

Reforesting Mine Lands Through the Carbon Market: One Nature-Based Solution for Two Deep Challenges



AppalachianVoices



*Photo courtesy of
Green Forests Work*

Introduction

Imagine a landscape that, 10 years ago, was a mountaintop removal coal mine resembling a moonscape, but is now carefully managed as a large-scale working forest growing trees to capture carbon dioxide from the atmosphere and combat climate change. That forest is steadily and measurably turning greenhouse gasses into a restored landscape, improving both the health of that ecosystem and global environmental conditions at the same time. Appalachian Voices is exploring making this vision a reality in the years to come through a reforestation project that engages with the emerging carbon offset market.

The need for mine reclamation across Appalachia is clear, with more than 600,000 acres of modern-era mines across Appalachia partially or totally unreclaimed, and 700,000 acres of pre-1977 abandoned mine land (AML) still in need of reclamation across the eastern states. Mine reclamation is the process of remediating damaged land and water after mining and it is costly. Appalachian Voices estimates the cost of completing reclamation of modern-era mines alone to be between at least \$7.5 billion to \$9.9 billion.^{1 2}

Additionally, a bonding crisis looms as more coal companies go through bankruptcy, forcing the reclamation liability of unreclaimed mine land onto state agencies' through the forfeiture process. In this, Appalachia faces a problem more significant than currently allocated state and federal funds can address.

At the same time, carbon markets are expanding across the United States, linking investors with projects that document the successful removal of carbon dioxide from the atmosphere. These markets trade the sale of carbon "credits" for the reduction and removal of carbon dioxide, which is accumulating in our atmosphere due to the burning of fossil fuels and causing climate change. In 2020, the markets surged to a value of \$277 billion worldwide.³ Carbon dioxide removal is an essential goal for addressing climate change, as agreed upon by scientists across the globe. The Intergovernmental Panel on Climate Change specified in its most recent report that all potential pathways to keep climate warming below 1.5 degrees Celsius – the target of the international Paris Agreement – require the active implementation of

Cover image: A maturing forest at Starfire Mine in Kentucky. Photo by Green Forests Work.

¹ Savage, Erin. "Repairing the Damage: Reclamation at Modern Mines." Appalachian Voices. July 2021.

https://appvoices.org/resources/RepairingTheDamage_ReclamationAtModernMines.pdf

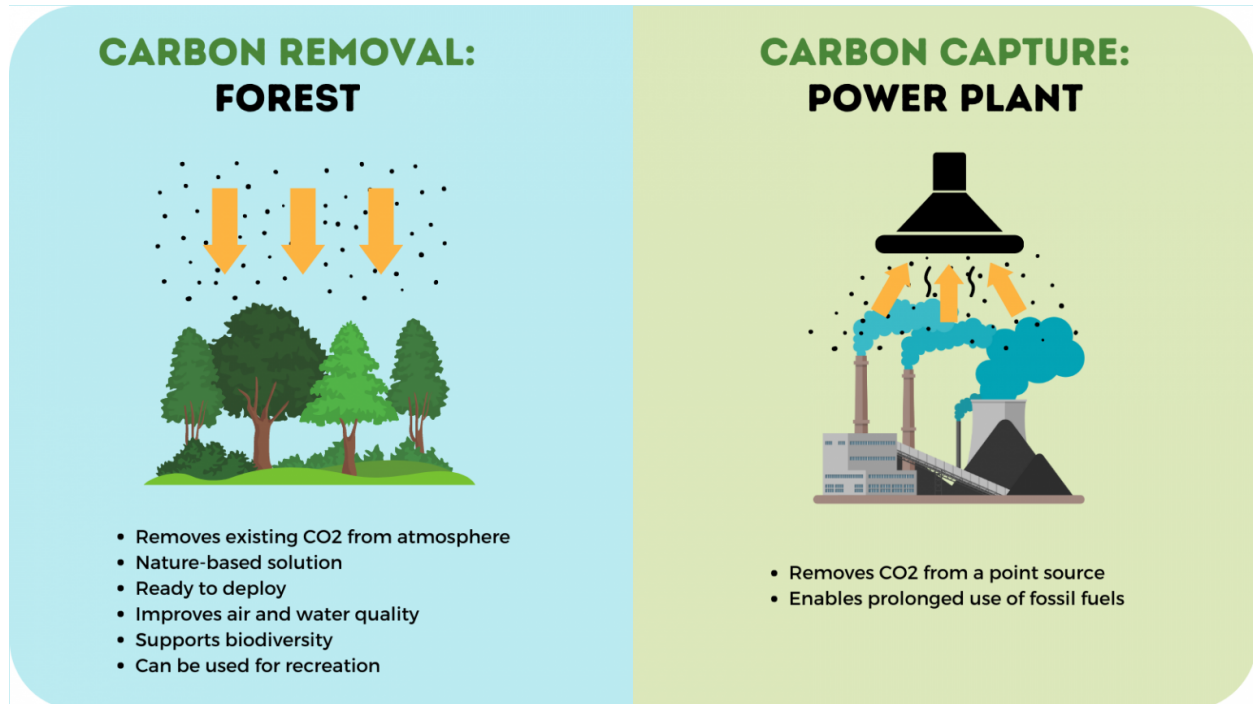
² Dixon, Eric. "Repairing the Damage: Cleaning Up the Land, Air, and Water Damaged by the Coal Industry Before 1977." Ohio River Valley Institute. April 2021.

