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Thank you, Mr. Chairman and members of the Subcommittee. I appreciate this opportunity to provide testimony on the U.S. Department of Energy's (DOE's) research efforts in carbon sequestration and, in particular, the Carbon Sequestration Atlas of the United States and Canada.

INTRODUCTION

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 cost-effective 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, among other things, to be tied to energy availability and consumption, particularly lower-cost fossil fuels like coal. To retain fossil fuels as a viable energy source, carbon capture and storage (CCS) technologies (also referred to as carbon capture and sequestration) is expected to play a pivotal role. Sequestration is a key climate change mitigation technology that the U.S. Department of Energy (DOE) is developing to ensure the continued use of fossil fuels in a possible carbon-constrained future.

On a global scale, CCS technologies have the potential, if deployed, to reduce overall climate change mitigation costs and increase flexibility in reducing greenhouse gas emissions.

According to a 2005 report on CO_2 capture and storage by the Intergovernmental Panel on Climate Change (IPCC), CCS technologies could account for at least 15% to as much as 55% of the global reductions in greenhouse gas (GHG) emissions, depending on the stabilization target level and timeframe for atmospheric concentrations of GHG. The IPCC report also states that technology development and improvements from industry and through research programs, such as DOE's Carbon Sequestration Program, could help reduce the current costs of capturing and storing CO_2 from power plants by 30% or more. A particularly beneficial aspect of certain CCS technologies is that their component parts – carbon capture, transportation, and storage – rely on technologies used and adapted from other commercial industries, thereby enhancing the availability and cost-competitiveness of CCS technologies as viable mitigation options.

DOE is taking a leadership role in advancing the development of CCS technologies. Through its Carbon Sequestration Program, 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 carbon sequestration could become an effective and economically viable option for reducing CO_2 emissions. DOE's research program has assembled government-industry-academic partnerships that are focused on developing the knowledge base, technologies, best practices and protocols to overcome barriers to the widespread deployment of CCS technologies so that sequestration can become a viable option in the near future.

A key goal for the Carbon Sequestration Program is the development of CCS technologies that will ensure safe practices, especially related to the protection of drinking water. The Program is addressing the key challenges that would ensure the safe, long-term permanence of CO_2 storage, including the development of monitoring, mitigation, and verification

technologies to track the fate of injected CO_2. The ultimate success of CCS projects will hinge in part on the ability to measure the amount of CO_2 stored at a particular site, the ability to confirm that the stored CO_2 is not harming the host ecosystem, and the ability to effectively mitigate any impacts associated with CO_2 leakage. A portfolio of technologies are under development that are being designed with a tentative goal of ensuring that after 100 years less than one percent of the injected CO_2 has leaked or is otherwise unaccounted for.

GEOLOGIC STORAGE POTENTIAL

Capturing CO_2 from fossil-fueled power plants is only one part of what is needed for sequestration to have a significant impact in reducing GHG emissions. Another major challenge is to ensure that adequate storage capacity is available for sequestration. Since 2003, DOE has been working with the Regional Carbon Sequestration Partnerships on CO_2 storage estimates in different geologies throughout the United States and Canada. In 2006, DOE released the first version of the Carbon Sequestration Atlas of the United States and Canada, which identified over 3,500 billion tons of potential storage capacity in deep saline formations, depleted oil and gas formations, and unmineable coal seams that potentially exist throughout these regions. This capacity, should it all prove viable, would be sufficient to store more than 600 years of the United States' total CO_2 emissions at current annual generation rates. As is typical of resource assessments, the economically viable storage capacity would likely be significantly smaller.

The 2006 Carbon Sequestration Atlas contains information on major CO_2 emission point sources, geologic formations with sequestration potential, and some terrestrial ecosystems that offer the potential for enhanced carbon uptake – all referenced to their geographic location to enable analysis of CO_2 sources and storage sites. An interactive version of the Atlas is publicly available through the National Carbon Explorer (NATCARB) website (www.natcarb.org).

