sincerely,

DocuSigned by:
Matt Belobraydic
775DACB519E64A8...
Matthew L. Belobraydic
Assistant Director for Geosciences

MLB/rlo

Attachment

APPENDIX B

RESUMES

KYLE GARDNER
Vice President – Engineering, Owner
Cobra Oil & Gas Corporation
2201 Kell Blvd, Wichita Falls, TX, 76308
Phone: 940-716-5100 Email: kgardner@cobraogc.com

Professional Summary

Mr. Kyle Gardner has over 14 years of experience as a petroleum engineer with privately held oil & gas companies. He currently manages Cobra Oil & Gas Corporation's operations, production & engineering team. He is also leader of Cobra's technical reservoir and petrophysical team. Kyle has a background in drilling engineering and a forte in carbonate petrophysical formation evaluation. He has a B.S. degree in Petroleum Engineering from Texas Tech University in Lubbock, Texas.

- 14 years of operational experience of managing daily production, drilling activities and completion efforts.
- Have planned, executed, and managed the vertical & horizontal drilling & completions of wells Cobra has operated in 9 different states of depths from 4,000' TVD to 18,000' TVD, most of which were wildcats of conventional and unconventional targets.
- Lead petrophysical formation evaluator with emphasis in bypassed conventional pay zones of carbonates.
- Experienced in residual oil zone research and field application in the Permian & Williston Basin's.
- Evaluates Cobra acquisitions and divestitures, creates operational budgeting, manages company operating expenses.
- Experienced in economic evaluation software, Echometer equipment and software, remote production management software.
- Board Member of the North Dakota Petroleum Council
- Board Member of the Texas Alliance of Energy Producers
- Member of SPE, AADE & AAPG.

Bud Dillard
(682) 429.5285
bud@cobraogc.com

EDUCATION

Robert L. Bolin Graduate School of Geology—Fall 2016 – May 2020
Midwestern State University, Wichita Falls, Texas
- M.S. Geology with Petroleum Geology Emphasis—GPA: 4.0
- Thesis Topic: Lower Spraberry, Jo-Mill Sandstone, Permian Basin -- Borden, Dawson, Howard and Martin Counties, West Texas

University of Texas at Arlington, Texas–Graduated in December 2014
- B.S. in Geology; Minor in Biology

Texas Christian University, Fort Worth, Texas—Fall 2008 – Fall 2011

WORK EXPERIENCE

Cobra Oil & Gas Corporation, Wichita Falls, Texas—May 2020 – Present
Williston Basin Geologist
- Working legacy fields with existing conventional PDP, stacked reservoirs on the Northern Madison Shelf, in addition to the Nesson and Billings Anticline areas
- Provide subsurface interpretation and project management as well as conduct local and regional field studies to evaluate potential behind-pipe pay zones

Cobra Oil & Gas Corporation, Wichita Falls, Texas—May 2017 – May 2020
Entry Level Geologist; Geo-Technician
- Proficient in IHS Petra software; some experience with IHS Kingdom and GeoGraphix softwares
- Worked NW Shelf Delaware Basin, Permian San Andres D in Lea and Eddy Counties, New Mexico; Hardeman Basin, Mississippian Chappel Limestone in Hardeman County, TX

Stivers Consulting, Inc., Graham, Texas—January 2015 – May 2016
Mud Logger
- Analyze/describe rock lithology via microscopy, evaluate hydrocarbon shows, monitor drilling activity, prepare mud log

University of Texas at Arlington, Arlington, Texas—August – November 2014
Student Research
- Assisted PhD student with processing rock samples for dissertation work: Reconstructing Paleogene paleoclimate & paleoenvironment for terrestrial rock of the Green River Basin, SW Wyoming, using carbon isotope ratio in sediments

LEADERSHIP & ADDITIONAL ORGANIZATIONS

Society of Sigma Gamma Epsilon, Texas Epsilon Zeta Chapter—Fall 2017 – Spring 2020
- National Honor Society for the Earth Sciences

American Association of Petroleum Geologists Student Chapter—Fall 2016 – Fall 2018

- Chapter President – Spring 2018 – Fall 2018
- Chapter Senator, Student Government Association – Fall 2016 – Fall 2017

North Texas Geological Society—Fall 2016 – Present

Fort Worth Geological Society—Fall 2022 – Present

JOSH AARON
6725 Kit Carson Trl, Wichita Falls, TX 76310 · 940-631-0408

jaaron@cobraogc.com

EXPERIENCE

JANUARY 2020 – PRESENT
WILLISTON BASIN PETROLEUM GEOLOGIST, cobra oil and gas co.

- *Provide subsurface interpretation and project management for oil and gas exploration in the conventional reservoirs (Ordovician-Mississippian, & Permian-Triassic Fms.) of the Williston Basin. Conduct local and regional field studies to determine extent and volumetric estimates of conventional oil & gas reservoirs and prioritize existing PDNP behind-pipe zones with greatest potential.*
- *Assisted on other projects including the Hardeman Basin (Mississippian Chappel Limestone), Uintah Basin (Entrada Sands), and Clay County, TX (Strawn Formation).*

JANUARY 2019 – JANUARY 2020
GEO TECHNICIAN/ ENTRY LEVEL GEOLOGIST, lmh energy

- *Performed all mud logging and actively participated in well logging and completions on exploration, and development wells. Constructed well log correlation and subsurface mapping on conventional prospects in KMA and Archer County fields, North Texas.*

MAY 2017 – AUGUST 2018
PRODUCTION OPERATOR, msb operating

- *Sustain production, maintain rig equipment, operate work-over rig, service flow and injection lines.*

EDUCATION

AUGUST 2017- DECEMBER 2019
MASTER OF SCIENCE IN PEROLEUM GEOLOGY, midwestern state university
The Robert L. Bolin Graduate School of Petroleum Geology
GPA: 4.0

- **THESIS**: Subsurface Isopach Mapping of the Major Depositional Sequences of the Ordovician Bromide Formation, South Central Oklahoma (Advisor: Jesse Carlucci, Ph. D.)
- ***LABORATORY/GRADUATE TEACHING ASSISTANT-*** *Lead multiple geology laboratory courses as an independent instructor. Developed management and oversight skills while directing these courses.*

AUGUST 2013- MAY 2017
BACHELOR OF SCIENCE IN GEOSCIENCES, midwestern state university

- **UNDERGRADUATE STUDENT RESEARCH**- Preformed facies examination through X-ray powder diffractometry (Rigaku Miniflex) on the Pontotoc Sandstone Submember of the Bromide Formation, Oklahoma.

MATTHEW L. BELOBRAYDIC
Assistant Director for Geoscience
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5030, mbelobraydic@undeerc.org

Principal Areas of Expertise

Mr. Belobraydic's principal areas of interest and expertise include stratigraphic and structural interpretations, geologic characterization, data science, process automation, geostatistical analysis, geomodeling, and uncertainty analysis.

Education and Training

M.S., Geology, Ball State University, 2006. Thesis: "Drainage Basin Analysis and Fluvial Geomorphic Reconstruction Plan for the Killbuck–Mud Creek Subwatershed, Delaware County, Indiana."

B.S., Geology, University of Idaho, 2003. Senior Project: "Drainage Analysis for Colfax South, Diamond, Dusty, Thera, Thornton Quadrangles and an Experimental Quadrangle of Eastern Washington."

Research and Professional Experience

September 2022–Present: Assistant Director for Geoscience, EERC, UND. Mr. Belobraydic collaborates with EERC subject matter experts, principal investigators, and leadership to prepare proposals and pursue new business opportunities and leads and manages projects in the areas of enhanced oil recovery (EOR) in conventional and unconventional formations, CO_2 and produced gas storage, natural resource management, critical materials resource characterization and recovery, geologic and synthetic materials characterization, produced water management, and the environmental aspects of energy development.

- Manages a team of petrophysicists and subsurface data management professionals.
- Coaches and mentors more than ten geoscientists in geology, stratigraphy, geostatistical, geologic modeling, and uncertainty methods.
- Develops strategic plans for petrophysical products and data-handling procedures for subsurface teams.
- Assists the Director of Analytical Solutions by providing business directions for technical reports and technical expertise.
- Creates project proposals and maintains client relationships.

December 2020–September 2022: Principal Geoscientist, Geoscience and Engineering Group, EERC, UND. Mr. Belobraydic collaborated with EERC subject matter experts and principal investigators to create geological interpretations and prepared proposals in the areas of EOR in conventional and unconventional formations, CO_2 and produced gas storage, natural resource management, geologic materials characterization, produced water management, and environmental aspects of energy development.

- Mentored geoscientists as subject matter expert in geology and geological modeling for more than ten federal, state, and private contracts.
- Coached modeling team members through team-building and workflow improvement exercises.
- Characterized reservoirs and depositional environments for projects to maximize subsurface understanding and minimize development risk.

- Managed resources, budgets, and timelines on projects to successfully complete within deadlines and scope.

October 2020 – December 2020: Temporary Geoscientist, EERC, UND. Mr. Belobraydic produced geology and geological modeling results for CO_2 storage projects as part of an integrated team of EERC subject matter experts. Specific activities included the following:

- Produced 3D geologic models for CO_2 storage for select clastic formation within the Williston Basin.
- Coached three geoscientists through geostatistical and geomodeling methods as on-the-job training.

September 2008–April 2020: Senior III Reservoir Geologist, Schlumberger, Denver, Colorado. Mr. Belobraydic produced data-driven client solutions as part of a multidisciplinary consulting team, improving internal technical processes and workflows to increase efficiency and maximize profits. Specific activities included the following:

- Managed team of petrophysicist, geophysicist, geologist, and reservoir engineers from proposal to project close as technical lead for more than ten client projects.
- Introduced Agile and Scrum project management to local consulting team, changing work processes, shortening turnaround times by 66% and increasing bottom line.
- Reviewed green energy workflows and processes for internal geothermal and carbon capture and storage teams as subject matter expert to mitigate risk and uncertainty.
- Initialized and maintained backlog for basin interpretation cloud subscription service as Scrum product owner to capture previously inaccessible market share.
- Adapted working style and deliverables to become trusted technical advisor for more than 20 client organizations, each with unique business priorities.
- Coordinated stakeholders and potential clients for four cloud subscription service offerings to maximize value, drive communication, and quantify feedback of results.
- Created harmonious and integrated team environments for technical staff from both Schlumberger and client organizations for project collaborations.
- Characterized petroleum systems and depositional environments for client acreage to maximize reservoir understanding and minimize development risk.
- Interpreted structure and stratigraphy for full 3D models, combining seismic data for conventional and unconventional plays in more than ten basins and 30 fields globally.
- Analyzed raw and interpreted data to generate geostastically accurate static reservoir models in Petrel on more than five projects per year for worldwide clients.
- Published and automated uncertainty optimization technique, reducing dynamic simulation iterations by 80% and generating a positive feedback loop to initial inputs.
- Built custom Python, SQL, and Petrel workflows, increasing productivity by up to 900%.
- Coached and mentored more than 30 individuals through organized team-building activities and formal career development.
- Created advanced modeling curriculum and training programs in Petrel for more than 25 junior geoscientists.
- Published results and methodologies for select client work as posters and papers to technical conferences and professional societies.
- Requested presenter to professional societies for geology, data science, and machine learning.
- Prepared and reviewed proposals, reports, and project documentation, effectively communicating technical results and methodology to clients and working teams.

September 2006–August 2008: CO_2 Enhanced Oil Recovery Research Assistant, UND. Mr. Belobraydic researched CO_2 enhanced oil recovery and sequestration potential for the Williston Basin alongside the EERC. Specific activities included the following:

- Generated systematic approach for assessing enhanced oil recovery and carbon dioxide sequestration for fields of interest.
- Produced 3D reservoir models to simulate enhanced oil recovery and carbon dioxide sequestration potential.

May 2005–May 2006: National Science Foundation GK–12 Fellow, Ball State University, Muncie, Indiana. Mr. Belobraydic provided in classroom support to Indianapolis Public Schools (IPS) teachers through inquiry-based lessons and assisted in professional development for K–8 science standards. Specific activities included the following:

- Developed middle school Earth science curriculum and lessons for IPS.
- Provided aid in the professional development of IPS teachers as a knowledge resource.

Professional Activities

Member, American Association of Petroleum Geologists
Member, Rocky Mountain Association of Geologists

Publications

Mr. Belobraydic has authored or coauthored numerous professional publications.

REMINGTON LEGER
Senior Geoscientist
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5199, rleger@undeerc.org

Principal Areas of Expertise

Mr. Leger's principal areas of interest and expertise include geomodeling, with proficiency in geology, geophysics, and unconventional play prospecting; data analysis; structural geology; database management, workplace safety, and resource exploration.

Education and Training

M.S., Geology, University of Tennessee, Knoxville, 2013.
B.S., Geology, Louisiana State University, Batton Rouge, 2009.
Software skills include Petrel E&P and Esri ArcGIS.

Research and Professional Experience

January 2021–Present: Senior Geoscientist, EERC, UND. Mr. Leger interfaces with a diverse team of scientists and engineers to assess project uncertainties in oil and gas development and geologic CO_2 storage. Specific activities include development of geophysical models of the subsurface, regional geological characterization, and petrophysical analysis of geophysical well log data.

July 2013–April 2020: Senior Geologist, Schlumberger, Midland, Texas. Mr. Leger provided in-house geoscience consulting at major players focused on Permian Basin exploration production. Activities included the following:

- Consulted with exploration and production teams in building pad-specific, regional asset, and basinwide geologic models to help companies decrease risk by increasing confidence and understanding of uncertainty of their reservoir models.
- Assisted client in construction of reservoir model of Midland Basin, which is currently used by company's business development team for asset evaluation.
- Implemented Studio database (Schlumberger's data management software) at large independent company working in Permian Basin, thus decreasing uptake time and integration of new database in company.
- Played pivotal role in assisting company in migrating from GeoGraphix to Petrel platform.
- Completed Schlumberger's 3-year fixed-step program: Built reservoir model of Jack Field in Gulf of Mexico using Petrel E&P software.

July 2013–February 2017: Geologist, Houston, Texas. Mr. Leger served as geophysics and geology in-house consultant for Petrel at over five companies working in the Permian Basin, Eagle Ford Basin, Haynesville Basin, and Gulf of Mexico. Specific activities included the following:

- Consulted on developing and improving workflows for asset evaluation, hydrocarbon assessment, and well planning, which resulted in streamlining common task and saving company time.
- Facilitated Petrel on-the-job training for clients helping users decrease uptake time and increased confidence in using the software.
- Conducted presales technical demonstrations.
- Certified lead instructor for seven Petrel Next courses.

- Taught Petrel course at Bureau of Ocean Energy Management in New Orleans.

Publications
Mr. Leger has coauthored numerous professional publications.

DR. LU JIN
Distinguished Reservoir Engineer
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5316, ljin@undeerc.org

Principal Areas of Expertise

Dr. Jin's principal areas of interest and expertise include reservoir modeling and simulation, CO_2/rich gas enhanced oil recovery (EOR) and associated CO2 storage in both conventional and unconventional reservoirs, engineering optimization, water coning control, and multiphase flow in porous media. He is particularly interested in subsurface oil–water–gas interactions, EOR techniques and development of old oil fields/unconventional resources.

Education and Training

Ph.D., Petroleum Engineering, Louisiana State University, 2013.
M.S., Petroleum Engineering, Louisiana State University, 2009.
B.S., Petroleum Engineering, Northeast Petroleum University, 2005.

Research and Professional Experience

October 2022–Present: Distinguished Reservoir Engineer, EERC, UND. Dr. Jin develops novel methods for renewable energy development in the Williston Basin, including geothermal development in the Bakken Formation and hydrogen conversion in oil reservoirs; leads scientific research activities on machine learning applications, enhanced oil recovery (EOR) technologies, database development for EOR operations, effective simulation methods for unconventional reservoirs, etc. Specific activities include the following:

- Serves as principal investigator for a North Dakota Industrial Commission (NDIC)-sponsored project, "Extending the Shale Revolution from Oil and Gas to Geothermal Development in North Dakota."
- Serves as principal investigator for an NDIC-sponsored project, "Examination of In-situ Hydrogen Conversion in Oil Reservoirs."
- Continues to serve as task lead and key reservoir engineer for a U.S. Department of Energy (DOE)-sponsored project, "CO_2 Enhanced Oil Recovery Improvement in Conventional Fields Using Rich Gas."
- Continues to serve as task lead and key reservoir engineer for a DOE-sponsored project, "Improving Enhanced Oil Recovery Performance Through Data Analytics and Next-Generation Controllable Completions."
- Serves as task lead and key reservoir engineer for an NDIC-sponsored project, "Unitized Legacy Oil Fields: Prototypes for Revitalizing Conventional Oil Fields in North Dakota."

January 2020–September 2022: Principal Reservoir Engineer, EERC, UND. Dr. Jin develops dynamic numerical models for CO_2/rich gas enhanced oil recovery in different reservoirs; oversees technical areas in reservoir engineering, including conventional, unconventional and enhanced oil and gas production, the geologic storage of CO_2 and natural gas, natural resource development, geocellular modeling, numerical simulation. Specific activities include the following:

- Serves as task lead and key reservoir engineer for a U.S. Department of Energy (DOE)-sponsored project, "CO_2 Enhanced Oil Recovery Improvement in Conventional Fields Using Rich Gas."

- Serves as task lead and key reservoir engineer for a DOE-sponsored project, "Improving Enhanced Oil Recovery Performance Through Data Analytics and Next-Generation Controllable Completions."
- Serves as key reservoir engineer for a DOE-sponsored project, "Bakken Rich Gas Enhanced Oil Recovery Project."
- Serves as co-principal investigator for an NDIC-sponsored project, "Exploration of Opportunities and Challenges for a North Dakota Petrochemical Industry."

August 2018–December 2019: Senior Reservoir Engineer, EERC, UND. Dr. Jin develops dynamic numerical models for CO_2 flow monitoring and prediction in different reservoirs; designs well testing plans for both producers and injectors to support the long-term success of field operations; develops innovative fractured reservoir models for the Bakken unconventional petroleum system; and serves as a simulation task lead for a variety of seismic projects. Specific activities include the following:

- Served as task lead and key reservoir engineer for a DOE-sponsored project, "Joint Inversion of Time-Lapse Seismic Data."
- Served as key reservoir engineer for a DOE-sponsored project, "Scalable, Automated, Semi-permanent Seismic Method for Detecting CO_2 Plume Extent During Geological CO_2 Injection – Phase II."

February 2015–July 2018: Reservoir Engineer, Reservoir Modeling and Simulation, EERC, UND. Dr. Jin's responsibilities include developing geophysical models of the subsurface and running dynamic simulations to determine the long-term fate of produced/injected fluids, including hydrocarbons, CO_2 storage, and brine, using oil and gas industry simulation software. Specific activities include the following:

- Served as task lead and key reservoir engineer for a DOE-sponsored project, "Plains CO_2 Reduction (PCOR) Partnership Phase III – Bell Creek Test Site."
- Served as Co-PI and key reservoir engineer for a DOE-sponsored project, "Improved Characterization and Modeling of Tight Oil Formations for CO_2 Enhanced Oil Recovery Potential and Storage Capacity Estimation."
- Served as key reservoir engineer for a DOE-sponsored project, "Scalable, Automated, Semi-permanent Seismic Method for Detecting CO_2 Plume Extent During Geological CO_2 Injection – Phase I."

January 2014–January 2015: Reservoir Engineer, InPetro Technologies, Inc., Houston, Texas. Dr. Jin's responsibilities included developing simulation and analytical models for unconventional reservoir development, especially for shale oil reservoirs; analyzing fluid PVT (pressure, volume, temperature) change during depletion and considering pore-size distribution (PSD) in simulations. Application of a new model in the Eagle Ford and Bakken Formations shows that oil reserves could be improved as much as 30% by integrating PVT and PSD effects.

August 2007–December 2013: Research Assistant and Reservoir Consultant, Department of Petroleum Engineering, Louisiana State University (LSU), Baton Rouge, Louisiana. Dr. Jin's responsibilities included modeling and evaluating the performance of Downhole Water Loop (DWL) well system in different oil fields, developing economical models for evaluation of the DWL system in various reservoir and market conditions, and identifying best reservoir candidates for the system; oil production rate could be improved as much as 200%. Constructed software (toolbox) using ECLIPSE and VBA for complex well system simulation, applied batch processing technology in simulation, achieved automatic task queuing, and reduced simulation time 67%.

- **January 2013–December 2013**: Reservoir Consultant, Joint Industrial Program (JIP), LSU, and Pluspetrol, Baton Rouge, Louisiana. Dr. Jin's responsibilities included simulating cold production of heavy oil in Massambala Field, Angola, identifying the mechanisms of high water cut in current wells,

optimizing the perforation length for conventional wells, and proposing two well systems, which could improve cumulative oil up to 80% or reduce produced water 75%, respectively.

- **May 2012–August 2012**: Internship, High Plains Operating Company, LLC (HPOC), San Francisco, California. Dr. Jin's responsibilities included simulating and analyzing the extra water production problems in the Ojo Encino Field, New Mexico, designing a DWS well system to produce oil from the thick transition zone, which could improve oil production rate by up to 20%.
- **May 2011–August 2011**: Internship, JIP, LSU, and HPOC, Baton Rouge, Louisiana. Dr. Jin's responsibilities included simulating performance of vertical and horizontal wells in the Ojo Encino Field, New Mexico, diagnosing water coning/cresting problems in the thick transition zone, determining the best location for water injection to minimize pressure interference, and suggesting well type to develop the field, which saved costs up to 30%.
- **January 2011–January 2013**: Senior Teaching Assistant, Drilling Fluids Laboratory, LSU, Baton Rouge, Louisiana. Served as lecturer and oversaw four teaching assistants and 80–100 students each year as well as supervised three senior students completing their senior design projects.

September 2005–August 2007: Production Consultant, JIP, China University of Petroleum, and CNPC. Dr. Jin's responsibilities included optimizing a large gas pipeline network in China, proposing new optimization algorithm and programming a software package for best operation in different conditions, reducing operational cost up to 23% (more than $20,000/day).

Professional Activities

Member, Society of Petroleum Engineers

Publications

Dr. Jin has authored or coauthored numerous peer-reviewed and other professional publications.

JAMES A. SORENSEN
Director of Subsurface Research and Development
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5287, jsorensen@undeerc.org

Principal Areas of Expertise
Mr. Sorensen's primary areas of interest and expertise are enhanced oil recovery (EOR) in unconventional tight oil formations, CO_2 utilization and storage in geologic formations, and tight oil resource assessment and development.

Education and Training
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1991.

Research and Professional Experience
October 2019–Present: Director of Subsurface Research and Development, EERC, UND. Mr. Sorensen is responsible for developing and managing programs and projects focused on conventional, unconventional, and enhanced oil and gas production; the geological storage of CO_2; geothermal; and other energy and environmental research.

July 2018–September 2019: Assistant Director for Subsurface Strategies, EERC, UND. Mr. Sorensen developed business opportunities, provided technical support and guidance regarding emerging areas of research, and served as a principal investigator and task manager for projects related to the sequestration of CO_2 in geologic media and the sustainable development of tight oil resources.

1999–July 2018: Principal Geologist, EERC, UND. Mr. Sorensen served as manager and co-principal investigator for programs to develop strategies for CO_2 utilization and storage. He also led research focused on enhanced oil recovery (EOR) in the Bakken.

1997–1999: Program Manager, EERC, UND. Mr. Sorensen managed projects focused on produced water management and environmental fate of natural gas-processing chemicals.

1993–1997: Geologist, EERC, UND. Mr. Sorensen conducted field-based hydrogeologic investigations focused on natural gas production sites.

1991–1993: Research Specialist, EERC, UND. Mr. Sorensen assembled and maintained comprehensive databases related to oil and gas drilling, production, and waste management.

Professional Activities
Member, Society of Petroleum Engineers

Publications
Mr. Sorensen has coauthored nearly 200 publications.

DR. JOHN A. HARJU
Vice President for Strategic Partnerships
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5157, jharju@undeerc.org

Principal Areas of Expertise

Dr. Harju's principal areas of interest and expertise include carbon sequestration, enhanced oil recovery, unconventional oil and gas development, waste management, geochemistry, technology development, hydrology, and analytical chemistry, especially as applied to the upstream oil and gas industry.

Education and Training

Ph.D., Petroleum Engineering, University of North Dakota, 2022.
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1986.

Research and Professional Experience

2002–Present: EERC, UND.
July 2015–Present: Vice President for Strategic Partnerships. Dr. Harju leads efforts to build and grow dynamic working relationships with industry, government, and research entities globally in support of the EERC's mission to provide practical, pioneering solutions to the world's energy and environmental challenges. He represents the EERC regionally, nationally, and internationally in advancing its core research priorities: coal utilization and emissions, carbon management, oil and gas, alternative fuels and renewable energy, and energy–water.

2003–June 2015: Associate Director for Research. Dr. Harju led a team of scientists and engineers building industry–government–academic partnerships to carry out research, development, demonstration, and commercialization of energy and environmental technologies.

2002–2003: Senior Research Advisor. Dr. Harju developed, marketed, managed, and disseminated research programs focused on the environmental and health effects of power and natural resource production, contaminant cleanup, water management, and analytical techniques.

2017–Present: Adjunct Lecturer, Department of Petroleum Engineering, UND.

1999–2002: Vice President, Crystal Solutions, LLC, Laramie, WY. Dr. Harju's firm was involved in commercial E&P produced water management, regulatory permitting and compliance, and environmental impact monitoring and analysis.

1997–2002: Gas Research Institute (GRI) (now Gas Technology Institute [GTI]), Chicago, IL.
2000–2002: Principal Scientist, Produced Water Management. Dr. Harju developed and deployed produced water management technologies and methodologies for cost-effective and environmentally responsible management of oil and gas produced water.

1998–2000: Program Team Leader, Soil, Water, and Waste. Dr. Harju managed projects and programs related to the development of environmental technologies and informational products related to the North

American oil and gas industry; formulated RFPs, reviewed proposals, and formulated contracts; performed technology transfer activities; and supervised staff and contractors. He served as Manager of the Environmentally Acceptable Endpoints project, a multiyear program focused on rigorous determination of appropriate cleanup levels for hydrocarbons and other energy-derived contaminants in soils. He led GRI/GTI involvement with industry environmental consortia and organizations, such as PERF, SPE, AGA, IPEC, and API.

1997–1998: Principal Technology Manager (1997–1998) and Associate Technology Manager (1997), Soil and Water Quality.

1988–1996: EERC, UND.
1994–1996: Senior Research Manager, Oil and Gas Group. Dr. Harju served as:
- Program Manager for assessment of the environmental transport and fate of oil- and gas-derived contaminants, focused on mercury and sweetening and dehydration processes.
- Project Manager for field demonstration of innovative produced water treatment technology using freeze crystallization and evaporation at oil and gas industry site.
- Program Manager for environmental transport and fate assessment of MEA and its degradation compounds at Canadian sour gas-processing site.
- Program Manager for demonstration of unique design for oil and gas surface impoundments.
- Director of the National Mine Land Reclamation Center for the Western Region.
- Co-PI on project exploring feasibility of underground coal gasification in southern Thailand.
- Consultant to an International Atomic Energy Agency program entitled "Solid Wastes and Disposal Methods Associated with Electricity Generation Fuel Chains."

1988–1994: Research Manager (1994), Hydrogeologist (1990–1994), Research Specialist (1989–1990), and Laboratory Technician (1988–1989).

Professional Activities
Member, National Coal Council (appointed 2018)
Member, National Petroleum Council (appointed 2010)
Member, Mainstream Investors, LLC, Board of Governors (2014–present)
Member, DOE Unconventional Resources Technology Advisory Committee (2012–2014)
Member, Interstate Oil and Gas Compact Commission (appointed 2010)
Member, Rocky Mountain Association of Geologists

Publications
Dr. Harju has authored or coauthored more than 100 professional publications and nearly 300 technical presentations.

BETHANY A. KURZ
Director of Analytical Solutions
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5050, bkurz@undeerc.org

Principal Areas of Expertise

Ms. Kurz's principal areas of interest and technical expertise include carbon capture, utilization, and storage (CCUS); produced natural gas storage; enhanced oil recovery (EOR) in conventional and unconventional oil and gas reservoirs; application of machine learning and data analytics to CCUS and oil and gas development; produced water and drilling waste management; assessment of critical materials in coal and produced brine; and resource management related to energy development.

Education and Training

M.S., Hydrogeology, University of North Dakota, Grand Forks, ND, 1998.
B.S., Geochemistry, Bridgewater State University, Bridgewater, MA, 1995.

Research and Professional Experience

May 2021–Present: Director of Analytical Solutions, EERC, UND. Ms. Kurz is responsible for developing business and research opportunities to address challenges in all areas of energy and natural resources development and management. She leads programs and projects related to CCUS; application of machine learning and artificial intelligence to CCUS and conventional and unconventional oil and gas development; EOR; produced water and drilling waste management; and critical materials resource assessments. Ms. Kurz also leads the EERC's research laboratories and a multidisciplinary team of scientists and engineers focused on addressing the needs of our partners and clients in areas related to energy development and management and environmental stewardship.

July 2018–April 2021: Assistant Director of Integrated Analytical Solutions, EERC, UND. Ms. Kurz was responsible for assisting the EERC's leadership team with developing business opportunities and successfully executing research projects related to oil and gas; natural resource management; and carbon capture, utilization, and storage. She oversaw a multidisciplinary team of scientists and engineers who work in the EERC's applied research laboratories. In that role, she was responsible for ensuring the quality assurance/quality control of data and results generated by the EERC's laboratories and integrating those results into the applied research efforts conducted by the Subsurface R&D team.

2011–July 2018: Principal Hydrogeologist, Laboratory Analysis Group Lead, EERC, UND. Ms. Kurz oversaw a multidisciplinary team of scientists and engineers and several of the EERC's analytical research laboratories that focus on classical and advanced wet-chemistry analyses; petrochemical, geochemical and geomechanical evaluation of rocks and soils; and advanced characterization of various materials, including metals, alloys, catalysts, and corrosion and scale products. Her primary areas of interest included the evaluation of water supply sources for the oil and gas industry, produced water management, characterization of geologic media for carbon storage and development and testing of proppants for use in hydraulic fracturing.

2002–2011: Senior Research Manager, Water Management and Flood Mitigation Strategies, EERC, UND. Ms. Kurz's responsibilities included project management, technical report and proposal writing,

public outreach, and the development of new research focus areas. Research activities included the evaluation of nontraditional water supply sources for municipal and industrial use, flood and drought mitigation, watershed-scale water quality assessments using hydrologic models, and public education and outreach on various water and energy issues.

1998–2002: Research Scientist, Subsurface Remediation Research, EERC, UND. Ms. Kurz's responsibilities included managing and conducting research involving remediation technologies for contaminated groundwater and soils, groundwater sampling and analysis, technical report writing, and proposal research and preparation.

Publications

Ms. Kurz has coauthored numerous professional publications.

APPENDIX C

REFERENCES

Burton-Kelly, M.E., Dotzenrod, N.W., Feole, I.K., Pekot, L.J., He, J., Butler, S.K., Kurz, M.D., Kurz, B.A., Smith, S.A., and Gorecki, C.D., 2018, Identification of residual oil zones in the Williston and Powder River Basins (Final Report): Report prepared by the Energy & Environmental Research Center for DOE Cooperative Agreement No. DE-FE0024453.

Dotzenrod, N.W., Dalkhaa, C., Pekot, L.J., He, J., Burton-Kelly, M.E., Feole, I.K., Bosshart, N.W., Peck, W.D., Ayash, S.C., and Gorecki, C.D., 2017, Fine-scale modeling and simulation of the Big Stick and T.R. Fields, North Dakota, USA (update): Report prepared by the Energy & Environmental Research Center for DOE Cooperative Agreement No. DE-FE0024453.

Harouaka, A., Trentham, B., and Melzer, S., 2014, Permian Basin production proves ROZ viability: Oil and Gas Journal, v. 113, p. 78–81.

Melzer, L.S., and Trentham, R.C., 2015, Recognition, exploitation of ROZs coming of age: www.epmag.com/recognition-exploitation-rozs-coming-age-812026#p=full August 3, 2015 (accessed May 22, 2023).

DIRECTOR'S COMMENTS
G-058-03
Bakken Production Optimization Program 4.0
Submitted by: Energy & Environmental Research Center
Principal Investigator: James A. Sorensen
Request for: $6,000,000
Total Project Costs: $12,000,000
Duration: 3 years

Description of the Project:

The Energy & Environmental Research Center (EERC) proposes a 3-year extension of the existing and highly successful Bakken Production Optimization Program (BPOP). The first 9 years of BPOP were sponsored by the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) and many of the Williston Basin's premier operating companies. Objective: To provide technical solutions and tools that optimize oil production, reduce carbon intensity, and lead to the broad deployment of technologies, including enhanced oil recovery (EOR), that enable continued sustainable development of North Dakota's vast Bakken resources. Expected results: Increased productivity and decreased carbon intensity of Bakken resources.
Participants: In addition to DOE, the EERC anticipates ongoing support of at least eight companies, including Chord Energy, ConocoPhillips, Devon, XTO Energy (a subsidiary of ExxonMobil), Hess Corporation, Liberty Resources LLC, Marathon Oil Company, and Petro-Hunt, L.L.C., which have supported previous BPOP phases. Additional partners are anticipated to join as the program continues.

Technical Reviewers' Recommendations: 3 Fund

Director's Recommendation: Recommend funding in the amount of $4,000,000 over 2 years

Conflicts of Interest: None

Vote: 6 yes; 0 nay, 1 absent and not voting

Energy & Environmental Research Center
15 North 23rd Street, Stop 9018 • Grand Forks, ND 58202-9018 • P. 701.777.5000 • F. 701.777.5181
www.undeerc.org

June 1, 2023

Mr. Reice Haase
Deputy Executive Director
North Dakota Industrial Commission
ATTN: Oil and Gas Research Program
State Capitol – 14th Floor
600 East Boulevard Avenue, Department 405
Bismarck, ND 58505-0840

Dear Mr. Haase:

Subject: EERC Proposal No. 2023-0150 Entitled "Bakken Production Optimization Program 4.0" in Response to the North Dakota Industrial Commission Oil and Gas Research Program Solicitation

The Energy & Environmental Research Center (EERC) is pleased to propose a continuation of a well-established research program that encourages and promotes the use of new technologies that have a positive economic and environmental impact on oil and gas exploration and production in North Dakota.

The $100 application fee for this proposal is provided through ACH Transaction No. 255028. The EERC, a research organization within the University of North Dakota, an institution of higher education within the state of North Dakota, is not a taxable entity; therefore, it has no tax liability.

This transmittal letter represents a binding commitment by the EERC to complete the project described in this proposal. If you have any questions, please contact me by telephone at (701) 777-5287 or by email at jsorensen@undeerc.org.

Sincerely,

DocuSigned by:
James Sorensen
James A. Sorensen
Director of Subsurface Research and Development

Approved by:

DocuSigned by:
Thomas Alfred Erickson
38EA2766DDAC46C...
for
Charles D. Gorecki, CEO
Energy & Environmental Research Center

JAS/bjr

Attachments

c/att: Brent Brannan, OGRP

Oil and Gas Research Program

North Dakota
Industrial Commission

Application

Program Title: Bakken Production Optimization Program 4.0

Applicant: Energy & Environmental Research Center

Principal Investigator: James A. Sorensen

Date of Application: June 1, 2023

Amount of Request: $6,000,000

Total Amt. of Proposed Project: $12,000,000

Duration of Project: 3 years

Point of Contact (POC): James A. Sorensen

POC Telephone: (701) 777-5287

POC Email Address: jsorensen@undeerc.org

POC Address:

15 North 23rd Street, Stop 9018

Grand Forks, ND 58202-9018

TABLE OF CONTENTS

ABSTRACT

The Energy & Environmental Research Center (EERC) proposes a 3-year extension of the existing and highly successful Bakken Production Optimization Program (BPOP). The first 9 years of BPOP were sponsored by the North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP) and many of the Williston Basin's premier operating companies. **Objective:** To provide technical solutions and tools that optimize oil production, reduce carbon intensity, and lead to the broad deployment of technologies, including enhanced oil recovery (EOR), that enable continued sustainable development of North Dakota's vast Bakken resources. **Expected Results:** Increased productivity and decreased carbon intensity of Bakken resources. **Duration:** 3 years (September 1, 2023 – August 31, 2026). **Total Program Cost:** The total value of the project is $12,000,000. This proposal requests $2,000,000 annually for 3 years ($6,000,000 total) from OGRP. The U.S. Department of Energy (DOE) will provide $1,000,000 of cash cost share toward field testing of a new flare reduction technology. Devon Energy Corporation (Devon) will provide in-kind contributions (valued at $3,000,000) in the form of unique data sets, core, and fluid samples that will be used to support the design and execution of a CO_2 injection test in a Bakken well. Liberty Resources, LLC (Liberty) will provide in-kind contributions (valued at $363,639) in the form of an EOR pilot test using rich gas and produced water. Consistent with the first 9 years of BPOP, the EERC anticipates sustained industry engagement in the form of annual partnership fees. Those contributions, reported to NDIC as received, will increase the total value of the program. Based on past levels of participation, the attendant budget includes $1,636,361 from annual partnership fees. The full value of these fees is anticipated to exceed $2,000,000 over the 3 years. **Participants:** In addition to DOE, the EERC anticipates ongoing support of at least eight companies, including Chord Energy, ConocoPhillips, Devon, XTO Energy (a subsidiary of ExxonMobil), Hess Corporation, Liberty Resources LLC, Marathon Oil Company, and Petro-Hunt, L.L.C., which have supported previous BPOP phases. Additional partners are anticipated to join as the program continues.

PROJECT DESCRIPTION

The Energy & Environmental Research Center (EERC) proposes to extend the scope of the existing and highly successful North Dakota Industrial Commission (NDIC) Oil and Gas Research Program (OGRP)-sponsored Bakken Production Optimization Program (BPOP). The EERC proposes a 3-year continuation of this program that optimizes petroleum production in North Dakota. The proposed program is a continuation of the collaborative effort between the state of North Dakota, the petroleum industry, and the U.S. Department of Energy (DOE) to develop solutions to challenges in the Bakken. Accomplishments over the past 9 years of BPOP are provided in Appendix A.

Industry and state stakeholders have expressed a desire to maximize productivity of wells and drilling spacing units (DSUs), increase the ultimate recovery of oil, and reduce the carbon intensity of Bakken operations. Stakeholders are interested in optimizing primary production throughout the Bakken play, including Tier 2 and 3 acreages, determining how to best implement commercial-scale enhanced oil recovery (EOR) using rich gas and/or CO_2, reducing flaring and fugitive methane emissions, mitigating well souring, and improving operational efficiencies. Technical advances that result from the proposed activities will not only serve to support the long-term productivity and economic vitality of Bakken assets but will also demonstrably reduce the carbon intensity of Bakken oil, thereby enhancing the environmental, social, and governance (ESG) standing of operators.

The success of BPOP to date suggests a high likelihood of a significant return on investment by the state and its industry partners. Throughout the first 9 years of the program, the EERC has demonstrated that the strength of BPOP rests in its ability to address a broad range of ever-changing technical priorities. Key topics that will be addressed during the next 3 years of BPOP include:

- Moving Bakken EOR from pilot testing to commercial-scale deployment:
  - Building on the success of Liberty's East Nesson EOR pilot, which used a novel approach to rich gas and water injection to yield over >5000 bbl of incremental oil.
  - Working with Devon Energy Corporation (Devon) to perform a robust laboratory, modeling, and field-based examination of the potential to use CO_2 for Bakken EOR, which would not only

leverage the state's nascent but growing CO_2 capture, utilization, and storage (CCUS) industry to improve ultimate recovery of Bakken oil resources but would yield low-carbon-intensity oil.

  - Performing techno-economic modeling exercises focused on evaluating holistic strategies for broadly deploying EOR across the basin that account for key reservoir, operational, and infrastructure factors, as well as working fluid options.

- Economically assessing, monitoring, and mitigating fugitive methane emissions:
  - Developing approaches and tools for assessing emissions from operations.
  - Evaluating technologies for monitoring and mitigating fugitive methane emissions.
- Developing and deploying a new flare reduction technology:
  - Field testing of the "Polar Bear℠" technology at BPOP partner locations.
- Pursuing research activities identified as being of high priority based on partner feedback:
  - Mitigation of hydrogen sulfide (H_2S) generation in Bakken wells.
  - Basinwide characterization of produced oil, gas, and water.
  - Basinwide statistical analyses of drilling, completion, refracturing, and production operations using machine learning (ML) and artificial intelligence (AI) techniques.
  - Reservoir characterization using advanced petrophysics and sequence stratigraphy methods to support Tier 2 and Tier 3 acreage development and EOR scheme designs.
  - Evaluation of the potential for an emerging wellhead-based real-time data collection and analysis technology to optimize gas lift and improve production economics.

Goals and Objectives: The primary goals of the proposed BPOP efforts are to 1) provide the state and industry with science-based insight to maintain the economic and environmental sustainability of the Bakken play in North Dakota, with an emphasis on reducing carbon intensity through commercialization of EOR using rich gas and/or CO_2, new flare reduction technologies, and methane emission management and 2) provide stakeholders with the knowledge needed to plan and implement innovative development strategies that will add value to Bakken Tier 1, 2, and 3 acreages.

Methodology: BPOP will be organized along multiple technical topic areas as state and industry priorities dictate. The flexibility of the stakeholder-driven program will provide the ability to address emerging issues as needed. Through BPOP, the EERC will continue to serve existing and new North Dakota Petroleum Council (NDPC) task force groups established to address challenges such as flaring, vapor pressure compliance, and emissions. The primary research topic areas are described below.

Enhanced Oil Recovery: Three activities will be conducted to develop knowledge and operational best practices that will support broad commercial implementation of EOR across the Bakken play.

Optimization of Rich Gas/Water EOR at East Nesson with Liberty Resources: As part of BPOP 3.0, Liberty Resources, LLC (Liberty) conducted an EOR pilot at its East Nesson location that included coinjecting rich gas and a fresh water/surfactant blend. The East Nesson pilot was successful at building reservoir pressure, containing the injected gas in the reservoir and estimated to ultimately yield >5000 bbl of incremental oil. A second injection cycle of water alternating gas (WAG) using rich gas and produced water to optimize the economics of operations is currently being planned for summer/fall 2023. Specific BPOP activities to support the Liberty pilot will include modeling and simulation to evaluate the reservoir response and performance of the second injection cycle. The data generated throughout the project will be processed and interpreted by EERC in close coordination with Liberty to assess the pilot performance.

Examination of CO_2 EOR in the Bakken with Devon: The EERC will work closely with Devon to conduct activities designed to ultimately culminate in the commercial deployment of an EOR project in the Bakken that uses CO_2 from an industrial source in North Dakota. The effort will include assessment and development of a business case that features CCUS, whereby incremental oil production is combined with 45Q tax incentives derived from CO_2 storage associated with EOR. Activities under BPOP 4.0 will include reservoir characterization, EOR pilot test design, pilot test site selection, procurement of the CO_2 necessary to conduct a pilot test, and execution of a CO_2 injection test. Reservoir characterization will include laboratory-, modeling-, and field-based efforts that will ultimately lead to design and execution of a pilot-scale test in a Bakken reservoir owned and operated by Devon. Field-based efforts conducted by

Devon could include, but are not necessarily limited to, collection of core, fluids, and/or baseline reservoir pressure and temperature data from reservoirs being considered as candidate locations for a pilot-scale CO_2 EOR test. Reservoir core and fluid samples will be used in laboratory experiments to evaluate the interactions between CO_2 and reservoir rocks and fluids under relevant reservoir conditions Testing may include minimum miscibility pressure (MMP); pressure, volume, temperature (PVT); CO_2-based oil extraction from rocks; and/or other tests to determine the EOR and CO_2 storage potential of the Bakken. Activities will include reservoir modeling simulation exercises to evaluate different CO_2 EOR operational scenarios in support of designing a CO_2-based EOR pilot test.

Basinwide Assessment of the Bakken EOR Potential: The lessons learned from the EOR pilot projects performed through BPOP and also those performed by other operators in the Bakken and other tight oil plays will be compiled and used to perform a wider assessment of Bakken EOR potential. Modeling and simulation scenarios will be performed to evaluate the EOR potential of different geologic regimes (i.e., Tier 1, 2, and 3 acreage). Both rich gas and CO_2 will be evaluated for EOR, and different operational scenarios (gas injection only, WAG injection, surfactant addition, etc.) will be assessed. The results of the modeling and simulation work will be extrapolated to inform development strategies and estimate the potential resource recovery and associated economic value for the entire Bakken play.

Methane Emission Mitigation and Flare Reduction: Cost-effectively mitigating methane emissions and reducing flaring have long been priorities of the state and industry and is an important element of reducing the carbon intensity of Bakken oil. The EERC will develop approaches and web-based tools for assessing methane emissions from operations. Technologies for monitoring and mitigating methane emissions will be evaluated. Data from NDIC indicate that approximately 66% of flaring is sourced from medium to small facilities where traditional gas capture techniques are uneconomical. However, a patented technology recently developed by the EERC, called Polar Bear^{SM}, is able to achieve near-zero flaring and capture storage tank vapors from these locations. Polar Bear^{SM} overcomes economic challenges by providing fit-for-purpose compression and vastly reducing the maintenance associated with

traditional compression. Tank vapors are particularly difficult to recover because of "tank breathing" which imparts air/oxygen into the tank headspace, often exceeding the allowable concentration for pipeline transport. Polar Bear^{SM} provides a means to recover the storage tank vapors eliminating the need to flare. Through BPOP 4.0, and with cofunding from DOE and BPOP partner support, this effort will test a prototype in a relevant environment to advance the technology readiness for field implementation. The objectives of the effort are to 1) develop and validate a novel technology to capture vapors from storage tanks to achieve zero or near-zero methane emissions; 2) complete engineering-scale testing of a prototype design functioning with anticipated gas components and at dynamic conditions to validate process controls, design parameters, and safety; and 3) advance the technology for field implementation.

Completion and Production Data Analytics: The EERC will assess the impacts of different completion techniques and operational parameters on well and DSU performance with the goal of identifying factors to optimize production. This activity will include the evaluation of geology and completion parameters such as DSU well count; lateral length; well spacing; treatment size; and completion type on oil, gas, and water production from hydraulically fractured and refractured wells. The analyses will leverage previous EERC work on refractured wells, completion optimization, lateral length, well spacing, and parent–child well interactions and utilize ML to identify and quantify trends at the DSU-, field-, and basin-scale. These learnings will provide data-driven foundations for quantifying optimal infill well completion designs and parent well management strategies to optimize Bakken development. In addition, the EERC will evaluate time-series trends in well completion practices and fluids production to better understand reservoir performance and predict future gas and water production volumes.

Fluids Characterization: The optimization of oil production in North Dakota requires accurate understanding of the fluids being produced. Oil, associated gas, and produced water are complex mixtures, and their chemical and physical properties can vary geographically and over the life of a well. Bakken fluids data collected by BPOP over 9 years has been used to identify and follow evolving trends in key basinwide performance indicators such as gas-oil ratio, oil-water ratio, and produced fluid

compositions. Detailed fluids data generated under this task will be used in the Completion and Production Data Analytics task.

Geological and Petrophysical Evaluations: To support the optimization of well completions and EOR, the quality of reservoir and source rock within the Bakken petroleum system will be assessed through use of sequence stratigraphy techniques and advanced petrophysical analyses. Leveraging previously gathered core analyses and logs, wells will be evaluated for lithology, water saturation, kerogen volumes, permeability, and reservoir quality. The EERC will apply learnings from high-tier data sets (e.g., spectroscopy and nuclear magnetic resonance logs) to wells with a more common data suite to build a reliable database for reservoir characterization through ML algorithms. The EERC will also work with at least one graduate student in the UND Harold Hamm School of Geology & Geological Engineering to develop a Bakken depositional framework, which, in turn, may guide future Bakken development strategies.

Understanding and Mitigating H_2S in Bakken Production Streams: H_2S is an undesired by-product of oil and gas production in both conventional and unconventional plays. Previous H_2S characterization activities under BPOP, including the analysis of H_2S isotope signatures, suggested at least two potential mechanisms of H_2S occurrence in Bakken wells, both of which are likely linked to well stimulation. In BPOP 4.0, the EERC will continue analysis of sulfur isotopes and focus on mechanisms to manage and/or mitigate H_2S generation, including the evaluation of completion practices to reduce the risk of souring.

Production Technology Optimization Assessment: This activity will focus on advancing concepts and technology to improve the efficiency of production facilities. Irregular flow behavior inherent in horizontal wellbores due to the undulating borehole trajectory has been modeled and studied within BPOP. Based on fundamental knowledge, the EERC will evaluate advanced concepts that can improve flow behavior and increase the efficiency of artificial lift. The EERC intends to work with BPOP partners and NeoTek Energy to evaluate a technology, developed by NeoTek Energy, that couples an advanced

wellhead analyzer with AI to guide real-time optimization of a gas lift system, with a goal of ultimately demonstrating the use of the technology in the field.

Facilities, Resources, and Techniques to Be Used: The EERC employs a multidisciplinary staff of about 300 and has 254,000 square feet of state-of-the-art offices, laboratories, and technology demonstration facilities, which enable staff to address a wide variety of research topics. The EERC houses eight analytical laboratories, including water resource characterization, petroleum resource characterization, and environmental chemistry. These laboratories have decades of experience and have been instrumental in previous Bakken research. The EERC has extensive geologic modeling, reservoir simulation, and data analytics experience and capabilities, including high-end workstation computers and a dedicated high-performance parallel computing cluster.

Environmental and Economic Impacts While Program Is Underway: The breadth of the program means the environmental and economic impacts will be wide-ranging and difficult to predict. However, the first 9 years of the program are evidence of the positive impact the program has had on North Dakota environmental concerns and economics related to Bakken development. Previous BPOP impacts are outlined in Appendix A, and maps are included in Appendix B.

Ultimate Technological and Economic Impacts: Ultimately, BPOP will provide broad technical and economic impacts. Each research task will have the potential to bolster oil and gas industry operations by improving resource recovery, decreasing costs, reducing environmental impacts, and increasing revenue. With original oil in place (OOIP) estimates for the Bakken Petroleum system ranging from 300 to 900 billion barrels, the impact of successful EOR operations alone could extend the lifetime of the play by decades, yielding billions of barrels of low-carbon-intensity incremental oil and billions of dollars of economic impact to North Dakota. In addition, flaring and methane emissions continue to be a major focus area for the state, industry, and federal government. The demonstration and implementation of a technology to economically capture gas from smaller volume well locations would provide a significant economic and environmental benefit to the state and industry.

Why the Project Is Needed: The past 9 years of this program resulted in unprecedented cooperation among state and industry partners in addressing headline issues. Multiple program partners have openly stated that the type of cooperation facilitated by this program exists nowhere else in the petroleum industry. BPOP efforts to date are summarized in Appendix A. It is anticipated that similar progress can be made on critical topics such as EOR, flaring and fugitive emissions management, future resource development strategies, H_2S mitigation, and other topics over the next 3 years.

STANDARDS OF SUCCESS

Success will be measured in the program's ability to address the oil and gas industry's critical issues as identified by OGRP and BPOP partners, ultimately resulting in more efficient resource development and cost savings. Developing options to help ensure the success of the oil and gas industry in North Dakota while conserving the state's resources leads to a strong state economy and the creation of jobs to support all aspects of oil and gas development. Annual meetings with OGRP and BPOP partners will be held, as a measure of success, to discuss project status and receive feedback and guidance. Success will also be measured by delivery of high-impact products to state and industrial stakeholders.

The current OGRP-approved process of reporting will be employed to deliver results. BPOP provides partners premium access to reporting of results from activities for a period of 15 months following review by select partners prior to release to the public on the BPOP website. Products will be prepared on specific topics to be determined based on partner guidance. Select products, as determined by BPOP partners, may be released after shorter review periods if early release is deemed to be of greater advantage to the partners. High-level progress updates will be provided in quarterly reports, in an executive summary format, to OGRP for inclusion on the OGRP website for immediate access by the public. An annual briefing to OGRP will highlight the successes of BPOP and next steps. A final report summarizing BPOP program achievements and challenges will be prepared. Presentations at technical conferences and public outreach events will cover pertinent topic areas.

BACKGROUND/QUALIFICATIONS

The EERC is a nonprofit branch of the University of North Dakota. Resumes of key personnel are provided in Appendix C. James Sorensen, Director of Subsurface R&D, will serve as Program Manager. Dr. John Harju, Vice President for Strategic Partnerships, will serve as Senior Program Advisor. Other key EERC personnel will include Bethany Kurz, Director for Analytical Solutions; Darren Schmidt, Assistant Director for Energy, Oil and Gas; Dr. Nick Azzolina, Assistant Director for Applied Data Analytics; Dr. Chantsalmaa Dalkhaa, Principal Reservoir Engineer; Matthew Belobraydic, Assistant Director for Geoscience; Marc Kurz, Principal Geologist; and Dr. Alexander Chakhmakhchev, Principal Scientist.

MANAGEMENT

The EERC manages over 200 contracts a year, with a total of over 1300 clients in 53 countries. Systems are in place to ensure that projects are managed within budget, schedule, and scope. Mr. Sorensen will oversee the entire program, with assistance in management of program activities and tasks by Ms. Kurz, Mr. Schmidt, and Dr. Azzolina. This will involve integration of tasks, program reporting, collaboration with industry and the Oil and Gas Research Council, recruiting of new partners, and strategic studies. The EERC will be responsible for coordination and execution of tasks, with assistance provided by program partners, and will disseminate results. Quarterly reports will be submitted to NDIC and partners 30 days after the end of each calendar quarter to provide highlights of ongoing research and anticipated future activities. A program kickoff meeting will be scheduled for fall 2023 to prioritize research areas with input from state and industry. At minimum, annual meetings will be scheduled to provide updates on research activities and discuss the direction of future activities. In addition, webinars will be held throughout the period of performance related to subjects within the scope of work.

TIMETABLE

This effort is proposed as a 3-year program (September 1, 2023 – August 31, 2026). Figure 1 summarizes the preliminary program timetable. Additional timetable detail will be developed as the program evolves.

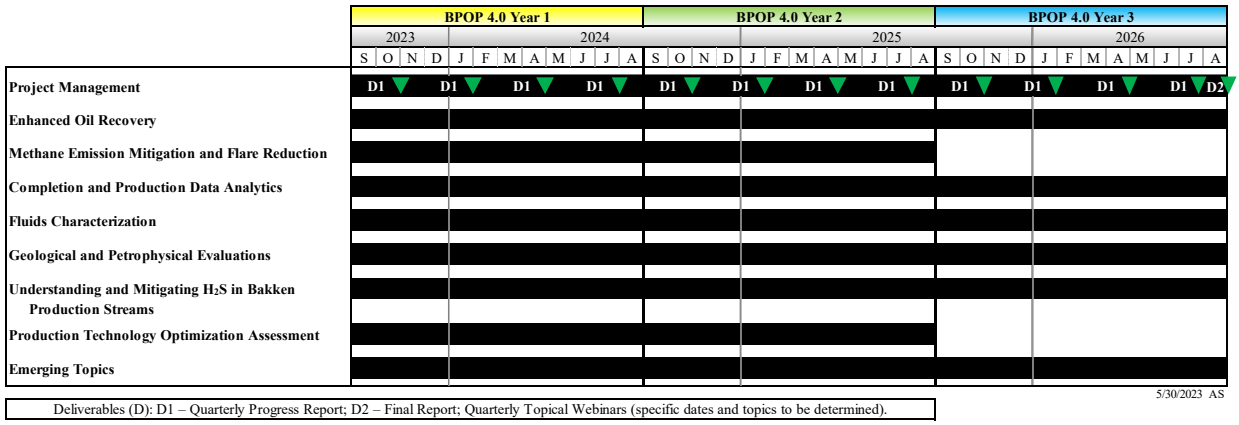


Figure 1. Preliminary program timetable.

BUDGET

The total estimated cost for the proposed effort is $12,000,000. $6,000,000 is requested from OGRP ($2,000,000/year). Cost share will include $1,000,000 cash from DOE (under contract negotiations, DOE Award No. DE-FE0032290). It is estimated that industry partners will provide a minimum of $1,636,361 in cash cost share. Support from at least eight companies is anticipated, including Chord Energy, ConocoPhillips, Devon, XTO Energy, Hess, Liberty, Marathon Oil Company, and Petro-Hunt, which all supported BPOP 3.0. This group includes six of the top top-oil producers in North Dakota, and their operations cover most of the Bakken play area (Appendix B). Liberty will provide in-kind cost share at a value of $363,639 based on costs associated with pilot operations. Devon is anticipated to provide in-kind cost share at a value of $3,000,000. Letters of commitment can be found in Appendix D as well as the letter from DOE notifying the EERC that is has been selected for award for the Polar Bear^{SM} project. The budget shown in Table 1 is based on previous EERC experience with BPOP. Budget notes can be found in Appendix E.

Table 1. Budget Breakdown

Project Associated Expense	NDIC Share (Cash)	DOE Share (Cash)	Industry Share (Cash & In-Kind)	Total Project
Labor	$3,303,682	$411,168	$1,009,994	$4,724,844
Travel	$167,314	$28,819	$0	$196,133
Equipment > $5000	$0	$209,871	$0	$209,871
Supplies	$72,800	$3,500	$0	$76,300
Subcontractor - Liberty Resources	$306,000	$0	$0	$306,000
Communications	$150	$170	$0	$320
Printing & Duplicating	$1,032	$664	$291	$1,987
Food	$9,957	$0	$0	$9,957
Professional Development	$1,800	$0	$0	$1,800
Freight	$0	$2,000	$0	$2,000
Laboratory Fees & Services				
EERC Analytical Research Lab	$49,485	$0	$0	$49,485
EERC Process Chemistry & Development Lab	$0	$12,600	$0	$12,600
EERC Document Production Services	$33,866	$28,707	$0	$62,573
EERC Shop & Operations	$0	$10,270	$0	$10,270
EERC Software Solution Services	$64,103	$0	$0	$64,103
EERC Technical Software Fee	$0	$9,450	$0	$9,450
EERC Engineering Services Fee	$3,721	$5,362	$0	$9,083
EERC Field Safety Fee	$0	$10,553	$0	$10,553
EERC Geoscience Services Fee	$42,792	$0	$12,440	$55,232
Outside Lab	$25,000	$0	$0	$25,000
Total Direct Costs	$4,081,702	$733,134	$1,022,725	$5,837,561
Facilities & Administration	$1,918,298	$266,866	$613,636	$2,798,800
Total Cash Requested	**$6,000,000**	**$1,000,000**	**$1,636,361**	**$8,636,361**
In-Kind Cost Share				
Liberty	$0	$0	$363,639	$363,639
Devon	$0	$0	$3,000,000	$3,000,000
Total In-Kind Cost Share	**$0**	**$0**	**$3,363,639**	**$3,363,639**
Total Project Costs	**$6,000,000**	**$1,000,000**	**$5,000,000**	**$12,000,000**

CONFIDENTIAL INFORMATION AND PATENTS/RIGHTS TO TECHNICAL DATA

This proposal has no confidential information. No patentable technologies are expected to be created.