<https://ohiorivervalleyinstitute.org/wp-content/uploads/2021/04/AML-Report-Dixon-ORVI-V1.1-4.pdf>

³ Chestney, Nina. "Global Carbon Markets Value Surged to Record \$277 Billion Last Year." *Reuters*. January 27, 2021.

<https://www.reuters.com/article/us-europe-carbon/global-carbon-markets-value-surged-to-record-277-billion-last-year-refinitiv-idUSKBN29W1HR>

carbon dioxide removal.^{4 5} Removal can occur in different forms, from direct capture technologies to nature-based solutions, like growing a forest or managing a grassland.



*Carbon removal and carbon capture are different methods of addressing CO2 emissions.
Image by Jimmy Davidson.*

Reforestation may be the key to marrying Appalachia’s need for mine land reclamation with the growth of global carbon markets. Expanding markets, combined with hundreds of millions of federal dollars made available by the Inflation Reduction Act and other federal legislation, make now the moment to act.⁶

Appalachian Voices recently received a grant to explore the possibilities of doing just that. This exploratory endeavor is funded by Carbon180, a non-profit organization advocating for carbon removal solutions. Appalachian Voices is joining a small cohort of other environmental justice organizations in this work. We are currently in the research and development phases of a pilot project to learn whether this approach is viable and scalable.

⁴ Harvey, Chelsea. “Carbon Removal Unavoidable as Climate Dangers Grow, New IPCC Report Says.” *Scientific American*. April 5, 2022.

<https://www.scientificamerican.com/article/carbon-removal-unavoidable-as-climate-dangers-grow-new-ipcc-report-says>

⁵ Intergovernmental Panel on Climate Change, Working Group III. “Sixth Assessment Report, Climate Change 2022: Mitigation of Climate Change.” April 4, 2022. <https://www.ipcc.ch/report/ar6/wg3/>

⁶ “Inflation Reduction Act.” H.R. 5376. 117th Congress. August 16, 2022. <https://www.congress.gov/bill/117th-congress/house-bill/5376>

If successful, the project may result in additional financial resources that could be used to reforest additional parcels, causing a domino effect to pursue reclamation across the region. Below are different phases of a reforestation project for carbon removal, which would take place over an average five to seven years.



Professional tree planters hike over ripped ground to begin planting trees at the Mammoth 22 project area in West Virginia, the site of a former mine. Photo courtesy of Green Forests Work.

Planning A Reforestation Project for Carbon Removal

Adapted from The Climate Trust⁷

1. Evaluate project feasibility. (Appalachian Voices is in this stage!)
2. Undertake site selection and begin creating a forest management plan with clear goals that are in line with verification standards.
3. Prepare the project site for planting by following reclamation procedures and locating saplings/seedlings.
4. Begin reforestation with tree planting.
5. When forest growth begins, complete a carbon inventory to estimate sequestration rates and annual storage.

⁷ Yankel, Christine. "FAQ: Forest Carbon Projects." The Climate Trust. August 1, 2014, updated February 8, 2018. <https://climatetrust.org/forest-carbon-projects-faq/>

6. Finalize and submit the completed forest management plan to a chosen carbon registry for review.
7. Hire a third-party project verifier and return verification to the chosen carbon registry.
8. Once approved by the carbon registry, the project will receive carbon offsets
9. Engage in the process of marketing and selling offsets.
10. Conduct ongoing monitoring and verification throughout project life.

Reforestation as a Climate Solution

Climate change is caused by accumulating levels of greenhouse gasses in the atmosphere that far fall outside of ranges normally seen in global nutrient cycling. Of these gasses, carbon dioxide (CO₂) emissions from the use of fossil fuels are powerful contributors to the global greenhouse effect.

Efforts to reduce carbon dioxide emissions are underway as countries transition to renewable energy economies. However, reductions in future emissions will not reduce the excess levels of carbon dioxide that are already in the atmosphere and will persist for centuries. We must urgently grapple with the need to reduce and remove these carbon dioxide levels, as future generations will live “under the sky we make.”⁸

Two carbon removal solutions are available to reduce those CO₂ levels.

