International Biochar Initiative

Introduction to Biochar

A multi-pronged climate change solution

Biochar is a powerful tool for mitigating the effects of climate change in agriculture and other industries, able to restore ecosystems and agricultural systems towards a circular, sustainable future. Biochar can be made with unused organic materials and can remove carbon and produce biofuels during its production.

Biochar carbon removal (BCR) that occurs during biochar production is a technologically ready, leading carbon dioxide removal (CDR) technology worldwide. Biochar has a CDR potential of 10% in over 25 countries, concentrated in Africa, South America, and Eastern Europe, and more than 20% in Argentina, Eswatini, Ghana, and Malawi – with even greater potential with the world's largest emitters, including Brazil, China, India, and the United States. BCR has the capacity to remove as much as 6% of current global greenhouse gas (GHG) emissions annually, the equivalent of India's yearly emissions, or taking 800 coal power plants offline.

What is Biochar? From its origins as a 1000+ year-old technique used by Indigenous peoples in the Amazon basin, biochar is a high-carbon, charcoal-like material created by heating waste organic matter (biomass) to high temperatures with low oxygen. This biomass might otherwise go to waste – crop residues and processing wastes, animal manure, sewage sludge, forest trimmings, and other non-marketable byproducts of biomass-based industries.

How Does Biochar Remove Carbon? Biomass like trees and other plants contain carbon dioxide (CO_2). When plants grow, they absorb CO_2 from the air as part of photosynthesis. When organic matter decomposes or burns, it releases CO_2 back to the atmosphere. By comparison, when biomass is instead transformed into biochar, the CO_2 stays locked inside. It becomes a carbon-rich material that can persist for thousands of years, improve soil health when integrated into soil, and store carbon rather than emitting it into the atmosphere.

Biochar carbon removal technology accounted for 94% of delivered carbon removal credits in 2023.

Due in part to its high accessibility as a carbon removal solution across widely varying technological scales – from simple on-the-farm kilns to industrial plants that can also generate energy. BCR is a circular solution that can cost as much as 1/3 less than alternative carbon removal technologies on a per-tonne basis.

How is biochar different from other biomass-based carbon removal solutions?

Biochar is a shovel-ready solution that not only removes emissions but also provides a host of social and economic co-benefits. These include its ability to retain more water and nutrients in soils, reduce irrigation needs, and increase crop yields, amongst many others. This is key, particularly within vulnerable agricultural communities on the frontlines of climate change. Biochar is also increasingly being used to replace high-emissions materials in products such as asphalt and concrete. Biochar production is also a positive alternative for managing waste materials that are often burned like crop or timber residues, improving air quality and human health.

How is biochar made and what are the byproducts?

Biochar is most effectively made from a process called pyrolysis, as well as through other forms of thermochemical conversion, notably gasification. Biomass like poultry litter, husks, tree prunings, etc., are heated in equipment at **very high temperatures** and **without/low oxygen**. Biochar production technologies are made at both small- and industry-scale – depending on the needs of the producer, project, or seller, and on the availability of sustainably sourced feedstock.

Biochar producers use local waste biomass streams, typically producing biochar close to the feedstock source to avoid costly transportation, and most importantly, use a feedstock that would otherwise be unused, decomposing, or put in landfills. While the feedstock material is heated, gasses like methane and carbon monoxide burn off, supplying energy and leaving the carbon-storing biochar as an end product.

The gasses from creating biochar can be combusted and used to produce heat or electricity, or they can be captured and processed into liquid biofuels.

How can society benefit from biochar use?

AGRICULTURE

enhances soil health • reduces acidity • improves water retention & drainage • increases microbial diversity • reduces chemical fertilizer requirements

WASTE MANAGEMENT

alternative to open dumping or pile burning • converts waste into valuable resource • destroys contaminants like PFAS • curbs odors • mitigate landfill contamination

INDUSTRIAL USES + BUILT ENVIRONMENT

replace materials of fossil & mineral orgin • improve existing products • improve thermal insulation • preserve structural integrity • seal away carbon dioxide

ABANDONED OIL + GAS WELLS

fill defunct wells • filter harmful gas leaks • block the formation of certain greenhouse gasses like carbon dioxide and methane

LANDSCAPE MANAGEMENT + CONSERVATION

provide conditions for thriving microbial biodiversity • decrease spread of invasive species • provide biomass end-use for invasive species reduction projects

FOREST MANAGEMENT (BEFORE + AFTER FIRES)

enrich forest soil • provide biomass end-use for fire reduction projects • carbon credit benefits • reduce particulate air pollution from open pile burning

LAND + WATER REMEDIATION

absorbs & immobilizes heavy metals / organic contaminants • removes inorganic pollutants like PFAS • removes sulfur compounds from gasses

ENERGY GENERATION

generate electricity and heat from pyrolysis process • produce and sell biofuels or bio-oil from gasses captured during pyrolysis

Explore in-depth descriptions of biochar's co-benefits in the online version of this publication: bit.ly/3TcIZ8M