Senate Committee on Commerce, Science and Transportation
Subcommittee on Science, Technology and Innovation

Testimony on Carbon Sequestration Technologies

By

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Mr. Chairman and Members of the Subcommittee, thank you for giving me the opportunity to discuss carbon sequestration technologies, also known as carbon capture and storage or CCS. My name is Chuck Fox and I serve as Vice President of Kinder Morgan CO2 Company, L.P. I have submitted a more detailed statement to the Committee and ask that it be made a part of the record of this hearing. I will summarize my remarks along five specific categories: Kinder Morgan's background with CCS related technologies, carbon capture science issues, transportation technology issues, storage issues and finally non-technical barriers to creating CCS in the U.S.

Kinder Morgan is one of the largest midstream energy companies in the U.S. It operates more than 30,000 miles of natural gas and products pipelines across the U.S., Canada and Mexico. Kinder Morgan CO2 Company is the largest pipeline transporter of CO2 in the world; the second largest CO2 enhanced oil recovery or EOR company; and the third largest oil producer in Texas. We have extensive experience in transporting CO2 and injecting it into the ground. Also, as a supplier of CO2, we have reviewed the capture processes in order to locate new sources.

Of the various CCS components, capture is the most costly. Today there are two viable processes, post combustion capture and pre-combustion capture, and one developing process, oxy-fuel combustion. Post combustion capture has been practiced for more than 60 years. The technology is well known, but unfortunately it is costly. CO2 is captured by bubbling flue gas through a liquid chemical absorbent. The process is energy intensive since post combustion gases have low concentrations of CO_2. The flue gas is primarily composed of nitrogen, the major constituent of air. Large volumes of flue gas must be managed. The pre-combustion capture and oxy-fuel processes seek to cut costs by reducing the flue gas volume by removing nitrogen from the system. In pre-combustion capture, a fossil fuel is reacted with steam and air or oxygen to produce a synthesis gas primarily composed of hydrogen and carbon monoxide. Next the carbon monoxide is reacted with steam to form more hydrogen and CO_2. Finally, this steam is separated, creating two gas streams – hydrogen and CO_2. Pre-combustion capture could be used with IGCC power plants. In fact, the gasification process is being used by the Dakota Gasification Company to supply CO_2 to an oil field in Canada. In oxy-fuel combustion, oxygen is used instead of air for combustion of fuels thereby eliminating nitrogen from the flue gas. The flue gas is composed primarily of water and CO_2. Unfortunately, combusting fuel in pure oxygen creates an extremely high temperature flame and existing steel cannot handle it. Given the relative costs, only the pre-combustion process seems to be viable for large scale capture in the near term. I have provided some suggestions for additional research in the supplement to my testimony.

The most economical way to transport large volumes of CO_2 is by pipelines. CO_2 has been transported safely for over 35 years. CO_2 is not as dangerous to transport by pipeline as other gases. It is not flammable, explosive, or poisonous. The main safety concern with transporting CO_2 is asphyxiation caused by a leak in the pipeline. Few accidents or leaks have been reported in CO_2 pipelines. None of the dozen leaks that occurred between 1986 and 2006 resulted in injuries. There are a few technical issues that must be resolved regarding the transportation of CO_2. Some suggestions for additional research are provided in the supplement to my testimony.

Geologic storage may present the most formidable challenge of any CCS development. Like transport, storage has a well established and documented history through established EOR activities. Though the science and engineering knowledge gained through EOR are well understood, the technology was not developed to store CO_2 for long periods. Relatively little is known about saline aquifers, the largest and most widespread of the CO_2 storage options. These aquifers need to be characterized. In addition, technology created for EOR must be extended so that the migration of CO_2 through the subsurface can be monitored and the ultimate fate of the CO_2 can be determined.

