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GOVERNMENT REPORT CRITICIZES U.S. PLANS FOR CARBON DIOXIDE BURIAL

[Rachel's introduction: The U.S. is planning to bury enormous quantities of carbon dioxide in the ground to reduce the threat of global warming. However, a new government report says the plan is plagued by serious technological, economic, legal and regulatory problems.]

By Tim Montague

In the U.S. today we burn coal to make half of all our electricity. This coal emits about 1.9 billion metric tons of carbon dioxide (CO2) per year, which is 33% of all U.S. CO2 emissions.[1] CO2 is the main culprit in the global warming problem. Rather than eliminate the problem by weaning ourselves off fossil fuels (coal, oil, and natural gas), government and industry are proposing an end-of-pipe solution -- they intend to solve the global warming crisis partly by capturing and storing CO2 emissions from coal-fired power plants. The CO2 would be captured as a gas, pressurized until it turned into a liquid, transported by pipeline to a suitable location, and pumped a mile or so below ground, intending for it to stay there forever.

This is called CCS, short for carbon capture and storage, and it is the coal and electric power industry's strategy for allowing the continued use of coal. If CCS never happens on a large scale, then the global-warming CO2 emissions from burning coal will eventually kill the coal industry.

The basic problem, according to climate experts like the IPCC (Intergovernmental Panel on Climate Change), is that we need to reduce CO2 emissions by something like 80% by 2030 if we want to avoid runaway global warming. To do this, we could generate electricity using machines that don't emit very much CO2 (wind, solar, geothermal) or we could add end-of-pipe filters to smoke stacks to capture CO2. According to some engineering projections, CCS filters could trap up to 90% of the CO2 from coal-burning power plants. However, to make a dent in the global warming problem, the International Energy Agency estimates that as many as 6,000 CCS projects would be needed, each injecting a million metric tons of CO2 a year into the ground.[2] In other words, this end-of-pipe approach would require creation of a major new waste disposal industry devoted to CO2.

How far along are we toward actually burying CO2 in the ground? Last month the Government Accountability Office -- the investigative arm of the U.S. Congress -- released a report [2 Mbyte PDF] that looks at the state of CCS in the U.S.

The GAO took a broad survey of government officials, scientists, nonprofits, and fossil company executives to find out just how far along CCS is in the U.S. and what needs to be done to help it expand.

They concluded that CCS faces serious technological, economic, legal and regulatory barriers.

The GAO report says that CCS entails five steps: 1) Carbon capture and compression into liquid C02; 2) transport to a storage location; 3) injection and storage deep underground; 4) long term monitoring to verify that the CO2 stays put; 5) remedial measures in case leakage occurs.[3]

Technological and Economic Barriers

The vast majority of coal power plants in operation today burn "pulverized" (powdered) coal to produce heat to create steam to drive a turbine to make electricity. Capturing the CO2 from the smoke stack of these power plants is difficult and costly, but not impossible. CO2 makes up just 15% of the waste stream from a coal plant, so it takes a lot of energy to concentrate the CO2 into a pure form that can be compressed and stored. There are currently no commercial-scale coal plants that do this. The world's first demonstration-scale pulverized coal power plant to capture and store its CO2 emissions went online in Germany this Fall.

Here in the U.S., the DOE (Department of Energy) began studying CCS in 1997. However, the DOE program has largely ignored the capture of CO2 from existing pulverized coal plants; instead, DOE has focused on "next generation" power plants employing IGCC (integrated gasification combined cycle) -- a new technology that doesn't burn pulverized coal. An IGCC coal plant resembles a chemical factory -- it treats coal with lots of heat and steam to break it into hydrogen and CO2 -- and then burns the hydrogen to make electricity and disposes of the other byproducts, including CO2. Capturing and burying the CO2 from IGCC plants is cheaper, in theory, than from a pulverized coal plant. But again, CCS from an IGCC plant has never been taken to commercial scale -- there are just two small demonstration IGCC plants in the U.S. today (near Tampa, Fla., and West Terra Haute, Ind.) and neither of them captures its CO2 emissions. Commercial scale IGCC (500 megawatt) plants are not expected until around 2020. (p.16)

Either way, capturing carbon, compressing it into liquid CO2, then transporting it and pumping it deep underground requires a lot of expensive equipment and energy. The GAO report says, "The cost of electricity production would increase by 35 percent for newly constructed IGCC plants with CO2 capture, compared to a 77 percent increase for newly constructed pulverized coal power plants equipped with CO2 capture." (pg. 19) Perhaps because the DOE has largely ignored existing pulverized coal plants, the GAO report doesn't give specific costs for adding CCS filters to existing power plants.

With the exception of the two small IGCC plants mentioned above, all U.S. coal-fired power plants burn pulverized coal; and one new pulverized coal plant is being built **each week** around the world today. So the GAO report strongly encourages the DOE and industry to stop focusing so much attention on IGCC plants and to get serious about capturing carbon from pulverized coal plants: "The outlook for widespread deployment of IGCC technology is questionable and the agency's funding related to IGCC technology has substantially exceeded funding for technologies more applicable to reducing emissions from existing coal-fired power plants," the GAO report says. (p. 31) In other words, the DOE has essentially ignored the biggest part of the problem.

