Pulling Carbon Dioxide Out of Thin Air

By ANNE EISENBERG    JAN. 5, 2013

WHETHER streaming from the tailpipes of cars or the smokestacks of so many power plants and factories, carbon dioxide emissions keep growing around the globe.

Now a Canadian company has developed a cleansing technology that may one day capture and remove some of this heat-trapping gas directly from the sky. And it is even possible that the gas could then be sold for industrial use.

Carbon Engineering, formed in 2009 with $3.5 million from Bill Gates and others, created prototypes for parts of its cleanup system in 2011 and 2012 at its plant in Calgary, Alberta. The company, which recently closed a $3 million second round of financing, plans to build a complete pilot plant by the end of 2014 for capturing carbon dioxide from the atmosphere, said David Keith, its president and a Harvard professor who has long been interested in climate issues.

The carbon-capturing tools that Carbon Engineering and other companies are designing have made great strides in the last two years, said Timothy A. Fox, head of energy and environment at the Institution of Mechanical Engineers in London.

“The technology has moved from a position where people talked about the potential and possibilities to a point where people like David Keith are testing prototype components and producing quite detailed designs and engineering plans,” Dr. Fox
said. “Carbon Engineering is the leading contender in this field at this moment for putting an industrial-scale machine together and getting it working.”

Should the cost of capturing carbon dioxide fall low enough, the gas would have many customers, he predicted. Chief among them, he said, would be the oil industry, which buys the gas to inject into oil fields to force out extra oil. The injection has minimal risk, said Howard J. Herzog, a senior research engineer at the Massachusetts Institute of Technology. “The enhanced oil recovery industry has put tens of millions of tons of carbon dioxide into the ground every year for decades with no problems,” he said.

Much of the carbon dioxide for enhanced oil recovery comes from naturally occurring underground reserves that are piped to oil fields, said Sasha Mackler, vice president of Summit Carbon Capture, a unit of Summit Power Group in Seattle. Summit Carbon Capture harvests carbon dioxide gas from coal and natural gas-burning plants before it can be spewed into the air.

The global demand for carbon dioxide will only grow as oil becomes scarcer and demands for transportation fuel rise, Mr. Mackler said. Direct capture from the atmosphere would offer another source for the gas.

Yet the cost of capturing carbon dioxide directly from the air has yet to be demonstrated, said Alain Goeppert, a senior research scientist at the Loker Hydrocarbon Research Institute at the University of Southern California. Dr. Goeppert recently reviewed the literature of air capture technology.

“There is a lot of speculation of how much it will actually cost,” he said, with estimates from $20 a ton to as much as $2,000. “We won’t know for sure until someone builds a pilot plant.” (An average passenger vehicle generates about five tons of carbon dioxide a year.)

Dr. Keith says he thinks it may be possible to lower the cost of capture toward $100 a ton as the company grows.

Carbon Engineering’s machines use a carbon-dioxide-absorbing solution of caustic soda to remove the gas from the air. “The issue at the pilot plant,” Dr. Keith
said, “will be to test the equipment at the scale the vendors tell us they need” to provide performance guarantees for a full commercial plant. The process is intended to collect at least 100,000 tons a year of the gas.

The concentration of carbon dioxide scrubbed from the flue gases of coal- and gas-fired power plants is about 5 percent to 15 percent, higher than that in the air, where it is about 393 parts per million. “You have to handle much larger volumes of gases” to capture the same amount of carbon dioxide from the air that you would from power plant flue gases, Dr. Goeppert said. “But Dr. Keith is going to be able to capture it with the absorbent he uses.”

The recovered carbon dioxide may be sold one day, not only for enhanced oil recovery, but also to feed algae to produce biofuel. It may also be sequestered in places like unmineable coal seams and oil and gas reservoirs, says a new Energy Department report.

Gas capture would be extremely important in developing a rational price for carbon emissions, said Dr. Fox of the British mechanical engineering society. “Whatever it costs to take it out of the air and store it away,” Dr. Fox said, “that’s the price polluters would pay if they want to put carbon into the air.”

Another advantage of direct air capture is geographic flexibility. “It doesn’t matter where you take the carbon dioxide out,” he said, since the gas is mixed evenly in the earth’s atmosphere. “You could have air capture machines in the Australian desert to account for New York City car emissions.”

Most important, air capture could be used to get rid of that last fraction of carbon dioxide that escapes into the air, for example, even from power plants outfitted to collect most of their emissions, said Klaus S. Lackner, a Columbia professor and a board member and adviser to Kilimanjaro Energy, another company working on collecting atmospheric carbon dioxide.

“I see direct air capture as the long-term way of dealing with all those emissions that can’t be dealt with in any other way,” he said.

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A version of this article appears in print on January 6, 2013, on Page BU3 of the New York edition with the headline: Pulling Carbon Dioxide Out of Thin Air.

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