STATUS OF ONGOING PROJECTS

The EERC is currently engaged in nine OGRP-funded projects. These ongoing projects, listed in Appendix F, are current on all deliverables.

APPENDIX A

BAKKEN PRODUCTION OPTIMIZATION PROGRAM
KEY ACCOMPLISHMENTS TO DATE

Energy & Environmental Research Center (EERC)

BAKKEN PRODUCTION OPTIMIZATION PROGRAM (BPOP) KEY ACCOMPLISHMENTS TO DATE

CURRENT BPOP PARTNERS

ConocoPhillips

devon

HESS

LIBERTY RESOURCES

Marathon Oil

OASIS PETROLEUM

PETRO - HUNT L.L.C.

XTO ENERGY

North Dakota oil & gas research program

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

NORTH DAKOTA OIL AND GAS DIVISION

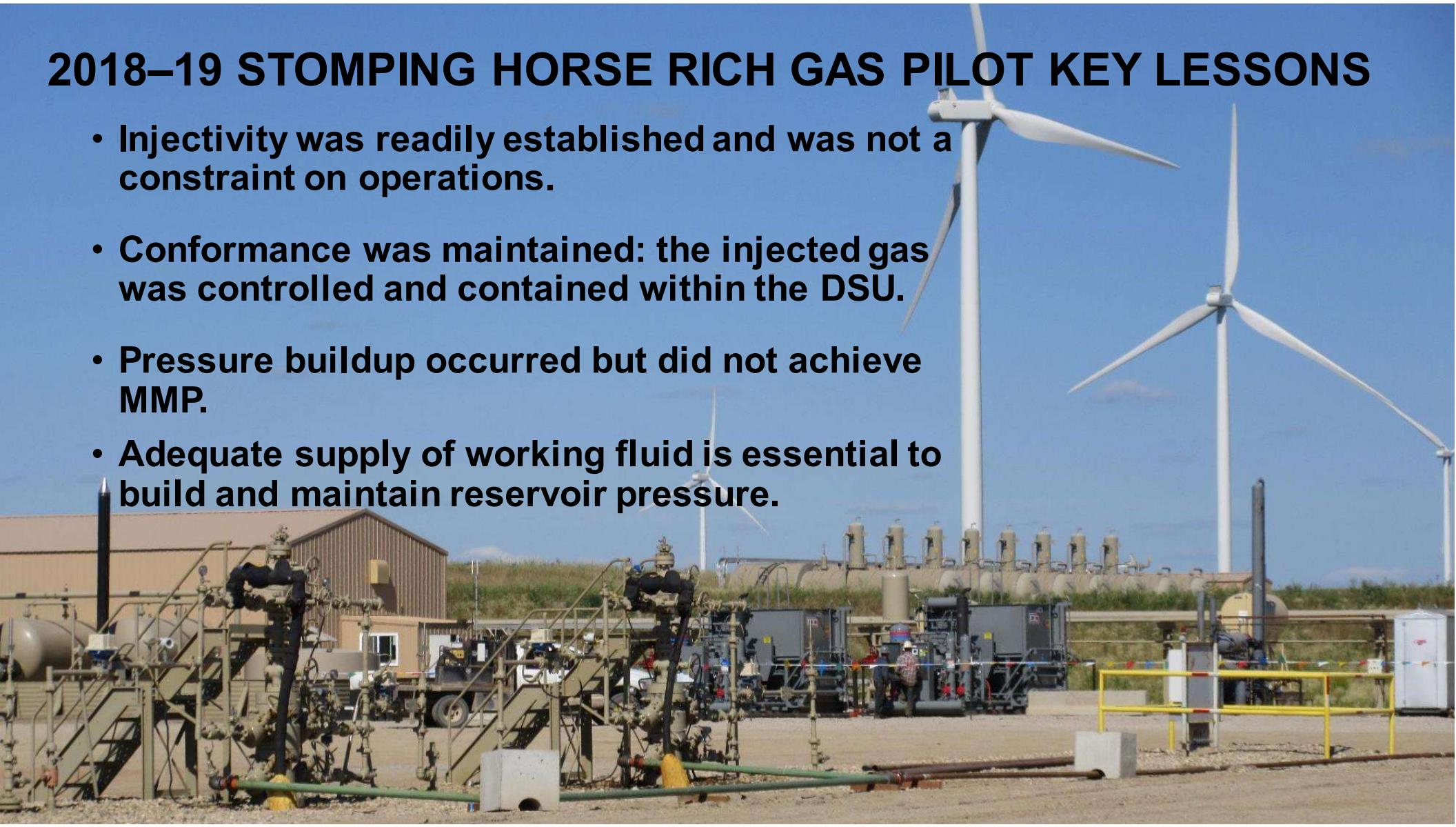
NORTH DAKOTA PETROLEUM COUNCIL

ENHANCED OIL RECOVERY (EOR) PILOT PROJECTS

- Two rich-gas EOR pilot projects supported through BPOP
  - Both conducted in conjunction with Liberty Resources
- Stomping Horse Field Demonstration
  - Supported by BPOP 2.0
  - Implemented in 2018 and 2019
- East Nesson Field Demonstration
  - Supported by BPOP 3.0
  - Implemented from 2021 to present
  - Included collaboration with EOR ETC on the demonstration of a novel gas injection technology

2018–19 STOMPING HORSE RICH GAS PILOT KEY LESSONS

- Injectivity was readily established and was not a constraint on operations.
- Conformance was maintained: the injected gas was controlled and contained within the DSU.
- Pressure buildup occurred but did not achieve MMP.
- Adequate supply of working fluid is essential to build and maintain reservoir pressure.



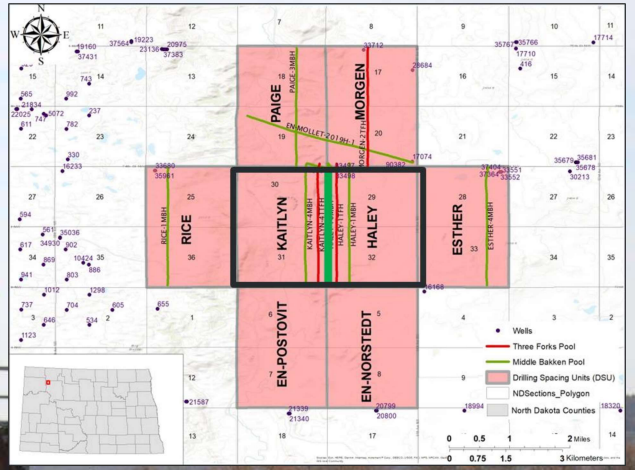
2021–22 EAST NESSON PROJECT HYPOTHESIS AND GOALS

- **Hypotheses:**
  - Coinjection of gas and water can increase pressure beyond MMP and help improve conformance and containment in the Bakken.
  - Coinjection process can lower injection pressure needed and associated cost.
- **The main goal and objective**:
  - To demonstrate the economic viability of enhanced oil recovery from the Bakken petroleum system by using produced rich gas in combination with water and surfactants.

EERC | UND UNIVERSITY OF NORTH DAKOTA

EAST NESSON EOR PILOT IMPLEMENTATION

Pilot Injection Start Date	September 10, 2021
Pilot Injection End Date	October 11, 2021
Number of Cycles	1
Pilot Production Start Date	October 12, 2021
Rich Gas Injected Volume	46MMscf (avg. ~1.5 MMscfd)
Water Injected Volume	40M bbl (avg. ~1.3 Mbwpd)
Surfactant Injected	~2400 gallons
EOR Technology Deployed	A novel EOR injection technology developed by EOR ETC

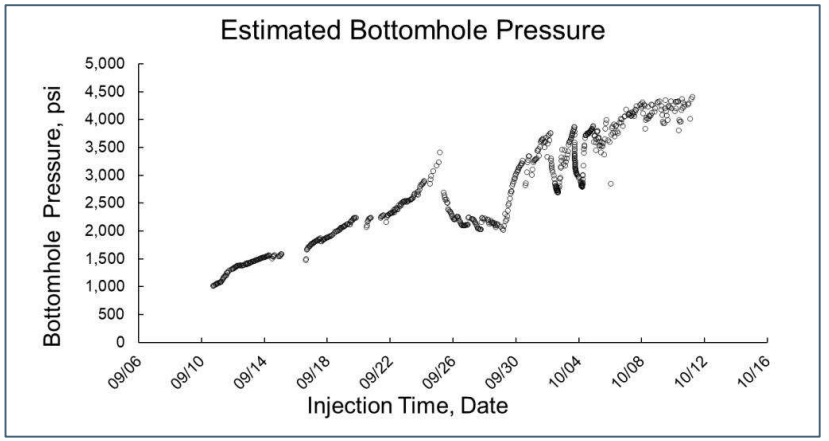


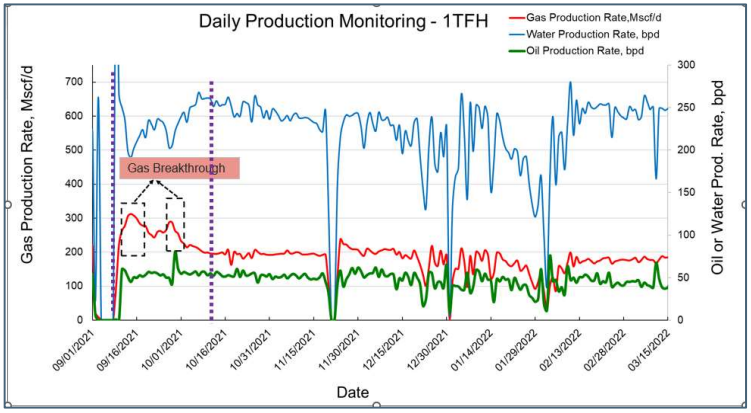
EAST NESSON EOR PILOT OPERATIONAL PRESSURES

Initial Bottomhole Pressure	~1000 psi
Est. Minimum Miscibility Pressure (MMP)	~2430 psi
Max. Wellhead Pressure (measured)	~1300 psi
Max. Bottomhole Pressure (calculated)	~4450 psi

KEY OBSERVATIONS FROM EAST NESSON 1st CYCLE

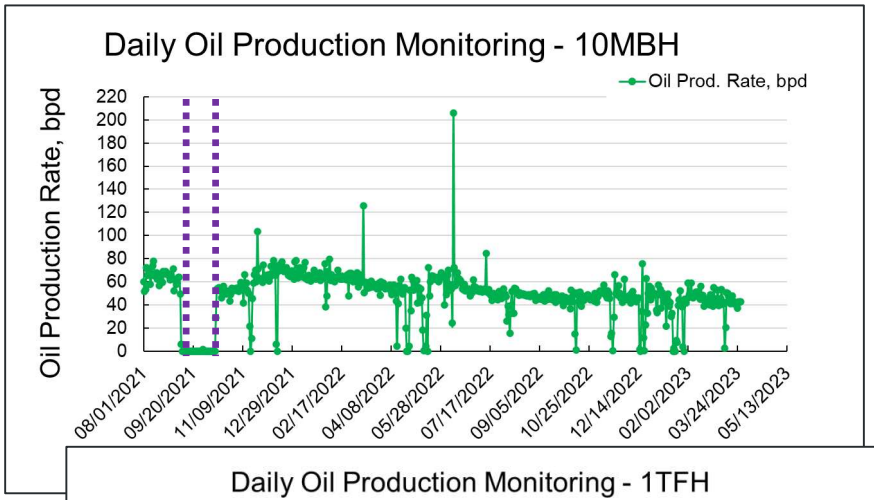
- Injectivity was readily established.
- Significant pressure buildup occurred (from 1000 to 4450 psi) and was maintained with coinjection, far beyond MMP.
- The lower wellhead injection pressure under 1300 psi was maintained by coinjection.
- A minor gas breakthrough at one of the adjacent wells was observed, but it was controlled and contained by increasing the water slug ratios to the well.

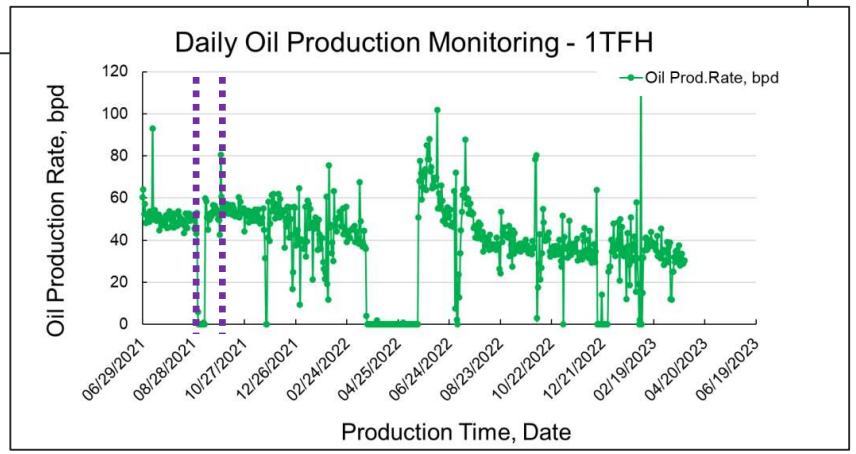




PILOT PRODUCTION RESPONSE

- Reservoir surveillance >19 months
- The estimated average oil rate uplift was 13.3 bpd (24%) for 10MBH (the EOR well).
- The estimated average oil rate uplift was 4.6 bpd (10%) for an offset well (1TFH) .

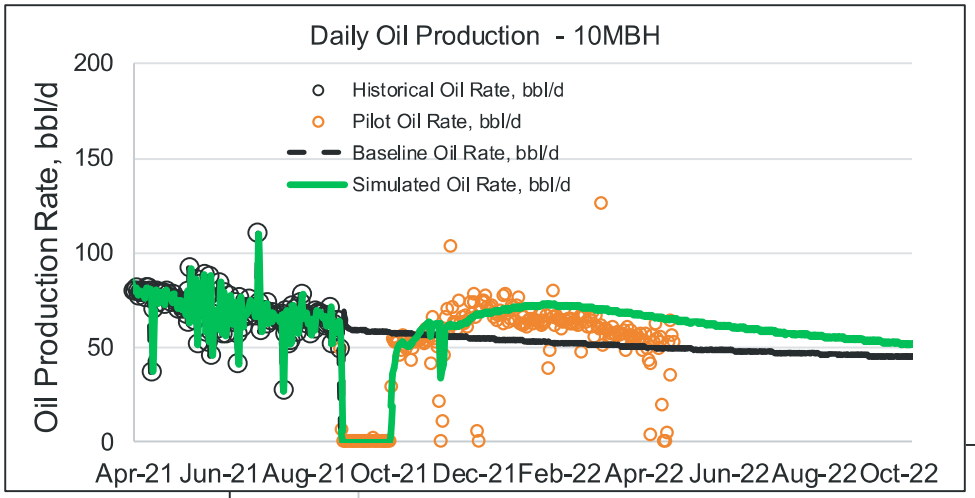


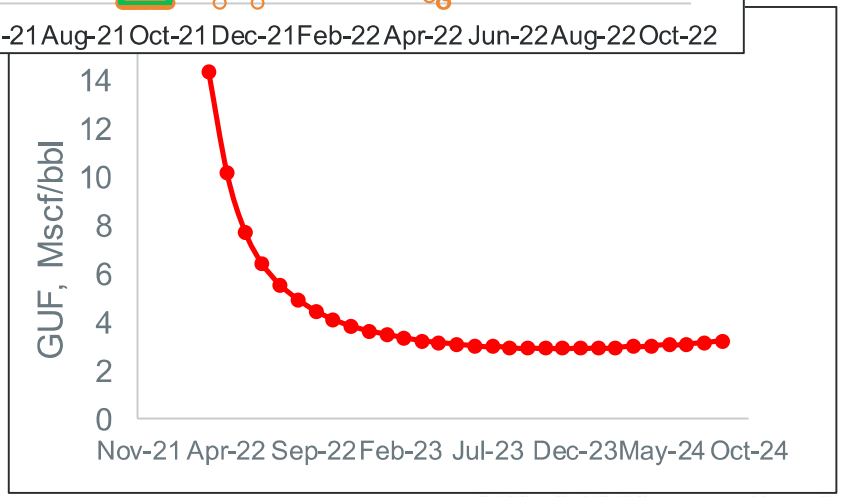


* Purple dashed lines show the injection period

PILOT INCREMENTAL OIL PRODUCTION

- The predicted incremental oil production from the pilot DSU is >5000 bbl over a 3-year period.
- A net GUF of ~5 Mcf per incremental oil barrel was estimated for the pilot project.
- Hoffman and Reichhardt (2020) report that this range (below 10) suggests an effective EOR process for unconventional reservoirs.





EAST NESSON EOR PILOT

- 1st cycle was a SUCCESS.
- 2nd cycle is being planned for summer/fall 2023.

East Nesson Bakken Enhanced Oil Recovery Pilot: Coinjection of Produced Gas and a Water-Surfactant Mixture

Gordon Pospisil; Larry Griffin; Tappan Souther; Stacy Strickland; Jeromy McChesney; C. Mark Pearson; Chantsalmaa Dalkhaa; James Sorensen; John Hamling; Bethany Kurz; Nicholas Bosshart; Michael Warmack; Ailin Assady; Jin Zhao; Brian Schwanitz; Adrian Williams; David Schechter; Abhishek Sarmah

Paper presented at the SPE/AAPG/SEG Unconventional Resources Technology Conference, Houston, Texas, USA, June 2022.
Paper Number: URTEC-3722974-MS
https://doi.org/10.15530/urtec-2022-3722974
Published: June 20 2022

Cite Share

Abstract

Objectives/Scope: In 2021, Liberty Resources LLC (Liberty) deployed an enhanced oil recovery (EOR) pilot via a single huff 'n' puff (HnP) well in a 2560-acre Bakken spacing unit in Mountrail County, North Dakota. The primary goal was to demonstrate the economic viability of EOR using produced gas with water and surfactant. The pilot was designed, permitted, and conducted by Liberty in partnership with the Energy & Environmental Research Center (EERC) and EOR ETC. The objectives were to 1) repressure the reservoir above the minimum miscibility pressure (MMP), 2) prove the concept
surface pressures ar
recovery through ro

Methods/Procedures
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JPT JOURNAL OF PETROLEUM TECHNOLOGY

Topics

ENHANCED RECOVERY

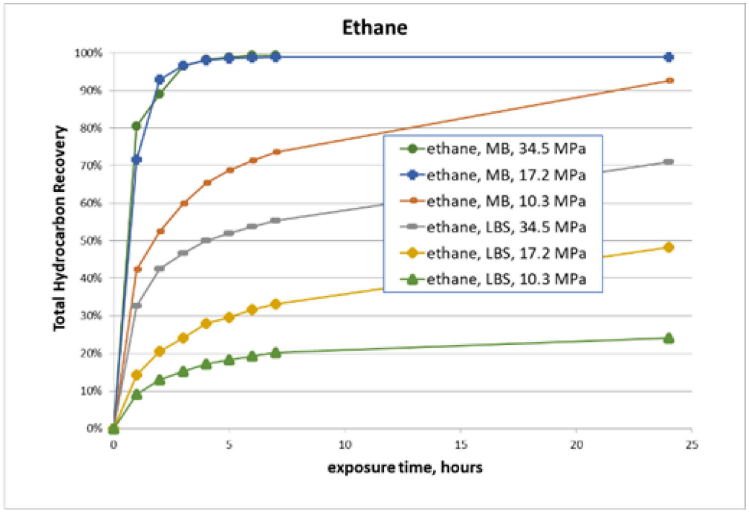
Water-Plus-Gas Injection on a Bakken Well Pad May Solve Problems That Stymied Shale EOR

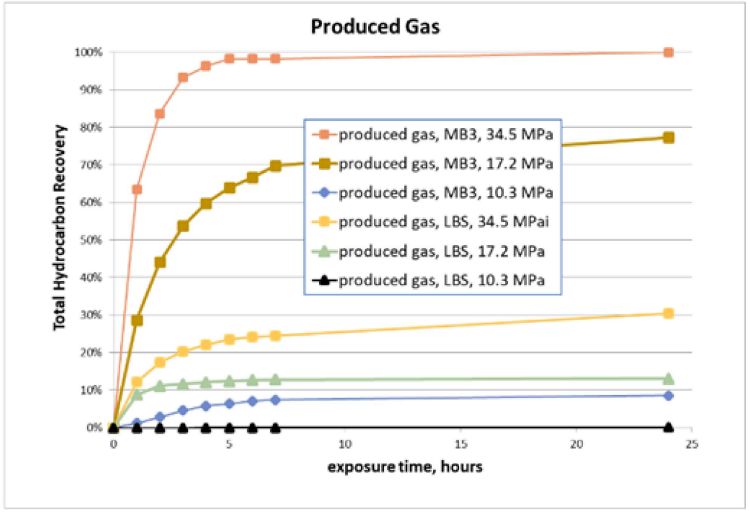
Injecting gas plus water proved more effective and less costly than gas-only injection in the Bakken.

October 1, 2022 By Stephen Rassenfoss
Journal of Petroleum Technology

EOR SUPPORT ACTIVITIES

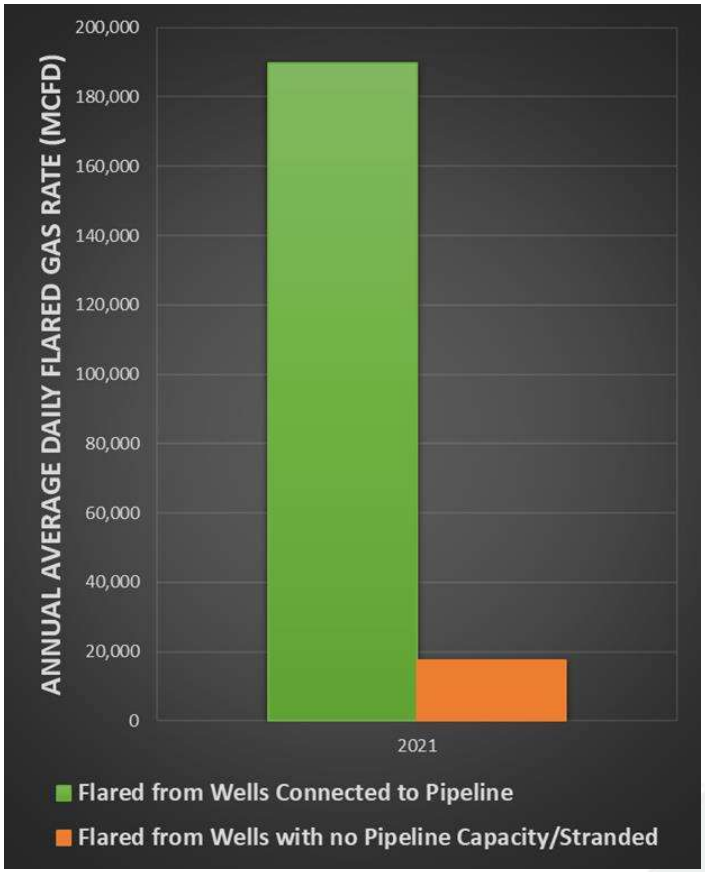
- BPOP has supported laboratory-based testing of Bakken crude oil and rock samples to better understand the potential for CO_2 and rich gas EOR in the Bakken petroleum system (BPS). BPOP activities in this space have included the following:
  - Minimum miscibility pressure (MMP) requirements of CO_2, methane, ethane, propane, and blends of gas to solubilize Bakken crude and maximize oil recovery.
  - Evaluation of the ability of various Bakken produced gases and gas blends to permeate various BPS rock types and effectively extract oil.





FLARING AND FUGITIVE EMISSION MITIGATION

- Early BPOP efforts (2013–2104) focused on participation in the North Dakota Petroleum Council's Flaring Task Force to formulate a multistage plan to decrease flaring rates:
  - BPOP provided flaring statistic analysis that served as the foundation for these plans. The BPOP team presented the resulting plan to the governor in January 2014, which is now integral to regulations enforced by ND DMR.
- More recent efforts have focused on development and implementation of a technology (Polar Bear^{SM}) that will economically eliminate flaring from wellsites where existing technologies for gas capture are uneconomical.



Polar Bear℠ provides cost-efficient recovery of flared gas that is not economical with conventional technology.

- Increase the environmental competitiveness of North Dakota oil
- Attract investment and jobs
- Generate revenue
- Patented
- Manufactured in North Dakota

Polar Bear℠

- Robust
- Adaptive
- Environmentally sensitive

POLAR BEAR℠ TECHNOLOGY PROGRESS

- BPOP has helped to advance the Polar Bear℠ technology through laboratory testing and support to develop a prototype.
- BPOP partners have closely monitored development of the technology, and as a result, the EERC acquired a license and three new patents.
- BPOP will support the first field trials of the concept in 2023.

Flaring is geographically distributed.

Many locations flare small volumes that, in aggregate, contribute to most of the remaining flared gas.

Solution is needed to capture gas for low flow rates at many locations and at higher rates for bulk and test facilities.

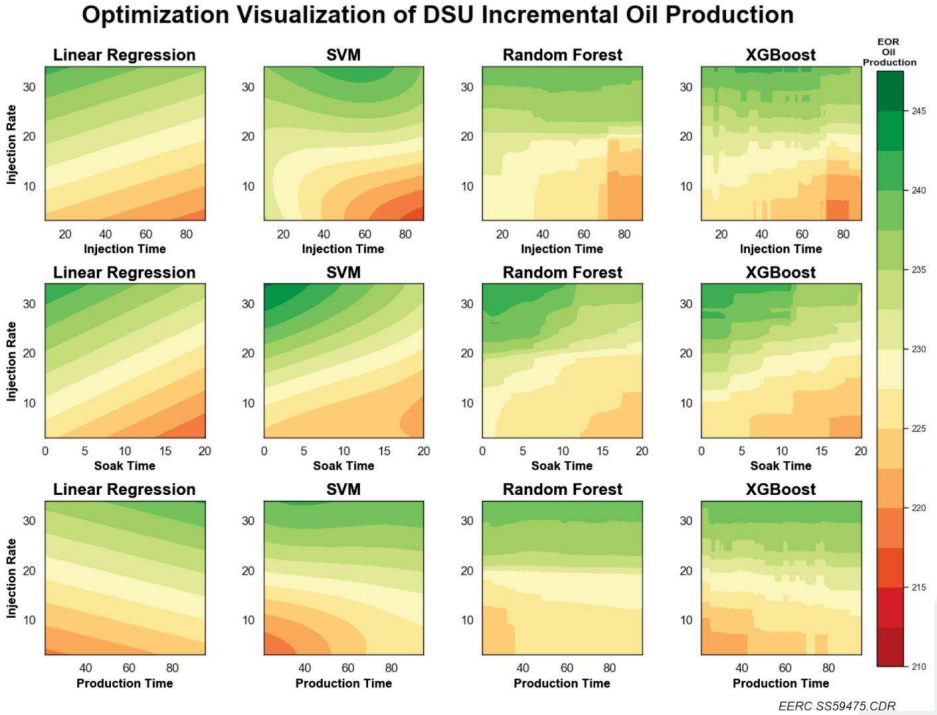
AI AND ML FOR EOR IN THE BAKKEN – 2021 HIGHLIGHTS

Artificial Intelligence & Machine Learning for Unconventional EOR Strategies – *Created algorithms informing reservoir performance predictions based on injection rate versus soak, production, and injection time.*

- *Created a tool for real-time visualization and forecasting to support real-time decision-making during production operations.*

Modeling Conformance Treatments and EOR Strategies – Explored advanced modeling and simulation techniques to determine mechanisms for improving conformance control in the Bakken, investigate alternative EOR strategies, and improve simulation run times.

- Embedded Discrete Fracture Modeling (EDFM) was shown to improve simulation run times and demonstrated excellent results matching fluid injection and production data.
- ***Modeling and simulation studies showed conformance could be gained through water injection or surfactant injection and demonstrated improvements in oil recovery.***



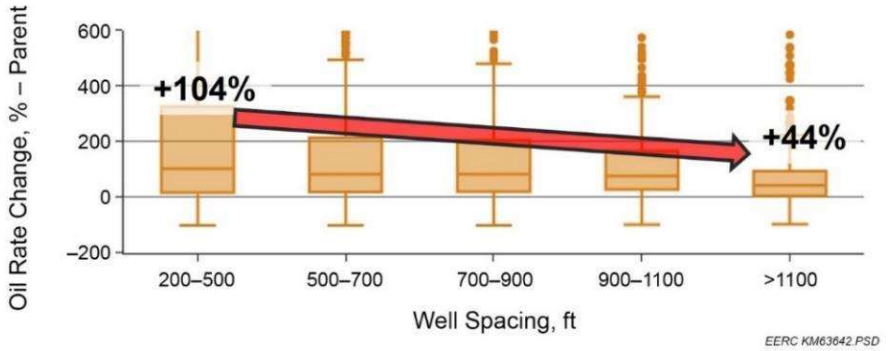
DATA ANALYTICS WORK PRODUCTS

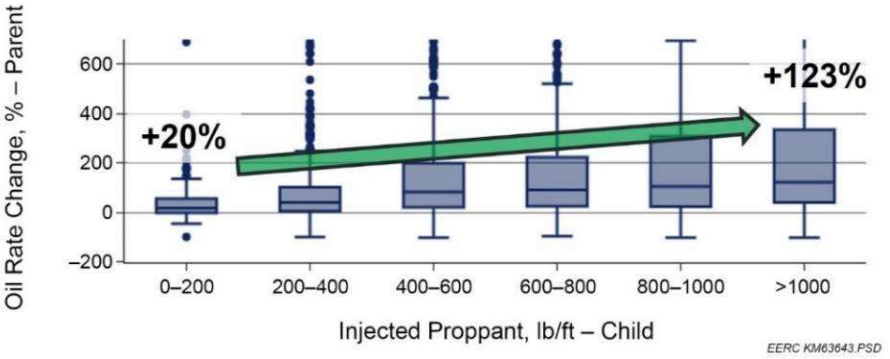
- Well completion and production: 7
- Refractured wells: 3
- H_2S in Bakken production: 1
- Online tools: 2

- We apply state-of-the-art statistics and ML tools to broad data sets of well completion and production to draw inferences about Bakken production and optimization.

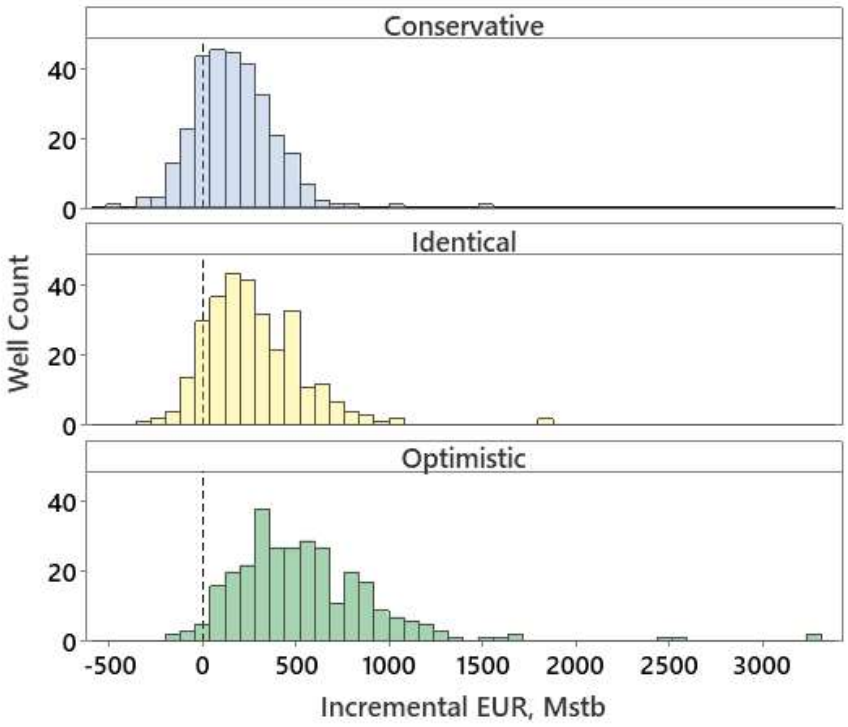
COMPLETION AND PRODUCTION DATA ANALYTICS

- The BPOP team applies state-of-the-art statistics and ML tools to identify key factors affecting oil, gas, and water production. Key topics include:
  - Quantify relationships between completion type/size and well production.
  - Evaluate completion optimization.
  - Assess parent–child well interactions and optimal DSU development.
  - Estimate core area expansion and future Bakken development potential.





REFRACTURED WELLS



- We continue to evaluate the performance of refractured wells to understand better the key factors that improve post-refrac well performance.
- This work has been continually updated as additional insight and data related to Bakken well refracs become available.
  - Three assessments have been conducted to date (2018, 2020, and 2023).
- The results suggest that 340 wells still exist in the Bakken that would be promising candidates for refracturing (single-stage completions, older completion dates, and barefoot completions).
- Refracturing these wells was estimated to produce a discounted net oil revenue of approximately $1.5 billion, which reflects the median outcome after deducting the refrac cost, taxes, and royalties.

H_2S GENERATION IN BAKKEN PRODUCTION

Goal

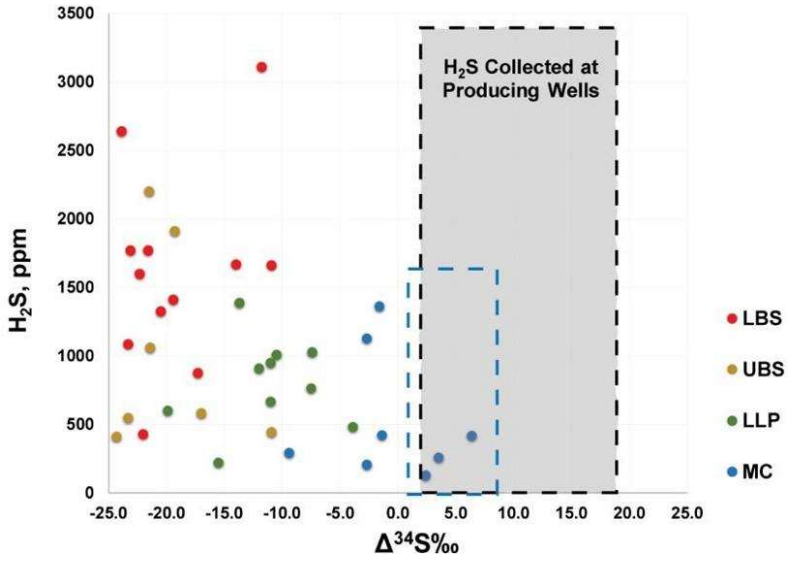
Understand mechanisms of the souring of Bakken production to develop a mitigation strategy

- Geochemical characterization of the source rocks and sulfur speciation work
- Laboratory simulation experiments including rocks and fluids
- Acquisition of H_2S concentration data provided by BPOP partners
- Collection of H_2S and fluid samples across the Bakken play
- Isotope characterization of S in H_2S, brine, and anhydrite
- Screening technologies to reduce the risk of souring

Results

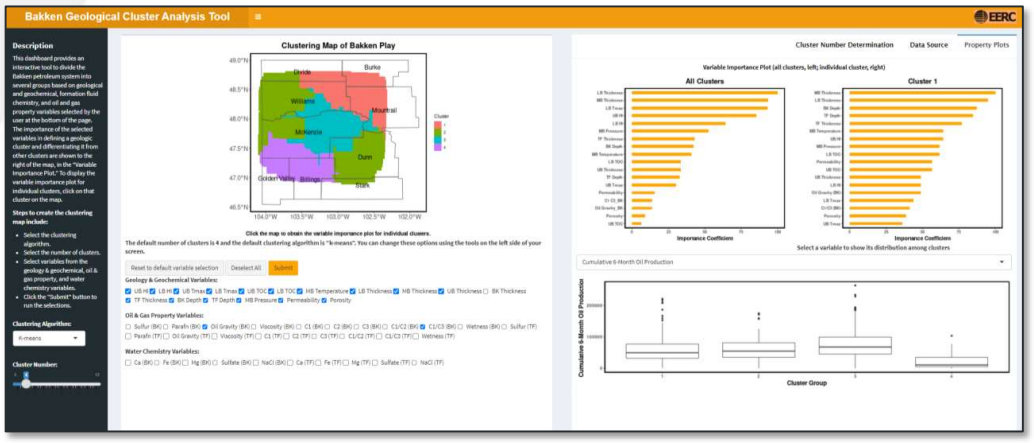
- Possible mechanisms of souring were identified.
- Lab experiments and S isotopes confirmed the mechanism of souring via out-of-zone completion.
- The next phase of BPOP will focus on evaluating technologies to reduce the risk of souring.

Values $\delta^{34}S$ of Source Rock Pyrolysis and Producing Well H_2S



The blue rectangle outlines the range where Mission Canyon $\delta^{34}S$ matches $\delta^{34}S$ of well-produced H_2S.

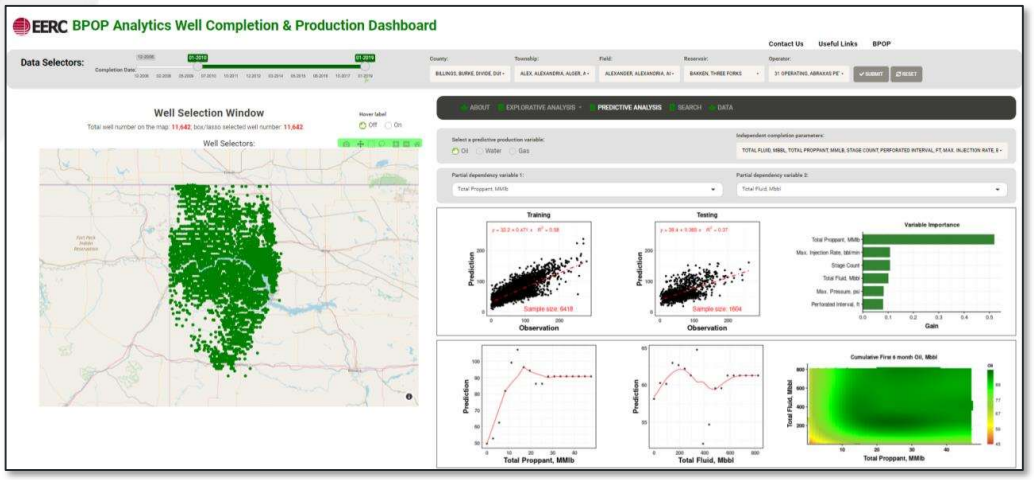
GEOLOGICAL CLUSTER ANALYSIS TOOL



- An interactive tool that subsets BPS into groups based on geological and geochemical, formation fluid chemistry, and oil and gas property variables selected by the user at the bottom of the page.
- The importance of the selected variables in defining and differentiating a geologic cluster from other clusters is shown to the right of the map in the "Variable Importance Plot." The user can click on that cluster on the map to display the variable importance plot for individual clusters.
- The tool provides value to our BPOP partners by providing an interactive resource for exploring the Bakken, investigating the relative importance of different features within specific geographic areas, and rapidly screening large amounts of information before moving forward with more detailed, site-specific analyses.

The Bakken Geological Cluster Analysis Tool can be found on the Partners-Only Website!

WELL COMPLETION & PRODUCTION DASHBOARD



- An interactive tool that allows the user to select a set of wells from BPS; explore relationships between oil, gas, and water production and several well completion parameters; and fit ML models.
- The predictive modeling uses Extreme Gradient Boosting (XGBoost) as the algorithm to construct predictive models for selected wells to predict well oil, gas, or water production (the response or target variable) from a set of user-defined completion parameters (the independent variables of features).
- The tool provides value to our BPOP partners by providing an interactive resource for exploring the Bakken and investigating which completion parameters drive oil, gas, and water production within subsets of the Bakken and rapidly screening large amounts of information before moving forward with more detailed, site-specific analyses.

The Analytics Well Completion & Production Dashboard can be found on the Partners-Only Website!

CARBON INTENSITY TOOL

Carbon Intensity Tool

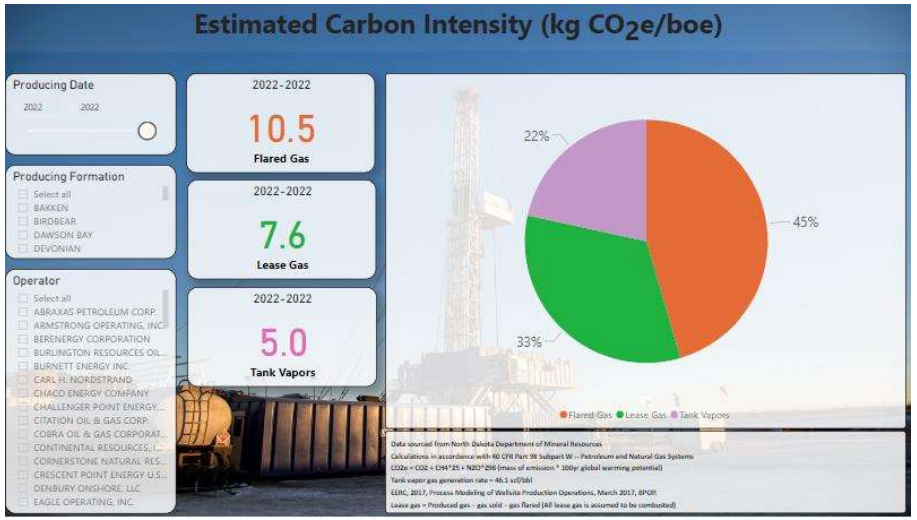
Premium

Date Published: 9/26/2022

'This dashboard provides an interactive tool to assess North Dakota oil & gas production related carbon intensity (kg CO_2e/boe). Produced Gas, Flared Gas, Lease Gas, and estimated Tank Vapors data is presented over time, shown geographically, and grouped by Central Tank Battery (CTB) f...'

Provides BPOP partners a means to examine temporal data pertaining to carbon intensity:

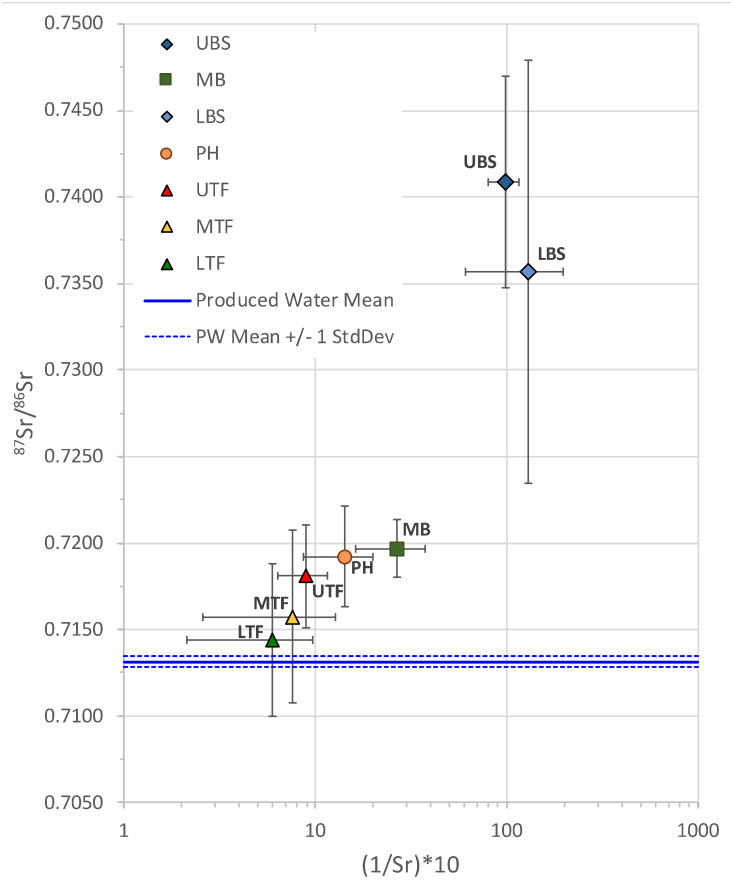
- Flaring
- Tank vapors
- Production plots
- Flaring profiles
- Geospatial tools and mapping



PRODUCED WATER AND OIL FINGERPRINTING

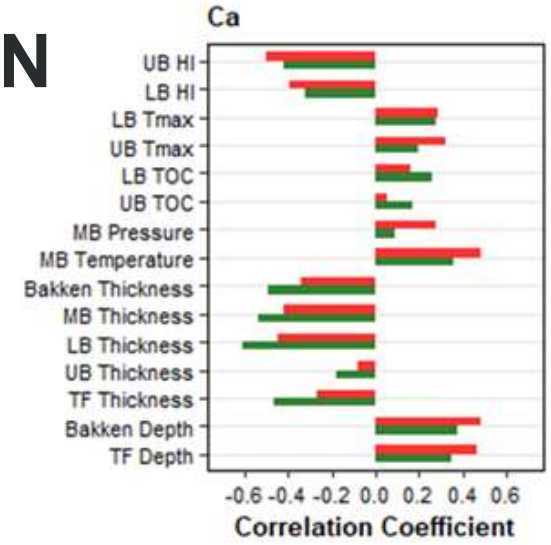
The BPOP team has been developing and testing fingerprinting techniques for produced fluids (water and oil) and rock extracts to:

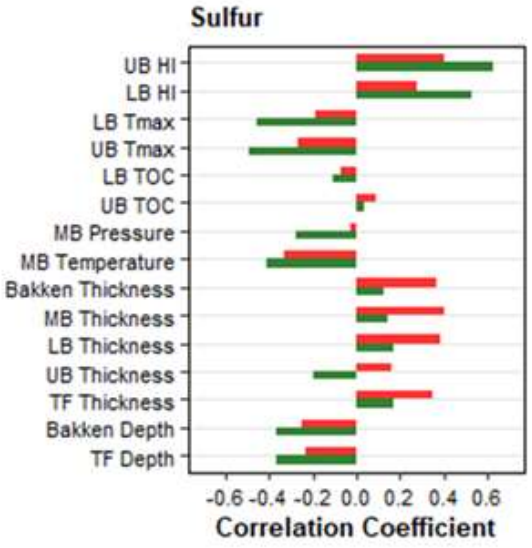
- Evaluate reservoir continuity.
- Understand reservoir drainage volume.
- Evaluate reservoir communication and mixing.
- Monitor production and compositional changes in produced fluids.
- Understand hydrocarbon charge from source rocks.



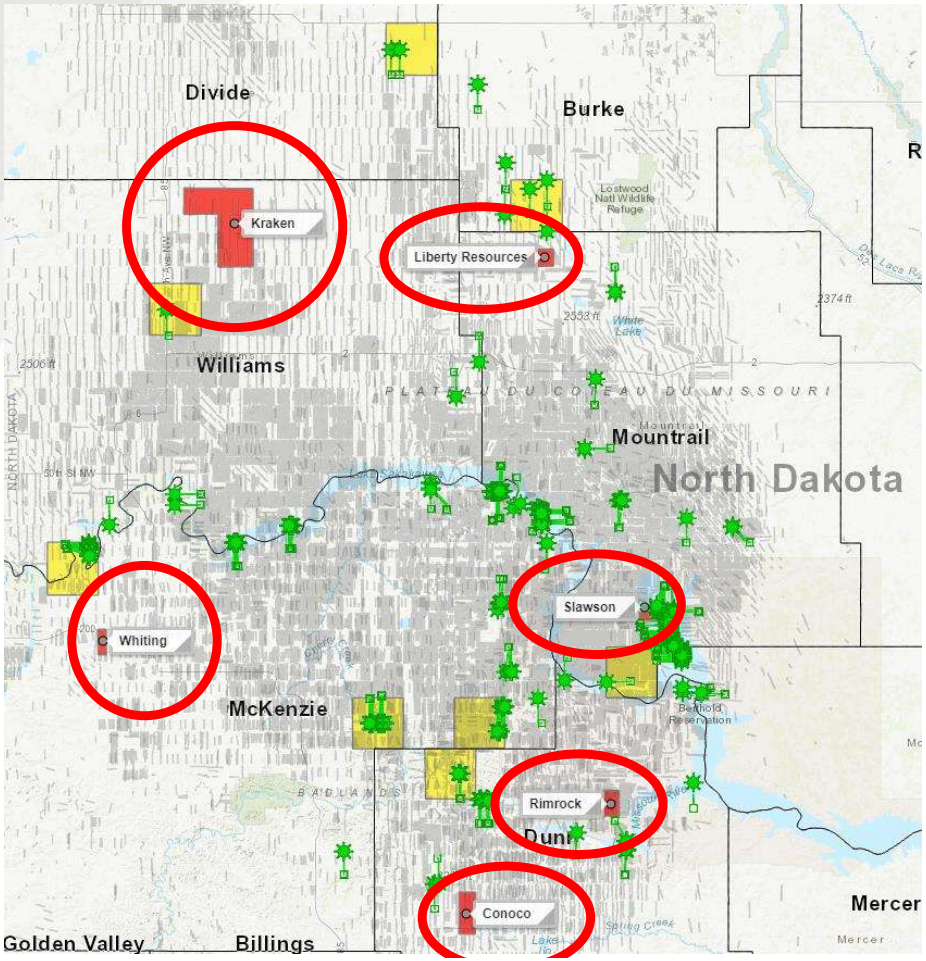
PRODUCED FLUIDS CHARACTERIZATION

- Through BPOP, the EERC has developed and continues to expand a data set of produced fluids compositions (brine and oil) to monitor changes in chemistry over time and to evaluate chemical differences in the different geologic units of BPS.
- The data collected through BPOP, coupled with the fluids fingerprinting techniques developed by the team, are being used to better understand the contribution of fluids from different zones (within and overlying/ underlying BPS) within produced oil and brine.





EVALUATION OF 3-MILE LATERALS



The red circles indicate new 3-mile horizontal well developments.

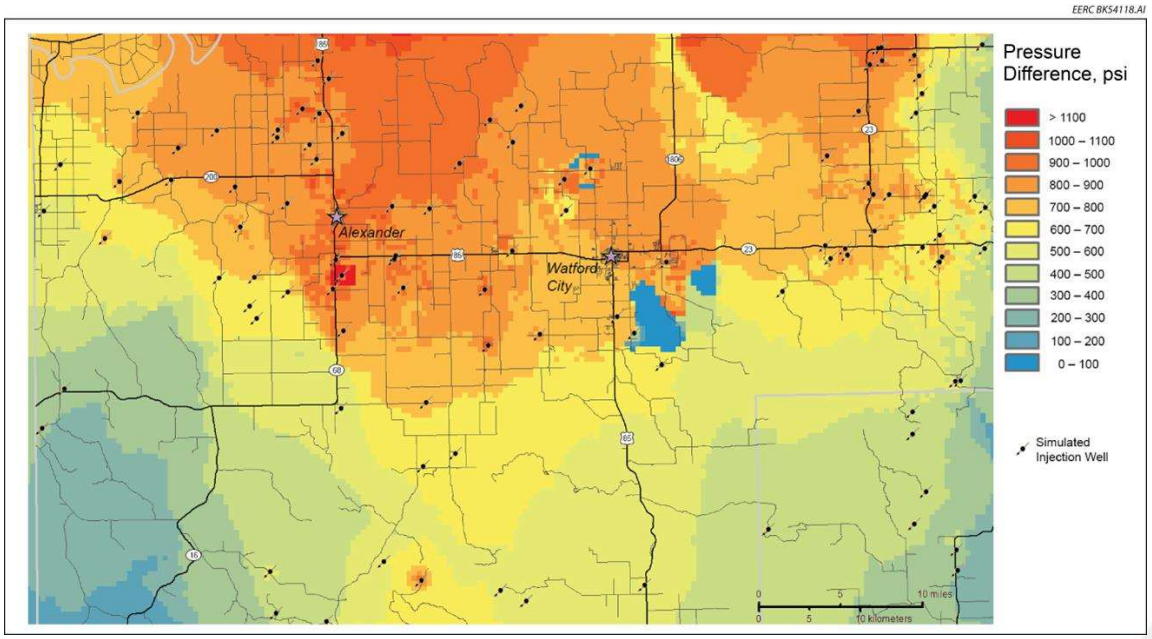
- As operators look for new ways to develop acreage outside of the core, BPOP investigated the history and prospect for 3-mile lateral wells.
- Extensive analysis was completed to compare **similar acreage** between 2- vs. 3-mile horizontal well performance.
- Data set: 235 wells dating back to 2011.
- Results provide insights to anticipated well performance targeting 50% additional EUR per well.
- Operators are pushing forward with 3-mile lateral plans. Development is no longer driven by geography and occurring in core and noncore areas.
- 70% of operators appear to be realizing anticipated additional production.

DSU SETBACK RULES

- BPOP facilitated a science-based process to determine if a change in rules regarding state drilling spacing unit (DSU) setbacks was prudent.
- To evaluate the impact of potential reductions in the setback distance from DSU boundaries, BPOP refereed several teams that performed independent modeling and numerical simulation based on criteria established by BPOP and the participants of the evaluation.
- The results of the effort were presented to the NDIC by the EERC and its partners in 2016, resulting in a reduction in DSU setbacks that allowed operators and the state of North Dakota to maximize the extraction of recoverable resources without undue risk to correlative rights.
- The estimated increase in tax revenue as a result of the changes was estimated at $1.27 billion.

SALTWATER DISPOSAL POTENTIAL OF THE INYAN KARA

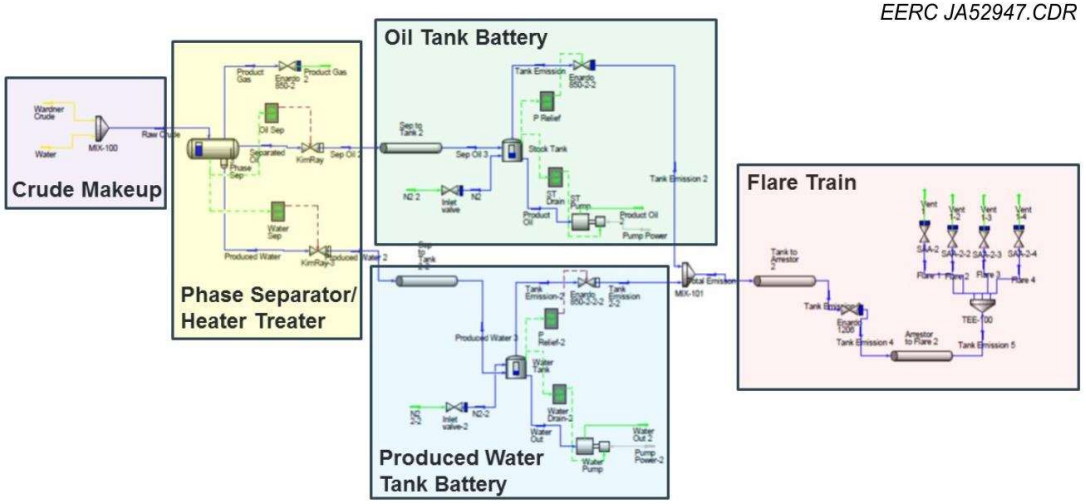
- Because of industry's reliance on the Inyan Kara Formation as a saltwater disposal (SWD) target, the BPOP team performed modeling and simulation to estimate local and regional pressure effects that have occurred as a result of historic SWD.
- Areas that may be suitable or problematic for disposal were evaluated through reservoir simulation of hypothetical future injection scenarios.



FACILITY PROCESS OPTIMIZATION

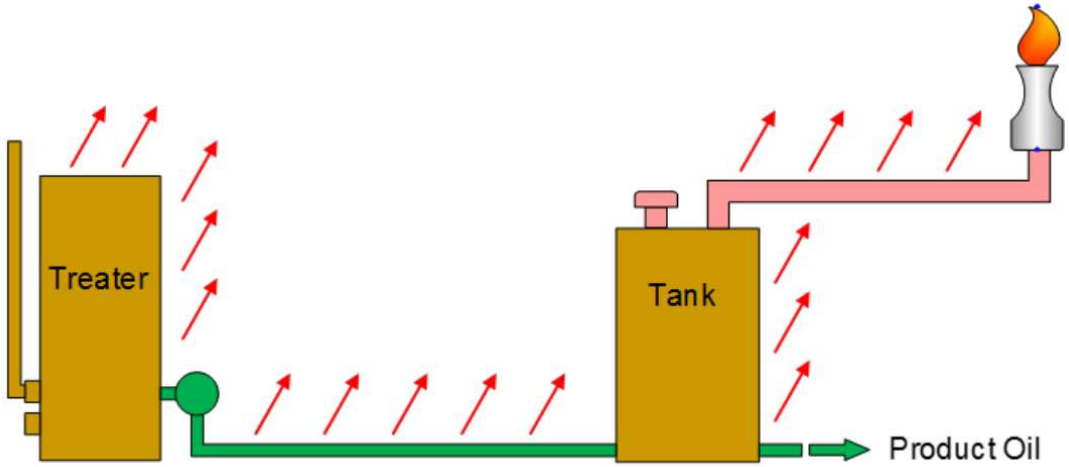
- Surface facilities are a key link in the overall Bakken production chain. Through BPOP, models were created with partner input to examine, in detail, parameters that affect fugitive emissions and crude oil properties.
- The modeling results were used to derive actionable suggestions for partner producers to consider in their facility operations as well as new, novel methods of operation.

