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MIT Technology Review

CLIMATE CHANGE

A stealth effort to bury wood for carbon removal has just raised millions

Kodama has raised more than $6 million from Bill Gates' climate fund and other investors, as it pursues new ways to reduce wildfire risks and lock away carbon in harvested trees.

By James Temple
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A California startup is pursuing a novel, if simple, plan for ensuring that dead trees keep carbon dioxide out of the atmosphere for thousands of years: burying their remains underground.

Kodama Systems, a forest management company based in the Sierra Nevada foothills town of Sonora, has been operating in stealth mode since it was founded last summer. But MIT Technology Review can now report the company has raised around $6.6 million from Bill Gates's climate fund Breakthrough Energy Ventures, as well as Congruent Ventures and other investors.

In addition, the payments company Stripe will reveal on Thursday that it's provided a $250,000 research grant to the company and its research partner, the Yale Carbon Containment Lab, as part of a broader carbon removal announcement. That grant will support a pilot effort to bury waste biomass harvested from California forests in the Nevada desert and study how well it prevents the release of greenhouse gases that drive climate change.

It also agreed to purchase about 415 tons of carbon dioxide eventually sequestered by the company for another $250,000, if that proof-of-concept project achieves certain benchmarks.

"Biomass burial has the potential to become a low-cost, high-scale approach for carbon removal, though there is a need for further investigation into its long-term durability," said Joanna Klitzke, procurement and ecosystem strategy lead for Stripe.

For the last several years, Stripe has pre-purchased tons of carbon dioxide that startups aim to eventually draw out of the air and permanently sequester, in an effort to help build up a carbon removal industry. It has also helped establish a different model for counteracting corporate climate emissions that goes beyond simply purchasing carbon credits from popular offsets projects, such as those that involve planting trees, which have come under growing scrutiny.

A handful of research groups and startups have begun exploring the potential to lock up the carbon in wood, by burying or otherwise storing tree remains in ways that slow down decomposition.

Trees are naturally efficient at sucking down vast amounts of carbon dioxide from the air, but they release the

carbon again when they die and rot on the ground. Sequestering trees underground could prevent this. If biomass burial works as well as hoped, it may provide a relatively cheap and easy way to pull down some share of the billions of tons of greenhouse gas that studies find may need to be removed to keep global temperatures in check in the coming decades.

But until it's been done on large scales and studied closely, it remains to be seen how much it will cost, how much carbon it could store, and how long and reliably it may keep greenhouse gases out of the atmosphere.

Dead wood

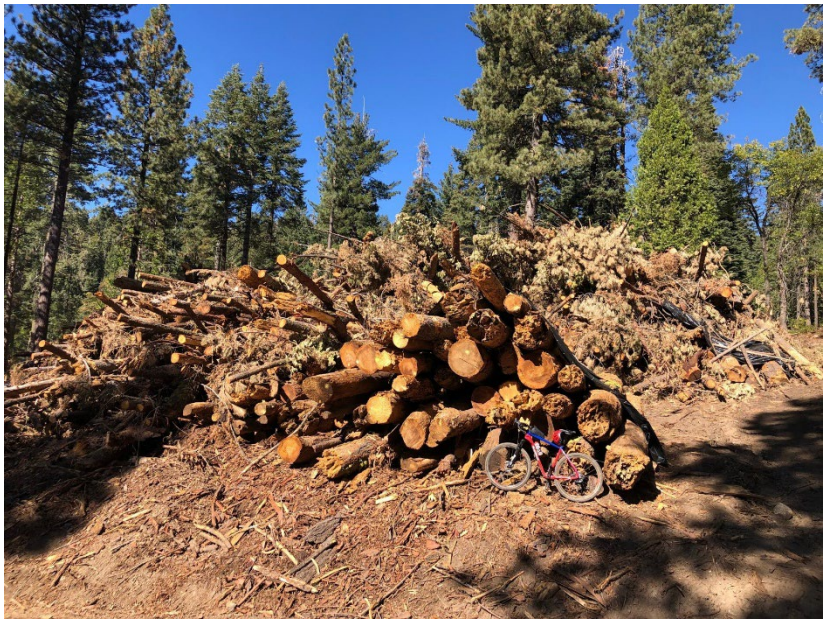
Forest experts have long warned that decades of overly aggressive fire suppression policies in the US have produced dense, overgrown forests that significantly increase the risk of major conflagrations when wildfires inevitably occur. Climate change has exacerbated those dangers by creating hotter and drier conditions.

Following a series of devastating fire years across the West, a number of states are increasingly funding efforts to clear out forests to reduce those dangers. That includes removing undergrowth, cutting down trees, or using controlled burns to break up the landscape and prevent fires from reaching forest crowns.

States are expected to produce more and more forest waste from these efforts as climate change accelerates in the coming years, says Justin Freiberg, managing director of the Yale Carbon Containment Lab, which has been conducting field trials exploring a number of "wood carbon containment" approaches under different conditions for several years.

But today, the harvested plants and trees are generally piled up in cleared areas and then left to rot or deliberately burned. That allows the carbon stored in them to simply return to the atmosphere, driving further warming.

Kodama hopes to address both the wildfire dangers and the emissions challenge. The company says it's developing automated ways of thinning out overcrowded forests that will make the process cheaper and faster (though it's not yet discussing this part of the business in detail). After stripping off the limbs from trees too small to be sold for timber, they'll load them into trucks and ship them to a prepared pit.



[Right] Small logs and other biomass collected by Kodama.

