Bichar Machine

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G’day, Liam Mannix here. Welcome to *Examine*.

In a warehouse somewhere near the border of Victoria and NSW sits a hulking machine built to fight the climate crisis.

When it ran, it ran perfectly, taking carbon that would have entered the atmosphere and sequestering it in the ground – essentially forever.

Today, it is silent. Decommissioned.

“It was before its time. We were too early,” says Lachlan Campbell, the man responsible for the machine. “But we couldn’t justify the expense, basically.”

The silence of the shipping-container-sized machine tells an important story as we race to decarbonise: even if the science behind a climate solution stacks up, the solution itself may not.

Campbell works as the sustainable agriculture facilitator for the North East Catchment Management Authority. His team spend much of their time stripping out the willow trees that choke many of the state’s waterways.

The waste is simply burned – releasing the carbon the trees have locked away into the atmosphere. “It’s a terrible waste,” says Campbell.

Their pyrolysis plant seemed the perfect solution.

The machines super-heat material in very low oxygen environments – without oxygen, rather than combustion you get pyrolysis – thermochemical decomposition. The water and volatile compounds within the wood boil away, chemical bonds break down, and what is left is a relatively unreactive lattice of mostly carbon atoms known as biochar. It looks like dirt, or charcoal.

Biochar is an intriguing substance, for two reasons. The carbon atoms are baked together into a highly stable structure – think of it as locking the carbon together. You can then bury it in the soil and the carbon should stay there, instead of being released into the atmosphere, for thousands of years.

The second attribute is more unexpected and more exciting. Industrial agriculture strips nutrients from the soil, which farmers replace with fertiliser (fertiliser production is responsible for 1 to 2 per cent of global emissions). Biochar's carbon lattice can hold nutrients in the soil, where they can be slowly released to support plant growth.

While plants respond differently to biochar, studies of its application show it led to an average increase of 20 per cent in crop yield. Plus, biochar generation can earn high-quality carbon credits, which traded at $US165 ($257) per metric tonne in 2024.

“It’s so good, it sounds like bulls--t,” says Ryan O’Connor, biochar manager at Green Man Char. “It’s magic, it really is.”

This feels like the sort of co-benefit we should be looking for as we try to solve the climate crisis. So why is Campbell’s biochar machine sitting silent?

Balwant Singh, a professor of soil science at the University of Sydney, might be best-placed to explain that.

“I have researched almost every aspect of biochar. We have published more than 20 papers on this. I published a book,” he says. “It has very little potential, if you consider all the factors and processes.”

The problem, as with many purported climate solutions, is not the final product – biochar seems to work. It is the extraordinary difficulty of building a low-cost, zero-carbon supply chain in a carbon-addicted world.

Biochar production is enormously energy-intensive. And you need vehicles to gather the waste, distribute the biochar, and bury it in the soil. “It all costs energy – and energy is CO2,” says Singh.

To get the price down, you need scale. But different feedstocks – wood, straw, manure, waste food – produce different biochars that are suitable for different soils and crops. And there are concerns about contamination.

The federal government has funded two National Biochar Initiatives. “I was part of both. We finished them seven or eight years ago. If it was a very viable technology, it would have been taken up,” says Singh.

Former climate commissioner Tim Flannery was one of biochar’s strongest early advocates. But as more has become known about the difficulty of scaling the technology up – particularly the difficulty of achieving economies of scale – his enthusiasm has cooled.

“If you’re looking at scalable solutions, it is not ready yet and may not be in the future. It will always have a niche role. But it’s not going to be a scalable solution,” Flannery says.

That may be true – Australia’s fledgling biochar industry admits it faces a tough sell until the market grows large enough to create economies of scale. “Our price is too high. [Customers]

want to pay $300 a cubic metre maximum, and ours is double that," says Ryan O'Connor.

This is also the problem Campbell's machine faced: after energy, labor and fuel costs are factored in, his machine is simply too expensive to run. It has become a stranded solution. "The figures don't add up."

But that's not the end of the story. At a factory in Port Melbourne, a team of Australian entrepreneurs is finding success overseas.

Earth Systems has sold the machines it makes to Sweden, Hong Kong, New Zealand and Israel, along with several Australian councils. Pictured above is the company's principal environmental engineer, Adrian Morphett, with one of the machines.

"The Australian market is growing rapidly," says O'Connor. "As the production scales up, the biochar price will find a balance."

What can we take from this story?

With limited resources and political will, we need to focus on solutions that can scale quickly and cut emissions sharply, like connecting solar and wind to the grid to replace coal. “What we have to do, first and foremost, is cut our burning of fossil fuel as quickly as we can,” says Flannery.

But decarbonising the entire economy will present complex problems – and require many niche solutions. And here, biochar could play a role.

“We need to employ all these things,” says Emeritus Professor Lesley Hughes, a co-author on the Intergovernmental Panel on Climate Change. “There isn’t a single brilliant solution because there will be different solutions in different circumstances.

“We need to employ all these solutions, as soon as possible, all at once.”

Liam Mannix

National Science Reporter

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