RealClear Energy

Is Carbon Capture Big Oil's Next Pay Day?

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July 09, 2024

https://www.realclearenergy.org/articles/2024/07/09/is_carbon_capture_big_oils_next_pay_day_1043389.html

THE PROPOSAL

Carbon capture and storage — the concept of sucking carbon dioxide (CO_2) from the atmosphere and storing it underground — is being considered as a way to reduce greenhouse gases. It's been suggested that such technology is a way to buy time while the world transitions away from fossil fuels to renewable energy. It's discussed as a possible way to stall global warming.

There is theory, and then there is reality.

OUR OPINION

Sucking CO_2 from the atmosphere is not a magical solution, as some have made it out to be. Operating carbon capture technology at a scale that would have a meaningful impact on the climate crisis, which is trending toward catastrophic impacts, would be a trillion-dollar endeavor annually — even in a best case scenario in which projects stay on budget, on schedule and the technology can both effectively work to capture and store emissions for the long term. In a worst case scenario, a lot of time and money can be wasted on an ineffective process that does little to nothing to reduce emissions, while polluters continue producing fossil fuels under the guise that their emissions are accounted for elsewhere.

The reality is that a serious approach to carbon capture with serious emission reductions in mind would involve huge capital outlays, huge electrical power consumption, and it would take decades to have any measurable effect on the amount of carbon dioxide in the atmosphere, if it worked at all. Not to mention the very real reason for concern if Big Oil is running the show. The fossil fuel industry — the sector most responsible for human-driven climate change — has sought to lead the charge of the budding carbon capture and storage industry in an effort to simultaneously rectify a polluting image and create a way to continue production of fossil fuels.

This path is not viable. It's not reasonable or responsible to distract from other emissions reduction strategies by entertaining the far-off potential of large-scale carbon capture to save the climate. Here's why:

THE COMPLEXITIES

Direct air capture is technically challenging. First, selectively capturing carbon dioxide molecules among the billions of other, more abundant, molecules found in air (including oxygen, O_2, ozone, O_3, nitrogen, N_2, sulfur and others) is difficult to begin with. Then there is the magnitude of the problem. At present, the atmosphere contains over 3,300 billion metric tons of CO_2, plus smaller quantities of other greenhouse gases — removing them would require an operation on a massive scale to have a meaningful impact and require power at an immense scale as well. Finally, CO_2 concentration in the atmosphere is about 0.04%. If the removal process was 100% efficient — an optimistic assumption — it would be necessary to process 2,500 tons of air to capture one ton of CO_2. Air movement would require considerable energy. Three physical processes might be deployed to capture CO_2. They are adsorption, absorption and membranes. Power will be required for pumping and compressing air or gas containing CO_2, and for extracting concentrated CO_2, and finally, it must be stored in some manner forever, such as in depleted oil fields or other underground strata, and this takes even more energy to accomplish.

Carbon capture will require large amounts of electricity — estimated as 2,500 kWh per metric ton of CO_2 or more. The end product is to obtain a concentrated stream of CO_2. Then, by various methods, the concentrate can be converted to a carbonate or methanol or used for enhanced oil recovery. Depending on the final process, additional energy and expense is required for pumping, storage, injection wells and other plant operations. Moving and eventually storing vast quantities of a dilute gas or liquid will require giant fans, huge pumps, and other equipment. The success of the concept depends on having large supplies of renewable energy for operation, rather than fossil fuels.

At a smaller scale, there may be some value in strategically sited carbon capture projects (if they were part of a more comprehensive emissions reduction strategy working to eventually end fossil fuel production): A variation on air capture can be used to extract CO_2 from existing power plant exhausts. Capturing carbon in this way would be easier to achieve because the exhaust from a modern gas-fired power plant is about 4 to 5% CO_2, which is 100 times greater than the atmosphere. Coal-fired power plant exhaust contain about 15% CO_2. Several pilot plants are using this approach.

