Lessons Learned by the DOE Regional Carbon Sequestration Partnerships in the Permitting and Licensing of Validation Phase (Phase II) Pilot Projects

Storage of Carbon Dioxide in Geologic Structures Biennial Review Subreport

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In July of 2002, the Interstate Oil and Gas Compact Commission (IOGCC) gathered states, represented by oil and natural gas regulators and/or state geologists, to inquire as to their level of interest in being directly involved in the regulation of the geologic storage of carbon dioxide (CO_2) should the federal government implement legislation to limit the quantity of CO_2 released into the atmosphere.

It was becoming clear that geologic storage of carbon likely would be one of the most efficacious means of limiting the release of CO_2, a greenhouse gas, into the atmosphere. Participants were not required to make a decision on the reality of climate change to realize that states needed to be deeply involved in the regulation of the emplacement of carbon into the subsurface. In part, this was based on the participants' understanding of state expertise in the regulation of regulatory analogues: oil and natural gas development, natural gas storage, acid gas injection, and CO_2 enhanced oil recovery (EOR).

Based on the decisions reached at that meeting, the IOGCC formed a "Geological CO_2 Sequestration Task Force" that produced, in early 2005, a report that examined the technical, policy, and regulatory issues related to the safe and effective storage of CO_2 in subsurface geological media (oil and natural gas fields, coal seams, and deep saline formations) for both enhanced hydrocarbon recovery and long-term CO_2 storage. This report came to be known as the IOGCC Task Force "Phase I" Report. Although the task force recognized in the report that states and provinces with Oil and Natural Gas Conservation Acts and states and provinces with natural gas storage statutes might be able to utilize those statutory and regulatory frameworks for CO_2 injection and storage, it concluded that some modification of those frameworks might be advisable or necessary.

As a result of the recommendations of the task force, the IOGCC re-commissioned the group under a new name -- the IOGCC Carbon Capture and Geologic Storage [CCGS] Task Force --- to create a "guidance document" for states and provinces. The most critical component of the document would be a Model CO_2 Storage Statute and Model Rules and Regulations governing the storage of CO_2 in geologic media. In September of 2007, the IOGCC formally approved A Legal and Regulatory Guide for States and Provinces, otherwise known as the IOGCC Task Force "Phase II" Report.

In the spring of 2010, the IOGCC CCGS Task Force published a "Biennial Report" that made minor adjustments to the model documents contained in the Phase II Report and reviewed the progress of states and provinces in establishing a legal and regulatory infrastructure for the geologic storage of carbon.

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In this report the task force turns its attention to the experience of early geologic carbon storage (GCS) projects in the U.S. in seeking licenses and permits to store CO_2 in the subsurface. It is largely the product of a meeting organized by the IOGCC of representatives of the seven Regional Carbon Sequestration Partnerships in Santa Fe, New Mexico, in January 2010. Planning of the Santa Fe meeting was aided by an informal survey of the Regional Carbon Sequestration Partnerships conducted by the IOGCC. The goal of this document is to discuss the issues encountered by the partnerships in licensing their Phase II "Validation Phase" pilot projects and, more importantly, to distill valuable lessons from the experience of these early projects with an eye to helping to ensure that succeeding projects and their regulators will benefit from this experience. This report will contain a number of recommendations to policymakers in both state and federal governments that it is hoped will make licensing and permitting of future CO_2 pilot and commercial projects an easier and smoother process.

In all of its phases, the task force has included representatives from IOGCC member states and international affiliate provinces, state and provincial oil and gas agencies, Department of Energy, DOE-sponsored Regional Carbon Sequestration Partnerships, the Association of American State Geologists (AASG), and observer-participants from the oil and natural gas industry. In Phase II, it has also included observer-participants from the U.S. Environmental Protection Agency (EPA), the U.S. Bureau of Land Management (BLM) and the environmental organization, Environmental Defense.

The task force gratefully acknowledges the support of the U.S. Department of Energy, the National Energy Technology Laboratory, and the New Mexico Institute of Mining and Technology. It also acknowledges the critical support of the states and provinces and other entities, including the seven Regional Carbon Sequestration Partnerships that so generously contributed their employees' time to the creation of this document.

Lawrence Bengal
Chairman,
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DISCLAIMER

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Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the New Mexico Institute of Mining and Technology or of The Department of Energy.

