Going negative: Removing carbon dioxide from the atmosphere

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Combining bioenergy with carbon capture and storage at a coal-burning power plant would result in a net-negative reduction of atmospheric CO2. Credit: Courtesy of U.S. Geological Survey

To combat climate change, President Obama has called for an 80 percent reduction in carbon dioxide (CO2) emissions by 2050. To help

achieve this goal, the President has encouraged big investments in wind, solar and other renewable forms of energy.

But a growing number of scientists warn that low-carbon technologies might not be enough to meet the President's 80 percent target. The solution, they say, could require a new suite of carbon-negative technologies that actually remove CO2 from the atmosphere.

This negative-emissions approach to reducing atmospheric CO2 will be the focus of a symposium at the 2015 annual meeting of the American Association for the Advancement of Science (AAAS) on Feb. 14, at the San Jose Convention Center.

"Renewables - such as solar, wind, hydro and bioenergy - and sequestration technologies, like carbon capture and storage (CCS), could help curb CO2 emissions," said symposium organizer Jennifer Milne, an energy assessment analyst at the Global Climate and Energy Project (GCEP) at Stanford University. "To augment these, technologies exist that remove atmospheric CO2 and potentially keep it out of the atmosphere. These negative-emissions technologies have benefits and downsides, and vary drastically in predicted cost."

In 2013, Milne and Stanford Professor Chris Field co-authored a GCEP report on negative emissions. Featured in the report is a promising technology called bioenergy with carbon capture and storage (BECCS). The BECCS approach can be used in power plants that generate electricity or factories that make chemicals and fuels.

Power plants fueled by coal and natural gas are among the world's biggest emitters of CO2. Several CCS projects are underway to capture the CO2 emissions before they enter the atmosphere and store them permanently underground.

BECCS goes a step further by taking advantage of the innate ability of plants to capture atmospheric CO2 for photosynthesis. In nature, the CO2 is eventually released back into the atmosphere as the plant decays.

At a BECCS facility, grass and other vegetation is burnt along with coal or natural gas. The CO2 emissions are captured and sequestered in the ground instead of going into the atmosphere, thus bypassing the decaying process. The result is a net-negative reduction in atmospheric CO2.

A number of technical and policy issues have to be addressed before BECCS can be implemented at scale. Some of the key challenges will be discussed by symposium speakers Peter Smith of the University of Aberdeen, Jennifer Wilcox of Stanford and James Edmonds of the Joint Global Change Research Institute.

Lisamarie Windham-Myers of the U.S. Geological Survey will compare BECCS with other land-management techniques - such as wetland restoration and sustainable agriculture - that could lead to the large-scale removal of atmospheric carbon as well as other environmental benefits. Peter Byck of Arizona State University will describe a sustainable ranching project that restores grazing land while soaking up atmospheric CO2.

Ken Caldeira of the Carnegie Institution's Department of Global Ecology at Stanford will discuss the physical science of negative emissions and their impact on the global carbon cycle.

"Negative-emissions technologies, such as BECCS, can be thought of as part of an insurance policy for climate-change mitigation," wrote symposium moderator Sally Benson, a professor of energy resources engineering at Stanford, in a 2014 guest editorial in the journal Science. "This approach still leaves unanswered questions, but to not consider it carefully would be too risky."

More information: Additional information about the symposium is available at the AAAS website: aaas.confex.com/aaas/2015/webp … ram/Session9663.html

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