Executive Summary: Report of the Interagency Task Force on Carbon Capture and Storage

August 2010

Executive Summary

Introduction

Carbon capture and storage (CCS) refers to a set of technologies that can greatly reduce carbon dioxide (CO_2) emissions from new and existing coal- and gas-fired power plants, industrial processes, and other stationary sources of CO_2. In its application to electricity generation, CCS could play an important role in achieving national and global greenhouse gas (GHG) reduction goals. However, widespread cost-effective deployment of CCS will occur only if the technology is commercially available and a supportive national policy framework is in place.

In keeping with that objective, on February 3, 2010, President Obama established an Interagency Task Force on Carbon Capture and Storage composed of 14 Executive Departments and Federal Agencies. The Task Force, co-chaired by the Department of Energy (DOE) and the Environmental Protection Agency (EPA), was charged with proposing a plan to overcome the barriers to the widespread, cost-effective deployment of CCS within ten years, with a goal of bringing five to ten commercial demonstration projects online by 2016. Composed of more than 100 Federal employees, the Task Force examined challenges facing early CCS projects as well as factors that could inhibit widespread commercial deployment of CCS. In developing the findings and recommendations outlined in this report, the Task Force relied on published literature and individual input from more than 100 experts and stakeholders, as well as public comments submitted to the Task Force. The Task Force also held a large public meeting and several targeted stakeholder briefings.

While CCS can be applied to a variety of stationary sources of CO_2, its application to coal-fired power plant emissions offers the greatest potential for GHG reductions. Coal has served as an important domestic source of reliable, affordable energy for decades, and the coal industry has provided stable and quality high-paying jobs for American workers. At the same time, coal-fired power plants are the largest contributor to U.S. greenhouse gas (GHG) emissions, and coal combustion accounts for 40 percent of global carbon dioxide (CO_2) emissions from the consumption of energy. EPA and Energy Information Administration (EIA) assessments of recent climate and energy legislative proposals show that, if available on a cost-effective basis, CCS can over time play a large role in reducing the overall cost of meeting domestic emissions reduction targets. By playing a leadership role in efforts to develop and deploy CCS technologies to reduce GHG emissions, the United States can preserve the option of using an affordable, abundant, and domestic energy resource, help improve national security, help to maximize production from existing oil fields through enhanced oil recovery (EOR), and assist in the creation of new technologies for export.

While there are no insurmountable technological, legal, institutional, regulatory or other barriers that prevent CCS from playing a role in reducing GHG emissions, early CCS projects

face economic challenges related to climate policy uncertainty, first-of-a-kind technology risks, and the current high cost of CCS relative to other technologies. Administration analyses of proposed climate change legislation suggest that CCS technologies will not be widely deployed in the next two decades absent financial incentives that supplement projected carbon prices. In addition to the challenges associated with cost, these projects will need to meet regulatory requirements that are currently under development. Long-standing regulatory programs are being adapted to meet the circumstances of CCS, but limited experience and institutional capacity at the Federal and State[1] level may hinder implementation of CCS-specific requirements. Key legal issues, such as long-term liability and property rights, also need resolution.

A climate policy designed to reduce our Nation's GHG emissions is the most important step for commercial deployment of low-carbon technologies such as CCS, because it will create a stable, long-term framework for private investments. A concerted effort to properly address financial, economic, technological, legal, institutional, and social barriers will enable CCS to be a viable climate change mitigation option that can over time play an important role in reducing the overall cost of meeting domestic and global emissions reduction targets. Federal and State agencies can use existing authorities and programs to begin addressing these barriers while ensuring appropriate safeguards are in place to protect the environment and public health and safety.

Status of CCS Technologies

CCS is a three-step process that includes capture and compression of CO_2 from power plants or industrial sources; transport of the captured CO_2 (usually in pipelines); and storage of that CO_2 in geologic formations, such as deep saline formations, oil and gas reservoirs, and unmineable coal seams. Technologies exist for all three components of CCS.

- Capture of CO_2 from industrial gas streams has occurred since the 1930s using a variety of approaches to separate CO_2 from other gases. These processes have been used in the natural gas industry and to produce food and chemical-grade CO_2. Existing capture technologies are energy-intensive, and consequently their application to coal-fired power plants and other industrial sources is expensive.
- The history of transporting CO_2 via pipelines in the United States spans nearly 40 years. Approximately 50 million tonnes of CO_2 are transported each year in the United States through 3,600 miles of existing CO_2 pipelines.