ABSTRACT

This "Lessons Learned" report represents the efforts of the IOGCC Carbon Capture and Geological Storage (CCGS) Task Force review of the work of the seven Department of Energy-sponsored Regional Carbon Sequestration Partnerships' (RCSPs) pilot projects. In working with the RCSPs, the IOGCC Task Force on Carbon Capture and Geological Storage compiled challenges – along with recommendations to address the challenges -- reported by the RCSPs. This report highlights the legal and regulatory hurdles faced during the pilot projects and identifies key areas where improvements can be made. In addition to the recommendations of the RCSPs, the IOGCC CCGS Task Force created its own distinct set of recommendations that identify actions that should be taken in the future to make licensing and permitting of CCGS projects more streamlined and efficient, thus guiding government and business through the initial phases toward commercialization.

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EXECUTIVE SUMMARY

This "Lessons Learned" report represents the efforts of the IOGCC Carbon Capture and Geological Storage (CCGS) Task Force review of the work of the seven Department of Energy-sponsored Regional Carbon Sequestration Partnerships' (RCSPs) pilot projects. The report documents the obstacles that the RCSPs faced and the efforts taken to overcome those obstacles. More importantly, for the purpose of this report and going forward, are the recommendations put forth in the report. Recommendations on streamlining project development came not only from the RCSPs but also from the IOGCC CCGS Task Force. The recommendations reflect a collective effort by the states, industry, and other key stakeholders to develop viable and comprehensive solutions to the institutional hurdles that have to be overcome before large-scale CCGS projects can commence.

In working with the RCSPs, the IOGCC Task Force on Carbon Capture and Geological Storage compiled challenges – along with recommendations to address the challenges -- reported by the RCSPs. Challenges and recommendations, which are discussed in-depth in this subreport, were categorized into five key areas: (1) Technical Capacity of the Regulator; (2) Regulatory Infrastructure and Systems; (3) Regulatory Jurisdiction; (4) Cooperation and Coordination among Regulatory Entities; (5) Stakeholder Buy-In.

In addition to the recommendations of the RCSPs, the IOGCC CCGS Task Force created its own distinct set of recommendations that identify actions that should be taken in the future to make licensing and permitting of CCGS projects more streamlined and efficient, thus guiding government and business through the initial phases toward commercialization. The key task force recommendations include the following:

Training of regulatory officials is critically important. The lack of experience with CCGS on the state and federal level can cause significant delays in the permitting and licensing of CCGS projects. The IOGCC recommends that it, in partnership with one or more of the RCSPs, works to develop and implement a CCGS training program for state and federal officials.

To facilitate development of large-scale CCGS projects, ***states should adopt the IOGCC model regulatory framework issued in 2007***. The framework represents the collective efforts of the states to develop comprehensive CCGS guidelines that would be relevant to all states regardless of regulatory capacity or experience.

Similar to the findings and recommendations of the RCSPs, the IOGCC CCGS Task Force also recommends that ***state and federal governments and agencies work together in the licensing, permitting, and active stages of CCGS projects***. Regulatory streamlining is key to the successful development of CCGS projects.

The task force also recognizes the critical importance of all stakeholders in the successful development of CCGS projects. ***All stakeholders should be engaged on every level, with efforts especially directed at public outreach and education***.

The IOGCC CCGS Task Force hopes these recommendations will facilitate development of large-scale CCGS projects with rational regulatory oversight that is responsive to both market forces and national carbon management policies.

EXPERIMENTAL METHODS

The data for this study were gathered through informal surveys, letters, personal interviews, site visits, and published reports. Sources include government officials, regulatory agency employees, private oil and gas company owners and employees, oil and gas service-industry owners and employees, academics, trade publications, and government documents. Necessarily, much of the information is anecdotal and somewhat subjective. Statistics cited are identified by source. Estimates are based on published statistical evidence with the methodology and source identified.

In many instances, the actions of a particular state, or several states, are cited as examples of approaches to challenges faced by oil and gas development. It should be noted that in most of these cases, other oil- and gas-producing states are using similar approaches; the cited examples are deemed to be the most representative or inclusive.

Section 1: Introduction

This report of the Interstate Oil and Gas Compact Commission (IOGCC), and specifically its Task Force on Carbon Capture and Geologic Storage (CCGS), constitutes a review of the experience of the U.S. Department of Energy's seven Regional Carbon Sequestration Partnerships (RCSPs) in seeking licenses and permits for their CO_2 geologic storage pilot projects in the second or "validation" phase of the work of the partnerships.[1] Appendix I to this report contains a list of those partnership pilot projects.

The information contained in this report is largely the product of a meeting of the representatives of the seven RCSPs and IOGCC CCGS Task Force Chairman Lawrence Bengal in Santa Fe, New Mexico, on January 21-22, 2010.