One solution is direct air capture technology, but this method is years away from commercial viability. In the United States, for example, the first large-scale direct air capture plant will not yet be operational for several years.⁹ Over the last two years, the federal government has committed billions of dollars to accelerate the development of direct air capture technology, including \$3.5 billion in one grant program alone, and the industry is expected to expand over the next decade.¹⁰



The Nature Conservancy staff enjoy a day of tree planting on former mine lands that TNC now owns. Photo courtesy of Green Forests Work

⁸ Nicholas, Kimberly. *Under the Sky We Make*. GP Putnam’s Sons. 2021.

⁹ International Energy Agency. “Direct Air Capture.” <https://www.iea.org/reports/direct-air-capture> Retrieved August 8, 2023.

¹⁰ Department of Energy. “Biden Administration Launches \$3.5 Billion Program To Capture Carbon Pollution From The Air.” May 19, 2022. <https://www.energy.gov/articles/biden-administration-launches-35-billion-program-capture-carbon-pollution-air-0>



Twenty-four species of trees and shrubs were planted at a former mine site near the Kentucky-Tennessee border by professional tree planters. Photo courtesy of Green Forests Work.

The second solution is nature-based, and these methods are available to us right now at scale.¹¹ Nature-based solutions are based on conservation, restoration, and better management of ecosystems to increase their capacity to pull CO₂ from the atmosphere. Forestry-based solutions may include planting new trees where they never were before, regrowing forests in areas where they have recently been cut down, and improving management practices of existing forests.¹²

Here, Central Appalachia enters the picture with possibility and promise.

Forests are the largest terrestrial sources of carbon absorption in the world.¹³ Reforestation can increase absorptive area and can take place on mine lands with native species that are selected to both restore natural ecosystems and maximize carbon sequestration potential.

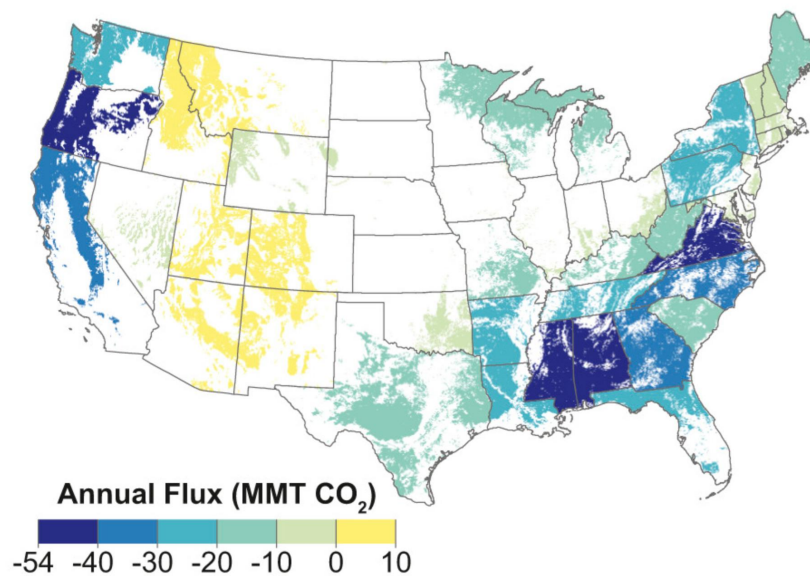
¹¹ Kolbert, Elizabeth. "Can Carbon-Dioxide Removal Save the World?" *The New Yorker*. November 13, 2017. <https://www.newyorker.com/magazine/2017/11/20/can-carbon-dioxide-removal-save-the-world>

¹² American University. "Fact Sheet: Nature-Based Solutions to Climate Change." <https://www.american.edu/sis/centers/carbon-removal/fact-sheet-nature-based-solutions-to-climate-change.cfm>

¹³ U.S. Forest Service. "R&D Hot Topic: Forest Carbon Status and Trends." April 2022. <https://www.fs.usda.gov/research/sites/default/files/2022-04/hot-topic-carbon-status.pdf>

The unique geologic makeup of the Appalachian Mountains leads to their great biodiversity and mineral richness, and is also a factor that leads to their high potential for success in nature-based carbon removal. Shown below, the U.S. Forest Service mapped forest carbon flux, which combines carbon dioxide emissions and removal, from the atmosphere (measured in MMT CO₂ eq., or metric tons of CO₂) and found that healthy forests in Central Appalachia uptake some of the highest amounts of carbon dioxide in the country.¹⁴ Combined with recent scientific studies, this data shows that the potential for removal and sequestration through forestry in this region may be high.¹⁵

