Carbon Capture and Storage at Basin Electric

Reliable Power

Basin Electric’s mandate is to provide reliable, safe, and affordable electricity to its members. Coal generation provides our membership with steady, reliable power with a fuel source that is located at the plant site. Carbon dioxide is a byproduct of fossil fuel combustion, whether from coal or natural gas. In addition to diversifying our electric generation portfolio with renewables, Basin Electric has made a responsible decision to put resources into figuring out how to capture and store carbon dioxide to ensure reliability while reducing emissions.

Basin Electric has 20 years of experience and knowledge gained in carbon dioxide capture through Dakota Gasification Company’s Great Plains Synfuels Plant. The project there was the first commercial-scale project to capture carbon dioxide from a coal facility and transport it for beneficial use. As of November 2020, the plant has captured 41 million metric tons of carbon dioxide since 2000. The plant captures about 2 million metric tons of carbon dioxide per year.

Why Dry Fork Station?

Dry Fork Station is Basin Electric’s newest coal plant, having begun operation in 2011. As the most up-to-date facility, it represents the best option for initial investment in new technologies.

Also, it was the site chosen as host site for the NRG COSIA Carbon XPRIZE competition, and where the Wyoming Integrated Test Center was therefore located. The Wyoming CarbonSAFE project was also chosen to move forward at Dry Fork Station.

Key Quotes

“We are conscientious stewards of the environment we all share. We are also innovation leaders in our industry, in that we are tackling the challenge of decarbonizing the economy through partnerships with federal and state governments, research centers, scientists, private companies, and universities. Our decarbonization efforts will focus, as our previous efforts in reclamation and other environmental initiatives did, on being conscientious stewards of the environment as well as our members’ capital.” - Todd Telesz, Basin Electric CEO and general manager

“We believe in an all-of-the-above energy strategy at Basin Electric, and research like this will help us learn whether carbon capture is an investment our membership will want to make. The Dry Fork Station is our newest power plant, and it made the most sense to continue with the research on that plant site. ... We’re involved in these projects (ITC and CarbonSAFE) to educate ourselves, not only about capturing and storing carbon dioxide generally, but also specifically for the Dry Fork Station.” - Jim Sheldon, Basin Electric supervisor of reliability and performance engineering

Wyoming Integrated Test Center

The Wyoming Integrated Test Center is a research hub located at Dry Fork Station for carbon capture technology research. It was the host site for the XPRIZE competition (which concluded in April 2021), and also for researchers outside of that competition. Wyoming ITC was funded largely by the State of Wyoming, and includes partnerships with Tri-State Generation and Transmission Association, National Rural Electric Cooperative Association, and Basin Electric.

Funding

The Wyoming ITC has surpassed $100 million in research and development funding, with a large portion coming from the U.S. Dept. of Energy (including $52 million from the Dept. of Energy in June 2021). Other investors include Membrane Technology and Research, the Government of Japan, and XPRIZE which included academic and private funding.
Status of Pilot Project and Recent Milestones

- As of July 27, 2021 Membrane Technology and Research (MTR) is the sole organization conducting research in the large test center. MTRs technology involves polymeric membrane technology which targets capturing 70% of the carbon dioxide from the flue gas stream.

- This pilot project consists of final design, procurement, and construction of an MTR carbon dioxide capture plant to prove the technology. The temporary equipment will be built at a size of 10 megawatt equivalent stream of flue gas from Dry Fork Station.

- This is considered Phase 3. Basin Electric has no contractual relationship or obligation associated with this phase, and is not involved in the design associated with this phase.

- The 10 megawatt pilot plant which will be built, operated for about a year, and then torn down, will use the space in the large test center of the ITC. (If the full-scale carbon capture equipment were to be built in the future, it would occupy the same space that the 10 megawatt temporary equipment will use.)

- The equipment used to prove this carbon dioxide capture technology is expected to reach the milestone of initial operation in 2023.

- Once operating, the demonstration is expected to operate for about a year to gather information and meet objectives proving the technology before it is dismantled.

TDA Research

TDA was the first tenant in the large bay at the Wyoming Integrated Test Center. TDA arrived on site in October 2019 to test a novel hybrid carbon capture system, which incorporates membrane and solid sorbent technologies to remove carbon dioxide from flue gas. The membrane removes about half of the carbon dioxide, with the remaining carbon dioxide being removed, or absorbed, by the sorbent. The sorbent is regenerable, meaning that it can be repeatedly used to process flue gas.

Although they completed a test campaign with their large demonstration system in 2020, they have another system at the Wyoming ITC they are testing, which started in spring 2021.

Membrane Technology and Research is partnering with TDA Research on the membrane technology for their system.

Membrane Technology and Research Full Scale FEED Study (Wyoming ITC)

By spring 2022, Basin Electric will have an estimated cost for commercial-scale carbon capture technology at Dry Fork Station via a FEED (front-end engineering and design) study being conducted by Membrane Technology and Research (MTR).