The majority of the licensing and permitting work by the partnerships on these pilot projects took place between 2005 and 2009, although at least two of the validation phase pilot projects have not yet commenced.[2] An examination of the table in Appendix I reveals that most of the pilot projects involved enhanced oil recovery (EOR), and were thus licensable in most of the relevant states under existing laws and regulations pertaining to such wells. For the remaining projects involving non-EOR storage, unfortunately none of the host states at the time of project licensing or permitting had new laws and/or regulations on the books similar to the Model CO_2 Storage Statute and Model Rules and Regulations

[1] Information of the DOE-sponsored Regional Carbon Sequestration Partnerships can be found at: http://www.netl.doe.gov/technologies/carbon_seq/partnerships/partnerships.html

[2] These include a Big Sky Regional Carbon Sequestration Partnership pilot project in eastern Wyoming and a West Coast Regional Carbon Sequestration Partnership pilot project in California.

described in Storage of CO2 in Geologic Structures: Legal and Regulatory Guide for States and Provinces[3], published by the IOGCC Task Force in 2007.

In addition to state law, there was also the need to comply with federal law[4], in particular the Underground Injection Control (UIC) Program[5] of the United States Safe Drinking Water Act SDWA)[6] In some states the UIC program is enforced by the state acting under "primacy" authority from the U.S. Environmental Protection Agency (EPA). In other states, the EPA enforces the UIC program through its relevant regional office.[7] Also affecting licensing and permitting of these wells under the UIC program, was guidance[8] that had been issued by EPA in March 2007 pertaining to use of a "Class V Experimental Technology Well Classification" for pilot geologic sequestration projects. Additionally, if the land on which the pilot project was located was federal or Indian land, federal/tribal involvement in the license/permit approv al process was also necessary. Because all of the partnership pilot projects received federal funding, they needed to meet the requirements of the National Environmental Policy Act (NEPA).[9]

Although not explicitly affecting the efforts of the RCSPs in their validation phase efforts to secure licenses and permits to inject CO_2, it is important to recognize that the EPA is actively engaged in a process to develop a rule10 that will govern the underground storage of CO_2 under the SDWA and the

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[3] Storage of Carbon Dioxide in Geologic Structures: A Legal and Regulatory Guide for States and Provinces, September 25, 2007, *available at:*http://groundwork.iogcc.org/sites/default/files/2008-CO2-Storage-Legal-and-Regulatory-Guide-for-States-Full-Report.pdf.

[4] In some cases applicable federal legislation also included the Endangered Species Act, Archaeological and Historical Preservation Act, Clean Air Act and Clean Water Act.

[5] Information on the Underground Injection Control Program can be found at: http://www.epa.gov/safewater/uic/basicinformation.html

[6] Information on the Safe Drinking Water Act can be found at: http://www.epa.gov/safewater/sdwa/basicinformation.html

[7] In some states, officials have agreed to assume enforcement responsibility under the UIC program. This is referred to as "primacy". In other states, enforcement responsibility remains with the EPA through the applicable EPA regional office. More detailed information on primacy can be found at: http://www.epa.gov/safewater/uic/primacy.html

[8] The guidance was issued jointly by the Director of the Office of Ground Water and Drinking Water and the Director of the Office of Atmospheric Programs at EPA. A copy of the guidance concerning "Using the Class V Experimental Technology Well Classification for Pilot Geologic Sequestration Projects – UIC Program Guidance (UICPG #83)" can be found at: http://www.epa.gov/safewater/uic/pdfs/guide_uic_carbonsequestration_final-03-07.pdf

[9] More information on National Environmental Policy Act can be found at: http://ceq.hss.doe.gov/index.html

[10] EPA is presently developing a rule under the UIC Program to cover CO_2 Geologic Sequestration Wells. More information on this rule development process can be found at: http://www.epa.gov/safewater/uic/wells_sequestration.html The EPA rule development process is anticipated to conclude in late 2010 or early 2011 with the publication of a final rule.

SDWA's UIC program. Most Phase III (validation phase) licensing and permitting is expected to take place with the new EPA rule in effect.

