PETER WEISBERG EXPLORES THE POSSIBILITIES FOR LINKING BIOCHAR WITH CARBON MARKETS

Sparking biochar's potential

I held biochar for the first time in March 2009 at an abandoned paper mill in a struggling timber town in Oregon. John Miedema, a self-taught electrical engineer, welder and founder of the Pacific Northwest Biochar Initiative, had convinced a local timber company to pilot biochar production utilising its waste woody biomass.

John struggled to start a small gasifier he had bought from an ex-commune. Sparks flew from the machine, and the small group of visiting biochar enthusiasts stepped back in fear. The sparks and the scraps of steel and welding equipment that littered the log yard were clear indications of the marginal nature of this technology. And yet, I knew biochar had enormous potential to change how we think about capturing and sequestering carbon.

Biochar is made by heating organic material to high temperatures with little or no oxygen in a process called pyrolysis. It looks and feels like charcoal. The difference is how they are used: charcoal is a fuel, while biochar is intended to sequester carbon and be buried in soils to enhance their productivity.

Biochar can be made from a huge range of systems, from household-scale cook stoves to industrial production units. Changing the feedstock, method and duration of pyrolysis or temperature changes biochar's chemical characteristics.

These characteristics impact the stability of the biochar's carbon and its effectiveness as a tool for carbon sequestration. Photosynthesis sequesters carbon in biomass as it grows, and this carbon is normally released back to the atmosphere as the biomass decomposes.

Biochar alters this cycle because it resists decomposition and, therefore, stores sequestered carbon for hundreds or even thousands of years. Carbon sequestered 2,000 years ago can still be found in the terra preta soils in the Brazilian Amazon.

This ability to alter the carbon cycle, combined with the scale at which biomass can, in theory, be grown and converted into biochar, means that this relatively untested technology could reduce greenhouse gas (GHG) emissions at a similar scale as energy efficiency or wind, solar or nuclear energy.

The International Biochar Initiative believes it could sustainably sequester 1 billion tonnes of carbon dioxide (CO_2) every year – equal to one of the eight "wedges" needed stabilise the concentration of greenhouse gases (GHGs) in the atmosphere. A variety of researchers estimate biochar production in the US could reduce emissions by between 100 and 500 million tonnes of CO_2 equivalent a year. At its maximum potential, biochar could mitigate up to 12 per cent of the world's current emissions.

Biochar also provides "sustainable development benefits." Amending soils with finely ground biochar increases a soil's surface area and its ability to retain moisture and nutrients. This increased fertility could be important as climate change degrades and leads to desertification of soils.

Before carbon markets can monetise the climate benefits of biochar projects, stakeholders must create protocols to qualify and quantify biochar projects as carbon credits.

Existing protocols capture a small subset of biochar's climate benefits: renewable energy and biomass generation protocols for this benefit are well established.

Some projects prevent feedstocks from decomposing without oxygen and releasing methane to the atmosphere; the clean development mechanism's small-scale avoidance of methane production from biomass decay through controlled

Biochar (right) made at John Miedema's (left) pilot biochar project in Oregon.

pyrolysis methodology captures these reductions.

Yet, renewable generation and methane avoidance represent only 20–60 per cent of biochar's GHG reductions. No existing methodology captures biochar's unique ability to sequester carbon in biomass that would otherwise be released to the atmosphere. Accounting for this distinct benefit has the complexity of both biomass energy and sequestration projects, with the added scientific challenge of characterising the properties of different types of biochar.

The Climate Trust recently wrote Carbon Market Investment Criteria for Biochar Projects, a report under review for publication by the California Energy Commission. It examines accounting issues and how they affect which biochar projects will and will not generate high quality carbon credits. Leakage, measurement and scale emerged as the three main barriers to creating offsets from biochar.

Leakage

Feedstocks that, in the absence of a project, will simply be burned without generating energy or left to decompose do not cause leakage and are the easiest to accurately quantify. If the feedstock used by a biochar project has alternate beneficial uses, however, the project could cause increased emissions outside of the project. If biochar projects pyrolyse merchantable wood, for example, harvest may increase elsewhere to make up for the reduced supply.

Biochar deserves the attention of carbon markets. No other technology offers such potential

The reduction in carbon stocks outside of the project needs to be quantified and deducted from its overall emission reductions. Unfortunately, it is difficult to accurately account for this, especially when emissions are influenced indirectly through global food or timber markets.

Until accounting protocols for land-use change mature, biochar projects that use feedstocks without any alternate beneficial use will be the most attractive to carbon markets.

Ongoing or upfront measurement

A portion of any biochar will always decompose. That portion varies depending mainly upon the temperature of pyrolysis and the environment into which the biochar is incorporated. Measuring how much of the carbon in biochar will remain sequestered for 100 years is essential to quantify the offsets a biochar project will generate.

There are different options for conducting this measurement. Rigorous protocols could require developers to measure the amount of biochar remaining every five or 10 years and use this data to calibrate decomposition models that will predict how the biochar will decompose over a century.

As more data is gathered, the models become more certain, and credits could be delivered based on this confidence. Ongoing measurement also requires project developers to track where all the biochar produced is sold and integrated into soils, which is likely to be either impossible or expensive.

Alternatively, projects could measure the permanence of their biochar upfront by testing the biochar only when it is produced and then generating decomposition models based on the results. Under the upfront measurement technique, credits would be delivered when the biochar is produced. Upfront measurement is preferable, but will require more research to enable quick and cost-effective characterisation of many different types of biochar.

Scale

Biochar projects must generate enough credits to cover the relatively fixed transaction costs of monitoring and verifying a project. However, biochar production is currently at a pilot scale. The project I visited in Oregon produces around 8.25 tonnes of biochar a year. Each tonne of biochar generated by the project reduces an estimated 2.18 tonnes of CO_2 equivalent, meaning the project reduces 18 tonnes of CO_2e per year.

While larger systems exist, no US projects produce biochar at a scale that justifies the transaction costs associated with monetising carbon credits. Before carbon markets can play a clear role, the industry needs to grow or biochar producers need to be aggregated under larger programmes.

Biochar is an early stage technology that's importance as a climate mitigation tool is still unclear. Yet, biochar deserves the attention of carbon markets, because no other technology offers such an enormous and almost entirely unrealised potential to remove carbon from the atmosphere and thereby mitigate climate change.

Compared with the challenges facing global land-use change and fossil-fuel dependence, biochar provides a golden opportunity to tackle global warming. Two developments are necessary: a high-quality protocol that ensures projects source only sustainable biomass and a robust carbon market to financially reward projects' unique carbon benefits. Taken together, biochar could soon become a household word. ●

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