Funding

MTR was awarded $5.1 million by the U.S. Dept. of Energy on Sept. 23, 2019. Basin Electric provided a letter of support providing a host site for the FEED study along with commitment to provide $560,000 cash or $720,000 of in-kind cost contributions.

Status of Full–Scale Project and Recent Milestones

- This is considered Phase 2. Basin Electric is regularly involved in the design associated with the full–scale FEED study occurring now.

- MTR is compiling a full-scale FEED study. This study will give stakeholders a solid idea of the cost of implementing the project at the size needed to capture all the carbon dioxide from the flue gas of Dry Fork Station. The phase is expected to be completed in spring 2022. At that point, Basin Electric will have an estimated cost for commercial-scale carbon capture technology at this location.

- Ideally, the final design, construction, and demonstration of the pilot plant would have been completed prior to the start of the full–scale FEED study to incorporate lessons learned into the scaled up design and cost estimate. However, given the timing of the Dept. of Energy Funding Opportunity Announcements (FOAs), MTR was awarded two FOAs in such a way that the full scale FEED study will be complete prior to the pilot plant being constructed.
Wyoming CarbonSAFE

Wyoming CarbonSAFE is a carbon storage research project implemented by the University of Wyoming’s School of Energy Resources (SER) and partners. The project has found that carbon dioxide can be stored underground near Dry Fork Station permanently, securely, and practically (cost-effectively).

**Funding**

Phase III of Wyoming CarbonSAFE was approved in April, when SER and its partners received a $15.4 million award from the U.S. Dept. of Energy (DOE). In addition, Basin Electric’s cost–share commitment is budgeted at $300,000 of in-kind and $1.2 million cash (each year of the three-year period, Basin Electric provides $100,000 of in-kind contributions and $400,000 cash). University of Wyoming’s cost-sharing contribution is $2.4 million. One partner, Schlumberger Global Energy Services and Equipment, is funding software and North Dakota’s Energy and Environmental Research Center is providing $615,000.

**Status of CarbonSAFE Project and Recent Milestones**

- Wyoming CarbonSAFE was launched in 2016. DOE determined the project had the merit and support to move to Phase II in 2018 and Phase III in 2020.
- Phase I: pre-feasibility study to determine whether there were any obstacles to project success
- Phase II: site characterization; a 9,800-foot well was drilled to study four different geological formations; a 3-D seismic survey was conducted to study the subsurface away from the well
- Phase III: finalizing site characterization, permitting wells for carbon dioxide storage, integrating carbon capture technology from Wyoming ITC (working with MTR), and environmental analysis for commercial operation
- Phase IV: would begin in 2023 if approval is granted to drill monitoring wells and inject carbon dioxide; Basin Electric would need to opt to go forward with another phase of the project, and also future federal funding would need to be granted.
- There is potential to utilize 45Q tax credits with this project.

Dakota Carbon Pipeline

The pipeline will carry carbon dioxide from the Great Plains Synfuels Plant to underground storage near the plant. Permits have been approved by the North Dakota Public Service Commission. Basin Electric’s board approved the project for construction at its September 2021 meeting. The pipeline will provide a path for 45Q tax credits as well. 45Q is Internal Revenue Service’s tax credit for carbon sequestration projects.

**Funding**

The pipeline provides a path to utilize the 45Q tax credit for carbon capture, utilization, and sequestration projects. Pipeline construction will begin fall 2021 and be completed by second quarter of 2022.

**Status of Dakota Carbon Project and Recent Milestones**

- On July 28, 2021, the pipeline received the Certificate of Corridor Compatibility and Route Permit.
- After board approval in September, construction will begin fall 2021 and be completed by second quarter of 2022.
- A storage facility permit from the North Dakota Industrial Commission will be required for the proposed injection well sites and storage reservoir at a later date. A test well was drilled in June and July 2021 on The Coteau Properties Company’s land to gather more information for the well permit application.

North Dakota CarbonSAFE

Basin Electric was part of the North Dakota CarbonSAFE project through Phase II. That project researched the feasibility of carbon dioxide storage underground near Golden Valley and Center, North Dakota. Basin Electric decided not to move forward with support of Phase III of that project because Wyoming CarbonSAFE project was more likely to yield promising results for the cooperative. Minnkota Electric Cooperative did move forward with support into Phase III as part of Project Tundra.
Antelope Valley Station FEED Study

Basin Electric worked with a third-party developer on a study into carbon capture at our Antelope Valley Station. In December 2010, Basin Electric’s board determined the cost of such innovation was much too costly for our membership. (The study indicated a demonstration-scale project which would capture 25% of the CO2 from the flue gas, and cost as much as $500 million.)

The FEED study, on which work began in February 2010, was conducted in conjunction with HTC Pureenergy of Regina, Saskatchewan, Canada. The cost of the FEED study was $6.2 million; about half ($2.7 million) was funded by the North Dakota Industrial Commission, with the rest funded by Basin Electric.

Carbon Dioxide Capture and Storage Research

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BASIN ELECTRIC/DYK FOK STATION
BASIN ELECTRIC/GREAT PLAINS SYNFRUELS PLANT
MINNKOTA POWER/MILTON R. YOUNG STATION