Scientists turn CO2 and excess solar power into liquid fuel -- study

Lacey Johnson, Environment and Energy Publishing, 3-30-12

Coal power and solar technology each have a significant flaw; one emits planet-warming carbon dioxide, and the other often generates more power during the day than it can efficiently store.

Now, researchers say they could have a solution to both setbacks: Use excess solar energy to convert CO2 emissions into liquid fuel.

By combining carbon dioxide, electricity and bacterial microbes, scientists have discovered a way to produce a form of gasoline, according to research released yesterday in the journal Science.

This new method "has never been done," says James Liao, a professor of chemical and biomolecular engineering at the University of California, Los Angeles, and co-author of the study. "No one has demonstrated how to use electricity to turn CO2 into fuel, directly."

And "directly" is the key to this discovery. While a handful of processes exist for converting carbon dioxide into fuel, they require multiple steps and are generally too expensive to be used on a large scale. Some techniques use sunlight, which requires large amounts of surface area, and others involve cumbersome chemical procedures.

What makes the UCLA study so special, says Liao, is the integration of two costly processes into one step.

2 metric tons of CO2 into 1 of fuel

The new method mixes CO2 and electricity to create formic acid -- a substance that occurs naturally in the venom of stinging insects, like bees and ants. Then, an engineered microorganism with the ability to withstand electricity, Ralstonia eutropha H16, converts the formic acid into fuel. The final product is 3-methyl-1-butanol and isobutanol -- liquid fuels that are compatible with combustion engines.

"The chemical that we make can be directly used as fuel," says Liao. "In existing processes, the chemical they make is very undefined."

Using this method, two metric tons of CO2 would create roughly one ton, or 360 gallons, of liquid fuel, estimates Liao. He and his fellow researchers envision the electricity to power the process coming from renewable energy sources, like excess production at a solar plant or wind farm, so no new emissions are created. When the fuel is burned, it re-emits the carbon dioxide but would create a net-zero increase in atmospheric CO2.

There are strong financial and political drivers for converting CO2 back into fossil fuel, and governments and private companies invest millions in this type of research every year. The U.S. Department of Energy has an entire subprogram devoted to producing fuels from CO2, and it contributed $4 million to help fund Liao and his colleagues' research.

If their system can be affordably duplicated on a commercial scale, it could take sequestered carbon from a coal-fired plant and transform it into fuel with the excess electricity from a nearby solar plant -- killing three birds with one stone.

For now, Liao cautions that "the exact cost remains to be seen." The researchers should know more in the next two years, when they hope to start building larger-scale experiments.

"Certainly, it requires a lot more work ... but we think this is a very promising direction."