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The key will be to ensure that what the company refers to as a "wood vault" keeps out oxygen and water that would otherwise accelerate decomposition and prevents greenhouse gases from leaking out.

In the field effort with Yale researchers, expected to begin in the third quarter of next year, the company intends to create a burial mound in the Nevada desert that's seven yards high, three yards deep, and 58 yards long and across.

They plan to cover the biomass with a geotextile liner and then bury that under soil and a layer of native vegetation selected to absorb moisture. Given the region's dry conditions, this will create a contained system that prevents "agents of decomposition from acting on the buried wood mass," ensuring that the carbon stays in place for thousands of years, says Jimmy Voorhis, head of biomass utilization and policy at Kodama.

Freiberg adds that they'll also leave wood exposed at the site and create smaller side vaults designed in different ways. The teams will continue to monitor them and compare decomposition rates and any greenhouse-gas leakage for years. The teams expect to be able to extrapolate long-term carbon storage estimates from that data, along with other studies and experiments.

Burial costs

Other startups and research efforts are taking different approaches to the problem.

The Australian company InterEarth believes that allowing trees to soak up salty groundwater before burying them will effectively pickle the wood, preserving it for extended periods.

The Carbon Lockdown Project, a public benefits corporation founded by University of Maryland professor Ning Zeng, has proposed creating pits that are lined with clay or other materials with low permeability.

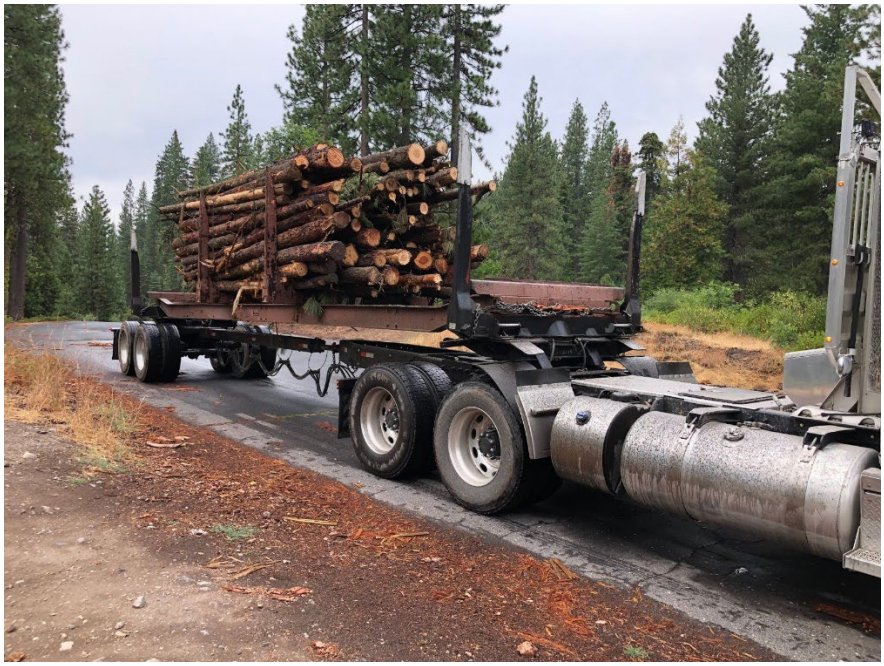
In a paper this year, Zeng and a colleague also highlighted a number of other potential approaches, including storing biomass in frozen sites, underwater, or even in above-ground shelters. His earlier work found that harvesting and storing wood could potentially remove several billion tons of carbon dioxide a year at a cost of well below $100 a ton.

But there are still many unknowns.

"We have to recognize that the science of wood harvesting and storage is still evolving," says Daniel Sanchez, chief scientist for biomass carbon removal and storage at Carbon Direct, which evaluates carbon removal efforts and corporate climate plans. "Most importantly, our understanding of what drives or doesn't drive decomposition of wood needs to be refined."

On top of that, residents and environmental groups are often opposed to forest thinning. Sawing down trees and removing them from the steep slopes of dense forests is a laborious and costly process that will be difficult to automate effectively. Hauling around bulky tree remains and digging big holes is also expensive and requires a lot of energy.

The climate emissions produced by removing, transporting, and burying wood will need to be carefully tallied and counted against the total carbon stored.



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Finally, there's the question of acquiring the necessary waste biomass.

A 2020 study by Lawrence Livermore National Lab found plenty to go around for these sorts of purposes today, estimating that 56 million "bone dry" tons of waste biomass are produced each year just in California from agriculture, logging, fire prevention, and other activities. (Wood is about 50% carbon by mass.)

But demands for it are set to rise as startups like Kodama, Mote Hydrogen, and Charm all seek out these sources for various biomass-related carbon removal efforts and the world races to achieve ambitious climate targets.

There's some risk that eventually all these efforts could create perverse incentives to remove more trees or agricultural material than necessary for fire prevention or healthy for ecosystems. After all, removing biomass also reduces the levels of nutrients that forests and farms get from rotting plants.

Kodama says it has done economic and carbon assessments for its full process. It's confident that it can achieve costs below $100 a ton of carbon, and estimates that emissions from the pilot project will only reduce the net amount of carbon ultimately sequestered by about 15%.

Merritt Jenkins, the company's cofounder and chief executive, says they plan to earn revenue from their forest thinning work, as well as by selling usable timber and carbon credits from its burial projects.

But Yale's Freiberg stresses that the critical mission of the moment is to use that Stripe grant to help answer these "big scientific questions around burial biomass … and demonstrate that this is indeed a solution worth backing.

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