EERC JA52947.CDR



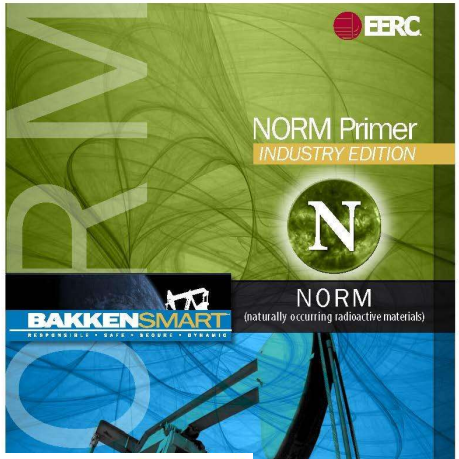
CRUDE OIL VAPOR PRESSURE MANAGEMENT

- Through BPOP, the EERC worked closely with industry operators to gather data, develop computer models, and validate them with field data to determine the optimal conditions for efficient operation of heater treaters.
- The results help operators comply with the state and midstream operators in cold weather and minimize hydrocarbon losses to gas stream in hot weather.



NORM-RELATED SUPPORT

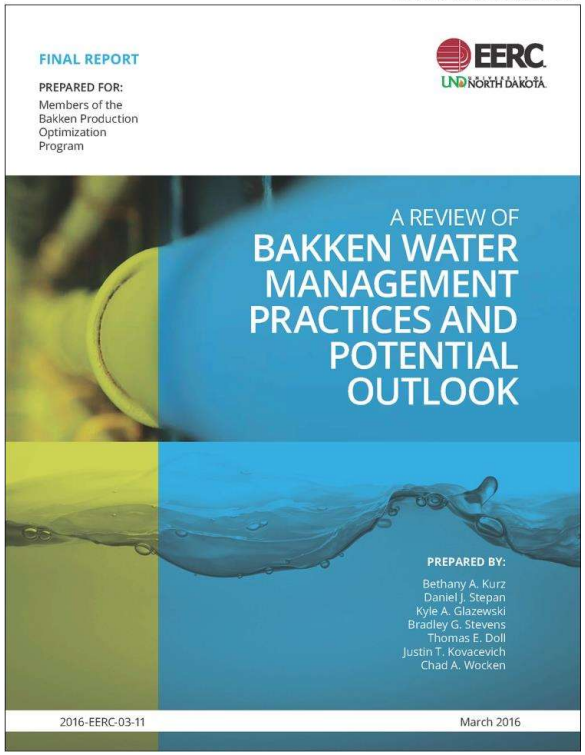
- BPOP representatives served as subject matter experts and advisors to NDPC's Naturally Occurring Radioactive Materials (NORM) Task Force.
- BPOP produced a series of NORM-related fact sheets and a primer to educate the general public on NORM and how NORM is regulated in North Dakota.
- The EERC coordinated a NORM sampling effort among several oil producers to further evaluate levels of NORM in drill cuttings, produced water, and fracturing fluid flowback. The results were interpreted by the EERC and used to help inform the state and the NORM Task Force.



ADDITIONAL ACCOMPLISHMENTS

- **Bakken Water Opportunities Assessment**
  - Performed two evaluations of key water use and handling issues in the Bakken, including estimation of future water supply and brine disposal needs, evaluation of brine treatment technologies and their applicability for Bakken produced water, and considerations for brine recycling and reuse.
- **Technical Forums for Industry**
  - BPOP provided a regular forum for peer-to-peer technical discussions on issues affecting all partners. Partners commented that this function is available nowhere else.

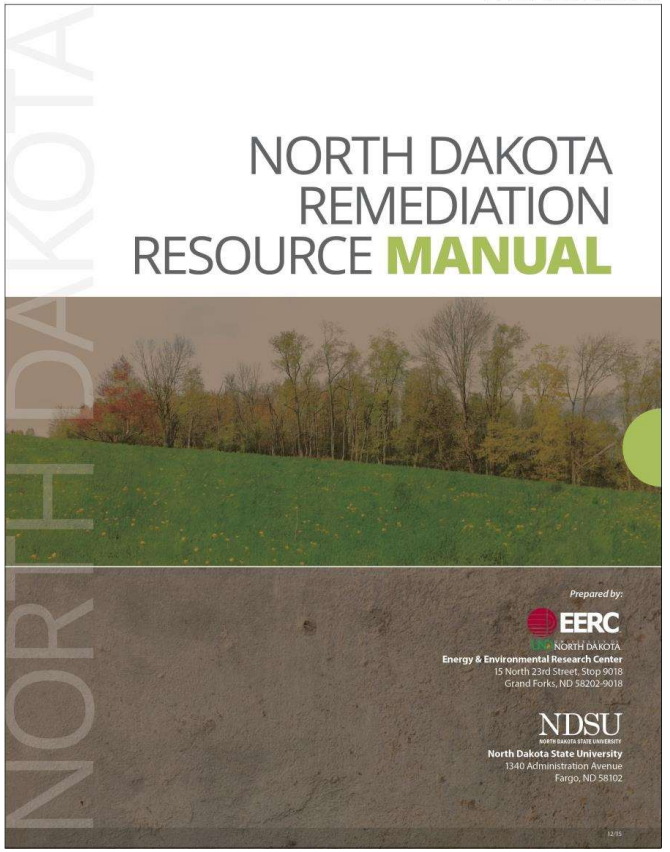
EERC JA52952.CDR



ADDITIONAL ACCOMPLISHMENTS

- **Remediation of Brine Spills**
  - BPOP coordinated discussion with state regulators and industry groups on the topic of best practices for remediation of brine spills associated with oil development. Based on the data and feedback received from these discussions, as well as from current research and literature, the EERC completed a best practices remediation manual that was shared with the state and industry.

EERC JA52956.CDR



APPENDIX B

OIL PRODUCTIVITY AND GEOGRAPHIC EXTENT OF BPOP PARTNER OPERATIONS

OIL PRODUCTIVITY AND GEOGRAPHIC EXTENT OF BPOP PARTNER OPERATIONS

The bar graph in Figure B-1 shows the top 20 operators in North Dakota in terms of daily oil production. BPOP 3.0 partner companies included four of the top five producers, six of the top ten producers, and eight of the top 20. The maps in Figures B-2 and B-3 show the geographic distribution of the BPOP 3.0 partners well locations, illustrating the fact that BPOP partnership spans a vast majority of the Bakken play in North Dakota. The eight BPOP partners also represent a diversity of company sizes, ranging from globally operating supermajors to companies for which the Bakken is the primary asset. This diversity within the partnership ensures that the views and needs of a wide variety of operators are served, fostering innovation, knowledge sharing, and broad applicability of results. It is anticipated that the eight BPOP 3.0 partners companies will continue their participation in BPOP 4.0. The EERC will actively recruit new partners and seek to grow the value of the program.

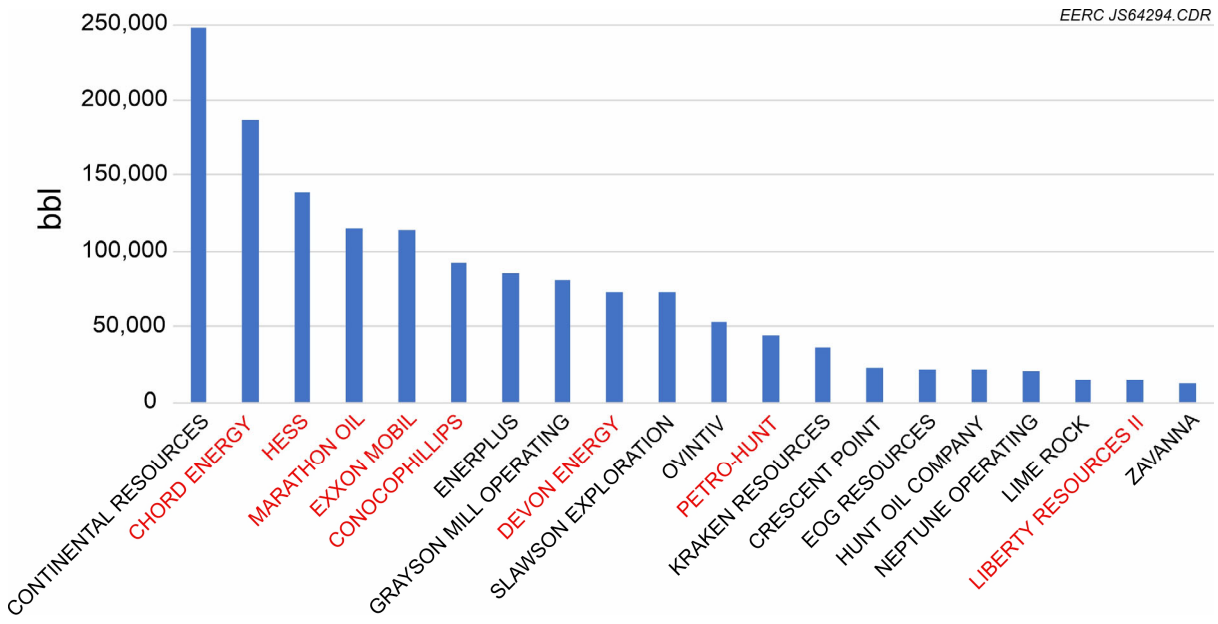


Figure B-1. Top 20 operators in North Dakota. BPOP partners are highlighted in red.

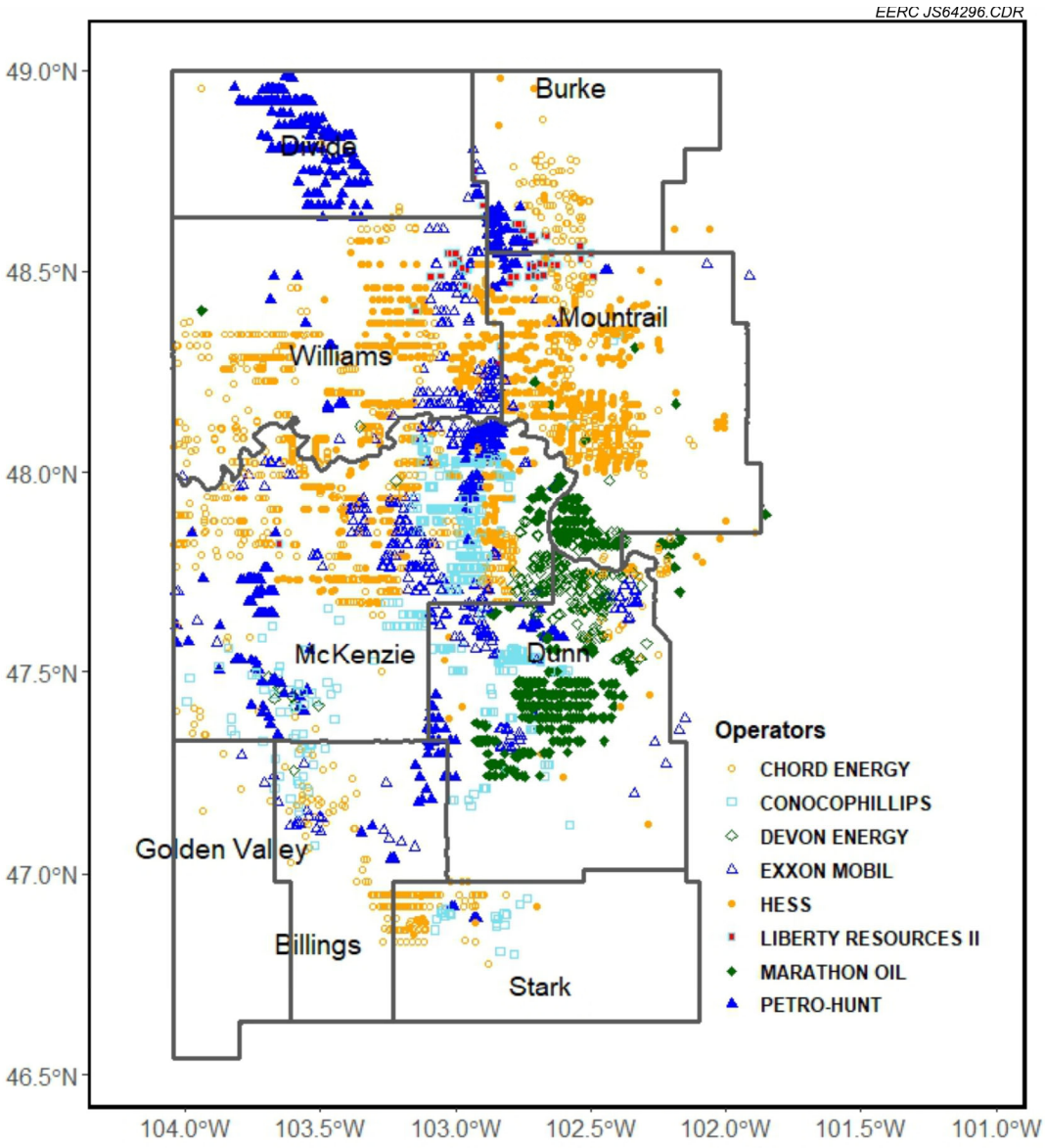


Figure B-2. Map showing geographic distribution of BPOP partner well locations.

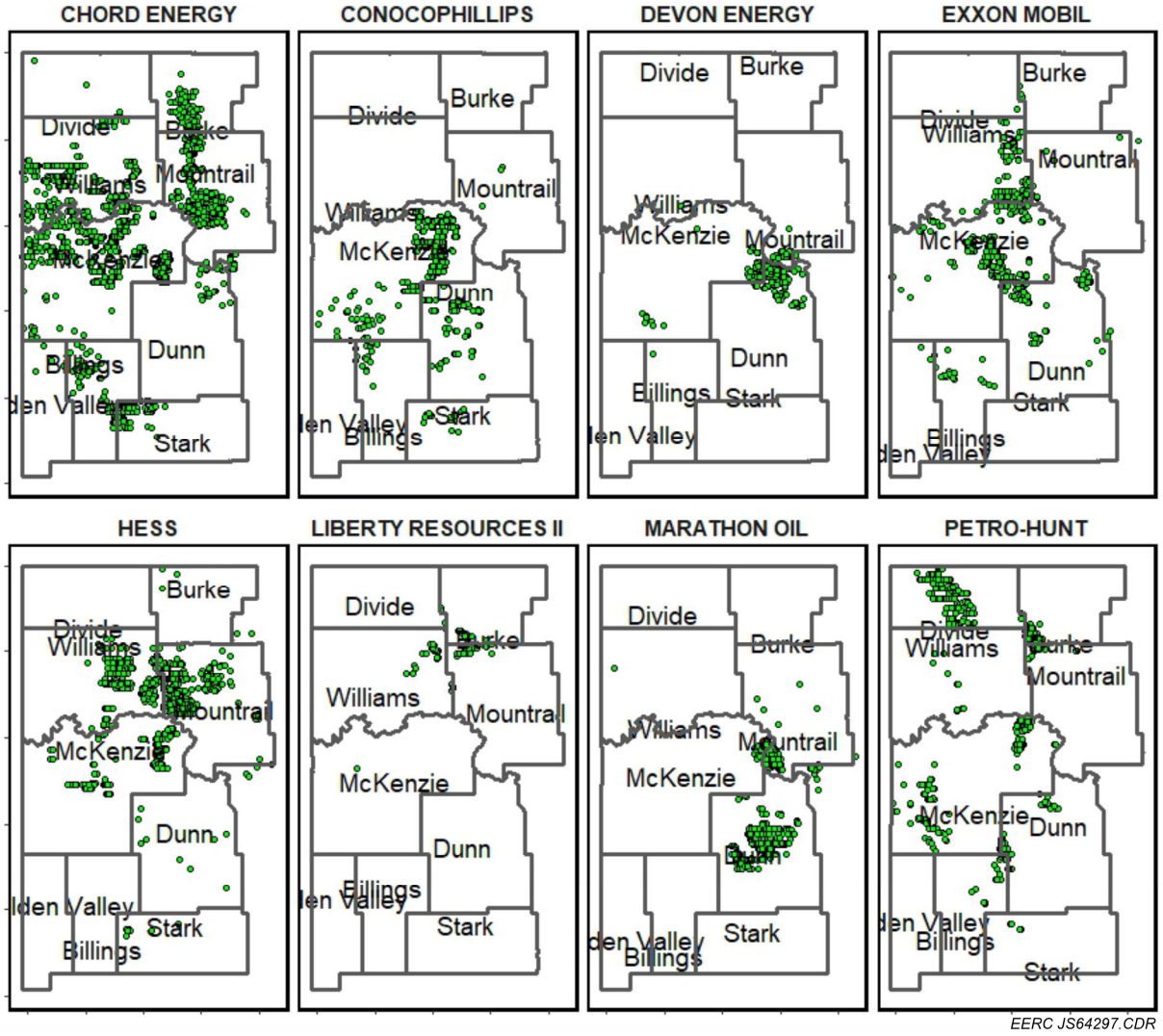


Figure B-3. Maps of well locations for each of the BPOP partners.

APPENDIX C

RESUMES OF KEY PERSONNEL

JAMES A. SORENSEN
Director of Subsurface Research and Development
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5287, jsorensen@undeerc.org

Principal Areas of Expertise
Mr. Sorensen's primary areas of interest and expertise are enhanced oil recovery (EOR) in unconventional tight oil formations, CO_2 utilization and storage in geologic formations, and tight oil resource assessment and development.

Education and Training
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1991.

Research and Professional Experience
October 2019–Present: Director of Subsurface Research and Development, EERC, UND. Mr. Sorensen is responsible for developing and managing programs and projects focused on conventional, unconventional, and enhanced oil and gas production; the geological storage of CO_2; geothermal; and other energy and environmental research.

July 2018–September 2019: Assistant Director for Subsurface Strategies, EERC, UND. Mr. Sorensen developed business opportunities, provided technical support and guidance regarding emerging areas of research, and served as a principal investigator and task manager for projects related to the sequestration of CO_2 in geologic media and the sustainable development of tight oil resources.

1999–July 2018: Principal Geologist, EERC, UND. Mr. Sorensen served as manager and co-principal investigator for programs to develop strategies for CO_2 utilization and storage. He also led research focused on enhanced oil recovery (EOR) in the Bakken.

1997–1999: Program Manager, EERC, UND. Mr. Sorensen managed projects focused on produced water management and environmental fate of natural gas-processing chemicals.

1993–1997: Geologist, EERC, UND. Mr. Sorensen conducted field-based hydrogeologic investigations focused on natural gas production sites.

1991–1993: Research Specialist, EERC, UND. Mr. Sorensen assembled and maintained comprehensive databases related to oil and gas drilling, production, and waste management.

Professional Activities
Member, Society of Petroleum Engineers

Publications
Mr. Sorensen has coauthored nearly 200 publications.

BETHANY A. KURZ
Director of Analytical Solutions
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5050, bkurz@undeerc.org

Principal Areas of Expertise

Ms. Kurz's principal areas of interest and technical expertise include carbon capture, utilization, and storage (CCUS); produced natural gas storage; enhanced oil recovery (EOR) in conventional and unconventional oil and gas reservoirs; application of machine learning and data analytics to CCUS and oil and gas development; produced water and drilling waste management; assessment of critical materials in coal and produced brine; and resource management related to energy development.

Education and Training

M.S., Hydrogeology, University of North Dakota, Grand Forks, ND, 1998.
B.S., Geochemistry, Bridgewater State University, Bridgewater, MA, 1995.

Research and Professional Experience

May 2021–Present: Director of Analytical Solutions, EERC, UND. Ms. Kurz is responsible for developing business and research opportunities to address challenges in all areas of energy and natural resources development and management. She leads programs and projects related to CCUS; application of machine learning and artificial intelligence to CCUS and conventional and unconventional oil and gas development; EOR; produced water and drilling waste management; and critical materials resource assessments. Ms. Kurz also leads the EERC's research laboratories and a multidisciplinary team of scientists and engineers focused on addressing the needs of our partners and clients in areas related to energy development and management and environmental stewardship.

July 2018–April 2021: Assistant Director of Integrated Analytical Solutions, EERC, UND. Ms. Kurz was responsible for assisting the EERC's leadership team with developing business opportunities and successfully executing research projects related to oil and gas; natural resource management; and carbon capture, utilization, and storage. She oversaw a multidisciplinary team of scientists and engineers who work in the EERC's applied research laboratories. In that role, she was responsible for ensuring the quality assurance/quality control of data and results generated by the EERC's laboratories and integrating those results into the applied research efforts conducted by the Subsurface R&D team.

2011–July 2018: Principal Hydrogeologist, Laboratory Analysis Group Lead, EERC, UND. Ms. Kurz oversaw a multidisciplinary team of scientists and engineers and several of the EERC's analytical research laboratories that focus on classical and advanced wet-chemistry analyses; petrochemical, geochemical and geomechanical evaluation of rocks and soils; and advanced characterization of various materials, including metals, alloys, catalysts, and corrosion and scale products. Her primary areas of interest included the evaluation of water supply sources for the oil and gas industry, produced water management, characterization of geologic media for carbon storage and development and testing of proppants for use in hydraulic fracturing.

2002–2011: Senior Research Manager, Water Management and Flood Mitigation Strategies, EERC, UND. Ms. Kurz's responsibilities included project management, technical report and proposal writing,

public outreach, and the development of new research focus areas. Research activities included the evaluation of nontraditional water supply sources for municipal and industrial use, flood and drought mitigation, watershed-scale water quality assessments using hydrologic models, and public education and outreach on various water and energy issues.

1998–2002: Research Scientist, Subsurface Remediation Research, EERC, UND. Ms. Kurz's responsibilities included managing and conducting research involving remediation technologies for contaminated groundwater and soils, groundwater sampling and analysis, technical report writing, and proposal research and preparation.

Publications

Ms. Kurz has coauthored numerous professional publications.

DR. JOHN A. HARJU
Vice President for Strategic Partnerships
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5157, jharju@undeerc.org

Principal Areas of Expertise
Dr. Harju's principal areas of interest and expertise include carbon sequestration, enhanced oil recovery, unconventional oil and gas development, waste management, geochemistry, technology development, hydrology, and analytical chemistry, especially as applied to the upstream oil and gas industry.

Education and Training
Ph.D., Petroleum Engineering, University of North Dakota, 2022.
M.Eng., Petroleum Engineering, University of North Dakota, 2020.
B.S., Geology, University of North Dakota, 1986.

Research and Professional Experience
2002–Present: EERC, UND.
July 2015–Present: Vice President for Strategic Partnerships. Dr. Harju leads efforts to build and grow dynamic working relationships with industry, government, and research entities globally in support of the EERC's mission to provide practical, pioneering solutions to the world's energy and environmental challenges. He represents the EERC regionally, nationally, and internationally in advancing its core research priorities: coal utilization and emissions, carbon management, oil and gas, alternative fuels and renewable energy, and energy–water.

2003–June 2015: Associate Director for Research. Dr. Harju led a team of scientists and engineers building industry–government–academic partnerships to carry out research, development, demonstration, and commercialization of energy and environmental technologies.

2002–2003: Senior Research Advisor. Dr. Harju developed, marketed, managed, and disseminated research programs focused on the environmental and health effects of power and natural resource production, contaminant cleanup, water management, and analytical techniques.

2017–Present: Adjunct Lecturer, Department of Petroleum Engineering, UND.

1999–2002: Vice President, Crystal Solutions, LLC, Laramie, WY. Dr. Harju's firm was involved in commercial E&P produced water management, regulatory permitting and compliance, and environmental impact monitoring and analysis.

1997–2002: Gas Research Institute (GRI) (now Gas Technology Institute [GTI]), Chicago, IL.

2000–2002: Principal Scientist, Produced Water Management. Dr. Harju developed and deployed produced water management technologies and methodologies for cost-effective and environmentally responsible management of oil and gas produced water.

1998–2000: Program Team Leader, Soil, Water, and Waste. Dr. Harju managed projects and programs related to the development of environmental technologies and informational products related to the North American oil and gas industry; formulated RFPs, reviewed proposals, and formulated contracts; performed technology transfer activities; and supervised staff and contractors. He served as Manager of the Environmentally Acceptable Endpoints project, a multiyear program focused on rigorous determination of appropriate cleanup levels for hydrocarbons and other energy-derived contaminants in soils. He led GRI/GTI involvement with industry environmental consortia and organizations, such as PERF, SPE, AGA, IPEC, and API.

1997–1998: Principal Technology Manager (1997–1998) and Associate Technology Manager (1997), Soil and Water Quality.

1988–1996: EERC, UND.
1994–1996: Senior Research Manager, Oil and Gas Group. Dr. Harju served as:
- Program Manager for assessment of the environmental transport and fate of oil- and gas-derived contaminants, focused on mercury and sweetening and dehydration processes.
- Project Manager for field demonstration of innovative produced water treatment technology using freeze crystallization and evaporation at oil and gas industry site.
- Program Manager for environmental transport and fate assessment of MEA and its degradation compounds at Canadian sour gas-processing site.
- Program Manager for demonstration of unique design for oil and gas surface impoundments.
- Director of the National Mine Land Reclamation Center for the Western Region.
- Co-PI on project exploring feasibility of underground coal gasification in southern Thailand.
- Consultant to an International Atomic Energy Agency program entitled “Solid Wastes and Disposal Methods Associated with Electricity Generation Fuel Chains.”

1988–1994: Research Manager (1994), Hydrogeologist (1990–1994), Research Specialist (1989–1990), and Laboratory Technician (1988–1989).

Professional Activities
Member, National Coal Council (appointed 2018)
Member, National Petroleum Council (appointed 2010)
Member, Mainstream Investors, LLC, Board of Governors (2014–present)
Member, DOE Unconventional Resources Technology Advisory Committee (2012–2014)
Member, Interstate Oil and Gas Compact Commission (appointed 2010)
Member, Rocky Mountain Association of Geologists

Publications
Dr. Harju has authored or coauthored more than 100 professional publications and nearly 300 technical presentations.

DARREN D. SCHMIDT
Assistant Director for Energy, Oil, and Gas
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5201, dschmidt@undeerc.org

Principal Areas of Expertise
Mr. Schmidt's principal areas of interest and expertise include oil and gas facilities, production, injection, well stimulation, enhanced recovery, power generation, and renewable technologies.

Education and Training
B.S., Mechanical Engineering, West Virginia University, 1994.
Registered Professional Engineer (Mechanical and Petroleum).

Research and Professional Experience
February 2021–Present: Assistant Director for Energy, Oil, and Gas, EERC, UND. Mr. Schmidt leads a team focused on research, development, and commercialization related to efficient and clean fossil fuel production, utilization, carbon management, and alternative fuels and renewable energy.

2016–January 2021: Principal Engineer, Research and Technology, Equinor, Williston, North Dakota. Mr. Schmidt provided leadership for Equinor's research portfolio in the Bakken/ Williston Basin, with a focus on low carbon. He developed a project focused on reducing flaring in which a patent application was filed. Earlier work included leading a team to develop CO_2 used in well stimulations. Through Equinor's involvement with the North Dakota Oil and Gas Research Program, research was completed to address requirements surrounding crude oil vapor pressure. Mr. Schmidt worked closely with Equinor's Williston office regional manager to support operations including serving as the regulatory liaison for the emergency response team.

2013–2016: Completions Engineer, Statoil Completions, Williston, North Dakota. Mr. Schmidt served as a completions engineer for Williams County, with a strong focus on safe operations. He led a successful program in 2015 to use 10% produced water in Statoil hydraulic fracturing operations. He was responsible for hydraulic fracture designs, quality of operations, implementing new procedures, enforcing standard operating procedures, and approving field work. He mentored interns and completions related research projects to improve performance.

2012–2013: Technical Advisor, Weatherford Fracturing Technologies, Williston, North Dakota. Mr. Schmidt provided leadership to the Williston district to ensure job quality, safety, personnel management, education, and training. He supported revenue; provided intelligence; conducted marketing; provided urgent response to customers, field services, and client-based technical assistance; and ensured quality reporting. He also provided technical guidance to the district stimulation fluids laboratory.

2008–2012: Senior Research Advisor, EERC, UND. Mr. Schmidt was responsible for procurement and execution of research projects related to the Bakken Formation in the Williston Basin. Projects included utilization of associated gas in drilling operations, laboratory investigation of conductivity associated with proppants, fracturing fluids, and rock formations, enhanced production from coal bed methane, geologic storage of CO_2, and oil-field drilling, production, and workover operations. Additionally, Mr. Schmidt

was an advisor to distributed biomass gasification development and contributed to the organization's revenue through research proposals, publications, and intellectual property.

1998–2008: Research Manager, EERC, UND. Mr. Schmidt's responsibilities included securing research contracts, managing projects, and performing engineering tasks in the areas of cofiring and biomass power systems, including combustion, fluidized-bed, gasification, microturbine, and internal combustion engine generators; energy efficiency; ground-source heat pumps; hydrogen production from biomass; and researching the behavior of biomass in combustion systems relative to ash fouling and trace elements.

1994–1998: Mechanical Engineer, Research Triangle Institute (RTI), Research Triangle Park, North Carolina. Mr. Schmidt's responsibilities included serving as project leader for a $3M Cooperative Agreement with the U.S. Environmental Protection Agency (EPA) to demonstrate electricity production using a 1-MW wood gasification technology. Significant experience included permit, design, installation, operations, and reporting. Other activities at RTI included support of marketing activities and coauthoring publications.

Summer 1993: Internship, EERC, UND, Grand Forks, ND. Mr. Schmidt supported combustion and coal ash studies.

Summer 1992: Internship, Foster Wheeler Development Corporation, Livingston, New Jersey. Mr. Schmidt supported gasification research and development.

Professional Activities

Appointed Member, North Dakota Oil and Gas Research Council
Cochair, North Dakota Petroleum Council Technology Solutions Group
Section Chair, Williston Basin Society of Petroleum Engineers

Publications

Mr. Schmidt has authored or coauthored over 80 peer-reviewed and other professional publications.

Patents

Method and Apparatus for Supply of Low-Btu Gas to an Engine Generator. U.S. Patent 8,460,413, June 11, 2013.
Application of Microturbines to Control Emissions from Associated Gas. U.S. Patent 8,418,457, April 16, 2013.
Hydrocarbon Gas Recovery Methods. U.K. Application No. 2009516.2, filed June 22, 2020.

DR. NICHOLAS A. AZZOLINA
Assistant Director for Applied Data Analytics
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5120, nazzolina@undeerc.org

Principal Areas of Expertise
Dr. Azzolina is a hydrogeologist and statistician with over 25 years of industrial and consulting experience, specializing in the analysis and modeling of large, complex environmental data sets.

Education and Training
Ph.D., Environmental Management and Science, Carnegie Mellon University, 2015.
M.S., Hydrogeology, Syracuse University, 2005.
B.A., Geological and Geophysical Sciences, Princeton University, 1997.

Research and Professional Experience
March 2023–Present: Assistant Director for Applied Data Analytics, EERC, UND.

September 2021–March 2023: Assistant Director for Applied Artificial Intelligence, EERC, UND. Dr. Azzolina manages technical staff and supports projects across the EERC's Subsurface Group that require expertise with machine learning, statistics, or data analytics. Example research areas and projects include (i) carbon dioxide (CO_2) management through carbon capture, utilization, and storage (CCUS); (ii) oil and gas production from conventional and unconventional reservoirs; (iii) water resource options for the energy industry, (iv) risk assessments for CCUS and other subsurface projects, and (v) life cycle analyses (LCAs) for CCUS and other subsurface projects.

December 2016–September 2021: Principal Hydrogeologist and Statistician, EERC, UND. Dr. Azzolina supported a broad array of projects related to CO_2 enhanced oil recovery (EOR), CCUS, unconventional oil and gas production, and chemical contamination of environmental media (soil, groundwater, and sediment). He also conducted LCAs and risk assessments for CCUS and other subsurface projects.

2010–2017: Independent Consultant, The CETER Group, Inc.

2008–2010: Scientist/Project Manager, Foth, Green Bay, Wisconsin.

2005–2008: Scientist/Project Manager, The RETEC Group, Inc., Ithaca, New York.

2004–2005: Scientist, O'Brien and Gere Engineers, Inc., Syracuse, New York.

2003–2005: Research Assistant/Head Teaching Assistant, Syracuse University, Department of Earth Science, Syracuse, New York.

2000–2003: Supervisor, McMaster-Carr Supply Co., Dayton, New Jersey.

1997–2000: Senior Field Engineer, Schlumberger Oilfield Services, Edinburg, Texas.

Publications
Dr. Azzolina has authored and coauthored numerous peer-reviewed and other professional publications.

DR. CHANTSALMAA DALKHAA
Principal Reservoir Engineer, Reservoir Engineering Team
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5448, dalkhaa@undeerc.org

Principal Areas of Expertise

Dr. Dalkhaa's principal areas of interest and expertise include numerical modeling and simulation of various enhanced oil recovery (EOR) techniques, including solvent and thermal methods and cold heavy oil production with sand (CHOPS); CO_2 sequestration and monitoring; and production evaluation and estimation of ultimate recovery of unconventional shale oil plays.

Education and Training

Ph.D., Petroleum and Natural Gas Engineering, Middle East Technical University (METU), Ankara, Turkey, 2010.
M.S., Petroleum and Natural Gas Engineering, METU, Ankara, Turkey, 2005.
B.S., Petroleum and Natural Gas Engineering, METU, Ankara, Turkey, 2003.
Proficient in the use of Petrel (geologic modeling), Eclipse (fluid flow reservoir simulation), CMG IMEX/STARS/GEM/CMOST, TOUGH2/TOUGHREACT, ArcGIS/Arcmap, and IHS Harmony/DeclinePLUS/RTA/Petra.

Research and Professional Experience

February 2020–Present: Principal Reservoir Engineer, Reservoir Engineering Team, EERC, UND. Dr. Dalkhaa coleads the Reservoir Engineering Team, supervises reservoir engineers and geoscientists, manages and oversees projects, contributes to research proposal writing and preparation, and conducts technical and research work.

June 2019–January 2020: Senior Reservoir Engineer, Reservoir Engineering Team, EERC, UND. Dr. Dalkhaa supervised junior reservoir engineers and student research assistants and worked with reservoir engineers, geologists, and geophysicists to develop and calibrate geologic models of the subsurface and run dynamic simulations to evaluate CO_2 EOR performance of oil fields and the long-term fate of CO_2 sequestration into saline aquifers, evaluate production performance of unconventional oil and gas reservoirs, and assess refracturing potential in the Bakken petroleum system.

2016–May 2019: Reservoir Engineer, Reservoir Modeling and Simulation, EERC, UND. Dr. Dalkhaa worked with teams of reservoir engineers, geologists, and geophysicists to develop and calibrate geologic models of the subsurface and run dynamic simulations to evaluate CO_2 EOR performance of oil fields and the long-term fate of CO_2 sequestration into saline aquifers, estimate ultimate oil recovery, and evaluate production performance of unconventional oil reservoirs.

2014–2015: Postdoctoral Fellow, Department of Chemical and Petroleum Engineering, University of Calgary, Calgary, Alberta, Canada. Dr. Dalkhaa's activities included the following:

- Construction of a geologic model of heavy Canadian oil fields using Petrel.
- Simulation of a wormhole formation and growth in CHOPS reservoir and history matching of reservoir fluid and sand productions.

- Assessment of reservoir performance of thermal, solvent, and hybrid EOR methods using CMG STARS.

2011–2014: Postdoctoral Fellow, Department of Geoscience, University of Calgary, Calgary, Alberta, Canada. Dr. Dalkhaa's activities included the following:

- Stimulation of microbial activities in a CHOPS reservoir in the Lloydminster area, Canada, to enhance oil recovery for a project funded by Natural Sciences and Engineering Research Council of Canada and Husky Oil Operation Ltd.
- Reactive transport simulation of CO_2 injection into a reservoir and CO_2 leakage to shallower formations for the Quest Project, funded by Shell Canada.
- Application of stable isotopic techniques in monitoring of injected CO_2 for the Quest Project and Swan Hills and PennWest CO_2 pilot projects.
- Simulation of CO_2 injection into a H_2S-containing aquifer located in central Alberta for a project funded by Carbon Management Canada.
- Oilfield fluid sampling and analysis at various fields (Pembina Cardium CO_2 EOR pilot, Swan Hills CO_2 EOR fields in the Western Canadian Sedimentary Basin).
- Laboratory work on CO_2 reactivity and microbial EOR in CHOPS reservoirs.

2006–2011: Research and Teaching Assistant, Department of Petroleum & Natural Gas Engineering, METU, Ankara, Turkey. Dr. Dalkhaa's activities included the following:

- Reservoir simulation of immiscible CO_2 and water alternating gas injection into a heavy oil field in Europe in southeastern Turkey using Eclipse/Petrel (2007–2009).
- Mentorship and guidance of senior year students for graduation projects and coordination of courses (2007–2011).
- Evaluation of coalbed methane production capacity from the Soma coal bed in Turkey (2011).

Professional Activities

Member, Association of Professional Engineers and Geoscientists of Alberta – Engineer in Training (2011–present)
Member, Society of Petroleum Engineers (2003–present)
Member, European Association of Geoscientists and Engineers (2010)
Member, The Geochemical Society (2012)
Technical Reviewer, *Journal of CO_2 Utilization* (since 2019), *International Journal of Greenhouse Gas Control* (since 2017), and *Greenhouse Gases: Science and Technology* (since 2017)
Postdoctoral Representative, Faculty of Science, University of Calgary (2012–2013)
General volunteer, MentorUp Calgary (2014)
General volunteer, APEGA (2014)
Member, EERC Social Cause Committee (since 2016)

Publications

Dr. Dalkhaa has coauthored several professional publications.

MATTHEW L. BELOBRAYDIC
Assistant Director for Geoscience
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5030, mbelobraydic@undeerc.org

Principal Areas of Expertise

Mr. Belobraydic's principal areas of interest and expertise include stratigraphic and structural interpretations, geologic characterization, data science, process automation, geostatistical analysis, geomodeling, and uncertainty analysis.

Education and Training

M.S., Geology, Ball State University, 2006. Thesis: "Drainage Basin Analysis and Fluvial Geomorphic Reconstruction Plan for the Killbuck–Mud Creek Subwatershed, Delaware County, Indiana."

B.S., Geology, University of Idaho, 2003. Senior Project: "Drainage Analysis for Colfax South, Diamond, Dusty, Thera, Thornton Quadrangles and an Experimental Quadrangle of Eastern Washington."

Research and Professional Experience

2022–Present: Assistant Director for Geoscience, EERC, UND. Mr. Belobraydic collaborates with EERC subject matter experts, principal investigators, and leadership to prepare proposals and pursue new business opportunities and leads and manages projects in the areas of enhanced oil recovery (EOR) in conventional and unconventional formations, CO_2 and produced gas storage, natural resource management, critical materials resource characterization and recovery, geologic and synthetic materials characterization, produced water management, and the environmental aspects of energy development.

- Manages a team of petrophysicists and subsurface data management professionals.
- Coaches and mentors more than ten geoscientists in geology, stratigraphy, geostatistical, geologic modeling, and uncertainty methods.
- Develops strategic plans for petrophysical products and data-handling procedures for subsurface teams.
- Assists the Director of Analytical Solutions by providing business directions for technical reports and technical expertise.
- Creates project proposals and maintains client relationships.

December 2020–2022: Principal Geoscientist, Geoscience and Engineering Group, EERC, UND. Mr. Belobraydic collaborated with EERC subject matter experts and principal investigators to create geological interpretations and prepared proposals in the areas of EOR in conventional and unconventional formations, CO_2 and produced gas storage, natural resource management, geologic materials characterization, produced water management, and environmental aspects of energy development.

- Mentored geoscientists as subject matter expert in geology and geological modeling for more than ten federal, state, and private contracts.
- Coached modeling team members through team-building and workflow improvement exercises.
- Characterized reservoirs and depositional environments for projects to maximize subsurface understanding and minimize development risk.
- Managed resources, budgets, and timelines on projects to successfully complete within deadlines and scope.

October 2020–December 2020: Geoscientist, EERC, UND. Mr. Belobraydic produced geology and geological modeling results for CO_2 storage projects as part of an integrated team of EERC subject matter experts. Specific activities included the following:

- Produced 3D geologic models for CO_2 storage for select clastic formation within the Williston Basin.
- Coached three geoscientists through geostatistical and geomodeling methods as on-the-job training.

September 2008–April 2020: Senior III Reservoir Geologist, Schlumberger, Denver, Colorado. Mr. Belobraydic produced data-driven client solutions as part of a multidisciplinary consulting team, improving internal technical processes and workflows to increase efficiency and maximize profits. Specific activities included the following:

- Managed team of petrophysicist, geophysicist, geologist, and reservoir engineers from proposal to project close as technical lead for more than ten client projects.
- Introduced Agile and Scrum project management to local consulting team, changing work processes, shortening turnaround times by 66% and increasing bottom line.
- Reviewed green energy workflows and processes for internal geothermal and carbon capture and storage teams as subject matter expert to mitigate risk and uncertainty.
- Initialized and maintained backlog for basin interpretation cloud subscription service as Scrum product owner to capture previously inaccessible market share.
- Adapted working style and deliverables to become trusted technical advisor for more than 20 client organizations, each with unique business priorities.
- Coordinated stakeholders and potential clients for four cloud subscription service offerings to maximize value, drive communication, and quantify feedback of results.
- Created harmonious and integrated team environments for technical staff from both Schlumberger and client organizations for project collaborations.
- Characterized petroleum systems and depositional environments for client acreage to maximize reservoir understanding and minimize development risk.
- Interpreted structure and stratigraphy for full 3D models, combining seismic data for conventional and unconventional plays in more than ten basins and 30 fields globally.
- Analyzed raw and interpreted data to generate geostastically accurate static reservoir models in Petrel on more than five projects per year for worldwide clients.
- Published and automated uncertainty optimization technique, reducing dynamic simulation iterations by 80% and generating a positive feedback loop to initial inputs.
- Built custom Python, SQL, and Petrel workflows, increasing productivity by up to 900%.
- Coached and mentored more than 30 individuals through organized team-building activities and formal career development.
- Created advanced modeling curriculum and training programs in Petrel for more than 25 junior geoscientists.
- Published results and methodologies for select client work as posters and papers to technical conferences and professional societies.
- Requested presenter to professional societies for geology, data science, and machine learning.
- Prepared and reviewed proposals, reports, and project documentation, effectively communicating technical results and methodology to clients and working teams.

September 2006–August 2008: CO_2 Enhanced Oil Recovery Research Assistant, UND. Mr. Belobraydic researched CO_2 enhanced oil recovery and sequestration potential for the Williston Basin alongside the EERC. Specific activities included the following:

- Generated systematic approach for assessing enhanced oil recovery and carbon dioxide sequestration for fields of interest.

- Produced 3D reservoir models to simulate enhanced oil recovery and carbon dioxide sequestration potential.

May 2005–May 2006: National Science Foundation GK–12 Fellow, Ball State University, Muncie, Indiana. Mr. Belobraydic provided in classroom support to Indianapolis Public Schools (IPS) teachers through inquiry-based lessons and assisted in professional development for K–8 science standards. Specific activities included the following:

- Developed middle school Earth science curriculum and lessons for IPS.
- Provided aid in the professional development of IPS teachers as a knowledge resource.

Professional Activities

Member, American Association of Petroleum Geologists
Member, Rocky Mountain Association of Geologists

Publications

Mr. Belobraydic has authored or coauthored numerous professional publications.

MARC D. KURZ
Principal Geologist, Process Chemistry and Development Team Lead
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5278, mkurz@undeerc.org

Principal Areas of Expertise

Mr. Kurz's principal areas of interest and expertise include design, operation, and maintenance of laboratory- and pilot-scale reactor systems for biofuel development; biofuel chemistry and analysis; design and implementation of subsurface and groundwater remediation technologies; and geophysical characterization testing.

Education and Training

B.S., Environmental Geology and Technology, University of North Dakota, 1993.
Postgraduate coursework in soil sciences, groundwater remediation, global change issues, satellite image processing, and geographic information systems (GIS), 2001–2007.
40-hour OSHA Training for Hazardous Waste Site Personnel, 1997 (refresher course, 2002).

Research and Professional Experience

May 2021–Present: Principal Geologist, Process Chemistry and Development Team Lead, EERC, UND. Mr. Kurz coordinates and conducts the analysis of various laboratory- and pilot-scale reactor product and by-product effluents to provide data for the calculation of material balances, conversions, and product qualities in support of EERC projects. He provides a variety of general and specialized analytical testing, including wet-chemical testing, thermogravimetric analysis (TGA)/differential calorimetry scanning (DSC), gas chromatography/mass spectrometry, flash point and cold-flow properties of fuels, and refinery gas analysis (RGA) of combustion gases.

2010–April 2021: Senior Geologist, Process Chemistry and Development Team Lead, EERC, UND. Mr. Kurz coordinated and conducted the analysis of various laboratory- and pilot-scale reactor product and by-product effluents to provide data for the calculation of material balances, conversions, and product qualities in support of EERC projects.

2007–2010: Research Scientist, Renewable Energy and Biofuel Technology, EERC, UND. Mr. Kurz served as a research scientist on projects related to alternative energy technologies. His primary responsibilities included conducting laboratory- and pilot-scale research experiments related to biofuel technology and operating various laboratory analytical instruments.

2000–2007: Research Scientist, Subsurface Treatment and Remediation Research, EERC, UND. Mr. Kurz served as a manager and co-principal investigator on a variety of research projects related to groundwater remediation and oil and gas industry-related issues. His responsibilities included supervision of graduate research assistants and fieldwork personnel, proposal writing, budget management, and presentation of project research at a variety of technical conferences.

1996–2000: Geologist/Research Scientist, Groundwater Remediation Program, EERC, UND. Mr. Kurz's responsibilities included researching and report writing on various remediation technologies for contaminated groundwater and soils, conducting extensive fieldwork activities, and performing

analytical laboratory testing. In addition, he was involved in research related to the exploration, production, and environmental aspects of coalbed methane exploitation.

1994–1996: Research Assistant, Water and Wastewater Treatment, EERC, UND. Mr. Kurz's primary responsibilities included various field- and laboratory-based research on a variety of water and wastewater remediation projects.

Publications

Mr. Kurz has coauthored several technical publications.

DR. ALEXANDER CHAKHMAKHCHEV
Principal Scientist
Energy & Environmental Research Center (EERC), University of North Dakota (UND)
15 North 23rd Street, Stop 9018, Grand Forks, North Dakota 58202-9018 USA
701.777.5393, achakhmakhchev@undeerc.org

Principal Areas of Expertise

Dr. Chakhmakhchev is a geoscientist with over 25 years of experience in the international petroleum industry. He has significant industry and academic expertise in geoscience and applying the results to petroleum exploration efforts, field development, production optimization, and problem solving in various geologic settings. In his career, he has focused on the geochemistry of oils and source rocks and applying the results to petroleum systems analysis and reservoir/production management. In his work, he has utilized a wide range of hydrocarbon indicators: gas and gasoline range hydrocarbons, n-alkanes, biomarkers, sulfur aromatics, diamondoids, and isotope composition of C, S, and metal distributions. He has developed new technologies for oil/oil/organic matter (OM) correlations, maturity evaluation, and phase type prediction of hydrocarbons lacking biomarkers (condensates and light oils). He has developed and conducted lab experiments simulating subsurface fluid behavior, including the vertical migration process in PVT (pressure, volume, temperature) cells. He has extensively used distributions of n-alkanes, biomarkers, and sulfur aromatic compounds for fingerprinting of fluids and indicators of depositional environments, type of source rock, lithologies, age, and biodegradation. He has identified and characterized OM of source rocks using techniques such as total organic carbon (TOC), Ro, Rock-Eval, infrared (IR) spectroscopy, biomarker distributions, gas logging, and carbon isotope composition. He has unitized various statistical technics in data interpretation, including cluster analysis, principal components, multiple regression, and gradient boosting. He has developed database structure and surface geochemistry information and data and performed basin-modeling studies using PetroMod and BasiMod and focusing on a new prospect risking, including time of oil generation, hydrocarbon charge volumetric assessment, and fluid-quality prediction.

Education and Training

Special Postdoctorate Program for Foreign Students, Shimane University, Japan, 1992–1994.
Ph.D., Petroleum Geochemistry, All-Russia Research Institute for Geological, Geochemical, and Geophysical Information Systems, Moscow, CIS, 1988–1992; dissertation: “Geochemical Methods of Oil and Gas Prospecting Using Multivariate Statistical Analysis.”
M.S., Petroleum Geology, Moscow State University, Moscow, Russia, 1982–1987.

Research and Professional Experience

2019–Present: Principal Scientist, EERC, UND. Dr. Chakhmakhchev leads projects and research work in the areas of enhanced oil recovery, production optimization, geochemical solutions, and environmental protection.

2017–2018: Senior Data Scientist, Applied Chem Data (ACDGL.com). Dr. Chakhmakhchev provided consulting services in completion optimization and monitoring and performance analysis of electric submersible pumps.

2014–2017: Principal Geochemist, Geochemistry Services, SGS Oil, Gas, and Chemical Services, The Woodlands, Texas. Dr. Chakhmakhchev’s activities included the following:

- Led global geochemical services in the areas of geochemical characterization of petroleum system, reservoir compartmentalization, production allocation, prediction of hydrocarbon type and quality of oil, migration and biodegradation processes, and monitoring enhanced recovery processes.
- Provided consulting work and interpretation for data generated by SGS laboratories and applied in petroleum exploration in frontier basins and unconventional resources.
- Completed standardization project for global SGS labs, aligning output formats with the best industry standards, including biomarker analyses (gas chromatography (GC])–mass spectroscopy (MS), whole oil GC, IR MS, Rock-Eval, and visual kerogen characterization.
- Helped operator in Colombia optimize an exploration program based on geochemical characterization of heavy biodegraded oil discovered.
- Advised oil and gas operator on the potential (liquids vs. gas) of unexplored zones in the Berkine Basin of Algeria Basin based on regional geochemical characterizations of gas condensates, light oils, source rock, gas-logging data, and basin modeling.
- Geochemically characterized oils and condensates produced in a shale play to understand the source and maturity level of fluids (Woodford, Eagle Ford).
- Created reservoir geochemistry workflows, and completed a pilot project for reservoir compartmentalization, production allocation, and production monitoring.
- Informed operator of the source of produced condensate samples and tested the fluids for possible contamination from oil base drilling mud.
- Using carbon and hydrogen isotope data and chemical composition of gas, explained the source (biogenic vs. thermogenic) of the gas discovered in Malaysia.
- Developed and conducted lab experiments simulating subsurface fluid behavior, including the vertical migration process in a PVT cell.
- Created tool/workflow-based sulfur isotope data to predict H_2S contamination in production streams in various locations of Kuwait.
- Investigated the composition of return fluids sampled during pressure testing and explained their nature and source using whole oil GC, biomarkers, oil-based mud (OBM) data, and published geochemical information on oils in India.
- Diagnosed tubing leaking in West Africa offshore wells using fluids composition data. Set up a fully capable geochemistry lab in Texas and Malaysia for petroleum characterization in source rock, oil, and ocean floor sediments using GS–MS–MS instrumentation and GC (high-resolution whole oil GC, HTGC).
- Built retention time database for various biomarkers based on global oil samples.
- Trained and coached chemists and junior geochemists in the organization.

2001–2014: Geoscience Data Advisor, IHS Energy, Global Support Organization, Houston, Texas; Director, Big Data and Analytics, IHS. Dr. Chakhmakhchev's activities focused on the following:

- Created solutions and new decision-making products focused on deep water, unconventional resources and based on various subsurface data integration, predictive analytics, and big data technologies.
- Predicted unconventional well performance in Niobrara play performance using log, geochemical, and mineralogy data and applying multivariate statistical analysis.
- Created algorithms for well log interpretation to correlate log patterns and shale oil production. Performed completion optimization modeling in the Eagle Ford shale play using U.S. well and production data-mining method, gradient boosting.
- Completed a significant number of consulting jobs covering the remaining exploration potential of basins, understanding risks and reserve estimates and analyzing country/regional/basin trends. In these assignments, integrated various data and information, including petroleum system characterization, basin geological history, depositional environment, OM maturity, timing of generation, migration and accumulation, and play/trap type information.

- Led a team of geoscience data advisors whose role was to provide training, consulting services, and support to IHS clients, including ExxonMobil, Marathon, Chevron, Shell, Anadarko, Noble, BHP, and others.

1996–2001: Project Manager, New Ventures, YUKOS Oil Company, Moscow. Dr. Chakhmakhchev managed integrated geologic studies internationally to identify prospective drilling targets and estimate potential reserve volumes.

1994–1996: Project Researcher–Geochemist, Japan National Oil Company, Chiba, Japan. Dr. Chakhmakhchev's activities included the following:

- Investigated lithology, source, and maturity effects on sulfur aromatic compounds and biomarker distributions in oil and OM of source rocks in Niigata and Akita Basins of Japan.
- Developed a new maturity parameter based on dibenzothiophene distributions successfully applied in overmature petroleum.
- Performed a comparison study of oils derived from siliceous sources of Japan, the United States, and Russia.
- Applied instrumentation including GC, GC–MS, and Rock-Eval.
- Analyzed petroleum systems in different worldwide basins: West Siberian Basin; Okhotsk Basin, Sakhalin; Timan–Pechora Basin; Akita and Niigata Basins (Japan); North Caspian Basin; Santa Barbara–Ventura, Santa Maria (USA).
- Performed 1-D basin modeling (BasinMod) in basins of Japan focusing on new prospect risking, including time of oil generation, hydrocarbon charge volumetric assessment, pressure, and fluid-quality prediction.

1992–1994: Postdoctoral Researcher, Shimane University, Japan North of Western Siberia. Dr. Chakhmakhchev's activities included the following:

- Identified effective source rocks and their depositional environment based on oil/source rock correlation and using biomarkers, gasoline hydrocarbons, and isotope composition.
- Revealed maturity trend(s) and the effects of biodegradation.
- Predicted HC type in unexplored territories.
- In basins of Russia, Kazakhstan, and Japan, investigated lithology effects (siliceous, carbonate, and argillaceous) on biomarker and aromatic sulfur compounds in oils.
- In Volgo-Ural Province (Buzuluk Depression), proposed new maturity indicators based on distribution of aromatic sulfur compounds for overmature petroleum lacking sufficient biomarkers.

1986–1992: Researcher–Geochemist, VNIIGeosystem, Moscow. Dr. Chakhmakhchev's activities included the following:

- Performed extensive geochemical data processing and interpretation using multivariate statistical methods (factor analysis, discriminant analysis).
- Focused on distributions of gasoline range hydrocarbons C5–C7 in oils and condensates derived from different OM sources and characterized by wide ranges of maturity level.
- Developed a technique to recognize overmature condensates derived from different types of OM (Types I–II and III).
- Created a database for surface geochemistry information.

Professional Activities

Member, European Association of Organic Geochemists
Member, American Association of Petroleum Geologists (AAPG)
Member, Society of Petroleum Engineers (SPE)
Member, Japanese Association for Petroleum Technology
Reviewer for AAPG and *Organic Geochemistry*

Publications

Dr. Chakhmakhchev has published over 20 research papers and four technical reports in leading international journals and participated in tradeshows and conventions, including the World Petroleum Congress, AAPG, SPE, IHS Regional Roundtables, and NAPE.

APPENDIX D

LETTERS OF COMMITMENT

devon

June 1, 2023

Mr. John Harju
Vice President for Strategic Partnerships
Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

Dear Mr. Harju:

Subject: Devon Energy Corp. – Letter of Support for the Project Entitled "Bakken Production Optimization Program (BPOP) 4.0"

Devon Energy (Devon) is interested in partnering with the Energy & Environmental Research Center (EERC) in the subject proposed project to investigate the feasibility of implementing large-scale enhanced oil recovery (EOR) in the Bakken petroleum system using carbon dioxide (CO_2) captured from industrial sources in North Dakota.

Devon supports the EERC's proposal to conduct a series of research activities as part of the proposed Bakken Production Optimization Program (BPOP) 4.0 efforts. Devon is willing to consider providing significant in-kind cost-share to the proposed BPOP 4.0 program. In-kind contributions may include, but are not necessarily limited to, access to unique core and fluid samples, reservoir diagnostics data, and any other qualifying costs that may be generated as part of future CO_2 EOR-related efforts being considered by Devon. It is estimated that the value of those contributions may be as high as $3,000,000. Should EERC be awarded funding for the proposed BPOP 4.0 efforts, it is anticipated that Devon will make a final decision regarding the specific nature and extent of its participation in the BPOP 4.0 EOR-focused activities.

We look forward to working with EERC in this exciting project to advance the science of CO_2-based EOR in tight reservoirs, reservoir conformance, fluid-fluid and fluid-rock interactions (including the potential for Bakken and Three Forks rocks to store CO_2), reservoir surveillance, and the understanding of tight complex reservoirs.

Should you have any questions, please do not hesitate to contact me by phone at (918) 237-2139 or by e-mail at William.Westler@dvn.com.

Sincerely,

William M. Westler Jr.
William Westler
BU Vice President - Rockies

March 13, 2023

SENT VIA ELECTRONIC MAIL

Sheryl Eicholtz-Landis, Business Point of Contact
University of North Dakoka
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018
slandis@undeerc.org

SUBJECT: Selection of Application for Negotiation Under Funding Opportunity Announcement Number DE-FOA-0002616, "Innovative Methane Measurement, Monitoring, and Mitigation Technologies (iM4 Technologies)"

Dear Ms. Eicholtz-Landis:

We are pleased to provide this update on your application. The Office of Fossil Energy and Carbon Management within the Department of Energy (DOE) has completed its evaluation of your application submitted in response to the subject Funding Opportunity Announcement (FOA). The application below has been recommended by the Office of Fossil Energy and Carbon Management for negotiation of a financial award (Note: This notification does not guarantee Federal Government funding, as funding will only be obligated upon completion of successful negotiations):

Application: "Polar Bear Ð Innovative Capture of Storage Tank Vapors", Principal Investigator Darren D. Schmidt, Application Control Number 13740484

Receipt of this letter does not authorize you to commence with performance of the project. DOE makes no commitment to issue an award and assumes no financial obligation with the issuance of this letter. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement. Only an award document signed by the Contracting Officer obligates DOE to support a project.

The award negotiation process may take up to 90 days. You must be responsive during award negotiations (i.e., provide requested documentation) and meet the stated negotiation deadlines. Failure to submit the requested information and forms by the stated due date, or any failure to conduct award negotiations in a timely and responsive manner, may cause DOE to cancel award negotiations and rescind this selection. DOE reserves the right to terminate award negotiations at any time for any reason.

