THE NEW DEAL

Carbon Dioxide Removal Technology

A Guide for State and Local Policymakers

As the dangerous impacts of climate change grow, including the increasing intensity and quantity of natural disasters, rising temperatures, and more frequent droughts, scientists around the world agree that reducing emissions of greenhouse gases is critical to preventing further damage[1]. In addition to the need to turbocharge society's shift to clean energy sources and invest in energy efficiency, policymakers have the opportunity to promote developing technologies with the potential to remove carbon dioxide already present in the atmosphere, safely storing it away or using it in durable and marketable products like low-carbon cement or jet fuel.

Promising carbon removal methods include negative emissions technologies, such as large-scale direct air capture (DAC). This entails capturing carbon dioxide from the ambient air, isolating it, and then transporting it in a pure form to be injected deep underground, where it can be stored and eventually become integrated naturally into the bedrock over time.

This figure illustrates commonalities and differences between high-temperature and low-temperature DAC processes. This figure is not meant to imply that both systems would be employed at a single facility.

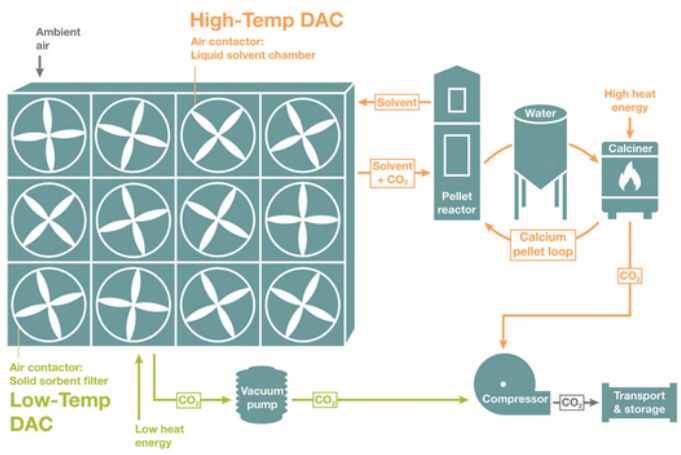

Figure authored by Carbon Solutions, 2023.

The process involves passing a large amount of air through a chemical solvent (liquid) or sorbent (solid), where CO2 is removed, transformed into material, or deposited in deep geological reservoirs for long-term sequestration. Research and development are underway, and there are already 18 DAC facilities in operation in Europe, USA, and Canada. Crucially, over the next couple of decades, large-scale DAC will begin chipping away at long-term carbon emissions, which will set us on a path to become net negative.

These novel engineered solutions are necessary because we cannot plant trees fast enough to effectively combat growing pollution, and we need to rapidly draw down hundreds of millions of tons of carbon dioxide to limit the effects of climate change as much as possible. In addition to the clear climate benefits, carbon dioxide removal methods such as DAC will lead to economic development and job creation opportunities that will further benefit communities, as well as give the US a global competitive advantage.

1 IPCC special report...limiting surface temperature warming to below 1.5°C of pre-industrial levels by 2050

Other carbon removal methods

Other methods for carbon removal are based on natural processes that can be enhanced with engineering or solely based on nature, e.g. planting trees. There is still a lot to learn about some of these emerging carbon removal solutions, particularly how to scale and rapidly deploy them. Early analysis suggests that multiple methods for enhancing both natural processes and human-assisted processes will eventually be needed alongside deep decarbonization of our energy systems so that we can meet the country's broader climate goals. Some of the numerous promising methods include:

- Soil Carbon Sequestration – practices and crops that increase the amount of carbon stored in soils.
- Biomass Carbon Removal and Storage – processes that use plants and algae to remove CO2 from the atmosphere and store it underground or in long-lived products.
- Enhanced Mineralization – removal of CO2 through reaction with alkaline materials such as crushed rocks spread over the ground.
- Ocean-Based CDR – amplification of the ocean's biological and abiotic carbon pumps, which pull CO2 from the atmosphere and transport the carbon into the deep ocean and marine sediments.
- Afforestation/Reforestation – storage of CO2 in newly grown or regrown forests.

Detailed Conceptual Renderings

What would these technologies look like if actually implemented?

Experts have identified key regions where carbon dioxide removal would be the most successful. These locations include areas in close proximity to geologic carbon storage formations and/or places that already have the existing pipeline infrastructure to support the capture, transport, and storage of the carbon. Size and scale of the technologies depend on where the plants are located.



Photo credit: Third Way / Gensler, "Picture It: Carbon Management Across America"

- Rural areas would generally have larger scale projects, while suburban and urban areas would be places for smaller-scale projects.
- In urban areas, this could mean having a small plant located on the rooftops of buildings, allowing for carbon capture.
- These technologies can be scaled up depending on the location in which they are placed.
- In large rural areas, carbon can be removed on a large scale, with large networks of pipelines and storage facilities.

Role for State and Local Governments

As more attention and investment are put into carbon dioxide reduction efforts, state and local leaders will play a crucial role in advancing these techniques as proof of concept. It is incumbent on local policymakers to seek out opportunities to implement and foster carbon dioxide removal methods as pilots to serve as blueprints for additional federal action and investment. Then, they must work to help bring these programs to scale, creating new jobs and reducing carbon in their communities.

- **Removing Roadblocks:** As new projects are pursued, one of the biggest obstacles in the implementation process is securing permits and determining where these projects will go. In order to allow for the implementation of these projects, a variety of documents must be submitted for approval that outline the community benefits that will be yielded from the project, data regarding environmental impacts, and plans for workforce training. Policymakers can ensure the process is as efficient as possible, without unnecessary obstacles.