CARBON SEQUESTRATION ATLAS OF THE UNITED STATES AND CANADA, 2006

The first version of the Atlas was released in 2006, as a result of cooperation and coordination among carbon sequestration experts in industry, academia, state, provincial, and Federal governments. The goal of the Atlas was to provide the first coordinated assessment of CCS storage potential across the majority of the United States and portions of western Canada. The Atlas also provides useful background information on the overall DOE Carbon Sequestration Program, and provides storage estimates for regions throughout the country, along with the methodology used to calculate these capacities. The Atlas relied on an extensive set of data collected by the Regional Carbon Sequestration Partnerships though December 2006. This represents the most comprehensive dataset on geologic formations with the potential to store CO_2. Without DOE's efforts, much of this information would likely have remained archived on paper or in separate databases. These efforts helped to resolve data quality issues between states that shared border and geologic basins. DOE and the Regional Carbon Sequestration Partnerships used these valuable digital datasets to apply a common set of methodologies to determine storage capacities that were applied consistently across all areas. The Atlas focused on three types of geological storage formations: oil and gas formations, unmineable coal seams, and saline formations. Other storage options are also being studied but estimates are not yet available for these unconventional storage options, such as basalt formations and organic-rich shale, nor are they expected to provide as much storage capacity as the formations that were studied. The Atlas relied on a team of geological experts and scientists from NETL and the Regional Carbon Sequestration Partnerships, including the United States Geologic Survey (USGS) and nearly every state Geologic Survey. The Atlas utilized an extensive set of information from databases maintained by the Regional Partnerships, the USGS National Coal

Resources Data System & Earth Resource Observation and Science (EROS) data center, the Geography Network, the Environmental Protection Agency (EPA) Emissions & Generation Resource Integrated Database (eGRID), and the Energy Information Administration (EIA).

DOE maintains all information used to develop the Atlas through a web-based geographic information system (GIS) – NATCARB, which is a relational database and GIS that integrates carbon sequestration data from key databases throughout the country. NATCARB is the world's first CO_2 source/sink database that provides a graphical user interface on the Internet and allows users to analyze regions of the country for CO_2 sources and geologic storage locations. Each of the Regional Carbon Sequestration Partnerships maintains a regional GIS and digital Atlas that provides NATCARB with constant updates to CO_2 emission sources and geologic capacity estimates. In addition, data for infrastructure, such as roads, rail lines, transmission lines, Federal boundaries, and municipal boundaries, are obtained from a number of different databases, such as EPA, USGS, and the Department of Transportation (DOT).

NATCARB is available "free-of-charge" on the Internet and receives more than 500 unique users per month. DOE and the NATCARB staff have supported many requests from other Federal agencies, industry, and researchers who are looking for information on geologic storage, and use the data to conduct detailed analyses of storage capacity in the United States.

Through NATCARB and the methodology created to estimate capacities, the 2006 Atlas of the United States and Canada was generated. The 2006 Atlas represents the first step toward gaining a comprehensive look at the potential for storage in the United States and parts of Canada. In the course of developing the storage estimates, it became clear that some areas had yielded more and better quality data than others. For example, a typical oil and gas field, which could be contained in a few square miles, could have hundreds to thousands of wells into a

formation that provides a wealth of data on the geology that, in turn, can be used to make accurate predictions of storage capacity. In contrast for some deep saline formations that typically underlie large areas, there may only be a handful of wells available to provide a basic understanding of the geology of the formation. This is the reality of the current knowledge of carbon storage in geologic formations. Prior to the DOE projects moving into the field, data were not previously collected with carbon storage in mind. As research in this area continues, additional and more comprehensive data are being generated and refined that will permit further improvements with future estimates. The methodology developed by the team of scientists and engineers represented by state geologic surveys, academia, industry, and national laboratories is considered to be a conservative approach and will be validated and refined after analysis of the data from the 30+ field projects that the DOE is implementing.

FIELD TEST PROGRAM, NATCARB AND THE ATLAS

The approach to addressing CO_2 sequestration depends on the fossil fuel use, and the type of geology at potential sequestration storage sites across the United States. DOE is funding a network of seven Regional Carbon Sequestration Partnerships to help develop technology, infrastructure, and best practices/protocols for implementing CO_2 sequestration in different geologies of the Nation. This approach includes engaging local organizations and citizens to contribute expertise, experience, and perspectives that represent their concerns and goals.

