SCOTT M. KLARA

NATIONAL ENERGY TECHNOLOGY LABORATORY

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Thank you, Mr. Chairman and Members of the Committee. I appreciate this opportunity to provide testimony on the Department of Energy's (DOE's) development of Carbon Capture and Storage (CCS) technologies as a potential solution to mitigate greenhouse gas emissions.

Fossil fuels will play an important role in the Nation's future energy strategy. In a scenario of a future carbon-constrained world, successfully developing technologies to mitigate the release of carbon dioxide (CO_2) into the atmosphere will permit the continued use of fossil fuels. Economic growth has been shown to be tied to energy availability and consumption. However, we are striving to reduce the energy intensity of the economy, which would help decouple economic growth and energy availability and consumption. To retain coal, and to a lesser extent natural gas, as viable energy sources, CCS technologies must play a central role. CCS is a key pathway that DOE is pursuing to make the continued use of fossil fuels practical in a possible carbon-constrained future.

DOE is taking a leadership role in the development of carbon capture and storage technologies. Through its Carbon Sequestration Program, which is managed within the Office of Fossil Energy and implemented by the National Energy Technology Laboratory (NETL), DOE is

developing both the core and supporting technologies through which CCS is expected to become an effective and economically viable option for reducing CO_2 emissions. We are working with the brightest minds in the country through research and development (R&D) with Government-industry-academic partnerships that are focused on developing the knowledge base and technologies to overcome potential barriers to the widespread deployment of carbon capture and storage technologies.

The Carbon Sequestration Program is addressing the key challenges that confront the wide-scale deployment of capture and storage technologies through research on cost-effective capture technologies; monitoring, mitigation, and verification technologies to ensure permanent storage; permitting issues; liability issues; public outreach; and infrastructure needs. As an example, today's commercially available capture and storage technologies will add approximately 80% to the cost of electricity for a new pulverized coal plant, and about 35% to the cost of electricity for a new advanced gasification-based plant.[1] The Program is aggressively pursuing developments to reduce these costs to less than a 10% increase in the cost of electricity for new gasification-based energy plants, and less than a 30% increase in the cost of electricity for pulverized coal energy plants (the 30% goal for pulverized coal energy plants is tentative and under development).

The Carbon Sequestration Program encompasses several key elements: Core R&D, Technology Validation, and Infrastructure Development. The Core R&D Program continues to make great strides toward meeting future technology needs. The Program has been performing CCS field tests for many years, drilling wells in potential storage locations and injecting small

[1] Cost and Performance Baseline for Fossil Energy Plants, Volume 1: Bituminous Coal and Natural Gas to Electricity, U.S. Department of Energy/National Energy Technology Laboratory, DOE/NETL-2007/1281, Final Report, May 2007.

quantities of CO_2 to validate the potential of key storage locations throughout the country. Substantial progress has occurred in the area of monitoring, mitigation, and verification with the development and refinement of technologies to better understand storage stability, permanence, and the characteristics of CO_2 migration.

Research is also focused on developing technology options that dramatically lower the cost of capturing CO_2 from fossil fuel energy plants. The research in this area can be categorized into three pathways: post-combustion, pre-combustion, and oxy-combustion. Post-combustion refers to capturing CO_2 from the stack gas after a fuel has been combusted in air. Pre-combustion refers to a process where a hydrocarbon fuel is gasified to form a mixture of hydrogen and carbon dioxide, and CO_2 is captured from the synthesis gas before it is combusted. Oxy-combustion is an approach where a hydrocarbon fuel is combusted in pure or nearly pure oxygen rather than air and produces a mixture of CO_2 and water that can easily be separated to produce pure CO_2. This research is exploring a wide range of approaches: membranes; oxy-combustion concepts; solid sorbents; CO_2 hydrates; and advanced gas/liquid scrubbing technologies. These efforts cover not only improvements to state-of-the-art technologies but also development of several revolutionary concepts, such as metal organic frameworks, ionic liquids, and enzyme-based systems.

A key centerpiece for the Program is the field program, which is being implemented through the Regional Carbon Sequestration Partnerships. The technologies, processes, and scientific knowledge necessary for carbon capture and storage depend in part on patterns of fossil fuel use and geology, which can vary between geographic regions of the United States, and even within regions. The Program is testing geologic storage in several different geologies in different regions of the country in order to build experience that will allow broad application of

carbon capture and storage. The Regional Partnerships are teams comprised of state agencies, universities, and private companies with the goal of developing the knowledge base and infrastructure for the wide-scale deployment of carbon capture and storage technologies. The seven Partnerships represent more than 350 unique organizations in 41 States, 3 Indian Nations, and 4 Canadian Provinces. It is important to note that the cost share for the Regional Partnerships is about 40% (including in-kind contributions of CO_2, a major program cost), which indicates significant industry and other partner interest in the success of this program.

