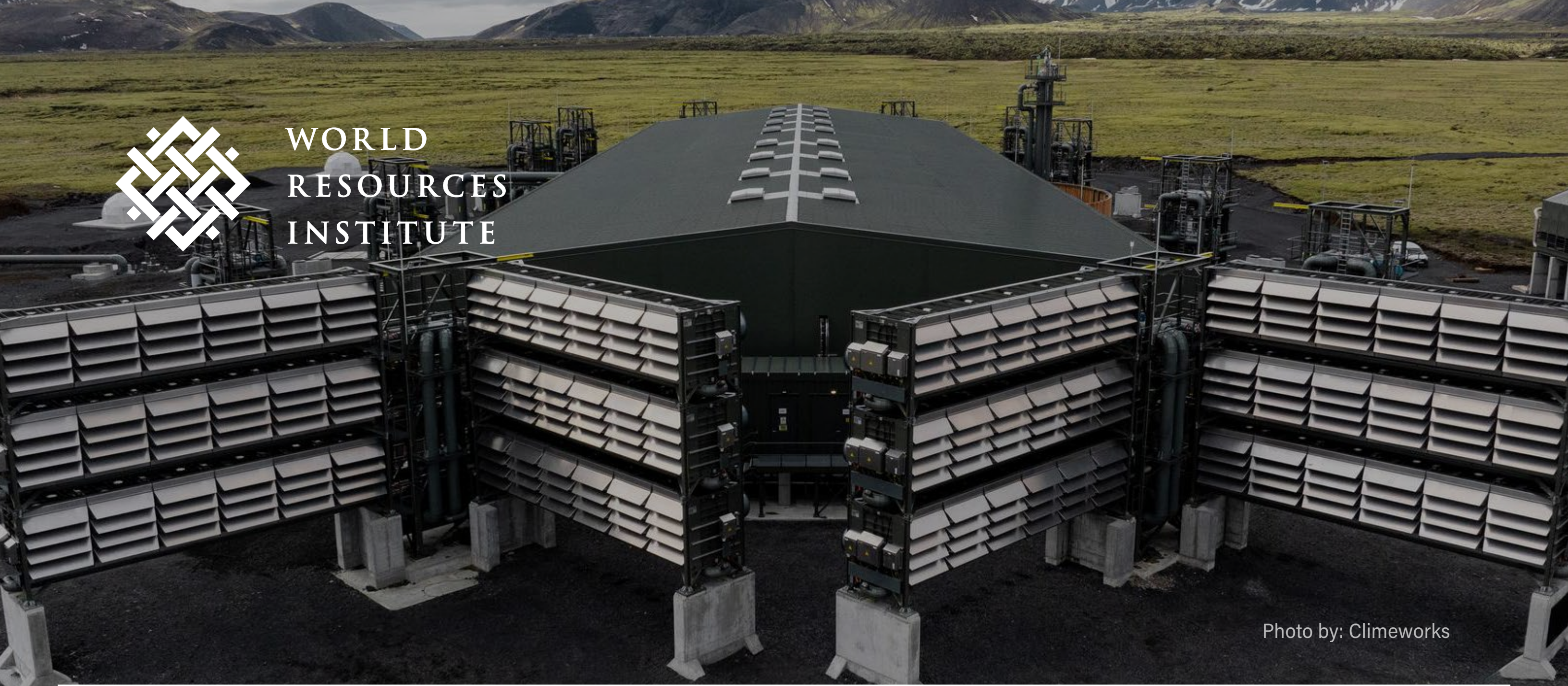


Photo by: Climeworks

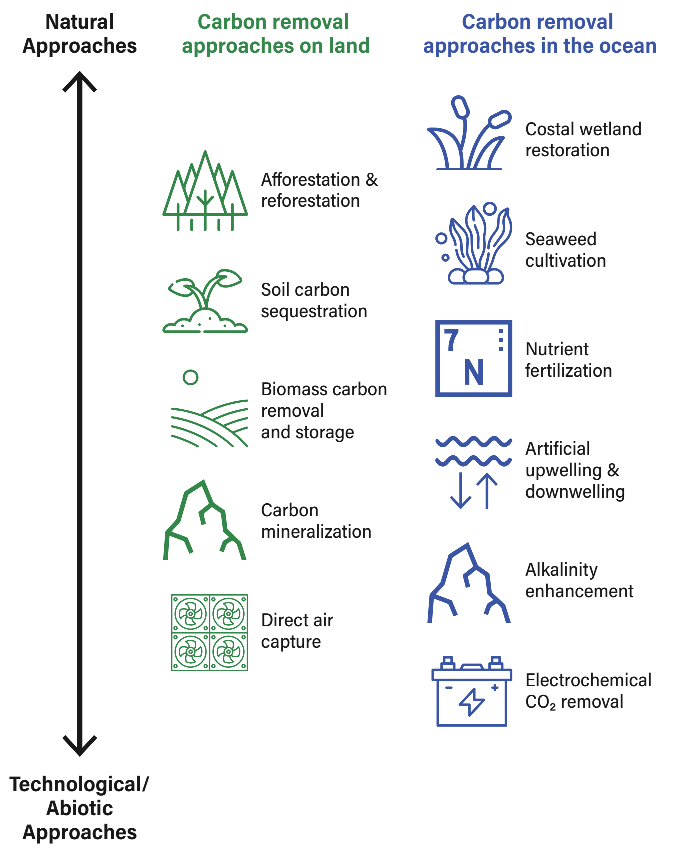
Carbon dioxide removal landscape

The United States has committed to reaching net-zero greenhouse gas emissions by 2050. Meeting that target requires deep and rapid emissions reductions — through shifts like increasing renewable energy, improving energy efficiency, and avoiding deforestation — and scaling carbon dioxide removal (CDR) to address remaining emissions that can't be abated.

CDR approaches remove carbon dioxide (CO_2) directly from the atmosphere and include technologies and approaches such as direct air capture, carbon mineralization, and a range of marine and biomass-based CDR methods. CDR approaches could remove more than a billion tons of CO_2 per year in the United States, but most are still in development or demonstration today. Each approach also comes with different potential risks and co-benefits, so a diverse portfolio of CDR approaches is needed to help balance these tradeoffs.

CDR, unlike other clean technologies such as solar PV or electric vehicles, does not have ready supply or demand. It is, above all, a public good of atmospheric clean-up, so policy is needed to create supply and demand. The U.S. government has taken significant strides in this direction by providing billions in public incentives in the Bipartisan Infrastructure Law (BIL) and Inflation Reduction Act (IRA), among other policies. However, there is still a large gap between where we need to be by midcentury and the level of CDR we're on track to reach by that point. Additional policy will be needed to bridge that gap.

A few prominent types of CDR are described below, along with key policy supports they have today.



Notes: The natural/biotic vs. technological/abiotic categorization shown here is illustrative rather than definitive and will vary depending on how approaches are applied.

DIRECT AIR CAPTURE (DAC)

DAC involves moving air over chemicals that selectively react with and capture CO_2. That CO_2 then needs to be sequestered underground or used in durable products to result in permanent storage. Among CDR approaches, DAC has received the most policy support in the United States, primarily as demonstration funding through the $3.5 billion Regional DAC Hubs program in the BIL and deployment support of up to $130-180/t$CO_2$ in the 45Q tax credit, which was expanded in the IRA. Research and development funding is also provided through annual budget appropriations.

BIOMASS CARBON REMOVAL AND STORAGE (BICRS)