Please complete the following items and submit to DOE no later than March 24, 2023:

- Pre-Award Information Sheet (available at https://www.netl.doe.gov/business/business-forms/financial-assistance)

If your organization or any subrecipient anticipates utilizing foreign nationals (FNs) in the performance of the award, your organization is required to provide a list of all FNs planned to participate on the award along with basic information about each. You must download and complete the "Foreign National Participation Document" located at https://www.netl.doe.gov/business/business-forms/financial-assistance under Post Selection Forms/Information and submit the completed document to basicinfo@netl.doe.gov with a courtesy copy to the assigned Project Manager (PM) and Grants Management Specialist.

Upon receipt of the completed "Foreign National Participation Document," we will create a secured file sharing drop box folder(s) for **ALL** FNs proposed to participate on the award. The purpose of the secured file folder is for your organization or any subrecipient to submit additional information.

As part of the requirement to submit additional information for all FNs, your organization must ensure completion of the "Foreign National Participation **Data** Document" also located at https://www.netl.doe.gov/business/business-forms/financial-assistance. The document and all required attachments must be uploaded to the secured file sharing drop box folder(s) provided by DOE's FN Request Coordinator. The assigned PM will contact the appropriate FN Data Entry POC in the event there are issues with the submission.

Please note that all FNs identified within the "Foreign National Participation Document" are **not** permitted to participate on the award until written authorization is received from the Contracting Officer.

The Contracting Officer will notify your organization of DOE's decision regarding the FNs participation on the award**.** The DOE reserves the right to request additional information or deny participation of any FN at any time.

Please provide the requested documents to the attention of Kate Hubbs, who is the Grants Management Specialist from the Finance and Acquisition Center handling the administrative portion of your application. Ms. Hubbs can be reached at Anna.Hubbs@netl.doe.gov. Robert Noll is the DOE Project Manager from the Project Management Division handling the technical portion of your application and can be reached at Robert.Noll@netl.doe.gov.

Sincerely,

Janet S. Laukaitis

Janet S. Laukaitis
Contracting Officer
Finance and Acquisition Center

cc: FOA File
Basicinfo@netl.doe.gov
Darren D. Schmidt, Principal Investigator, dschmidt@undeerc.org
Robert Noll, Project Manager, Robert.Noll@netl.doe.gov
Kate Hubbs, Grants Management Specialist, Anna.Hubbs@netl.doe.gov

APPENDIX E

BUDGET NOTES

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

BACKGROUND

The EERC is an independently organized multidisciplinary research center within the University of North Dakota (UND). The EERC is funded through federal and nonfederal grants, contracts, and other agreements. Although the EERC is not affiliated with any one academic department, university faculty may participate in a project, depending on the scope of work and expertise required to perform the project.

INTELLECTUAL PROPERTY

The applicable federal intellectual property (IP) regulations will govern any resulting research agreement(s). In the event that IP with the potential to generate revenue to which the EERC is entitled is developed under this project, such IP, including rights, title, interest, and obligations, may be transferred to the EERC Foundation[‡], a separate legal entity.

BUDGET INFORMATION

The proposed work will be done on a cost-reimbursable basis. The distribution of costs between budget categories (labor, travel, supplies, equipment, etc.) and among funding sources of the same scope of work is for planning purposes only. The project manager may incur and allocate allowable project costs among the funding sources for this scope of work in accordance with Office of Management and Budget (OMB) Uniform Guidance 2 CFR 200.

Escalation of labor and EERC recharge center rates is incorporated into the budget when a project's duration extends beyond the university's current fiscal year (July 1 – June 30). Escalation is calculated by prorating an average annual increase over the anticipated life of the project.

The cost of this project is based on a specific start date indicated at the top of the EERC budget. Any delay in the start of this project may result in a budget increase. Budget category descriptions presented below are for informational purposes; some categories may not appear in the budget.

Salaries: Salary estimates are based on the scope of work and prior experience on projects of similar scope. The labor rate used for specifically identified personnel is the current hourly rate for that individual. The labor category rate is the average rate of a personnel group with similar job descriptions. Salary costs incurred are based on direct hourly effort on the project. Faculty who work on this project may be paid an amount over the normal base salary, creating an overload which is subject to limitation in accordance with university policy. As noted in the UND EERC Cost Accounting Standards Board Disclosure Statement, administrative salary and support costs that can be specifically identified to the project are direct-charged and not charged as facilities and administrative (F&A) costs. Costs for general support services such as contracts and IP, accounting, human resources, procurement, and clerical support of these functions are charged as F&A costs.

Fringe Benefits: EERC fringe benefits consist of two components that are budgeted as a percentage of direct labor. The first component (26%) is a fixed percentage approved annually by the UND cognizant audit agency, the Department of Health and Human Services. This portion of the rate covers vacation, holiday, and sick leave (VSL) and is applied to direct labor for permanent staff eligible for VSL benefits.

The approved rate will be charged to the project. The second component (30%) is estimated on the basis of historical data and is charged as actual expenses for items such as health, life, and unemployment insurance; social security; worker's compensation; and UND retirement contributions. These benefits will be charged based on expenses actually incurred and will vary by individual.

Travel: Travel may include site visits, fieldwork, meetings, and conferences. Travel costs are estimated and paid in accordance with OMB Uniform Guidance 2 CFR 200, Section 474, and UND travel policies, which can be found at http://und.edu/finance-operations (Policies & Procedures, A–Z Policy Index, Travel). Daily meal rates are based on U.S. General Services Administration (GSA) rates unless further limited by UND travel policies; other estimates such as airfare, lodging, ground transportation, and miscellaneous costs are based on a combination of historical costs and current market prices. Miscellaneous travel costs may include parking fees, Internet charges, long-distance phone, copies, faxes, shipping, and postage.

Equipment: Equipment is budgeted as part of the DOE related work for the Polar Bear effort and will be paid for with DOE funds. A gas supply system will be fabricated to demonstrate the performance to capture tank vapors, and a flow meter will be purchased to test the capture of the tank vapors in the manufactured model.

Supplies: Supplies include items and materials that are necessary for the research project and can be directly identified to the project. Supply and material estimates are based on prior experience with similar projects. Examples of supply items are chemicals, gases, glassware, nuts, bolts, piping, data storage, paper, memory, software, toner cartridges, maps, sample containers, minor equipment (value less than $5000), signage, safety items, subscriptions, books, and reference materials. General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are included in the F&A cost.

Subcontractor – Liberty Resources, LLC: Liberty Resources, LLC, will conduct a second injection cycle at its EOR pilot at its East Nesson location. Expenses will include regulatory and contract supervision, preparation and operation of the injection cycle, water and gas supplies, well work, and surveillance.

Professional Fees: Not applicable.

Communications: Telephone, cell phone, and fax line charges are included in the F&A cost; however, direct project costs may include line charges at remote locations, long-distance telephone charges, postage, and other data or document transportation costs that can be directly identified to a project. Estimated costs are based on prior experience with similar projects.

Printing and Duplicating: Page rates are established annually by the university's duplicating center. Printing and duplicating costs are allocated to the appropriate funding source. Estimated costs are based on prior experience with similar projects.

Food: Expenditures for project partner meetings where the primary purpose is dissemination of technical information may include the cost of food. EERC employees in attendance will not receive per diem reimbursement for meals that are paid by project funds. The estimated cost is based on the number and location of project partner meetings.

Professional Development: Fees are for memberships in technical areas directly related to work on this project. Technical journals and newsletters received as a result of a membership are used throughout the development and execution of the project by the research team.

Operating Fees: Operating fees generally include EERC recharge centers, outside laboratories, and freight.

EERC recharge center rates are established annually and approved by the university.

Laboratory and analytical recharge fees are charged on a per sample, hourly, or daily rate. Additionally, laboratory analyses may be performed outside of the university when necessary. The estimated cost is based on the test protocol required for the scope of work.

Document Production Services recharge fees are based on an hourly rate for production of such items as report figures, posters, and/or images for presentations, maps, schematics, website design, brochures, and photographs. The estimated cost is based on prior experience with similar projects.

Shop and Operations recharge fees cover specific expenses related to the pilot plant and the required expertise of individuals who perform related activities. Fees may be incurred in the pilot plant, at remote locations, or in EERC laboratories whenever these particular skills are required. The rate includes such items as specialized safety training, personal safety items, fall protection harnesses, respirators, CPR certification, annual physicals, protective clothing/eyewear, research by-product disposal, equipment repairs, equipment safety inspections, and labor to direct these activities. The estimated cost is based on the number of hours budgeted for this group of individuals.

Engineering Services recharge fees cover specific expenses related to retaining qualified and certified design and engineering personnel. The rate includes training to enhance skill sets and maintain certifications using Webinars and workshops. The rate also includes specialized safety training and related physicals. The estimated cost is based on the number of hours budgeted for this group of individuals.

Geoscience Services recharge fees are discipline fees for costs associated with training, certifications, continuing education, and maintaining required software and databases. The estimated cost is based on the number of hours budgeted for this group of individuals.

Software Solutions Services recharge fees are for development of customized websites and interfaces, software applications development, data and financial management systems for comprehensive reporting and predictive analysis tools, and custom integration with existing systems. The estimated cost is based on prior experience with similar projects.

Technical software fees are user fees for ASPEN modeling software.

Field safety fees cover safety training and certifications, providing necessary PPE and annual physicals. The estimated cost is based on the number of days individuals are budgeted to work in the field.

Freight expenditures generally occur for outgoing items and field sample shipments.

Outside labs are budgeted for isotope analyses of water samples.

Facilities and Administrative Cost: The F&A rate proposed herein is approved by the U.S. Department of Health and Human Services and is applied to modified total direct costs (MTDC). MTDC is defined as total direct costs less individual capital expenditures, such as equipment or software costing $5000 or more with a useful life of greater than 1 year, as well as subawards in excess of the first $25,000 for each award.

Cost Share: Cash cost share is being provided in the form of annual partnership payments from BPOP partners. A total of $1,636,361 is expected in cash from partners. In-kind cost share will also be provided by Liberty Resources, LLC and Devon in the amounts of $363,639 and $3,000,000 respectively. Cost share will include $1,000,000 cash from DOE (under contract negotiations, DOE Award No. DE-FE0032290).

APPENDIX F

STATUS OF ONGOING PROJECTS LIST

STATUS-OF-ONGOING PROJECTS LIST

Project Title	Contract Award No.
Bakken Production Optimization Program 3.0	G-051-98
Field Study to Determine the Feasibility of Developing Salt Caverns for Hydrocarbon Storage in Western North Dakota	G-054-104
Hydrogen Energy Development for North Dakota	G-054-105
Improving EOR Performance Through Data Analytics and Next-Generation Controllable Completions	G-050-97
iPIPE 2.0: The Intelligent Pipeline Integrity Program	G-055-108
iPIPE: The Intelligent Pipeline Integrity Program	G-046-88
PCOR Initiative to Accelerate CCUS Deployment	G-050-96
Underground Storage of Produced Natural Gas – Conceptual Evaluation and Pilot Project(s)	G-049-092
Unitized Legacy Oil Fields: Prototypes for Revitalizing Conventional Oil Fields in North Dakota	G-045-086

Energy & Environmental Research Center (EERC)

PLAINS CO_2 REDUCTION (PCOR) PARTNERSHIP

North Dakota Industrial Commission
Oil and Gas Research Council
July 21, 2023

Kevin Connors
PCOR Partnership Program Manager
Assistant Director for Regulatory Compliance and Energy Policy

20 YEARS PCO2R Partnership

PCOR PARTNERSHIP

2003–PRESENT

The PCOR Partnership addresses regional capture, transport, use, and storage challenges facing commercial carbon capture and storage (CCS)/carbon capture, utilization, and storage (CCUS) deployment. The PCOR Partnership focuses on:

- Strengthening the technical foundation for geologic CO_2 storage and enhanced oil recovery (EOR).
- Advancing capture technology.
- Improving application of monitoring technologies.
- Promoting integration between capture, transportation, use, and storage industries.
- Facilitating regulatory frameworks.
- Providing scientific support to policy makers.
- Engaging the public through outreach and education

20 YEARS PCOR Partnership | EERC | U.S. DEPARTMENT OF ENERGY | NETL NATIONAL ENERGY TECHNOLOGY LABORATORY

Critical Challenges. Practical Solutions.

PCO2R Partnership — PARTNERSHIP MEMBERS

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

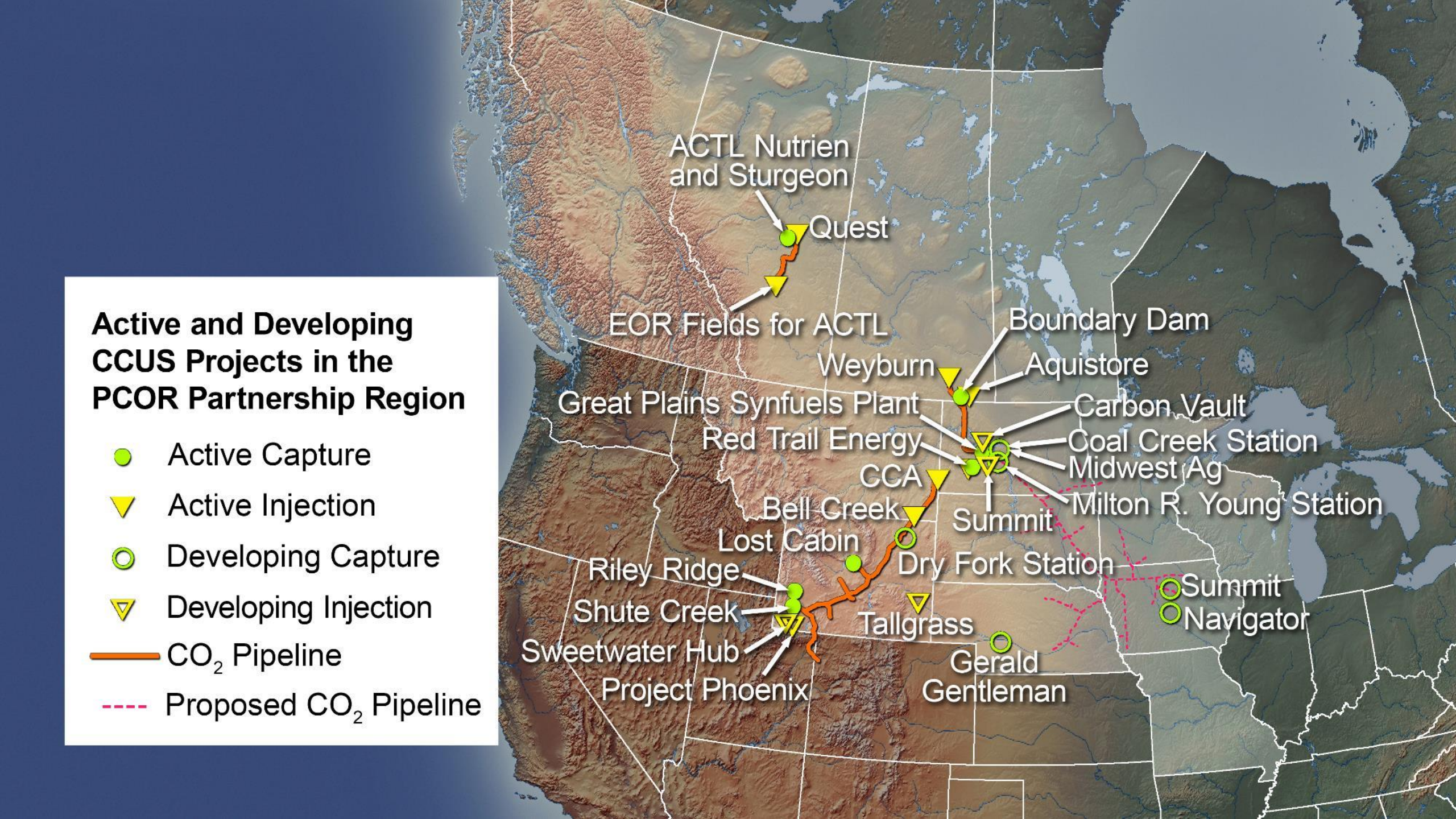
EERC UNIVERSITY OF NORTH DAKOTA

North Dakota Industrial Commission

UAF Institute of Northern Engineering, University of Alaska Fairbanks

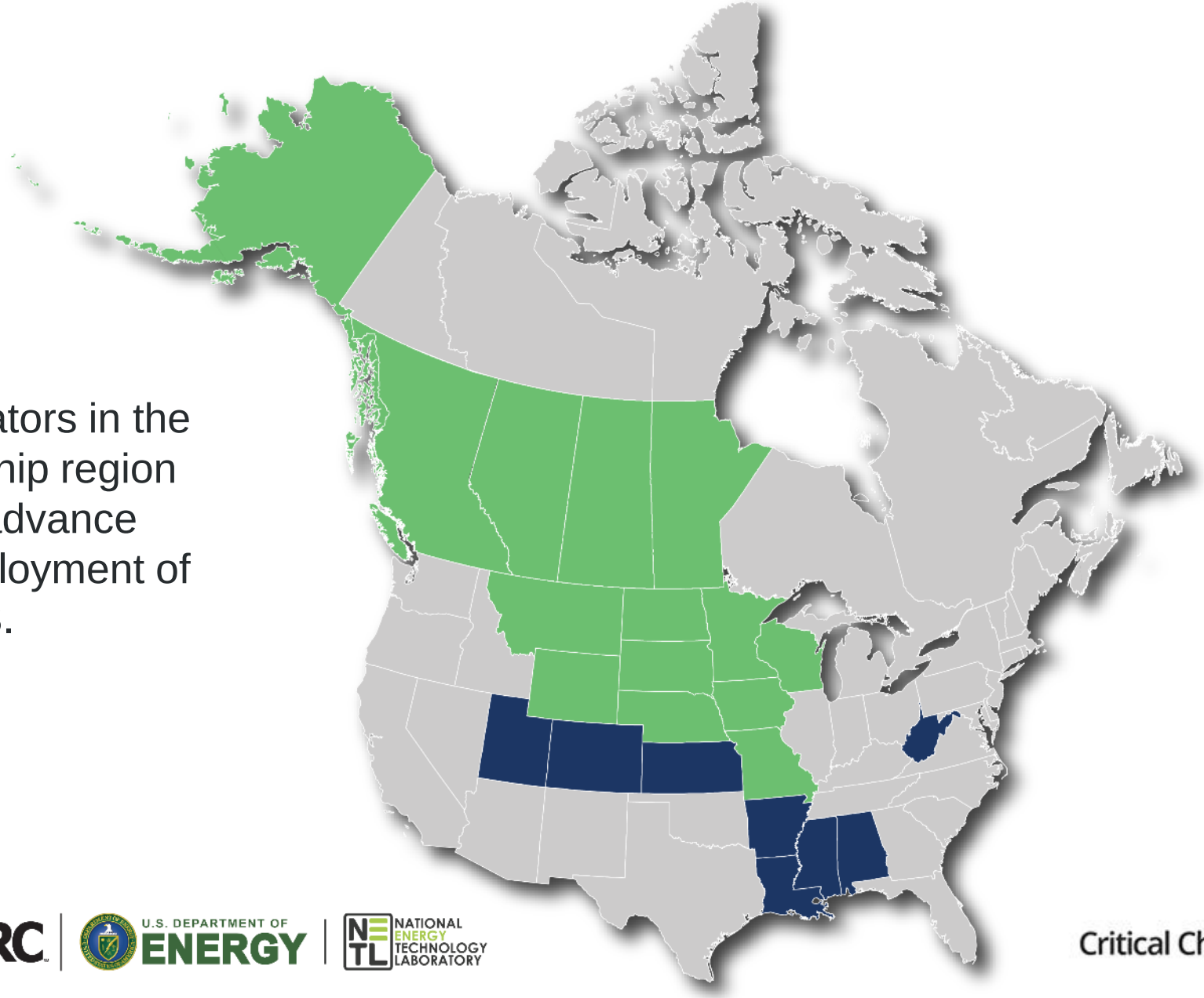
University of Wyoming, School of Energy Resources

06/23


Active and Developing CCUS Projects in the PCOR Partnership Region
Active Capture
Active Injection
Developing Capture
Developing Injection
CO_2 Pipeline
Proposed CO_2 Pipeline
ACTL Nutrien and Sturgeon
Quest
EOR Fields for ACTL
Boundary Dam
Weyburn
Aquistore
Great Plains Synfuels Plant
Carbon Vault
Red Trail Energy
Coal Creek Station
Midwest Ag
CCA
Milton R. Young Station
Bell Creek
Summit
Lost Cabin
Dry Fork Station
Riley Ridge
Summit
Navigator
Shute Creek
Tallgrass
Sweetwater Hub
Gerald Gentleman
Project Phoenix

2023 REGULATORY ROUNDUP REPRESENTATION

Engaging regulators in the PCOR Partnership region and beyond to advance commercial deployment of CCS and CCUS.



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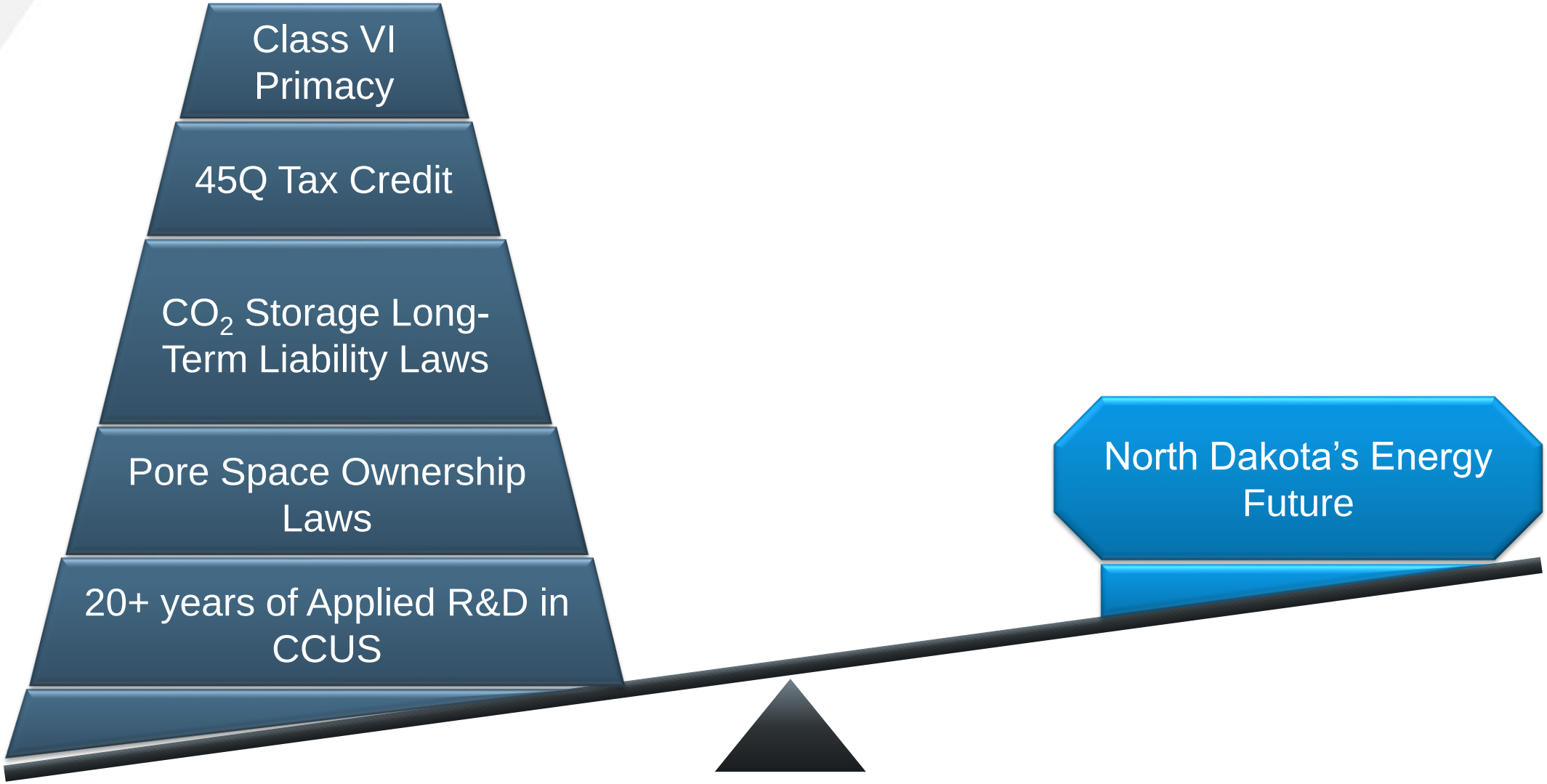
NORTH DAKOTA'S LEVERAGE



PCOR'S VALUE TO NORTH DAKOTA

- Regional and state leadership and expertise in CCS and CCUS.
- Help the state of North Dakota maintain a leadership role in the deployment of CCS and CCUS.
- Advance carbon management practices, including CO_2 utilization to ensure the greatest ultimate recovery of the state's oil and gas resources.

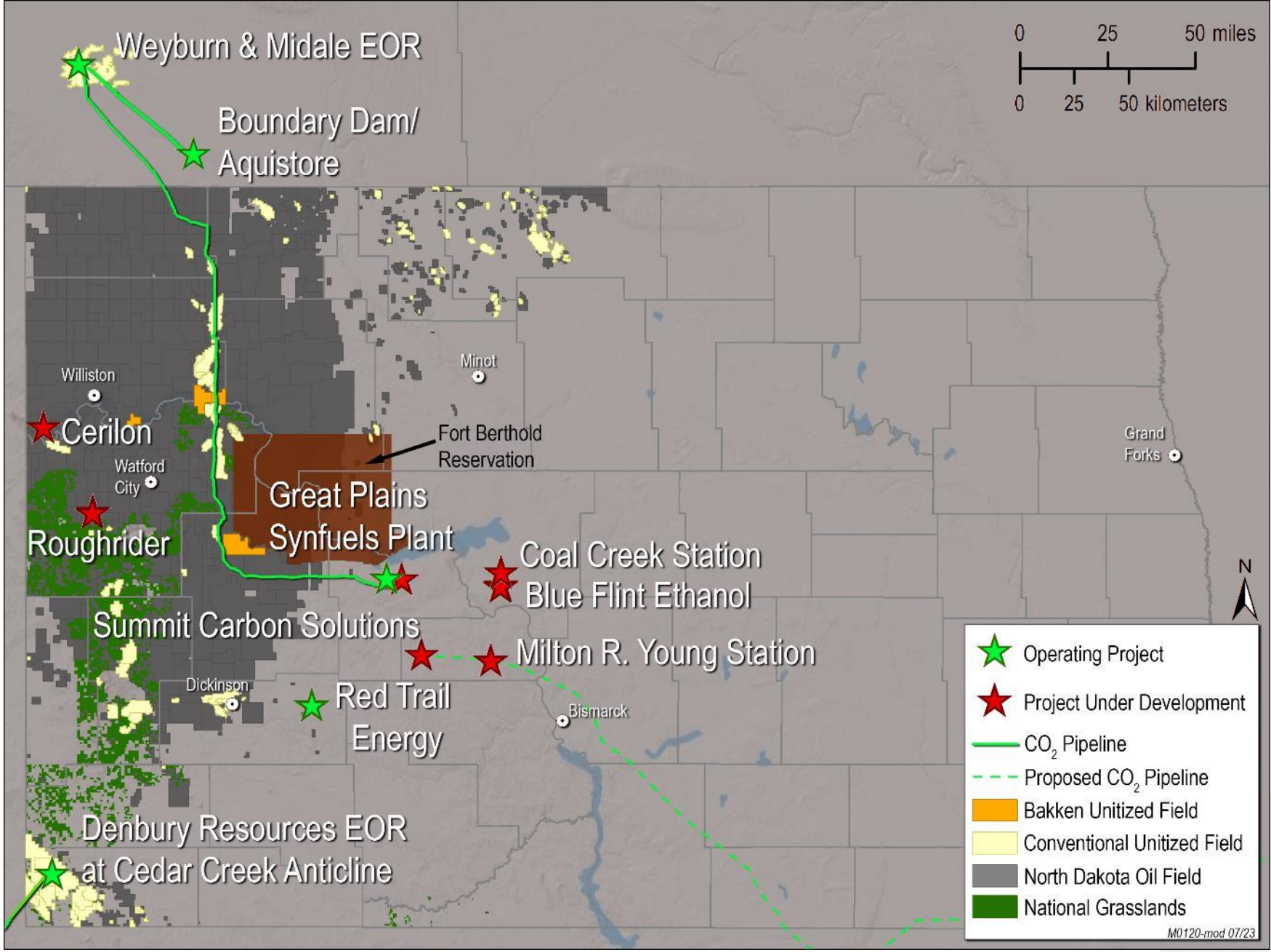
Geologic Storage Permits Approved in ND:

1. Red Trail Richardton Ethanol Broom Creek Storage Facility #1, Stark County
   - Permit to inject issued March 2023.
2. Minnkota Center Milton R. Young Station (MRYS) Broom Creek Storage Facility #1, Oliver County
3. Minnkota Center MRYS Deadwood Storage Facility #1, Oliver County
4. Dakota Gasification Company (DGC) Beulah Broom Creek Storage Facility #1, Mercer County
5. Blue Flint Underwood Broom Creek Storage Facility #1, McLean County
   - Permit to inject issued May 2023.

Pending Geologic Storage Permits in ND:

1. DCC West Project LLC (Broom Creek) (hearing 6/30/2023)

NORTH DAKOTA CCS/CCUS ACTIVITY



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FUNDED PCOR BUDGET

- The North Dakota Industrial Commission (NDIC) committed to supporting PCOR's 5-year effort by matching U.S. Department of Energy (DOE) funding with cash cost share:
  - Up to $2M through the Lignite Research Program (LRP).
  - Up to $2M through the Oil and Gas Research Program (OGRP).

- The EERC applied for $5M in additional funding from DOE in 2022. DOE recompeted the appropriated funds through a new Funding Opportunity Announcement (DE-FOA-0002799). Likewise, 2023 appropriated funds will be recompeted per DOE's Notice of Intent (DE-FOA-0003013).

- The EERC requests the remaining cost-share commitment from OGRP for $500,000.

	2019	2020	2021	Total
DOE	$5,000,000	$5,000,000	$5,000,000	$15,000,000
NDIC – OGRP	$500,000	$500,000	$500,000	$1,500,000
NDIC – LRP	$500,000	$500,000	$500,000	$1,500,000

PCOR BUDGET

Funding Source	Commitment to DOE Program as of May 2023	May 2023* Request	Total Program
DOE	$15,000,000		$15,000,000
NDIC OGRP	$1,500,000	$500,000	$2,000,000
NDIC LRP	$1,500,000	$500,000	$2,000,000
University of Wyoming	$377,424		$377,424
University of Alaska Fairbanks	$375,450		$375,450
Industry	$0	$1,139,990	$1,139,990
Total	$18,752,874	$2,139,990	$20,892,864

* If DOE does not provide additional funding, the May 2023 request will be considered complementary funding to advance the goals and objectives of the PCOR Partnership Program and will not be reported to DOE as cost share.

SUMMARY

- There is a continued need for the PCOR Partnership to lead the region in CCUS.
- PCOR can help the state of North Dakota maintain a leadership role in carbon management, including the deployment of CO_2 utilization technologies to maximize the ultimate recovery of the state's oil and gas resources.
- The PCOR Partnership continues to grow with new industry, state, and regulatory members each month.

Kevin Connors
Assistant Director for Regulatory Compliance and Energy Policy
kconnors@undeerc.org
701.777.5236

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

www.undeerc.org
701.777.5000

THANK YOU

Critical Challenges. Practical Solutions.

CLEAN SUSTAINABLE ENERGY AUTHORITY PROJECT MANAGEMENT AND FINANCIAL REPORT

Reice Haase, Deputy Executive Director, NDIC

July 28, 2023

CSEA
CLEAN SUSTAINABLE ENERGY AUTHORITY

NORTH Dakota
Be Legendary.™

ACTIVE PROJECTS

10
Active Projects

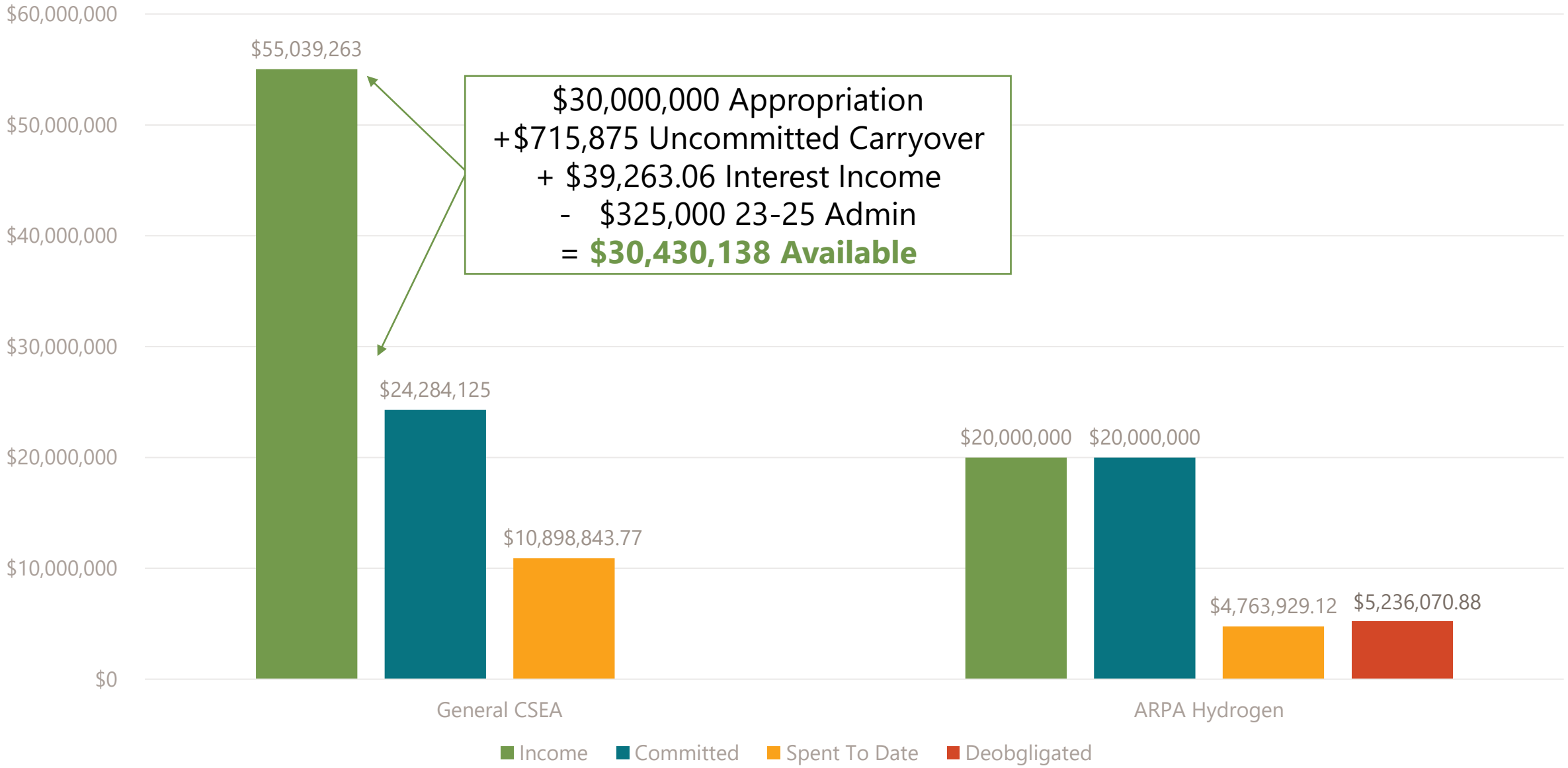
$15.6 Million*
Paid To Date

$44.3 Million
Awarded Dollars

$23.3 Million
Payable Dollars

$30.4 Million
Cash Available for Commitment in 2023-2025 biennium

Clean Sustainable Energy Fund



CSEA Project Status

Project Name	Company	Total Project Cost	Loan	Grant Committment	Spent to Date	Deobligation	Remaining Obligation
Dakota H2 Hub	Bakken Energy LLC	1,750,000,000.00	80,000,000.00	10,000,000.00	4,763,929.12	5,236,070.88	-
Cerilon GTL	Cerilon GTL ND Inc. GTL Project	2,800,000,000.00	40,000,000.00	7,000,000.00	6,300,000.00	-	700,000.00
Unlocking the Full Potential of Produced Water as a key Component of Clean Sustainable Energy	Wellspring Hydro	2,200,000.00	-	1,000,000.00	366,086.50	-	633,913.50
Commercial Deployment of Carbon Dioxide Capture & Geological Sequestration in McLean County	Midwest AgEnergy Group	58,800,000.00	15,000,000.00	3,000,000.00	2,700,000.00	-	300,000.00
Front-End Engineering and Design for CO2 Capture at Coal Creek Station	Energy & Environmental Research Center (EERC)	15,065,200.00	-	7,000,000.00	1,532,757.27	-	5,467,242.73
Solving North Dakota Flaring	Valence Natural Gas Solutions	44,000,000.00	15,000,000.00	-	-	-	-
Internal Combustion Engine Carbon Capture and Sequestration	Enerplus Resources (USA) Corporation	18,110,000.00	-	1,000,000.00	-	-	1,000,000.00
Project Tundra	Minnkota Power Cooperative	1,400,000,000.00	100,000,000.00	-	-	-	-
Liberty H2 Hub Front-End Engineering and Design	Energy & Environmental Research Center (EERC)	24,290,528.00	-	10,000,000.00	-	-	10,000,000.00
Project Phoenix: Manufacturing bio-degradable polymers using methane as a feedstock	Newlight Technologies	8,371,250.00	-	4,185,625.00	-	-	4,185,625.00
Geothermal Power Generation for Oil and Gas Production	Enerplus (USA) Corporation	2,197,000.00	-	1,098,500.00	-	-	1,098,500.00
		4,373,033,978.00	**170,000,000.00**	**44,284,125.00**	**15,662,772.89**	**5,236,070.88**	**23,385,281.23**

PROJECT HIGHLIGHT: VALENCE

Captured over 1.7 Billion Cubic Feet ("BCF") of otherwise flared gas

Emissions reductions of over 155,000 tons of CO_2e

= **$31.3 Million** in additional tax revenue to the state

Clean Sustainable Energy Authority

Grant Round 4 Recommendations (July 25, 2023)

Grant #	Application Title	Applicant	Principal Investigator	Grant Funding Recommended	Loan Recommended	Total Project Costs	Category	Duration
C-04-A	Bushel Farm Traceability Dashboard	Bushel, Inc.	Luke Swenson	$3,500,000	$0	$12,265,250	IT/Agriculture	36 months
C-04-D	Project Tundra	Minnkota Power Cooperative	Andrew Sorbo	$0	$150,000,000	$1,400,000,000	Carbon Capture	4 years
C-04-E	Project Phoenix	Newlight Technologies, Inc.	Kenton Kimmel	$0	$30,000,000	$446,000,000	Carbon-negative manufacturing	35 months
C-04-F	Lignite Combustion Product Enhancements	Rainbow Energy Center	Jessica Bell	$0	$42,500,000	$85,000,000	Coal Facility Waste	30 months
C-04-G	Unlocking the Full Potential of Produced Water	WellSpring Hydro	Mark Watson	$5,000,000	$0	$250,886,700	Produced Water	26 months
Total All Funds:				**$8,500,000**	**$222,500,000**	**$2,194,151,950**		
Remaining Funds Available:				**$21,900,000**	**$27,500,000**			

Submitted by: Bushel, Inc.
Project Duration: 36 months
Total Project Costs: $12,265,250
Request for: $5,529,362 grant

Summary of Project: This project supports the creation of a farm traceability dashboard for tracking carbon reductions in production agriculture.

Technical Review Results

Overall Technically Sound (217/315)		
Good	1	
Fair	2	
Questionable		

BND Economic Feasibility Recommendation

Overall Economic Feasibility	
Yes	X
No	

Technical Committee Scores

	Score (Out of 50)
Charlie Gorecki	28
Josh Teigen	40
Dave Glatt	25
Lynn Helms	38
Justin Kringstad	35
Rachel Retterath	37
Todd Steinwand	33
John Weeda	25 with condition

Average: 33

CSEA Recommendation: Approve $3,500,000 grant for Software Development and Pilot Program tasks

Clean Sustainable Energy Authority

North Dakota Industrial Commission

Application

Project Title: Bushel Farm Traceability Dashboard

Applicant: Bushel Inc.

Date of Application: May 18, 2023

Amount of Request
Grant: $5,529,362
Loan:

Total Amount of Proposed Project:
$12,265,250

Duration of Project: 36 Months

Point of Contact (POC): Luke Swenson

POC Telephone: (701)238-1880

POC Email: Lswenson@bushelpowered.com

POC Address: Bushel Inc.
503 7th St N
#300
Fargo, ND 58103

TABLE OF CONTENTS

Please use this table to fill in the correct corresponding page number.

ABSTRACT

Objective:

Bushel is proposing the creation of the Bushel Farm Traceability Dashboard to aggregate all aspects of farming activities to help increase adoption and production of lower carbon renewable energies. Bushel will reduce the carbon footprint of agriculture and the renewable energy sector by using Bushel's extensive network, expertise, and software platforms to enable farmers a simple path to creating differentiated, lower carbon (more sustainable) commodities.

This will be done by creating more robust integrations with existing Bushel software solutions, which are currently in use in approximately 45% of North American grain receiving facilities. Additionally, growers use Bushel software to oversee more than 100 million acres of mapped cropland today. Removing the complexity of gathering, standardizing, cleaning, and reporting on the many aspects of different lower carbon projects is one of the biggest challenges governments, states, companies, and individuals face. Bushel is uniquely positioned to tackle this in a fashion that will take others years to attempt to replicate and Bushel will be commercially available in 36 months across the country.

Expected Results:

This project will have significant environmental and economic impacts in North Dakota and beyond.

Environmental Impact: Within five years Bushel anticipates software adoption by renewable energy refiners/processors will be >70%, up from +/-40% of ethanol and <10% of soybean crush today. The increase in adoption will feed Bushel's goal of over 7 million tons of carbon being sequestered annually by 2028, five years after Bushel starts development. This reflects 6% of US corn and soybean acres adopting new sustainable practices. Additionally, Bushel's project partners forecast 25-50% of renewable fuel production requiring lower carbon inputs by 2030, which would significantly exceed Bushel's modeled impact. In addition, the Bushel Farm Traceability Dashboard will be applicable to all 320 million acres of primary cropland in America.

Economic Impact: This project will benefit everyone from the farmers who grow commodities to ethanol and renewable diesel processors/refiners, to commercial grain entities, consumers, and the state of North Dakota. Conservative, annual revenue projections are upwards of $25 million for North Dakota farmers and $560 million nationwide. Revenues for processors and refiners will reflect similar results.

Duration: 36 Months

Total Project Cost: $12,265,260

Participants:

- Bushel Inc.
- Red Trail Energy
- North Dakota Soybean Processors
- ANEW Climate

PROJECT DESCRIPTION

Objectives:

What if North Dakota capitalized on the private business foundation of Bushel's digital data collection platform to unlock scalability for lowering carbon and environmental impacts for the sustainable energy and production agriculture industries in North Dakota and beyond? Bushel, Inc., a North Dakota-based company, has amassed potentially the largest digital grain and field level dataset in the U.S. over the past six years.

With its secure digital reach, infrastructure, and widespread user adoption, Bushel is uniquely positioned to provide the technology infrastructure necessary for sustainable agriculture production to scale in North Dakota and beyond. By partnering with the Clean Sustainable Energy Authority (CSEA), Bushel aims to deploy its data collection platform to empower farmers to prove out, verify, and demonstrate traceable, sustainable practices that can be utilized to produce differentiated grains for renewable energy refiners and processors.

Bushel will develop the “Bushel Farm Traceability Dashboard” to change the landscape of low carbon agricultural and renewable energy production. This dashboard will be built into the already existing *Bushel Farm* farm management software platform.

Historically, the procurement, tracking, and profitability of sustainably produced inputs have posed significant challenges for renewable energy refiners as farmers aren’t properly equipped or incentivized to adopt sustainable, lower emissions practices. Tracking field level information is difficult for the farmer. Additionally, providing a program that requires a high level of administration is taxing on the grain buyer. Bushel’s solution helps both parties connect with the right data in real time. Efficient administration of data collection, aggregation, standardization, and distribution will provide adoptable, premium solutions for sustainably produced energy products, and help reduce agricultural and renewable energy emissions. To effectively monetize changes in inputs for sustainable and renewable energies, as well as sustainable foods, we must address the monetization and existing heavy burden of change management aspects for farmers.

The United States and global economy are driving demand for sustainable energy. They are being led by both states and industry with the likes of California driving the narrative, while the federal government tries to catch up with plans around how to help carbon markets succeed. We are rapidly approaching a crossroads where hundreds of millions of tons of carbon reduction will be necessary each year, yet the supply is woefully insufficient to meet those needs. The agriculture industry, more than any other industry in the developed world, is well positioned to help reduce carbon footprints and effectively market and monetize the results of collective sustainability efforts.

To compound the situation, many companies, cities, regions, and individuals have made pledges to reduce their respective carbon footprints in the coming years. Some aim to achieve this by 2025, while

many more have set targets for 2030. Shockingly, more than two-thirds of the largest 2,000 publicly traded companies that made such pledges have no roadmap to reduce their carbon footprint.

This presents a significant market opportunity for new products and revenue generation, unlike anything seen before in agriculture or energy production. Just as the shale revolution reshaped fossil energy production in the US, the carbon and sustainability needs of our economy are now reshaping agriculture. This opportunity allows both industries to collaborate and achieve rapid scale adoption in a way that benefits them mutually.

Bushel's proposal seeks to bridge the gaps in the supply chain, facilitating faster and more efficient market growth to meet the increasing demand for sustainably sourced grains. By doing so, we will enhance the capacity of renewable energy processors and refiners to produce premium sustainable energies that can meet the world's needs while drastically reducing the carbon footprint of both renewable energy and agriculture. We will do this from a position of helping farmers be incentivized for their change in practice, rather than legislative action. This is how the industry can shift to meet the carbon sequestration needs coming from corporations and states in the coming years.

By combining Bushel's existing software platforms with further development, the company envisions enabling renewable energy refiners to create premium sustainable energy solutions using more sustainable agricultural practices while increasing revenues throughout the supply chain. Currently, Bushel has connected approximately 2,400 grain elevator/processor locations through its platform, engaging over 100,000 farmers, and mapping more than 110 million acres of fields. In our home state of North Dakota we have over 100 elevator/processor locations using Bushel with their farmers and over 4,000 more farmers specifically using Bushel Farm. Over the past decade, Bushel has invested over $100 million in its products, with $37 million dedicated solely to the development of the Bushel Farm platform, which will specifically house the Bushel Farm Traceability Dashboard.

Leveraging its North Dakota headquarters and existing network, Bushel aims to create a user-friendly, permission-enabled, and secure digital interface within the next 24 months. Bushel will enable farmers to confidently track and market differentiated commodities to existing and future renewable energy refiners. The commercialization effort will coincide with the development process, utilizing Bushel's network, dedicated staff, and industry representatives to drive adoption and awareness of the market potential for premium, lower carbon renewable energy products. This project will make a significant impact on North Dakota in the near term and will expand to all American farmers.

One of the challenges in monitoring and reporting greenhouse gas emissions (GHGs) and carbon sequestration lies in the need to collect and manage data from as many as 10-20 disparate systems. These data sources include proof of yield reports, crop inputs, field-level activities, soil samples, storage activity, and more. Bushel recognizes the significance of developing a streamlined and comprehensive sign-up/management system that handles this information. If chosen to advance this pivotal technology within the state and the country, Bushel is committed to pursuing the project alongside the CSEA and other projects. Given Bushel's unique position at the intersection of data, technology, and sustainability, the company is best suited to tackle the complexities of this opportunity.

Bushel possesses a unique set of capabilities that positions us as a leading force to address the immense challenges associated with carbon reduction. Our extensive reach and expertise enable us to undertake a project of this scale with confidence. The economic impact of our Dashboard will be just as significant as the environmental impacts. From farmers to refiners, the change in ease of adoption and monetization will have far reaching implications to renewable energies and reducing the carbon footprint of energy and agriculture in North Dakota.

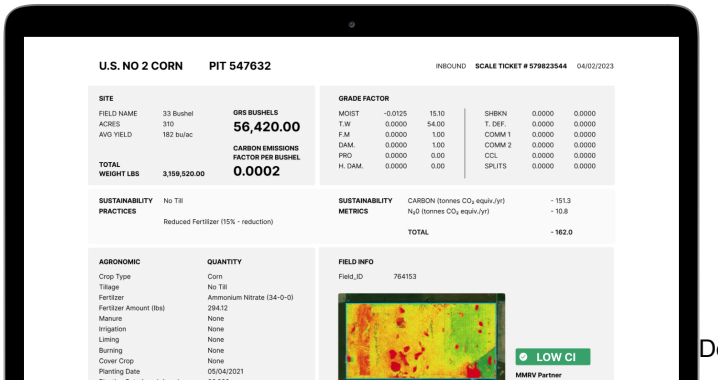
Methodology:

The value of this dashboard is that unlike many sustainability projects that point to a single methodology, Bushel is creating technology that can house, facilitate and support any existing and future methodology. This means the best projects available today, and the highest quality, scalable methodologies of the future can seamlessly scale on Bushel's network. That is something exclusive to Bushel and its reach across American agriculture. Think of Bushel as the interstate upon which the sustainability data will reside. Bushel can be the catalyst for adoption in a location where the farmers and industry trust their data to reside, and be used to create value.

Starting from the farm gate, Bushel is able to support the adoption and success of all existing and future methodologies, achieving scale and impact throughout the entire supply chain. This is unseen in American agriculture today. There is no other company that has the field level reach, grain accounting data points, and farmer adoption of digital tools. Bushel's technology is designed to enable market participants to adopt and scale sustainable practices, both today and in the future with significant ease compared to older existing methodologies/projects. For baseline sake of argument, we have utilized a simple methodology from the University of Nebraska Lincoln focusing on cover crops and no-till. As a baseline for result assumptions in this proposal, the programs integrated into our flexible platform will likely vary by region. Different regions may adopt diverse practices such as low carbon fertilizer, no till, strip till, cell grazing, cover crops, water management, double cropping, natural fertilizer, and more.

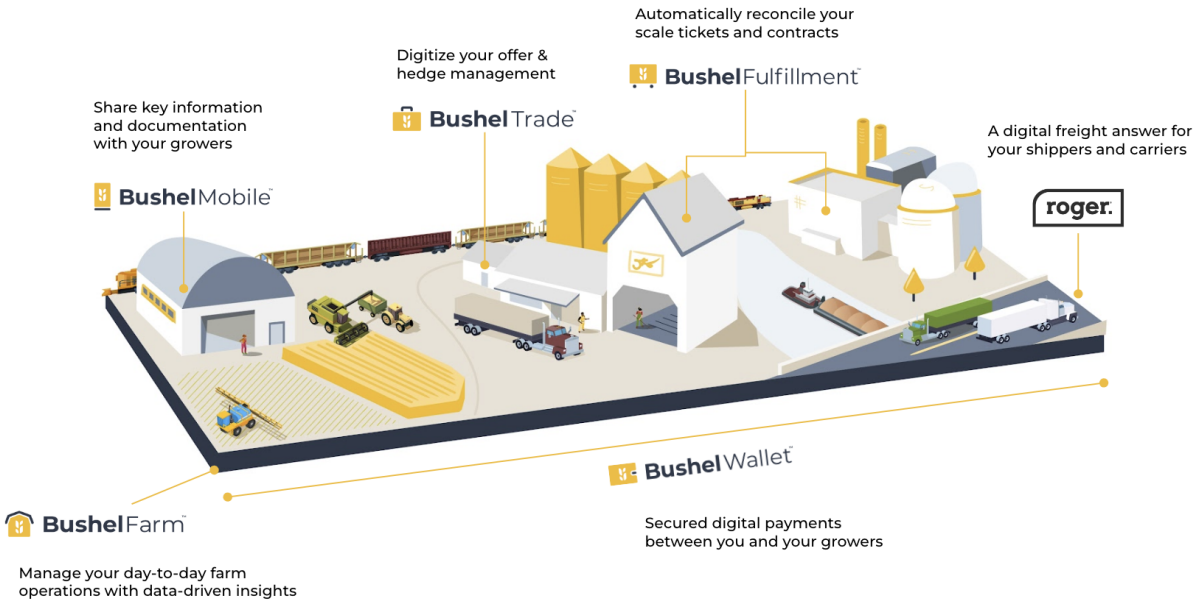
The proliferation of sustainability programs in the US has led to a heavy reliance on multiple metrics that are present in many programs, ranging from field-level data on tillage and fertilizer practices to logistical metrics such as the distance grain travels before processing. However, the fragmented and incomplete nature of available data often hinders the creation of new markets. This is where Bushel is unique: Bushel has brought together disparate datasets that have the ability to unlock new revenue for both farmers and grain facilities/processors.

To address this, issue Bushels brings together commercial industry activity and all of the farmer's field activities. This creates a "super scale ticket" for the grain buyers our farmers sell to, enabling them to confidently know they have bought a true, low carbon differentiated commodity. Our rapid growth has made Bushel one of the largest



repositories of farmer field activity data globally, combined with all delivery, contract, and quality metrics. While our connections were initially established to streamline transactional business with elevators, they have inadvertently created a pipeline that enables the true marketability of sustainably sourced agricultural products and traceability.

Although sustainability reporting was not our original plan, Bushel is now just a few steps away from being able to handle all the activities necessary to validate and transfer all relevant data for sustainable practices from the farmer to the end of the supply chain. The availability of our datasets can support existing sustainability initiatives within the industry and facilitate the easier creation and scalability of future low carbon energy products. We can further assist by leveraging our extensive network in the grain space to facilitate partnerships between end-users and the industry in developing future product methodologies.



In addition to benefiting the renewable energy sector, the Bushel Farm Traceability Dashboard can also aid other industries such as food, livestock, low carbon coal power, etc. With new North Dakota legislation allowing large-scale livestock production in North Dakota, our platform can help monitor power usage and emissions in those facilities. This would enable a dairy to accurately source low carbon corn, DDGs, and alfalfa, and potentially consume low carbon captured coal power off of Minnkota Power Cooperative's transmission from Project Tundra. Resulting in some of the lowest carbon footprint dairy products accessible in the world – and it works for all confinement protein sources.

Through a strategic alliance with Anew Climate and other key stakeholders in the sustainability markets, Bushel is uniquely positioned to drive the creation, adoption, and success of new projects more effectively than previously possible due to the existing fragmented systems in place. By leveraging our

integrated platform, Bushel has the capacity to enable the implementation of innovative methodologies from various market participants, thereby fostering greater adoption of sustainable practices.

What sets us apart is the significant support we have garnered from companies like Anew that have traded over 600 million tons of emissions credits individually. This substantial backing underscores our commitment to facilitating the adoption of current and future methodologies, ensuring a comprehensive approach to sustainability.

With Bushel as the catalyst, revolutionizing the sustainability landscape and empowering diverse stakeholders, we are paving the way for a more cohesive and impactful future. The Bushel Farm Traceability Dashboard holds immense potential to transform multiple sectors, enabling sustainable practices, driving market development, and generating positive environmental impact. By embracing this innovative solution, we can usher in a new era of sustainability, creating a more resilient and prosperous world for generations to come.

Anticipated Results:

In 2020, the agriculture sector alone accounted for approximately 670 million metric tons of carbon dioxide, representing 11.2% of total US emissions. Transportation contributed 27.3%, while industry accounted for 30.3% of emissions. With the Traceability Dashboard operating at scale, the agriculture sector has the potential to make significant changes to this distribution by incentivizing practice changes and supporting renewable fuels initiatives. Bushel's goal is to reduce agriculture's footprint faster than any other segment of our economy.

When looking at the net outcome environmentally, we have to pick a baseline methodology for our dashboard to compare against. Success means the adoption of any sustainable practice. Bushel will specifically reference The Carbon Farming analysis conducted by the University of Nebraska Lincoln which has shown that implementing practices such as no-till farming and cover crops can result in an average sequestration benefit of 0.76 metric tons per acre per year. Although these practices may not be universally applicable to every field or farmer, there are various opportunities to make sustainable adjustments in different regions of North Dakota and the entire country. If you extrapolate broad findings like this across the breadth of the US you can see the potential benefits. If region specific practices resulted in that same level of sequestration, you could see upwards of 200 million tons of carbon sequestration per year across the approximately 320 million acres of primary grains in the US. Flexible, scalable technology such as our proposed Traceability Dashboard enable the market to achieve reductions of this magnitude, and allow agriculture to make some of the largest and quickest adjustments to meet future carbon requirements. Bushel Farm's Traceability Dashboard will enable farmers to better realize the returns on their practice changes. The need for a solution that accounts for all crops, not just renewable energy inputs, means that even during off rotation years those farmers can continue to reap the benefits of their sustainable activities.

Consequently, this will enable North Dakota to continue its progress toward becoming the first carbon-neutral state in the country. Our goal is to have 10 million acres administering new sustainable practices by 2028, sequestering (or reducing) approximately 7.6 million tons of carbon per year. This can be accomplished in North Dakota alone with a strong launch and market support.

From a financial perspective, the opportunities are equally significant. Our approach is to create scalability at the farm gate and extend that to consumers led by the opportunity of market value monetization. Based on CARB's data, the potential value for lower carbon corn/beans at the farm gate ranges from 10 to 40 cents per bushel. If the US renewable industry were to scale to using 50% low carbon differentiated grains by 2030, the revenue increase for farmers would exceed $25 million in North Dakota and $560 million across the US annually. These estimates assume a conservative premium of only 15 cents per bushel for farmers. The actual premium to meet the demand when 2030 corporate obligations arrive is likely to be much stronger.

The net result of Bushel Farm's Traceability Dashboard is that renewable energy processors will have a direct, digital pathway to access the necessary data for procuring differentiated grains, enabling the creation of lower carbon fuel products at renewable energy refining facilities on a large scale. This data will empower corn/soybean processors and grain buyers to confidently offer premium prices for sustainably sourced commodities, thus increasing supply and options for consumers. This project holds significant potential for farmers not only in the US but also across the world.

Facilities:

Development for this project will be led by Bushel Inc., headquartered in Fargo, North Dakota. While our partners and supporters span across the country, we believe it is essential to begin piloting our tools with companies based in North Dakota. Our initial focus will be on demonstrating the value of our solutions in multiple sectors, starting with ethanol and renewable processors within our state.