MEASURING CARBON FLUX ON FORESTED LAND



Total greenhouse gas emissions and removals, or flux, across the U.S in 2018. Removal is indicated by negative values. From “R&D Hot Topic: Forest Carbon Status and Trends,” published by the U.S. Forest Service.¹⁶

Growing forests on mine land qualifies as **reforestation** because the land was recently forested in the last century or so. Planting new trees where they never were before

¹⁴ U.S. Forest Service. *Ibid.*

¹⁵ Foerstel, Karen. “Scientists Identify Forest Carbon ‘Hotspots’ Across U.S. with Greatest Potential to Fight Climate Change and Protect Species.” The Nature Conservancy, September 14, 2021. <https://www.nature.org/en-us/newsroom/forest-carbon-hotspots-identified-us/>

¹⁶ U.S. Forest Service. *Ibid.*

(**afforestation**) or improving management practices of existing forests (**proforestation**) are other types of nature-based forestry projects that are best suited to other types of land.¹⁷

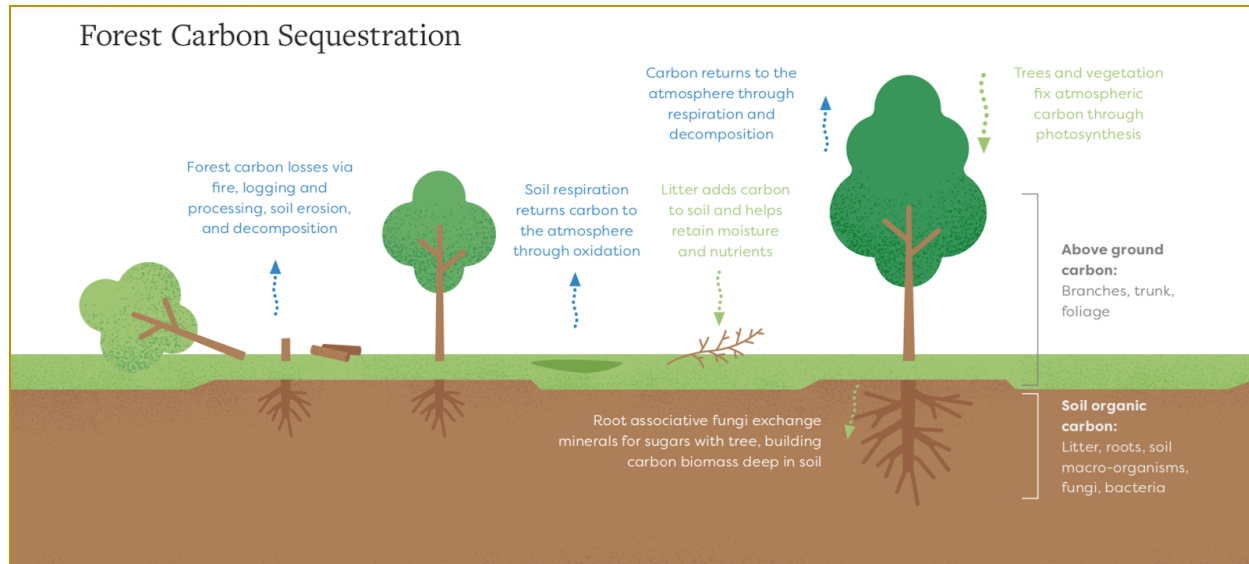


Image from “Forest Carbon Removal,” published by Carbon180.¹⁸ Adapted from Minnesota Board of Water and Soil Resources.

Carbon sequestration success in forests is highly dependent on site quality. Mining degrades the land on which it takes place in many ways, and relative to reforestation, removal of topsoil can be the most damaging for tree regrowth. Soil compaction is another prominent characteristic and challenge of planting on mined sites, because mining activities like backfilling and grading are known to compact the soil to such a degree that tree growth can become impossible. Forests will not grow on these lands without active intervention to loosen and aerate mine site soils.¹⁹

Fortunately, while these and other characteristics of mined sites are degraded, they can be remediated. Reclamation guidance from the Appalachian Regional Reforestation Initiative (ARRI) and documented sequestration rates for soils and tree biomass would inform the foundation of such a remediation plan.

¹⁷ American University. “Fact Sheet: Nature-Based Solutions to Climate Change.”

<https://www.american.edu/sis/centers/carbon-removal/fact-sheet-nature-based-solutions-to-climate-change.cfm>

¹⁸ Carbon180. “Forest Carbon Removal.”

<https://static1.squarespace.com/static/5b9362d89d5abb8c51d474f8/t/602b5c7110a23e723d4e06db/1613454456899/Carbon180+Ed+Packet+Forestry.pdf>

¹⁹ Graves, Donald H., Christopher D. Barton, Richard Sweigard, Richard Warner. “Carbon Sequestration on Surface Mine Lands.” University of Kentucky Department of Forestry, June 22, 2005.

