Carbon Capture and Storage:
A Regulatory Framework for States

Summary of Recommendations

IOGCC

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NETL

What is Carbon?

Carbon dioxide (CO_2) is a colorless, odorless, non-poisonous gas that is a normal part of Earth's atmosphere. As a greenhouse gas, CO_2 traps heat radiated by the Earth into the atmosphere and is critical for keeping our planet habitable. At normal atmospheric conditions, CO_2 makes up a very small fraction of the Earth's atmosphere and occurs in four forms: gas, liquid, supercritical fluid and solid.

THE ISSUE: Too much carbon

While CO_2 is critical to life on earth, it also contributes to the prospect of global climate change. The natural carbon cycle is an exchange of carbon between atmosphere, oceans and terrestrial biosphere. The weight of scientific evidence suggests that human activity has altered the operation of the natural carbon cycle to the extent that CO_2 formed by the combustion of hydrocarbons is not completely absorbed in the exchange process and remains in the atmosphere for a period of 50 to 200 years.

Fueled by the increase of carbon dioxide in the Earth's atmosphere – attributed by many climate scientists to the activities of man – governments worldwide, including the United States, have mobilized to examine ways to decrease the emission of carbon dioxide into our atmosphere from anthropogenic sources.

IOGCC: Finding a solution

The Interstate Oil and Gas Compact Commission (IOGCC), as an authority on issues surrounding oil and natural gas, extensively researched an opportunity to mitigate the release of CO_2 into the atmosphere. Carbon capture and geological storage (CCGS) – capturing carbon dioxide before it is released into the atmosphere and storing it in underground geologic formations, is a promising option.

The growing interest of government and industry in the storage of CO_2 stems from the fact that the increasing amounts of the gas is largely the consequence of burning carbon fuels for energy. In the United States, 98 percent of carbon dioxide is emitted as the result of the combustion of fossil fuels; consequently, carbon dioxide emissions and energy use are highly correlated.

For this reason IOGCC formed its *Geological CO_2 Sequestration Task Force,* which, for the last year, has been examining the technical, policy and regulatory issues related to safe and effective storage of CO_2 in the subsurface (depleted oil and natural gas fields, saline formations and coal beds). Funded by the U.S. Department of Energy (DOE) and the National Energy Technology Laboratory (NETL), the Task Force is comprised of representatives from IOGCC member states and international affiliate provinces, state oil and natural gas agencies, DOE, DOE-sponsored Regional Carbon Sequestration Partnerships, the Association of American State Geologists (AASG) and other interested parties.

The process of CCGS can be divided into four components, labeled by the Task Force as capture, transportation, injection and post-injection storage. The required components of CO_2 injection have been used effectively to increase oil production within the Permian Basin region of west Texas and southeast New Mexico since 1972, and many other regions since the early 1980s.

The Recommendations

Given the jurisdiction, experience and expertise of states and provinces in the regulation of oil and natural gas production and natural gas storage in the United States and Canada, states and provinces will play a critical role in the regulation of CCGS. Regulations already exist in most states and provinces covering many of the same issues that need to be addressed in the regulation of CCGS.

Capture

The capture of industrial or anthropogenic CO_2 can be defined as the process of gathering, drying, purifying and compressing the CO_2 stream to allow transportation to a market, enhanced oil recovery (EOR) operation or storage site.

There are four technologies currently available for CO_2 capture from anthropogenic sources, which incorporate the process of gathering, drying and purifying.

These are most often combined in one or more physical or chemical processes such as glycol adsorption, membrane separation or amine adsorption.

The Task Force has concluded that given the substantial regulatory framework that currently addresses emissions standards, there is little need for state regulatory frameworks in this area. Specific recommendations are summarized below.

1. Existing federal air regulations do not define CO_2 as a pollutant. There is no need for state regulation to do otherwise. However, states that may have already defined CO_2 as a waste, air contaminant or pollutant may be advised to reassess that definition so as to not negatively impact CCGS development.

