CARBON DIOXIDE ON THE MOVE
by Richard Doctor

Abstract

Excerpts from the paper below:

*"*Commercial [CO2] capture systems . . . would increase the cost of electricity by around 33 percent at present, but time and competition will likely lower these system costs.*"*

"The transport of carbon dioxide may add another 11 percent to the cost of electricity with carbon capture. Factor in the administrative costs of revised Transportation regulations for new pipeline construction -- a necessary step -- and the costs could increase further."

COMMENT:
Assuming that anthropogenic CO2 is indeed deleterious to the environment, the cost of sequestering it is a clue to the extent to which society subsidies the burning of fossil fuels. In addition to CO2, of course, there are the large undisputed costs of the public health effects and other environmental damage from the various non-CO2 pollutants. If Doctor's 33% and 11% are indicative of the societal cost of just the CO2, coal-fired electricity is selling for less -- perhaps much less -- than 2/3 of its true cost.

Which, of course, makes nuclear power a clear bargain even before the cost of new plants is accurately known.

George Stanford

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Carbon Dioxide on the Move

BY RICHARD DOCTOR

Capturing the polluting greenhouse gas is easy; getting rid of it is harder.

Suppose you are a power plant manager -- and a responsible corporate citizen -- in a world newly persuaded that mandatory greenhouse gas controls are part of the cost of doing business: What will keep you awake at night?

It won't be the challenge of capturing polluting carbon emissions. Commercial capture systems are already available, and many have long-established records of service in the natural gas and petroleum industry. True, they would increase the cost of electricity by around 33 percent at present, but time and competition will likely lower these system costs.

Let's say that your plant -- in this case, a brand-new coal-gasification facility on the site of an old, scrapped pulverized-coal-fired boiler -- produces electricity while emitting the fewest pollutants of any coal-based technology ever, and it uses the very latest technology for capturing carbon. The costs and impacts on your productivity have been significant, but it's all been worth it: Not only is everything working, but it's working as designed. So, your worries are over, right?

Not so fast. Unless you are the exception rather than the rule, your facility is not sitting on top of a suitable geological storage reservoir. Certain geological formations are unusually well suited for carbon dioxide storage.

Today, carbon dioxide flooding of declining oil fields is the world market; this approach lets plant owners sequester carbon dioxide and produce a marketable product -- oil. Late in its life, a reservoir is injected with carbon dioxide to reduce the viscosity of the trapped oil so it flows more easily. Then water and carbon dioxide are alternately used to sweep the oil to the producing wells. Typically, each kilogram of crude oil recovered

requires two to three times its weight in carbon dioxide.

Such opportunities are limited when compared with the amount of carbon dioxide recovery needed to make an impact on greenhouse-gas emissions. Most captured carbon dioxide will need to be transported to a suitable storage area, which has the potential to introduce additional costs, depending on plant location.

Putting a pipeline in the ground is a well-understood process, but resolving issues such as pipeline rights-of-way and river crossings can significantly increase construction costs.

As a plant owner, a few factors are in your favor. The United States has developed an infrastructure with more than 2,500 kilometers (1,550 miles) of carbon dioxide pipelines, which currently transport over 40 million metric tons of carbon dioxide per year for use in oil recovery. This pipeline network has operated safely since the 1980s and depends on established technology with a well-formed set of regulations. On the other hand, your entire industry has never had to deal with these regulations before. They are complex and

costly, and they have the potential for high liability. For this reason, a company familiar with the pipeline business will likely construct and operate this pipeline, taking on the liability in the process.

Even so, you have more to consider. At a public hearing about permits for a new carbon dioxide pipeline, concerned citizens might bring forward news reports about the tragic deaths of more than 1,700 people in 1986 from carbon dioxide releases in the Cameroons, around the volcanic-gas-fed Lake Nyos. “Could an accident associated with your operations create a similar tragedy?” they might ask. The answer is: not on a comparable scale, considering that the estimated release for the Lake Nyos catastrophe -- 0.15 cubic kilometers (0.04 cubic miles) -- is nearly the entire carbon dioxide release from all U.S. coal-fired electric power capacity for one hour. But hazards do exist. In 1996, a restaurant supply company delivery driver died during a routine carbon dioxide drop off near Cincinnati. Though the driver was trained, aware of the hazards, and working in a familiar location, an imperceptible and invisible carbon dioxide leak collected to a concentration

of at least 10 percent, with fatal consequences.

Also, the EPA examined the dangers associated with carbon dioxide use in fire suppression over a 35-year period and found that out of the 51 carbon dioxide "incident" records, there were a total of 72 deaths and 145 injuries.

These potential dangers demand more costly design and construction for carbon dioxide pipelines, and more stringent inspection standards, than for natural-gas pipelines. Whereas natural gas is buoyant in air and could ignite from a breached pipe, carbon dioxide sinks in air. If carbon dioxide comes out of a pipeline it will cool or freeze, intensifying this sinking. One leak could have serious repercussions, both for your company and for the rest of the industry.

Pipeline safety in general is a concern, since uninformed digging in the pipeline right-of-way frequently causes pipeline accidents. Marking pipeline routes—the common practice in populous areas—can create a poor corporate image or worse: U.S. officials say pipelines are potential

terrorist targets. In the United States, Department of Transportation regulations call for inspecting "hazardous materials and carbon dioxide" pipelines every two weeks, compared with once every quarter (13 weeks) for natural gas pipelines.

These extra rules and inspections come with a price. The transport of carbon dioxide may add another 11 percent to the cost of electricity with carbon capture. Factor in the administrative costs of revised Transportation regulations for new pipeline construction -- a necessary step -- and the costs could increase further.

Power plant owners face a world of new and significant regulatory headaches. If U.S. plants were to sequester a meaningful fraction of their electric-power carbon dioxide emissions -- say, 50 percent -- pipeline regulators would have to monitor the transport of 25 times the amount of carbon dioxide they safely manage today. The necessity of maintaining this oversight represents one additional challenge and cost for our future in a greenhouse-gas-constrained world.

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the section leader for Hydrogen and Greenhouse Gas Engineering at Argonne National Laboratory. He was the co-chair for the "Transport of CO2" chapter of the Intergovernmental Panel on Climate Change Special Report on Carbon Dioxide Capture and Storage (2005).

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