

# Ethanol carbon sequestration plant holds lessons for coal

**Christa Marshall, Environment & Energy Publishing, 9-12-11**

A leading agriculture company is about to put the United States on the map with the world's biggest carbon sequestration projects.

In coming months, Archer Daniels Midland will ramp up construction on an initiative to grab carbon dioxide emitted from an ethanol facility and inject the gas underground. The Department of Energy announced the project's groundbreaking at the company's facility in Decatur, Ill., in late August.

When combined with a separate, related sequestration project starting this fall on the same corn processing plant, the initiative will pump more industrially captured carbon dioxide underneath the earth for permanent storage in deep saline rock reservoirs than ever has been attempted in the United States. While the project is focused on ethanol, the company says it is optimistic that its efforts will pave the way to try similar emission controls for fossil fuels like coal.

"This is critical" for the U.S. carbon capture and sequestration industry, said Scott McDonald, ADM's project manager for the Illinois Industrial Carbon Capture and Sequestration project, in an interview last week with *ClimateWire*. "We are developing the model that others will follow."

The action comes at a time when climate legislation is dead on Capitol Hill and other large carbon capture and sequestration (CCS) projects are defunct from lack of funds. Earlier this year, the Ohio-based utility American Electric Power pulled the plug on a storage project in saline aquifers tied to a large coal plant, because of cost concerns.

Analysts say ADM's project is significant for studying how a large amount of human-generated CO<sub>2</sub> will behave underground in the Illinois Basin, a rock formation stretching across three states and sitting near some of the nation's highest-polluting coal plants and industrial factories. Because stored gas behaves differently in different geological spots, there are limits on how much knowledge from other global CCS projects can be applied to the United States, they say.

"There are three projects in the world doing this kind of large-scale sequestration," said Kurt Waltzer, an analyst at the Clean Air Task Force. "This will be the fourth." The others are off the coast of Norway and in Algeria.

## **Injecting porous rocks the key to the future**

If carbon capture and sequestration is ever proven at commercial scale in the United States, a large chunk of the nation's emitted CO<sub>2</sub> will have to eventually be stored in the Illinois Basin because of its proximity to coal-dependent Midwestern states, experts say.

There have been other large-scale injections of CO<sub>2</sub> in the United States in oil fields, where the greenhouse gas is used to push out more crude in a process known as enhanced oil recovery. There also has been extensive work on the transfer of CO<sub>2</sub> in pipelines, said Waltzer.

The difference with the ADM initiative is its scale and its permanent storage of the gas in saline rock formations, outside of oil fields, said Waltzer. That distinction is important, he said, since CCS will have to rely

on saline rock formations, and not on oil field storage entirely, if it is ever to be successful at a commercial level, he said.

With saline rock formations, captured carbon dioxide is pumped thousands of feet underground into porous rock holding briny water. The other U.S. attempts to build such a fully integrated system -- from emitting source to permanent storage in saline aquifers -- stalled before reaching commercial size.

The first step in the process begins this fall, when researchers from the Illinois State Geological Survey will begin injecting underground 1,000 metric tons daily of carbon dioxide emitted from ADM's facility in Decatur.

That will coincide with construction of a second, larger effort -- run by ADM -- that will triple the injection level eventually to 3,000 metric tons daily. The ADM project is scheduled to begin its underground injections in 2013. Together, the two sites will pump more than 3.5 million tons underground of total captured CO<sub>2</sub>, the equivalent of the annual emissions of roughly 600,000 automobiles.

The CO<sub>2</sub> will come from a plant that processes corn into multiple products, including corn syrup, food chemicals and ethanol.

#### **\$141M in federal aid, but looking for more**

The purity of the CO<sub>2</sub> stream from the biological fermentation process, in comparison to, say, that from a coal plant, is one reason why this project is moving forward when many other CCS projects are not, explained McDonald.

The purity makes the capture process cheaper than what is needed to capture CO<sub>2</sub> from the burning of coal, which creates a much more complex stream of gases than a wet corn mill. With coal, solvents are needed to strip CO<sub>2</sub> out of a mix of nitrogen and other emissions.

"We can do this at about a quarter of the cost at a different type of plant. We have a much lower hurdle," said McDonald. He called ethanol the "low-hanging fruit" for carbon capture.

The overall cost of ADM's project is \$207.5 million, with most of that -- \$141 million -- supplied by the Department of Energy as part of President Obama's 2009 economic stimulus package. In comparison, American Electric Power's project would have cost \$668 million to integrate saline injection with capture from a large coal plant.

Despite the lower cost, the agriculture giant likely will not be able to continue underground injections beyond 2015 --the scheduled end date -- without new funding from the federal government, McDonald said. It is possible that some of the captured CO<sub>2</sub> could be used for enhanced oil recovery, he said, since CO<sub>2</sub> grabs a price in that process because of its value in pumping out more crude.