2. Devise standards for measurement of CO_2 concentration at capture point to verify quality necessary for conformance with CCGS requirements.

3. Involve all stakeholders, including the public, in the rule-making process at the earliest possible time.

> “The Task Force has concluded that given the substantial regulatory framework that currently addresses emissions standards, there is little need for state regulatory frameworks in this area.”

Transportation

Transportation is defined as the process of moving pressurized CO_2 via pipeline, tank transport or ship to the site of injection from the capture of the CO_2 (following processing, gathering and compression).

Many state, provincial and federal regulations exist in the United States and Canada to deal with transportation design, construction, operations, maintenance and emergency response for spills. In addition, groups such as the American Petroleum Institute (API), the American Gas Association (AGA) and the American Society for Testing and Materials (ASTM) have established standards for pipeline construction and material selection.

These well-established regulations and pipeline construction and material standards will adequately address CO_2 transportation. Specific recommendations are summarized below.

1. Require clarity and transparency in any potential statute and regulation development.

2. For transportation of CO_2 by pipeline, utilize regulatory structures from existing U.S. Department of Transportation (DOT), Office of Pipeline Safety (OPS) and state rules and regulations governing CO_2 pipeline construction, operation, maintenance, emergency responses and reporting.

> "Current well-established regulations and pipeline construction and material standards will adequately address CO_2 transportation."

3. Include CO_2 in states' "call before you dig" protocol.

4. In development of state permitting procedures, identify areas of special concern such as heavily populated areas and environmentally sensitive areas so that additional safety requirements can be considered.

5. While the "open access" issue is ultimately a federal concern, states must be aware of the relevancy of the open access issue as it affects state regulatory responsibilities.

6. Review existing state eminent domain statutes to determine if CO_2 meets the requirements necessary to allow the use of state eminent domain authority for CO_2 pipeline construction. Clarify state eminent domain powers affecting the construction of new CO_2 pipelines while respecting private property rights.

7. Identify opportunities for use of existing rights of way, both pipeline and electric transmission, for transportation of CO_2.

8. Allow for CO_2 transportation in pre-existing pipelines used to transport other commodities providing that safety, health and environmental concerns are addressed.

9. Involve all stakeholders, including the public, in the rule-making process at the earliest possible time.

Injection

Injection is defined as the placement, through wells, of CO_2 under pressure into underground geological formations. There are four primary options for the geologic storage of CO_2: in depleted oil and natural gas reservoirs; in deep saline formations; in salt caverns; and adsorption within coal beds that cannot be mined. Other possible storage options include organic shales, fractured basalts and hydrates. Specific recommendations are summarized below.

1 Require clarity and transparency in all statute and regulation development.

2 Existing regulatory frameworks provide a successful analogue for CCGS and should be examined to determine if they will adequately address the unique properties of CCGS.

3 States and provinces with natural gas storage statutes should utilize their existing natural gas regulatory frameworks, with appropriate modifications, for CCGS.

4 Should the U.S. Environmental Protection Agency (EPA) recommend that injection of CO_2 for non-EOR purposes be regulated under the Underground Injection Control (UIC) program, the Task Force strongly recommends reclassifying such wells either as a subclass of Class II or a new classification. The Task Force strongly believes that inclusion of non-EOR CCGS wells under Class I or Class V of the UIC program would not be appropriate.

5 States and provinces with regulations for acid gas injection should utilize their regulatory frameworks, with appropriate modifications, for CCGS.

6 Review existing CO_2 EOR, natural gas storage and acid gas regulations to ensure that operational plans for addressing public health and safety, as well as release or leakage mitigation procedures, are adequate.

7 Regulations governing permitting processes should adequately address reservoir properties relative to the interaction of CO_2 with rock matrix and reservoir fluids.

8 Well and equipment operational regulations should take into account the unique properties of CO_2.

9 Regulations governing permitting processes for non-EOR CO_2 injection projects should respect existing property rights dictated by state law in issuing CO_2 storage site permits.

