Carbon removal policies must consider full climate effects of CO_2 removal to meet climate goals, SFU-led study suggests

Carbon dioxide removal from the atmosphere is essential for limiting global warming levels but may also pose its own climate risks if a holistic, Earth system approach is not considered, a study led by Simon Fraser University finds. Given these risks, researchers say prioritizing emission reductions over removals is key.

A crucial component of the 2015 Paris Agreement, a legally binding international treaty on climate change, is the goal to limit average global temperatures increases to well-below 2°C above pre-industrial levels, and pursue efforts to limit global warming to 1.5°C above pre-industrial levels.

This requires reaching net-zero carbon dioxide (CO_2) emissions—a balance between CO_2 emitted into and removed from the atmosphere—by or around the year 2050, alongside deep reductions in methane and other emissions. It is often assumed that if such a balance is achieved, the net effect on the climate would also be zero.

Carbon dioxide removal (CDR) refers to sequestration of CO_2 from the atmosphere through deliberate human activities and storage it in terrestrial, ocean or geologic reservoirs. Examples include planting trees on previously deforested or unforested lands, sequestering carbon in agricultural soils, producing bioenergy and capturing and storing the carbon emissions, fertilizing the ocean to stimulate biological production, and capturing CO_2 directly from the air.

“A holistic estimation of the climate effects of CDR is required to ensure that achieving net zero has the intended effect of limiting warming” says Zickfeld, who is also director of SFU’s Climate Research Lab.

The study, published in Nature Climate Change, urges that climate effects of CDR beyond CO_2 sequestration must be considered, including permanence of CO_2 storage in trees and soils, changes in the reflectivity of landscapes, and the full suite of greenhouse gasses emitted into the atmosphere.

According to the study, for carbon dioxide removal efforts to balance the climate effects of CO_2 emissions, permanent carbon storage is required, meaning that stored carbon must remain undisturbed for hundreds to thousands of years.

“Carbon stored in trees is vulnerable to natural disturbances such as droughts, wildfires, and insect outbreaks, which are projected to become more frequent and severe in many regions as global temperatures continue to increase and could be re-released much sooner,” explains Zickfeld. “Carbon stored in seagrass meadows or mangrove forests can also be re-released following marine heatwaves.”

Some CDR approaches may also impact energy at the Earth’s surface when deployed at a large-scale, resulting in so-called “biogeophysical” effects on. Large-scale planting of trees in agricultural areas or grasslands, for instance, reduces how well the land surface can reflect sunlight, resulting in a warming effect.

According to Zickfeld, neglecting these effects can result in additional warming if CDR is used to balance fossil fuel emissions, potentially compromising the achievement of climate goals.

AVAILABLE SFU EXPERTS

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