At the time the project was announced several years ago, Archer Daniels Midland was fully expecting that a carbon cap might be coming in the United States, McDonald said. That, along with the stimulus package and consideration of low-carbon fuel standards in California, provided an impetus.

"We have to see either a price on carbon or additional [financial] incentives for sequestration," he said about the possibility of extending the effort.

#### **Next stop: coal?**

Even though the capture part of the project involves ethanol, it still holds lessons for coal, which spews about a third of U.S. greenhouse gas emissions, analysts said.

The Mount Simon sandstone in the Illinois Basin has the potential to hold billions of tons of CO<sub>2</sub> from the Midwest's coal plants, according to the Department of Energy. In making the announcement, the department said the sandstone could hold all of the more than 250 million tons of CO<sub>2</sub> produced each year by every industry in the Illinois Basin region.

There needs to be thorough testing at every new injection site to determine its unique characteristics, said Robert Finley, a director at the Illinois State Geological Survey.

This is especially true since ADM will be using a new type of injection well authorized by U.S. EPA, called Class 6, designed specifically for carbon dioxide storage.

Under the new well classification, operators are expected to keep close tabs on how an underground greenhouse gas plume moves about in porous rock.

With this in mind, the researchers with the Illinois State Geological Survey are testing equipment that has never been used before with carbon sequestration, including seismic sensors that use vibrational energy to create a detailed image of the gas plume. That is important for knowing where monitoring stations for CO<sub>2</sub> need to be set up in the first place, said Finley.

"A big unknown is whether the carbon dioxide will move radially or in a circular fashion," he said.

### **A 'triple subsidy,' say enviros**

The resulting data should help reassure state public utility commissions -- which have rejected many large projects out of cost concerns -- about the viability and accuracy of the technology, Finley said.

The fact that two injection sites will be running simultaneously off the same plant -- one run by the Illinois State Geological Survey and the other by ADM -- also will provide critical information, according to McDonald. There needs to be a better understanding of how two underground greenhouse gas plumes interact with each other, he said.

That will be important for other capture projects down the road, he said, since a large power plant would require multiple injection wells to store all its carbon dioxide.

Carbon capture and sequestration has its share of critics. Some environmentalists slam it for sopping large amounts of federal money on an unproven technology that they say should be used more for renewable power.

"This is in a sense a triple subsidy on something we don't know will work," said Kyle Ash, a senior legislative representative at Greenpeace. The corn and ethanol industries already get federal help, before carbon capture money from the Department of Energy comes into play, he said.

There also have been studies questioning the safety and cost-effectiveness of these types of underground injections. Perhaps most notably, a husband-and-wife team of geologists challenged the notion in a peer-reviewed paper last year that there is enough space underground to do commercial scale carbon storage (*ClimateWire*, May 3, 2010). That analysis was slammed by much of the carbon capture industry as making inaccurate presumptions, but the couple maintain that their argument is accurate.

## **ADM insists no risks of leakage**

Another question is how carbon dioxide will react with the unique minerals in the Illinois Basin's rock. In 2010, Duke University researcher Robert Jackson found that, in theory, carbon dioxide leaking from underground storage sites -- including in central Illinois -- could contaminate drinking-water aquifers with pollutants such as uranium under the wrong conditions.

He said the ADM project was important for testing, but said he wouldn't want to live directly over the site until any leakage risks are better understood. The risks are small, but important to determine, he said.

"Most wells won't leak very much. Some of them may. We need to understand what the environmental consequences are if they do," he said.

But McDonald said there were no serious leakage risks. The Illinois Basin was selected specifically because of its special qualities, including its deep layers of impermeable, protective rock sitting above CO<sub>2</sub> storage sites 7,000 feet beneath the earth's surface.

The area has been studied thoroughly with three-dimensional imaging, and there are no pathways for CO<sub>2</sub> to escape, he said.

"We feel very confident that we can store large volumes of CO<sub>2</sub> at this site for a long period of time," he said.

A carbon capture and sequestration proposal in Greenville, Ohio, stalled in 2009 amid loud objections from local residents about the possibility of leakage and depressed property values. ADM has not run into similar problems, partially because of its reputation in the community, according to Finley. The company has said the project will create 260 jobs.

Outreach also may have been a factor. McDonald said his company worked hard to educate the community about the project through letters to residents, meetings with government officials and scheduled events at the Illinois State Fair and in town meetings. School teachers came out to the site, Finley said.

The company obtained permits from 300 landowners who would be affected by the initial seismic testing of the site, and there wasn't much concern, he said. The underground plume will be confined to rural areas, he said.

"We have billions of dollars invested in this," McDonald of ADM said. "If there was any doubt or any real risk that there would be leakage, we just wouldn't do it."