<https://www.osti.gov/servlets/purl/881815>

Appalachian Regional Reforestation Initiative

The Appalachian Regional Reforestation Initiative is a program of the Office of Surface Mining Reclamation and Enforcement (OSMRE), a coalition of groups, including citizens, the coal industry, and government dedicated to restoring forests on coal mined lands in the Eastern United States. The coalition is a cooperative effort between OSMRE, state agencies in Alabama, Kentucky, Maryland, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia, industry partners, environmental organizations, academia, and landowners.

ARRI is dedicated to forest restoration on active, abandoned, and legacy (bond-released) mine land sites throughout Appalachia using a reclamation technique known as the Forestry Reclamation Approach (FRA). Under the 1977 Surface Mining Control and Reclamation Act (SMCRA), FRA is considered by OSMRE and state mining agencies to be an “appropriate and desirable” method of mine land reclamation.

General Forestry Reclamation Approach principles involve:

- Creating a suitable reforestation growth medium
- Minimizing compaction of existing growth medium
- Planting native trees, shrubs, and tree-compatible ground plants
- Using proper tree planting techniques



More than 500 pounds of seeds composed of several species of native warm-season grasses and wildflowers were spread at a former mine site in Kentucky. Photo courtesy of Green Forests Work.

To inform FRA implementation, ARRI issues Forest Reclamation Advisories on topics related to each stage of the reclamation process. Advisory No. 4, for example, focuses specifically on effective processes to reforest compacted soils on mine sites, providing best practices for ripping compacted areas to loosen soils so that trees may finally grow on that land once more. Advisory No. 9, detailing guidance for selecting native tree species, includes frameworks to distinguish from over sixty native species and select those with the best chance of success. Site-specific considerations such as varying needs for drainage, sunlight, and ideal temperature are also discussed in great detail.

This guidance is practical and accessible. Green Forest Works, a non-profit tree planting organization dedicated to restoring healthy and productive forests across Appalachia, has seen great success with application of FRA, including in recent ambitious efforts to revive the American chestnut.²⁰

Planning for Carbon Sequestration

Reforestation of mine lands is possible with active intervention, and such a forest planted for optimal carbon sequestration would be informed by decades of research into best practices.

Scientists have shown that it is possible for former mine sites to sequester nearly as much carbon in tree biomass as is sequestered on trees on an adjacent non-mined site.²¹ To provide ballpark measurements, hardwood trees grown on mined land tend to sequester ~300 tons of carbon per acre. The same trees grown on non-mined land tend to sequester ~500 tons/acre. That reduction in productivity reflects how site quality can be degraded by mining activities. However, even that reduced amount is more than double what existing vegetation, such as grasslands, on the same land can sequester. In fact, it's six times greater, as grassland sequestration averages ~50 tons/acre. Forests make a big impact.^{22 23}

These measurements come from technologies that estimate carbon content based on the dry weight of plant matter from trees, which is also known as biomass. Biomass is the carbon byproduct of photosynthesis. On-the-ground survey tools can be used in the measurement process, typically consisting of simple field measurements of overall tree size

²⁰ Shao, Elena. "At Old Coal Mines, the American Chestnut Tries for a Comeback." *The New York Times*. September 16, 2022.

<https://www.nytimes.com/2022/09/16/climate/coal-mine-american-chestnut.html>

²¹ Li, Xioshu, Jian Yang, Andrew Stainback, Christopher D. Barton. "Valuing the Environmental Benefits from Reforestation on Reclaimed Surface Mines in Appalachia." *Journal of American Society of Mining and Reclamation*, vol. 7, no. 1, November 2018. <http://doi.org/10.21000/JASMR18010001>

²² Li, Xioshu. *Ibid.*

²³ Burger, J.A. and Carl Zipper. "How to Restore Forests on Surface-Mined Land." Virginia Cooperative Extension publication, 460-123, 2018

<https://vtechworks.lib.vt.edu/bitstream/handle/10919/84253/CSES-211.pdf?sequence=1>

and density. This data is then fed into modeling programs.²⁴ High altitude aerial remote sensing, rather than on-the-ground field sampling, can also be used. The U.S. Forest Service also provides a comprehensive list of tools that may be relied upon for basic calculations related to quantifying forest carbon for planning or reporting.^{25 26}

Naturally, nuances exist in these estimation processes, especially with regard to the time needed for trees to reach their carbon capture potential, greenhouse gas emissions involved in setting up a plot, and underestimating tree losses due to inevitable human and climatic disturbances.^{27 28}