- **Building Public Support:** Policymakers can also play a role in championing and advocating for these projects to residents in their communities, making clear the workforce and community benefits they will bring. The implementation of these practices can cause an influx of higher-quality jobs, while having a significant economic impact on surrounding communities. The data for the co-benefits from these practices is actively being compiled, along with making the data more accessible to communities.
    - However, one report found "a typical 1 megaton capacity DAC plant can generate roughly 3,500 jobs across the sectors in the DAC supply chain," while "Cement and steel employment could increase by at least 50% relative to current levels" if DAC reaches full scale.

Available Federal Funding Streams

The combined climate investments from the Inflation Reduction Act and the Bipartisan Infrastructure Law total more than $430 billion, and the combined impact of the two laws will make significant progress in mitigating climate change, enhancing the nation's energy sector, and creating high-quality jobs and new economic opportunities for communities.

States have the opportunity to magnify the benefits of these investments by creating carbon management plans, passing complementary incentives, and removing unnecessary permitting roadblocks.

The Infrastructure Innovation and Jobs Act, more commonly known as the Bipartisan Infrastructure Law (BIL), codified the potential benefits of carbon removal for the climate and as a driver of economic growth. The Biden-Harris Administration have promoted four programs from the BIL that will provide $3.7 billion to kick-start the carbon dioxide removal industry in the United States:

- Carbon Utilization Procurement Grants - $100 million to provide grants to **states, local governments, and public utilities** to support the commercialization of technologies that reduce carbon emissions while also procuring and using products developed from captured carbon emissions.
    - **Current Status:** Expected Funding Opportunity Announcement Issue Date: Q3 2023.
- Direct Air Capture Commercial and Pre-Commercial Prize - totaling $115 million to promote diverse approaches to direct air capture, including funds to incubate and accelerate research and development of breakthrough solutions. The funds will be made available in three phases (develop, design, and deliver).
    - **Current Status:** Submission deadline for the first phase is September 26, 2023.
- 4 Regional Direct Air Capture Hubs - $3.5 billion to develop four domestic regional direct air capture hubs, each of which will demonstrate a direct air capture technology at commercial scale. The first funding opportunity will provide $1.2 billion to begin the process of conceptualizing, designing, planning, constructing, and operating direct air capture hubs.
    - **Current Status:** Application is closed.
- Bipartisan Infrastructure Law Technology Commercialization Fund (TCF) - which will invest $62 billion in a range of clean energy activities and programs, including:
    - Lab Call - $15 million to accelerate the commercialization of carbon dioxide removal technologies, including direct air capture, by advancing measurement, reporting, and verification capabilities.
        - **Current Status:** Application is closed.
    - "Pathways to Commercial Liftoff" - develop reports and accelerate clean energy technologies, including carbon management and removal.
    - Manufacture of Advanced Key Energy Infrastructure Technologies (MAKE IT) Prize - aims to catalyze domestic manufacturing of critical clean energy technology components, move manufacturing facilities from planning to shovel-ready, and enable strategies for vibrant manufacturing activities in communities.
        - **Current Status:** Application is closed.

The Inflation Reduction Act (IRA) is expected to have significant impacts on the energy industry. The IRA Guidebook provides an overview of the various programs and initiatives. "Incentives for clean energy and climate-related program spending include" funding to encourage carbon capture, utilization, and storage (CCUS) projects. The IRA will provide long-term extensions of existing tax incentives, such as the 45Q Tax Credit for Carbon Sequestration, to ensure strong commercial interest and provide a basis for potential large-scale deployment.

Policy Points: State and Local Actions

What are best practices for state and local leaders?

Colorado Senator Chris Hansen's two bills to advance the state's clean energy transition were signed into law.

- HB23-1210 will ensure that carbon management projects (i.e. carbon storage and direct air capture) are eligible for grants under the industrial and manufacturing operations of the state's clean air grant program and provide for the creation of a carbon management roadmap. The roadmap will be presented to the newly named Energy and Carbon Management Commission (see SB23-285). It will provide recommendations on the policies and incentives to utilize Colorado's resources and industries, incentivize new carbon management technologies, and safely implement them while protecting communities and growing local economies.
- SB23-285 will update the Oil and Gas Conservation Commission to be named the Energy and Carbon Management Commission, giving the commission authority to regulate beyond oil and gas. This legislation creates a pathway for new state regulatory approvals, including enabling expanded geothermal electric generation and underground storage.

North Dakota House Minority Leader Josh Boschee touted the successful launch of a large-scale CO2 capture project, supported by state and federal funding. Boschee believes that Project Tundra demonstrates the value of private-public partnerships, highlighting the cooperation between the private sector, the state government, and the federal government. The project receives financial support from the state and the federal tax credit, 45Q, that incentivizes capturing carbon and was just expanded by the BIL. When operational, the facility will sequester CO2 from the state's largest coal plant, utilizing the state geography to safely store millions of metric tons of the CO2.

Other State Efforts

In reaction to the carbon management provisions of the Bipartisan Infrastructure Law, other states have passed legislation to prepare, as well as spur the development of, carbon capture utilization and sequestration projects in their communities. These efforts include setting ambitious carbon removal targets and laws to clarify and streamline land use and permitting for carbon capture, utilization, and sequestration projects.

- California - Established commitments and action plan to achieve carbon neutrality by 2045.
    - CA AB 209 (2022) - Budget bill that establishes the Carbon Removal Innovation Program. The Carbon Removal Innovation Program will provide financial incentives for eligible projects that advance technologies for direct air capture of atmospheric carbon. Eligible projects shall include technology research, development and demonstration, and prototype and pilot research test centers to remove atmospheric carbon.
- Montana, North Dakota, and Wyoming - have approved legislation to clarify their laws governing pore space ownership, an important component of safe carbon storage.