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US should reuse captured CO2 for concrete, aviation fuel — report

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Products made with carbon dioxide could play a valuable role in a net-zero future, but expanding their market reach will require a wide array of policy changes, according to a new report from the National Academies of Sciences, Engineering and Medicine.

The report, released this month and mandated by Congress in the Energy Act of 2020, provides a big picture look at the potential market opportunities for carbon utilization — where CO2 is embedded into products. It finds that the U.S. could lock captured or removed CO2 into some durable products, like concrete, as part of a broader effort to cut planet-warming emissions and meet the Biden administration's goal of a net-zero emission economy by 2050.

While the world should electrify as much of the economy as possible, “we can’t talk about decarbonization for many aspects of civilization — namely the materials that we use, the food that we eat, the chemicals that we use, the pharmaceuticals that we need,” said Emily Carter, chair of the committee that wrote the report and a professor of mechanical and aerospace engineering at Princeton University.

Carbon utilization can help make the products the world will continue to need, she said.

The industry is still nascent, but “can operate at a global annual scale of multiple gigatonnes” in a net-zero economy, complementing carbon capture and storage, the road map said. That could help maintain a balance between the greenhouse gas emissions entering the atmosphere and those removed.

The Department of Energy sponsored the 631-page report, which also examined the prospects for using coal waste to make products like critical minerals, carbon fiber and asphalt. The report recommended that Congress fund research into such uses.

In assessing carbon utilization, the report authors divided carbon-based products into two categories: short-lived ones, like chemicals or aviation fuels, and long-lived ones, like concrete and construction materials.

CO2 coming from a natural gas-fired power plant should only be used to make durable products, Carter said. Any used in fuels or chemicals will just be released into the atmosphere, accomplishing only a delay in emissions.

But CO2 molecules taken from a smokestack and converted into road-paving material — or into a component of concrete to make buildings — is “sort of the most massive use of carbon," Carter said.

“If it’s used for those purposes, it’s locked up for presumably centuries and that’s what we mean by durable,” she said. “Durable we define as a hundred years or more.”

The report offered a range of recommendations. Among them: Facilities that capture and convert CO2 into products should be co-located; DOE should support efforts to educate the public about carbon management; and the federal government should develop processes for the certification, permitting and approval of common CO2-derived materials.

The report also recommended that the Pipeline and Hazardous Materials Safety Administration work with national labs to model, test and mitigate hazards around CO2 pipelines. New pipeline projects have met resistance from some environmental and landowner groups, who worry about leaks and eminent domain.

In an email, DOE declined to comment on the report, but said the agency is “making strides to advance new CO2 pipeline development projects to meet broader decarbonization goals.” The department also pointed POLITICO's E&E News to several engineering studies tied to CO2 pipelines.

Matt Fry, one of the report's authors, said building carbon utilization facilities next to CO2 capture or removal facilities could reduce the need to build as many CO2 pipelines.

The report points to the Midwest and Gulf Coast as two regions well-suited to co-locating CO2 capture and utilization facilities.

“Given the multiple utility and feedstock needs for CO2 capture and utilization, and the expense, challenge, and public concern over new pipelines, sites where all needed components are co-located are distinctly advantageous for CO2 utilization deployment,” the report said.

Volker Sick, a professor of mechanical engineering at the University of Michigan, said sustainable aviation fuel and construction materials made with CO2 have the greatest market potential.

“The amount of concrete and aggregates that we produce is enormously high, so the amount of carbon dioxide that you can durably store in these materials is really in the gigatons per year,” said Sick, a report author.

Electric cars and trucks are already a reality, paving the way for electric power to replace fuels for ground transportation. But long-haul aviation has no “technology within reach that could replace a kerosene-like fuel,” Sick said, adding that demand for aviation fuel grows every year.

Sustainable aviation fuel releases CO2, meaning it would need to be captured and turned back into fuel in a net-zero economy. The large amount of electricity that would require is still better for the climate than emitting more carbon into the atmosphere, Sick said.

One advantage of using CO2 in products — rather than storing it underground — is that storage is “based on geology, and you have to take that to the appropriate geology," Fry said.

“You can build an aviation fuel facility next to an emissions source a lot easier than you could make that geology appear,” he said.

But he said that the amount of carbon captured — from point sources like power generation plants and industrial facilities — will end up being far greater than the volume that CO2 utilization can handle. Most captured emissions, he said, will still need to be sequestered underground.