We are thrilled to have the support and participation of **Red Trail Energy**, a leading sustainable energy producer. They have expressed their commitment to pilot our dashboard and are eager to potentially become the first carbon-negative ethanol facility in the country. Their letter of support is attached, highlighting their enthusiasm for our project.

Additionally, **North Dakota Soybean Processors** has agreed to pilot the Bushel Farm Traceability Dashboard. NDSP will own and operate a new soybean processing plant expected to begin operations in Summer 2024. NDSP has also agreed to provide a letter of support for our project and the value it would bring.

From an energy and food ingredient perspective, **The Arthur Companies** has already stepped forward and expressed their interest. Their milling venture in the Pacific Northwest is already experiencing

significantly monetized demand for the solution that Bushel is offering within this project. Also being a future supplier to NDSP, they see the synergies and support for each other.

Through collaboration with partners like **Anew Climate**, Bushel can leverage its consolidated data set to uncover and develop new carbon methodologies and projects that were previously impossible due to the challenges of aggregating essential datasets. This partnership enables the acceleration of market evolution, surpassing the pace witnessed thus far. By combining our forces, we can catalyze the emergence of innovative initiatives and propel the carbon space towards unprecedented growth and impact.

Dr. Dave Ripplinger from North Dakota State University has been helpful in an advisory capacity, and will continue to assist as we progress with this project and encounter many challenges and opportunities as the emissions and renewable fuels markets evolve in the coming years.

We are grateful for the enthusiastic response from these organizations, all of whom eagerly embraced the opportunity to participate in our project. Their support and involvement will be invaluable as we advance and demonstrate the effectiveness of our solutions. With strong domestic investment in ethanol, bean processing, and refining, North Dakota has top tier facilities, infrastructure, and intellectual capital for a project such as this.

Resources:
The value added by Bushel's existing network is rooted in its expansive reach, boasting over 2,500 locations nationwide that serve as direct farmgate buyers. Moreover, our products foster direct interactions with over 100,000 farmers. This network encompasses several prominent grain buying entities in the country, including many within the top 20 grain traders, offering valuable testing opportunities for all aspects of our Traceability Dashboard and future applications.

In addition to our project partners, pilots, and advisors, we will engage various other parties to bolster our project. Our core development team will be based in Fargo, benefiting from the comprehensive expertise of Bushel's development teams. To meet our staffing requirements, we will combine new hires with specialists from other areas of Bushel as necessary. Once the project is underway, we will assemble a dedicated team in collaboration with our existing Bushel Farm team.

Furthermore, we have established relationships with retail agricultural companies, land grant institutions, researchers, economists, lobbyists, regulators, and more. These connections will play a pivotal role as we navigate the different phases of the project, offering support, expertise, and guidance.

We are excited to have Anew Climate as a partner as the largest developer of environmental attribute projects in North America. Their storied history going back decades will be helpful as our dashboard takes shape. With the ability to develop new projects as industry and consumer demands change and emerge, they will help increase adoption even more rapidly when commercialization occurs.

Some of our partners may take on specific tasks or contribute to certain project components, utilizing our shared funding to develop elements that may not fall directly within Bushel's purview or to facilitate the commercialization of products and methodologies moving forward. These partnerships may involve:

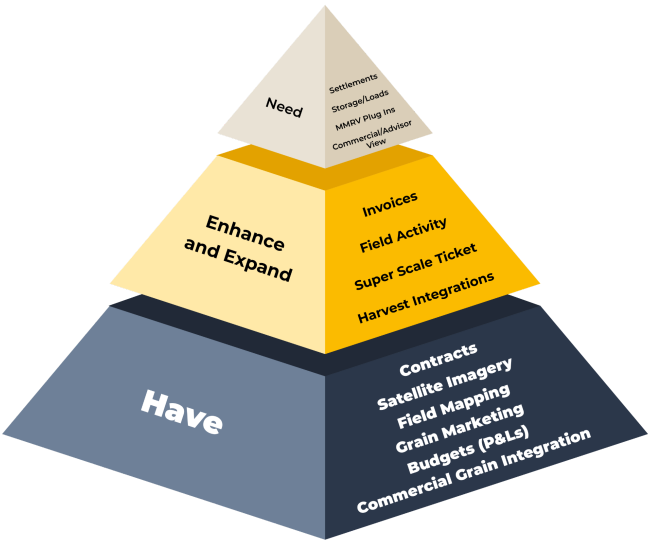
- Cross-industry committees for research, input, and oversight on our development.
- Collaborative efforts with Land Grant Institutions to create and support methodologies for potential differentiated commodity products.
- Collaboration with Market/MMRV/Trading companies to develop and commercialize new methodologies using the foundation of Bushel's Traceability Dashboard, overcoming previous challenges in commercialization.
- An industry advisory committee as our Traceability 0Dashboard comes to fruition.

Techniques to Be Used, Their Availability, and Capability:

From a development perspective, our team already comprises nearly 100 full-time software developers who have been instrumental in building the technologies that have brought us to where we are today. For our sustainability push, we will expand this team while maintaining the same commitment to quality software development that our customers have come to expect. As a secure software company dealing with data, money movement, and privileged confidential information, we adhere to SOC 2 compliance standards, ensuring that every aspect of this project, from design to development to security, is held to the highest standards.

We will leverage Bushel's significant investment in our two core products directly. The APIs between the commercial entities and farmers will play a crucial role in every step of this project. Bushel Farm, our farmer-facing farm management software, will serve as the host platform for the Traceability Dashboard. Developing the Traceability Dashboard will require a diverse range of developers, including front-end developers, UX/UI experts, graphic designers, back-end coders, Q/A specialists, marketing professionals, branding experts, and more. We will draw from the playbook that has already proven successful with our existing customer base.

Bushel's extensive connections and network will be utilized to seamlessly integrate field-level data, grain contracts, deliveries, and all necessary parameters with the processing facilities. This will enable efficient and paperless management of all records in the production of these lower carbon and more sustainable energies.



Our partners, carbon market participants, MMRVs (Measurement, Monitoring, Reporting,

and Verification), and other yet-to-be-named collaborators will connect to Bushel's APIs for authentication and to store the relevant data, attributes, and certifications related to the grains and renewable energies created. Purchasers, and those in the supply chain buying differentiated commodities, will have access to this information as well through our new advisor/commercial view.

Environmental and Economic Impacts while Project is Underway:

During the initial 24-month phase of this project, the environmental impacts will be limited to farmers and land directly involved in the pilot process. All field data will be tracked through Bushel Farm. Once the connections are established (estimated to be early 2025), we will commence co-marketing the opportunities and scalability of these results alongside Bushel Farm's new Traceability Dashboard.

By the start of the 2025 growing season, we anticipate that commercialization efforts will be in full swing and the potential of the Traceability Dashboard will become increasingly evident. This significant milestone will not only generate additional revenue for participating farmers but also mark the inaugural season of lower carbon sustainably produced agricultural products that can be scaled and marketed through the renewable energy pipeline.

Ultimate Technological and Economic Impacts:

The current Carbon Accounting process in various industries is extremely fragmented, involving disconnected parties and cumbersome paper-based systems, along with laborious support, audit, and verification processes. Our ultimate objective is to revolutionize the agricultural industry's ability to process and report in real-time by developing a paperless, digitally permissioned reporting system that is instantly adaptable to unlimited market changes and opportunities. As the carbon and sustainability markets continue to evolve, our adaptable toolset will meet the changing parameters.

Through our Traceability Dashboard, we not only support existing specialty products and processes but also facilitate faster market evolution, providing unmatched ease compared to competing products. The economic impact of our solution extends beyond our state or country and has global scalability. Once commercially launched on a broad scale, our solution has the potential to significantly increase farmers' revenues nationwide. According to estimates by CARB, farmers in North Dakota could generate $30-50 per acre in additional revenue. By 2025, North Dakota is projected to produce over 500 million gallons of ethanol and renewable diesel annually from corn and soybeans. Introducing a scalable option for farmers to monetize their sustainable practices and sell premium products could potentially generate over $50 million per year for our state's farmers. Additionally, by capturing a 10 cent per gallon premium on sustainable fuels, refiners in North Dakota alone could gain an additional $50 million in revenue.

These estimates focus solely on the impact within North Dakota, but when expanded nationwide, the multiplier effect becomes even more significant. Increasing the value of corn and soybeans to processors

by just 15 cents per bushel (with estimates suggesting that lower carbon inputs can be worth upwards of 40 cents more per bushel according to CARB) would result in an annual revenue increase of $1.15 billion for US corn and soybean producers. Similarly, applying this to the national scale of our 20 billion gallon ethanol and renewable diesel markets, a 10 cent per gallon increase in the value of the fuel created translates to an additional $2 billion in revenue annually.

Furthermore, this proposal only scratches the surface of the value derived from other areas of monitoring and enablement, such as livestock, grain for food, feedstock, and monitoring agriculture-related energy use. The second-order effects of this project have the potential to redefine agriculture and create new revenue opportunities for decades to come.

Why the Project is Needed:

With the increasing focus on carbon reduction, discussions about the need for change have intensified. However, scalable opportunities that can effectively incentivize a shift in practices are lacking. The United States is rapidly approaching a critical point in supply and demand, and our existing infrastructure is ill-prepared for this challenge. Surprisingly, despite more than one-third of the largest 2,000 publicly traded companies committing to significant carbon footprint reduction by 2025 or 2030, over two-thirds of these companies lack a concrete plan or strategy to achieve these goals. Many of these corporations lack a solid understanding of production agriculture and how our technology can assist them in achieving their objectives.

Considering Bushel's proven success in other areas of agriculture and data, we believe this is the most promising investment opportunity for CSEA in this biennium. By leveraging our market reach and addressing the sustainability needs of our state, corporations, and country, Bushel is well-positioned to assist all stakeholders involved.

Given the United States' prominent role in renewable fuels production and the imminent revolution in renewable diesel, no industry is better positioned than agriculture to make a significant impact on carbon reduction. To fulfill the objectives of these corporations, it is crucial to incentivize the production of American commodities such as corn, soybeans, and other grains while establishing robust systems to monitor and track their sustainable attributes.

Although niche products have emerged and achieved limited success in the market, there has yet to be an infrastructure with comprehensive market-making capabilities that can truly establish a scalable market for the industry's success. This is precisely where Bushel, along with CSEA, our customers, network, and partners can surpass previous attempts and drive the industry forward.

STANDARDS OF SUCCESS

The primary objective of our project is to enable farmers and renewable energy processors to effectively monetize the adoption of widespread sustainable practices, thereby reducing the carbon footprint of agriculture and energy, while increasing revenue for farmers and the renewables industry. To date, farmers have faced challenges in embracing, reporting, and deriving value from differentiated commodities within the sustainability revolution.

By providing the market access to an agnostic tool that is able to collect, store, and disseminate data to any parties with secure data-permissioning, Bushel will enable market participants to adopt and scale sustainable practices. Additionally, we will also increase the market's ability to evolve quickly, attract, and create new practices, methodologies, and ideas. This feeds directly into our state's goal of carbon neutrality and makes it all the more attainable.

The ultimate measure of success for this project is whether Bushel has successfully developed and implemented a scalable platform that encompasses the necessary functionality to track, monitor, and facilitate the sale of differentiated commodities across diverse platforms, products, and suppliers.

To consider this project a success internally, Bushel aims to have over 10 million acres in Bushel Farm actively engaged in differentiated commodity reporting by the 2028 marketing year. This adoption would translate to an estimated sequestration of 7.6 million tons of carbon that year (based on a University of Nebraska Lincoln study on carbon farming), yielding significant ripple effects on Bushels revenue and subscription base.

The public and private sectors will both benefit from our finished Traceability Dashboard as the increase in the market for carbon offsets, differentiated commodities, and easier movement of data will enable all participants to increase participation, liquidity, and motivation around sustainability.

With such widespread adoption, there would be no limit to the scalability of Bushel Farm, as it could accommodate any number of acres moving forward. We firmly believe that the combination of our product and the growing market for sustainable renewable energies has the potential to revolutionize traceability in agriculture on a global scale.

BACKGROUND/QUALIFICATIONS

Our leadership has often joked 'had we known the effort it would take to build what we have built… Bushel might not have ever started.' The effort behind perfecting data integrations and data standardization across the continent has been arduous, but rewarding. Over the past 7 years, Bushel has scaled from 40 employees to over 200 employees today. Our Fargo-based team has proven itself time and again through our dedication and continued success.

Bushel's leadership team comprises individuals from various backgrounds, each with a strong agricultural history. Chief Technology Officer, Randy Gerhold, brings extensive experience from Microsoft, overseeing large-scale software projects. Co-founders Jake Joraanstad and Ryan Raguse have deep agricultural roots, growing up near Rolla and the Red River Valley. Chief Growth Officer, Michael Sharov, brings decades of expertise from John Deere, Granular, and Caterpillar, including his role as head of product strategy. Camille Grade, Chief Market Officer, is renowned for her branding, adoption, and visionary skills. The rest of Bushel's team possesses diverse experience in ag-tech, integrations, M&A, and software sales. We believe our leadership team represents the most well-rounded group in agri-tech today.

Bushel has integrated with 15+ different agriculture accounting platforms and an infinite number of variations within them which is something unmatched in the agtech industry. That effort and expertise has allowed Bushel to reach a scale of data and service to the industry that wasn't previously possible. Of the top 20 grain companies in the US, Bushel has relationships with over half of them – and more coming online each month.

Bushel works with some of the biggest agriculture companies in North America to help them solve problems through the effective deployment of software solutions. These customers include, but are not limited to: Cargill, Archer Daniels Midland, Consolidated Grain and Barge, The Andersons, AB In-Bev, Koch Industries, Bobcat, Ingredion, Animal Health International, Roger and, many more.

MANAGEMENT

Bushel has extensive experience in managing large-scale custom projects for our own software as well as third party-customers. In a similar fashion, we will monitor and stage investments from CSEA, working in focused teams with project managers, developers, and executive oversight to ensure progress, manage hurdles, and prevent scope creep.

Our Quarterly Planning and Alignment meetings will be the major planning ground each quarter, complemented by smaller sprints within these periods, enabling our teams to flex and focus depending on the specific needs of each project point. Monthly reporting documents will be submitted to CSEA, providing specific data points for each project.

One of the advantages of partnering with Bushel is our efficient structure, which enables us to avoid wasted time on full-time employees. We can flexibly allocate resources across various types of domain expertise (software developers, graphic designers, project managers, etc.) without experiencing any latent time in our schedules. As a result, this will reduce the overall cost of creating the Bushel Farm Traceability Dashboard.

To prevent scope creep in spending and better protect North Dakota's investment, we will hire a Senior Project Accountant so that we go above and beyond for reporting and monitoring our state's valuable capital.

To ensure maximum effectiveness and promote collaboration across various sectors, Bushel has a strategic plan in place to establish an inclusive and diverse advisory team. This cross-industry committee will play a vital role in shaping the project, ensuring that the perspectives and insights of all relevant stakeholders are taken into account. The objective is to develop a highly adaptable, reliable, accessible, and secure platform that meets the needs of all market participants.

Outlined below is a hypothetical breakdown of our preferred committee, reflecting a wide range of stakeholders from different sectors. This diverse composition will provide a comprehensive and well-rounded view:

1. North Dakota State University (Production Agriculture/Renewable Energies)
2. UND (University of North Dakota) EERC (Energy & Environmental Research Center)
3. Bio-Refiners and Processors (Ethanol/Renewable Diesel)
4. Fossil Fuel Industry (Coal/Oil & Gas Representative)
5. Regulatory (CARB - California Air Resources Board)
6. Independent Representative (Financial/Regulatory Sector)
7. Agricultural Representative (Farmer)
8. Governance (BND/State of North Dakota)

Bushel has always believed that better products are created by diverse, broad-reaching contributions. This collaborative approach will foster innovation and efficiency across industries, enabling the project to make a meaningful, sustainable, and lasting impact.

TIMETABLE

A project-by-project outline is provided as a separate appendix to this proposal titled: *Confidential: CSEA: Project Timetable/Budget Estimates*. Bushel will provide quarterly planning outlooks and regular updates as we advance through each independent objective within this overall proposal. These reports will be shared with CSEA following our Quarterly Business Review process, which all of our development teams follow for reviewing the previous quarter's activities.

While a significant portion of the project involves integrations, security, and API development, we anticipate the visible results to be delivered in the following sequential manner as we progress through the development stages.

Q3 2024: Farmers will have the ability to import most, if not all, their field-level activities directly into their Bushel Farm account from the top 10 necessary Machine Data integrations. We will also enhance the robustness and cost-effectiveness of our backend connections.

Q1-Q2 2025: Growers can permission their information to be shared through the Traceability Dashboard, handing buyers the needed sustainability metrics with which to create their low carbon test batch. Pilot

processors can conduct a 'test run' of specific grain data through their system. Success in this milestone will launch our overall commercialization and marketing strategy, targeting buyers across North America.

Harvest 2025: We anticipate producing and selling our first commercial batch of renewable, lower carbon fuel to an end user from one of our pilot facilities.

2026: Farmers will have the ability to consider and adjust their growing practices on a broad scale to meet the specific grain buying entities' product options. Our commercialization team, along with our MMRV and registry partners, will vigorously pursue and adopt products and processors into Bushel, further expanding the market for these renewable, sustainable differentiated commodities.

Our commercialization team, MMRV, and registry partners will be full-scale pursuing and adopting products and processors into Bushel to continue increasing the market for these renewable, sustainable differentiated commodities.

BUDGET

This is the Summary Budget, more details into the use, staffing and allocations are broken out in our attached appendix: ***Confidential****: CSEA Project Timetable/Budget Estimate*

Project Associated Expense	NDIC Grant	NDIC Loan	Applicant's Share (Cash)	Other Project Sponsor's Share	Total
Software Development	$3,702,600		$4,525,400		$8,228,000
Pilot Program	$440,100		$537,900		$978,000
Marketing Allocation	$553,162		$676,088		$1,229,250
Commercialization Plan	$823,500		$1,006,500		$1,830,000
Total	$5,519,362		$6,745,888		$12,265,250

CONFIDENTIAL INFORMATION

We have attached the confidentiality request document, which outlines the sensitive nature of the attached appendices and emphasizes the need for their security. We kindly request that the following items, be treated as confidential due to the competitive and protectionist nature of agri-tech, the emissions markets and associated technologies:

1. Project Timetable/Budget Estimates
2. Business Plan
3. Historical Financial Statements (these will be shared directly with the Bank of North Dakota)
4. Budgeted Projections

These materials contain crucial information regarding our competitive advantage, encompassing our strategic direction, speed, and partnerships. Particularly, our planning efforts for the development of our Dashboard, interconnected products, and go-to-market strategy are at a high risk of theft and replication. Therefore, it is of utmost importance that the confidentiality of these documents is maintained.

PATENTS/RIGHTS TO TECHNICAL DATA

Any patents or rights that the applicant wishes to reserve must be identified in the application. If this does not apply to your proposal, please note that below.8

Bushel reserves all rights under its pending or granted patents

- *Commodity tracking system and method16/100,129*
- *Blind commodity marketplace 16/542,937*
- *BLIND COMMODITY MARKETPLACE 2019321690*
- *BLIND COMMODITY MARKETPLACE 1120210029214*
- *Qualitative commodity matching 17/569,271*
- *BLIND COMMODITY MARKETPLACE PCT/US19/47065*
- *User interface for adjusting component proportions 17/730,141*
- *Computer display screen with component proportionality element 29/845,734*
- *Commodity Tracking System and Method US 11,100,579*
- *System and Method for Field Variance Determination US 9, 734,400*
- *SYSTEM AND METHOD FOR REMOTE NITROGEN MONITORING AND PRESCRIPTION US 9,652,840*
- *System and Method for Crop Health Monitoring US 9,638,67*

STATE PROGRAMS AND INCENTIVES

Here is a list of all state programs that Bushel has participated in during the past 10 years we have been in business.

- **Operation Intern North Dakota Department of Commerce Workforce Development**
  - 05/31/2021-06/01/2022 = $14,648.30
- **Legacy Investment for Technology Loan Fund (LIFT)**
  - 06/08/2020 - 06/08/2027 = $1,000,000.00
- **North Dakota Jobs Credit**
  - 01/22/2013 - 01/22/2023 = $519,619.21
- **North Dakota Development Fund Loan**
  - 12/08/2017 - 01/01/2022 = $500,000.00
- **Bank of North Dakota New Venture Capital Loan**
  - 12/08/2017 - 01/01/2022 = $300,000.00
- **Growth Initiative Fund Loan**
  - 12/08/2017 - 01/01/2022 = $300,000.00

Submitted by: Minnkota Power Cooperative
Project Duration: 4 years
Total Project Costs: $1,400,000,000
Request for: $150,000,000 loan

Summary of Project: This project supports the installation of carbon capture system at the Milton R. Young Station capable of sequestering up to 4 million tons of CO_2 per year.

Technical Review Results

Overall Technically Sound (275/315)		
Good	3	
Fair		
Questionable		

BND Economic Feasibility Recommendation

Overall Economic Feasibility	
Yes	X
No	

Technical Committee Scores

	Score (Out of 50)
Charlie Gorecki	47
Josh Teigen	46
Dave Glatt	43
Lynn Helms	41
Justin Kringstad	43
Rachel Retterath	48
Todd Steinwand	49
John Weeda	49

Average: 46

CSEA Recommendation: Approve $150,000,000 loan

Clean Sustainable Energy Authority

North Dakota Industrial Commission

Application

Project Title: Project Tundra

Applicant: Minnkota Power Cooperative

Date of Application: May 18, 2023

Amount of Request
Grant:
Loan: Up to $150,000,000 additional for a total of $250,000,000

Total Amount of Proposed Project: $1,400,000,000

Duration of Project: Construction – 4 years

Operations – 20 years

Point of Contact (POC):
Andrew C. Sorbo, Minnkota Power Cooperative
Vice President of Strategic Initiatives

POC Telephone: 701-795-4204

POC Email: asorbo@minnkota.com

POC Address: 5301 32nd Ave. South
Grand Forks, ND 58201

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ABSTRACT

Objective: The goal of Project Tundra is to demonstrate post combustion carbon capture (PCCC) and carbon dioxide storage in North Dakota, preserving the use of lignite and the associated jobs, ensuring enough reliable and dispatchable power is on our grid, and moving North Dakota closer to its carbon neutral goal. Minnkota plans to transform the MRYS, a critically important dispatchable energy resource, while also maintaining the existing high-paying jobs and essential economic impact for the local communities and surrounding region as the US transitions to low-carbon energy through policy changes, regulatory requirements, or other mechanisms. MRYS has dispatched at more than a 90% average running plant capacity factor over the past five years in the competitive Midcontinent Independent System Operator (MISO) electric market, which demonstrates its favorable production cost relative to the market. MRYS operates at a predictable cost, and has performed reliably through recent market volatility, protecting the member-owners of Minnkota from financial risk and exposure to high-priced energy markets.

At a design capacity of up to 4,000,000 metric tons per year, Project Tundra will be the largest single-train PCCC in the world that will feature a "station" approach to carbon dioxide (CO_2) emissions control as opposed to the "dedicated unit" configuration being proposed by the rest of the industry. The additional commitment requested in this application coupled with the prior amount authorized will pave the way for Minnkota to raise the additional capital needed for a possible start of construction for Project Tundra by the end of Q1- Q2 2024.

Expected Results: A commitment from the Clean Sustainable Energy Authority (CSEA) for the requested additional $150 million for a total $250 million low-interest loan will help close the gap and demonstrate that Project Tundra is worthy of consideration by other potential investors.

Past support from the NDIC has directly funded Project Tundra research and development activities, along with grants from the U.S. Department of Energy. That support coupled with a strong CSEA commitment has enabled Minnkota Power Cooperative Inc. (Minnkota) to (a) finalize and complete the design, (b) attract private investors to fund the remaining development and commit hundreds of millions in project equity, and (c) complete all facets and details needed for the project to go into construction in Q1- Q2 of 2024.

Duration: Construction of Project Tundra is estimated to take four years to complete. The operating life thereafter is designed for at least 20 years.

Total Project Cost: Construction and commissioning costs of the PCCC and supporting balance of plant is estimated at $1.30 billion. The adjacent CO_2 storage facility is anticipated to cost an estimated $100 million to be ready to start receiving CO_2. See Sources and Uses within the Confidential Appendix A.

Participants: Minnkota is the project sponsor and will be a partner in the ownership of the project. We expect the U.S. Department of Energy will participate in funding capital cost of the project through direct demonstration grants.

Minnkota, with the assistance of Sargent & Lundy who will be the Owner's Engineer, will provide overall construction management on behalf of the project owners and lenders for both the PCCC and the CO_2 storage facility.

PROJECT DESCRIPTION

Objectives: Project Tundra is an initiative to build the world's largest post-combustion carbon dioxide (CO_2) capture facility at the existing Milton R. Young Station (MRYS), a lignite-based power plant in North Dakota. The proposed project is designed to capture up to 4 million metric

tons of CO_2 annually from MRYS. The captured CO_2 will be safely and permanently stored in geologic formations approximately 5,000 and 9,000 feet underground directly under the MRYS.

The proposed project is being developed by Minnkota Power Cooperative, Inc.[1] (Minnkota), a regional generation and transmission cooperative that provides wholesale power to 11 member-owner distribution cooperatives in eastern North Dakota and northwestern Minnesota. Minnkota is the operator of the two-unit MRYS. The MRYS is a valuable asset for Minnkota due to its reliable, resilient, and cost-competitive operating characteristics. MRYS has dispatched at over 90% average capacity factor over the past five years in the competitive Midcontinent Independent System Operator (MISO) electric market, which demonstrates its favorable production cost relative to the market. However, it is anticipated that the facility has the potential to face a carbon-constrained or carbon-managed future through policy changes, regulatory requirements, or other mechanisms. Project Tundra will help preserve this important power resource for Minnkota's cooperative members, while also maintaining the existing high-paying jobs and essential economic impact for the local communities and surrounding region. The MRYS and adjacent lignite mine are the largest employers in Oliver County and according to data from the North Dakota Job Service, Oliver County had the second-highest average annual wages in the state in 2022.

Methodology

The economics of the proposed project are based on:

- The Internal Revenue Service Section 45Q federal tax credit program, which will provide a tax credit of $85/tonne of CO_2 captured and permanently sequestered in secure geologic

[1] www.minnkota.com

storage. The period during which tax credits can be claimed is 12 years from the start of commercial operation and the value of the credits is indexed to inflation, which in the project's model increases the credits to over $100/tonne at the end the 12-year period. The law also provides for not-for-profits like electric cooperatives to receive "direct pay" payments from the IRS instead of tax credits on a 1:1 basis. For-profit companies may also receive direct pay for the first 5 years of operations and then for the remaining 7 years it reverts to tax credits;

- Under our equity structure, Minnkota's partners will not only be able to monetize their share of the 45Q tax credits (after the direct pay period), but they will also monetize Minnkota's share of other tax attributes. Together, the direct pay and the monetized value of the other tax attributes create a strong and very creditworthy revenue stream for the project participants that would underpin repayment of a CSEA-backed loan. A more detailed live cash flow model showing revenue streams using multiple base-case runs will be discussed within the confidential Appendix A. The actual live cash flow model will be provided to the Bank of North Dakota directly in conjunction with this application.

StorageCo will be owned by a joint venture company which in turn is owned by Minnkota and its partner(s).

The $1.40 billion in costs for CaptureCo and StorageCo will be funded by equity contributions from Minnkota and its partner(s), potential DOE grants, and a loan through CSEA. The CSEA funds play a critical role within the project's overall capital stack. Project Tundra holds three main risks for investors: technology, storage, and capital. The technology risk is covered by the chosen technology vendor. The storage risk is mitigated by the State of North Dakota's leadership in holding primacy over required permitting, leading Minnkota to now hold the nation's largest Class

VI Storage permit and an approved Environmental Protection Agency (EPA) Monitoring, Reporting and Verification (MRV) plan. These projects, while promising, still require enormous federal and state support on financing to attract the necessary private capital investment. Even with the enhancement of 45Q, inflation and scale-up risk still necessitate state support to offset capital risk. The capital risk of a project of this magnitude will only be mitigated by decreased capital spend, as the potential returns are driven off performance, not investment levels. This reduced capital spend takes several forms: an acceptable Engineering, Procurement, and Construction (EPC) cost, DOE funds, private funds raised by Minnkota, and CSEA funds.

In the base case, $3.8 billion in total direct pay and tax credits plus $700 million in monetized other tax attributes combine for $4.5 billion in cash available during the first 12 years of operations. During those years that cash will be used for:

- $2.3 billion to pay for operating costs
- $2.2 billion in distributions to pay back the $1.40 billion investment, cover interest payments and provide a return to investors.

After the first 12 years of operations during which the CSEA loan will be repaid and equity investors will achieve their target returns, the project owners will evaluate the market conditions to determine how to operate the facility in the then-current environment.

To complete the remaining development work needed to close on the financing described above and begin construction, the project development team will need to complete the following by December 2023: **1)** the final construction-ready design for the CO_2 capture plant and the short on-site CO_2 pipeline; **2)** final, firm contract offers for the CO_2 capture plant, CO_2 pipeline, and

the CO_2 geologic storage facility; **3)** have a firm budget for the operating costs for all project components, and **4)** have all permits in hand, including the Class VI drilling and storage permits.

ANTICIPATED RESULTS

CO_2 Capture Plant:

Unique features of the proposed CO_2 capture plant include:

- The Technology Provider's most advanced capture technology, which brings much needed commercial-ready technology to the carbon capture industry.
- Demonstrating CCS on coal-fired flue gas at full utility-scale with an increase of 2.5X compared to the largest existing similar project, Petra Nova.
- The proposed project will capture and store up to 4 million tonnes per year of CO_2.
- The first time CCS technology will be applied on lignite coal flue gas demonstrating methods to mitigate challenges unique to lignite (in particular North Dakota lignite), including ultrafine particulate produced during lignite combustion.
- The project will demonstrate construction and operation methods for the North Dakota climate with design strategies to mitigate the impact of cold weather on a process and piping that runs with large volumes of water.
- A steam supply source extracted from multiple units simultaneously.
- The project will demonstrate a "station" approach to carbon capture by simultaneously drawing flue gas from two lignite boilers into one carbon capture system showing that CCS technology is capable of decarbonizing the power production of multiple units at one station.

CO_2 Geologic Storage Facility:

As with the CO_2 capture plant/technology, Project Tundra includes unique, new, and innovative features in the geologic storage component. These are summarized below:

- An estimated 4X increase, in terms of volume of CO_2 injected, over the next largest existing saline formation geologic storage project in the U.S. (ADM Decatur project).
- First multi-million tonne per annum commercial geologic storage project in North Dakota.
- Use of "stacked storage" that involves the injection and storage of CO_2 into multiple geologic horizons. This design optimization minimizes the aerial extent of the CO_2 pool in the subsurface.

Facilities

Minnkota is a regional generation and transmission cooperative headquartered in Grand Forks, ND, providing wholesale power to 11 member-owner rural electric distribution cooperatives. Minnkota is also affiliated with Northern Municipal Power Agency (NMPA), which serves the electric needs of 12 municipalities in the same geographic region as the Minnkota member-owners. Minnkota serves as the operating agent of NMPA. Figure 1 provides a map showing the Minnkota and NMPA service territory.

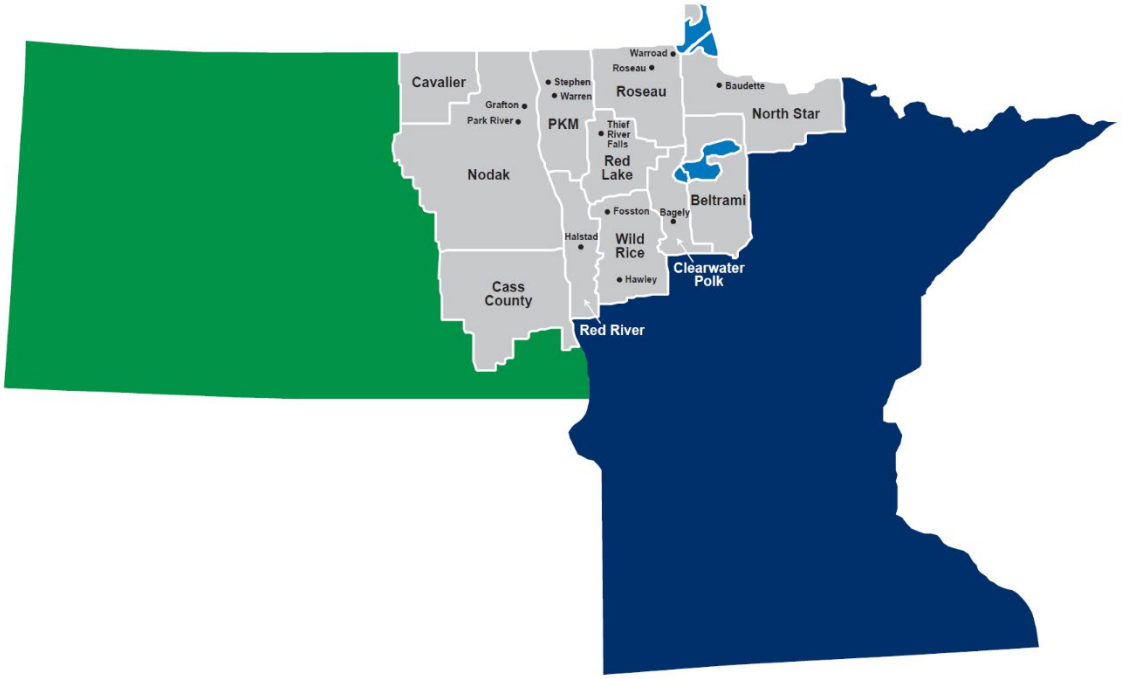

Figure 1. Minnkota-NMPA Service Territory

Minnkota's primary firm and dispatchable generating resource is the two-unit Milton R. Young Station (MRYS), a lignite coal-fired power plant in North Dakota and the host plant for the proposed carbon dioxide (CO_2) capture and geologic storage project. Unit 1 at MRYS is owned and operated by Minnkota. Unit 2 at MRYS is owned by Square Butte Electric Cooperative (Square Butte) and as Square Butte's operating agent, Minnkota operates Unit 2. Square Butte has the same 11 member-owners as Minnkota (but has a separate set of individuals from the 11 member-owners sitting on the board of directors) and only has one employee, the General Manager, who is also the President & CEO of Minnkota.

Resources

A. Amount of Expected Equity Investments

The Borrower (Minnkota) expects that in order to raise equity for the project a sponsor equity contribution is needed from Minnkota. The balance of the $1.40 billion capital

needed for the PCCC system plus the capital needed for the CO_2 storage facility will be sourced from other equity sponsors with large tax capacities and from demonstration grants from the U.S. Department of Energy.

B. Preliminary Funding Plan for Guaranteed Obligation

The Guaranteed Obligation will be a loan in the amount of $250 million ($100 million CSEA commitment made in the 2021-23 biennium, plus the $150 million CSEA commitment we are seeking in the 2023-2025 biennium) made to the project company, which will be the owner of the PCCC system. Minnkota, and the ultimate project company, will work closely with the Bank of North Dakota to provide an appropriate collateral package. Potential structures are predominantly driven off developing the most tax efficient structure to prevent leakage.

C. Timing of Equity Contributions and Debt Funding

The Borrower contemplates there will either be a construction loan facility with a guaranteed take-out commitment (upon final commercial operation of the project) from construction lenders or the entire construction funding will come from equity partners, called upon pro-rata to equity positions during the construction period.

D. Timing of Debt Repayment

The Borrower expects the term of the debt to be 12 years from the time the project commences commercial operations. The payments are expected to be “sculpted” over the term to maintain agreed coverage ratios while considering variations in free cash flow due to operations and maintenance cycles of the capture system and MRYS. A potential model describing debt structure and repayment of the CSEA loan is further described within the confidential Appendix A.

E. Federal Support

To date the project has received several grants, including approximately $33 million ($16.9M-CarbonSAFE, $9.8M-DOE-NETL for the FEED Study and $6M for Project Carbon 1 and 2, Pre-FEED and Pilot Test) in direct federal Department of Energy grants to advance this project to construction. The bipartisan effort to pass §45Q tax credit reform recognizes the important role carbon capture will play in the nation and world. Carbon capture projects are capital intensive, and there is a recognition that early movers of projects, such as this one, will require enhanced support to get to construction as evidenced by not only raising the value of §45Q but also the authorization of large demonstration grants enacted by Congress. In the alternative of not receiving a large grant through the infrastructure package, an existing loan guarantee program through the DOE serves as a further opportunity to raise capital through low-cost financing. Minnkota has explored the application process for this loan program and has passed the first phase of the DOE's diligence in an effort to keep all capital stack options open. These programs are not additive, thus, if the project receives a grant from the DOE, the proposed project would not be eligible for a federal loan guarantee or vice versa. In either case, these programs are needed to improve the economics of the project and there is much optimism about the proposed project's competitive edge to capture one of the large federal demonstration grants or qualify for the loan guarantee program. Additionally, the Inflation Reduction Act created a new voluntary $9.7 billion grant and loan program designed specifically for electric cooperatives that purchase or build new clean energy systems, which includes carbon capture technology. On May 15, 2023, USDA published the Notice of Funding Opportunity Announcement in the Federal Register, starting a

short timeline for interested co-ops to pursue these funds. Minnkota will explore opportunities through this program, but it is currently considered a second option behind the Department of Energy grant.

F. Other Non-federal Support/Incentives

At this time, there are no other non-federal government-direct financial incentives available for the construction of the proposed project or during operations other than the CSEA loan program. There are, however, several indirect forms of financial support from North Dakota, such as tax incentives, that will benefit the project. These are listed in Table 1 along with their citations to the North Dakota Century Code. Note that some of these incentives are only applicable to enhanced oil recovery (EOR) projects. EOR is not currently part of the proposed project but may represent an opportunity in the future.

Table 1. *ND tax incentives for CCUS* (ND Century Code Chapters 57-39.2, 57-40.2, 57-51.1, 57-60)

- Sales and use tax exemption for CO_2 equipment to compress, gather, collect, store, transport, or inject CO_2.
- CO_2 capture equipment on a coal (or other) facility is considered personal property, exempt from property tax.
- Oil extraction tax exemptions for incremental production from a secondary or tertiary recovery project.
- Sales and use tax exemption for CO_2 used for EOR.
- CO_2 equipment at a wellsite is considered personal property, exempt from property tax.
- CO_2 capture system exemption from ad valorem and coal conversion facilities privilege tax.
- Sales and use tax exemption for environmental upgrade materials used in power plants and processing plants.
- Property tax exemption for pipeline property and associated transportation and storage equipment used for EOR.
- Coal conversion facilities privilege tax credit for CO_2 capture.

Techniques to be used, their availability and capability:

This section of the application provides the detailed technical information for the proposed project.

Description of Project Design

There are three major components to the proposed project: 1) the PCCC or CO_2 capture plant, 2) the 0.25 mile CO_2 pipeline, and 3) the CO_2 geologic storage facility. This section will provide information on the basic processes involved in the design of each.

CO_2 Capture Plant

Figure 2 provides a simplified block flow diagram of the major processes involved in the CO_2 capture plant and how they are integrated with the existing MRYS. As shown, both Unit 1 and Unit 2 are available to provide flue gas to the capture plant. Normal operation involves 100% of Unit 2 and 20% of Unit 1 flue gas being routed to the capture plant with the balance being routed to its existing chimney. During Unit 2 outages, 100% of Unit 1 will be available to feed the capture plant. Unit 2 flue gas can also be routed to its existing chimney during startup/shutdown or during capture plant outages. Flexibility in the design will also allow 100% of the Unit 1 flue gas to be routed to the capture plant with the remaining coming from Unit 2 to utilize the full capacity of the facility.

The capture plant requires a significant quantity of steam for solvent regeneration. This will be provided by extracting steam from the Unit 1 and 2 steam turbines. A unique feature of the proposed project, as described previously, is that flue gas from both coal-fired units along with extracted steam from both units will be routed to the capture system simultaneously.

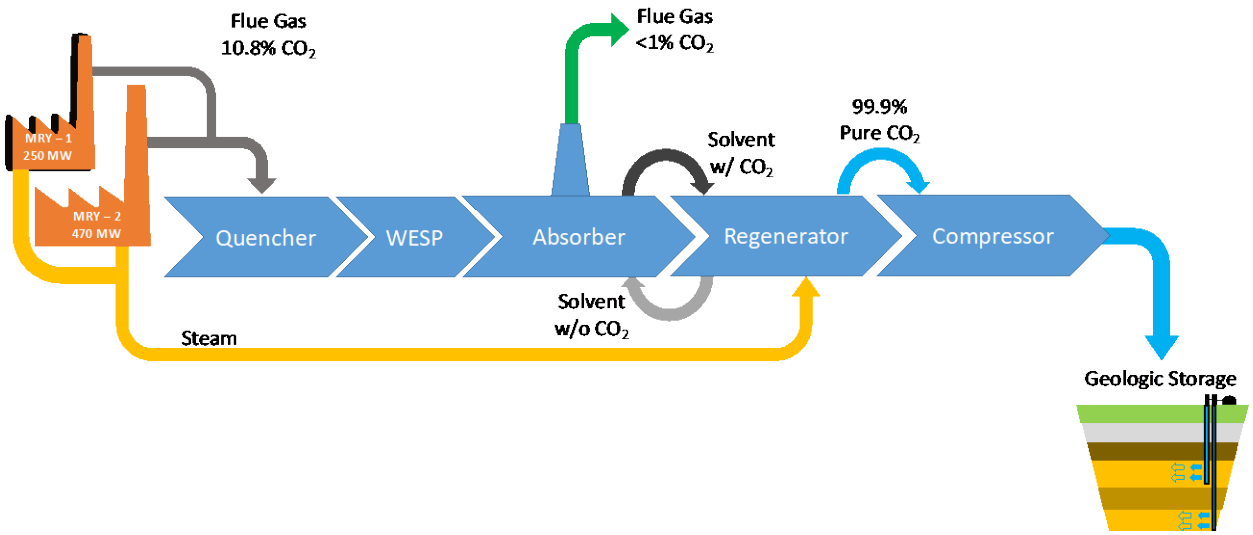

***Figure 2**. Block flow diagram for the CO2 capture plant and its integration with the existing MRYS. During normal operation, 100% of Unit 2 flue gas and **20%** of Unit 1 flue gas is routed to the capture plant. Unit 1 flue gas is available to feed the capture plant during Unit 2 outages. Both units will provide steam required for the amine solvent regeneration and provide flue gas that feeds the capture system.*

Summary of Carbon Capture Process:

The technology (generalized schematic in Figure 3) is an advanced amine-based process specialized for removal of CO_2 from low pressure, oxygen-containing flue gas. The basic plant configuration consists of: **1)** a 2-stage Direct Contact Cooler (DCC) for flue gas cooling and SO_2 removal, **2)** an Absorber for CO_2 separation, **3)** a Regenerator for solvent regeneration and the release of pure CO_2, and **4)** a compression and dehydration system to supply pipeline-ready CO_2 at the fence line. The process begins in the DCC for flue gas conditioning. Then, as the conditioned flue gas flows up the Absorber, CO_2 is chemically absorbed into a circulating solvent stream flowing down the column.

The CO_2-loaded solvent is then pumped from the bottom of the Absorber, through a heat recovery exchanger where it is heated against hot CO_2-lean solvent, and into the top of the Regenerator. As the solvent flows down the Regenerator, it is contacted by steam, which strips the CO_2 from the solvent, producing an overhead mixture of steam and CO2. The steam/CO2

product is cooled and the steam is condensed and separated from the CO2 product. Hot CO2-lean solvent from the bottom of the Regenerator is pumped back through the heat recovery exchanger where it is cooled against the cold CO2-loaded solvent before being returned to the top of the Absorber. Although not part of the standard flow sheet, for the Tundra project a wet electrostatic precipitator (WESP) is also included in the process design (see Figure 2). This is due to challenges unique to the application of the proposed project on North Dakota lignite flue gas.

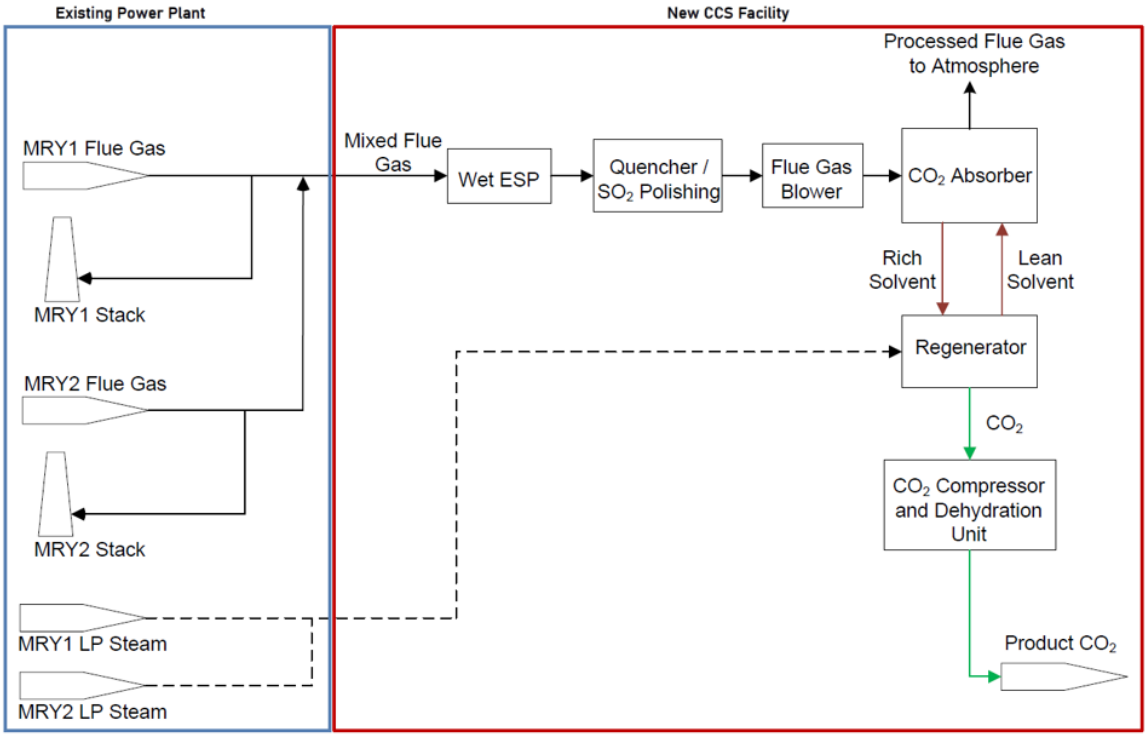

Figure 3. *Generalized schematic of the Project Tundra CO2 capture technology*

CO_2 Pipeline

In 2021, Burns & McDonnell completed a Front-End Engineering and Design (FEED) study for the CO_2 pipeline. Building on this FEED study, Minnkota has been assisted by Sargent & Lundy and Baker Hughes, who are currently in the process of design and engineering for the CO_2 pipeline. The proposed project currently contemplates one CO_2 injection well pad, which would

contain up to three injection wells. The well pad is located 0.25 miles to the south of MRYS. The CO_2 pipeline and its associated infrastructure and instrumentation will enable transport and metering of the captured and compressed CO_2 from the capture plant to the injection wells.

A common metering station will be located at the boundary limit of the CO_2 capture plant and one 16-inch (OD) underground pipeline will transport the CO_2 in a dense phase to the well pad location.

The well pad will include its own metering station. No pump stations or mainline valves are expected to be required; the CO_2 compressor located at the CO_2 capture plant is being designed to provide all of the pressure needed to accommodate the pipeline pressure drop and the hydrostatic injection pressure for the Broom Creek geologic formation where the majority of the CO_2 is planned to be stored. If needed, an injection booster pump will be installed to enable injection in the Deadwood formation, the deeper formation with higher pressure of the two target formations.

Although the proposed project does not contemplate selling CO_2 for enhanced oil recovery (EOR), a tie-in point will be included in the design in the event a market for CO_2-EOR develops in the future.

CO_2 Geologic Storage Facility

The proposed project targets dedicated CO_2 geologic storage in multiple saline formations beneath the MRYS and the adjacent lignite mine. Dedicated storage is possible in sedimentary basins where there are layers of porous and permeable rocks (i.e., sandstone) that are sealed above and below by impermeable caprocks (i.e., shale). The proposed project overlies the Williston Basin and there are multiple suitable layers for dedicated geologic storage. Figure 4

provides the stratigraphic column underlying the proposed project area and notes the lowest underground source of drinking water (USDW) and three geologic horizons that are currently being characterized by the project team for injection and storage of the captured CO_2.

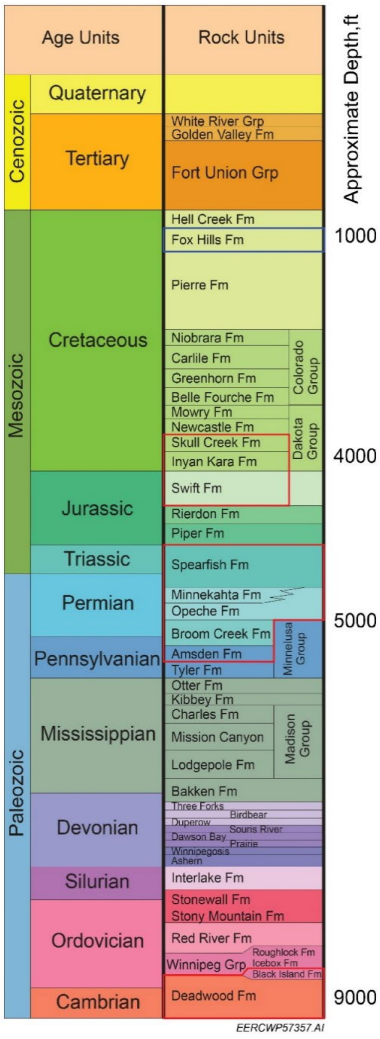

Figure 4. *Stratigraphic column underlying the area near the proposed project. The lowest USDW (Fox Hills) and the three target formations (Inyan Kara, Broom Creek, Deadwood) and their overlying and underlying cap rocks are highlighted.*

Minnkota worked with the Energy & Environmental Research Center (EERC) in developing the proposed plan for the Project Tundra storage site (Tundra SGS). The storage facility permit and Class VI drilling permit were issued by the North Dakota Industrial Commission on January 21, 2022, NDIC Order No. 31583-31588. The proposed storage development consists of two phases

beginning with Phase 1 CO_2 storage operations in the Broom Creek Formation. Two wells are proposed for Phase 1 into the Broom Creek Formation. Upon construction and operation of those two wells, an assessment will be made of their operational capabilities to determine whether there is a need for additional capacity. If needed, Phase 2 of development would commence, which includes the construction and operation of one additional well and the booster pump for injection into the Black Island–Deadwood Formation. There are a number of contingency options available for fine-tuning injection operations such as a possible construction of a third injection well into the Broom Creek if needed.

Environmental and Economic Impacts while Project is Underway

Impact on Environment/Greenhouse Gas Emissions

The proposed project is a post-combustion CO_2 capture and storage project that will capture and geologically store up to 4 million tonnes/year of CO_2. There are two sources of CO_2 for this project. The design specification is that more than 90% of the CO_2 in the Unit 2 and Unit 1 flue gas entering the capture plant will be captured during normal operation (Unit 2 at 100% of its total flue gas flow while 20% of Unit 1's total flue gas flow) and only 100% of either Unit 1 or Unit 2 when one is in an outage.

When considering planned outages on each of the units (3-5 short cleaning outages per year and one major maintenance outage every 3 years), provided below is the maximum total contribution of captured CO_2 from each of the sources.

- Unit 2 at MRYS (455 MW) – 3.20 million tonnes/year
- Unit 1 at MRYS (250 MW) – 0.80 million tonnes/year
- Total CO2 captured and sequestered – 4.0 million tonnes/year

Ultimate Technological and Economic Impacts

Economic Impacts

One of the primary motivating factors for Minnkota's pursuit of the proposed project is preserving the MRYS in the face of a likely carbon-managed future and the availability now of federal and state programs to offset the cost of installation and operation. The MRYS today employs approximately 170 people and the associated Center Mine employs approximately 180 more. The average salary for employees of the MRYS and Center Mine is more than $100,000, significantly higher than the state average of $60,215.[2] If the MRYS and the Center Mine (MRYS is its only customer) were forced to retire early (years ahead of their useful lives), as with numerous other coal plants and mines in the U.S., the negative economic impact on Oliver County and the State of North Dakota would be tremendous.[2] Additionally, the cost of an early facility closure has a complex impact to Minnkota, including likely having to raise electric rates for tens of thousands of North Dakotans and Minnesotans served by Minnkota's member-owners. Minnkota and its members serve a diverse consumer base, including agricultural centers, rural areas and many low-income communities. Conversely, Minnkota's service territory also includes the growing areas of Fargo and Grand Forks, where the price of electricity is directly tied to their economic competitiveness regionally and nationally.

Why the Project is Needed

One of the key drivers for the proposed project is the continued utilization of the MRYS in the face of a likely carbon managed future. MRYS is a valuable asset for Minnkota providing low-cost, reliable baseload power that has proven to be dependable and resilient – no matter if it is

[2] https://www.ndlmi.com/admin/gsipub/htmlarea/uploads/lmi_empwagesind2022.pdf

100 degrees or 30-below-zero Fahrenheit. The proposed project will also preserve the high-paying jobs and essential economic impact in the local communities and surrounding region. MRYS has dispatched at over 90% average capacity factor over the past five years in the MISO electric market, which demonstrates its competitive production cost and important role the electric market.

STANDARDS OF SUCCESS

The standards by which the success of the project is to be measured.

A. Emissions reduction

The proposed project will capture and geologically store up to 4 million tons/year of CO_2, and achieve an additional reduction of approximately 200 tons/year of particulate and approximately 2,000 tons/year of SO_2 that would otherwise be emitted to the atmosphere.

B. Increased energy sustainability

The project provides a low-carbon source of dispatchable, reliable electric capacity that provides grid stability, particularly with an increasingly strained grid.

C. Value to North Dakota

North Dakota has the opportunity to lead the region, nation and world on not only reducing carbon emissions, but also in developing new carbon markets. Project Tundra represents an enormous advancement of technology to capture and safely store emissions. Preservation of reliable electric baseload assets is of tantamount importance in this project, but also represents potential future opportunity of enhanced oil recovery, greenhouse development and other utilization opportunities in the state.

D. Explanation of how the public and private sector will make use of the project's results, and when and in what way

The learnings and confidence gained from a successful demonstration of this project will help make follow-on projects more successful and give capital markets more confidence to invest in this space.

E. The potential commercialization of the project's results

This project can help serve as a blueprint for carbon capture technology on other coal-fired power plants, gas-fired plants and other industrial processes. The potential advancement of this technology will require multiple vendors and will benefit from competition.

F. How the project will enhance the research, development and technologies that reduce environmental impacts and increase sustainability of energy production and delivery of North Dakota's energy resources

The project will be the largest postcombustion carbon capture project in the world and will demonstrate that coal has a place in the low-carbon energy market the industry is transitioning toward. Further, the availability of large volumes of CO_2 for future EOR activities in North Dakota's oil fields (including possibly the Bakken) sets the stage for the state's produced oil to be certified with a lower carbon intensity than most oil on the market today.

G. How it will preserve existing jobs and create new ones

The proposed project is expected not only to preserve the high paying jobs for the 350 direct employees of the MRYS and Center Mine (not to mention the many indirect jobs that support ND's lignite industry), it is expected to add up to 600 additional high-paying

construction (temporary) and 20-30 new permanent jobs. Minnkota is presently working with the Bank of North Dakota and FTI Consulting to develop a Regional Economic Models, Inc. (REMI) model to identify the deeper positive economic impacts of Project Tundra.

H. How it will otherwise satisfy the purposes established in the mission of the Program

The outlined purpose of the CSEA program is to support research, development and technological advancements through partnerships and financial support for projects ready for commercialization that reduce environmental impacts. Project Tundra brings together each part of that mission, for all the reasons previously stated in this application. If constructed, this project would play a critical role in current and future energy production, natural resource development, environmental stewardship, while also preserving and enhancing jobs in the state.

BACKGROUND/QUALIFICATIONS

Please provide a summary of prior work related to the project conducted by the applicant and other participants as well as by other organizations. ***This should also include summary of the experience and qualifications pertinent to the project of the applicant, key personnel, and other participants in the project.***

Project Sponsor Capabilities and Qualifications

The Project Sponsor, Minnkota, has the experience, expertise, and wherewithal to develop, finance, construct, and operate this project successfully. Minnkota owns and operates MRYS Unit 1, while also operating Unit 2 on behalf of its owner Square Butte Electric Cooperative, which is owned by the same 11 distribution member cooperatives that own Minnkota. Minnkota's generation portfolio also includes energy purchased from three North Dakota wind

farms and hydroelectricity purchased from the Garrison Dam in central North Dakota. Minnkota operates and maintains a robust set of electric transmission infrastructure, including more than 3,350 miles of transmission line and 260 substations.

As the project developer, Minnkota is coordinating all aspects of the project development and has dedicated staff in place for project management, engineering & design, environmental/permitting, legal, and financing. As the operator of MRYS, Minnkota has unique knowledge that is necessary for the integration of the CO_2 capture plant. Minnkota also has more than 50 years of experience in coal-fired generation and the use of lignite fuel and its unique characteristics. Minnkota has hosted and managed several major construction projects at MRYS, with the most recent being $425 million in environmental upgrades completed in 2007-2011 (described in more detail below).

In addition to construction projects at MRYS, Minnkota's Power Delivery division manages a portfolio of construction and maintenance projects ranging from $35-50 million annually. The capital budget from 2023-2025 totals $100 million with approximately half of that being associated with 69 kV transmission line projects. The remaining amount was used on distribution substation upgrades and maintenance, high voltage substation/line work and telecommunication and demand response system uprates. Projects are scoped and scheduled in-house and utilize both in-house and contracted labor. One of the largest transmission projects in Minnkota's history, the $350 million Center to Grand Forks 345 kV line, was completed in 2014 (described in more detail below).

Experience in the Fossil Sector

Prior to describing two specific examples that demonstrate Minnkota's experience on similar

large construction projects, this section will first describe Minnkota's significant experience in the fossil sector.