BiCRS includes a range of processes that use biomass to remove carbon, ranging from biomass gasification to create hydrogen to direct burial of biomass. Ideally, waste biomass feedstocks are used to avoid land use change associated with biomass feedstock cultivation that can threaten biodiversity or food security. Bioenergy with carbon capture and storage (BECCS) is supported by the 45Q tax credit and can receive up to $60-85/t$CO_2$. However, BECCS may not provide net-negativity if the biomass feedstocks used trigger land use change or deplete natural carbon stocks.

CARBON MINERALIZATION

Carbon mineralization includes different types of processes that accelerate natural reactions between atmospheric CO_2 and certain minerals in rocks, removing and sequestering CO_2 permanently. Certain types of ground rock can be spread on crop fields, known as enhanced rock weathering, or added to the ocean, known as ocean alkalinity enhancement. Or mineralization can be used as a storage option: CO_2 can be injected underground into certain types of rock where it mineralizes and is permanently sequestered. Carbon mineralization does not have as much policy support as DAC, but is eligible for smaller pools of funding like the Department of Energy's Purchase Pilot Prize and the Carbon Negative Shot Pilots (for which DAC and BiCRS are also eligible).

SEAWEED CULTIVATION

Seaweed cultivation involves growing, harvesting, and sinking seaweed, which absorbs dissolved CO_2 from surface waters as it grows and transforms it into its tissues. The seawater then re-equilibrates with the atmosphere by taking up more CO_2, resulting in atmospheric carbon removal. Relatively little federal funding is dedicated to marine CDR (mCDR) research today. ARPA-E has provided funding in recent years for seaweed cultivation for biofuel production and in 2023, the National Oceanographic Partnership Program provided $24 million to 17 mCDR research projects, though few were focused on biotic approaches.

Learn more about our work

wri.org/carbonremoval

CONTACT

CHRISTINA DECONCINI

Director, Government Affairs

christina.deconcini@wri.org

JENNIFER RENNICKS

Deputy Director, Government Affairs

jennifer.rennicks@wri.org

KATIE LEBLING

Research Associate, Carbon Removal

katie.lebling@wri.org

ABOUT WRI

World Resources Institute is a global research organization that turns big ideas into action at the nexus of environment, economic opportunity, and human well-being.

WORLD RESOURCES INSTITUTE

10 G Street, NE
Washington, DC 20002
+1 (202) 729-7600
WRI.org