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Ways to Reduce Atmospheric Carbon Dioxide

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Abstract:
Many experts and decision-makers have come to the conclusion that removing carbon from the atmosphere will be vital to maintain the increase in global temperatures below two degrees Celsius, as agreed upon in the Paris Climate Accord, as global carbon dioxide emissions continue to rise. In its fifth assessment report, the Intergovernmental Panel on Climate Change (IPCC) of the United Nations determined that many climate models can only achieve the two-degree Celsius target when carbon removal technologies are taken into consideration as feasible policy alternatives.

1. Introduction

The most straightforward method to limit climate change is to stop emitting greenhouse gases. The amount of greenhouse gases released into the atmosphere from a particular activity or region is reduced using emissions reduction measures. Reducing emissions could aid in preventing millions of premature deaths caused by air pollution over the course of the next century, according to a 2013 study funded by the National Institute of Environmental Health Sciences. In addition to enhancing general air quality and protecting human health, reducing carbon emissions is crucial in the fight against climate change.

There are a few other ways to lower the quantity of carbon in our atmosphere in addition to reducing emissions, which is ultimately accomplished by ceasing the use of fossil fuels. Yet there are several.**Methodology**

1.1 Carbon Dioxide Removal

Carbon dioxide removal (CDR) involves taking this greenhouse gas out of the atmosphere and storing it underground or under the ocean floor, ideally for a very long time. There are both nature-based and technology-based approaches to CDR.

The two main strategies for removing carbon from the atmosphere are tree planting and forest restoration or conservation efforts, and direct air capture (DAC), according to a World Resources Institute report released in 2020. Trees have been one of the best CDR tactics for thousands of years because of their ability to sequester and store carbon as long as they stay standing. Earth's forests have a net absorption of 7.6 billion metric tons annually, which represents about one-third of annual global emissions. DAC, on the other hand, vacuums carbon dioxide out of the air.

1.2 Direct Air Capture

DAC facilities use giant fans to suck carbon dioxide out of the atmosphere and either store it underground in geological formations, or reuse it (like for synthetic fuel and concrete). Carbon Engineering in Canada and Climeworks in Switzerland are two examples of companies developing this type of technology. Clime works has built the world's largest DAC plant in Iceland, which began operating in 2021. The facility, known as Orca, is capable of capturing 4,000 metric tons of carbon annually (equivalent to the emissions produced from 504 homes' energy use in one year) and pumping it underground where, when mixed with water, the gas will cool and turn into stone.
There are currently 19 DAC facilities operating around the world. The International Energy Agency states that an average of 32 large-scale plants need to be built annually between now and 2050 to reach global climate goals.

1.3 Carbon Sequestration

Carbon sequestration refers to how—through biological, chemical, and physical processes—carbon dioxide is naturally removed from the atmosphere and locked away in the planet's soils, oceans, trees, and rocks. For instance, as a tree grows, photosynthesis captures carbon dioxide from the atmosphere and stores it in the trunk, branches, leaves, and roots.

Carbon sequestration, however, also has its limitations. For instance, deforestation, wildfires, and other disturbances to the world's woodlands cause around 8 billion metric tons of CO2 trapped in trees to be lost, according to the Environmental Defense Fund. This is why strategies to slow climate change often involve an emphasis on stopping deforestation, restoring cleared areas, and enabling damaged woods to re grow.

Other limitations exist, as well. Global warming is already reducing the ocean's ability to absorb carbon. Additionally, carbon sequestration requires farmers to not till or plow their fields, disturbing the soil, because carbon dioxide that has been stored in the soil may be released back into the atmosphere, defeating the original purpose of keeping carbon dioxide out of the atmosphere. A shift to regenerative agriculture is occurring in some places of the world, which emphasizes the importance of soil health and adopting different practices so as to not disturb it.

1.4 Negative Emissions Technology

Carbon removal technologies are also referred to as negative emissions technologies (NETs). The potential of NETs to rapidly remove carbon dioxide on a massive scale is one key advantage in comparison to natural systems, which are slower to absorb carbon and sometimes face external threats (like wildfires).

However, while large-scale NETs are considered critical to meeting ambitious international climate change targets, these technologies still largely remain in the research and development phase, or are not yet scaled up. Facilities built so far remove just a tiny fraction of the carbon dioxide that scientists say is necessary to make a difference. But governments are getting behind these efforts. The U.S. Department of Energy announced in May 2022 that it would provide $3.5 billion to groups developing direct air capture and related technologies. In addition, the

U.K.'s Department for Business, Energy, and Industrial Strategy announced in July 2022 the equivalent of a $64 million investment in carbon removal technologies.

1.5 Carbon Capture and Storage

A close cousin to both carbon dioxide removal and carbon sequestration is carbon capture and storage (CCS), which involves, for example, capturing CO2 from point sources, like a coal plant's smokestack, and then permanently storing it underground or under the ocean floor; in fact, the International Energy Agency predicts that CCS could be responsible for removing as much as 20% of total CO2 emissions from industrial and energy production facilities. Removing carbon as soon as it is burned and either storing it underground or using it to improve oil and gas recovery is a more common and fully established approach than direct air capture.
But the implementation of commercial-scale CCS is costly, which creates a big barrier to widespread use. Additionally, "the deployment of CCS has been hindered by uncertainty in geologic storage capacities and sustainable injection rates," according to the scientific journal *PNAS*. Other reports note the problem of leakage of CO2 from stored carbon.

1.6 Carbon Stock Protection

Then there's the approach of carbon stock protection, which separates forest areas that should be preserved as High Carbon Stock (HCS) and High Conservation Value (HCV) from degraded lands with low carbon and biodiversity benefits that could be developed. In the context of wildlife survival and reducing carbon emissions, restoration efforts should strive to reduce net emissions of greenhouse gasses, maximize the capacity of habitats to store and reduce pollution, and preserve and enhance biodiversity.

2. Conclusion

Systems for removing carbon dioxide are practical, offer a number of advantages, and are advancing in both policy and research. The most crucial aspect of carbon removal systems is that they address climate change, one of the gravest challenges to the planet. To avoid the two degree Celsius threshold and a potential tipping point into a climate catastrophe, carbon removal must be incorporated into our policy measures.

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