

Black to the Future: Biochar and Forests

Biochar at a glance

Creating biochar from wood usually burned in slash piles provides multiple benefits such as soil remediation and reducing wildfire risk.

What is biochar?

In forested landscapes, biochar is a carbon-rich soil amendment produced from woody residues (slash). Making and using biochar moves excess organic matter (e.g., branches, twigs) from projects that remove excess trees in overstocked forests to degraded soils that need it. For generations, Native Americans have been making and using biochar to improve the soil, and soil enhancement remains the dominant use today.

Making biochar in the woods

There are a few ways to convert slash to biochar in the woods. One way is to build slash piles on top of a deck of large logs. Then the piles are ignited from the top, creating a flame cap that helps reduce the amounts of smoke and particulates. When the flames go out, the coals are quenched leaving biochar. Just like a campfire, prescribed fire, or wildfire, quenching (either with water or by raking out the coals) prevents the smoldering wood from becoming ash. Biochar can also be produced in the woods using kilns and air curtain burners, which are moved between log landing sites. Just like designed slash pile burns, converting slash into biochar using kilns, or air burners produces less smoke and releases fewer particulates into the atmosphere, and doesn't damage the soil.

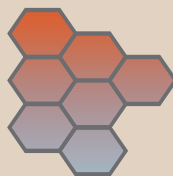
The CharBoss is an in-woods biochar production unit designed to be transported between locations to convert slash into biochar during forest management operations.



How can biochar be used?



Soil Amendment: Currently, biochar from woody residues is primarily used as a soil amendment. When added to soil, it enhances nutrient retention, which can assist with plant establishment. Depending on the amount applied and soil texture, biochar increases plant available water and increases soil organic matter. Biochar can also be added to nursery soils where it reduces nutrient leaching and the need for irrigation when growing native plants.



Site Remediation: When observed at the molecular level, biochar has a unique honeycomb structure, and this is what increases nutrient retention or adsorption of heavy metals or other soil contaminants. These properties make biochar useful for mine soil reclamation and for stormwater management. The honeycomb structure can even house beneficial microbial communities!



Renewable energy source: Current and future biochar technologies can produce energy co-products, such as bio-oil and gas, making them renewable sources of energy. By offsetting fossil fuels, this renewable bioenergy further contributes to biochar being carbon neutral to carbon negative.

The Biochar Recipe

The ingredients to make biochar are low- to no-value slash that would otherwise be burned in piles or left on-site to decompose. Biochar is made by burning slash in an oxygen-limited environment at relatively low-to-moderate temperatures (572° F – 1500° F). It can be produced at many scales, from small, on-site log landings to large, off-site facilities with a steady supply of woody biomass such as a bioenergy production facility.

Different biochar production methods and systems vary in their capabilities. For example, when biomass is dry, all methods can easily produce biochar. However, some biochar production systems, like air curtain burners and off-site facilities are able to continuously process wet biomass. Off-site facilities can also co-produce byproducts such as bio-oil and renewable gas. These byproducts can be captured and used for bioenergy, but because of the difficulty in processing, storing, and using liquid and gaseous fuels, most operations that include these byproducts are centralized, not mobile.



On-site production in harvest areas can create biochar from slash by using kilns or air curtain burners like the Charboss.

Biochar Benefits

Forest management activities that create biochar offer several benefits: 1) Converting non-merchantable woody biomass to biochar may generate revenue; 2) Converting excess woody biomass to biochar reduces forest fuel abundance



and wildfire risk; 3) Applying biochar to degraded soils can improve soil health by increasing soil moisture and soil pH, and it sequesters carbon.

Biochar and a changing climate

Biochar production systems can be carbon neutral or even carbon negative compared to biomass disposal by open burning. While some carbon is

released to the atmosphere during biochar production, once added to the soil, it sequesters substantially more carbon than alternative biomass disposal methods, such as chipping, burning, or



simply leaving it on-site to decompose.

Biochar decays much slower than biomass. This means that it releases carbon very slowly, sequestering carbon for hundreds to thousands of years.



Who can use biochar?

Anyone interested in improving soil health and combating climate change can use biochar! Biochar is especially useful on degraded soils that have little native organic matter.

How do I learn more?

This [Science You Can Use](#) describes the production, use, and benefits of biochar in more detail. You may also read these publications by RMRS scientists on the [production of biochar using forest biomass](#) and biochar's role in [providing ecosystem services to forests](#). RMRS has a [web page](#) dedicated to biochar related content, as well.



Biochar created from woody biomass in an Idaho forest. USDA Forest Service photo by Timothy Nicosia.

Rocky Mountain Research Station researchers work at the forefront of science to improve the health and use of our Nation's forests and grasslands. More information about Forest Service research in the Rocky Mountain Region can be found [here](#).

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