[1] References to "States" also include Tribal governments.

- Globally, there are four commercial CCS facilities sequestering captured CO_2 into deep geologic formations and applying a suite of technologies to monitor and verify that the CO_2 remains sequestered.[2,3] These four sites represent 25 years of cumulative experience on safely and effectively storing anthropogenic CO_2 in appropriate deep geologic formations (Dooley et al., 2009). DOE estimates that there are hundreds to thousands of years of storage potential in similar geologic formations in North America (NETL, 2008). Similarly, the Department of the Interior's U.S. Geological Survey (USGS) is leveraging DOE's efforts to generate a comprehensive catalogue of national sequestration potential.

Though CCS technologies exist, "scaling up" these existing processes and integrating them with coal-based power generation poses technical, economic, and regulatory challenges. In the electricity sector, estimates of the incremental costs of new coal-fired plants with CCS relative to new conventional coal-fired plants typically range from $60 to $95 per tonne of CO_2 avoided (DOE, 2010a). Approximately 70–90 percent of that cost is associated with capture and compression. Some of this cost could be offset by the use of CO_2 for EOR for which there is an existing market, but EOR options may not be available for many projects.

Research, development, and demonstration (RD&D) programs such as those currently being conducted by DOE can help reduce project uncertainty and improve technology cost and performance. The focus of CCS RD&D is twofold: 1) to demonstrate the operation of current CCS technologies integrated at an appropriate scale to prove safe and reliable capture and storage; and 2) to develop improved CO_2 capture component technologies and advanced power generation technologies to significantly reduce the cost of CCS, to facilitate widespread cost-effective deployment after 2020.

Status of CCS in the United States

The Federal government is already pursuing a set of concrete initiatives to speed the commercial development of safe, affordable, and broadly deployable CCS technologies in the United States, including: RD&D of CCS technologies; the development of regulations that address the safety, efficacy, and environmental soundness of injecting and storing carbon dioxide underground; and the assessment of the country's geologic capacity to store carbon dioxide. All of this work builds on the firm scientific basis that now exists for the viability of CCS technology.

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[2] Since the 1970s, engineered injection of CO_2 into geologic reservoirs has taken place for purposes of enhanced oil recovery, resulting in the development of many aspects of reservoir management and operation needed for safe large-scale injection and geologic storage of CO_2.

[3] Sleipner in the North Sea, Snøhvit in the Barents Sea, In Salah in Algeria, and Weyburn in Canada.

Long-term integrated testing and validation programs are needed for technical, economic, and regulatory reasons. DOE is currently pursuing multiple demonstration projects using $3.4 billion of available budgetary resources from the American Recovery and Reinvestment Act[4] in addition to prior year appropriations. Various other incentives, such as tax credits and loan guarantees, are also available to many projects.

Up to ten integrated CCS demonstration projects supported by DOE are intended to begin operation by 2016 in the United States. These demonstrations will integrate current CCS technologies with commercial-scale power and industrial plants to prove that they can be permitted and operated safely and reliably. New power plant applications will focus on integrating pre-combustion CO_2 capture, transport, and storage with Integrated Gasification Combined Cycle (IGCC) technology. Power plant retrofit and industrial applications will demonstrate integrated post-combustion capture. These projects, plus others supported by Federal loan guarantees, tax incentives, and State-level drivers, cover a large group of potential CCS options. However, some proposed demonstration projects may not proceed for economic or other reasons. Looking toward long-term deployment, additional actions may be required to help overcome the uncertainty of evolving climate change policy and the high cost of applying currently available CCS technology, consistent with addressing market failures.

Barriers to CCS Deployment

The lack of comprehensive climate change legislation is the key barrier to CCS deployment. Without a carbon price and appropriate financial incentives for new technologies, there is no stable framework for investment in low-carbon technologies such as CCS. Significant Federal incentives for early deployment of CCS are in place, including RD&D efforts to push CCS technology development, and market-pull mechanisms such as tax credits and loan guarantees. However, many of these projects are being planned by the private sector in anticipation of requirements to reduce GHG emissions, and the foremost economic challenge to these projects is ongoing policy uncertainty regarding the value of GHG emissions reductions.