Legal and Regulatory Barriers

As we have seen, to make a difference in the global warming problem, CCS would require creation of a major new waste disposal industry devoted to CO2. The GAO report says government needs to develop rules governing all aspects of this new industry -- transporting, injecting and storing vast quantities of CO2. And government needs to clarify what existing laws apply to stored CO2. GAO says, "Key regulatory and legal issues will need to be addressed if CCS is to be deployed at commercial scale. Among these issues are (1) confusion over the rules for injecting large volumes of CO2, (2) long-term liability issues concerning CO2 storage and potential leakage, (3) how property ownership patterns may affect CO2 storage." (p. 23)

The Safe Drinking Water Act says the EPA (U.S. Environmental Protection Agency) should protect public health by preventing waste- injection wells from endangering underground sources of drinking water. "However," the GAO report says, "the injection of CO2 for long- term storage raises a new set of unique issues related to its relative buoyancy, its corrosiveness in the presence of water, and large volumes in which it would be injected." (p. 23)

The "new set of unique issues" arises from the main CCS plan, which is to bury CO2 in places where the deep earth is comprised of sandstone saturated with water not suitable for drinking. CO2 pumped into the ground will push the water aside and fill the pores in the sandstone with liquid CO2. In these situations, the injected CO2 will be "buoyant" -- meaning it will constantly be trying to move upward. The plan is to select underground locations where an impervious layer of rock, or "caprock," prevents CO2 from rising back to the surface. However, any water in contact with CO2 will turn into carbonic acid and begin to eat away minerals in the rocks. Finally, to make a dent in the global warming problem would require burial of tremendous quantities of CO2. The GAO report says "it is likely that thousands or tens of thousands of injection wells would need to be developed and permitted in the United States." (pg. 40)

Each of these burial wells would need to be approved by government, but the well owners would be liable for any harm their well might cause. In July of 2008, the EPA issued a 'proposed rule' under the Safe Drinking Water Act, which says in part "that well operators remain responsible indefinitely for any endangerment of underground sources of drinking water." (p. 39)

The EPA is clearly concerned about the safety of underground storage of CO2. But it is still unclear whether U.S. hazardous waste laws will apply to CCS. The GAO says, "RCRA [Resource Conservation and Recovery Act] and CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act] could pose similar complications for CCS projects. RCRA authorizes EPA to establish regulations governing the treatment, storage, and disposal of hazardous waste. A hazardous waste is generally defined as a solid waste that either (1) exhibits certain characteristics (ignitability, corrosivity, reactivity, or toxicity) or (2) has been listed as a hazardous waste by EPA." (p. 41)

CERCLA established the Superfund program to clean up hazardous waste dumps. But CO2 is not listed as a hazardous substance under CERCLA. "However," GAO says, "the [EPA] rule's preamble cautions that injected CO2 streams could contain hazardous constituents that would make these streams 'hazardous.'" (p. 41)

One might ask, if CO2 is not hazardous, why go to all the trouble of burying it deep in the ground?

According to the GAO, the federal government and other parties might be held liable if CO2 stored below public lands leaked onto adjoining property. "If CO2 was injected for geologic storage and it migrated underground into neighboring mineral deposits, for example, it could interfere with the adjacent mineral owners' abilities to extract those resources, and the injection well's operator could be held liable for nuisance, trespass, or another tort." (p. 25)

An even bigger concern, according to the GAO, is the absence of a national strategy to reduce CO2 emissions, "...without which the electric utility industry has little incentive to capture and store its CO2 emissions." (p. 3) This really cuts to the heart of the matter. Why would any coal power executive invest in expensive and experimental technology to capture and store CO2 when all it's going to do is hurt their bottom line?

Public Opposition

The GAO report touches on an important issue for toxics and climate justice activists. A 2005 study of the general population of the U.S. found that just 4 percent of respondents were familiar with carbon capture and storage. And, "Thus far at least, there has been little public opposition to the CO2 injections that have taken place in states such as Texas to enhance oil recovery." (p. 48) But the GAO warns that the public health hazards and public opposition to large scale CCS could stifle its progress. Hazards like suffocation from leaking CO2, contamination of drinking water, or increased risk of earthquakes are just some of the concerns associated with CCS. So the GAO recommends that public agencies "immediately develop, in consultation with other agencies, a public outreach effort to explain carbon capture and sequestration." (p. 49)

In sum, the coal industry's future depends upon rapid development of a large new CCS industry. If the goal is to reduce U.S. CO2 emissions by something like 80% by 2030, just 22 years from now, then existing power plants -- most of which would still be functional in 2030 -- will need CCS to eliminate the bulk of their emissions, or they will need to be replaced by solar, wind and geothermal plants. The present slow pace of development of CCS for existing coal plants is probably keeping coal and electric utility executives awake at night. On the other hand, if CCS were deployed more rapidly and something went seriously wrong in an early demonstration, you could forget the grand- scale deployment of CCS that the coal and electric power industries are counting on.

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[1] A metric ton = 2200 pounds. According to the U.S. Energy Information Administration (EIA), in the U.S. in 2006, CO2 emissions totaled 5890.3 million metric tons (mmt). Of this, the electric power

industry emitted 2343.9 mmt, or 39.8% of the total; of this 2343.9 mmt, coal accounted for 1937.9 mmt, or 82% of the electic power sector's total CO2 emissions and 32.9% of the nation's total CO2 emissions. See the Excel spreadsheet tab labeled "All,ElecPwr_CO2" at http://www.eia.doe.gov/oiaf/1605/gg_rpt/excel/hi storical_co2.xls

[2] International Energy Agency, Near-term Opportunities for Carbon Dioxide Capture and Storage; Global Assessments Workshop in Support of the G8 Plan of Action (Paris, France: International Energy Agency, 2007), pg. 7. Available at http://www.precaution.org/lib/iea_global_assessments_wkshop.070601.pdf

[3] See page 9, but also see pg. 39 where the GAO acknowledges the need for "site closure and emergency and remedial response."