The seven Regional Carbon Sequestration Partnerships that form this network currently include more than 350 unique organizations, universities, and private companies spanning 42 states, and four Canadian provinces. Collectively, the seven Regional Carbon Sequestration Partnerships represent regions encompassing 97% of coal-fired CO_2 emissions, 97% of industrial CO_2 emissions, 97% of the total land mass, and essentially all the geologic sequestration sites in

the United States that are potentially available for carbon sequestration. With the Regional Carbon Sequestration Partnerships, DOE is evaluating numerous sequestration options to assess which are best suited for different geologies of the country, and is developing a test framework to validate and potentially deploy the most promising carbon sequestration technologies.

DOE's sequestration field test program is structured on a multi-phase approach. The first phase, called the Characterization Phase, was initiated in 2003 and focused on characterizing opportunities for CCS, identifying CO_2 sources and storage locations. The Characterization Phase was completed in 2005 and led into the current Validation Phase. This second 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, DOE identified the most promising opportunities for carbon sequestration and is performing widespread, multiple geologic field tests– more than 30 field tests in total. The geologic sequestration tests include projects in deep saline formations, unmineable coal seams, depleted oil and gas fields, and basalt. DOE is also addressing key infrastructure issues related to regulatory permitting, transportation of CO_2, pore space ownership, site access, liability, and public outreach and education.

The third phase of the Partnerships, the Deployment Phase, was initiated in Fiscal Year 2008. This phase is focused on conducting large-scale injection tests to confirm the application of CO_2 capture, transportation, injection, and storage at a scale near future commercial deployments. The geologic formations being tested during this phase represent vast geographic coverage, large storage capacities, and natural impermeable seals that are expected to ensure the safe long-term storage of CO_2. These geologic storage formations could serve as candidates for initial deployment of future commercial applications of CCS technologies throughout the United

States. Even though the field test program is being implemented in three phases, it should be viewed as an integrated whole, with many of the goals and objectives transitioning from one phase to the next. Accomplishments and results from the Characterization Phase have helped to refine goals and activities in the Validation Phase, and the knowledge gained from the Validation Phase is being used to enhance the Deployment Phase.

Over the course of these field projects, DOE will develop Best Practice Manuals on topics such as site characterization, site construction, operations, monitoring, mitigation, closure, and long-term stewardship. These Manuals will serve as guidelines for future geologic sequestration activity and help transfer the lessons learned from DOE's funded research to all stakeholders.

Data generated by each Regional Carbon Sequestration Partnership is maintained and updated locally or at specialized data warehouses, and assembled, accessed, and analyzed through NATCARB. As research continues within the second and third phases of the field test program, the data from the field tests and continued characterization activities will be available to refine and augment the 2006 version of the Atlas, leading to more accurate and improved versions in future years.

UPDATES AND FUTURE VERSIONS OF THE ATLAS

The Atlas is not a static document but will be regularly updated as more data and insight are gained. Since release of the *2006 National Carbon Sequestration Atlas of the United States and Canada (Atlas I),* the Regional Partnerships, NATCARB, NETL, representatives from the Carbon Sequestration Leadership Forum, various State Geological Surveys, and USGS have been working on developing an update. This update (*Atlas II*) is scheduled for release in November 2008. The primary focus of this update is to include additional basins and formations

to the CO_2 storage portfolio, refine CO_2 storage estimates, and clearly define the CO_2 resource and the uncertainties associated with the current estimates of capacity, and express the limitations on how this data should be portrayed. In addition, *Atlas II* will provide updated information on the location and quantity of stationary CO_2 emissions, the locations and storage potential of various geologic sequestration sites, Federal lands information for CO_2 storage, as well as an update on DOE's field activities. The investment made by the United States and its non-Federal partner organizations has resulted in a valuable national resource available to any individual, private company, and organization wanting to learn more about the role that carbon sequestration can play in mitigating GHG emissions.

CONCLUSION

Carbon sequestration 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, source/sink identification, and best practices and protocols will be available. The Atlas is an important part of this mission, and future updates and enhancements will help pave the way for wide-scale deployment of CCS technologies.

Mr. Chairman, and members of the Subcommittee, this completes my written statement.