Collectively, the seven Regional Carbon Sequestration Partnerships represent regions encompassing 97% of coal-fired CO_2 emissions, 97% of industrial CO_2 emissions, 96% of the total landmass, and essentially all of the geologic storage sites in the country that can potentially be available for carbon sequestration. The field test program is structured with a three-phase approach.

The first phase, called the Characterization Phase, was initiated in 2003 and focused on characterizing regional opportunities for carbon capture and storage, and identifying regional CO_2 sources and storage formations. The Characterization Phase was completed in 2005 and led into the current Validation Phase.

The Validation Phase focuses on field tests to validate the efficacy of carbon sequestration technologies in a variety of geologic storage sites throughout the country. Using the extensive data and information gathered during the Characterization Phase, we identified the most promising opportunities for carbon sequestration in their regions and are performing widespread, multiple geologic field tests an – more than 25 field tests in total. We are also addressing key infrastructure issues related to permitting, space ownership, site access, liability, public outreach, and education. It is important to note that small-scale CO_2 injection is already

occurring at several sites throughout the country and in Canada. Our close cooperation with the Environmental Protection Agency (EPA) and other Federal and State agencies has led to favorable permitting decisions for these projects. We continue to work closely with EPA and others in developing CCS regulations, which will provide additional certainty regarding CCS project siting and development.

The third phase, the Demonstration Phase, of the Partnerships was initiated in fiscal year 2008. This phase is focused on conducting large-scale injection tests in representative geologies to demonstrate that CO_2 capture, transportation, injection, and storage can be accomplished at a scale equivalent to future commercial deployments. The geologic structures to be tested during these large-volume sequestration tests will likely serve as the candidate sites for initial deployment of future commercial applications of carbon capture and storage technologies. DOE is developing a peer-reviewed plan to be completed this spring that will identify the scientific and engineering test parameters to guide design and selection of large-scale tests. Items to be addressed include: rate of injection, duration of injection, and number and phasing of tests.

Over the course of these field projects, DOE, with support from the Regional Carbon Sequestration Partnerships, will develop Best Practice Manuals on topics such as site characterization, site construction, operations, monitoring, mitigation, closure, and long-term stewardship. These Manuals, which will be developed in conjunction with DOE's Office of Science, will serve as guidelines for a future geologic sequestration industry, including regional considerations, and help to transfer the lessons learned from DOE's Program to all stakeholders.

DOE recognizes the importance of developing the talent base in engineering, science, trades, law, and government. These disciplines will be necessary for a future sequestration industry. Partners such as industry, universities, and government see the need to train students

and professionals in carbon capture and storage. DOE research and field projects can serve as the foundation for training grounds, future text books, and case studies that will educate the future workforce for carbon capture and storage deployment.

Of particular note relative to Program accomplishments, the Sequestration Program has produced the world's first CO_2 source/sink database – the "National Carbon Sequestration Database and Geographical Information System (NATCARB)." NATCARB provides a graphical user interface on the internet that allows users to search regions of the country for CO_2 sources and geologic storage locations. NATCARB is constantly updated with emerging information through databases that are maintained by the Regional Partnerships, as well as databases from the Environmental Protection Agency and the United States Geological Survey. NATCARB is available "free of charge" on the internet and is now receiving over 600 unique users per month from across the world.

The Sequestration Program has created a national methodology to assess the capacity for CO_2 storage in the United States and Canada. A National Atlas (another world first) was generated using NATCARB. The "2006 Carbon Sequestration Atlas of the United States and Canada" shows the aggregate CO_2 storage capacity for geologic formations in the United States and parts of Canada to be estimated at over 3,500 billion tons, enough capacity to store more than 600 years of the United States total CO_2 emissions at current annual generation rates. The Atlas, along with these storage estimates, will be updated every few years as emerging new information is incorporated into the NATCARB database.

In summary, CCS will likely play an important role in mitigating CO_2 emissions under potential future stabilization scenarios. The Department's Sequestration Program is playing a key role in ensuring that carbon capture and storage technology will be available. The United

States should continue to show leadership in technology development and future deployment. This leadership could bring economic rewards in the new business opportunities it creates here and abroad, and through the Carbon Sequestration Leadership Forum and other organizations, it will provide important leverage to help speed engagement by critical developing countries like China and India. I applaud the efforts of this Committee for taking a leadership role in this very important issue.

Mr. Chairman, members of the Committee, this completes my statement. I would be happy to answer any questions you may have.