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CARBON CAPTURE AND STORAGE CASE STUDY

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STATE RESOURCE MANAGEMENT: PRACTICAL APPROACHES TO REGULATORY APPLICATIONS

Carbon dioxide (CO_2) is a colorless, odorless, non-poisonous gas that is a normal component of Earth's atmosphere. CO_2 and other "greenhouse gases" trap heat at the Earth's surface and are crucial to making the planet habitable. The release of CO_2 from organic matter through respiration, decay, or combustion is a part of a constant exchange between the earth and its atmosphere. Plants use CO_2 for photosynthesis and the oceans absorb and release CO_2 at the surface. The concern is that too much CO_2 could have a detrimental effect on Earth's climate.

The U.S. Environmental Protection Agency (EPA) has tracked the quantity of anthropogenic, or man-made, CO_2 emissions since 1990. A United Nations panel, which collects similar inventories from other member nations, concluded that the natural carbon cycle is unable to maintain its proper balance due to increased levels of CO_2 introduced into the atmosphere by humans. Since the industrial revolution, human activity – most notably the burning of fossil fuels for power generation, industrial use and transportation and the deforestation of land for agricultural and urban use – appears to be increasing the amount of CO_2 released into the atmosphere faster than oceans and plants are able to absorb it. Some scientists believe that the increased levels of atmospheric CO_2 and other greenhouse gases is increasing the earth's temperature to a level at which the certain regions of the planet could eventually become uninhabitable.

With the identification of CO_2 as a leading contributor to global warming, people around the world are seeking solutions to mitigate the release of anthropogenic CO_2 into the atmosphere. Numerous approaches are in various stages of development and implementation including: creation of economic incentives to reduce emissions such as a carbon tax or a cap and trade mechanism; reforestation, wetlands restoration, and other activities that increase the number of plants and microorganisms available to naturally remove CO_2 from the atmosphere; and carbon capture and storage (CCS) into oceans or underground geologic formations.

The geologic storage of CO_2 is among the most immediate and viable strategies for mitigating the release of CO_2 into the atmosphere. The U.S. oil and gas industry first began injecting CO_2 into underground formations to improve recovery in 1972 and remains the world leader in CO_2 enhanced oil recovery (EOR) technology. As long as it remains part of the EOR process and is not released into the atmosphere, CO_2 is stored. Consequently, EOR projects throughout the U.S. provide a potential major repository for anthropogenic CO_2.

According to DOE's National Energy Technology Lab, a 2001 study "shows that by 2020, EOR and CBM [coalbed methane natural gas] recovery could reduce CO_2 emissions by 200 million tons per year (the equivalent of CO_2 emissions from 100 coal-fired power plants)."[1] In addition to adding approximately 260 million barrels per year of incremental domestic oil production and increasing domestic natural gas production by about 1.1 trillion cubic feet per year, researchers estimate that increased production from CO_2 EOR projects could reduce the U.S. trade deficit by $8.3 billion per year.

[1] *http://www.netl.doe.gov/technologies/carbon_seq/FAQs/benefits.html*

Many of the major sources of CO_2 emissions are proximate either to producing fields that would benefit from enhanced recovery or potential sequestration sites, reducing the need for costly pipeline networks. Additionally, use of CO_2 for enhanced recovery offsets the cost of capture through improved productivity. As the human footprint grows, the extent to which we can balance its carbon impact is not only good for the environment, but also good for the economy.

Further, the U.S. has abundant deep saline formations, some of which are used for natural gas storage and other purposes. A Department of Energy (DOE)/Regional Carbon Sequestration Partnerships (RCSPs) examination of a number of deep saline formations lists an estimated potential storage capacity ranging from 919 to more than 3,300 billion metric tons (from 1,014 to more than 3,700 billion tons) of CO_2.

Because both the technology used for geologic CO_2 sequestration and the potential issues related to land use and environmental protection are very similar to those associated with oil and gas development, the IOGCC established a Carbon Capture and Geologic Storage (CCGS) Task Force to examine the technical, policy and regulatory issues related to the safe and effective storage of CO_2 in subsurface geologic media. The Task Force, assembled in December 2002, included representatives from IOGCC member states, international affiliate provinces, state and provincial oil and gas agencies, the U.S. DOE and its sponsored Regional Carbon Sequestration Partnerships, the Association of American State Geologists, and independent experts. Key conclusions from the task force meetings include:

- *CO_2 should be viewed as a valuable commodity and regulated using a resource management framework;*
- *No other jurisdiction has the experience and expertise of the states and provinces in the regulation of oil and natural gas production and natural gas storage – factors critical to the effective regulation of geologic CO_2 storage.*

While some argue that governments should regulate CO_2 as a waste product, Task Force members assert that such an approach sidesteps the public's role in both the creation of CO_2 and in mitigating its release into the atmosphere. Further, a waste management model leaves the burden on industry to dispose of a product from which the public must be "protected." Conversely, a resource management framework encourages public and private sector partnership in which every party shares responsibility for reducing and mitigating CO_2 emissions and allows for a unified regulatory framework.

