

A 'green' use for air-captured CO₂: Growing beneficial algae

Algae and cyanobacteria can be cultivated to make fuels, chemicals, proteins, pigments and other useful products

By Gabriela Harrod, ASU News
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As the world looks for ways to reduce greenhouse gases, researchers are exploring not only how to pull carbon dioxide from the air, but also what to do with it once it is captured.

A team of Arizona State University researchers is testing one possible answer: using CO₂ from the air to help grow cyanobacteria and algae, tiny photosynthetic organisms that can be used to make fuels, chemicals, proteins, pigments and other useful products.

The approach could help solve a problem in algae and cyanobacteria cultivation. Like plants, these organisms need CO₂ to grow. One common way to deliver it is called sparging, which involves bubbling CO₂ gas through the water in a pond or reactor. But much of that gas escapes before the organisms can use it.

“If you’re bubbling with CO₂, most of it is going up into the air,” said [Wim Vermaas](#), a Foundation Professor in the [School of Life Sciences](#) and a [senior Global Futures scientist](#).

That challenge is at the center of two recent papers from ASU researchers, including Vermaas, that explore a different way to feed carbon to cyanobacteria and algae: capturing CO₂ directly from the air and delivering it into the liquid where the organisms grow.

The technology uses polymers that capture CO₂ when dry and release it when wet. In the system developed by ASU researchers, the material is carried on a rotating belt. As the belt moves through the air, the polymer dries and adsorbs CO₂. As it moves into the liquid growth medium, it releases that CO₂. Then the belt rotates back into the air and repeats the process.

Vermaas describes it as “a bucket brigade of bringing CO₂ into the medium.”

The work connects direct air capture, a technology designed to remove carbon dioxide from the atmosphere, with the cultivation of cyanobacteria and algae.

"We are developing a platform that can capture carbon directly from ambient air and deliver it where it creates value, whether that is cultivating algae and cyanobacteria, enhancing greenhouse food production, supporting carbon mineralization or enabling other carbon-based manufacturing processes," said [Justin Flory](#), associate director of research for ASU's [Center for Negative Carbon Emissions](#), who was the first author of the papers. "The same core technology can connect direct air capture to many different pathways for putting atmospheric carbon to productive use."

For the researchers, the idea was not simply to capture CO₂, but to make it useful. If algae or cyanobacteria cultivation is scaled using conventional CO₂ sparging, Vermaas said, the process risks wasting large amounts of CO₂ and sending much of it back into the atmosphere. Using ordinary air is not a simple substitute, because air contains only about 0.04% CO₂, meaning enormous volumes would be needed to deliver enough carbon for growth.

"So what we came up with was this idea: Let's absorb CO₂ from the air onto those polymers," Vermaas said.

[The first](#) of the two papers focuses on the application: whether air-captured CO₂ can support the growth of cyanobacteria. Researchers tested the system at multiple scales, from small flasks to a 12-liter bench system and an outdoor raceway pond at ASU's Arizona Center for Algae Technology and Innovation in Mesa.

In those tests, the team showed that cyanobacteria could grow using CO₂ harvested by the polymers and released into the growth medium. According to Vermaas, growth was "just as good as it would be otherwise," showing that the organisms did not need conventional CO₂ sparging to receive the carbon they needed.

The [companion paper](#) focuses more closely on the system itself: how the rotating belt works, how quickly the material dries and reloads with CO₂, and what it would take to make the approach more practical and affordable.

The team also tested the approach in an 840-liter (roughly 300 gallons) outdoor raceway pond, giving researchers a chance to move beyond tightly controlled lab conditions. Seeing the pilot-scale system work outside was encouraging, Vermaas said.

"You can go from 50 milliliters to 800 liters," he said. "That's a 16,000-fold scale-up, and it works."

The rotating belt itself can be understood in everyday terms as a moving track carrying small packets of polymer. Vermaas compared the polymer packets to permeable bags, "like a tea bag," that allow water and CO₂ to move while keeping the material contained. In the demonstrated system, the belt moved directly through the algae pond; the liquid medium was not transferred elsewhere, but served as the place where the organisms could grow.

The research also points to the realities of moving an academic concept toward a usable technology. The team found that the polymer materials need to dry faster, resist biofouling, last longer under outdoor conditions and become more cost effective. In outdoor and cultivation settings, biological material can build up on the polymer and reduce performance. The beads can also become brittle over time after repeated wetting, drying and exposure to ultraviolet light.

"There's still a lot that needs to be done," Vermaas said. "That's part of the role of academia: to develop early ideas that others can help move forward."

The companion paper's techno-economic analysis suggests the approach could become competitive with other carbon-capture systems if the materials improve. The researchers estimate current capture costs at about \$229 per tonne of CO₂ delivered into alkaline solution, with the potential to drop into the \$60 to \$100 range as polymer capacity, durability and system design improve.

For now, Vermaas said the pilot-scale system should be seen as a proof of concept, not a complete climate solution, "but if you scale it further, it could help."