PILOT PLANTS

The first plant, known as Orca, was developed by a company called Climeworks and opened in Iceland in 2021. This plant has the added advantage that it is powered by geothermal energy, so it does not release greenhouse gases during operation. It has capacity for capturing 4,000 metric tons of CO_2 per year at a recovery cost of $600-$800 per metric ton. At this plant, captured gas is bubbled into water and injected underground, where it hardens into stone. Climeworks recently announced the construction of a second plant in southern Iceland with capacity to capture 36,000 metric tons of CO_2 per year when completed. After collecting and sequestering the CO2, Climeworks sells "offsets based on that captured carbon," to those looking to make up for a significant carbon foot print.

Currently a larger plant with capacity of 500,000 metric tons of CO_2/year and a construction cost of $1.1 billion is being constructed by Occidental Petroleum — yes, an oil company — in the Permian basin area of Texas and is tentatively named *Stratos*. Occidental will be using $1.2 billion from the Biden administration's Inflation Reduction Act for "direct air

capture projects." Occidental's estimate is that it currently costs $500 to $1,000 to capture one metric ton of carbon dioxide. Occidental Petroleum CEO Vicki Hollub described the proposed plant: Captured CO_2 would be injected deep into underground reservoirs (former oil fields), where, in theory, it would be trapped and could potentially form new carbonate minerals. The carbon dioxide also could be sold to companies manufacturing plastics or synthetic fuels, or alternatively, it could be injected to produce more oil and gas from old wells. Hollub defended the idea of using captured CO_2 to produce more fossil fuels, claiming that there would be no net increase in CO_2 emissions, since the greenhouse gases released by the new fossil fuels production would be offset by the amount being removed from the atmosphere.

At 2,500 kWh/mtCO_2, the *Stratos* plant would require 2 650-MW solar farms, at an approximate cost $2.5 billion each, just to capture CO_2, not including storing it underground. Occidental says it plans to build 130 plants by 2035. Occidental is not alone: Chevron, Exxon and BP are all investing in carbon capture.

A more important question is: How effective would direct air capture plants be in reducing the burden of greenhouse gases currently in the atmosphere? One part per million (ppm) of CO_2 in the atmosphere equals 7.8 billion metric tons of CO_2. To reduce atmospheric CO_2 by *just 1 ppm* would take 15,800 of Occidental's Stratos plants, an investment of $17 trillion. For context, this sum is greater than the net worth of all the major oil companies. Last year, global emissions of carbon dioxide exceeded 40 billion metric tons. Using the most optimistic estimate of capture cost — $500 per metric ton — it would cost an estimated $20 trillion in operating expense to remove one year's emissions.

A BETTER ALTERNATIVE

Why spend so much money to remove CO_2 from the atmosphere, when we could just not put it there in the first place? Why not charge a fee to polluters for putting it there, rather than allowing polluting to be free and removing emissions to be cost-prohibitive at scale? About 50 countries have instituted some form of a carbon tax, which is a fee charged to entities that emit carbon dioxide in the course of their operations. Carbon taxes in existence today range from $1 per metric ton to $100 per metric ton. One might reasonably ask, wouldn't it make more sense to spend $100 dollars to prevent carbon from going into the atmosphere, as opposed to spending $5,000 to take it back out again? You can guess the answer: This measure has historically been bitterly opposed by oil companies.

PAYDAY

Shell and other oil companies are embarking on similar projects, planning to rebrand themselves as "carbon capture" companies, although they will actually continue to produce and profit from fossil fuels. Critics claim that this is a move to sidetrack efforts to reduce fossil fuel use. Occidental says, "selling CO_2 and carbon credits could become a billion-dollar business" and "could save our industry." Yet, Professor Mark Z. Jacobson of Stanford University describes proposals for carbon capture as a dangerous distraction, likely to do "more harm than good."

Given that globally scalable, reliable carbon capture technology is not a reality, attention paid to carbon capture promises from fossil fuel companies could not only worsen emissions but cost

us valuable time in the race to slow the worsening impacts of climate change. We should know better than to trust fossil fuel polluters with saving the planet.

Craig Smith and William Fletcher are co-authors of "The Global Climate Crisis: What To Do About It," published by Elsevier in March.

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