Minnkota's Joint System has interests in three coal units, which represent approximately 55% of the Minnkota Joint System's generation capacity and 67% of the energy production. The three coal units are all located in North Dakota and fire North Dakota lignite coal:

- MRYS, Unit 1: Owned and operated by Minnkota, Unit 1 has nominal rating of 250 MW_{net} and was placed in service in 1970. It is a single wall cyclone-fired unit that is equipped with the following controls: advanced separated over-fire air (SOFA) and selective non-catalytic reduction (SNCR) for nitrogen oxide (NO_X) control, wet lime flue gas desulfurization (WFGD) scrubber for sulfur dioxide (SO_2) control, an electrostatic precipitator (ESP) for particulate matter (PM) control, and a halide and post-combustion activated carbon injection for mercury control.
- MRYS, Unit 2: Owned by Square Butte and operated by Minnkota, Unit 2 has a nominal rating of 455 MW_{net} and was placed in service in 1977. It is an opposed wall cyclone-fired unit that is equipped with the following controls: SOFA and SNCR for NOx control, WFGD for SO_2 control, ESP for PM control, and halide and post combustion activated carbon injection for mercury control.
- Coyote Station: NMPA owns 30% of Coyote and Minnkota is the operating agent for NMPA (Otter Tail Power operates Coyote). Coyote is a single unit, with a nominal rating of 427 MW and was placed in service in 1981. Coyote has a cyclone-fired boiler and is equipped with the following controls: SOFA for NOx control, dry flue gas desulfurization and fabric filter baghouse for SO_2 and PM control, and uses activated carbon injection for mercury control.

Minnkota continues to pursue and foster fossil energy technology, as evidenced by Minnkota's current and past involvement in cost share and engineering support for a number of DOE-funded research projects, including: 1) demonstration of multi-gamma based sensor technology for as-fired coal property measurement (DE-FE00031750), 2) mitigation of aerosol impacts on ash deposition and emissions from coal combustion (DE-FE00031756), 3) rare earth element extraction and concentration at pilot-scale from North Dakota coal-related feedstocks (DE-FE00031835), 4) novel concepts of the utilization of carbon dioxide from utility and industrial sources (DE-FE00031916), 5) energy storage for fossil power generation. Minnkota and EERC also previously completed a FEED study for Project Tundra with Fluor (DE-FE0031845) and a CarbonSAFE project for their storage complex (DE-FE0031889) and 6) recovery and refining of rare earth elements for lignite mine wastes (DE-FE0002618). This demonstrated, strong commitment to advancing fossil energy technology, combined with more than 70 years of experience operating and maintaining fossil fuel conversion plants, positions Minnkota well to execute on Project Tundra.

MRYS Environmental Upgrades

Background:

From 2007 to 2011, approximately $425 million was invested in MRYS to install a series of air quality control system upgrades on each of the two units to modernize the facility and ensure compliance with environmental regulations. New controls and associated infrastructure were installed for SO_2 and NOx, with each of the major sub-projects for both units further described below.

The Unit 1 projects consisted of the following five major components:

1. Electrical upgrade of the unit ($51 million) – Construction of the Unit 1 electrical upgrades were necessary to provide fault protection of the existing aging electrical system, and to provide capacity for load additions from the air quality control upgrades. The project included new Unit 1 auxiliary transformers; a replacement generator breaker; an electrical building to house medium and low voltage switchgear, motor control centers and distributed control system equipment; isolated phase bus modifications, a new backup diesel generator, a fuel handling electrical upgrade and substation, and duct banks.
2. Installation of a new WFGD scrubber ($113 million) – Construction of a single module wet lime open-spray SO_2 scrubber. The scope included connecting ductwork and structural steel from the boiler exit to the refurbished chimney, two replacement induced-draft fans, all associated foundations, dampers and control devices, buildings, electrical, HVAC and other utility services, and the distributed control system.
3. Upgrade of the former Unit 2 dry chimney to a wet chimney for Unit 1's use ($12 million) – Construction to retrofit the 564-foot "dry" chimney to a chimney suitable for wet service with the new wet scrubber. The chimney was wallpapered by installing 316L stainless over the existing mild steel and Corten metals of the dry chimney.
4. Installation of over-fire air and selective non-catalytic reduction systems on the boiler ($16 million) – Construction included installation of a complete separated over-fire air (SOFA) system and selective non-catalytic reduction system (SNCR) for NOx control on the Unit 1 boiler. The SOFA system components included SOFA piping, nozzles, dampers, control drives, as well as significant modifications to the existing cyclone boiler lignite drying system. The SNCR system involved installation of systems to support urea

injection in multiple zones in the boiler. Supporting systems included metering and dilution water modules, storage tanks and supporting systems, and expanding the plant's water treatment system.

5. Installation of a joint new lime reagent preparation system to serve Unit 1 and Unit 2 ($42 million) – Construction to install two new vertical ball mill slakers and associated pumps, tanks, and distribution systems. The project included two bolted, 3,000-ton lime storage silos.

The Unit 2 projects consisted of the following four major components:

1. Electrical upgrade of the unit ($76 million) – Construction of the Unit 2 electrical upgrades were necessary to provide fault protection of the existing aging electrical system, and to provide capacity for load additions from the air pollution control upgrades. The project included new Unit 2 auxiliary transformers; a replacement generator breaker; an electrical building to house medium and low voltage switchgear, motor control centers and distributed control system equipment; isolated phase bus modifications, a new backup diesel generator, a fuel handling electrical upgrade and substation, and duct banks.
2. Upgrade of the existing WFGD scrubber on Unit 2 ($2 million) – Included assessment for duty of two existing open spray tower absorbers, and installation of minor efficiency improvements, replacement demister panels, and replacement of the outlet ducts from the modules to the new chimney.
3. Installation of new wet chimney ($67 million) – Construction included installation of a 6,425 cubic yard continuous-pour concrete slab-on-grade chimney foundation, and a 550-foot concrete chimney with fiberglass-reinforced plastic flue gas liner.

4. Installation of separated over-fire air (SOFA) and selective non-catalytic reduction systems on the boiler ($18 million) – Construction included installation of a complete SOFA system and SNCR system for NO_X control on the Unit 2 boiler. The SOFA system components included SOFA piping, nozzles, dampers, control drives, as well as significant modifications to the existing cyclone boiler lignite drying system. The SNCR system involved installation of systems to support urea injection in multiple zones in the boiler. Supporting systems included metering and dilution water modules, storage tanks and supporting systems, and expanding the plant's water treatment system.

Project Management:

Minnkota and the project engineering consultant Burns & McDonnell evaluated options to pursue these projects on an EPC basis or on a "multi-contract" basis. Minnkota selected the multi-contract approach, and utilized plant project managers and Minnkota's procurement department to issue all contracts related to the projects. Burns & McDonnell provided project schedules, design, plans and specifications, bidding assistance, and review of vendor submittals. Burns & McDonnell also provided construction observation, however overall construction management was Minnkota's responsibility. Minnkota did not add personnel to complete the projects.

Operation and Maintenance:

As the operator of both Units 1 and 2, Minnkota is responsible for the operation and maintenance of the facilities' equipment/infrastructure. With the completion of the final work in 2011, the projects were all in service. The projects have all been in service for at least 12 years and have

performed as expected, while additional efficiencies have been gained through operating and maintenance experience. Maintenance is performed using both in-house and contracted labor.

Center to Grand Forks 345 kV Transmission Line

Background:

In 2009, it was determined that Minnkota would construct a $350 million, 250-mile-long 345 kilovolt (kV) transmission line in North Dakota between the Center 345 kV Substation (northeast of the Milton R. Young Generation Station, near Center, North Dakota) and the Prairie Substation (west of Grand Forks, North Dakota). The Center to Grand Forks 345 kV Transmission Line Project (CGF Project) was constructed to deliver existing baseload generation to Minnkota's cooperative members in North Dakota and Minnesota.

This project helped provide much needed transmission capacity in North Dakota as new resources are brought on to the grid.

The CGF Project consisted of the following six major components:

1. 345 kV High Voltage Transmission Line – Construction of 250 miles of a new, high-voltage transmission line. The line is constructed with single-pole steel structures approximately 150-feet-high and placed approximately 1,000-feet apart. The typical right-of-way (ROW) is 150-feet-wide. Conductor is 959.6 kcmil Suwanee trapezoidal wire (TW) type aluminum conductor steel reinforced (ACSR) cables and two shield wires – one a fiber-optic static line and the other an extra high strength (EHS) steel cable.
2. Center 345 kV Substation Upgrades – Installation of 345 kV circuit breakers, 345 kV dead-end structures, a new 345/230 kV transformer and associated bus work, new 345 kV

switches and associated foundations, steel structures, and control panels. A line reactor was also added to the north end of the substation.

3. Additional 230 kV Tie Line – Construction of a 1,500-foot-long 230 kV tie line paralleling the existing tie line on Minnkota-owned property to complete a transmission-to-transmission interconnection with the Square Butte 230 kV Substation.
4. Square Butte 230 kV Substation Upgrades – Installation of 230 kV circuit breakers and line terminal equipment to the new 345 kV interconnect.
5. Prairie 230/345 kV Substation Upgrades – Installation of new 345 kV circuit breakers, 345 kV dead-end structures, two new 345/230 kV transformers and associated bus work, new 345 kV switches and associated foundations, steel structures, and control panels. Addition of 230 kV circuit breakers to accommodate interconnecting with the existing 230 kV ring bus.
6. Fiber Optic Regeneration Stations – Construction of four fiber optic regeneration stations along the transmission line route to re-amplify the protection and control signals carried in the optical ground wire (OPGW). Each station has a small control building to house the electronic equipment in a fenced-in area.

Minnkota was able to coordinate all federal, state and local permitting and environmental requirements and met all applicable guidelines. The project schedule required Minnkota to parallel the design and the route permitting to meet the in-service date. This required engineering, procurement and environmental work to be done simultaneously, something that is typically not done. The extremely short schedule (four years) required a concerted effort in multiple areas, including these primary phases:

- Route application and permitting – This process included determining the 250-mile transmission line route and conducting multiple public hearings across the 11 impacted counties in North Dakota.
- Complete Environmental Assessment (EA) – this included an alternative evaluation study (AES), a macro-corridor study (MCS), a biological assessment (BA), and a Class III Intensive Archaeological Resources Inventory in compliance with Section 106.
- Equipment procurement, manufacture and delivery – To meet the in-service date, Minnkota ordered long lead-time items early in the process to allow for delivery and construction on schedule. Due to the expedited nature of the project, this was done before the permitting process was completed.
- Construction – this included simultaneous work on 250 miles of line, two high voltage substation rebuilds, modifications to an existing substation and construction of four repeater stations.

Project Management:

Minnkota supported the Project with a project manager (PM) to coordinate all project activities, schedule and budget. Minnkota also provided all of the material procurement from internal resources. Additional contracted labor was required for the following: **1)** line and substation design, **2)** construction management, **3)** environmental and permitting, and **4)** right of way easements. The construction of the 250-mile line was done by contracted labor in addition to the substation civil work. However, Minnkota crews did a majority of the electrical work within the substations and in-house support and guidance was provided by environmental, engineering, operations, legal, finance and various other groups.

Operation and Maintenance:

The CGF Project was energized in 2014 and at that time doubled Minnkota's existing 345 kV transmission line assets. The Project is part of the bulk electric system (BES) and therefore meets specified North American Electric Reliability Corporation (NERC) requirements. All 345 kV transmission is included in the high voltage maintenance program and is patrolled annually by helicopter, fixed wing aircraft and ground patrol. Regular vegetation management is conducted and maintenance is done as needed.

The expansion of both the Center and Prairie 345 kV substations added additional assets to the electrical operation's maintenance program and are included in the standard rotation for equipment inspections. Both sites are included in the BES and meet all NERC requirements.

The addition of four repeater stations expanded the telecommunication assets and are regularly inspected and maintained.

Minnkota conducted the design and construction of the Project without adding any additional personnel. Contracted labor was used during construction but ongoing maintenance is done by Minnkota personnel.

Financing of the MRYS Environmental Upgrades and CGF Project

Minnkota's portion of the $425 million Environmental Upgrade Projects and the $350 million CGF Project were funded by loans from the Rural Utilities Service (RUS), an operating unit of the United States Department of Agriculture, via RUS Guarantees made to the Federal Financing Bank (FFB). As a rural electric cooperative, Minnkota has had tremendous success utilizing the low interest, long amortization loans offered through the RUS. Minnkota's utilization of RUS

financing coincides with the preferred industry practice of financing long-term assets with appropriately amortized funds, ensuring intergenerational equity is achieved on large capital projects. Minnkota secures outstanding debt under an Indenture, with U.S. Bank acting as Trustee. The Indenture secures certain obligations of Minnkota equally and ratably by a first priority lien on substantially all of Minnkota's tangible assets and certain of its intangible assets, whether now owned or acquired in the future. Square Butte's portion of the $425 million Environmental Upgrade Projects was financed half through RUS and half through CoBank, ACB, and similarly secured using Square Butte's Indenture.

Principal Participants Capabilities and Qualifications

This subsection of the Application will focus on and describe the capabilities of the team Minnkota has put together to develop and bring the proposed project to commercial operation. Minnkota has a fully integrated team in place including all of the technical, legal and financial pieces necessary. The following sections highlight the key team members, their role(s) on the project, and a description of the capabilities that each member brings to the proposed project.

Technology Provider – See Confidential Appendix A

Owners Engineer

A-6 Owners Engineer

Sargent & Lundy

As Owner's Engineer S&L is providing engineering and technical support to Minnkota in managing the technology providers portion of the project scope as well as engineering and execution planning for Minnkota's portion of the balance of plant which will be construction and commissioned by Minnkota using various contractors.

S&L is one of the longest-standing and most experienced full-service architect engineering firms in the world. Founded in 1891, the firm is a global leader in power and energy with expertise in grid modernization, renewable energy, energy storage, nuclear power, and fossil-fueled power plants. S&L has been involved in numerous first-of-a-kind projects and concepts throughout our more than 130-year history. Our identity is rooted in a culture of innovation and quality. We have been at the forefront of new design throughout this time, often on initiatives for new technologies or concepts within the power generation markets.

S&L has extensive experience conducting technical evaluations for CO_2 capture projects over the last decade, including feasibility, Pre-FEED, and FEED studies for clients which included preliminary system engineering, project layout, preliminary design, and cost estimates. S&L has completed 45 projects with an additional 25 active projects currently on-going, for nearly 40 clients involving 15+ technologies since 2007.

Among the most notable projects for S&L was the Petra Nova Carbon Capture Project, which was awarded the Best Project of Merit award from Engineering News Record (ENR). S&L's work on the Petra Nova project included multiple FEED studies, Owner's Engineer services during project implementation, and detailed design of the 240 MW equivalent (MWe) slipstream carbon capture unit onto NRG's W.A. Parish Unit 8. The Owner's Engineering services included both design oversight and the detailed design of critical systems that tied into the host site, such as the flue gas ductwork supply and wastewater treatment.

Construction Management – See Confidential Appendix A

Constructor – See Confidential Appendix A

David Greeson Consulting (Proven Project Development Group)[3]

David Greeson is a consultant to the carbon capture and power generation industries. He was the developer (from inception through commissioning) of the $1 billion Petra Nova CO_2 Capture and Enhanced Oil Recovery Project in Texas and is currently working with multiple clients in various stages of development of CCUS projects. Mr. Greeson has been working with Minnkota for about the last three years, focusing on the business development and financing aspects of the proposed project.

Hunt International Energy Services (HIES)

Marion Cole is a principal with HIES, an independent energy industry consulting firm established in 1999. Mr. Cole has 40 years of experience in power systems engineering, operations and consulting, with expertise focused on power and pipeline sectors with both U.S. and international clients. Mr. Cole was a key member of the engineering team that developed the Petra Nova project and he supported both the CO_2 capture plant and the 81-mile CO_2 pipeline that transported the captured CO_2 to the enhanced oil recovery fields. Mr. Cole is a consultant to Minnkota focused on the engineering, design and construction aspects of the CO_2 capture plant and the CO_2 pipeline and he is actively engaged currently on both FEED studies.

Global Structured Finance (GSF)[4]

Minnkota has retained the advisory services of GSF to support the full capital stack raise for the proposed project. GSF, founded in 2005, is a structured finance advisor, providing strategic advice and innovative financing solutions to meet its clients' capital raising, investment, tax and

[3] https://www.davidgreeson.com/
[4] https://www.gsfadvisors.com/

accounting needs. More specifically, GSF is engaged in providing advisory services to clients in connection with the financing of assets with significant tax benefits (principally tax credits, as well as depreciation and interests deductions).

GSF also provides placement services and has closed transactions and maintains relationships with all major tax-motivated investors.

The GSF Advisors energy team recently left a major European Bank where they conducted business as Capstar Partners and were responsible for tax equity advisory and investments. Capstar Partners was an independent firm founded in 1990 providing investment banking services to clients in the tax advantaged asset finance market. It was acquired by a European bank in 2001. The team is led by Phil Mintun, who was the founder and head of the Capstar renewable energy tax equity team, and François-Xavier ("FiX") Terrasse, who was responsible for the bank's tax equity investments and led the most highly structured transactions.

Since 2005, the team has raised $20.7 billion from 19 tax equity investors to finance over 25GW of renewable energy facilities – 114 wind farms, 37 utility scale solar plants, 4 geothermal facilities, 4 distributed generation solar portfolio as well as 1 fuel cell portfolio and 1 biomass plant. In addition, the team has been active advising clients on carbon capture and sequestration projects over the past several years.

Holland & Knight LLP

Holland & Knight has been retained as Project Counsel and has significant experience in energy and infrastructure development and financings.

Holland & Knight's Energy & Natural Resources Industry Sector Group brings together a cross-practice and experienced group of more than 225 lawyers and professionals, in 34 offices, to represent and advise a wide array of stakeholders across the energy and natural resources value chain. Furthermore, more than 50% of the firm's energy team members are diverse.

The firm's attorneys have represented energy industry clients for more than 120 years, in all 50 states as well as more than 80 countries around the globe. As a result, Holland & Knight not only provides integrated service through the collaboration of attorneys across a broad range of practice areas, but these attorneys also truly understand the industry and have a pulse on recent market trends as well as insight into how to best navigate an increasingly complex regulatory environment.

Holland & Knight is ranked among the top global firms for Energy & Natural Resources by *Chambers Global* 2023 as well as among the top U.S. firms for Energy: Renewable / Alternative Power by *The Legal 500 United States* 2022.

The firm's history of excellence in serving the regulatory, compliance and policy needs of clients in addition to commercial, financial and operational experience uniquely positions their team to provide legal counsel on increasingly complex transactions. This well-established experience combined with a team of well-regarded, high-profile litigators, makes Holland & Knight's energy practice well positioned to provide the full range of legal services to Project Tundra.

For more than four decades, Holland & Knight has been privileged to provide services to the electric cooperative industry in the U.S. They have the leading electric cooperative practice in the country, a key component of which is assisting their clients with the development of major projects and obtaining necessary financing. Their lawyers understand the electric cooperative

business, and the breadth and depth of their practice experience brings extra value to electric cooperative clients such as Minnkota.

The firm's lawyers have extensive experience guiding clients through all phases of EPC contracts, each based on individual client and client industry needs offering guidance from design concept, property acquisition and contract negotiations to risk management, contract compliance, claims management, alternative dispute resolution and litigation. Holland & Knight is experienced at resolving disputes arising from EPC and design/build agreements (both through litigation, as well as via arbitration, mediation, negotiation and other forms of alternative dispute resolution).

Holland & Knight's experience in cooperative finance includes structuring and negotiating an array of financing transactions, including traditional interim (construction) and permanent debt financing, tax exempt bond financing, non- and limited-recourse project financing, leveraged and synthetic leases and other structured vehicles. Both inside and outside the cooperative industry, Holland & Knight represents developers, utilities and their subsidiaries, investors and financial institutions in the sourcing and negotiation of senior, mezzanine and subordinated project loans, corporate credit financings, domestic and international private placements, Rule 144A offerings, public bond offerings, lease financings, construction and term loan financings, bridge financing and operating lines of credit.

Holland & Knight lawyers are well-versed and able to handle all relevant types of financing documentation, project documentation and the coordination of the two (negotiating and drafting project documentation to be financeable). The firm's broad experience includes the Department of Energy and Department of Agriculture federal loan guarantees and various tax and tax-equity

advantaged structures involving monetizing tax credits, cash grants, production tax credits and clean renewable energy bonds (CREBs).

Additionally, Holland & Knight has significant experience representing cooperatives, alternative energy project developers, cash equity sponsors and tax equity investors in tax equity transactions including partnership flips, sale-leasebacks and inverted leases involving wind, solar, hydropower, geothermal, biomass and landfill gas facilities. Given the significant tax benefits associated with alternative energy projects, their team ensures compliance with the requirements to claim federal tax credits (including production and investment tax credits), as well as any available state tax incentives. Their representation of clients in IRS controversies at the IRS administrative level and in trial and appellate level courts provides great insight in properly structuring a transaction to avoid or withstand IRS scrutiny.

MANAGEMENT

*A description of **how** the applicant will manage and oversee the project to ensure it is being carried out on schedule and in a manner that best ensures its objectives will be met, **and a description of the evaluation points to be used** during the course of the project.*

Since the proposed project is currently in development, this section will provide the key staff and summary of roles for Minnkota's development of the proposed project. Once the project reaches the construction phase, this list of key staff will change. Further, each of the key staff listed below are full-time Minnkota employees. Information about Minnkota's external resources (consultants, engineering, permitting, legal, financing) that have been engaged to develop the proposed project can be viewed in the previous section.

Key Minnkota staff are considered the Project Manager and the component leads (Engineering, Geologic Storage, Legal, Financing) and are listed below. The key staff are supported by the CEO, CFO and General Counsel, who are also listed below.

- Robert "Mac" N. McLennan, President & CEO: Overall project oversight and direction.
- Kay L. Schraeder, Vice President & CFO: Overall financial oversight and direction.
- Gerad C. Paul, Vice President & General Counsel: Overall legal oversight and direction.
- Craig Bleth, Vice President of Project Development: Project Manager
- Shannon R. Mikula, Special Projects Counsel: Geologic Storage Facility Lead, Environmental Manager, and In-house Project Counsel
- Andrew C. Sorbo, Vice President – Strategic Initiatives: Commercial & Financing Lead

In addition to the above-named key staff, Minnkota has dedicated (full or in part) several additional staff to this project development. Further, as detailed above, Minnkota's key staff and their expertise are strongly augmented by the external experts retained to bring this project to commercial operation.

TIMETABLE

Please provide a project schedule setting forth the starting and completion dates, dates for completing major project tasks/activities, and proposed dates upon which the interim reports will be submitted.

Because of the first-of-a-kind at this scale and in this application nature of this project, Minnkota is expecting to need all permits and other regulatory approvals completed prior to financial close. To meet the target schedule of start of construction by the end of first Quarter of 2024, Minnkota has submitted permit applications on a schedule to have all approvals by the end of 2023. The storage facility permits were issued in January 21, 2022, NDIC Order No. 31583-31588. The air

permit PTC application was filed in May 2023, which should enable final approval by the end of 2023.

BUDGET

*Please use the table below to provide an **itemized list** of the project's capital costs; direct operating costs, including salaries; and indirect costs; and an explanation of which of these costs will be supported by the financial assistance and in what amount. The budget should identify all other committed and prospective funding sources and the amount of funding from each source. **Please feel free to add columns and rows as needed.** Higher priority will be given to projects with a high degree of matching private industry investment.*

Minnkota is negotiating a capital structure that will involve equity contributions from Minnkota and its partner(s) to fund the construction of the CO_2 capture plant ("CaptureCo") and the CO_2 pipeline and storage facility ("StorageCo"). In this structure the 45Q tax credits and NOLs (the NOLs and tax credits are referred to as "tax attributes") will roll up to the joint venture where Minnkota and its partner will divide the tax credits and tax attributes. It is expected that Minnkota's partner will monetize the tax attributes and uses the proceeds to pay for operating costs. Under this structure, the project would need $1.40 billion in capital and that would come from a DOE grant and sponsor equity from Minnkota and its partner(s), and a CSEA loan.

As noted above, the FEED study will produce a final detailed engineering project price that will be reflected in a fixed-firm Engineering, Procurement and Construction (EPC) contract offer. CapEx costs for the CO_2 geologic storage facility (StorageCo) will consist of a combination of fixed-firm and reimbursable contracts since pricing for drilling activities is not generally fixed. Preliminary quotes for these services are included in the $1.40 billion estimated total project cost estimate. See additional detail in the Confidential Appendix A.

Preliminary Sources and Uses during construction and at COD: Confidential – Appendix A

PATENTS/RIGHTS TO TECHNICAL DATA

Any patents or rights that the applicant wishes to reserve must be identified in the application. If this does not apply to your proposal, please note that below.

See Confidential Appendix A for listed Patent rights.

STATE PROGRAMS AND INCENTIVES

Any programs or incentives from the State that the applicant has participated in within the last five years should be listed below, along with the timeframe and value.

Project Tundra, through Minnkota as project sponsor, received great support from the North Dakota Lignite Research Council (LRC). Minnkota was awarded in 2018 grant funds for use on the feasibility engineering and design as well as the front-end engineering and design (FEED) for the capture technology retrofit to lignite coal-fired generating assets and for use on a FEED of a pipeline transport for captured CO_2 and EOR surface facility system for the legacy oilfield west of the Milton R. Young Station. The LRC grant funds were instrumental in the early and intermediary stage of research and engineering of the project to determine the applicability and feasibility of the technology design on lignite fuel gas. Additionally, Minnkota leveraged these LRC grant funds on a 1:4 ratio securing federal funds from the Department of Energy National Energy Technology Laboratory, CarbonSAFE and Office of Fossil Energy. Lastly, in February 2022 the NDIC approved an LRC grant to fund on a 50-50 basis a portion of the final engineering work needed to finance the project and move into the construction phase.

Submitted by: Newlight Technologies, Inc.
Project Duration: 35 months
Total Project Costs: $446,000,000
Request for: $150,000,000 loan

Summary of Project: This project supports the construction of a facility in North Dakota that will manufacture AirCarbon, a plastics-alternative that is carbon-negative and biodegradable.

Technical Review Results

Overall Technically Sound (195/315)		
Good	1	
Fair		
Questionable	1	

BND Economic Feasibility Recommendation

Overall Economic Feasibility	
Yes	X
No	

Technical Committee Scores

	Score (Out of 50)
Charlie Gorecki	43
Josh Teigen	45
Dave Glatt	41
Lynn Helms	42 with conditions
Justin Kringstad	40
Rachel Retterath	43
Todd Steinwand	40
John Weeda	49

Average: 43

CSEA Recommendation: Approve $30,000,000 loan

Clean Sustainable Energy Authority

North Dakota Industrial Commission

Application

Project Title: Project Phoenix: Manufacturing bio-degradable polymers using methane as feedstock.

Applicant: Newlight Technologies, Inc.

Date of Application: May 19, 2023

Amount of Request
Grant: $ 0 USD
Loan: $150 MM USD

Total Amount of Proposed Project: $446 MM USD

Duration of Project: 35 months from CSEA Approval

Point of Contact (POC): Kenton Kimmel, Chief Technology Officer, Newlight Technologies

POC Telephone: (714) 556-4500

POC Email: kk@newlight.com

POC Address: Newlight Technologies, Inc.

14382 Astronautics Lane

Huntington Beach, CA 92647

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ABSTRACT

Background:

Founded in 2003, Newlight is a nature-inspired biotechnology company based in California that is converting air and greenhouse gas into a biomaterial called AirCarbon®. Newlight's mission is to help end plastic pollution and climate change by replacing plastic with AirCarbon, creating global-scale economic and environmental value.

Newlight uses a technology that is found in ecosystems throughout the world, including in the ocean, wherein naturally-occurring microorganisms consume air and greenhouse gas, including methane and carbon dioxide, through fermentation to produce a muscle-like material inside of their cells called PHB. PHB is an energy storage material made in most living organisms, from marine microorganisms to the roots of plants, and can be melted into shapes as a replacement for plastic. Newlight is the first company to directly transform greenhouse gases into PHB, a biomaterial that the company calls AirCarbon, at commercial scale.

AirCarbon competes on performance with various grades of polypropylene, the second largest-volume plastic in the world. With a variety of potential industries to serve, Newlight's primary focus is on addressing ocean plastic pollution by displacing plastic in the foodware market, starting with straws, cutlery, and coated paper products. In addition to foodware, Newlight is also seeding expansion in automotive and fashion applications. Newlight launched its first commercial-scale AirCarbon production facility in 2020, and today Newlight's customers and partners include Shake Shack, Nike, Target, H&M, Ben & Jerry's, Sumitomo, US Foods, and Sysco, with millions of AirCarbon units delivered to consumers to date.

In this application, we are requesting financial support in the form of a $150 million loan to support EPC related to a future plant in North Dakota.

We have completed two stage gates, FEL1 and FEL2. Newlight is poised to award FEL3/FEED contract to Burns & McDonnell after having competitively bid to ten recognized EPC firms. Newlight also received a CSEA grant in 2022 ($4,185,625), this money will be used for FEED in addition to money awarded here.

Objectives:

Newlight executed a feasibility /location study that was partially funded by the Renewable Energy Program/Industrial Council in 2021. This study, concluded in 2022 as Phase 1 of the overall project, showed that there is reason to believe that developing a large-scale industrial plant to produce AirCarbon in the state, while challenging, is very feasible, and several sites were considered. While Newlight has signed a contract to build a plant in Ohio, Newlight is still very interested in developing a facility at the Marley Crossing/Savage Services location near Trenton (like many of the projects under CSEA consideration).

However large the potential, currently Marley Crossing is undeveloped land, and to support an AirCarbon plant, gas, water, and power infrastructure and related suppliers need to be in place and fully

vetted. Mitigating the risks associated with the infrastructure build-out and the input costs associated with the site needs to work to meet shareholder targets. In addition, the climate of North Dakota will result in some special requirements related to climate and transporting equipment into the area. Solving these cost inputs, engineering and infrastructure issues is the primary objective of Phase II in this request.

The objectives are:

- Fund engineering, design, construction, commissioning and startup work for a plant in northwest North Dakota engineered to North Dakota's specific climate and associated construction window as well as additional engineering to support future carbon sequestration opportunities.

- Fund further work that supports the build-out of needed infrastructure at Marley Crossing, by working with suppliers (and the other project developers at Marley Crossing) to obtain the optimal infrastructure and input economics to pass through the final "gate" and began plant construction.

- Work with the State and Williams County to find solutions or mitigation strategies for any open challenges and/or risks that once mitigated can help to add Newlight to the state's portfolio of leading-edge technologies companies that will contribute to realizing the state's Carbon Neutral 2030 goal, CSEA's goals and benefit ND overall.

Expected Results:

- Complete the engineering and plant design through several milestone gates, including any special requirement needed in North Dakota.
- Construct, start up and operate AirCarbon plant in North Dakota.

Duration:

We expect the project will take approximately 35 months to complete after CSEA loan approval.

Total Project Costs:

We anticipate total project costs to be $446 million.

Participants:

The participants include Newlight, Burns & McDonnell for FEL3/FEED and selected specialty contractors and consultants. EPC contractor to be confirmed at future date.

PROJECT DESCRIPTION

Objectives:

The long-term objective of the project is to increase the demand for State's renewable energy and plentiful methane gas through in-state production of a natural, biodegradable material that is a viable alternative to single-use plastic – AirCarbon. North Dakota has established an aggressive carbon neutral goal by 2030, and a key component of that will be finding environmentally sound, local uses for natural gas that does not rely on pipeline delivery out of state. We believe that AirCarbon production become a major component of that goal. For us, achievement of the long-term goal requires the execution on a set of near-term project phases. The second phase of the overall project (this funding request) is focused on engineering, design, and the cost of infrastructure build-out as well as leveraging the work that has been done in the State in the carbon sequestration area.

Single-Use Plastics and AirCarbon

Single-use plastics made from petroleum are not bio-degradable. They are the cause of massive environmental problems that are forcing many governments to implement or consider restrictions. However, most experts forecast large increases in plastic demand due to the low-cost to produce and the high costs of making materials that have the same performance characteristics. Some newer materials are compostable. These products only degrade when disposed into hot industrial composts, of which there are limited only few. In contrast, AirCarbon is able to degrade in natural environmental conditions, including in home compost, soil, and other environments. AirCarbon has been certified "Plastic-Free" by Oceanic Global and pass home, soil, and water compostability testing through TUV Austria, one of the world's leading end-of-life certification bodies.

An estimated 17.6 billion pounds of plastic enter the marine environment every year, resulting in government bans and restrictions on using single-use plastics around the globe. While there have been significant efforts to replace single-use plastics with other materials, implementation has been slow due to their cost structure, performance characteristics, or limited degradability.

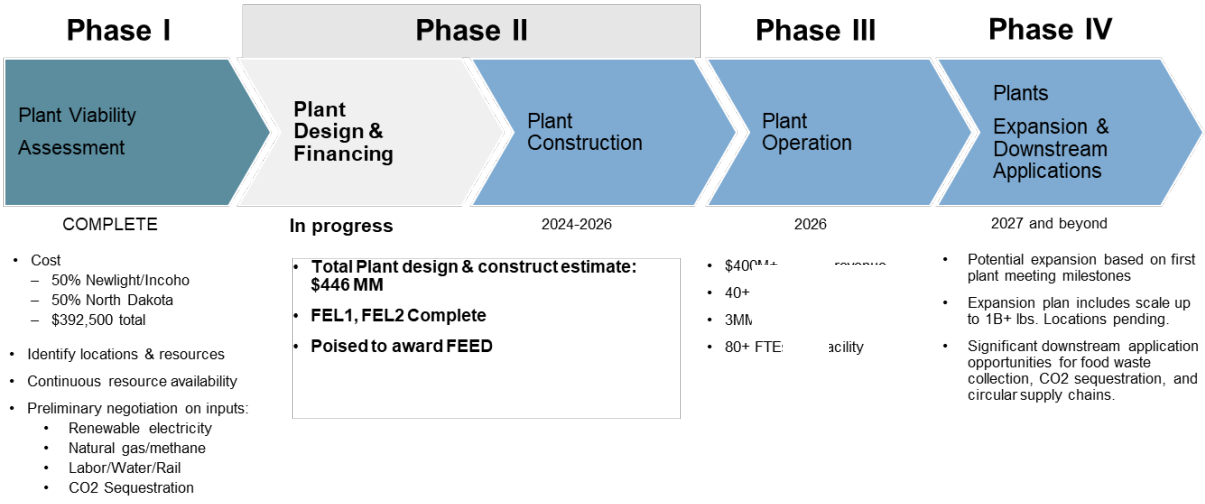
After 19 years in development, Newlight has developed an innovative technology that overcomes those barriers - a natural, regenerative, carbon-negative material that utilizes air and methane or CO2 gas (instead of petroleum) as feedstock inputs.

AirCarbon is also known as PHB, and PHB is produced throughout nature, including by ocean-based micro-organisms that consume carbon in the form of methane or CO2. AirCarbon is environmentally degradable because microorganisms in the environment recognize it as a natural food source. It melts for forming products (at around 350^{oF}) and is durable in hot and cold conditions (also making it SGS-certified dishwasher-safe).

Newlight's California Headquarters & Air Carbon cutlery

Project Description - High Level Project Approach:

The objective is to construct and operate an AirCarbon plant and the approach is designed into four phases (see below). While Newlight has signed an agreement to build its next plant in Ohio, Phase I was focused on understanding the viability of where to locate a future plant in North Dakota. Upon approval by Newlight's board, we are prepared to execute FEL3/FEED phase in order to prepare for detailed design and construction completion in 2026.



The progress during and since the completion of Phase I includes the following:

- **Engineering and Design:** The FEL2 (30%) design has been completed for the Ohio site and the ISBL process design will be very similar for the North Dakota site. Preliminary FEL3/FEED design work has commenced. Newlight has been investing and will continue to invest in this effort through the CSEA evaluation period, showing a commitment to the development of the project in North Dakota.

- **Site Selection:** The evaluation of site options across western ND was narrowed down to be around the Marley Crossing/Savage Services operations to support transportation logistics. We have not yet selected a specific site. Newlight has signed a contract with a site in Ohio but is still very interested in developing a second site in North Dakota. Newlight will enlist local contractors to support finalizing a site if this loan request is accepted.

- **Equipment & Labor:** Some of the equipment and infrastructure needed for the plant are long lead time, particularly the large complex reactor vessels, electrical gear, waste water treatment plant, etc. We plan to leverage the logistics practices for the adjacent facilities in order to plan for deliveries to our site. We will optimize use of local firms for goods and services supply. Newlight will leverage the FEED contractor for conducting labor studies and equipment deliveries throughout FEED execution.

- **Infrastructure Requirements, Key Cost Drivers & Implications for Total Installed Cost Estimation:**
  Two key cost drivers with a high degree of sensitivity and risk for AirCarbon production are electricity and gas costs. The estimate of these two drivers out of Phase I were at an FEL1 accuracy due to market variability and greenfield infrastructure options still under development. Understanding and mitigating buildout challenges will be critical in the success of the project.

  We also have interest in the State's carbon sequestration strategy and will be evaluating the options to drive value.

- **State Support:** Thus far, the North Dakota Commerce Department has been very helpful in listening our requirements and providing early FEED funding. The Marley Crossing site is a greenfield location that does not yet have established infrastructure to deliver the power, gas, and water to our specifications. Understanding and participating in the development and availability (e.g., reliability and timing) of that infrastructure is an important step to the success of the project.

Methodology

A milestone-based gated approach to perform projects aligns project objectives with the business needs to execute the projects in the most efficient way. The gates methodology is a process of progressive

definition of the project. This process is based on a planned and standardized series of reviews (gates) at the end of each phase.

This breakdown in phases or stages and the normalized control points at each end is an improvement of the classic approach, where the organizations may have points of control, but they are not as standardized as the ones that this technique offers. Gates methodology is consistent with Construction Industry Institute Best Practices.

Based on the progress made in Phase I, Phase II will have two parts. The first part will have several goals that we will organize into milestones to review at specific "gates" that include the following:

Engineering and Design: Manage FEED Contractor to update the engineering design to include the option of operating in the ND climate 7/24/365, completing FEED to include changes that incorporate the North Dakota operating climate. Identifying and requisition key long lead equipment and activities during FEL3 will minimize overall project schedule. The inside battery limits engineering design effort in many ways is common to the Ohio and Marley Crossing developments which benefits the overall project schedule. The initial grant will cover the FEED component for the installation in North Dakota. We are sharing the engineering costs with a focus on the infrastructure requirements for the North Dakota installation.

This methodology drives a common base plant design (exception is the cold weather design components specific to North Dakota), thus sharing the engineering design across the two facilities.

- **Site Layout :** The management team visited the Trenton area and noted the appeal of a few specific sites in the Marley Crossing area that could meet requirements with the proposed infrastructure build out. In Phase II we plan to narrow down and focus on the optimal site and developing plot plans and general arrangement drawings that are aligned across the two sites for inside battery limits.

- Validate equipment deliveries, cost estimate and current labor studies for the region.

- **Finalize Infrastructure Requirements & Implications for Economic Evaluation:** In FEED we plan to focus on the key cost drivers (e.g., electricity, gas, water & carbon sequestration) and the supporting infrastructure costs to better refine overall economic evaluation. This includes working with and supporting the Trenton Infrastructure group to design win/win solutions for all stakeholders (e.g., companies locating at Trenton, County & State organizations).

  An important example of this is power. Finding and/or developing a reliable, renewable power source that also meets economic targets is a critical success factor.

- **State Support:** As the project continues to progress, we will work with the local authorities and vocational programs to identify local contractors and training initiatives to support the project.

Anticipated Results:

We anticipate that completing FEED will provide us with the engineering plans and detailed infrastructure insights and other needed information to allow us to make a well-informed decision regarding the plant operations to meet targeted economics. We will continue to focus on refining the key value drivers (e.g., cost inputs) and mitigate any key risks. FEED work will include:

- **Engineering and Design:** Provide specific list of deliverables suitable to move forward into EPC. These deliverables will support both locations, Ohio and North Dakota, and will include climate-specific components.

- **Site Selection:** Site location and overall sit plan will be finalized early in FEED for North Dakota.

- **Equipment and Labor:** Labor costs and availability will be developed based on the most recent labor study. Preliminary quotes or firm quotes for 85% of equipment costs will have been received by the end of FEED.

Infrastructure Requirements & Implications to Total Installed Cost:

This will require more informed assessment of key operating inputs including assessing the reliability/availability timing, input quality (e.g., methane gas target of 90%) and cost (commodity and infrastructure) for the key operating inputs (e.g., electricity, gas and water including potable, cooling, and waste management). We anticipate and plan to support the Trenton Infrastructure group to design win/win infrastructure solutions for all stakeholders (e.g., companies locating at Trenton, County & State organizations). Finally, we anticipate identifying potential partners and strategies to support the State's carbon sequestration goals to further optimize our economics and ESG goals.

We will conduct meetings with and gain commitments from key infrastructure utility providers to validate timelines and delivery volumes that can support the project.

- **State & County Support:** During Phase II, the plan is to work with the ND Commerce Department to articulate any needs such that the State/County is aware of project status and can continue to support the ongoing project installation.

With the completion of the FEED scope, we believe the State will see that Newlight has demonstrated due diligence in defining the scope of the work in the region where it is to be constructed before moving into detailed engineering and construction. This will provide a level of comfort that the State can add Newlight and AirCarbon production to the State's portfolio of new vibrant, leading-edge technologies

and companies that are selecting ND and contributing to its Carbon Neutral goal. The output of the above work will produce a high-level work plan that considers, integrates and optimizes realization of Newlight's and the State's (e.g., infrastructure support) goals.

Facilities:

Owner facilities at the site location will be required upon mobilization to the active construction site.

Resources:

We will employ a number of resources but to a large part the following partners will be the focus:

- Newlight subject matter experts
- Burns & McDonnell Engineering
- Trenton Infrastructure partners (including ND State and the County)
- EERC (carbon sequestration expertise)
- Key ND equipment fabricators
- Subject matter experts and consultants

Other consultants or services to be used may include electricity pricing experts, site selection contractors, and legal advisors for purchasing and sales agreements and we will try to utilize ND experts where possible. Environmental consultants will be required to support project development and assist during reviews with the North Dakota Department of Environmental Quality. State organizations will be contacted with respect to permitting requirements and we will continue to work with the Commerce Department to best position the plant for success.

Techniques to Be Used, Their Availability and Capability:

We plan to utilize a number of techniques to complete the work effort as listed below.

- OSHA best practices
- Reliability and Maintainability analysis
- Construction Industry Institute Best Practices
- Advanced work packaging
- Continuous financial model update
- Labor Studies
- Continuous evaluation of risk profile (Risk management workshops)
- Logistics planning studies

If we recognize the need for additional capability the project team will include local contractors, legal support, and technical consultants prior to looking outside ND.

Environmental and Economic Impacts while Project is Underway:

Environmental impacts and risks will be identified in FEED and any mitigations needed will be delineated for the EPC contractor.

Ultimate Technological and Economic Impacts:

While the FEED phase of the project is to support development of EPC and infrastructure requirements of building an AirCarbon plant near gas facilities in North Dakota. The ultimate goal of the project is to create an entirely new industry based on a new way to utilize gas and energy. That new industry: AirCarbon products.

AirCarbon is expected to be able to compete favorably with traditional oil-based plastic as well as with other alternative polymers both in functionality and price with the "right" input cost structure. This assumes that we can produce AirCarbon with inputs sourced at the "right" cost, quality and reliability requirements that will allow us to successfully compete in the marketplace. If we produce AirCarbon at competitive levels, then we can expect continued economic impact growth from the planned plant as well as any potential expansion efforts based on market needs.

This effort will also create secondary benefits for North Dakota-based suppliers of gas, renewable wind energy, transportation, and other employers. And most importantly, it will create continued demand for the state's plentiful carbon resources that cannot rely on interstate pipelines for delivery and instead use the gas in North Dakota to support the growth of its own value-added industrial base.

The infrastructure build-out will ultimately also support the entire Marley Crossing development, the companies that supply the inputs, and the region in general. The area will see development and employment from the plant, the construction, and the ancillary businesses surrounding the development through cost sharing and infrastructure development that may offset the ups/down economic cycles associated with the current carbon industry.

Once Phase II is successfully complete we will operate a plant that will employ 70-100 people directly, with many more that were involved in construction. This will spur secondary developments in the Williston/Trenton region, and the project has support from other development partners and the county economic development office.

Why the Project is Needed:

North Dakota's Bakken region was blessed with plentiful oil and gas. Over time, the oil/gas ratio (OGR) has increased, and the North Dakota Pipeline Authority predicts that ratio to continue. They also predict that output may exceed pipeline capacity in the near future. It will be critical to the state and the energy sector to find "local" productive use for that amount of gas, and an industry that uses gas without reliance on limited and intra/interstate pipeline capacity is of great interest. Introducing AirCarbon production locally in the Bakken where that excess gas can be used to make an environmentally friendly, carbon-negative, ocean-safe plastic alternative is one logical solution.

This also supports the Governor's 2030 Carbon Neutral target. Newlight will essentially sequester carbon in the product during its useful life. It is our intent to find a way to harness renewable power, and to sequester any carbon dioxide that is produced during AirCarbon production. Also, it provides a very

tangible product that people of all persuasions can touch and feel and understand the story of how forks, knives, spoons, and straws are helping an energy-producing state become carbon-neutral. AirCarbon made from North Dakota methane will represent a product that is biodegradable in nature and will not accumulate in the oceans.

Finally, our intent is for this to be a first plant and we intend to expand as the market for AirCarbon grows. For the plant under consideration in this application, which would provide 70-100 environmentally attractive jobs that provides North Dakotan's the opportunity to work for a leading technology company in a growing industry. As the company grows, so will the economic and social benefits to the state.

STANDARDS OF SUCCESS

The project will support the design and operations of an economically viable plant that meets Newlight's success criteria. Those criteria include:

- Safety in Construction and Operations
- Achieving a design that will meet economic performance thresholds.
- Engineering to meet specific North Dakota challenges.
- Confidence that when plant construction commences, the economics and infrastructure and delivery mechanisms (pipeline, waterline/s, or powerlines) are in place to meet the construction timelines with adequate lead times to alleviate any potential construction/operating delays.

If successful, Newlight will move to finance and build North Dakota's first AirCarbon plant. Developing an AirCarbon industrial base in North Dakota can support the state's energy sector by increasing demand for renewable energy, providing a new market for gas feedstocks (which supports further build out of gas gathering assets leading to a reduction in flaring) while promoting the state of North Dakota as a leader in innovative environmental stewardship.

To move the project into Phase III, Newlight needs to complete the engineering, construction, and commissioning.

Upon completion of engineering and design, Newlight will transition into the construction phase that includes:

- A significant number of indirect design, supply and construction jobs in North Dakota.
- A plant that will, when operational, will create 100 environmentally friendly jobs over the next five years.
- Increase in supplier revenues and jobs to support plant inputs, especially renewable energy, water, and gas/CO2 feedstock and transportation costs.

BACKGROUND/QUALIFICIATIONS:

Newlight Technology and Burns & McDonnell

Founded in 2003, Newlight is a nature-inspired biotechnology company based in California that is converting air and greenhouse gas into a biomaterial called AirCarbon®. Newlight uses a technology that is found in ecosystems throughout the world, including in the ocean, wherein naturally-occurring microorganisms consume air and greenhouse gas, including methane and carbon dioxide, through fermentation to produce a muscle-like material inside of their cells called PHB. PHB is an energy storage material made in most living organisms, from marine microorganisms to the roots of plants, and can be melted into shapes as a replacement for plastic. Newlight is the first company to directly transform greenhouse gases into PHB, a biomaterial that the company calls AirCarbon, at commercial scale. AirCarbon competes on performance with various grades of polypropylene, the second largest-volume plastic in the world. With a variety of potential industries to serve, Newlight's primary focus is on addressing ocean plastic pollution by displacing plastic in the foodware market, starting with straws, cutlery, and coated paper products. In addition to foodware, Newlight is also seeding expansion in automotive and fashion applications. Newlight launched its first commercial-scale AirCarbon production facility in 2020, and today Newlight's customers and partners include Shake Shack, Nike, Target, H&M, Ben & Jerry's, Sumitomo, US Foods, and Sysco, with millions of AirCarbon units delivered to consumers to date.

Burns & McDonnell is a family of companies bringing together an unmatched team of more than 13,500 engineers, construction and craft professionals, architects, planners, technologists and scientists to design and build our critical infrastructure. With an integrated construction and design mindset, we offer full-service capabilities. Founded in 1898 and working from 70 offices globally, Burns & McDonnell is ranked 7th on the 2023 annual survey of Top 500 Design Firms by Engineering News-Record (ENR) magazine and is 100% employee-owned.

Mark Herrema, CEO

Mark Herrema is the co-founder and CEO of Newlight Technologies. In 2003, Mark co-founded Newlight with Kenton Kimmel with a vision of using greenhouse gas as a resource to make high-performance sustainable materials. Newlight has been honored to receive industry recognition as "Biomaterial of the Year" by the Nova Institute, "Innovation of the Year" by Popular Science, and "Technology Pioneer" by the World Economic Forum. In 2016, Newlight was awarded the Presidential Green Chemistry Challenge Award by the U.S. Environmental Protection Agency. Mark graduated magna cum laude from Princeton University, and has since garnered 19 years of experience in process engineering, polymer functionalization, and strategic business development.

Kenton Kimmel, CTO

As CTO and co-founder of Newlight, Kenton has over 19 years of industrial experience in chemical, process, electrical, mechanical, and automation engineering. Kenton has been instrumental in the design, scale-up, and optimization of the company's biomaterial manufacturing technology, including the engineering, construction, commissioning, and optimization of the company's production lines. Prior to his work at Newlight, Kenton held a position in the In Vitro Microbiology Group at Allergan Pharmaceuticals where he conducted research on genetic markers and gene expression of potent neurotoxins for use in cosmetic surgery. Kenton graduated from Northwestern University with a Biomedical Engineering B.S.E degree, double specializing in Biomaterials & Biotechnology and Transport Processes & Tissue Engineering.

Evan Creelman, Chief Business Development Officer

Evan Creelman joined Newlight in 2006 and has been prominent in the creation of Newlight's extensive network of development and commercial partners. Evan now leads the company's business development efforts, and prior to joining Newlight, Evan worked with Mercer Management Consulting in the Airline, Retail, and Private Equity industries. Evan graduated cum laude from Northwestern University with a degree in Applied Mathematics & Economics, holds a master's in accounting from the University of California - Irvine, and is a Chartered Financial Analysis® (CFA).

Rob Clark, Corporate Project Director

More than 40 years' experience in project management as owner or contractor, in diversified international and regional project management, engineering and construction, with project sizes up to 30 billion dollars. Rob was VP-Project Director on a project awarded the Hydrocarbon Processing Petrochemical Project of the Year. Rob's projects have always been onshore, downstream, in the areas of refining, petrochemicals, power and environmental, with projects executed in Europe, Asia, North and South America. He has presented at conferences in Asia and the U.S. on EPC topics such as Front- End Engineering Design (FEED), Risk, Ethane and Ethylene, Site Selection and Construction Labor. He was active on the Construction Industry Institute Research Team for Modularization.

MANAGEMENT

Our partner Burns & McDonnell is a recognized expert in their field. Newlight has previous experience working with the firm and is confident in their management techniques.

Burns & McDonnell is a family of companies bringing together an unmatched team of more than 13,500 engineers, construction and craft professionals, architects, planners, technologists and scientists to design and build our critical infrastructure. With an integrated construction and design mindset, we offer full-service capabilities. Founded in 1898 and working from 70 offices globally, Burns & McDonnell is ranked 7th on the 2023 annual survey of Top 500 Design Firms by Engineering News-Record (ENR) magazine and is 100% employee-owned.

The ability to manage a project of this size requires the team to be able to deliver each stage of the project in a structured, stepwise manner. The project shall be progressed in a proven, industry standard stage gated process, consistent with the Construction Industry Institute Best Practices. The approach will continuously develop further quantification and reduction of risk, with refinement and development of cost and schedule to ensure project certainty.

The project team shall combine global best practices, reviewing past lessons learned providing the team with inputs to craft a fit for purpose project execution strategy.

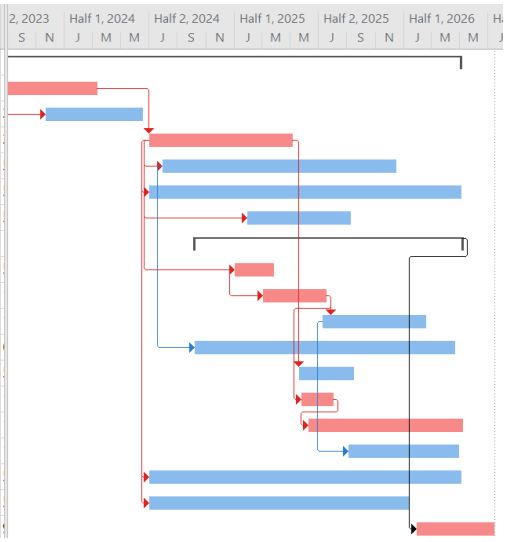
As Newlight has developed they have assembled a multi-cultural project execution team with experience in projects up to $30 billion dollars.

TIMETABLE

Our proposal aligns the already completed FEL1 and FEL2 engineering and design work to build this plant through a set of logical milestones that will align with the project's reporting and funding through CSEA. Funding will be used to contract our engineering firm, Burns & McDonnell, and support Construction and Commissioning of the North Dakota plant as well as support our work to develop the Marley Crossing infrastructure plans.

The below Gantt chart shows the detailed engineering milestone plan and timing.

Task Name	Duration	Start	Finish
E4 Engineering	**720 days**	**Tue 8/1/23**	**Mon 5/4/26**
FEED	32 wks	Tue 8/1/23	Mon 3/11/24
Permit Submission and Approval	7.5 mons	Tue 11/21/23	Mon 6/17/24
Detailed Design	11 mons	Tue 7/2/24	Mon 5/5/25
Procurement (LLE +)	18 mons	Tue 7/30/24	Mon 12/15/25
Procurement of Electrical Substations	24 mons	Tue 7/2/24	Mon 5/4/26
Module Assembly	8 mons	Tue 1/28/25	Mon 9/8/25
E4 Construction	**414 days**	**Tue 10/8/24**	**Fri 5/8/26**
Site Prep	12 wks	Thu 1/2/25	Wed 3/26/25
Foundations & Roadways	20 wks	Mon 3/3/25	Fri 7/18/25
Building Erection	8 mons	Wed 7/9/25	Wed 2/18/26
MCC and Electrical Buildings	20 mons	Tue 10/8/24	Mon 4/20/26
Equipment Setting	17 wks	Tue 5/20/25	Mon 9/15/25
Structural Steel	10 wks	Mon 5/26/25	Fri 8/1/25
Piping	48 wks	Mon 6/9/25	Fri 5/8/26
Electrical and Instrumentation	34 wks	Wed 9/3/25	Wed 4/29/26
AEP Electrical Power Supply	24 mons	Tue 7/2/24	Mon 5/4/26
Wastewater Treatment EPC	20 mons	Tue 7/2/24	Mon 1/12/26
E4 Commissioning and Startup	**6 mons**	**Thu 1/29/26**	**Wed 7/15/26**



BUDGET

*Please use the table below to provide an **itemized list** of the project's capital costs; direct operating costs, including salaries; and indirect costs; and an explanation of which of these costs will be supported by the financial assistance and in what amount. The budget should identify all other committed and prospective funding sources and the amount of funding from each source. **Please feel free to add columns and rows as needed.** Higher priority will be given to projects with a high degree of matching private industry investment.*

Project Associated Expense	NDIC Grant	NDIC Loan	Applicant's Share (Cash)	Other Project Sponsor's Share	Total
FEED	$4,185,625 (2022 grant)		$12,814,375		$17MM
Detailed Engineering & LLE		$59 MM	$59 MM		$118 MM
Procurement & Construction		$91 MM	$207 MM		$298 MM
Commissioning & Start Up			$13 MM		$13 MM
Total	$4,185,625 (2022 grant)	$150,000,000	$291,814,375		$446,000,000

These estimates are based on experience in estimating and quoting similar projects.

CONFIDENTIAL INFORMATION

A person or entity may file a request with the Commission to have material(s) designated as confidential. By law, the request is confidential. The request for confidentiality should be strictly limited to information that meets the criteria to be identified as trade secrets or commercial, financial, or proprietary information. The Commission shall examine the request and determine whether the information meets the criteria. Until such time as the Commission meets and reviews the request for confidentiality, the portions of the application for which confidentiality is being requested shall be held, on a provisional basis, as confidential.

If the confidentiality request is denied, the Commission shall notify the requester and the requester may ask for the return of the information and the request within 10 days of the notice. If no return is sought, the information and request are public record.

Note: Information wished to be considered as confidential should be placed in separate appendices along with the confidentiality request. The appendices must be clearly labeled as confidential. If you plan to request confidentiality for **reports** if the proposal is successful, a request must still be provided.

To request confidentiality, please use the template available at http://www.nd.gov/ndic/CSEA-app-doc-infopage.htm.

PATENTS/RIGHTS TO TECHNICAL DATA

Any patents or rights that the applicant wishes to reserve must be identified in the application. If this does not apply to your proposal, please note that below.

STATE PROGRAMS AND INCENTIVES

As mentioned, Phase 1 of the project was provided with 50% funding via the Renewable Energy Program. The total project cost was $392,500, of which the state funded 50% or $196,250. This Phase was completed in January 2022, resulting in a positive feasibility with 5 locations presented and evaluated. Of these, the Marley Crossing/Trenton site adjacent to the Savage Services location was the top site.

Newlight also received a CSEA grant in 2022 to support FEED engineering for an AirCarbon plant in North Dakota. The total project FEED cost was forecasted at $8,371,250 of which the state grant will fund 50% or up to $4,185,625. This work has not yet commenced and is expected to be initiated in 2023 with completion in 2024. We are requesting another$150MM for the project in North Dakota. While the first plant is planned to be constructed in Ohio, we are confident we can construct an additional plant in North Dakota.

These are the only state programs that Newlight has participated in.

Submitted by: Rainbow Energy Center
Project Duration: 30 months
Total Project Costs: $85,000,000
Request for: $42,500,000 loan

Summary of Project: This project supports the commercialization of recycling of bottom ash and flue gas desulfurization materials at Coal Creek Station for beneficial reuse.