Carbon sequestered in soil is also a potentially important pathway to explore in plotting the course of a reforestation project. In the United States, carbon distribution in forests is found in mineral soils (~60%), trees and large roots (30%), and forest floor litter (10%). After mountaintop removal mining, carbon content in spoil material soil is quite low, so the potential to document an increase may be significant.²⁹ Sophisticated analytics tools can also distinguish between “old” carbon from mining activities and new carbon from forest activities when examining soil carbon content.^{30 31} Sequestration potential depends on initial soil organic carbon (SOC), stand growth rates, site’s biological carrying capacity, stand age, and product utilization.³²

²⁴ U.S. Forest Service. *Ibid.*

²⁵ U.S. Forest Service and U.S. Department of Agriculture Climate Change Resource Center. “Carbon Estimation Tools: A Primer.” <https://www.fs.usda.gov/ccrc/tools/carbon-primer>

²⁶ U.S. Forest Service and U.S. Department of Agriculture Climate Change Resource Center. “Tools.” <https://www.fs.usda.gov/ccrc/tools/>

²⁷ Lefebvre, David, Adrian G. Williams, Guy J.D. Kirk, J. Burgess, Jeroen Meersmans, Miles R. Silman, Francisco Roman-Danobeytia, Jhon Farfan, Pete Smith. “Assessing the carbon capture potential of a reforestation project.” *Scientific Reports*, 11, article number: 19907, October 2021. <https://doi.org/10.1038/s41598-021-99395-6>

²⁸ Amichev, Beyhan Y., James A. Burger, Jason A. Rodrigue. “Carbon Sequestration by Forests and Soils on Mined Land in the Midwestern and Appalachian Coalfields of the U.S.” *Forest Ecology and Management*, vol. 256, issue 11, pp. 1949 - 1959, November 2008. <https://doi.org/10.1016/j.foreco.2008.07.020>

²⁹ Maharaj, Sally, Christopher D. Barton, Tasso A.D. Karathanasis, Harry D. Rowe, Susan M. Dimmer. “Distinguishing ‘New’ From ‘Old’ Organic Carbon on Reclaimed Coal Mine Sites Using Thermogravimetry: 2. Field Validation.” *Soil Science*, vol. 172, no. 4, pp. 302-312, April 2007. <https://doi.org/10.1097/SS.0b013e3180314702>

³⁰ Maharaj, Sally, Christopher D. Barton, Tasso A.D. Karathanasis, Harry D. Rowe, Susan M. Dimmer. “Distinguishing ‘New’ From ‘Old’ Organic Carbon on Reclaimed Coal Mine Sites Using Thermogravimetry: 1. Method Development.” *Soil Science*. vol. 172, no. 4, pp. 302-312, April 2007. <https://doi.org/10.1097/SS.0b013e3180314702>

³¹ Littlefield, Tara, Christopher D. Barton, Mary Arthur, Mark Coyne. “Factors Controlling Carbon Distribution on Reforested Mine Lands and Regenerating Clearcuts in Appalachia, USA.” *Science of the Total Environment*, vol. 465, pp. 240-247, November 2013. <https://dx.doi.org/10.1016/j.scitotenv.2012.12.029>

³² Amichev. *Ibid.*

Many Benefits

Beyond carbon sequestration, Appalachian Voices is keenly aware of the wider ecosystem benefits that will take place during the reforestation process, as well as connections to local economies. These benefits can include:

- Enhanced air and water quality³³
- Decreased soil erosion
- Increased resilience of surrounding communities to extreme weather events (for example, floods or droughts)³⁴
- Restoration of ecological and wildlife communities
- Improvements in area biodiversity³⁵
- New outdoor recreation opportunities
- Local job opportunities in forest maintenance
- Addressing the increasing abandoned mine site trend

Documenting these multi-benefits will be key to demonstrating for buyers on the carbon market that the Appalachian Voices project is a high-quality investment. After measurement and verification of both carbon sequestration rates and related multi-benefits, Appalachian Voices can enter the carbon market and begin to sell carbon credits for the reforested land.



³³ North Carolina Forest Service. “Healthy Forests for Clean Water.” <https://ncforestservice.gov/publications/UF0115.pdf>

³⁴ Karjalainen E, Tytti Sarjala, Hannu Raitio. “Promoting Human Health Through Forests: Overview and Major Challenges”. *Environmental Health Preventative Medicine*, vol. 15, January 2010. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2793342/>

³⁵ Buotte, P. C., Beverly E. Law, William J. Ripple, and Logan T. Berner. “Carbon Sequestration and Biodiversity Co-Benefits of Preserving Forests in the Western United States.” *Ecological Applications*, vol. 30, issue 2, March 2020. <https://doi.org/10.1002/eap.2039>

What is a Carbon Market?