Although some technological barriers exist that could delay the economical application of CCS to mitigate climate change. Non-technical barriers must also be surmounted. Of all CCS issues, none is as contentious or critical as the issue of ultimate liability. Companies may not be willing to enter the storage business unless there is some relief from an eternal and unlimited liability. Another topic, discussed in the recent IOGCC report on CCS, is ownership of the storage site. The issue of mineral rights vs. surface rights must be settled prior to creation of a site. In addition, the use of eminent domain to create storage sites and pipeline right of ways must be defined by the states or federal government. Also, much of the pipeline industry has migrated toward the Master Limited Partnership (MLP) structure. The current tax law may not define revenues received for the transportation of CO2 for CCS to be qualifying income. As such, the tax structure would not support the development of a CCS transportation infrastructure.

Even with these challenges, I believe that industry is prepared to respond positively to society's call to find economical methods to mitigate climate change.

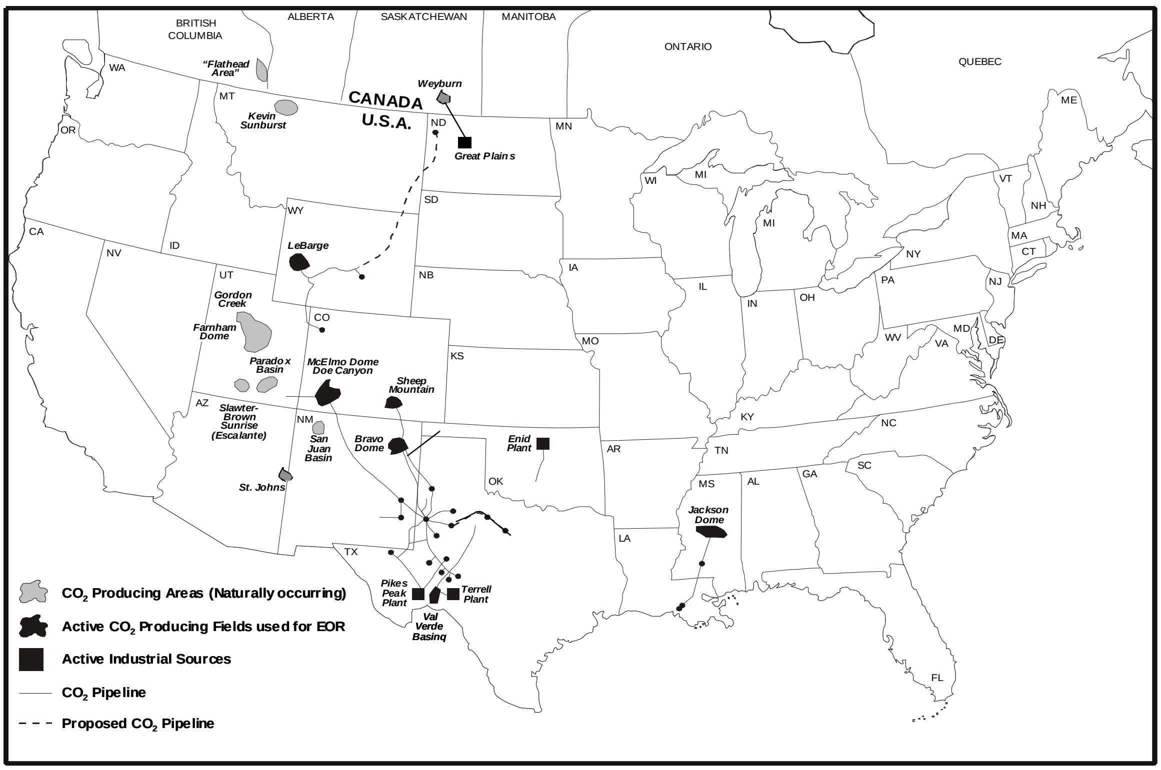

Figure 1. Source: Figure 1.9 from "Practical Aspects of CO2 Flooding," Jarrell et.al., Society of Petroleum Engineers 2002.