10 Existing monitoring regulations currently in use for CO_2 EOR, natural gas storage and acid gas injection that do not not adequately address monitoring and verification requirements for CO_2 storage should be amended to ensure that the CCGS is performing as expected relative to safely storing CO_2 away from the atmosphere, accounting for those volumes and establishing leak detection protocols.

11 Adapt and modify established permitting regulations and standards for site characterization for purposes of CCGS. Consider results of DOE-sponsored partnership research and other ongoing research.

12 Involve all stakeholders, including the public, in the rule-making process at the earliest possible time.

Post-Injection Storage

Post-injection storage is defined as storage in depleted oil and natural gas reservoirs (including terminated CO_2 EOR projects), saline aquifers, salt caverns and coal beds that are not able to be mined.

The licensing and permitting processes for CCGS projects are designed to establish suitability and capability of a potential geologic storage structure to confine CO_2. The permitting process developed for EOR projects and natural gas storage projects contains reservoir characterization elements, which should be reviewed to ensure that they properly address CCGS issues.

Following completion of the injection phase, a regulatory framework needs to be established to address monitoring and verification of emplaced CO_2, leak mitigation for the stored CO_2 and determination of long-term liability and responsibility. Recommendations are summarized below.

1. Require clarity and transparency in all statute and regulation development.

2. Consider the potential need for legislation to clarify and address the unknown issues that may arise in the ownership of storage rights (reservoir pore space) and payment for use of those storage rights.

3. Research the chemical transformations that are likely to take place in the reservoirs over long periods of time which may impact, positively or negatively, reservoir integrity in CO_2 storage time frames. Some work has already been done in this area.

4. Construct a regulatory framework for the storage stage that allows for the potential of future removal of CO_2 for commercial purposes.

5. Given the long time frames proposed for CO_2 storage projects, innovative solutions to protect against orphaned sites will need to be developed. The current model utilized by most oil and natural gas producing states and provinces – whereby the government provides for ultimate assurance in dealing with orphaned oil and natural gas sites – may provide the only workable solution to this issue. This can be accomplished through state and provincial government administration of federally guaranteed industry-funded abandonment programs.

6. Establish technical standards for well abandonment and site closure accounting for specialized concerns dealing with the unique properties of CO_2 impacts on reservoir characteristics, well construction and cementing techniques normally used in the oil and natural gas industry.

7. Establish procedures for long-term reservoir management and monitoring. A new framework will need to be established to address the long-term monitoring and verification of emplaced CO_2 to confirm that injected volumes remain in place.

8. Establish a regulatory threshold requiring mitigation procedures to be initiated.

9. Involve all stakeholders, including the public, in the rule-making process at the earliest possible time.

CONCLUSION

The increase in CO_2 requires the development of strategies to reduce CO_2 concentrations, whether or not these strategies ever need to be deployed. One of the strategies that needs to be investigated and perfected is CCGS, especially the injection of CO_2 for purposes of EOR. For half a century the states and provinces have been the principal regulators of EOR in the United States and Canada, as well as for natural gas and hydrogen sulfide storage.

Regulations already exist in petroleum producing states and provinces covering many of the same issues that need to be addressed in the regulation of CCGS. Given the significant number of CO_2 EOR injection projects in the United States, "storage" of CO_2 is already, in essence, taking place.

Significantly, CO_2 EOR injection and storage also promises a substantial additional benefit to our economy and national security by increasing the amount of oil the United States is able to produce domestically from existing fields. This increases the likelihood that CO_2 EOR projects will be the vehicle that will drive CCGS development.

These projects can be the means by which we build both injection/storage experience, regulatory and otherwise, and physical infrastructure (pipelines/facilities). Thus, the EOR, natural gas storage and acid gas injection models will likely provide a technical, economic and regulatory pathway for long-term CO_2 storage.

DESERVING THANKS

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The Interstate Oil and Gas Compact Commission is a multi-state government agency that champions conservation and efficient recovery of domestic oil and natural gas resources while protecting health, safety and the environment.

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