



STATE OF THE SCIENCE

CARBON DIOXIDE REMOVAL'S ROLE IN ACHIEVING THE PARIS AGREEMENT'S GOALS



More than a decade's worth of research finds that carbon dioxide removal (CDR), which is removing carbon pollution from the atmosphere and safely storing it, will be necessary to achieve the goals of the Paris Agreement. Meeting the goals of the Paris Agreement and stopping the worst impacts of climate change raises important questions about the role of CDR, how much of it is required and when, and how it can be deployed responsibly. The Institute for Carbon Removal Law and Policy created a Science Primer on the state of CDR science, which is available online.

THE ROLE OF CARBON DIOXIDE REMOVAL IN MEETING THE PARIS AGREEMENT

There is no time left to waste in meeting the goals of the Paris Agreement. Climate pollution, or greenhouse gases that the world emits, will remain in the atmosphere even if the world stopped adding additional pollution today. Carbon dioxide (CO₂) emitted by human activity is already fueling the increase of extreme weather events and climate impacts around the world.

The world's carbon budget is running out. One comparison of CDR to the carbon budget is to consider the carbon pollution that the world is emitting now as garbage being added to a landfill. The world needs to stop adding more garbage, or carbon

pollution, to the landfill by rapidly deploying climate solutions like energy efficiency and solar panels. But even after no more garbage is added, there are still existing emissions (or garbage) that need to be addressed if the landfill is overflowing. CDR is a way of addressing all of the garbage in the landfill, including the legacy emissions that will continue to exist in the atmosphere and cause dangerous climate impacts even after the world stops adding new climate pollution.

CALCULATING THE PATHWAYS TO STABILIZE THE CLIMATE

The Intergovernmental Panel on Climate Change (IPCC), a UN scientific agency that aggregates and endorses existing peer-reviewed science from around the world, identifies CDR as crucial to limiting warming to 1.5°C. There is scientific consensus that the world needs some level of CDR to meet the goals of the Paris Agreement, but a crucial question remains: how much carbon removal is required to meet this goal?

The total amount of CDR required to meet the Paris Agreement goals will depend upon the speed and scale of stopping climate pollution. In an extensive analysis of the results of different published studies, Fuss *et al.* (2018) found that scenarios achieving 1.5°C included carbon removal deployment by 2050 ranging from 1.3 to 29 gigatons of CO₂ removal per year, with most falling between 5 and 15 gigatons of carbon removal. Multiple reports from other scientific experts reach similar conclusions. A 2017 report from the United Nations Environmental Program finds that meeting the Paris Agreement goals will require annual carbon removal of 10 gigatons a year by 2050 and 20 gigatons a year by 2100. A report on carbon removal from the National Academy of Sciences mirrors the same numbers of the United Nations Environment Program report.

Scientists have identified some scenarios in which the world holds warming below 1.5°C without large-scale carbon removal, although this becomes all but impossible if current emissions trajectories continue through 2030. Scientists have modelled a few scenarios that meet the 1.5°C target with limited use of technological carbon removal, but these require dramatic progress in other kinds of ambitious mitigation efforts such as battery storage and expansion of forest land. These may incur other types of co-benefits or drawbacks, especially for countries in the Global South who have to balance how to best utilize farmland and forests.

INTEGRATING SOCIAL JUSTICE AND GOVERNANCE CONSIDERATIONS IN CARBON REMOVAL DEPLOYMENT

Investing in CDR now aligns with scientific consensus that the world needs some level of it to prevent the worst impacts of climate change, which can work to protect the people who are most at risk of suffering from climate impacts. CDR impacts need to be fully assessed to realize all benefits and to identify potential risks. Conversations about carbon removal will benefit from the evaluation of which forms of carbon removal to use; where, when, and how much; and the policies and institutions needed to foster responsible carbon removal deployment. Based on the scientific need for CDR, an ongoing conversation about the responsible deployment of carbon removal is urgently needed.