Even with financial support, challenges such as legal and regulatory uncertainty can hinder the development of CCS projects. Regulatory uncertainty has been widely identified as a barrier to CCS deployment. Though early CCS projects can proceed under existing laws, there is limited experience at the Federal and State levels in applying the regulatory framework to CCS. Ongoing EPA efforts will clarify the existing regulatory framework by developing requirements tailored for CCS, which will reduce uncertainty for early projects and help to ensure safe and effective deployment. Experience gained from regulating and permitting the first five to ten CCS projects will further inform potential changes to existing requirements and the need for an enhanced regulatory framework for widespread CCS deployment.

[4] Public Law 111-5.

The Task Force identified a range of views concerning potential long-term liabilities (i.e., those arising after closure of a CO_2 storage site) and the extent of any potential impacts on widespread deployment. Many States planning CCS projects are taking steps to address long-term liabilities associated with geologic storage of CO_2. The Task Force's preliminary assessment is that the existing Federal and State legal framework should be adequate for at least an initial group of five to ten commercial-scale projects. However, because of divergent views on the topic and limited time to analyze a complex set of underlying issues and drivers, additional analysis is needed to determine the most appropriate legal or regulatory structures for addressing potential long-term liabilities associated with widespread deployment.

Aggregation of pore space and associated property rights are also important for CCS projects. Historically, pore space issues have been handled by States. Several States are taking actions to address aggregation of pore space for geologic storage on private lands. Based on experience thus far, the Task Force believes States are best positioned to address pore space issues on private lands.

Public awareness and support are critical to the development of new energy technologies and are widely viewed as vital for CCS projects (IPCC, 2005; CRS, 2008; IEA, 2009c). Whether the public will support or oppose commercial-scale CCS projects is largely unknown (Malone et al., 2010), and the public's reaction may be project-specific. However, enhanced and coordinated public outreach will improve awareness of the role of CCS as one option to reduce GHG emissions. Integration of public information, education, and outreach efforts throughout the lifecycle of CCS projects will help identify key issues, foster public understanding, and build trust between communities and project developers.

Proposed Plan to Overcome Barriers

Support for Technology Development

To foster the success of early CCS projects, including five to ten commercial-scale demonstrations by 2016, DOE and EPA should create a Federal agency roundtable to act as a single point of contact for project developers seeking assistance to overcome financial, technical, regulatory, and social barriers facing planned or existing projects. As needed, this roundtable should provide technical support to State and Federal permitting authorities and permit applicants. This roundtable should also create a technical committee composed of experts from the power and industrial sectors, NGOs, State officials, and research community. Together with DOE and EPA, the technical committee would conduct a periodic review of CCS demonstration projects to track their progress and, broadly, identify any additional research, risk management, or regulatory needs. The technical committee could also, as requested by DOE or EPA, provide input on a range of CCS technical, economic, or policy issues.

DOE should continually review the adequacy of capture technologies and classes of storage reservoirs to enable safe and cost-effective widespread CCS deployment within ten years. This ongoing assessment, coupled with input from the technical committee outlined above, will assist the Administration in targeting any remaining technology gaps.

Increased Federal coordination would enhance the government's ability to assist these projects by providing more effective incentives and/or addressing barriers. DOE, in coordination with EPA, Treasury, and USDA, should track the use and efficacy of Federal financial support for CCS projects. Increased coordination will enhance the government's ability to tailor Federal funding and assistance to each project's market context, improve the clarity of eligibility criteria for projects to receive Federal support, allocate resources efficiently, and enable the Administration to more effectively consult with Congress and the States on the efficacy of existing incentives.

The Administration should continue to support international collaboration that complements domestic CCS efforts and facilitates the global deployment of CCS. Most CCS technology RD&D is being supported by the United States and other developed countries. Leveraging resources and sharing results across these countries will improve the viability of CCS and potentially speed up global commercialization. Energy and economic modeling suggests that CCS in coal-dependent emerging economies plays a key role under some future policy and economic scenarios in achieving global climate change mitigation goals. The United States should continue its cooperation with large coal-dependent emerging economies with rapidly expanding power sectors, to facilitate a constructive dialogue and help to avert the locking in of inefficient, high-GHG emission power generation assets for decades. Failure to do so may make subsequent CCS deployment more difficult and increase the cost of global climate change mitigation.