Technical Review Results

Overall Technically Sound (256/315)		
Good	3	
Fair		
Questionable		

BND Economic Feasibility Recommendation

Overall Economic Feasibility	
Yes	X
No	

Technical Committee Scores

	Score (Out of 50)
Charlie Gorecki	43
Josh Teigen	42
Dave Glatt	43
Lynn Helms	43
Justin Kringstad	43
Rachel Retterath	46
Todd Steinwand	36
John Weeda	50

Average: 43

Recommendation: Approve $42,500,000 loan

Clean Sustainable Energy Authority

North Dakota Industrial Commission

Application

Project Title: Lignite Combustion Product Enhancements

Applicant: Rainbow Energy Center

Date of Application: May 19, 2022

Amount of Request
Grant: $0
Loan: $42,500,000

Total Amount of Proposed Project: $85,000,000

Duration of Project: 30 months
(May 2023 – October 2025)

Point of Contact (POC): Jessica K. Bell

POC Telephone: (701) 891-9708

POC E-Mail: Jessica.Bell@rainbowenergycenter.com

POC Address: 918 E Divide Ave, Suite 400

Bismarck, ND 58501

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ABSTRACT

Objective: The objective of this project is to support the Clean Sustainable Energy Authority (CSEA) goal that focuses on the reduced environmental impacts and increased energy sustainability. The project also brings increased value to North Dakota. To support these objectives, the project team proposes to complete a fully commercialized operation to optimize the beneficial use of both bottom ash material and flue gas desulfurization (FGD) materials at Coal Creek Station, an 1151-megawatt coal-fired power plant located between Washburn and Underwood, North Dakota. The proposed project will result in the commercial facilities necessary to process these materials to bring them to commercial grade for utilization as commodities as compared to permanent storage in solid waste facilities. Building on the experiences in other states, the project will launch a system of lignite coal combustion material transformation that is a first of its kind in North Dakota. Project details include a) detailed design and costing of materials to build the drying and grinding facilities; b) engineering and material balances required to file for all project permits; and c) materials needed to commercialize enhanced management of coal combustion materials. The project team proposes to advance on-site capabilities to manage coal combustion materials previously disposed of in solid waste facilities and convert them into commodities ready to market throughout the region.

Expected Results: This project will establish a design basis and cost estimate possessing sufficient detail to support the final construction of equipment on site at Coal Creek Station. Upon its completion, Coal Creek Station will have the equipment needed to convert coal combustion materials such as bottom ash and FGD materials to commodity-grade products, including bottom ash at ASTM- C618-23^{E1} and quality gypsum material. Ultimately, this will result in technological advancements with our partners that reduce environmental impacts and increase sustainability of coal electricity production through reducing the amount of non-marketable products placed in permanent storage and CO_2 emissions. The project team aims to serve as an example of how North Dakota can deploy additional technologies at existing coal-fired power plants to reduce CO_2 emissions, improve the marketability of coal combustion products, reduce disposal of valuable products and pursue Governor Burgum's goal of carbon neutrality by 2030.

Duration: 30 months (May 2023 – October 2025)

Total Project Cost: The proposed total cost is $85,000,000, with $42,500,000 loan from the North Dakota Industrial Commission (NDIC) and $42,500,000 cash from Rainbow Energy Center, LLC (Rainbow Energy Center).

Participants: The project lead is Rainbow Energy Center, and the project will be conducted in partnership with EcoMaterial Technologies, Inc., Barr Engineering Co. and NDIC through the Clean Sustainable Energy Authority.

PROJECT DESCRIPTION

Objectives: The objective of this project is to support the Clean Sustainable Energy Authority (CSEA) goal that focuses on the reduced environmental impacts and increased energy sustainability. The project also brings increased value to North Dakota. To support these objectives, the project team proposes to complete a fully commercialized operation to optimize the beneficial use of both bottom ash material and flue gas desulfurization (FGD) materials at Coal Creek Station, an 1151-megawatt coal-fired power plant located between Washburn and Underwood, North Dakota. The proposed project will result in the commercial facilities necessary to process these materials to bring them to commercial grade for utilization as commodities as compared to permanent storage in solid waste facilities. Building on the experiences in other states, the project will launch a system of lignite coal combustion material transformation that is the first of its kind in North Dakota. Project details include a) detailed design and costing of materials to build the drying and grinding facilities; b) engineering and material balances required to file for all project permits; and c) materials needed to commercialize enhanced management of coal combustion materials. The project team proposes to advance on-site capabilities to manage coal combustion materials previously disposed of in solid waste facilities and convert them into commodities ready to market throughout the region.

Methodology: The tasks for this project are outlined in the details below. Barr Engineering Co. will work concurrently with EcoMaterial Technologies and REC staff to implement the initiatives outlined in this proposal to be completed by June of 2025. Engineering and design details will be completed for both facilities prior to construction commencement. Upon completion of construction, facilities will operate as outlined in the details provided in this application.

Project Management and Planning: The management of all project activities will be performed by REC personnel over the duration of the project period of performance as well as the operation of the facilities. Barr Engineering Co and EcoMaterials Technology Inc will be resources for these tasks that include communication of project activities and direction with the project team to provide updates and obtain inputs to prioritize the project focus. Specific activities will include task coordination, risk management/mediation, managing budget resources and subcontractors, the preparation of a comprehensive final report, securing cost-share dollars, and planning and executing project status meetings.

Engineering and Design: This task will focus on the engineering and design of the bottom ash grinding, the FGD processing facilities, and the integration into plant operation. Barr Engineering Co has completed the development of the design for the FGD process and will utilize this design to complete construction and begin processing the FGD materials. EcoMaterials Technology Inc has recently completed a bottom ash grinding facility in Texas and will be able to reference this success through the development of this site to begin marketing the product into the commercial marketplace.

Anticipated Results: The project results will support the mission of the CSEA to develop and deploy large-scale commercial projects that reduce environmental impacts and increase the sustainability of energy production. Results will support advancement of the current state of the art technologies to include 1) oxidization of FGD material to industry specifications, 2) the grinding of bottom ash material to industry specifications, 3) elimination of the need to dispose of large amounts of lignite coal combustion materials in solid waste facilities and 4) reduction of carbon dioxide in concrete and other products. Deliverables will include a detailed design basis and on-site equipment that would result in the

production of products deliverable to the market for consumption in the region, growing and diversifying the state's economy.

Facilities: The project experts anticipate footprints of 7.5 to 8 acres for these facilities to process the coal ash products for beneficial application. Bottom ash handling will consist of dewatering the product and grinding the ash to combine with other coal ash products for market. This will require multiple siloes, heat, and a mill to create a marketable product that can be beneficial. FGD will be processed in a processing building of vacuum belts through oxidization resulting in a product prepared to bring into a market that requires an additional step of processing to be a wallboard or agricultural beneficial products. Partners for these processes are Barr Engineering to complete the FGD processing with specific application to the Coal Creek FGD stream and EcoMaterials as the marketing partner for these products.

Resources: A team of industry experts will perform all project activities with Rainbow Energy Center overseeing the project in its entirety. For over 25 years, EcoMaterials Technology Inc has successfully marketed Coal Creek Station's coal ash products into markets across the US. EcoMaterials and their subsidiary, Synmat, have expertise in marketing all products that are expected to be produced with these additional technologies. Barr Engineering Co has dedicated resources into specifically researching Coal Creek Station's FGD stream to develop a process that will be site specific for the material produced. Barr Engineering has over 55 years of experience working in various plant sites in the area and has historical expertise working at Coal Creek Station since the commissioning of the units into commercial operation. The engineering and scientific research staff is equipped with state-of-the-art analytical, modeling, and engineering facilities to address a wide variety of energy, environmental, and mineral resource research topics. Both EcoMaterials Technology, Inc. and Barr Engineering Co. are committed to providing all necessary personnel and resources to ensure the timely completion of all activities outlined in this proposal. Industry sponsor and future plant owner Rainbow Energy Center will provide additional project advisory services. EcoMaterials and Barr Engineering have been a part of project teams that have executed similar project scopes of work focused on North Dakota utilities and bring experience gained from design and construction multiple other facilities that are similar to these proposed for Rainbow Energy Center.

Techniques to Be Used, Their Availability, and Capability: The foundation of the techniques to be used for these processes is one that many other utilities have utilized to handle their coal ash materials. The intention is to tie multiple technologies together and create a beneficial use of the products to create and grow a revenue stream.

The Bottom Ash facility will consist of a dewatering area as well as a pulverizer that grinds the material into a usable size that is consistent with our currently marketed fly ash. Once that material passes through the pulverizer, it will be blended with the fly ash and marketed to end users. Once the project is complete and the site is operational, it will be running as an ongoing process for our site. It will be able to process and blend 350k tons of bottom ash that REC has identified as a maximum in the previous 5 years.

The FGD processing facility will be made up of a process that will dry the FGD material and process it through oxidization and vacuum filtering techniques. There are multiple markets that can be impacted by this production process as a beneficial use. These markets consist of agricultural uses, wallboard

production, and cement intergrind. The expectations for this FGD end-product will depend on the process chosen given the markets and costs associated with achieving required specifications for each operation. An estimation of 165k tons of FGD material has been identified as the capacity for this facility based on the current operational production at Coal Creek Station.

Environmental and Economic Impacts While Project Is under Way: The proposed projects will require new environmental permits as well as the modification of existing environmental permits from the North Dakota Department of Environmental Quality. These projects will not affect any existing or partner facilities.

Ultimate Technological and Economic Impacts: The lignite-fired power plants in ND present an opportunity to economically demonstrate the utilization of Coal Ash while reducing environmental impacts. The economic health of the central region of North Dakota is tied to energy jobs in the area. Currently, the lignite industry directly employs 3623 people, with another 9500 indirect employees supported by the industry, accounting for over $5.4 billion in economic impact. Technology advances that continue the responsible use of lignite and bring new industries to the region are critically needed to sustain and grow these jobs. This project provides a basis to market coal ash materials. It is a large-scale commercial project that will reduce environmental impacts and increase sustainability of energy production and delivery.

Why the Project Is Needed: The management of coal combustion residuals is a priority for Coal Creek Station. Conversations with regulators at the state and federal levels have resulted in an even deeper look into options for beneficial uses of lignite coal combustion residuals. As the concrete market continually calls for more fly ash, already currently utilized for beneficial use in concrete, it was determined that Coal Creek Station's bottom ash could be utilized and sold in the same market as it's fly ash. Market specifications require the material to be dried and ground to qualify for beneficial use in the concrete market, as is requested in this proposal.

FGD material at Coal Creek Station is currently disposed of in a coal combustion residuals solid waste facility regulated by both the state of North Dakota's Department of Environmental Quality (DEQ) and the United States Environmental Protection Agency (EPA). If oxidized and dried, this material could qualify for beneficial use in several ways as gypsum. The EPA released a study in 2023 qualifying this oxidized and dried FGD material for beneficial use on agricultural lands. Industry spec gypsum can also be used in wallboard and cement. In order for proper oxidation and drying to occur, special equipment is needed, and the cost of that equipment is included in this proposal.

The beneficial use of fly ash, bottom ash, and FGD as gypsum reduces carbon dioxide (CO_2) emissions as they replace other products currently on the market that produce CO_2 emissions while being created and processed. Beneficial use also reduces the amount of material that needs to be disposed of in landfills decreasing environmental impact and footprints.

This project is set up for success, as it is driven by three major forces: markets, economics and environmental improvements. Markets continually demand additional ash for use in concrete, and the bottom ash will qualify as high-quality spec material to be included in that product. The business case for these sales continue to be strong, and Rainbow Energy Center is excited to partner with Eco Material Technologies to further penetrate that market. Eco Material Technologies will also play a large role in marketing the gypsum material once it is converted so that it can be used for agricultural purposes, wallboard creation or to further enhance concrete materials. Beneficial use of these materials has environmental benefits to improve the sustainability of our day to day life. The longevity of a project of

this size is immense, as this project will drastically reduce the need for permanent storage and disposal of coal combustion residuals.

The new drying and grinding facilities will produce high-grade materials, enhancing the byproduct markets and adding value to North Dakota through growing and diversifying the state's economy. By seeking a way to use these materials in a beneficial way, Coal Creek Station will be able to continue to utilize lignite to create electricity in a carbon-constrained world. This project supports the core mission of the CSEA to develop large-scale commercial projects which reduce environmental impacts and increase sustainability of energy production and delivery.

STANDARDS OF SUCCESS

This project accelerates environmental stewardship and the enhancement of carbon management at Coal Creek Station. The pathway for success for Coal Creek Station has been outlined through projects such as carbon capture technology and integration of renewables into the electricity production mix. Enhancing this vision by promoting beneficial use of materials previously disposed of is yet another example of the environmental excellence we strive for at Coal Creek Station. Reducing our carbon footprint helps the state of North Dakota get one step closer to achieving their goal of carbon neutrality by 2030. Taking the steps needed to add beneficial use of our products not only extends the life of Coal Creek Station, it enhances and diversifies North Dakota's economy in a way all citizens benefit from. This creation of jobs, both direct and indirect, also helps the local communities and economy remain strong.

BACKGROUND/QUALIFICATIONS

Rainbow Energy Center (REC) plans to dewater the solids generated by the Coal Creek Station Units 1&2 flue gas desulfurization (FGD) system. The FGD bleed stream solids are mostly calcium sulfite. The FGD will be sent to a new facility that will oxidize (inject air) to produce calcium sulfate or better known as Gypsum. The process entails oxidizing the FGD slurry in a series of large tanks. Once the oxidation occurs that material stream will go to a series of vacuum belts that will dewater the material to 15% moisture. The gypsum will then be loaded onto trucks or railcars to send out to market. Approximately 175,000 tons of gypsum will be produced each year.

Rainbow Energy Center plans to grind the solids generated by the Coal Creek Station Units 1&2 boiler bottom ash (BA) system. Conveyance of the BA will remain the same by sluicing it to a dewatering area. Once in the dewatering area the BA will be piled to dewater and transported by large haul trucks to a new processing system. BA will be pulverized and blended with our current flyash stream. The final blended product will then be loaded onto trucks or railcars to send out to market. Approximately 300,000 tons of BA will be processed each year.

Project Team: Rainbow Energy Center will serve as the lead organization for this project. Dwayne Rhodes, Doug Rhodes, and Jim Glass with EcoMaterials Technologies Inc will focus on the continued marketing and sales of the bottom ash and fly ash into their existing markets, as well as introduce the sale of gypsum into the market.

Rainbow Energy Center is committed to executing a fully commercialized operation to optimize the beneficial use of both bottom ash material and flue gas desulfurization (FGD) materials at Coal Creek Station. Key personnel from Rainbow Energy include Stacy Tschider (President), Jeff Jonson (Executive Vice President), Chris Faul (VP Operations), Lyndsey Roemmich (VP Finance), Jackie Fleck (Director of Business Development) Jessica Bell (Director of Government Relations & Public Affairs), Jon Price (Special Projects Manager) and John Bauer (current Plant Manager).

MANAGEMENT

REC is the lead organization for this project and will oversee all tasks and management activities associated with this project. REC will schedule regular internal and external meetings with project staff and advisors to ensure that the project is conducted using acceptable scientific methodologies and practices in accordance with the project plan (budget, schedule, deliverables, and milestones) and is meeting quality objectives. EcoMaterials Technology, Inc. in conjunction with their subsidiary Synmat, will research and develop the market for these products and identify additional infrastructure that may be needed to support logistical aspects of marketing these products. EcoMaterials Technology, Inc. will also use their previous experience from developing and completing their project to operation in order to complete the bottom ash processing facility. Barr Engineering Co. will be the developing engineer for the FGD processing facility and work with REC to complete the FGD processing to operation.

Once the project is initiated, the project team will engage in weekly conference calls to review project status and future directions. Quarterly reports will be prepared and submitted to project sponsors for review. Regular meetings will be held to review the status and results of the project and discuss directions for future work. A broad team approach is key to successful execution of this project.

Project progress will be measured by completion of milestones and deliverables as noted in the project timeline in Figures 1 and 2. The milestones and deliverables are at key times during the project design, permitting, and costing components of the project. The deliverables are indicated where key design documents and reports are noted, while the milestones are noted as key accomplishments during the project's progress.

TIMETABLE

The project timeline can be found in Figures 1 and 2. The combination of both projects is scheduled for 30 months, with a projected start date of May 2023. The start date may depend on procurement of the Coal Creek Station by Rainbow Energy Center. This timeline is necessary to maintain a schedule that could allow for operation to begin by October 2025.

	Engineering	215 days	Tue 5/9/23	Mon 3/4/24
	Design Engineering	170 days	Tue 5/9/23	Mon 1/1/24
	Permitting	160 days	Tue 7/25/23	Mon 3/4/24
	Procurement	245 days	Tue 6/6/23	Mon 5/13/24
	Grinding Mill	44 wks	Tue 6/6/23	Mon 4/8/24
	Raw Ash Building	28 wks	Tue 8/15/23	Mon 2/26/24
	Switchgear	45 wks	Tue 7/4/23	Mon 5/13/24
	1500 ton silos	34 wks	Tue 9/5/23	Mon 4/29/24
	1000 ton silos	30 wks	Tue 9/5/23	Mon 4/1/24
	500 ton silo	30 wks	Tue 9/5/23	Mon 4/1/24
	Implementation	461 days	Mon 5/1/23	Mon 2/3/25
	Civil	271 days	Mon 5/1/23	Mon 5/13/24
	Mechanical	255 days	Tue 10/24/2:	Mon 10/14/24
	Electrical	35 wks	Tue 6/4/24	Mon 2/3/25
	Dry commissioning	6 wks	Tue 2/4/25	Mon 3/17/25
	Process commissioining	4 wks	Tue 3/18/25	Mon 4/14/25
	Turnover to Operations	1 day?	Tue 4/15/25	Tue 4/15/25
	Punchlist Items	7 wks	Tue 4/15/25	Mon 6/2/25
	Final Completion	0 days	Mon 6/2/25	Mon 6/2/25

Figure 1. Bottom Ash Project Gantt chart.

Task Name	Duration	Start	Finish
Coal Creek Station - FGD Dewatering	**220 wks**	**Thu 7/15/21 8:00 AM**	**Wed 10/1/25 5:00 PM**
Phase 1 - Preliminary Engineering	**89.4 wks**	**Thu 7/15/21 8:00 AM**	**Sat 4/1/23 8:00 AM**
Project Kick-off and Preliminary Engineering	6 wks	Fri 7/15/22 8:00 AM	Thu 8/25/22 5:00 PM
Prepare Design Basis Document (includes BoD, GA, PFD, prelim eqpt list)	12.6 wks	Fri 8/26/22 8:00 AM	Tue 11/22/22 5:00 PM
Submit Design Basis to client for review	18.6 wks	Mon 10/17/22 8:00 AM	Wed 2/22/23 5:00 PM
Phase 2 - Detailed Engineering	**57.8 wks**	**Thu 3/2/23 8:00 AM**	**Tue 4/9/24 5:00 PM**
Preliminary design: Oxidation sys; Dewatering sys; WW treatment; Major BOP	**39.4 wks**	**Wed 3/15/23 8:00 AM**	**Thu 12/14/23 5:00 PM**
Prepare oxidation & dewatering equipment RFP	**11.8 wks**	**Wed 3/15/23 8:00 AM**	**Mon 6/5/23 5:00 PM**
B&W engineering study, preliminary design	**21.6 wks**	**Wed 3/15/23 8:00 AM**	**Fri 8/11/23 5:00 PM**
Prepare other major equipment specifications	**15.2 wks**	**Fri 8/11/23 5:00 PM**	**Mon 11/27/23 5:00 PM**
Detailed Design	**90.4 wks**	**Mon 7/18/22 8:00 AM**	**Tue 4/9/24 5:00 PM**
Civil Site	**6 wks**	**Mon 7/18/22 8:00 AM**	**Fri 8/26/22 5:00 PM**
Geotechnical	**27.4 wks**	**Mon 8/22/22 8:00 AM**	**Wed 3/1/23 8:00 AM**
Phase 3 - Construction	**90.6 wks**	**Mon 1/8/24 8:00 AM**	**Wed 10/1/25 5:00 PM**
Procurement	**66.2 wks**	**Mon 1/8/24 5:00 PM**	**Tue 4/15/25 5:00 PM**
Major equipment procurement (transformer critical path)	66.4 wks	Mon 1/8/24 8:00 AM	**Tue 4/15/25 5:00 PM**
Startup and commissioning	10.6 wks	Mon 7/21/25 8:00 AM	Wed 10/1/25 5:00 PM

Figure 2. FGD Project Gantt chart.

BUDGET

The proposed budget is $85,000,000, with $42,500,000 loan from NDIC and $42,500,000 cash from Rainbow Energy Center. The budget includes all engineering, equipment, building materials, construction, and commissioning of the facilities. The detailed breakdown is shown in Table 1. The budget notes can be found in Appendix G.

Table 1. Estimated Capital Costs

Project Associated Expense	NDIC Grant	NDIC Loan	Rainbow Energy Center Share (Cash)	Total Project
Mobilization, demolition, and sitework	$ -	$ 999,146	$ 999,146	$ 1,998,291
Foundations and concrete	-	719,255	719,255	1,438,509
Engineering	-	105,000	105,000	210,000
Equipment		-	-	-
Mechanical	-	10,497,307	10,497,307	20,994,614
Electrical	-	2,992,633	2,992,633	5,985,265
Storage	-	2,087,500	2,087,500	4,175,000
Material Handling	-	1,428,901	1,428,901	2,857,802
Process	-	3,795,608	3,795,608	7,591,217
Other	-	294,500	294,500	589,000
Architecture, steel and building	-	4,128,184	4,128,184	8,256,369
Construction	-	-	-	-
Structural	-	2,855,500	2,855,500	5,711,000
Mechanical	-	2,950,830	2,950,830	5,901,659
Electrical	-	2,800,000	2,800,000	5,600,000
Other	-	834,594	834,594	1,669,188
Commissioning	-	606,127	606,127	1,212,255
Indirect costs	-	5,404,915	5,404,915	10,809,831
Total Project Costs	$ -	$ 42,500,000	$ 42,500,000	$ 85,000,000

TAX LIABILITY

Neither Rainbow Energy Center nor its parent company, REMC Assets, LP, have an outstanding tax liability owed to the State of North Dakota or any of its political subdivisions.

Submitted by: WellSpring Hydro
Project Duration: 26 months
Total Project Costs: $250,886,700
Request for: $5,000,000 grant, $50,000,000 loan

Summary of Project: This project supports the extraction of elements from oilfield produced water to manufacture industrial commodities, including lithium, caustic soda, hydrochloric acid, calcium chloride, and chlor-alkali products.

Technical Review Results

Overall Technically Sound (222/315)		
Good	1	
Fair		
Questionable		

BND Economic Feasibility Recommendation

Overall Economic Feasibility	
Yes	X
No	

Technical Committee Scores

	Score (Out of 50)
Charlie Gorecki	Abstain
Josh Teigen	36
Dave Glatt	37
Lynn Helms	38
Justin Kringstad	35
Rachel Retterath	41
Todd Steinwand	40
John Weeda	42

Average: 38

CSEA Recommendation: Approve $5,000,000 grant

Clean Sustainable Energy Authority

North Dakota Industrial Commission

Application

Project Title: Unlocking the Full Potential of Produced Water as a Key Component of Clean Sustainable Energy

Applicant: Mark Watson

Date of Application: May 18, 2023

Amount of Request
Grant: $5,000,000 USD
Loan: $50,000,000 USD

Total Amount of Proposed Project: $250,886,700 USD

Duration of Project: 26 Months

Point of Contact (POC): Mark Watson

POC Telephone: (281) 813-6735

POC Email: mark@wellspringhydro.com

POC Address: 4828 Highway 85 Williston, ND 58801

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ABSTRACT

Background:

Wellspring Hydro is a locally founded North Dakota company with a mission to unlock the full potential of produced water as a feedstock for sustainable, clean energy. Wellspring Hydro is requesting financial support for commercialization of an innovative solution that will diversify the state's economy through an environmental solution. The Wellspring Hydro process is based on combining proven technologies in a novel way to develop products from various renewable components, including produced water waste stream as the key feedstock.

Wellspring Hydro's project will produce commercially essential commodity products in the State of North Dakota in a sustainable format that will diversify the economy, bolster existing industries (clean sustainable energy), and operate with a vision of zero waste or harmful emissions.

Wellspring Hydro was awarded a $1 M grant from the Clean Sustainable Energy Authority (CSEA) in December 2021 focused on the execution of the FEL-3 engineering and design study to position for commercialization. Wellspring hydro is in the final steps to complete this critical stage before Financial Investment Decision (FID) by utilizing these grant funds, an equity match from Hargrove Engineers and other private equity investment. The FEL 3 engineering study (led by Hargrove Engineers and Constructors) was completed in May 2023, with final cost estimates expected to be completed by June 2023. The purpose of the FEL 3 study was to provide a +/- 10% estimate for a 150 ton per day chlor-alkali plant to be located outside of Williston, ND.

The overall salt recovery process design has been validated through four independent bench-scale testing performed in 2021, 2022 and 2023. The quality of salt contained in North Dakota's geology has proven to be of high quality, more than adequate for chlor-alkali use. The salt in North Dakota is only second to Chilean Salt which is considered by many to be the Gold Standard. Due to the quality and significant quantity of salt in North Dakota, Wellspring Hydro has the technical feasibility of success to progress the project.

Wellspring Hydro's cost to build and install a new greenfield 150 STPD membrane plant in Williston, North Dakota, is $250 million. With an IRR of 21%- and 5-year payback, this project on its own merits is a crucial investment for the state of North Dakota, aligned with the intent of the Clean Sustainable Energy Authority's mission.

Objectives:

Finalize, execute, and deliver.

	Key Deliverables	Funds	Results
1	**Field Validation – Technology and Commercial**	$4.0 M	The critical objective is to demonstrate technical viability in the field (in multiple stages and scopes), to receive the commercial assurances provided by performance guarantees from technology providers.
2	**Initial Detail Design**	$6.0 M	The critical objective is the completion of Initial Detailed Design to finalize technology vendors and identify the procurement of specialized technology and long-lead items as a prerequisite for objective 3.
3	**Procurement of Specialized Equipment**	$100.0 M	The critical objective is to secure specialized and long-lead item equipment to meet overall timeline. The objective will require early funds to complete “Issue for Purchase” (IFP) technical packages with vendors and make initial downpayments on equipment.
4	**Detailed Engineering Plan**	$8.5 M	The critical objective is to continue detailed engineering in parallel to early construction in preparation for equipment installation and process start-up.
5	**Construction & Plant Start-up**	$ 131.5 M	The critical objective is to execute engineering plans of all construction activities required from onsite mobilization through construction completion and pre-commissioning for a seamless implementation of the full-scale facility.

Indicates Grant Funds

Indicates Loan Funds

Expected Results:

The primary result is to complete the construction and start-up of the Wellspring Hydro Chlor-alkali facility by Q4 2025.

Key Deliverables	Results
Validation of Technology in the Field	Technology validation of a field trial designed to create high-quality salt from Bakken produced water based on the proposed Wellspring Hydro process. This will yield performance guarantees with the technology provider and final assurances in the proposed process.
Lithium Extraction	As a component of the field trial process and Initial Detailed Design, Wellspring Hydro will be able to develop the lithium extraction process of the "mother liquor" stream. There are multiple technology providers that have completed initial feasibility and will progress to Equipment proposals.
Production of High Value Commodity Products	Wellspring Hydro's project will produce commercially essential commodity products Caustic Soda and Hydrochloric Acid. Both products have current demand in industrial and energy sectors and future demand in the support of clean sustainable energy (Carbon Capture, Oil & Gas production, and lithium extraction).
Sustainable Use of Produced Water Waste	40+% reduction in produced water that enters the plant will be realized, along with the creation of all process fresh water needs from the treated condensate stream off the crystallizer. Value is created from what is currently wasted.
Financial Impact	The business is projected to have a year one of $82.6 M revenue and support fifty-three full-time employees. The current unleveraged financial returns yield a 21.7% IRR and $170.0 M NPV. Year 1 EBIDTA is expected to be $54.0 M with steady performance within +/- 5% consistency through year 5 EBIDTA at $53.8 M. The full-rate state tax on product sales is expected to be ~$5.5 M per year.

Indicates Grant Funds

Indicates Loan Funds

Duration:

The detailed design, construction and start-up is expected to take 24-26 months after the Financial Investment Decision, planned for September 2023.

Critical Milestones

Milestone	Milestone Date
FEL-3/DD Kick-off Meeting	15 Feb 23
FEL-3 Complete	15 Jun 23
Financial Investment Decision (FID)	01 Sep 23
Field Validation – Technology and Commercial	01 Nov 23
Initial Detailed Design	01 Dec 23
Procurement of Specialized Equipment	01 Jan 24
Detail Design Complete	23 Jun 24
Construction Mobilization	04 Jan 24
All Major Equipment	03 Oct 24
Mechanical Completion	05 Sep 25
Start-Up	31 Oct 25

Grant funds will be allocated to Field Validation – Technology and Commercial and Initial Detailed Design, expected to be completed by December 1st, 2023. The timeline for these grant deliverables is expected to be 5-6 months total from funding.

Loan funds will be allocated on procurement of specialized equipment, expected to begin immediately after funding through January 1st, 2024. The prerequisite for the procurement process is the completion of initial detailed design, led by Hargrove Engineers.

Total Project Cost:

Capital Estimates	Cost in USD
Technical and Commercial Viability	$4,000,000.00
Front-End Engineering & Design	$6,000,000.00
Working Capital	$3,694,040.00
Upfront Land & Development	$1,506,550.00
Labor	$17,016,249.86
Material	$6,665,618.00
Indirect Labor/Construction Equipment	$3,101,831.00
Subcontract	$32,065,894.00
Material Sales Tax	$533,250.00
Freight-Equipment	$1,074,214.00
Contractor's Mark-Up	$666,562.00
Process & E/I Equipment - SWD	$8,000,000.00
Process & E/I Equipment - Front-End	$30,000,000.00
Process & E/I Equipment - Chlor-Alkali	$60,036,505.00
Detailed Engineering	$8,500,000.00
Procurement & Start-up Support	$2,675,328.00
CM Services	$5,350,658.00
Home Office & Contingency	$60,000,000.00
Total	$250,886,700

Indicates Grant Funds

Indicates Loan Funds

Participants: Identified partners for execution of Grant and Loan request. Additional partner information is available in the Business Plan, and specific technology partners are outlined in resources.

- Wellspring Hydro – Management Team - Williston, ND
- Hargrove Engineers & Constructors – Birmingham, AL
- Tormod Operators – Birmingham, AL
- Mastec Infrastructure - Coral Gables, FL
- FCI Constructors – Denver, CO
- InDemand – Bismarck, ND
- Produced Water Partner(s)
- Salt Crystallizer Partner(s)
- Lithium Extraction Partner(s)

PROJECT DESCRIPTION

Objectives:

Wellspring Hydro (WSH) intends to build a modern chlor-alkali plant in Williston, North Dakota which will use crystallized sodium chloride salt deriving from the Williston Basin oilfield brine (i.e., produced water); creating high quality sodium chloride salt and water from an oilfield waste stream to feed a chlor-alkali process will be a first of its kind.

Wellspring Hydro's cost to build and install a new greenfield 150 STPD membrane plant in Williston, North Dakota, is $250 million.

Finalize, execute, and deliver.

1. Field Validation – Technology and Commercial
    a. Wellspring Hydro will complete final technical and commercial viability of the front-end process through field trial demonstrations in parallel with detailed design. This process has been validated through four independent bench-scale tests performed in 2021, 2022 and 2023. Commercial viability will require the selected technology in the field to align with vendor processes to provide performance guarantees for the required specifications.
    b. The critical objective is to demonstrate technical viability in the field (in multiple stages and scopes), to receive the commercial assurances provided by performance guarantees from technology providers. This will include final salt crystallization bids with multiple vendors, who have completed technical evaluations.
    c. Further development and confirmation testing with Lithium partner to focus on mother liquor lithium extraction of up to two hundred tons per year.
2. Initial Detailed Design
    a. From the Financial Investment Decision (FID), Wellspring Hydro will begin Front-End Engineering Design with Hargrove to perform the detailed engineering sufficient to produce procurement and construction documents for the supply of fabrication, construction installation, materials and equipment and the full construction and start-up of the plant.
    b. The critical objective is the completion of Initial Detailed Design to finalize technology vendors and identify the procurement of specialized technology and long-lead items as a prerequisite for objective 3.
3. Procurement of Specialized and Long-lead Equipment
    a. Hargrove and Associates Purchasing Department will provide procurement support services for the Project. Hargrove will be responsible for the procurement of all major equipment, minor equipment, tagged instruments, fabricated materials.
    b. As a part of FEL-3 process, Wellspring Hydro and Hargrove have identified a bidder list, completed technical packages an Engineering Requisition Worksheet (ERW) for engineered equipment and issued Requests for Quotation (RFQ). The bids have been received and analyzed for technical and commercial consideration. These costs are utilized in the final cost estimate for FEL-3.

c. The critical objective is to award specialized and long-lead item equipment to meet overall timeline. The objective will require early funds to complete "Issue for Purchase" (IFP) technical packages with vendors and make initial downpayments on equipment.

4. Detailed Engineering Plan
    a. Following Initial Detailed Design phase and in parallel of the procurement plan, Hargrove will continue to provide engineering services as required by the construction work to clarify or revise the engineering documents provided for the construction of the project. Hargrove will provide information requested to assist the contractors in the construction of the project and the coordination of their activities, including 3-D Model review assistance at the site.
    b. Detailed discipline engineering will continue for 10 months post FEED Phase and to achieve the engineering construction release dates.
    c. The critical objective is to continue detailed engineering in parallel to early construction in preparation for equipment installation and process start-up.
5. Construction & Plant Start-up
    a. Wellspring Hydro will work with Hargrove (Engineering and Design) and Mastec (Construction Management) to formulate the contract documents for the construction contracts per the project contracting strategy. Hargrove will assist by providing technical and construction management support during the duration of project through mechanical completion.
    b. Wellspring Hydro will formulate the Project Completion Plan and will assist with planning QA/QC functions to assure incremental acceptance of the plant and coordination with the start-up team. Wellspring Hydro will utilize Mastec to fulfill its construction obligations. Wellspring Hydro will manage all construction activities required to complete the work to the point of being ready for commissioning.
    c. The critical objective is to execute engineering plans of all construction activities required from onsite mobilization through construction completion and pre-commissioning for a seamless implementation of the full-scale facility.

Methodology:

Modern Chlor-Alkali technology includes sophisticated membrane cells to split apart the NaCl molecule via electrochemical reactions. The salt and water streams fed to the membrane cells must be highly purified to operate efficiently. Hargrove Engineering has designed and managed multiple chlor-alkali plant projects and will coordinate the overall project design for the entire Wellspring Hydro facility.

1. Field Validation – Technology and Commercial
    a. Field testing is an important progression from the successful bench scale tests to show consistency and longitudinal analysis in various stages.
    b. The key methodology steps include:
        i. Stage 1 – In field testing of produced water over 60-day initial scope. Key success criteria would be longitudinal analysis over time to quantify any unknown constituent in the water and selection of optimate pre-treatment chemistry.

ii. Stage 2 – Full scale commercial trial to create salt out of produced water with mobile crystallizer of selected technology provider. Key success criteria would be to confirm ability to meet consistent high-quality salt specification, while evaluating corrosion and scale impact to equipment.
iii. Through field trial validation, Wellspring Hydro will finalize the process to bid on the Salt Crystallizer technology with a vendor that can meet both commercial and technical requirements to meet company and investor objectives. Based on multiple bench scale validation, the critical focus is the commercial commitments that can be offered through a field trial and performance guarantees.
iv. Lithium Extraction – Wellspring Hydro will qualify multiple lithium extraction vendors to select a technology partner for Detailed Design. Multiple vendors have verified their capability through bench scale results with the mother liquor output.

2. Initial Detailed Design
    a. Once the Wellspring Hydro Executive Leadership has approved the project, the next step will be to commence initial detailed design in order to perform enough engineering to develop design to a point in which various quantities can be established. Each system will be assigned to a system engineer who will be responsible for the entire design of the respective system.
    b. The key methodology steps include design criteria, P&ID's, specifications, installation details and other discipline focus areas:
        i. A kick-off meeting for the initial detailed design phase will be held to establish the path forward for the project.
        ii. Once the heat & material balance has been validated and process requirements confirmed, the next effort will be developing the P&IDs to approval level.
        iii. For expediency purposes major process equipment will be committed and procured during the initial detailed design phase of the project. This will mitigate project cost risk and impact on schedule to improve the overall engineering productivity ***(Highlighted in objective 3 – procurement of specialized equipment).***
        iv. The schedule is based on a quick turnaround of the approved P&IDs to commence detail design post IFA (Issued for Approval) as early as practical and solidify the equipment layout.
3. Procurement of Specialized Equipment
    a. Hargrove will provide procurement assistance services for Wellspring Hydro. Each chlor-alkali unit operation is based on proven technology supplied by experienced and respected technology suppliers.
    b. The key methodology steps include:
        i. Upon receipt of a Wellspring Hydro approved Award Recommendation, Hargrove will enter the proposed purchase order and issue purchase order.
        ii. The Engineers will be responsible for revising the RFQ technical package to an "Issue for Purchase" (IFP) technical package. This represents the final agreed upon purchase specifications and will be made a part of the purchase order.

iii. Purchase orders will require additional engineering support from vendors and require downpayments on equipment to expedite delivery schedule.
iv. Hargrove will expedite receipt of the vendor data from the supplier based on the Vendor Data Requirements established by the originating Engineer.
v. The Engineers will review and approve all vendor data for the items they originate regarding compliance with the requirements of the design.
vi. Hargrove will expedite delivery of the equipment and materials.

4. Detailed Engineering Plan
    a. As the project progresses, Detailed Engineering will be an ongoing effort to support the installation and completion of the process. The system engineer will continue to "own" the P&ID and is responsible for the specification of all equipment, and coordination of all supporting discipline tasks necessary for the complete definition and documentation of the system. The system engineer is also responsible for the expenditure of resources (engineering manhours, budgeted dollars for materials, etc.) associated with those systems under his or her control.
    b. The methodology of the Detailed Design will include:
        i. Development of equipment specifications will be in parallel in certain cases with approval of P&ID's and will commence upon client approval of all P&ID's.
        ii. Detailed discipline engineering continues for 10 months post FEED Phase and to achieve the engineering construction release dates procurement PO dates as listed in the estimate basis will need to be committed during this phase of the project.
5. Construction & Plant Start-up
    a. Wellspring Hydro and Hargrove will formulate the contract documents for the construction contracts per the project contracting strategy. Wellspring Hydro will administer these contracts as construction manager by providing technical and construction management support during the duration of project through mechanical completion.
    b. The basic methodology steps to execution will be in five basic phases:
        i. "Enabling civil work"—piling, underground piping & electrical.
        ii. "Get out of the ground:" Foundations, slabs, development.
        iii. "Install the equipment:" Steel erection, equipment erection.
        iv. "Bulk installation:" Piping, electrical and instrument work.
        v. "Project completion:" Testing, checkout, turnover by system.

Anticipated Results:

Validation of Technology in the Field

In the first objective, Wellspring Hydro will complete final validation of a process to use crystallized sodium chloride salt deriving from the Williston Basin oilfield brine (i.e., produced water); creating high quality sodium chloride salt and water from an oilfield waste stream to feed a chlor-alkali process. The field test will be creating sodium chloride salt with Bakken produced water in the field, further validating the multiple bench scale tests completed in 2020.

- Technology validation of creating high-quality salt from Bakken produced water that will yield performance guarantees with the technology provider and final assurances in the proposed process. The output of the field trial and vendor selection will ensure that Wellspring Hydro will be positioned for commercial assurances.

Lithium Extraction

As a component of the field trail process and Front-End Engineering & Design, Wellspring Hydro will be able to develop the lithium extraction process of the "mother liquor" stream. There are multiple technology providers that have completed initial feasibility and will progress to Equipment proposals. After Wellspring Hydro recovers salt and water from the produced water the lithium present in the produced water will be concentrated, making it a high potential feedstock to a lithium recovery process.

- Wellspring Hydro is seeking a process patent for removing salt from waste oilfield produced water which in turn concentrates the feed brine into a "mother liquor" stream. This concentrated mother liquor creates ideal feedstock as it increases the lithium by a factor of up to four times. This concentration allows for even more efficient extraction by Wellspring Hydro and its partner over the standard brine process. Due to this concentration upgrade, the potential for up to 3.5 tons of lithium extraction per week is achievable and will yield nearly 4M in accretive revenue and 91,000,000 gallons of water saved.

Production of High Value Commodity Products

Wellspring Hydro's project will produce commercially essential commodity products Caustic Soda and Hydrochloric Acid. Both products have current demand in industrial and energy sectors and future demand in the support of clean sustainable energy (Carbon Capture, Oil & Gas production, and lithium extraction). The primary focus of the plant will be to produce and sell caustic soda (at 50% and 25% NaOH concentration), hydrochloric acid (at 35% HCl concentration). All products are currently imported into North Dakota with limited regional production. All products will meet industry standards.

- Caustic Soda - Caustic soda will be sold locally and regionally for use in various heavy industries such as refineries, power stations, pulp mills and for carbon capture projects. Wellspring Hydro's products, specifically caustic soda, will be consumed in local and regional sustainable-clean-energy projects and designed to capture or sequester carbon from power generation. Wellspring Hydro will be a key chemical supplier to the burgeoning CCS/CCUS (Carbon Capture and Storage/Carbon Capture, Utilization and Storage) industry in North Dakota and surrounding

states. Project Tundra at Milton R. Young station and Coal Creek Station will require substantial amounts of NaOH (caustic soda) to scrub sulfur dioxide (SO2) to zero. This need is driven by the Amine CO2 removal technology employed in large scale carbon capture such as those at power stations that utilize coal with sulfur content. Currently all Caustic Soda is imported into the State at a premium. Wellspring Hydro will be able to supply all the States projected needs.

- Hydrochloric Acid - The hydrochloric acid will be sold predominately into the local and regional oil and gas industry; other consumers include food processing and steel manufacturing industries in neighboring states. In North Dakota there is a significant opportunity to develop production enhancement acidification of existing wellbores and well recompletions to maximize the Williston Basins oil output. Many current producers utilize large acid jobs to open calcium carbonate scaled perforations and liners that restrict production. These large acid production enhancement jobs are limited by cost and availability of HCl. WSH can help provide stability to production enhancement support the oil and gas industry through consistent supply.
- Optional Calcium Chloride Addition – Wellspring Hydro is also evaluating the production of a third product of liquid calcium chloride (35% CaCl2). This proven process reacts hydrochloric acid with limestone, which would allow the business to maximize operating rates and diversify the product portfolio. Liquid calcium chloride has a strong regional demand in the Upper Mid-west US and Canada for dust control and snow removal/de-icing.

Sustainable Use of Produced Water Waste

The execution of this project will solidify a sustainable business model built on the use of produced water waste, as defined as the Wellspring Hydro original opportunity statement.

- Through a circular economy model, 10,000 BBL per day will be used as feedstock to the salt recovery system and the Chlor-alkali facility to make products. The current disposal zone of the Dakota formation is experiencing over pressurization in certain areas, this challenge will continue as infield development of the Williston Basin continues. Wellspring Hydro offers an environmentally useful solution to simple injections.
- With an initial scope of 10,000 BBL per day, Wellspring Hydro has a vision to use technology developments for the opportunity to expand the scope and utilize more produced water. Expansion opportunities could come in various scopes; from another full-scale facility to components of this process including lithium extraction, calcium chloride production from produced water and other emerging opportunities.

Financial Impact

The business is projected to have a year one of $82.6 M revenue, split between HCL at $30.9 M, Caustic at $47.5 M, and produced water/other at $4.2M. The production volumes and product price forecasts are (detailed in the Business Plan) are diversified into different markets both local and regional.

- The current unleveraged financial returns yield a 21.7% IRR and $170.0 M NPV. Year 1 EBIDTA is projected to be $54.0 M with steady performance within +/- 5% consistency through year 5 EBIDTA at $53.8 M. This is based on a flat price forecast to represent a conservative approach and provide opportunity of long-term contract capability.

- The full-rate state tax on product sales is expected to be $5.5 M per year. The facility will employ a total of fifty-three employees, forty-six employees to support the cost of product and seven employees supporting administrative and company operations.

Facilities:

The facility will include a pre-treatment, evaporator/crystallizer system, chlor-alkali electrolytic cells, caustic evaporator, a hydrochloric acid synthesizer, and a Saltwater Disposal (SWD) well, and all associated utility, storage and loading facilities for bulk shipments via truck and rail.

Specific process facilities include.

- Salt Crystallizer & Evaporator
- Primary Brine Treatment: Brine Precipitation and Filtration
- Secondary Brine Treatment
- Brine Electrolysis
- Anolyte Handling and Dichlorination
- Catholyte Handling
- Excess Hydrogen Generation
- Chlorine Cooling & Demisting
- Cell Hydrogen Cooling & Demisting
- Hydrochloric Acid Synthesis
- Caustic Evaporation
- Sodium Hypochlorite Bleach Production & Emergency Vent System
- Liquid Calcium Chloride Production (Optional)
- Utilities

General and functional facilities include.

- Administration Offices
- Onsite Laboratory
- Storage Facilities: Water, Salt, Caustic Soda, Hydrochloric Acid

Resources:

Subject matter experts will assist in engineering, design, implementation, and construction.

Subject Matter Expert Resources	
Hargrove Engineers	Palmer Lawrence
Mastec Infrastructure	SHECO
FCI Constructors	Dixie Engineering
InDemand	Bertrams
Ekato	Verantis
DrM	TennyCo
Marmon Industrial Water	Mersen
American Crane	CEJCO
Applebee Church	Voigt-Abernathy
Verantis	Flowserve

Other consultants or services to be used include electricity pricing experts and legal advisors for purchasing and sales agreements. Environmental consultants may also be required to assist during reviews with the North Dakota Department of Environmental Quality.

Techniques to Be Used, Their Availability and Capability:

Independent, credible third-party resources will be utilized as identified in earlier sections. The subject matter expert resources will license their technology and services as a part of the procurement process to be implemented in the Wellspring Hydro design.

The availability of specialty process equipment is a critical component of the schedule with lead times of equipment reaching 14-16 months due to market constraints on key materials. As outlined in the loan fund request, Wellspring Hydro will utilize funds to secure availability with early downpayments on key items.

Environmental and Economic Impacts while Project is Underway:

Wellspring Hydro is committed to avoiding accidents and unplanned occurrences that may result in injury to employees, interruption of production, or damage to equipment or property. This policy, applies to every task undertaken, is to take every action necessary in engineering, planning, assigning, and supervising all jobsite operations to establish and maintain safe and healthful working conditions on our projects and protect the public and the environment.

During the scope of this project, there must be interaction between the Wellspring Hydro, Hargrove, and the appropriate North Dakota regulatory agencies to communicate details about the plant design including specific plans to address environmental and safety concerns. Wellspring Hydro, Hargrove and Mastec will work together to interpret and communicate the permit requirements so that the regulatory

requirements are clearly and specifically understood by all the contractors. Williams County has taken an active role in establishing construction and operations phase employee counts along with traffic surveys and logistical needs.

Wellspring will employ up to 250 contractors at peak construction phase. Wellspring Hydro has communicated with local authorities and plans will begin months prior to peak phase to establish transportation logistics and housing requirements for the influx of staff required to accomplish construction in an efficient manner.

The Site Manager will work with the environmental department to develop procedures for isolation of the project site for storm water runoff, testing, pumping and disposal of storm water from excavations, and containment areas. Any temporary breach of containment structures will also be addressed to assure that no contamination will reach the storm water systems.

Fire water tank installment will be critical to establishment of the site for Wellspring Hydro. The size of the take will be appropriate for the development of the site and will be filled prior to operational start up. If other companies are building in the area a coordinated effort will be made to build out and support a local fire staff and EMS plan with local community leaders which will cover the entirety of the site build out

Ultimate Technological and Economic Impacts:

This is a first of its kind process utilizing well known and understood chlor-alkali technology that has been available since the 1970's. While oilfield brine is becoming more commonly reused, recycled, and even crystallized to derive value driven products, to our knowledge there are no other chlor-alkali plants in the world that uses oilfield produced water as its feedstock for salt. We have patented a process to leverage this waste stream to create products which are used in the industry as well as create net new surface fresh water, water that did not exist as fresh water before. The new fresh water will be used exclusively by our plant as process water needs such as cooling, ultrapure brine, cathode dilution, and salt saturation.

The business is projected to have a year one of $82.6 M revenue and support 53 full time employees. The current unleveraged financial returns yield a 21.7% IRR and $170.0 M NPV. Year 1 EBIDTA is expected to be $54.0 M with steady performance within +/- 5% consistency through year 5 EBIDTA at $53.8 M. The full-rate state tax on product sales is expected to be ~$5.5 M per year. There will be partnership opportunities as highlighted in the Standards of Success that could have an even larger initial Economic Impact.

Why the Project is Needed:

This plant will be designed to enable recovery of more valuable salts and elements. All products to be made by Wellspring Hydro are presently consumed by businesses and industries in North Dakota but are imported from other states. This project represents a new industry for North Dakota, creating sustainable jobs and tax revenues in the state.

The output will benefit North Dakota by proving out a new concept to recover salt from a waste stream from the oil and gas fields and using it to make valuable products which are used in the industry, i.e. hydrochloric acid, caustic soda, with the potential of calcium chloride and a small amount of sodium hypochlorite (bleach) required in the State and region. All these products are used to some extent in the oil and gas industry, excess production will be exported out of state, thus generating new income for the state. In addition to the valuable commodities that will be recovered, the current disposal zone of the Dakota formation is experiencing over pressurization in certain areas, this challenge will continue as development of the Williston Basin continues. Wellspring Hydro offers an environmentally useful solution to over pressurization.

Wellspring Hydro will systematically manage our power, water, and carbon footprint to underpin North Dakota's goals as a multi-resource energy policy state. Our products support more efficient oil production, lower carbon capture costs, and resource attainment of previous waste streams. Overall Wellspring Hydro's proven concept may be utilized again as North Dakota's petrochemical industry grows.

1. Local Production of key products
2. Sustainable Produced Water Source
3. Lithium Production

STANDARDS OF SUCCESS

Various standards of success will be identified and employed to solve the technical hurdles herein. These standards examine both the technical and commercial aspects of the project while adding depth and outlining value.

Reduced Environmental Impacts

Oil and gas operations in the Williston Basin dispose of 1.5 - 1.8 million barrels (63-75 million gallons) of produced water per day. This is 25% more than all the industrial process water use in North Dakota. Wellspring Hydro's scope focuses on a portion of this current waste stream and our vision is to create valuable commodities and rare earth metals extraction through alternate water utilization.

Wellspring Hydro will separate salt and fresh water from produced water; the remaining concentrated stream (referred to as "mother liquor") will be sent to additional processes and eventually to SWD after all useful material can be economically derived. This process of crystallization, concentration and extraction will lead to a 40% reduction in produced water disposed and creation of net new freshwater, used as project process water.

The elevated concentration of remaining elements in the "mother liquor" such as lithium and magnesium along with other salts and metals, create potential for further value-added processing. Beyond the valuable commodity chemistries and essential elements, Wellspring Hydro being a first of its kind facility with healthy returns also sees itself as a champion for further process and product development in the areas of, Environmental Stewardship, Energy Efficiency, Sustainability, Economic Diversification, and Jobs Creation.

Increased Energy Efficiency

Wellspring Hydro will be a key chemical supplier to the burgeoning CCS/CCUS (Carbon Capture and Storage/Carbon Capture, Utilization and Storage) industry in North Dakota and surrounding states. The Northern Plains are known for their vast coal reserves and critical baseload power generation, however changing climates both political and environmental related are now signaling the importance of CCS/CCUS. Technological advances, tax incentives, and attractive geologic CO2 target zones in North Dakota are leading to testing for storage zones and will soon place North Dakota on top as the world leader in carbon capture. To achieve the status of the world's leading carbon capture State, projects such as Project Tundra at Milton R. Young station and Coal Creek Station will require large amounts of NaOH (caustic soda) to scrub sulfur dioxide (SO2) to zero. This need is driven by the Amine CO2 removal technology employed in large scale carbon capture such as those at power stations that utilize coal with sulfur content. Currently all Caustic Soda is imported into the State at a premium. Wellspring Hydro will be able to supply all the States projected needs and will have 50% of its NaOH as a net export for the state to surrounding states.

Specific to the Wellspring Hydro plant, a large part of the power demand will interruptible, a benefit in managing and balancing North Dakota's electrical grid during periods of high demand. As of the

submission of this document, no less than four potential partner companies have expressed interest in striking deals for natural gas Co-Gen power generation to use stranded in-basin natural gas that may otherwise hamper oil production. Micro-grid wind, solar, heat pumps and battery backup are part of the office facility build out scope pending tax incentive confirmation and financial justification.

While Wellspring Hydro itself will have the ability to invest in a small carbon capture facility totaling up to 23,000 tons per year (as an added scope), it will not benefit from the Q45 tax credit initially due to size. Two potential partners have reached out to WSH to better understand potential carbon capture and fit. Both companies have expressed interest in "testing current technologies" in conjunction with the chlor-alkali facility.

Energy Sustainability

Lithium extraction in North Dakota by Wellspring via Brine Extraction is attractive for the Williston Basin area and North Dakota for many reasons; it does not require the surface area needed when compared to traditional solution mining which demands large evaporation ponds. The potential for carbon neutrality is feasible with further partnerships focused on natural gas combustion stream aggregation or direct air capture (DAC) technologies of which Wellspring Hydro is engaged in multiple conversations with companies offering both. The water used in Wellspring hydro's process is water that is recycled from the influent produced water stream. The process does not need the 500,000 gallons of water traditionally required to extract a single ton of lithium, Lastly, the process requires hydrochloric acid and caustic soda which Wellspring Hydro will produce at its plant. This synergistic effect further reduces the production cost of North Dakota lithium.

Wellspring Hydro's patented process of removing salt from oilfield produced water waste concentrates the feed brine into a "mother liquor" stream. This concentrated mother liquor creates ideal feedstock as it increases the lithium by a factor of up to 4x. This concentration allows for even more efficient extraction by Wellspring Hydro and its partner over the standard brine process. Due to this concentration upgrade, the potential for up to 3.5 tons of lithium extraction per week is achievable and will yield up to $4M in accretive revenue and 91,000,000 gallons of water saved. Lithium production in North Dakota will provide sustainable energy and local supply chain to meet the growing lithium demand – specifically in electric vehicles.

Value to North Dakota

This project can lead to significant environmental, technological, and economic impacts to the state of North Dakota. Through the successful implementation of this project, Wellspring Hydro will help demonstrate the value of produced water from Oil & Gas operations while allowing for further innovative testing onsite. The ultimate standard of success would be to provide North Dakota with a key piece in a future petrochemical strategy.

Explanation of How the Public and Private Sector will make use of the Projects Results, and when, and in What Way

By the end of 2025, carbon capture projects, oil and gas and other local industries will enjoy up to a 30% cost reduction and consistent supply of essential commodities. This is driven by a subsidized feedstock of produced water from oil and gas production and/or salt cavern development. Caustic soda (carbon capture, crude refining, bio refining, gasification water process treatment, power generation water treatment, lithium extraction), Hydrochloric Acid (oil and gas operations, lithium extraction), and North Dakota Counties (Calcium Chloride – dust control, oil and gas) will all benefit from Wellspring Hydro's strategic location, differentiated feedstock, and low operating cost in Western North Dakota. These products which are all purchased outside of North Dakota currently will immediately realize a large logistical cost savings over current suppliers who rely on rail and trucking to bring current products in from thousands of miles away. Caustic soda is essential in water treatment performed as a part of routine preventative maintenance at many industrial plants in North Dakota, however the largest use of caustic will be sulfur dioxide scrubbing at the planned carbon capture projects at Milton R. Young Station and Coal Creek Station power plants. These projects will together consume nearly half of Wellspring Hydro's caustic soda production. Current supply chains are not set up for this increase in use by North Dakota which would only lead to higher than projected operating costs or potential delays and shutdowns due to lack of consistent supply without Wellspring Hydro to fill the increased caustic need by these essential projects.

Currently oil and gas completions and operations are finding it difficult to locate consistent hydrochloric acid streams and most transloading companies are looking to bring in product from as far away as Texas where they must compete with the Permian Basin demand. This adds delays and significant cost increases due to long logistics routes and creates supply-demand constraints on the limited existing streams. Wellspring Hydro's plant would eliminate the need for North Dakota oil and gas producers to go outside the State for hydrochloric acid and furthermore would allow for North Dakota to become an exporter of HCl to the surrounding region.

Wellspring Hydro will evaluate an expansion into Calcium Chloride production, which has significant value to both the private and public sector. Like oil and gas operators, the counties in North Dakota purchase many commodity products that must be trucked or railed in from out of state. Magnesium Chloride ($MgCl_2$) and Calcium Chloride ($CaCl_2$) both come exclusively from out of state production. North Dakota and surrounding states (SD, MT, MN) utilize a high volume of these products for dust control. The annual consumption of calcium chloride for North Dakota is 5.6 thousand metric tons, and 18.1 thousand metric tons for the surrounding states. In addition, the US and Canada are large consumers of deicing products due to harsh winter conditions. $CaCl_2$ outperforms $MgCl_2$ and has a lower environmental impact. Wellspring Hydro has the operational flexibility to produce a large portion of the $CaCl_2$ used by North Dakota and export to the surrounding states.

How the project will enhance the research, development and technologies that reduce environmental impacts and increase sustainability of energy production and delivery of North Dakota's energy resources.

Wellspring Hydro will enhance the development and operations of technologies that reduce environmental impact by suppling crucial raw materials to processes used in carbon capture. Materials that will have the lowest environmental footprint of any commodities on the market. This is due to extremely short supply chains, a zero-emission production facility, and use of a current waste stream for a feedstock.

With its own facility, Wellspring Hydro will work to create a proposed test facility to implement and trial new and emerging technologies and processes. The focus of which would be threefold in a nonspecific order, first to reduce environmental impact, second to lower cost associated with WSH and adjacent projects, third to remain on the forefront of developments in the energy and commodity sectors.

To date Wellspring Hydro has discussed partnerships with companies covering.