As of the date of this report, laws governing aspects of CO_2 geological storage have been passed and are in effect in eight states,[11] yet the only overlap with states that have partnership pilot projects is Wyoming, North Dakota, and Texas. As noted above, none of these three states had either the legislation or implementing regulations on the books and effective at the time of the pilot project deployment.[12] The possibility exists, however, that one of the validation phase projects that has yet to commence, the Big Sky Carbon Sequestration Partnership pilot project located in Wyoming, could potentially find itself governed by Wyoming's new carbon sequestration laws or its impending rules and regulations for carbon sequestration. To be so governed, the project would have to be a non-EOR project because the new Wyoming sequestration laws apply only to non-EOR projects.[13] As of the writing of this report it is not known whether the project will be a non-EOR or an EOR storage project. In either case, the project well(s) also will be governed under the UIC program. These new rules will not initially affect projects that include an EOR component. It is yet to be determined what approach EPA will take when EOR operations cease and the project operator seeks to convert to a storage-only project. It should be noted, some states have addressed this issue in their regulations.

It is the goal of this document in the sections that follow to distill the valuable lessons from the experiences of these early projects with an eye to helping ensure that the partnerships implementing succeeding projects (in the third or "development phase"), and their federal and state regulators, will benefit from this experience. The report will both indentify the challenges encountered by the partnerships in the validation phase (Phase II) and, more importantly, the remedies and solutions offering the most potential to make the process work more smoothly and in a timelier manner in the future.

In Section 2, the report will identify and discuss the principal challenges encountered and the lessons learned by the seven RCSPs in licensing and permitting their validation phase pilot projects. It will also make some specific recommendations.

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[11] Washington, effective in July 2007; Wyoming, effective in July 2008 and July 2009; North Dakota, effective in April and July 2009; Montana, effective in May 2009; Texas, effective September 2009; Oklahoma, effective June 2009; Louisiana, effective August 2009; and Ohio, effective June 30, 2010. While each of these states' legislation addresses the basic legal framework for CO_2 storage in the state, there is considerable variation among the statutes and the degree to which the states have addressed issues such as pore space ownership, aggregation of storage rights, and long-term liability. It should also be noted that a ninth state, Kansas, has put into place through regulations a basic framework for the geologic storage of CO_2. That regulatory framework was effective on February 25, 2010.

[12] North Dakota's regulations became effective on April 1, 2010. Wyoming and Texas will not have regulations covering the geologic storage of CO_2 in place until later in 2010.

[13] The IOGCC Model Statute (*supra* note 2) and most, if not all, of the state statutes being enacted, including Wyoming, pertain to the geological sequestration of CO_2 that does not involve EOR. This is in large part because oil and natural gas producing states almost all have laws and regulations already on the books that govern the licensing of CO_2 EOR wells.

Section 3 of the report will summarize and expand upon the recommendations made in Section 2. It will identify actions that could be taken in the coming months and years that have the most potential for ensuring that the licensing and permitting process will run more smoothly in the development phase projects to follow. The appendices will contain, respectively, a listing of the validation phase pilot projects (Appendix I), a bibliography of Best Practice Manuals produced by the partnerships (Appendix II) and the results of a survey of the RCSPs conducted by the IOGCC in advance of the Santa Fe Meeting (Appendix III).

Section 2: Challenges Encountered and Lessons Learned by the Partnerships

The purpose of this section is to identify and discuss the principal challenges encountered and the lessons learned by the seven RCSPs in seeking licenses and permits for 22 CO_2 geologic storage pilot projects. What the partnerships were ultimately seeking from government regulators were the rights to drill and inject CO_2 into geologic formations.

Each license or permit had the potential to involve multiple state regulatory agencies, federal departments, agencies, and regional offices as well as local governments. Most of the pilot projects involved a different amalgam of research partners, many with little or no experience in seeking regulatory approval. As might be expected, the challenges that were encountered by the seven partnerships were numerous and varied. For the purposes of this report those challenges have been synthesized into five principal categories.

Each will be addressed in turn. For each, lessons learned by the partnerships will be identified and some recommendations proffered. If heeded, it is hoped the recommendations will improve the efficiency of the licensing and permitting experience going forward.

Challenge #1: Technical Capacity of the Regulator

There were a number of both state and federal regulatory organizations with insufficient technical expertise to grant the licenses or permits requested in a timely and efficient manner.

One of the most common experiences of the partnerships in their development phase work was working with state and/or federal regulatory personnel with an inadequate understanding of the subject matter of the request. The experience of one of the partnerships (Partnership X) is offered to illustrate this challenge.

The first issue encountered by Partnership X was uncertainty within the state as to whether the oil and natural gas regulatory agency or the environmental agency had responsibility for permitting the well. Eventually, the oil and gas agency demurred and the environmental agency assumed jurisdiction. That agency decided to permit the well as a Class I non-hazardous well. However, the agency had not permitted such a class of well since the late 1970s and the last career employee who had institutional memory of the well had retired. As a consequence, it took the environmental agency 11 months to permit the well.

