Technologies multiply to put CO2 to work -- and make money

Umair Irfan, Environment & Energy Publishing, 7-26-11

One man's pollution is another man's raw material. In this case, it's carbon dioxide (CO2), one of the most notorious greenhouse gases. Government regulators, researchers and private companies have now found ways to sequester waste CO2 and put it to work in making paints, plastics and fuels. In doing so, they seek to find a way to simultaneously reduce emissions, produce low-cost materials and even make some money.

Faced with the lack of a federal policy on reducing carbon, making money is not just icing on the cake; it is essential. Issues with cost have stalled a number of projects involving carbon capture and storage (CCS), a method of reducing emissions from coal and gas power plants.

Earlier this month, American Electric Power (AEP), one of America's largest power companies, stopped work on its new CCS plant in New Haven, W.Va., citing the financial environment. "We are placing the project on hold until economic and policy conditions create a viable path forward," said Michael Morris, AEP's chairman and CEO, in a press release.

According to the U.S. Energy Information Administration, 1 ton of coal produces 2.86 tons of CO2 when burned. In CCS, CO2 is then extracted from the air or from smokestacks using different mechanisms. The system then stores it permanently or in a way that the gas dissipates very slowly. The result is a net reduction in greenhouse emissions. However, the method is currently expensive and inefficient and suffers serious drawbacks when it comes to where to store the gas.

Turning CO2 waste into feedstock could help offset some of these costs and spur further CCS development. Waltham, Mass.-based Novomer is a company that is attempting to do just that. Using a method developed by Geoffrey Coates, a professor in the Department of Chemistry and Chemical Biology at Cornell University, CO2 can be used to make materials.

"[We] developed a catalyst that will take an epoxide," a triangular molecule made from carbon and oxygen, "and combine it with carbon dioxide," said Coates. "The catalyst then makes a polymer that is then 50 percent by weight CO2 that can be used for a number of applications."

Containers, coatings and foams

Using captured carbon not only puts waste to use, but supplants the need for new resources. "Virtually all the big polymers, all their carbon comes from fossil fuels, whether it be natural gas or coal," said Coates.

The resulting materials can be used for containers, coatings and foams, said Peter Shepard, executive vice president of polymers at Novomer. "Some of the chemistry was actually practiced at laboratory scale in the '70s," said Shepard. "The processes were not [economically] viable as commercial technologies."

Coates' process helped change that. "His initial focus was on cost," said Shepard. "This was well before CO2 was seen as a greenhouse gas." Because of this, CO2-based polymers were seen as a commercial product first and an environmentally friendly material second, allowing Novomer to build its business model around selling its product at low cost and not relying on government subsidies, according to Shepard. He also points out that Novomer develops industrial chemicals like acrylic acid using recycled carbon.

Yet, as a solution to emissions, Shepard is skeptical about reusing carbon. "It's a viable option," he said. "It definitely helps move in the right direction, but it will not solve the world's CO2 problem." The global need for CO2 in materials production is orders of magnitude smaller than the world's carbon output, said Shepard.

An attack from multiple angles

However, converting combustion byproducts to polymers and chemicals is not the only way to repurpose CO2. John Litynski, sequestration technology manager at the Department of Energy's National Energy Technology Laboratory (NETL), suggested that CO2 can also be used as the working fluid in geothermal plants instead of water.

Litynski also described how storing CO2 can be used to harvest fuels at the same time. Declining oil fields are regularly injected with CO2 to drive up yields, he said, and according to the Intergovernmental Panel on Climate Change, 30 million to 50 million tons is stored in oil fields annually. Using captured carbon for this purpose can make a substantial impact in overall emissions, and new storage technologies would allow more CO2 to be stored more densely. This not only creates a cost offset from oil sales, but also offsets the carbon from burning the extra extracted fuel.

Despite the initial expenditures needed for the modifications and retrofitting needed to install CCS, as well as the infrastructure to transport and store carbon waste, Litynski said that there are still benefits to implementing this process, even without government incentives.

"Absent climate legislation or action in some other way, you get an incremental benefit, but you also build out a huge amount of infrastructure," he said. "If you build pipelines and injection wells -- the incremental costs -- once the infrastructure is developed, the overall cost is much lower." The NETL is investigating a number of approaches to CCS and is about five years from testing second-generation versions of the technology, according to Litynski.

Coates concurs that attacking emissions from multiple angles is good idea. "It's my opinion that there's not going to be one cure-all for the CO2 problem," said Coates. "A number of solutions are going to have to be devised."