NRECA
America's Electric Cooperatives

Update on the Wyoming Integrated Test Center (ITC):

DOE Awards Funding to Test New Carbon-Capture Membrane Process

Key Highlights

- Department of Energy awarded $13 million to the Gas Technology Institute (GTI) to test a new hybrid carbon capture membrane.
- The membrane developed by Ohio State University, consists of three layers and will improve two desirable membrane features: selectivity and permeability.
- Small pilot-scale testing at the ITC is expected to begin in late 2021, after GTI has built, permitted, installed and commissioned the system.
- The goal of testing — which will be conducted for a minimum of 2 months — is to demonstrate that the membrane process meets DOE's performance goal for carbon-capture technologies: a 90% capture rate with 95% purity at a cost of no more than $40 per tonne of capture.

What has changed?

In the past 10 to 15 years, various types of membranes have been developed and tested for their ability to capture CO_2 from the post-combustion flue gas of fossil fuel-fired power plants. The membrane separation process is considered one of the most promising methods for post-combustion CO_2 capture from these power plants.

The membranes tested have consisted of either thin layers of either polymer materials (organic, plastic) or inorganic materials (metal, ceramic). While polymer membranes can be mass produced and are very cost-effective, inorganic membranes are expensive to produce but exhibit much better performance.

The challenge has been to develop a membrane that is both effective and economical. That has now been done.

To test a new hybrid membrane process, the Gas Technology Institute has received total project funding of $16.25 million; GTI has received $13 million through a DOE investment program, as well as an additional $3.25 million in non-federal funding provided as in-kind cost share by the Wyoming Integrated Test Center (ITC). The membrane, developed by the Ohio State University (OSU), is scheduled to begin small pilot-scale testing at the ITC in the 4th quarter of 2021, after GTI has built, permitted, installed and commissioned the system. The project brings together OSU's new hybrid membrane and GTI's process experience.

What is the impact on electric cooperatives?

Carbon capture research at the ITC, supported by NRECA, is aimed at exploring innovative ways of reducing carbon dioxide emissions. Breakthroughs, such as the GTI carbon capture process based on OSU's hybrid membrane, can offer new options for cooperatives with coal and gas fired power plants. The Wyoming ITC is continuing to find ways to reduce Carbon Capture cost and ultimately the levelized cost of energy subject to carbon capture technology.

What do cooperatives need to know or do about it?

This novel membrane system has the potential to provide a cost-effective way for co-ops with both coal- and natural gas-fired power plants to significantly reduce their carbon emissions. It would be beneficial for cooperatives to learn more about the GTI project and watch for test results.

The membrane material represents the "next generation" that will improve two desirable features: selectivity and permeability, said Dr. William (Will) Morris, an expert in CO_2 capture technologies with a PhD in chemical engineering. Dr. Morris is a consultant to NRECA's Business and Technology Strategies Department's Generation, Environment and Carbon work group. Permeability determines how much of the target is pushed through the membrane and how easily the membrane differentiates between the gasses, he added.

The membrane, which combines the advantages of membrane gas separation and solvent absorption, consists of a thin layer of "zeolite Y" — a particularly effective synthetic filtering material — sandwiched between an inorganic intermediate and a polymer cover. These three layers sit atop a polymer support, which in turn rests on a woven backing. The result combines the separation performance of inorganic membranes with the cost-effectiveness of polymer membranes.

One goal is to scale-up the research to a project that is 18 times the size of the bench-scale laboratory work. When the project reaches demonstration scale, the goal is to capture carbon dioxide from a 100 MW power plant or equivalent slip stream. The testing also seeks to demonstrate that the process can use different types of coal. Initially, testing will use flue gas from the combustion of Powder River Basin coal.

Another goal is to achieve a purity of at least 95% for the captured CO_2, because demand for quality carbon dioxide is growing in the oil, chemical and food industries. "The carbon dioxide produced by other membranes may need additional cleaning to bring it to pipeline quality," said Morris. "That can be expensive." With the hybrid membrane process being developed by OSU and GTI, such cleaning will not be needed.

In earlier testing at DOE's National Carbon Capture Center, the process used commercial size 8-inch diameter modules on a 0.5 MWe equivalent of coal-derived flue gas. The membrane process demonstrated 90% CO_2 capture with CO_2 purity greater than 97%.

At the ITC, continuous steady-state testing will be conducted for a minimum of 2 months to collect data needed for further process scale-up. A techno-economic analysis and an environmental health and safety assessment will be conducted to validate the potential of the membrane process to achieve DOE's performance goals of a 90% capture rate with 95% purity at a cost of no more than $40 per tonne of capture.

More Information on Research at the ITC

Additional information about the Wyoming ITC can be found on NRECA's website cooperative.com: https://www.cooperative.com/programs-services/bts/Pages/Wyoming-Integrated-Test-Center-Carbon.aspx

NRECA is monitoring activities at the Wyoming ITC and will continue to provide updates to benefit our members. Our next *NRECA Advisory* will discuss DOE cost-shared funding to support the development and advancement of carbon capture technologies. Awards have been made to nine new projects — including this GTI project — for coal and natural gas power and industrial sources.

Contacts for Questions

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