Although the Task Force recognized that states and provinces might have statutory and regulatory frameworks that could accommodate CO_2 injection and storage, they also recognized that some modification might be necessary, especially for the post-injection storage stage for which no regulation existed. Adding representatives from the EPA and the U.S. Bureau of Land Management (BLM), along with observers from an environmental organization, the Task Force began a second phase of the project aimed at developing a set of model rules and regulations that States could adapt for use in governing geologic CO_2 sequestration.

The principles guiding the Phase II model were the requirements for a framework that is seamless, simple, flexible and responsive, doable, and has a positive public presentation. A seamless "cradle to grave" framework with fully integrated regulatory oversight and clearly identified risk parameters maximizes the potential economic

and environmental benefits. A simple solution helps avoid the temptation to over-regulate for the exotic, while flexibility and responsiveness allow modification on an as-needed basis to account for new knowledge and experience and the differences in the State's requirements. Doable, because the speed at which the issue is progressing demands solutions that States can implement quickly. Finally, a positive public presentation will encourage creative, cooperative solutions that provide economic and environmental benefits to all.

Among the issues the CCGS Task Force sought to address in the model rules are:

- *Ownership of reservoirs and associated pore space;*
- *Permitting guidelines that require operators to submit detailed engineering and geological data along with a CO_2 injection plan that includes a description of mechanisms of geologic confinement that prevents migration of CO_2 beyond the proposed storage reservoir;*
- *Long-term monitoring and liability.*

The United States is one of a few countries in the world that does not limit property ownership to the surface; most governments own 100% of the mineral rights including oil, gas, coal, precious metals and gemstones. In the U.S., ownership rights vary from state to state, and even within some state borders, and are based on common law, various treaties and a number of court decisions. Some states allow separation of surface and mineral rights while others do not. In cases where the Federal Government owns the mineral estate the BLM is responsible for overseeing mineral development. In the case of severed estates, where surface and mineral ownership are held separately, the mineral estate is dominant over the surface estate, meaning that the mineral owner has the right to develop the resources and must be granted surface access within bounds determined by the state and federal statutes. With the exception of federal lands, the right to use reservoirs and associated pore space is considered a private property right, generally a function of state law, that must be acquired from the owner.

In partnership with the New Mexico Institute of Mining and Technology and the DOE, the IOGCC Geological CO_2 Sequestration Task Force published a set of model rules and regulations in late 2007. Eighteen states and four Canadian provinces reviewed the guidance document and seven have moved into legislative discussions. A few states have promulgated some new rules and regulations based on the Task Force model.

Wyoming is among the first states to enact legislation specifically addressing CO_2 geological sequestration. Task Force member John Corra, director of the Wyoming Department of Environmental Quality reports that the state enacted three pieces of legislation.

> ***"HB58 clarifies the responsibilities of the pore space owner and the injector. This goes to long-term liability and the law imposes ownership of the CO_2 on the injector. HB57 prioritizes the rights of subsurface users, so that mineral rights are dominant over pore space rights. HB80 allows for unitization, so that once 80% of surface owners are in agreement, the terms and conditions can be applied to all others. This enables assembly of land large enough for sequestration."***

Wyoming's Department of Environmental Quality (DEQ) and the Wyoming Oil and Gas Commission have been working together to develop and publish rules and regulations to implement the new legislation. Wyoming has posted the rules for public review and the working group is engaged in developing proper funding assurances and bonding requirements to minimize environmental and financial risks to the public. The state also has dedicated funding to research potential sites. The University of Wyoming is assisting in the pilot testing and study of two sites with differing geology and settings. The testing will assess the suitability of CO_2 for enhanced gas production and for injection in deep saline formations.

Public and industry reaction to Wyoming's actions concerning CO_2 sequestration has been favorable. Public perceptions and attitudes, which the Task Force identified as one of the principle components of CO_2 regulation through a resource management framework, appear to support the state in its efforts to mitigate the impact of carbon emissions and applaud Wyoming's willingness to look for the potential of CO_2 storage to expand economic development. According to Corra, "We are balancing the needs and doing what we can do and what we do well. Our Legislature is creating the necessary legal framework and along with Governor Dave Freudenthal they are funding significant research and development activities."

