

# Initiate Carbon Removal Opportunities to Enhance Economic Prosperity and Job Creation for West Virginians

## Executive Summary

Carbon, in its many forms, has long provided economic development opportunities for West Virginia. The nature of those activities has changed over time, and today West Virginia has a new opportunity to leverage the competitive advantage of its natural resources: by capturing carbon out of the ambient air. Proactive policymaker and stakeholder actions to capture this burgeoning opportunity in the near-term can place West Virginia in the lead of long-term carbon management markets.

## What are the Potential Options for Carbon Dioxide Removal in West Virginia?

Carbon dioxide removal (CDR) removes the carbon dioxide (CO<sub>2</sub>) already in the atmosphere, relying very heavily on natural resources. Forests, agricultural land, and wetlands capture carbon dioxide naturally. Forest and agriculture feedstocks can produce biofuels, bioproducts, and biopower. Underground reservoirs and abandoned oil and gas wells can store the CO<sub>2</sub> that is captured through bioenergy with carbon capture and storage (BECCS) and direct air capture (DAC).

**Forestland:** With about [12 million acres](#) of forestland, West Virginia is the [3rd](#) most forested state in the United States. [Over half](#) of this land is owned by small family foresters (10% of West Virginia's total population), [78%](#) of whom wish to maintain their forests for future generations.

**Forest Products:** Forest products generate approximately [\\$3.2 billion annually](#) and employ [more than 30,000](#) West Virginians across all [55 counties](#). West Virginia is [2nd](#) in the United States in terms of standing hardwood forest area. The forest products industry plays an important role in CDR by facilitating CO<sub>2</sub> capture and providing long-lasting wood products that can substitute for high-carbon-intensity materials like concrete.

**Agricultural Crops and Soil:** West Virginia's agricultural industry (not including timber) contributes [\\$800 million annually](#) to the state's economy and grows crops that could store CO<sub>2</sub> or generate bioenergy (biopower and biofuels). [Almost 70%](#) of farms produce livestock or cultivate pastureland as their primary commodity. If managed properly, pastureland sequesters carbon in the soil. In addition, processing crop residue and livestock manure can result in [renewable natural gas](#).

**Wetlands:** Proper conservation, management, and restoration of West Virginia's inland wetlands can potentially store [more CO<sub>2</sub> per acre than coastal wetlands](#) while at the same time supporting West Virginia's tourism industry. For example, the wetlands of the Canaan Valley National Wildlife Refuge attract 73,500 annual visits, resulting in 33 jobs and roughly [\\$2.7 million](#) in economic benefit—mostly from out-of-town visitors.

**CO<sub>2</sub> Storage:** BECCS and DAC require a geological location that can store any CO<sub>2</sub> that is not turned into products. Luckily, the same geology that supports West Virginia's fossil fuel industry, including former oil and gas reservoirs, unmineable coal seams, and saline formations, can potentially be used to store CO<sub>2</sub> and provide job opportunities for those in former coal communities.



### Key Messages and Recommendations

**Cr**eat Carbon Reduction Opportunities in West Virginia

**R**estore Carbon into West Virginia's Natural Resources

**B**enefit West Virginia's Economic Prosperity and Create Jobs for West Virginians

**O**pen CDR Opportunities While Protecting West Virginia's Ecology, Conservation, Economy, and the Environment

**N**urture West Virginia's Disadvantaged Communities

The following graphic provides key findings and recommendations that West Virginia policymakers should take to initiate carbon reduction opportunities to enhance economic prosperity and job creation for West Virginians. It is followed by a table that provides information on the costs, annual investment options, and amount of potential CO<sub>2</sub> removal.