That balance is part of what makes the research compelling: It is both imaginative and practical, pairing a simple visual idea with a complex global challenge. A belt moves through air and water. A material grabs carbon, lets it go and grabs more. Microscopic organisms use that carbon to grow.

The project also reflects the kind of team-based research needed to move climate technologies forward, bringing together expertise in life sciences, engineering, materials science, carbon capture and economic analysis. Collaborators include the School of Life Sciences, the Center for Negative Carbon Emissions and the [Arizona Center for Algae Technology and Innovation](#).

"This is one of those things that needs a whole team of different people," Vermaas said. "We all have different skills and expertise. We need to work together."

Vermaas hopes the papers help the work reach people who can support the next stage of development. Like many university-born technologies, he said, promising ideas can stall in the difficult space between proof of concept and real-world product.

The next step is finding ways to keep improving the system: better polymers, less fouling, longer lifetimes and designs that can operate at larger scales. If those pieces come together, ASU's rotating-belt system could offer a less wasteful way to cultivate cyanobacteria and algae while pulling carbon from the air.

This work also aligns with ASU's Changing Futures campaign and its commitment to "Reshape our Relationship with the Planet," which supports research and partnerships aimed at building a more sustainable future. Readers interested in learning more about engagement opportunities can visit the [Changing Futures campaign site](#).

In the meantime, the research offers a clear example of how basic discovery can become applied climate innovation, and how ASU scientists are working across disciplines to test ideas that may help shape more sustainable systems in the future.

This story originally appeared on [ASU News](#).

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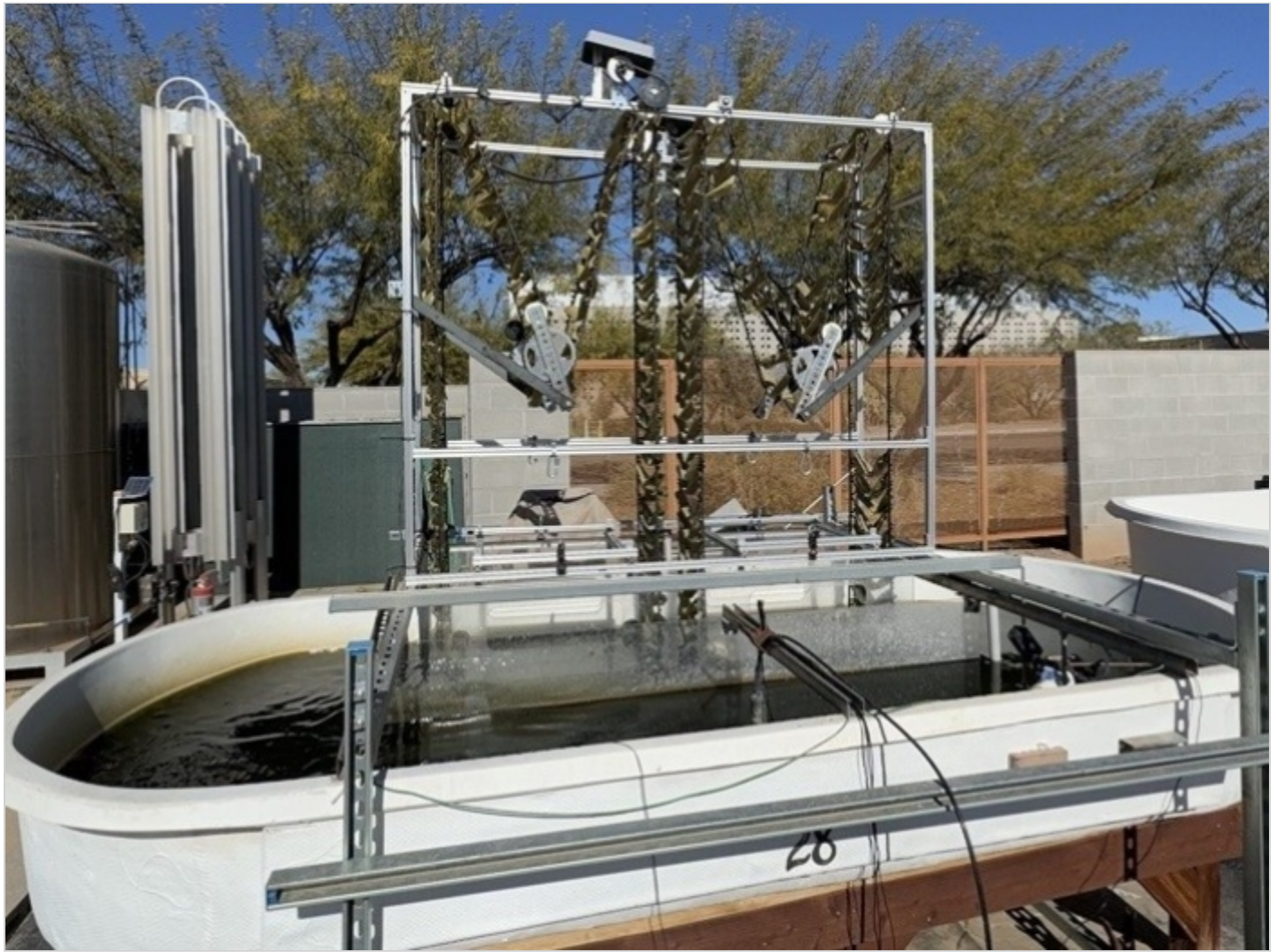
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Main image

