greentechenterprise

NEWS | CARBON MANAGEMENT

HERMAN K. TRABISH: APRIL 7, 2011

Could Waste Heat Be the Secret for Carbon Capture?

Is using waste heat to power emissions absorbers a preposterous idea whose time has come?

Capturing waste heat from power plants would make the idea of carbon-negative power plants economically feasible, according to Columbia University professors Graciela Chichilnisky and Peter Eisenberger.

"That idea was considered preposterous," Chichilnisky said. But the idea is now their proprietary technology and is being commercialized by Global Thermostat (GT), a company co-owned by Chichilnisky, author of the concept of the international carbon market, Eisenberger, the founder of Columbia's Earth Institute, and financier Edgar Bronfman, Jr.

A carbon-negative power plant becomes possible, Chichilnisky said, when the plant's byproductheat, which is usually wasted, is used to drive technology that removes carbon dioxide (CO2)from ambient air. A power plant equipped with GT technology, she said, can capture more carbon than it emits.

"Right now," Chichilnisky said, "you look at a power plant and you say, 'That's a source of carbon.' With co-generation, you look at a power plant and you say, 'This plant is cleaning the atmosphere.'"

While something like this might get financed through cap-and-trade programs in the future, the first trial will be in oil fields for enhanced oil recovery (EOR). Executives in Canada have already discussed how carbon capture can become economical via EOR at tar sands sites. (Editor's note:Codexis, which told us it was getting into carbon capture a month ago, formally unfurled an experiment with Alcoa today.)

The idea of capturing carbon from the air is not new, Chichilnisky said. The World War II-era German Navy originated it as a means of making submarine air breathable. Both David Keith and Klaus Lackner have similar technologies aimed at combating climate change.

GT essentially captures the heat from power plants and/or industrial equipment to drive its CO2 capture equipment. To capture one ton of CO2, the unit uses 4 X 10-to-the-9th joules of energy. Over 90 percent of that heat captured goes to capturing CO2. The other roughly ten percent of the energy is used to generate

the eight kilowatt-hours of electricity that drive the unit's fans and move air at 2.5 meters per second long enough to capture a ton of CO2 from the ambient air.

Four commercial deals involving EOR applications are in the works, Chichilnisky said. The first could be announced this summer.

"Our preferred embodiment," Chichilnisky said, "is to attach our structure to a renewable power source like a concentrating solar power plant" making the technology, she said, "seriously carbon negative." At present, the 35-foot-tall pilot structure at Stanford Research Institute (SRI) can use prevailing winds rather than its electric-powered fans to move air.

"A commercial plant is economically feasible," Chichilnisky continued. "Units could capture one million tons or more of CO2 per year." What makes the GT solution so viable is that units can be placed wherever the CO2 can be reused, eliminating the need for an infrastructure to transport power plants' flue-captured CO2.

"It costs approximately 1.5 million to 2 million dollars per mile to build a pipeline to transport CO2," Chichilnisky said. A 300-mile pipeline that would deliver power plant-captured CO2 to a non-productive oil field to enhance recovery might cost roughly $500 million. "With $500 million," Chichilnisky said, "GT can build several plants that would capture millions of tons of CO2 from the air per year."

"The market for EOR," Chichilnisky added, citing Department of Energy numbers, "is $800 billion over the next ten years."

Will it work? Waste heat is a tremendous, untapped resource and one our favorite concepts here at Greentech Media. Back in 2008, researchers at UC Berkeley estimated that the U.S. consumes 100 quadrillion BTUs, or quads, of energy a year and that 55 to 60 of those quads get dissipated as waste heat. The Wartsila-Sulzer two-stroke diesel engine for ships is considered one of the most efficient in the world: Half of the energy gets converted to waste heat.

Half, and in many cases more, of the energy in quite a large number of data centers gets consumed by air conditioners to get rid of waste heat. Think of it: half of the power bill goes to getting rid of another form of energy that cost you money but you couldn't use.

Echogen, a startup, says it can exploit a fluid called supercritical carbon dioxide ($ScCO_2$) to convert heat into power for less than four cents per kilowatt-hour. The average retail price of electricity in the U.S. hovers above 9.5 cents. On the opposite end of the spectrum, companies such as Komatsu, Alphabet Energy and Phononic Devices are devising chips that can convert heat to power directly -- no mechanical compression needed. Wrapping these around components in a car or truck could provide power to run the air conditioner, which in turn would boost mileage. This could offer a cheap, quick way to meet CAFE standards.

But, like in many green fields, the challenge lies in the details. Heat from servers and computer equipment is "low grade," i.e., not enough of it exists to make a recovery system worthwhile. Factories and power plants are complex environments. Can the heat really be captured efficiently and economically and put to use?

Once captured, the CO2 can be made into plastics or cement, which sequesters it. Or, Chichilnisky said, it can be economically used, in conjunction with advanced refining processes that split hydrogen from water,

to make methanol and, then, high-octane carbon neutral gasoline. Again, problems exist here, too. CO2 is an inert molecule and companies such as Calera and Skyonic who hope to transform CO2 into commercial products have found that it's challenging to keep down the energy and costs required to mineralize the gas. The concept's great, but the science is hard.

This isn't Bronfman's first CO2 investment. He also plunked money into a small company that haslicensed technology from NASA to turn sewage into algae fuel.

“The gasoline is carbon-neutral in the sense that once you burn it you produce carbon, but it starts from carbon you took from the atmosphere in the first place, so you are closing the carbon cycle.” Using only water and GT unit-filtered air, gasoline can be produced at gas stations, eliminating the need for fuel transport. “That’s our most preferred model right now.”

“Creating power plants that are carbon negative,” Chichilnisky said, “can increase the energy that is needed for economic progress in developing nations without destroying the stability of the world’s climate.” Because she helped author the UN’s Kyoto Agreement, she is confident that entrepreneurs will be able to use the Clean Development Mechanism to achieve this.

“Developing nations will sign on,” she said, “because they will be able to create the energy they need to grow. Carbon-negative power plants will also take care of global warming. And it generates export revenues and manufacturing jobs in the U.S., so we will sign on. And, since the investment will go into power companies, they will sign on. All that is missing,” she said, “is for people to be comfortable with the concept” of a carbon-negative power plant that reverses the usual equation: Energy reduces emissions instead of generating them. “It is difficult to believe right now. But it will happen.”

http://www.greentechmedia.com/articles/read/could-waste-heat-be-the-secret-for-carbon-capture/