In 2006, New Mexico Governor, Bill Richardson issued an executive order requiring state action to reduce emissions. In December 2007, the State released a Blueprint for the Regulation of Geologic Sequestration of Carbon Dioxide. New Mexico, which generates power for itself and its more populous neighbors, California and Arizona, is also participating in a DOE-sponsored Southwest Regional Partnership's pilot project site in the San Juan Basin that is studying permanent CO_2 sequestration in conjunction with enhanced gas recovery. However, legislation to regulate geologic sequestration failed to pass in 2009.

Kansas passed HB2419 in 2007 mandating the development of regulations by July 1, 2008. The Kansas statute is limited in scope and primarily mandates development of regulation for CO_2 injection wells. The rules are currently open to public comment. The Kansas Corporation Commission expects to bring up the regulations, which received a public hearing in March, for final approval by the summer of 2009. The rules are largely based on the IOGCC model as well as their gas storage regulations and a EPA proposed rule creating a new class of wells under the EPA's Underground Injection Control (UIC) program.

North Dakota appears to be embracing a resource management framework for CO_2 sequestration by involving industry and the public and incentivizing CO_2 for EOR projects. Legislation introduced in 2005 by Gov. John Hoeven, Sen. Rich Wardner and members of the state Senate and House expands the tax incentive for enhanced oil and gas recovery using CO_2. Governor Hoeven said. "The technology that this bill encourages can help to substantially increase production in our state, generating good paying jobs for our citizens and added revenues for our rural communities."

In April, the North Dakota Legislature passed two pieces of legislation on CO_2 sequestration. Gov. Hoeven signed the first, which establishes jurisdiction for regulation of CO_2 storage under the ND Industrial Commission's (NDIC) Oil and Gas Division, on April 8, 2009 and it will go into effect August 1. The second piece of legislation, also signed April 8, grants ownership of the pore space to the surface owner and took effect immediately. According to Lynn

Helms, Director Department of Mineral Resources NDIC, the Oil and Gas Division will begin working on rules to implement the legislation in August and will continue to use the IOGCC Task Force model as guidance.

In Oklahoma, Senate Bill 1765 established the Oklahoma Geologic Storage of Carbon Dioxide Task Force with a mandate to submit a report with legislative recommendations by December 1, 2008. That report was completed and submitted and legislation introduced in 2009. Notable among the group's accomplishments is the development of the Oklahoma Carbon Sequestration Certification Program and Carbon Offset Registry, voluntary programs designed to verify the quantity of stored CO_2 claimed for an offset – assurances fundamental to the sale, trade, or transfer of offsets.

Oklahoma has also passed legislation granting jurisdiction for CO_2 sequestration in saline or non-oil and gas producing formations to the Oklahoma Department of Environmental Quality (OKDEQ) and CO_2 injection for EOR to the Oklahoma Corporation Commission (OCC). The legislature has also authorized the OKDEQ and the OCC to promulgate new rules for geologic CO_2 sequestration and voted to continue the state's CO_2 Storage task force.

Texas lawmakers recently provided tax incentives that have attracted "possibly the first conventional coal-fueled power plant in the world to capture 85 to 90 percent of its carbon dioxide (CO_2) that would otherwise be emitted into the air and provide for its geologic storage" according to Tenaska, the company building the facility. The company says that the CO_2 captured at the plant, which will supply electricity to 600,000 Texas homes, will be used to enhance oil and gas recovery in the Permian Basin.

The Texas Legislature is awaiting Governor Rick Perry's signature on CSHB 1796 permitting the General Land Office (GLO) and the Bureau of Economic Geology at the University of Texas at Austin to build and operate a carbon dioxide repository. The partnership will inject CO_2 into underwater salt formations on state-owned offshore submerged land.

Montana recently passed SB498 to create a framework for geologic CO_2 sequestration. The law gives the State Board of Oil and Gas jurisdiction over geologic CO_2 sequestration and grants ownership of pore space to the surface owner. On the matter of long-term liability, the bill imposes liability a 30-year monitoring and liability requirement after which responsibility passes to the state.

Carbon capture and geologic storage is a relatively recent topic for state and federal lawmakers and one where pioneers are forging new ground. States have a variety of factors, from geological to political, that will influence how they regulate CCGS within their own borders. Fortunately, for oil and gas producing states the expertise to protect health, safety, and the environment resides within existing state agencies and existing legal frameworks can be modified to addresses issues such as property ownership and liability. Because of foundational work accomplished by the IOGCC CCGS Task Force, states have available to them comprehensive guidelines to support their efforts to develop state-appropriate regulations. Additionally, the Task Force is continuing its efforts by bringing to light the experiences and best practices of those who are moving forward in this arena.