Partnership Requests (30 total)

- Lithium Extraction (6)
- Carbon Capture (4)
- Salt cavern deveoplent and support (3)
- Natural gas Co-Gen (4)
- Magnesium chloride production (2)
- Potash solution mining (1)
- Calcium chloride production (2)
- Customized commodity chemical blending (2)
- Water recycle and reuse for industrial process water supply(3)
- Water recycle for Ag reuse (1)
- Alternate SWD zone development (2)

It is important to remember the listed partnership opportunities will be completely stand-alone partnerships, JVs, or licensing opportunities. These will only represent the upside on the current business plan and financial outlook through combined synergies. The opportunities listed show the strategic nature of looking at our assets in North Dakota from a different vantage point which allows for the investigation of innovative ideas in a field environment following laboratory confirmation.

How it will preserve existing jobs and create new ones.

Wellspring Hydro will preserve existing jobs by supporting the oil and gas industry through lower costs, readily available commodities to ensure wells can be completed and produced at a $/barrel that is in line with that of competing states. The Wellspring Hydro production plant will create fifty-three full-time high-paying jobs ranging from front office to production crews.

As detailed in the previous section, Wellspring Hydro's unique intersection of industrial process, commodities production, and oil and gas water reuse it will present an opportunity for further testing and expansion for innovation in an environmentally sustainable format due to the inherent natural assets in Northwestern North Dakota.

BACKGROUND/QUALIFICIATIONS

Leadership Team

Wellspring Hydro management team is supported by industry and local resources to develop a robust business plan and positioned to execute with investment.

Steve and Carla Kemp, Founders, Wellspring Hydro.

- Steve and Carla are local entrepreneurs that founded Wellspring Hydro in 2016 and are based in Williston, ND. Steve and Carla have started multiple ventures in IT, real estate, and financial markets.

Mark Watson, CEO, Wellspring Hydro.

- Mark has over 13 years-experience in acquisitions/mergers, project management, and entrepreneurial start-ups. Mark, MBA, specializes in developing business plans, financial modeling, marketing analysis, and valuation/capital funding.

Mat Hirst, COO, Wellspring Hydro.

- Mat has over 16 years-experience in developing sales and operations teams in the oil and gas industry. Mat, based in Bismarck, ND, specializes in water technologies with expertise in executing sales strategies, people management, and driving operational efficiencies.

Norm Christensen, Technical Advisor, Wellspring Hydro.

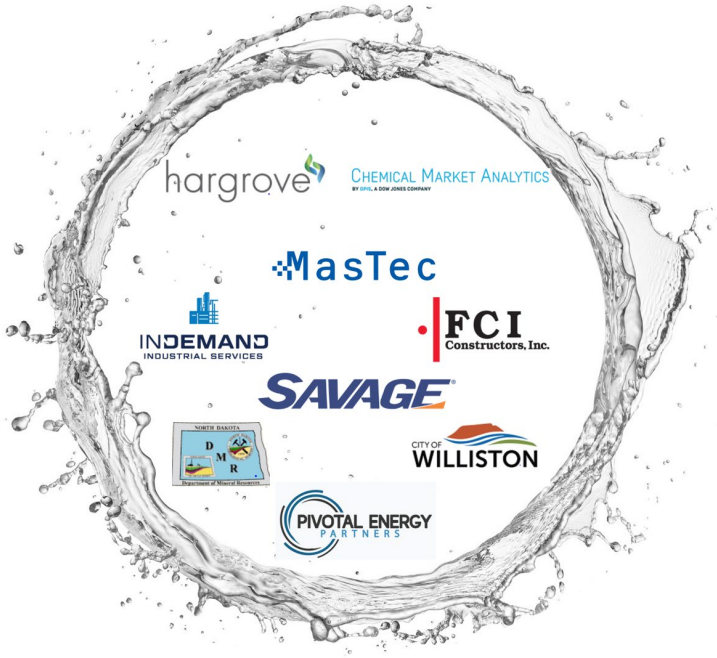
- Norm's career has spanned more than 40 years, including direct involvement in the chlor-alkali industry in both North and South America. A chemical engineer, Norm has held senior positions in both Fortune 100 and small companies in engineering, operations, sales and marketing and general management roles. Norm recently (2015) oversaw on the construction of a chlor-alkali facility in San Antonio, TX.

Partners & Suppliers

Wellspring Hydro has worked with subject matter experts to validate components of the business plan from our engineering leads and local partners.

A few key leads from the project team consists of the following individuals:

- **Scott Cooper,** Project Lead, Hargrove Engineers + Constructors. Scott has thirty years of experience working in project management and design engineering. Has established project procedures, coordinates changes in scope, monitors and controls engineering activities, cost analysis, planning, scheduling, estimating, procurement of process equipment. Scott is the project lead for the Wellspring Hydro FEL-2 and upcoming FEL-3 projects.
- **Justin C Merritt**, P.E, Hargrove Engineers + Constructors. Justin has over eighteen years of experience in a variety of process industries, including chlor-alkali, petrochemicals, minerals processing, biofuels, and lithium. Project experience includes work on six chlor-alkali plants.
- **Amanda Hayes**, Process Engineer, Hargrove Engineers + Constructors. Amanda has over fifteen years of experience as a Process Engineer in the chemical industry. Experience in writing procedures, process safety management, root cause analysis, and process studies.
- **Bill Johnson**, Project Manager, Hargrove Engineers + Constructors. Bill has over twenty-five years of experience as a Process Engineer in the chemical industry. Experience in writing procedures, process safety management, root cause analysis, and process studies.
- **Chuck Carr**, VP Strategic Insights, Chemical Market Analytics (Formerly IHS Markit). Chuck serves as the group lead for consulting projects, primarily responsible for the sale and execution of consultant engagements in the Americas region.
- **Justin Anderson,** Director of Operations, Savage Services. Justin manages operations and business development for Savage Services in the North Dakota region. Justin has helped negotiate an LOI for a logistics and transload partnership, that includes capital investment.



MANAGEMENT

Wellspring Hydro will operate a steering team consisting of the Wellspring Hydro management team, Hargrove project and engineer leads and Tormod operations group. The steering committee will meet monthly to review the strategic process of execution including project timeline, cost projections, regulatory approvals and other critical item highlighted by the working team.

Monthly Steering Team Meetings

Executive Review with the steering team to evaluate progress and assess critical actions, risk register and schedule.

The project will be organized as an integrated team, containing representatives from both Wellspring Hydro, Mastec and Hargrove. The Activities of the project will be coordinated by a core Project Team, the main members of which will be: (full role descriptions available for reference in business plan)

Weekly Project Meetings

During the kick-off meeting for Initial Detail Design, an agreement for the time, place and format of the weekly project meeting will be agreed upon. The purpose of this meeting is to maintain an open line of communication between all parties. These meetings will be transitioned to the field during the construction phase. The agenda will be as follows:

- Upcoming Safety Reviews
- Design Safety Concerns
- Calendar of Events
- Planned Field Trips
- Last Week Accomplishments
- Key Milestones for the Coming Week
- Outstanding Action Items
- Schedule
- Current week releases
- Events

Weekly Reports and Meetings

The Project Manager will issue weekly progress reports which will describe the progress of Hargrove services and of other project participants and will evaluate the progress and performance of the project team against the project plan. The weekly meeting format will be changed to focus on issues that need attention and should publish meaningful and useful metrics that update everyone on progress versus plan.

Wellspring Hydro Steering Team			
Mark Watson			
Scott Cooper			
TBD - Investor Appointed Lead			
TBD - Third Party Industry Expert			
Engineering Stage		**Construction Stage**	
Role	**Lead**	**Role**	**Lead**
Operations Lead – Mat Hirst			
Wellspring Project Manager	TBD	Construction Manager	Mastec
Hargrove Process Principal	Scott Cooper	Site Manager	Mastec
Hargrove Project Engineer	Bill Johnson	Quality Manager	Mastec
Wellspring Process Lead	Norm Christensen	Field Materials Supervisor	Mastec
Wellspring Start-Up Manager	TBD	Controls Manager	Mastec

Wellspring Hydro Operations Lead – Mat Hirst

Finalize the plant data by the development of the Engineering contractor's data to include commissioning and other records required for the future operation of the plant. Identify system start-up requirements.

Wellspring Hydro Project Manager – TBD

Accountable to the Steering Committee; acquire, direct, and control all the resources required to implement the project from development through to beneficial manufacture so that the business intent, as expressed in the Project Proposal or subsequent amendments, can be achieved.

Hargrove Project Principal – Scott Cooper

Accountable to the Wellspring Hydro Project Manager, the role holder will be responsible for the provision of Hargrove resources to deliver the project scope of work.

Hargrove Project Engineering Manager – Bill Johnson

Accountable to the Hargrove Project Principal, and responding to the Wellspring Hydro Project Manager, the role holder will be responsible for the coordination of design activities to meet the project time, cost, and quality targets.

Wellspring Hydro Process – Norm Christensen

Responsible for the production review of process packages including PFDs, P&IDs, equipment data sheets and process description.

Wellspring Hydro Start-up Manager – TBD

Define and implement a start - up plan, detailing Plant Systems, procedures, resources, and responsibilities for all stages of plant turnaround and commissioning by setting and monitoring measures of performance in order to achieve the agreed schedule.

Construction Manager – Mastec

Mastec will utilize its construction management organization to fulfill its construction obligations. Mastec will manage all construction activities required to complete the work to the point of being ready for commissioning.

Site Manager - Mastec

The site manager will report to the project manager on the project and will coordinate all functions with the Wellspring Hydro Operations Manager for all construction-related matters. The site manager will be responsible for:

Quality Manager - Mastec

The Project Quality Manager will perform or cause to be performed those inspections required by the project specifications. He will also review and approve the Quality Plans of all the subcontractors and audit the quality control records of the contractors (e.g., welder certifications).

Field Materials Supervisor - Mastec

The field materials supervisor will be responsible for all field procurement-related activities including receiving, inspecting, and warehousing all engineered items at the site. Field purchasing of bulks will be performed by the individual trade contractors.

Controls Manager - Mastec

During construction, the project controls manager will be responsible for coordinating cost, planning, and scheduling activities of all subcontractors to provide the management tools for controlling construction cost and schedule. Reporting will be provided to Wellspring Hydro which will be appropriate to the form of contracts and as determined the project controls plan.

TIMETABLE

The timeline is based cumulative outlook for the FEL-3 study, market research study and the combined output analysis.

Critical Milestones:

Milestone	Milestone Date
FEL-3/DD Kick Off Meeting	15 Feb 23
FEL-3 Complete	15 Jun 23
Financial Investment Decision (FID)	01 Sep 23
Field Validation – Technology and Commercial	01 Nov 23
Initial Detailed Design	01 Dec 23
Procurement of Specialized Equipment	01 Jan 24
Detail Design Complete	23 Jun 24
Construction Mobilization	04 Jan 24
All Major Equipment	03 Oct 24
Mechanical Completion	05 Sep 25
Start-Up	31 Oct 25

Full Project Timeline:

BUDGET

As referenced in the management section, Wellspring Hydro will have monthly updates on cost/budget reports in addition to the criteria set by the CSEA process.

Project Associated Expense	NDIC's Share	Applicant's Share (Cash)	Applicant's Share (In-Kind)	Applicant's Equity Investment	Total
Technical and Commercial Viability	$2,000,000*			$2,000,000	$4,000,000
Initial Detailed Design	$3,000,000*	-	-	$3,000,000	$6,000,000
Process Equipment	$50,000,000**			$50,000,000	$100,000,000
Detailed Design				$8,500,000	$8,500,000
Chlor-Alkali Facility				$131,386,700	$230,386,700
Total	$55,000,000	-	-	$5,000,000	**$250,886,700**

*Designates grant fund budget - $5,000,000 USD

- Technical and Commercial Viability - $5,000,000 USD
    - Consultants and Technical Support - $506,550 USD
    - Stage 1 Field Trial - $650,000 USD
    - Stage 2 Field Trial - $3,843,350 USD
- Initial Detailed Design - $5,000,000 USD
    - Quoted by Hargrove as first 6 months of detailed design for required engineering and technical support to make procurement decisions.

** Designates loan fund budget - $50,000,000 USD

- Specialized Process Equipment - $50,000,000 USD

CONFIDENTIAL INFORMATION

A person or entity may file a request with the Commission to have material(s) designated as confidential. By law, the request is confidential. The request for confidentiality should be strictly limited to information that meets the criteria to be identified as trade secrets or commercial, financial, or proprietary information. The Commission shall examine the request and determine whether the information meets the criteria. Until such time as the Commission meets and reviews the request for confidentiality, the portions of the application for which confidentiality is being requested shall be held, on a provisional basis, as confidential.

If the confidentiality request is denied, the Commission shall notify the requester and the requester may ask for the return of the information and the request within 10 days of the notice. If no return is sought, the information and request are public record.

Note: Information wished to be considered as confidential should be placed in separate appendices along with the confidentiality request. The appendices must be clearly labeled as confidential. If you plan to request confidentiality for **reports** if the proposal is successful, a request must still be provided.

To request confidentiality, please use the template available at http://www.nd.gov/ndic/CSEA-app-doc-infopage.htm.

Wellspring Hydro has submitted for the attached Business Plan as confidential information by CSEA and the state of North Dakota. This document holds confidential and proprietary information around the research, development, and execution of the novel Wellspring Hydro project.

PATENTS/RIGHTS TO TECHNICAL DATA

Any patents or rights that the applicant wishes to reserve must be identified in the application. If this does not apply to your proposal, please note that below.

This is a first of its kind process utilizing well known and understood technology that has been around since the 1970's. As included in the CSEA Grant scope from December 2021, Wellspring Hydro will complete the process patent application with the results of the FEL-3 defined engineering and design study. This process patent will illustrate a process to leverage this waste stream to create products which are used in the industry as well as create net new fresh surface water. This process is expected to begin in June 2023.

STATE PROGRAMS AND INCENTIVES

Any programs or incentives from the State that the applicant has participated in within the last five years should be listed below, along with the timeframe and value.

Wellspring Hydro has a long-standing partnership with North Dakota from the original concept stage supported by UND, NDIC and City of Williston. The support from the state has allowed Wellspring Hydro to fund the research and development into this novel process (patent pending).

Agreement	Company/Division	Investment	Commentary
Research Grant	NDIC	$110,000	Concept support with UND partnership starting in 2016
Grant Match	City of Williston Star Fund	$225,000	Investment into Concept Stage and FEL-2 Engineering with development in Trenton
Promissory Note	ND Dev Fund	$250,000	Investment into successful FEL-2 engineering and design work in 2020
Promissory Note	ND Dev Fund	$750,000	Investment into commercial and technical development, highlighted by Veolia Pilot Lab
Grant	NDIC – CSEA Fund	$1,000,000	CSEA Grant awarded in December 2021 for FEL-3 engineering & design
Total Investment		**$2,335,000 USD**	

*Promissory notes and grant detail can be provided upon request.

ACTIVE PROJECTS

36
Active Projects

$34.2 Million
Paid To Date

$64.4 Million
Awarded Dollars

$27.8 Million*
Outstanding Committed Dollars

$366,829
Uncommitted Dollars Available Today

2023-2025 BIENNIUM:

Estimated Income:

$18.5 million

Grant Management and Digitization Costs:

$250,000

Lignite Plant of the Future Commitment:

$500,000

CO2 Utilization Commitment:

$100,000

Non-Match Commitments:

$4.5 million

Total All Commitments:

$6.25 million

North Dakota
Industrial Commission

Doug Burgum	Drew H. Wrigley	Doug Goehring
Governor	Attorney General	Agriculture Commissioner

MEMORANDUM

TO: Doug Burgum, Governor and Chair

Drew Wrigley, Attorney General

Doug Goehring, Agriculture Commissioner

FR: Reice Haase, Deputy Executive Director

DT: July 28, 2023

RE: Lignite Litigation Funding

The 68th Legislative Assembly included $3 million in the 23-25 budget appropriation for the Office of the Industrial Commission to be utilized for lignite litigation related expenses. The authorizing language from HB 1014 is as follows:

SECTION 31. EMERGENCY. The following are declared to be an emergency measure:

1. **The sum of $3,000,000 from the general fund in the operating expenses line item included in subdivision 1 of section 1 of this Act and identified as one-time funding in section 2 of this Act for lignite litigation expenses.**

Under guidance by the Industrial Commission, the Office of the Industrial Commission will work with the Attorney General, who is the attorney for the Industrial Commission pursuant to 54-17-03, to determine necessary and appropriate legal services and qualifying lignite litigation expenses to be funded from this appropriation. Such services and expenses may include:

- Payment to Special Assistant Attorney Generals engaged by the Industrial Commission and appointed by the Attorney General for lignite litigation services.
- Payment to Special Assistant Attorney Generals engaged by the Industrial Commission and appointed by the Attorney General for the production or review of comment letters necessary to support the administrative record in lignite related matters reasonably expected to result in litigation.
- Payment to Special Assistant Attorney Generals engaged by the Industrial Commission and appointed by the Attorney General for amicus curiae purposes.

As of the date of this memorandum, lignite related matters reasonably expected to result in litigation include:

- The EPA Mercury and Air Toxics Standards (MATS) Rule
- The EPA Guidance on Regional Haze Plans
- The EPA Section 111 Greenhouse Gas Emissions/Carbon Rule

ENHANCE PRESERVE AND PROTECT PROJECT

R&D, Environmental, and Transmission Planning Services

This project builds on previous work to preserve and protect the existing lignite fleet in North Dakota and to identify opportunities to enhance the future of the state's lignite resources. Previous regulatory policy jeopardized the future of North Dakota's lignite resources, and that regulatory environment continues to be dynamic. This project will allow for flexibility and timeliness in working with the industry and regulators so that North Dakota can make the best use of its vast lignite resources.

Previously a technology development roadmap was developed, and the Advanced Energy Technology (AET) Program was initiated. In order to achieve project objectives, the EPP Project team will continue to develop and implement research & development, environmental, legal, power markets, and transmission strategies. The EPP Project team will work with the ongoing AET Program partners; develop strategies and oversee legal activities that may require litigation due to state and federal statutes and regulations including, if needed, legal support; and participation in the planning processes focused on the development of new transmission infrastructure and other related transmission activities.

ENHANCE PRESERVE AND PROTECT PROJECT
R&D, Environmental, and Transmission Planning Services

Key personnel involved in the management of the EPP Project are:

- Angie Hegre – Project Manager will administer the project, coordinate task efforts, and organize reporting and task meetings.
- Mike Holmes – Principal Investigator and technical representative to the Industrial Commission. Mike will provide EPP project oversight and will lead R&D and strategic studies activities as well as play a support role in all tasks. Amendment includes $500K study on "Technology Options For Future Lignite-Fired Power Generation"
- LEC President/CEO Jason Bohrer, who will serve as a policy advisor to the EPP Project.
- Jonathan Fortner will oversee the environmental strategies and activities and lead the power markets task.
- ~~John Weeda will serve as the ND Transmission Authority Director.~~ With amendment, Transmission Authority base funding will be provided by the state with support from the EPP project.

The Project team will work along with consultants who have legal, research & development, environmental, and transmission technical expertise to execute the project.

TASK	2023												2024												2025											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Task 1.0 Project Management																																				
1.1 Reports																																				
1.2 Advanced Energy Technology Projects																																				
1.3 Adminstration and Support																																				
Task 2.0 Research and Development																																				
2.1 Preserve, Protect and Enhance R&D																																				
Task 3.0 Environmental Strategies																																				
3.1 Technical Services Coordination																																				
Task 4.0 Markets & Planning Strategies																																				
4.1 Technical Services Coordination																																				
Task 5.0 Legal Strategies																																				
5.1 Coordination of Legal Strategies																																				
Task 6.0 Transmission Activities																																				
6.1 Transmission Development Planning																																				
6.2 Owner/Development Outreach																																				
6.3 Government Interaction																																				
6.4 Technical Services																																				

Summary of Milestones and Deliverables:

Contract Award / Project Start: January 1, 2023	
Semi Annual Report due dates	
Completion / Project End Date: December 31, 2025	
Schedule	

Project Schedule with Deliverables

BUDGET – EPP Project Cost Summary by Task Requested Amendment

	Original	Amendment Request
Project Management	$596,978	$598,297
Power Market	$517,470	$637,107
Research & Development	$1,129,445	$1,629,445
Environmental	$392,008	$392,008
Transmission	$671,896	$255,360
Legal/Marketing	$211,391	$211,391
Total	$3,519,189	$3,723,608
		$204,418

FUNDED PCOR BUDGET

- The North Dakota Industrial Commission (NDIC) committed to supporting PCOR's 5-year effort by matching U.S. Department of Energy (DOE) funding with cash cost share:
  - Up to $2M through the Lignite Research Program (LRP).
  - Up to $2M through the Oil and Gas Research Program (OGRP).

- The EERC applied for $5M in additional funding from DOE in 2022. DOE recompeted the appropriated funds through a new Funding Opportunity Announcement (DE-FOA-0002799). Likewise, 2023 appropriated funds will be recompeted per DOE's Notice of Intent (DE-FOA-0003013).

- The EERC requests the remaining cost-share commitment from LRP for $500,000.

	2019	2020	2021	Total
DOE	$5,000,000	$5,000,000	$5,000,000	$15,000,000
NDIC – OGRP	$500,000	$500,000	$500,000	$1,500,000
NDIC – LRP	$500,000	$500,000	$500,000	$1,500,000

PCOR BUDGET

Funding Source	Commitment to DOE Program as of May 2023	May 2023* Request	Total Program
DOE	$15,000,000		$15,000,000
NDIC OGRP	$1,500,000	$500,000	$2,000,000
NDIC LRP	$1,500,000	$500,000	$2,000,000
University of Wyoming	$377,424		$377,424
University of Alaska Fairbanks	$375,450		$375,450
Industry	$0	$1,139,990	$1,139,990
Total	$18,752,874	$2,139,990	$20,892,864

* If DOE does not provide additional funding, the May 2023 request will be considered complementary funding to advance the goals and objectives of the PCOR Partnership Program and will not be reported to DOE as cost share.

Minutes of a Meeting of the Industrial Commission of North Dakota

Held on June 29, 2023 beginning at 12:30 p.m.

Governor's Conference Room – State Capitol

Present: Governor Doug Burgum, Chairman

Attorney General Drew H. Wrigley

Agriculture Commissioner Doug Goehring

Also Present: This meeting was open through Microsoft Teams so not all attendees are known.

Agency representatives joined various portions of the meeting.

Governor Burgum called the meeting of the Industrial Commission to order at approximately 12:42 p.m., and made a minor modification to the agenda to place the Public Finance Authority topics at the beginning of the agenda, followed by Housing Finance Agency.

NORTH DAKOTA PUBLIC FINANCE AGENCY

Ms. DeAnn Ament presented for consideration of approval the following 2 loan applications:

i. Fargo – Clean Water - $25,000,000 increase to existing previously approved $126,500,000 loan. The requested loan term is 30 years and the City of Fargo will issue revenue bonds payable with wastewater fees and sales tax revenues. The average annual payment for the revenue bonds will be $6,605,073.

A motion was made by Commissioner Goehring and seconded by Governor Burgum that the Commission approve a $25,000,000 Clean Water State Revolving Fund loan increase for the city of Fargo.

On a roll call vote, Governor Burgum and Commissioner Goehring voted aye. The motion carried.

ii. Bismarck – Clean Water - $45,000,000. The requested loan term is 20 years and the City of Bismarck will issue revenue bonds payable with sewer user fees. The average annual payment for the revenue bonds will be $2,916,012.

A motion was made by Commissioner Goehring and seconded by Governor Burgum that the Commission approve a $45,000,000 Clean Water State Revolving Fund loan increase for the city of Bismarck.

On a roll call vote, Governor Burgum and Commissioner Goehring voted aye. The motion carried.

Ms. Ament gave a presentation of the report of State Revolving Fund loans under $2,000,000 approved by Public Finance Advisory Committee:

i. Fargo – Clean Water - $1,000,000 increase to existing previously approved $20,229,000 loan. The requested loan term is 30 years and the City will issue revenue bonds payable with wastewater user fees and sales tax revenue.

ii. Bismarck – Drinking Water - $2,000,000 with $1,500,000 loan forgiveness. The requested loan term is 20 years and the City will issue revenue bonds payable with water user fees.
iii. Galesburg – Drinking Water - $606,000. The requested loan term is 30 years and the City will issue improvement bonds payable with special assessments.

Ms. Karen Tyler presented for consideration of approval the reappointment of Keith Lund to Public Finance Advisory Committee.

The memo states:

"The North Dakota Public Finance Authority Policy P-2A states that the Industrial Commission shall appoint a three-member Advisory Committee to review information and make recommendations to the North Dakota Public Finance Authority Executive Director and the North Dakota Industrial Commission.

The policy states that the individuals appointed to this Committee must have background in municipal finance and/or economic development.

The current makeup of the Advisory Committee is:
Keith Lund, Grand Forks
Linda Svihovec, Bismarck
John Phillips, Beulah

Keith Lund's term will expire on July 1, 2023, and he is willing to continue his service to the PFA and Advisory Committee. Keith is the President and CEO of the Grand Forks Region Economic Development Corporation and has served on the Committee since 2011. He brings expertise in municipal finance and economic development and has provided valuable input to the Committee and the PFA Executive Director. Keith has been an active participant in the work of the Committee, and currently serves as Chairman. DeAnn has stated that his knowledge of the needs of urban communities and the complexities they face in funding infrastructure and his understanding of the role of the PFA is important to the work of the Authority. **Therefore, it is my recommendation that Keith Lund be reappointed for a three-year term effective immediately and extending to July 1, 2026.**

Respectfully submitted,

Karen Tyler"

It was moved by Commissioner Goehring and seconded by Governor Burgum that the Industrial Commission accept the recommendation of the Interim Executive Director and approve the reappointment of Keith Lund for a three-year term to the Public Finance Authority Advisory Committee effective immediately and extending to July 1, 2026.

On a roll call vote, Governor Burgum and Commissioner Goehring voted aye. The motion carried.

NORTH DAKOTA HOUSING FINANCE AGENCY

Mr. Brandon Detlaff presented for consideration of approval increases to annual income limits for FirstHome and Down Payment Closing Cost Assistance (DCA) programs.

The Department of Housing and Urban Development (HUD) published new median income numbers on May 15, 2023. These numbers are used to establish the Annual Income limits for the FirstHome,

FirstHome Start, FirstHome DCA, and HomeAccess Programs. The new statewide median income for North Dakota increased $3,600 (3.72%) to $100,400 for 2023. This compares to the national median income increase of $6,200 (6.89%) to $96,200. The proposed 2023 limits range from $100,400 to $127,420 depending on family size and county. The NDHFA Advisory Board recommends the approval of the new Income limits effective for loan reservations dated on or after July 1, 2023.

It was moved by Commissioner Goehring and seconded by Governor Burgum that the Industrial Commission approve the form of Program Directive NO 121 per Exhibit 1 partially set forth below, new Annual Income limits effective for loan reservations under the FirstHome (Standard/Start/HomeAccess) programs dated on or after July 1, 2023, and to approve changes to the DCA Program Limits per Exhibit 2, partially set forth below, effective for loan reservations dated on or after July 1, 2023.

Maximum Annual Income

FirstHome/Start/HomeAccess

County	Family Size Less than 3	Family Size 3 or more
Mercer/Williams	$110,800	$127,420
Stark	$109,600	$126,040
Burleigh/Morton/Oliver	$108,600	$124,890
Cass	$104,100	$119,715
McKenzie	$102,700	$118,105
All Other Counties	$100,400	$115,460

DCA INCOME LIMITS
07/01/2023

	FAMILY SIZE*							
COUNTY	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
Mercer/Williams	62,100	70,950	79,800	88,650	95,750	102,850	109,950	117,050
Stark	61,400	70,200	78,950	87,700	94,750	101,750	108,750	115,800
Burleigh/Morton/Oliver	60,850	69,550	78,250	86,900	93,900	100,850	107,800	114,750
Cass	58,350	66,650	75,000	83,300	90,000	96,650	103,300	110,000
McKenzie	57,550	65,750	73,950	82,150	88,750	95,300	101,900	108,450
All Other Counties	53,600	61,250	68,900	76,550	82,700	88,800	94,950	101,050

On a roll call vote, Governor Burgum and Commissioner Goehring voted aye. The motion carried.

Mr. Dettlaff presented for consideration of approval increases to acquisition cost limits for the FirstHome Standard, Start, HomeAccess, and DCA programs.

The IRS issues a Revenue Procedure each year that provides the average area purchase price for counties in each state and a nationwide minimum. This is done by adjusting the FHA loan limits to consider the differences between average and median purchase prices. The IRS tax code then requires

setting Acquisition Cost limits at no more than 90% of the applicable average area purchase price as provided in the Revenue Procedure.

It was moved by Commissioner Goehring and seconded by Governor Burgum that the Industrial Commission approve the Acquisition Cost Limits for the FirstHome Standard, Start, HomeAccess, and DCA programs as adjusted per Program Directive 120, partially set forth below, effective July 1, 2023.

PROGRAM DIRECTIVE NO. 120

Area Limits
(Maximum Acquisition Cost)

The following Program Directive will serve as written notice of the Area Limits (as defined in the 1994 Mortgage Purchase Agreement dated as of August 3, 1994) for the Acquisition Cost of a Single-Family Residence. These Area Limits are **effective for Mortgage Loans in which the Reservation is dated on or after the herein effective date.**

Previously Occupied

All Counties	1 Unit	2 Unit	3 Unit	4 Unit
	$481,176	$616,111	$744,679	$925,491

Previously Unoccupied

All Counties	1 Unit Only
	$481,176

Attorney General Wrigley joined the meeting at this time.

Ms. Jennifer Henderson presented a report on Authorizing Declaration of Intent to Issue Multifamily Revenue Bonds, Lashkowitz Riverfront 4, Fargo.

On May 25, 2023, NDHFA issued a Declaration of "Official Intent" to issue Multifamily Revenue Bonds in the amount not to exceed $14,000,000. The proceeds of the bonds will be used for the construction of Lashkowitz Riverfront 4, an 83-unit apartment complex located at 101 2nd St South, Fargo, North Dakota.

The issuance of tax-exempt bonds is required for a project to qualify for a non-competitive 4% tax credit allocation. The authority to issue the intent declaration was given by a Resolution Authorizing Declarations of Intent adopted by the Commission on March 24, 2015.

Fargo Housing and Redevelopment Authority, a North Dakota Housing Authority, is proposing the demolition of the existing 248-unit public housing complex known as the Lashkowitz Highrise and replace it with the new construction of 110 units to be developed as a twin 4 percent/9 percent transaction. The 4 percent transaction, for which tax-exempt bonds will be issued, will consist of 83 units and comprise floors 2-4. The remaining units will be financed as a separate asset utilizing 9 percent competitive credits. This transaction will remove units from public housing and replace with traditional affordable housing as part of a repositioning strategy.

The issuance of an official intent memo declares the intention to issue multifamily bonds, however does not obligate the Agency to give final approval for the issuance of the bonds. Final approval for issuance of the bonds can only be authorized by independent action of the Industrial Commission. Prior to final

bond issuance, the application must meet underwriting conditions and receive an approval for 4% tax credits. Once underwriting conditions are met, the project will then be presented to the Commission with a request to approve the issuance of a Resolution Authorizing Revenue Bonds and approve the substantially drafted bond documents. A copy of the declarations can be found on the website.

Ms. Tyler presented for consideration of approval the recommendation of reappointment of Ninetta Wandler and Jim Farnsworth to Housing Finance Advisory Board.

The memo reads as follows:

"The North Dakota Century Code 54-17-07.1 states:

> **54-17-07.1. Advisory board - Rules.**
> The Industrial Commission shall appoint a six-member advisory board consisting of representatives of lenders, the residential real estate industry, the mobile home and manufactured housing industry, and homeowners and buyers, and in consultation with such board may adopt rules and regulations for the conduct of its housing finance program which may, among other matters, establish requirements for the type and purchase price of dwelling units and multifamily facilities eligible to be financed, the income limits for eligible low or moderate income persons or families, the interest rates and other terms of mortgage loans to be financed, requirements relating to federal or private mortgage insurance or guarantees, and the general terms and conditions for the issuance and security of housing revenue bonds to be issued.

The current terms for HFA Advisory Board members Ninetta Wandler (Real Estate) and Jim Farnsworth (Manufactured Housing) will expire on July 1, 2023. Ms. Wandler was first appointed to the advisory board on January 22, 2004 and currently serves as board Chair. Mr. Farnsworth was first appointed to the board on December 28, 2010. Both members are interested in continuing their service on the advisory board and the full board voted to support this reappointment at the March 10, 2023 advisory board meeting.

I recommend the Industrial Commission accept the recommendation of the HFA Advisory Board and reappoint Ninetta Wandler and Jim Farnsworth for three-year terms, and also reappoint Ninetta Wandler as Chair.

Respectfully submitted,

Karen Tyler"

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission accept the recommendation of the Interim Executive Director approve the reappointment of Ninetta Wandler and Jim Farnsworth for three-year terms on the Housing Finance Agency Advisory Board, and also reappoint Ninetta Wandler as the Chair of the Advisory Board.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

Mr. Dave Flohr gave a brief Housing Finance Agency Legislative update where he stated that the Housing Finance Agency was approved to hire four new FTE's which will be used for finance and IT positions.

NORTH DAKOTA INSURANCE RESERVE FUND

Brennan Quintus presented for consideration of approval the reinsurance policy recommendation for the Excess Loss Reinsurance Coverage.

The State Fire and Tornado Fund provides property insurance coverage to over 1,200 state agencies and local governments and protects over $19.5 billion of total insured value (TIV). The North Dakota Insurance Reserve Fund (NDIRF) administers the Fund through a contract with the North Dakota Insurance Department. The contract has been in place since June 2019. The NDIRF is a member-owned nonprofit corporation that provides liability, automobile, and equipment coverage to North Dakota local governments. Currently, the Fund has excess loss reinsurance for claims over $2 million up to $250 million through Travelers. The deposit premium paid on this reinsurance was approximately $5.4 million based on over $18 billion of property values as of August 1, 2022, which translates to a rate of .029273 per $100 of insured value. N.D. Cent. Code § 26.1-22-21 requires the Insurance Commissioner to procure excess loss reinsurance with the approval of the Industrial Commission. The Fund's current excess loss reinsurance treaty expires at midnight on July 31, 2023.

Travelers quoted a limit of $250 million over a $2 million retention per occurrence at a rate of .03316 per $100 of TIV. Based on a TIV of $19,621,296,125, the deposit premium with Travelers is $6,506,490.

Due to the change in terms made by Travelers in 2022, NDIRF staff began work on finding alternative options for the Fund shortly after the 2022 renewal. NDIRF staff, through a reinsurance broker, approached reinsurance companies all over the world. We were able to compile a shared and layered structure that includes multiple reinsurance companies taking different portions of a $250 million limit above a $2 million retention per occurrence at a rate of .0351 per $100 of TIV. Based on a TIV of $19,704,027,873, the deposit premium for this structure is $6,918,270. The main benefit of this structure is that all NDFT properties will be covered through the same program, and the Fund will not need to buy reinsurance coverage for separate properties.

It is recommended that the Fund accept the shared and layered structure. This structure will guarantee that all Fund property is reinsured in the short term. The structure will also provide long-term stability because no single carrier can dictate terms like Travelers has done over the past two years. Aside from multiple reinsurers participating in the program, the terms offered in the shared and layered structure are either better or the same as the terms Travelers has provided.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission accept the recommendation of the North Dakota Insurance Commissioner regarding the Excess Loss Reinsurance Coverage for property coverage provided by the Fire and Tornado Fund, and approve the proposal for a shared and layered program policy with participation of the insurers as presented, which will provide reinsurance coverage of $250,000,000 with a $2,000,000 deductible per occurrence on Total Insured Value of $19,704,027,873, with a total policy premium of $6,918,270.

This motion acknowledges that the Century Code specifies that insurance must be purchased from "authorized" insurance companies, and further acknowledges that the Century Code does not specify whether non-admitted companies qualify as "authorized" companies. However, this same section of the century code, N.D.C.C. § 26.1-22-21, provides a general exception that, among other things,

authorizes the Commissioner and the Industrial Commission to disregard the authorized insurance company requirement with the approval of the Industrial Commission, and such approval is herein recommended under this motion.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

NORTH DAKOTA MILL AND ELEVATOR

Mr. Vance Taylor presented for consideration of approval capital projects expenditures – Midds Storage Project Phase III and Industrial Vacuum purchase.

Phase III of the project will be the final phase and includes electrical for the building and the collection system, steam for the building, and the plant side midds and screening collection system to move the midds and screenings from the milling units to the new midds building to the processed and loaded. The total cost of Phase III is $18,800,000, bringing the total project cost to $56,000,000. The purchase of a portable industrial vacuum will improve cleaning efficiency, sanitation levels and employee safety throughout the terminal elevator and outside areas of the facility and the cost is $175,000.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approve the following capital project expenditures:

Phase III of the Midds Storage and Handling project with costs totaling $18,800,000 which includes electrical for the building and the collection system, steam for the building, and the plant side midds and screening collection system to move the midds and screenings from the milling units to the new midds building to be processed and loaded. With the approval of Phase III which is the final phase of the project the total project cost is $56,000,000.

The purchase of a portable industrial vacuum at a cost of $175,000 to improve cleaning efficiency, sanitation levels and employee safety throughout the terminal elevator and outside areas of the facility.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

Mr. Taylor presented for consideration of approval a Mill and Elevator Profits Transfer for Fiscal Year 2023.

The memo reads as follows:

"North Dakota Century Code § 54-18-19 and 54-18-21 state the following:

> **54-18-19. Transfer of North Dakota mill and elevator profits to general fund.** The industrial commission shall transfer to the state general fund fifty percent of the annual earnings and undivided profits of the North Dakota mill and elevator association after any transfers to other state agricultural-related programs. The moneys must be transferred on an annual basis in the amounts and at the times requested by the director of the office of management and budget.
>
> **54-18-21. Annual transfer.** Within thirty days after the conclusion of each fiscal year, the industrial commission shall transfer five percent of the net income earned by the state mill and elevator association during that fiscal year to the agricultural products utilization fund.

Mill management is planning to close their books on July 21, 2023, and is proposing to make the transfers no later than July 25, 2023. Therefore, we are requesting that the Industrial Commission authorize the transfer of 50% of the Mill FY 2023 profits to the General Fund and the 5% of net income to the Agricultural Products Utilization Fund utilizing unaudited numbers by no later than July 25, 2023, with Mill management reporting the amount of the transfers to the Commission at the next Industrial Commission meeting.

Respectfully submitted,

Vance Taylor
Karen Tyler"

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley to authorize the North Dakota Mill to transfer 5% of the net income earned by the Mill for fiscal year 2023 to the Agricultural Products Utilization Fund (APUF) and transfer to the General Fund 50% of the annual earnings and undivided profits of the Mill after any transfers to other state agricultural-related programs as per the request of the Office of Management and Budget Director noting that the transfers will be based on unaudited year-end results and reserving the right to adjust the transfer numbers once the year-end results have been audited. Further that Mill management reports the amount of the transfers to the Commission at the next Industrial Commission meeting.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

STATE ENERGY RESEARCH CENTER

Mr. Reice Haase presented for consideration of approval modifications to Contract No. SERC 2019-01 to incorporate 68th Legislative Assembly changes.

In 2019, North Dakota's 66th Legislative Assembly established the Energy & Environmental Research Center (EERC) as the State Energy Research Center (SERC) through Senate Bill No. 2249. The legislation included $5 million of funding per biennium to fulfill three objectives: 1) conduct exploratory, transformational, and innovative research of technologies and methodologies that facilitate the prudent development and clean and efficient use of the state's energy resources; 2) provide greater access to energy experts for timely scientific and engineering studies to support the state's interests; and 3) educate stakeholders on issues related to the state's energy resources through public outreach.

In 2023, North Dakota's 68th Legislative Assembly passed Senate Bill No. 2161 in continuing support of SERC efforts. This bill reaffirms SERC's mandate and directs the following actions:

- Changing the end date of SERC activities and funding from its current end date of June 30, 2027, to June 30, 2029.
- Raising the SERC fund limit from $5 million per biennium to $7.5 million per biennium.

In keeping with the directive of Senate Bill No. 2161, the EERC requests a modification to NDIC Contract No. SERC 2019-01 to update the end date to June 30, 2029, and increase the funding amount to $7.5 million per biennium. The scope of work will remain the same.

In addition to the actions directed by Senate Bill No. 2161, House Bill No. 1014 contained two legislatively directed projects for SERC, specifically a salt cavern underground energy storage research project (Section 15) and a study related to prospective in-state resources of economically feasible accumulations of critical minerals (Section 14). The EERC will submit separate requests for these projects at a later date.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approves the following amendments to Contract SERC 2019-01, and authorizes the Office of the Industrial Commission to execute an amended contract as follows:

- **Extend the end date of the contract from June 30, 2027 to June 30, 2029**
- **Increase the State Energy Research Fund limit from $5,000,000 per biennium to $7,500,000 per biennium**

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

NORTH DAKOTA OUTDOOR HERITAGE FUND

Mr. Haase presented the Outdoor Heritage Fund Project Management and Financial Report. The Industrial Commission has awarded funding for 213 projects for a total of $76,383,949. To date, there has been $4,222,260 of commitments that have been returned. Every county in North Dakota has received some sort of funding or benefit from the Outdoor Heritage Fund. There are currently 74 active projects, $13.3 million paid to date, $47.9 million awarded, $34.3 million payable, and $6.9 million available for commitment.

Mr. Bob Kuylen presented for consideration of approval the Outdoor Heritage Fund Advisory Board recommendations for Grant Round 22 applications:

i. 22-2 (C) McLean County Water Resource District: Katz Dam Fish Passage, $112,572.75
ii. 22-3 (D) Coyote Clay Target League: Coyote Clay Target Range, $293,158
iii. 22-4 (C) National Wild Turkey Federation: Turkey's enhancing Water Quality and Wildlife Habitat, $200,000
iv. 22-5 (B) North Dakota Conservation District Employees Association: North Dakota Statewide Tree Planting Initiative, $2,550,000
v. 22-6 (C) Theodore Roosevelt Presidential Library Foundation: TRPL Prairie Enhancement Land Management Phase I, $498,374
vi. 22-7 (B) Pembina County Historical Society: Pembina County Community Orchard, $8,900
vii. 22-8 (C) North Dakota Wildlife Federation: The Conservation Capacity Program, $30,000
viii. 22-9 (C) North Dakota Natural Resources Trust: North Dakota Partners for Wildlife Project 3, $1,957,500
ix. 22-10 (A) American Foundation for Wildlife: Howard Oppegard Landing Improvements, $50,550
x. 22-11 (D) Williams County Parks: Epping Springbook Dam Algae Control, $131,921
xi. 22-12 (D) Turtle Mountain Band of Chippewa: TMBCI Belcourt Lake Rejuvenation Phase II, $105,741

A motion was made by Commissioner Goehring and Seconded by Attorney General Wrigley that the Industrial Commission accept the Outdoor Heritage Fund Advisory Board recommendations for the Grant Round 22 applications for the amounts listed above.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

Mr. Kuylen presented for consideration of approval the Outdoor Heritage Fund Advisory Board recommendations for amendments to the following contracts:

i. 021-208 Audubon Dakota: UWP Initiative, reallocation of $45,000 within budget line-items

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission accepts the recommendation of the Outdoor Heritage Fund Advisory Board and authorizes the Office of the Industrial Commission to amend Contract 021-208 – Urban Woods and Prairies Initiative Pollinator Plots Project to reallocate $45,000 of project funding as follows:

Budget Line Item:	Original OHF Amount:	Revised Amount:	
Seed Mix	$29,375	$27,000	
Seeding Labor	$7,500	$0	
Land Management	$75,000	$39,875	
Plant Plugs	$0	$45,000	

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

ii. 017-169 Audubon Dakota: ND Conservation Forage Program transition payment timeline

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission accepts the recommendation of the Outdoor Heritage Fund Advisory Board and authorizes the Office of the Industrial Commission to amend Contract 017-169 – North Dakota Conservation Forage Program to allow transition payments to be paid in full within the first year of enrollment.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

NORTH DAKOTA RENEWABLE ENERGY PROGRAM

Mr. Haase presented the Renewable Energy Program Management and Financial Report. There are currently 17 active projects, $1.7 million has been paid to date, there has been $6.6 million awarded, there is $4.8 million that is outstanding committed, and $1.1 million cash available for commitment in the Renewable Energy Fund.

Mr. Haase presented for consideration of approval the following Grand Round 51 applications:

i. R-051-C 4H2, Inc.: DEFC Research and Development, $346,915.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission accepts the recommendations of the Renewable Energy Council and approves funding for application R-051-C – DEFC Research and Development and authorizes the Office of the Industrial Commission to enter into a contract with 4H2, Inc. for the amount of $346,915.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

NORTH DAKOTA DEPARTMENT OF MINERAL RESOURCES

Dr. Lynn Helms presented for consideration of approval the following cases:

i. **Order 32416 for Case 29808** regarding the termination of the Tracy Mountain-Tyler Unit operated by Northwestern Production, LLC in Billings County, ND, the temporarily abandoned status of wells with the unit, the reclamation status of wells within the unit, and the bond amount required for the operation of the unit.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approves Order No. 32416 issued in Case No. 29808 authorizing the Tracy Mountain-Tyler Unit, Billings County, ND to remain in full force and effect; approving a bond reduction for the operation of the Tracy Mountain-Tyler Unit pursuant to NDAC Section 43-02-03-15 from $995,000 to $724,000; authorizing the Director to issue an administrative order reducing the bond amount when non-compliant wells have been brought into compliance; and/or such other relief.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

ii. **Order 32617 for Case 30008** regarding an application of Resonance Exploration, LLC for an enhanced oil recovery pilot project in the South West Roth-Madison Pool, Bottineau County, ND.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approves Order No. 32617 issued in Case No. 30008 approving an application of Resonance Exploration (North Dakota) LLC for an order granting temporary authority to use the proposed Resonance Fylling 6-36H INJ well to be located in a 720-acre spacing unit comprised of the E/2, E/2W/2 of Section 36, T.l63N., R.79W. and NE/4, E/2NW/4 of Section I, T.l62N., R.79W., Bottineau County, ND, as an injection well for an enhanced oil recovery pilot project in the West Roth-Madison Pool, and such further and additional relief.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

iii. **Order 32618 for Case 30009** regarding an application of Resonance Exploration, LLC for an enhanced oil recovery pilot project in the South Westhope-Spearfish/Charles Pool, Bottineau County, ND.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approves Order No. 32618 issued in Case No. 30009 approving an application of Resonance Exploration (North Dakota) LLC for an order granting temporary authority to use the proposed Resonance Stratton l6-12H INJ well to be located in a 640-acre spacing unit comprised of the S/2SW/4 of Section I and the S/2, NW/4, and S/2NE/4 of Section 12, T.l62N., R.80W., Bottineau County, ND, as an injection well for an enhanced oil recovery pilot project in the South Westhope-Spearfish/Charles Pool, and such further and additional relief.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

Mr. Bruce Hicks presented the Oil and Gas Division Quarterly Report. In Q1 2023 there were 231 Permit Applications Received, a rig count of 46, and a producing well count of 17, 538. There was 1,056,285 Barrels of Oil per Day and the Gas Capture rate in the Bakken was 95%.

Discussion was had surrounding the issues of laying down rigs due to workforce shortages. Governor Burgum stated that drilling rig employees are among the most important in the State, so this is an issue that needs to be resolved.

A RESOLUTION OF APPRECIATION WAS MADE

Whereas, Bruce Hicks has served the North Dakota Industrial Commission for 43 years, and has been employed by the Department of Mineral Resources in several capacities since its creation in 1981, including his current position as Assistant Director; and

Whereas, Bruce has been dedicated to the Department's mission of encouraging and promoting the development, production, and utilization of oil and gas in the state in such a manner as will prevent waste, maximize economic recovery, and fully protect the correlative rights of all owners to the end that the landowners, the royalty owners, the producers, and the general public realize the greatest possible good from these vital natural resources; and

Whereas, During Bruce's tenure with the Department, North Dakota's average monthly oil production has grown from approximately 100,000 barrels per day in 1980 to over 1.1 million barrels per day in 2023; and

Whereas, Bruce's work during this time fostered a stable regulatory environment within which the incredible growth of North Dakota's oil and gas industry was made possible, which has resulted in the greatest possible good for all North Dakotans, revenues from which are used to fund public infrastructure like drinking water, schools, and roads; and

Whereas, Bruce's dedication to the Industrial Commission and to the State of North Dakota, including his service as a representative of North Dakota on the Interstate Oil and Gas Compact Commission, will leave a lasting legacy for all citizens of our state and is deserving of recognition.

Now, therefore, the North Dakota Industrial Commission hereby expresses deep gratitude to Bruce Hicks for his 43 years of service to the citizens of North Dakota and wishes him the very best in his retirement.

Adopted this 29th day of June, 2023.

Dr. Helms gave an update on litigation:

i. Case No. 31-2020-CV-0018 – Northern Oil and Gas, Inc. vs. Continental Resources, Inc; Board of University and School Lands and ND Industrial Commission et al – Ordinary High Water Mark challenge
ii. Blue Appaloosa – appeal of Industrial Commission Order 31208

iii. Case No. 27-2022-CV-00305 – Blue Steel Oil and Gas, LLC v. North Dakota Industrial Commission, Slawson Exploration Company, Inc and White Butte Oil Operations, LLC – appeal of Industrial Commission Order 31501
iv. Dominek v Equinor et al – allocation of production from overlapping spacing units
v. Liberty Resources vs. NDIC et al – appeal of Industrial Commission Order 31792
vi. North Dakota Industrial Commission v. U.S. Department of Interior – quarterly lease sales

Dr. Helms gave an update on the Dakota Access Pipeline Environmental Impact Statement cooperating agency comments. There is currently a delay as leadership has to approve the release of comments.

Dr. Helms gave an update on the rule revision process. The process has been started and ideas have gone out to staff. The process will be brought to the September 7, 2023 Industrial Commission meeting for approval on public comments.

Dr. Helms presented for consideration of approval the submittal of agency comments in support of the State of Louisiana Application for Underground Injection Control Class VI Primacy.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approves the submittal of agency comments in support of the State of Louisiana Application for Underground Injection Control Class VI Primacy.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

Dr. Helms presented for consideration of approval the Resolution of the North Dakota Industrial Commission Naming Hearing Examiners.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission accept the Resolution of the North Dakota Industrial Commission Naming Hearing Examiners as presented.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

A RESOLUTION WAS MADE

Whereas, Section 38-08-04.1 of the North Dakota Century Code provides that the Industrial Commission may use hearing examiners under such rules and regulations as the Commission may prescribe; and

Whereas, Section 43-02-03-93 of the North Dakota Administrative Code provides that the Commission may by motion designate and appoint qualified individuals to serve as examiners,

NOW, THEREFORE, the Industrial Commission rescinds all prior appointments of examiners and designates and appoints the following individuals to serve as the Commission's examiners as it relates to the Commission's responsibilities under Chapter 38-08 of the North Dakota Century Code:

David Garner, Assistant Attorney General
Matt Sagsveen, Assistant Attorney General
Lynn D. Helms, Ph.D., Director, Department of Mineral Resources and Director, Oil and Gas Division
Mark Bohrer, Assistant Director, Oil and Gas Division
Ashleigh Day, UIC and Treating Plant Manager, Oil and Gas Division
Michael Ziesch, EGIS Staff Officer, Department of Mineral Resources
David Tabor, Field Supervisor, Oil and Gas Division

This Resolution shall be effective as of July 1, 2023.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that under the authority of North Dakota Century Code Sections 6-09-35, 44-04-18.4, 44-04-19.1, 44-04-19.2, the Industrial Commission enter into executive session for the purposes Bank of North Dakota confidential business, for Department of Mineral Resources attorney consultation, and to consider Clean Sustainable Energy Authority confidentiality requests.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

The Commission is met in executive session regarding Bank of North Dakota business pursuant to N.D.C.C. 6-09-35 to consider those items listed on the agenda under Bank of North Dakota confidential business. Only Commission members, their staff, Commission staff, and BND staff participated in that executive session.

After the Bank of North Dakota executive session, the Commission met in executive session for attorney consultation related to the case listed on the agenda. Only Commission members, their staff, Commission staff, and Department of Mineral Resources staff participated in that executive session.

After the Department of Mineral Resources executive session, the Commission met in executive session regarding to consider Clean Sustainable Energy Authority confidentiality requests. Only Commission members, their staff, and Commission staff participated in that executive session.

Any formal action taken by the Commission occurs after it reconvenes in open session.

Governor Burgum reminded the Commission members and those present in the executive sessions that the discussions must be limited to the announced purposes which was anticipated to last approximately 1 hour and 10 minutes.

The executive session began at 4:00 p.m.

The Meeting Closed to the Public for Executive Session Pursuant to NDCC 6-09-35, 44-04-18.4, 44-04-19.1, 44-04-19.2

BANK OF NORTH DAKOTA EXECUTIVE SESSION

Industrial Commission Members Present
Governor Doug Burgum

Attorney General Drew H. Wrigley
Agriculture Commissioner Doug Goehring

BND Members Present
Craig Hanson, BND

Others in Attendance

Ryan Norrell	Governor's Office
Karen Tyler	Industrial Commission Office
Reice Haase	Industrial Commission Office
Brenna Jessen	Industrial Commission Office

DEPARTMENT OF MINERAL RESOURCES EXECUTIVE SESSION

Industrial Commission Members Present
Governor Doug Burgum
Attorney General Drew H. Wrigley
Agriculture Commissioner Doug Goehring

DMR Members Present
Lynn Helms, DMR
Mark Bohrer, DMR

Others in Attendance

Ryan Norrell	Governor's Office
John Reiten	Governor's Office
Philip Axt	Assistant Attorney General
Matt Sagsveen	Attorney
Karen Tyler	Industrial Commission Office
Reice Haase	Industrial Commission Office
Brenna Jessen	Industrial Commission Office

CLEAN SUSTAINABLE ENERGY AUTHORITY EXECUTIVE SESSION

Industrial Commission Members Present
Governor Doug Burgum
Attorney General Drew H. Wrigley
Agriculture Commissioner Doug Goehring

Others in Attendance

Ryan Norrell	Governor's Office
John Reiten	Governor's Office
Karen Tyler	Industrial Commission Office
Reice Haase	Industrial Commission Office

The executive session ended at 5:25 p.m. and the Commission reconvened in open session.

During the Bank of North Dakota executive session, the Commission made a motion regarding one increase in a credit line.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

During the Department of Mineral Resources executive session, the Commission consulted with its attorney.

During the Clean Sustainable Energy Authority executive session, the Commission considered confidentiality requests.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission accept the recommendation of its Deputy Director and pursuant to North Dakota Century Code sections 54-63.1-06, 44-04-18.4 and 44-04-19.2 grant the confidentiality requests and determine that the information described in the Grant Round 4 requests consists of trade secrets and/or financial or proprietary information and is confidential.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

A RESOLUTION OF APPRECIATION WAS MADE

Whereas, Al Anderson has admirably served as the first Director of the Clean Sustainable Energy Authority since September 27th, 2021, and was instrumental in implementing the program by working with members of the Authority and the Industrial Commission to support research, development, and technological advancements that reduce environmental impacts and increase sustainability of energy production; and

Whereas, Al has a distinguished career serving North Dakota and the United States, beginning with his service in the United States Marine Corps from 1973-1977, and continuing with over 30 years serving the energy industry in the private sector and 5 years as director of the North Dakota Department of Commerce; and

Whereas, Under Al's leadership, the Clean Sustainable Energy Program has funded 11 projects which will make North Dakota a world leader in the production of clean sustainable energy, and will diversify and grow North Dakota's economy; and

Whereas, These 11 projects at completion would represent an amount of carbon capture that would be equal to over 1/3 of North Dakota's annual production, and have already resulted in the capture of over 1 billion cubic feet of natural gas which would have otherwise been flared, yielding over $30 million in additional tax revenues to the State that would have otherwise been lost; and

Whereas, Al has announced his intention to retire effective July 1, 2023.

Now, therefore, the North Dakota Industrial Commission hereby expresses deep gratitude to Al Anderson for his service to the citizens of North Dakota and wishes him the very best in his retirement.

Adopted this 29th day of June, 2023.

OFFICE OF THE INDUSTRIAL COMMISSION

Ms. Karen Tyler presented for consideration of approval the May 25th, 2023, Industrial Commission meeting minutes.

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approve the May 25, 2023, Industrial Commission meeting minutes.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

Ms. Tyler presented for consideration of approval the executive salary adjustments pursuant to legislative recommendation.

The memo reads as follows:

"Senate Bill 2015 adopted by the 2023 Legislative Assembly states in part:
The 2023-25 biennium compensation adjustments for permanent state employees are to average 6 percent per eligible employee for the first fiscal year of the biennium and are to average 4 percent per eligible employee for the second year of the biennium. The increases for the first year of the biennium are to be given beginning with the month of July 2023, to be paid in August 2023, and for the second year of the biennium are to be given beginning with the month of July 2024, to be paid in August 2024. Increases for eligible state employees are to be based on documented performance and are not to be the same percentage increase for each employee.

The Industrial Commission Agency Directors continue to lead with excellence and a dedicated commitment to serving North Dakota citizens and businesses, and supporting the Industrial Commission in executing on its vast portfolio of responsibilities. I am recommending the following salary increases effective July 1, 2023:

	Current	**6%**	**New**
DeAnn Ament	128,503	7,710	136,213
Dave Flohr	153,690	9,222	162,912
Lynn Helms	276,271	16,576	292,847
Vance Taylor	358,378	21,503	379,881

Regarding the Interim Executive Director salary, my current compensation from the Industrial Commission is $60,000. A 6% increase is $3,600.

Respectfully submitted for your consideration,
Karen Tyler"

It was moved by Commissioner Goehring and seconded by Attorney General Wrigley that the Industrial Commission approve the 6% salary increases for Industrial Commission executives as approved by the Legislature for the first fiscal year of the 2023-2025 biennium, and as recommended by the Interim Executive Director.

On a roll call vote, Governor Burgum, Attorney General Wrigley, and Commissioner Goehring voted aye. The motion carried unanimously.

With no further business, the Industrial Commission meeting adjourned at 5:30 p.m.

The next meeting is scheduled for Thursday, July 27th, 2023 at the Bank of North Dakota Conference Room.

North Dakota Industrial Commission

Karen Tyler, Interim Executive Director