Carbon capture could be a financial opportunity for US biofuels

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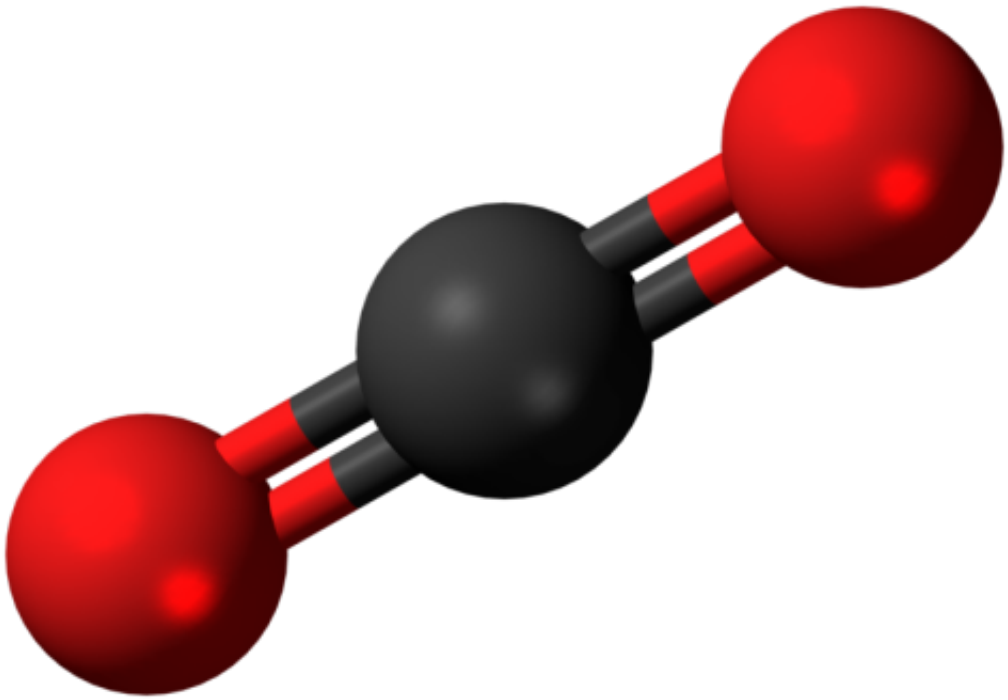

Ball-and-stick model of carbon dioxide. Credit: Wikipedia

Although considered critical to avoiding catastrophic global warming, the feasibility of removing carbon dioxide from the atmosphere and storing it underground - known as negative emissions - has been in question.

"There's really no scenario that meets the world's climate goals without negative emissions," said Katharine Mach, a senior research scientist at Stanford's School of Earth, Energy and Environmental Sciences. "But most technologies for carbon removal are immature, largely unavailable or expensive."

But researchers at Stanford and other institutions have found new hope for cost-effective carbon capture and sequestration (CCS). Their study, published April 23 in *Proceedings of the National Academy of Sciences*, runs the numbers on different options for removing carbon dioxide from the atmosphere in the U.S. and finds opportunities where it is not only commercially feasible with existing technology, but profitable.

Plants do the work

The most widely discussed strategy for removing carbon dioxide from the atmosphere involves growing plants, which absorb CO_2, as a first step. Those plants can then be processed to produce energy, and any resulting CO_2 emissions from that energy production would be captured and stored underground.

While it seems straightforward, these technologies - known as bioenergy with carbon capture and sequestration, or BECCS - have not been fully developed and many areas don't have geology that's suitable for storing CO_2. What's more, pipelines would need to be built to take CO_2 from bioenergy plants to areas suitable for storage. There are also serious questions about how BECCS would scale globally and compete with plants grown for food production or impact ecosystems and biodiversity.

However, the group found that one type of BECCS technology could work immediately for U.S. ethanol producers. What's more, given current and predicted future financial incentives, the approach could even turn a profit.

"We found that between tax credits for CCS and upcoming financial incentives from low-carbon fuel standards, CCS is an untapped financial opportunity for ethanol producers across the U.S.," said Daniel Sanchez, a postdoctoral scholar with the Carnegie Institution for Science and lead author on the paper.

The United States is the largest producer of ethanol in the world, producing 15.8 billion gallons in 2017. Ethanol is made by fermenting biomass such as corn, which produces a high-purity CO_2 by-product that is easier and cheaper to capture, compress and inject underground than other emitted sources of CO_2. Right now, these emissions are largely vented to the atmosphere in the process of making ethanol.

"Negative emissions at biorefineries is commercially ready and affordable. It offers a compelling way to build the real-world experience we need to develop future BECCS technologies," said Mach.

Financial incentives

The researchers estimate that 60 percent of all CO_2 emitted annually through the production of ethanol at the country's 216 biofuel plants (about 1 percent of all CO_2 emissions from the U.S.) could be captured at low cost, under $25 per metric ton of CO_2.

Further, if credits for captured CO_2 were set at $60 per metric ton, it could incentivize sequestration of 30 million metric tons of CO_2 each year that are otherwise vented into the atmosphere - equivalent to emissions from powering 3.2 million homes for one year - and pay for the construction of 4,300 miles of pipeline infrastructure needed to transport the CO_2 for storage at appropriate sites across the country.

These incentives are in line with new tax credits included in the Bipartisan Budget Act of 2018 signed by the president in February. The

bill amended section 45Q of the tax code so that power plants or CO_2-emitting facilities are eligible for tax credits for captured CO_2 for up to 12 years.

"There are many ways to incentivize and unleash negative emissions technologies, one of which this administration and Congress may have just put into place," said Mach.

Another financial incentive comes in the form of low-carbon fuel standards, such as those implemented in Oregon, California and British Columbia. It works by giving tradeable credits for fuels that exceed the standard and deficits to those who don't.

Right now, accounting for CCS isn't included in the standards, but on April 27, California will consider updating its rules to include new protocols that would quantify the value of carbon removal in the fuel production process. If adopted, fuel producers could collect more credits by selling lower-carbon ethanol in California.

"This is an opportunity not only for biofuel producers to make profits, but also for CCS technology to be more widely piloted and developed. This is an essential first step if we're going to deploy carbon removal at levels necessary to keep dangerous climate change in check," said Sanchez.

More information: Daniel L. Sanchez el al., "Near-term deployment of carbon capture and sequestration from biorefineries in the United States," *PNAS* (2018). www.pnas.org/cgi/doi/10.1073/pnas.1719695115

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