Corporations are currently reckoning with their contribution to climate change, examining the carbon emissions caused by fossil fuel energy use for production, transportation, and other contributors. Companies like Microsoft, Delta, Disney, and Apple are investing significant financial resources into offsetting this contribution by purchasing carbon credits, leading to an industry trading in excess of \$250 billion.

To fund the restoration and reclamation Appalachian Voices hopes to accomplish, a project must fulfill several standards to meet the status of a high-quality carbon credit.³⁶ The standards center around planning reforestation with a long-term, multi-decadal framework.

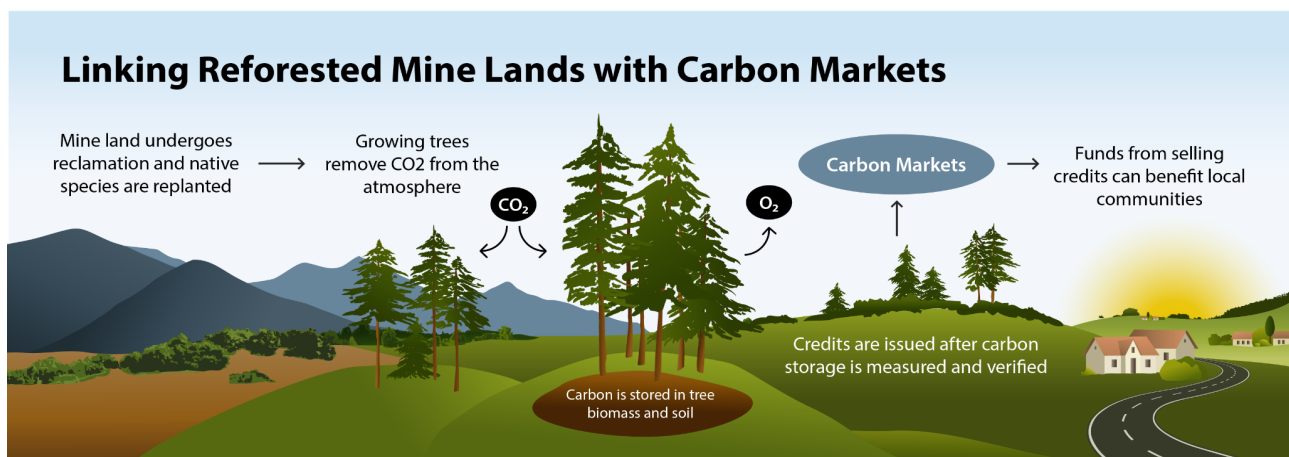


Image by Marcie Hancock

For a project to receive status as a carbon credit, it must demonstrate the following:

- **Permanence**, that management plans for forest health and maintenance must extend at least 100 years and undergo regular third-party verification every ~6 yrs
- **Non-leakage**, that the execution of this project does not produce unintended emissions elsewhere
- **Additionality**, that documents this forest provides additional carbon sequestration than would happen on this land without the project taking place
 - Note: We will choose a land site to reforest that was previously either not reclaimed, or poorly reclaimed, when mining concluded.
- Forests will be maintained against land conversion or other disturbances
- Carbon sequestered in trees will not return to the atmosphere from burning (ex: for fuel) or rotting (ex: as one would see in an unmaintained forest)

³⁶ Carbon Direct. "Criteria for High Quality Carbon Dioxide Removal." 2023.

<https://insights.carbon-direct.com/hubfs/Criteria-High-Quality-Carbon-Dioxide-Removal.pdf>

- This means dead trees need to be harvested with plans that guarantee that tree carbon remains sequestered in wood (ex: used in a construction projects)

To document that Appalachian Voices' project meets these requirements, a third-party verifier will evaluate the forest site. After a successful evaluation, verification is granted, and the project will enter the carbon markets. Eligibility criteria and registration are tracked through various agencies, and each registry uses a unique carbon accounting protocol, but they have the above standards in common.³⁷ Three of the most common registries are the American Carbon Registry (ACR), Climate Action Reserve (CAR), and Verified Carbon Standard (VCS).

Once ready for the carbon markets, different units will be used when describing sequestration amounts for trade. Sequestered carbon is traded as a carbon offset in MtCO₂e, or “metric tons of carbon-dioxide equivalent.” MtCO₂e is the number of metric tons of CO₂ emissions with the same global warming potential as one metric ton of another greenhouse gas. Offsets are calculated as the difference between a project's estimated amount of carbon sequestration and the amount a baseline would sequester (in this example, comparing amounts of forests versus grasslands).

- Other gasses are also measured in MtCO₂e to compare their potency as a greenhouse gas. For example, methane is twenty-five times more potent a greenhouse gas than CO₂, so one ton of methane is equivalent to twenty-five MtCO₂e.

