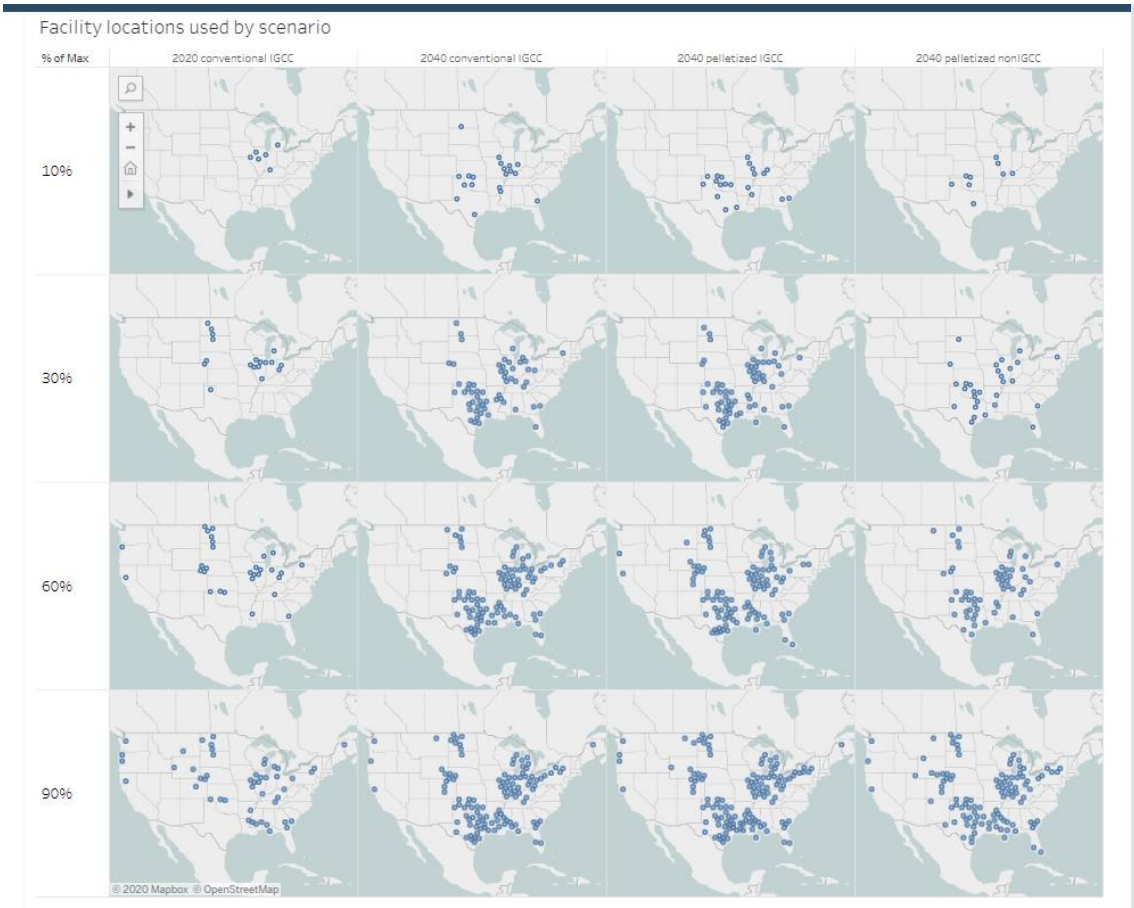
Bioenergy, carbon capture combo could cost-effectively mitigate carbon dioxide

Media Contact: Stephanie Seay, 865.604.3384, seaysg@ornl.gov



An interactive visualization shows potential progression of BECCS to address carbon dioxide reduction goals. Credit: ORNL, U.S. Dept. of Energy

The combination of bioenergy with carbon capture and storage could cost-effectively sequester hundreds of millions of metric tons per year of carbon dioxide in the United States, making it a competitive solution for carbon management, according to a new analysis by Oak Ridge National Laboratory scientists.

Bioenergy with carbon capture and storage, or BECCS, uses carbon absorbed by plants from the atmosphere to create energy. Carbon dioxide is captured during the conversion process — such as electricity generation or biofuels production — and stored underground. The result is a negative-emissions technology.

The ORNL analysis published in the journal *Land* confirmed that the approach can sequester from 200 million metric tons per year of CO_2 in the near term to more than 700

million tons per year by 2040. The study pegged the cumulative potential of CO_2 sequestration in the United States at 46 billion tons by the year 2100 using BECCS. This represents 4% to 30% of global CO_2 sequestration that could be needed by BECCS by 2100 as outlined in various scenarios by the Intergovernmental Panel on Climate Change, IPCC 2018 report.

BECCS is one solution to achieving a limit of a 1.5 degrees Celsius global temperature increase cited by the IPCC, which the panel says is necessary to avoid the most far-reaching impacts of environmental change. BECCS is also cited as part of the solution in a 2018 report of the National Academies Press.

“The research is aimed at improving our understanding of BECCS and informing potential strategies to deal with environmental issues,” said ORNL lead investigator Matthew Langholtz.

The ORNL team set out to explore the supply and costs of BECCS under a range of biomass options, logistics and power generation scenarios. The BECCS model examined near-term and long-term biomass supply scenarios, using both conventional and pelletized biomass, and two power generation technologies.

Under a near-term scenario using up to 206 million tons per year of biomass, as much as 181 million tons CO_2 can be sequestered annually at average costs ranging from $62 to $137 per ton, the scientists found. Under a long-term scenario using up to 740 million tons per year of biomass, as much as 737 million tons CO_2 can be sequestered annually at average costs ranging from $42 to $92 per ton.

The team’s results suggest there are large-scale opportunities to implement BECCS at moderate cost across the country, particularly in the Midwest, southern Great Plains and Texas. The model found BECCS has the potential to reach 20 gigawatts of power generation capacity in the United States, representing about 5% of the nation’s current electric generation capacity.

These estimates may be reduced if future competing demand reduces biomass availability, or could be magnified if demand for renewable energy increases, according to the analysis.

“With full accounting, the model found that BECCS is more cost competitive than previously anticipated,” Langholtz said. “BECCS produces electricity, for instance, and that generates revenue to be taken into account. You’re producing electricity in a way that both sequesters CO_2, and avoids CO_2 emissions compared with conventional power sources.”

The work drew on multiple disciplines across ORNL, including expertise in biomass

feedstocks, transportation supply chains, data analytics, electric demand and power plant modeling, carbon capture analysis and geological reservoir assessment. Data from the ORNL-produced *Billion Ton Report, Vol. 2*, which analyzes possible environmental effects associated with the potential production of at least 1 billion tons of nonfood biomass per year by 2040, informed the study.

The ORNL research team included Ingrid Busch, Abishek Kasturi, Michael Hilliard, Joanna McFarlane, Costas Tsouris, Srijib Mukherjee, Olufemi Omitaomu, Melissa Allen-Dumas, Christopher DeRolph, Maggie Davis, Esther Parish and Susan Kotikot.

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