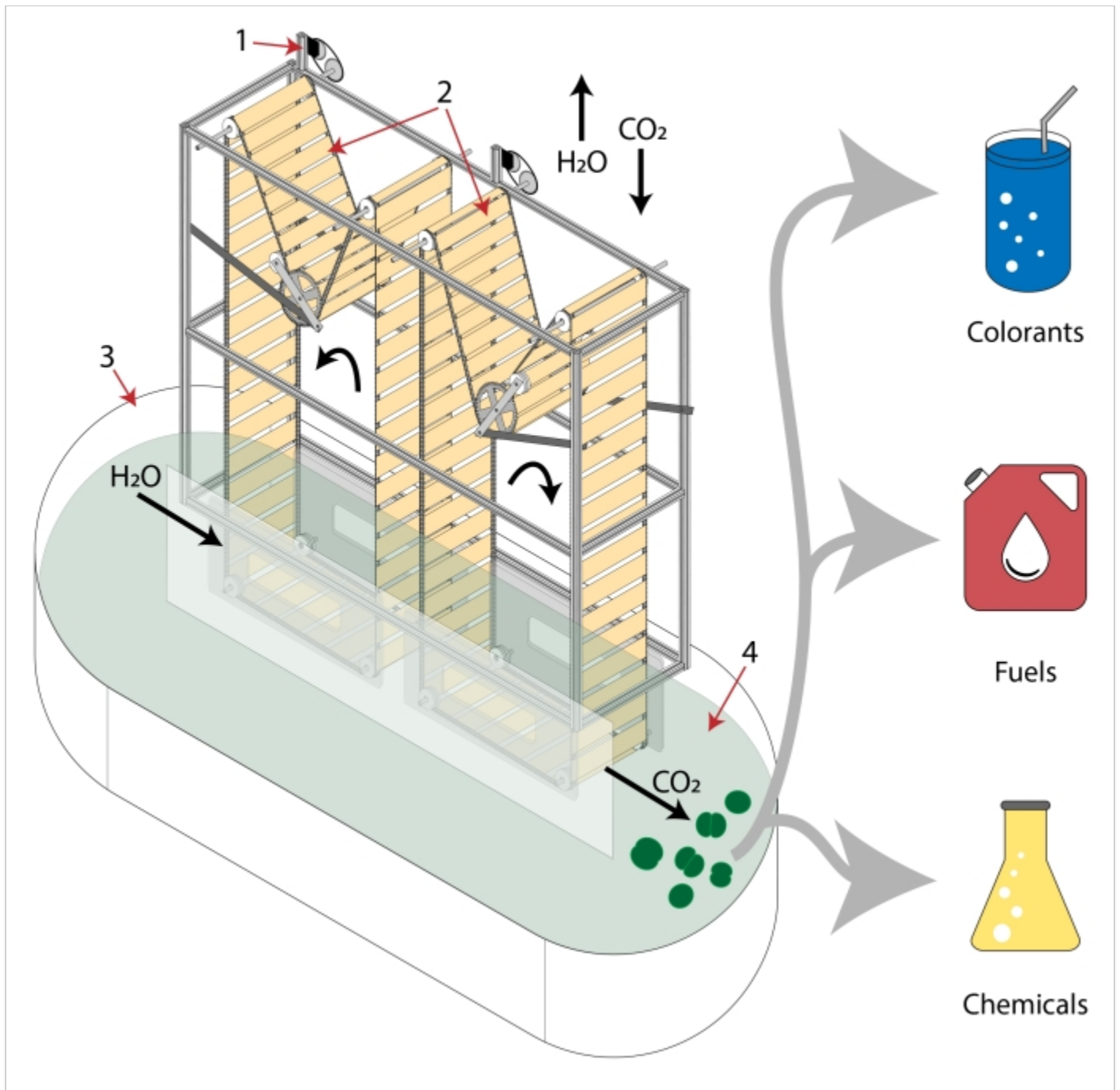


A laboratory technician examines algae samples at ASU's Arizona Center for Algae Technology and Innovation in Mesa. Photo by Deanna Dent/Arizona State University

Text image(s)



The outdoor pond system at ASU's Arizona Center for Algae Technology and Innovation in Mesa uses a rotating belt to move CO₂-capturing polymer packets between air and a cyanobacteria growth pond. The material captures carbon dioxide when dry and releases it into the liquid medium when wet. Photo courtesy of Justin Flory/ASU



The broader process behind the research: Carbon dioxide is captured from air, released into liquid growth medium and used by cyanobacteria or algae to grow biomass that can support products such as colorants, fuels and chemicals. Image courtesy of Wim Vermaas/ASU