C A R B O N	<p><b>Create Carbon Reduction Opportunities in West Virginia:</b> West Virginia has the most scientific and technological carbon reduction potential for CDR options using natural methods as well as bioenergy with carbon capture and sequestration (BECCS) and direct air capture (DAC). Whatever CDR options are chosen, care should be taken to establish appropriate standards and verification processes.</p>	<p>Work with Federal agencies and leading nongovernmental organizations to develop appropriate standards for net carbon accounting of sequestered carbon.</p> <p>Fund a study by the National Academies of Science, Engineering, and Medicine on the appropriate criteria to consider in determining the optimal harvest cycle for maximizing the carbon removal potential by forests and forest products.</p>
	<p><b>Restore Carbon into West Virginia's Natural Resources:</b> The chief challenge for the implementation of BECCS and DAC options is developing a better understanding of the ability to store CO<sub>2</sub> in West Virginia.</p>	<p>Sustain BECCS as part of the U.S. Renewable Fuel Standard.</p> <p>Fund a study that examines both community and technical opportunities and challenges to identify suitable locations for DAC demonstration projects in West Virginia.</p>
	<p><b>Benefit West Virginia's Economic Prosperity, and Create Jobs for West Virginians:</b> CDR has the potential to generate economic prosperity and job creation, particularly in West Virginia's coal communities and other rural communities.</p>	<p>Invest in economic incentives for CDR activities such as reforestation, improved forest management, forest products, bioenergy, DAC, and CO<sub>2</sub> storage in southern West Virginia and other disadvantaged communities in the state.</p> <p>Increase resources to provide technical assistance, and advise small forest, farmland, rangelands, and wetland owners on CDR activities at relevant West Virginia state agencies and West Virginia University and West Virginia State University Extension Services.</p>
	<p><b>Open CDR Opportunities While Protecting West Virginia's Ecology, Conservation, Economy, and the Environment:</b> Some CDR methods may have side effects that impact the state's ecology, conservation, economy, and environment. The West Virginia University team believes that the potential societal benefits of CDR outweigh the societal costs based on what we know today.</p>	<p>Take steps to protect the economic health, human health, and ecology of local communities near CDR facilities and related CO<sub>2</sub> storage operations by</p> <ul style="list-style-type: none"> <li>• monitoring potential concerns;</li> <li>• improving the communities' environmental and ecological quality;</li> <li>• maximizing economic co-benefits; and</li> <li>• responding to unanticipated issues.</li> </ul>
	<p><b>Nurture West Virginia's Disadvantaged Communities:</b> Socio-economically disadvantaged communities in West Virginia can benefit from CDR activities. However, care must be taken to ensure that past mistakes are not repeated by ensuring that local communities are involved in decision-making from the earliest stages and that they economically benefit from CDR investments.</p>	<p>Facilitate access to federal, state, and non-profit CDR-related assistance programs for historically underserved communities to create economic opportunities and provide environmental, health, and safety protection.</p> <p>Require that CDR companies negotiate a community benefit agreement that includes the design and use of a community fund and addresses community concerns and recommendations from stakeholders (i.e., both landowners and non-landowners).</p>

CDR Method	Potential CO <sub>2</sub> Removal (million metric tons CO <sub>2</sub> e/year by 2050)	Cost Estimate (\$/ton CO <sub>2</sub> e) 2025-2045	Annual Investment Estimate (million \$/year)
Natural (forestland, crops, soil, and wetland management)	1.1-8.8	11-11	12-97
Bioenergy with Carbon Capture and Storage (new build)	2.7-13.2	120-96	324-1267
Direct Air Capture (DAC)	0-8	243-201	0-1608

**For More Information:** This policy brief, written by Dr. Deborah D. Stine, is based on a policymaker guide entitled [Carbon Dioxide Removal and West Virginia: A Science and Technology Policy Perspective](#), published under West Virginia University's [Bridge Initiative in Science and Technology Policy, Leadership, and Communications](#). More policy briefs are available on the Bridge website. The Bridge Initiative identifies challenges and opportunities facing West Virginia and provides a bridge between the expertise of WVU and West Virginia's policymakers. See <https://scitechpolicy.wvu.edu/cdr> or email [scitechpolicy@mail.wvu.edu](mailto:scitechpolicy@mail.wvu.edu) for more information. Photo Credits: [Agriculture](#), [Bioenergy](#), [Direct Air Capture](#), [Forests](#), [Wetlands](#) © 2023 West Virginia University This work is licensed under a Creative Commons Attribution-No Derivative License Works 4.0 License.