GEOENGINEERING MONITOR

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Biochar   Photo by Marcia O'Connor via Flickr

Biochar

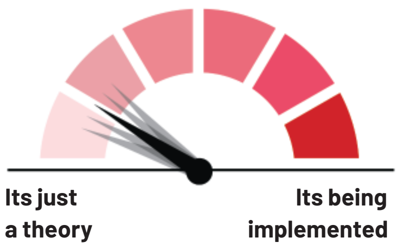
Description and purpose of the technology

Biochar is produced from biomass through heating in the absence of oxygen or under low oxygen levels. This transformation process is known as pyrolysis and the resulting “biochar” is a solid and charcoal-like substance. This proposed carbon dioxide removal (CDR) approach uses very large quantities of biomass, such as forestry or agricultural products and wastes, and high pyrolysis temperatures, e.g. up to 900°C, to produce a carbon-rich residue which can be mixed into soil, where carbon is – theoretically – stored and absorbed into plants.

Biochar is also promoted as a solution to soil degradation and low crop yields. The substance’s interactions with varying soils conditions and environments are, however, far from being fully understood. The chemical composition, properties and durability of biochar are not consistent, because they depend on a large number of variables such as biomass feedstock, pyrolysis temperature and time as well as soil properties, climate conditions and application rates.

Point of Intervention:

Reality Check:



That is why the effects of biochar on soil carbon and soil fertility in field trials are contradictory – with outcomes that are positive, negative or neutral.[1]

A widely promoted idea suggests that biochar should be produced in pyrolysis plants which recover energy in the form of gas or oil along with the biochar. However, such systems are not technically proven at a commercial scale.[2]

Long-term effects of biochar in soils have not been researched, but promoters of biochar point to Amazonian black soils known as terra preta, where Indigenous groups buried large amounts of organic matter to enhance soil fertility. Radiocarbon dating suggests that the organic remnants date back thousands of years, but such tests do not clarify the initial quantity of organic matter applied to the soils.[3]

Studies assume that only a small share – about one fifth of the carbon absorbed by plants through photosynthesis – can be stored by transforming biomass into biochar, because a proportion of the biomass breaks down into gaseous and liquid components. It is also important to bear in mind that the production process is energy-intensive.[4]

Therefore, a theoretically effective version of biochar would be produced at an industrial scale using large land areas for biomass plantations and demand a large amount of renewable energy.

The demand for land would compete directly with food production, and thus impact on peasant and indigenous territories and livelihoods, while demand for zero-carbon electricity would place stress on the transition away from fossil fuels. As a result, larger-scale biochar production could increase prices for both food and renewable energy.

Actors involved

Biochar has received support from financial backers such as Shell, ExxonMobil, Chevron, and the Bill and Melinda Gates Foundation. It has received corporate support from the Canadian tar sands industry by companies like Cenovus or Conoco Philipps. Despite this extensive funding, biochar has still not been developed at a larger scale. Hungry to get carbon credits, national and transnational biochar initiatives, research projects, producers and field trials, have proliferated.

Initially, small biochar projects in the Global South multiplied. Few of these were accompanied by scientific studies, and many appeared to serve mainly as attempts to attract greater investment for biochar.

Meanwhile, biochar projects are distributed worldwide and biochar research is increasingly organized by interregional biochar initiatives or financed by public funds in Europe, Australia, China and in the USA. Many biochar initiatives and biochar producers are members in the US-based International Biochar Initiative (IBI), with many of the members from Asia and Northern America. IBI organizes annual biochar conferences and actively promotes offsetting, carbon markets, commercialization and demonstration of biochar production.[5]

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Impacts of the technology

In 2010, members of IBI published an article in Nature Communications suggesting that 12% of the world's annual greenhouse gas emissions could be offset with "sustainable biochar."[6] This figure has been quoted extensively. Less cited is the fact that the article assumed that 556 million hectares of land would be converted to biochar production, an area 1.7 times the size of India.

The second figure confirms fears that an ambitious global biochar programme would require land-conversion to industrial, chemical-intensive, monoculture plantations on a vast scale, with large impacts on peasants livelihoods, biodiversity and ecosystems.[7] Instead, biochar proponents prefer to talk about burning "wastes and residues," but the potential is very limited. To achieve 1% of Germany's greenhouse gas reduction target for the year 2030 by producing biochar, for example, the total quantity of solid and fermentable biomass available in Germany would need to be pyrolyzed.[8]

Biochar proponents claim that burning biomass is "carbon neutral" because the carbon released during combustion will be reabsorbed by new trees or crops. But only a small share – about one fifth of the carbon absorbed by plants through photosynthesis – can be stored by transforming biomass into biochar. Some studies do not support the claim that biochar remains stable in soils, instead showing increases in CO_2 emissions from biochar amended soils.

Moreover, the lifecycle assessment for biochar production gives it a lackluster prognosis. It is energy- and emission-intensive, due to factors like energy expenditures for high pyrolysis temperatures, biomass drying, transit distances for biomass and biochar and incorporation of biochar into soils.[9]

A report produced by the European Commission points out that large-scale production and application of biochar would compete with biomass necessary for building up humus, that biochar does not directly feed soil organisms and is also concerned about the persistent pollution of soils with potential contaminants such as PAHs, dioxins, PCBs or heavy metals.[10]

It is important to note that there is no such thing as "waste" in ecosystems. In forests, for example, everything is recycled, via decay, supporting regeneration and regrowth. In many places, definitions of waste have been expanded to include virtually any wood that is not valued as saw logs, so timber harvests become more intense and destructive by removing biomass from forests. In agriculture, there are often better, more ecologically sustaining options for residues, such as compost, mulch, animal fodder, and bedding.

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Industrial forestry and agriculture practices have already wreaked havoc on ecosystems; creating a market for the waste products of unsustainable practices is not a step in the right direction.[11]

Reality check

Despite concerns around biochar's impacts and unanswered questions about its effectiveness, the number of biochar projects has continued to grow worldwide. Currently, at least 140 biochar trials – many of them on the scale of laboratories and greenhouses – are taking place or have been recently completed worldwide, with a number of pilot pyrolysis plants being built.[12] A World Bank-funded survey identified 150 biochar projects in 2011 and IBI mentioned more than 300 biochar producing companies in 2015.[13] However, scientific studies show that the effects of biochar on soil carbon and soil fertility in field trials are contradictory and that the potential for biochar is very limited due to the large quantities of biomass needed.[14]

Further reading

Biofuelwatch, "***What have we learned about biochar since Biofuelwatch 2011 report was published?***" https://www.biofuelwatch.org.uk/wp-content/uploads/biochar-briefing-2020.pdf

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Declaration: ***'Biochar,' a new big threat to people, land, and ecosystems***, https://www.rainforest-rescue.org/news/1150/declaration-biochar-a-new-big-threat-to-people-land-and-ecosystems

The African Biodiversity Network and Biofuelwatch, "***Biochar Land Grabbing: The impacts on Africa***," http://www.biofuelwatch.org.uk/wp-content/uploads/biochar_africa_briefing2.pdf

ETC Group and Heinrich Böll Foundation, "***Geoengineering Map***," https://map.geoengineeringmonitor.org/

Endnotes

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