Providing Legal & Regulatory Clarity and Support

Federal agencies must work together to design requirements for CCS using existing authorities in complementary ways. By late 2010, EPA should finalize rulemakings for geologic sequestration wells under the Safe Drinking Water Act (SDWA) and GHG reporting for CO_2 storage facilities under the Clean Air Act (CAA), and propose a Resource Conservation and Recovery Act (RCRA) applicability rule for CO_2 that is captured from an emission source for purposes of sequestration. EPA guidance to support implementation of these rules should also be provided at the same time. By late 2011, EPA should finalize the RCRA applicability rule. EPA and the Department of the Interior (DOI) should immediately formalize coordination and prepare a strategy to develop regulatory frameworks for CCS for onshore and offshore Federal lands. Ratification of the London Protocol (LP) and associated amendment of the Marine Protection, Research, and Sanctuaries Act (MPRSA) as well as amendment of the Outer Continental Shelf Lands Act (OCSLA) will ensure a comprehensive statutory framework for the storage of CO_2 on the outer continental shelf.

Federal and State agencies must work together to enhance regulatory and technical capacity for safe and effective CCS deployment. Specifically, EPA, in coordination with DOE, DOI, and State agencies, should develop capacity-building programs for underground injection control regulators. Educating permit writers and other key officials will greatly enhance their capability and efficiency in issuing and enforcing technically sound permits. These programs should leverage existing efforts such as the DOE Regional Carbon Sequestration Partnerships (RCSPs). DOE and EPA should also identify data needs and tools to support regulatory development, permitting, and project development.

The Task Force emphasizes that appropriate monitoring, oversight, and accountability for CCS activities will be essential to ensure the integrity of CCS operations, enable a sustainable CCS industry, and provide a strong foundation for public confidence. DOE and EPA, in consultation with other agencies, should track regulatory implementation for early commercial CCS demonstration projects and consider whether additional statutory revisions are needed. This will enable the Administration to more effectively consult with Congress and the States if the existing framework proves ineffective.

Federal agencies should begin to develop National Environmental and Policy Act (NEPA) analyses related to CCS as early as possible to help ensure timely completion of robust and comprehensive environmental reviews. Where appropriate to Federal agency decision-making, agencies should consider development of Programmatic Environmental Impact Statements for use in tiered NEPA analysis and initiate this process. CEQ should consider development of CCS-specific NEPA guidance.

Efforts to improve long-term liability and stewardship frameworks should continue. By late 2011, EPA, DOE, Department of Justice (DOJ), DOI, and Treasury should further evaluate and provide recommendations to address long-term liability and stewardship in the context of existing and planned regulatory frameworks. Of the seven options identified by the Task Force, the following four approaches, or combinations thereof, should be considered: (1) reliance on the existing framework for long-term liability and stewardship; (2) adoption of substantive or procedural limitations on claims; (3) creation of an industry-financed trust fund to support long-term stewardship activities and compensate parties for various types and forms of losses or damages that occur after site closure; and (4) transfer of liability to the Federal government after site closure (with certain contingencies). Open-ended Federal indemnification should not be used to address long-term liabilities associated with CO_2 storage.

Public Outreach

To enhance and coordinate public outreach for CCS, DOE and EPA should leverage existing efforts to coordinate among Federal agencies, States, industry, and NGOs to gather information and evaluate potential key concerns around CCS in different areas of the United States. Using this information, DOE and EPA should develop a comprehensive outreach strategy among the

Federal government, States, industry, and NGOs having two components: a broad strategy for public outreach, targeted at the general public and decision makers, and a more focused engagement with communities that are candidates for CCS projects, to address issues such as environmental justice. A first step should be to immediately establish a clearinghouse for public access to unbiased, high-quality information on CCS. Over time, outreach tools should be developed for project developers and regulators with input from DOE, EPA, Department of Transportation (DOT), and DOI.

Conclusion

CCS can play an important role in domestic GHG emissions reductions while preserving the option of using abundant domestic fossil energy resources. However, barriers hamper near-term and long-term demonstration and deployment of CCS technology. While the largest of these barriers is the absence of a Federal policy to reduce GHG emissions, the Task Force has outlined specific actions the Federal government could take under existing authority and resources to address these barriers. For widespread cost-effective deployment of CCS, additional action may be needed to address specific barriers, such as long-term liability and stewardship. Timely development of cost-effective CCS could reduce the costs of achieving our Nation's climate change goals.

CCS can also play a major role in reducing GHG emissions globally. Continued leadership to develop and deploy CCS technologies as one option to address global climate change will position the United States as a leader in climate change technologies and markets. However, widespread cost-effective deployment of CCS will occur only if the technology is commercially available at economically competitive prices and supportive national policy frameworks are in place.