In general, two types of carbon markets trade these offsets: voluntary and compliance/regulatory markets. **Voluntary markets** exist where companies or individuals buy credits voluntarily, usually for a sustainability goal. **Compliance markets** like “cap-and-trade” exist when laws or regulations mandate a limit on the quantity of greenhouse gasses that a person or company can emit.

Carbon Market Engagement

The world's most reputable voluntary carbon marketplaces are administered by non-governmental organizations and private businesses. These groups are charged with verifying carbon removal using protocols designed to ensure accountability, additionality, and transparency. Projects meeting these exacting criteria may market verified carbon offsets to buyers for whatever price the market will bear. Offset projects tend to yield premium prices when developers satisfy the toughest criteria.

³⁷ Parajuli, Rajan, Mark Megalos, Tatyana Ruseva, Stephanie Chizmar, Mansfield Fisher. “An Introduction to Forest Carbon Offset Markets.” North Carolina State Extension publication, July 2019. <https://content.ces.ncsu.edu/an-introduction-to-forest-carbon-offset-markets>

Appalachian Voices has determined that the standards and frameworks promulgated by Verra establish the highest bars in the voluntary carbon marketplace. Founded in 2007, Verra is a non-profit business that serves as a secretariat for a vast library of carbon accounting methodologies for diverse offset projects from afforestation and ecosystem restoration to plastic waste abatement and coal mine methane reduction. Many of Verra's methodologies for developing and monitoring offset projects are rooted in methodologies first deployed in the 1990s to govern offset projects deployed under the Clean Development Mechanism. With decades of experience holding offset projects to the highest standards, Appalachian Voices feels confident in Verra's methodologies.

Although carbon credits have been widely used in Appalachia to generate revenue for compliance actions and routine forest stewardship, there is little precedent for offset revenue associated with the reforestation activity envisioned by Appalachian Voices. While there is no methodology available to govern mineland reforestation, Appalachian Voices has identified a suitable methodology that can be employed with minimal modification. Verra's Methodology for Improved Agricultural Land Management, also known as VM0042, offers a modular approach to determining the carbon sequestered as a consequence of extreme, positive land use changes. Though originally conceived for agricultural applications, it has been widely used for reforestation applications. Expert consultations with Verra leadership confirm that the methodology could be deployed by Appalachian Voices without an expensive and time-consuming modification process.

As Appalachian Voices contemplates offset market engagement, the next steps will involve employing a consultant to help the core technical team design a project that will conform with the verification methodology, and thereby ensure timely generation of marketable offsets. Appalachian Voices will also explore the technical and financial viability of other natural carbon sequestration techniques. For example, when silicate rocks like basalt are crushed into a powder and exposed to rain, carbonate compounds leach over time into the soil providing an important soil amendment while locking atmospheric carbon permanently into the soil and water. Basalt and other silicate minerals are widespread in West Virginia at a comparatively low cost.

To bring this forestry carbon removal project into being, it is likely that Appalachian Voices would need to be creative in seeking funding sources. Availability at state and federal levels has not yet caught up with the need for climate-specific funding of nature-based solutions.

However, hopeful signs are on the horizon. Expansion at the federal level recently arrived in the form of the Inflation Reduction Act. Within the IRA, more than \$300 million was allocated for forestry projects. This includes \$150 million for underserved landowners to adopt

climate mitigation or forest resilience practices and \$250 million for underserved and small forest landowners to participate in emerging private markets.³⁸

Additionally, the USDA Healthy Forests Reserve Program offers financial assistance to help landowners restore, enhance and protect privately owned forests through conservation easements. HFRP supports the recovery of endangered and threatened species under the Endangered Species Act, improves plant and animal biodiversity, and enhances carbon sequestration. The program offers 10-year restoration agreements and 30-year or permanent easements for specific conservation actions.

Participating landowners will receive a Forest Stewardship Council (FSC) forest management plan for the property, a forest carbon inventory, assistance with carbon credit development and marketing, and potential additional income from the sale of carbon credits. Some landowners may avoid regulatory restrictions under the Endangered Species Act by restoring or improving habitat on their land for a specified period of time.

HFRP is administered in Virginia through a Regional Conservation Partnership Program project with The Nature Conservancy in the following target counties: Bland, Buchanan, Dickenson, Giles, Grayson, Lee, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe.

Conclusion

This project will be made possible with support from local partners, communities, leading practitioners, and researchers to develop a framework tailored for Appalachian ecology and economic needs. Appalachian Voices seeks your feedback to refine the process of this project development as we go. We invite your thoughts, comments, and feedback.

³⁸ Carbon180. "The IRA Funding That's Boosting Carbon Removal." August 2022. <https://carbon180.medium.com/the-ira-funding-thats-boosting-carbon-removal-1c93ba5008dc>

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