What are the Administration Priorities for Climate Change Technology?

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2318 Rayburn House Office Building

Oral Testimony of Dr. Sally M. Benson

Chairman Biggert and members of the sub-committee, thank you for the opportunity to provide testimony on this important and timely topic. I am Dr. Sally Benson, a hydrogeologist at Lawrence Berkeley National Laboratory and since 1999 I have led a team of earth scientists working on geologic sequestration of carbon dioxide (CO_2).

Today nearly 2 million tons of CO_2 are sequestered annually in geologic formations at the Sleipner Project in the North Sea and in the Weyburn oil field in Canada. More commercial projects are planned in Algeria, Australia and off-shore Norway. In addition to these successful commercial projects, the existence of naturally occurring CO_2 reservoirs proves that CO_2 can be sequestered for hundreds of thousands of years or more.

Depleted oil and gas reservoirs are especially promising for long term sequestration because they have seals that have stood the test of time. They are also attractive because CO_2 sequestration can be combined with enhanced oil recovery, a mature technology applicable to an estimated 80% of oil reservoirs. The availability of an abundant low-cost supply of CO_2 could be a boon to the domestic oil industry. A similar idea can be applied to enhance the recovery of natural gas from deep coal beds.

Now, to answer your first question about the most important outstanding technical issues. Sandstone formations filled with saltwater, such as the Mount Simon Formation in the Midwest, the Frio Formation along the Texas Gulf Coast, and the Central Valley in California, are estimated to have the capacity to accommodate hundreds of years of CO_2 emissions at today's rates. That natural gas has been stored at over 50 aquifer storage sites in the U.S. alone, demonstrates that appropriately sited projects can safely and effectively sequester CO_2 underground. The best sequestration sites will be at depths between three-quarters and two miles deep, have several hundred feet of porous and permeable sands, and be overlain by at least one thick and continuous seal. However, site selection criteria have yet to be developed and capacity estimates have not yet been validated by regional or site-specific field experiments.

Monitoring to verify that CO_2 is safely and effectively sequestered, or to provide early warning in the event that a project is failing, is also needed. Methods developed by the oil and gas industry such as injection well pressure monitoring and 3-D seismic surveys can be used. But more studies are needed to develop standard protocols for monitoring.

Computer models that predict the performance of a sequestration project also need to be verified. While reservoir simulation is a mature technology, the capability of today's models need to be extended to include accurate representation of geochemical and geomechanical processes that are important for geologic sequestration. These models need to be validated by a number of site specific studies that cover the range of geologic settings that could be used for CO_2 sequestration.

The potential environmental consequences of geologic sequestration are well understood based on analogous experience from the oil and gas industry, natural gas storage, EPA's Underground Injection Control Program and places such as Perrier in France where CO_2 naturally seeps out at the ground surface. The highest probability risks are associated with improper injection well completions, abandoned wells and inadequate characterization of the sequestration site. Over time, technologies and monitoring protocols have been developed to manage and mitigate these concerns.

To summarize the most important outstanding technical issues, geologic sequestration of CO_2 is in practice today and more is planned. However, to fully evaluate the potential for large-scale application, a research program that combines site-specific field studies with a directed-research program are must:

- Provide regionally validated estimates of sequestration capacity;
- Enhance our understanding of the geochemical reactions and geomechanical processes that enhance or compromise sequestration security;
- Provide validated approaches to modeling and monitoring; and
- Perform regional and site-specific risk assessments.

To answer your question about what portion of these uncertainties can be reduced by additional research, all of them can be. However, because the site-specific nature of the factors that provide secure geologic sequestration, pilot-tests should be located in each of the regions with a large concentration of stationary CO_2 sources. While many of these issues can be addressed by small scale pilot-tests, eventually, full scale demonstration projects will be needed.

With regard to the committee's second and third questions, are we ready for a full-scale demonstration and what work is needed before a site is selected? The full-scale geologic sequestration projects at Sleipner and Weyburn attest to this fact that a full-scale demonstration can be carried out today. However, first, potential sites need to be screened, pilot-tests must be carried out, including demonstrating that our models and monitoring methods are adequate, a risk assessment is needed and permits must be obtained.

To answer your fourth question, estimated costs for geologic sequestration of CO_2 range from about $3 to $10 per ton, depending on site specific considerations such as how many injection wells are needed, surface facilities, economy of scale and monitoring requirements.

In summary, geologic sequestration is an important component of a climate change technology portfolio. It offers the potential for deep reductions in CO_2 emissions while allowing continued use of fossil fuels. Efforts are underway to address the important technical issues and success can be assured by a sustained commitment to an adequate program of directed-research, pilot-tests at regionally relevant sites and full-scale demonstration.

Thank you for your attention.