In this example, the permit applicant was a company with employees experienced in securing state environmental permits. It is possible to conclude that there would have been even greater delay with an inexperienced permit applicant, something likely to happen as the partnerships move into the

licensing and permitting of development phase projects. Other partnerships experienced similar delays due to state and federal unfamiliarity with the permitting process.

One clear observation or lesson learned was that at both state and federal levels of regulatory oversight, there was a great deal of difference among the states and EPA regions in terms of the organizational capacity to license these development phase pilot project wells.

In states with active oil and natural gas regulatory programs in place, the regulators were much less daunted by the licensing and permitting of CO_2 geologic storage wells and were able to issue permits and licenses in a more timely manner. States with little or no oil and natural gas regulatory experience had a great deal more difficulty.

Similarly, concerning administration of the UIC program, states and EPA Regional Offices with experience licensing Class II (oil and natural gas waste) wells under the UIC program had much faster and more efficient processes. This lesson learned supports a recommendation contained in the IOGCC 2007 Legal and Regulatory Guide for States and Provinces[14] that the state oil and natural gas regulatory agency, by virtue of its experience licensing and regulating similar wells, should be given first consideration by a state legislature as the most appropriate state agency to designate as the lead regulator of the geologic storage of CO_2.[15]

Another lesson-learned is that there are states and EPA regional offices with significant experience licensing these kinds of wells. That expertise could be leveraged to train and support capacity-building in states and regions with less or no experience.

Recommendation: Training programs should be created and conducted at the state, federal, and local levels where regulators do not possess the necessary technical expertise to permit and license CO_2 geologic storage wells in an efficient and timely manner. (Modeling analysis expertise in particular was noted as a common technical deficiency in regulatory offices.)

Recommendation: In some states, in addition to training, it may be necessary to add staff to license and permit these new wells in a timely matter, especially when commercial-scale development begins.

Challenge #2: Regulatory Infrastructure and Systems

The partnerships encountered a number of state and federal regulatory systems where deficiencies, at times very minor, in systems and procedures for permitting and licensing CO_2 storage wells led to significant delays in issuing the permit/license.

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[14] *Supra* note 3.

[15] It is also clear that whether it is the state oil and natural gas regulatory agency or the state environmental agency that is given authority over CO_2 storage wells, the other agency must play a key role in the process.

On example of this would be a state where the rules specify that a particular agency may issue a permit only when the application is "complete." The problem is that the rules do not adequately define what constitutes an adequate or "complete" application. This leads to uncertainty and delay.

Another common observation of the partnerships was that the projects for which permits were being sought were small-scale "pilot" projects, designed to allow all parties, regulated and regulator, to learn from the experience. The problem was that the rules and systems in place didn't recognize the "pilot" nature of the project and forced the permit applicant to comply with rigid and inflexible permitting requirements that were inappropriate for small-scale "test" projects. An additional observation of the partnerships was that overly prescriptive regulations, state and federal, were observed to have had the effect of encouraging inefficiency and unnecessary delay.

Based on their development phase experience, partnerships were generally of the opinion that principle or performance-based regulatory frameworks would be much more efficient and timely for the oversight of CO_2 geologic storage projects. Overly prescriptive regulations for project development, and particularly for research projects, were not flexible enough to account for the unknowns that will inevitably be encountered during project development.

Recommendation: EPA and state regulatory agencies should develop a streamlined permit process for small-scale (validation phase) projects for the evaluation of geologic properties at potential CO_2 storage sites.

Recommendation: States should tighten up on the definition and/or explanation as to what constitutes a "complete" or adequate permit application.

Recommendation: States should implement principle or performance-based regulatory frameworks for CO_2 geologic storage. Additionally, a "waste-disposal" orientation in the regulatory frameworks likely will be more prescriptive and inflexible.

Recommendation: States should pursue the adoption of legislation and the promulgation of regulations for the geologic storage of CO_2 along the general lines of the IOGCC model regulatory framework issued in 2007 and updated in 2009.

Challenge #3: Regulatory Jurisdiction

In a number of states the partnerships encountered uncertainty as to which state agency had jurisdiction over the permitting and licensing of pilot project wells.

An example of this was set forth above. In some states with primacy under the UIC program this manifested as uncertainty between state agencies over which had the lead responsibility for different classes of wells and/or different components of a project. The net result was delay in the ability of a partnership project to acquire a permit to drill or inject.

Recommendation: Relevant state agencies should be encouraged to work together to clarify, via interagency agreement or otherwise, agency jurisdiction with respect to the licensing and permitting of CO_2 storage wells. This will be especially important once a final EPA rule for the underground storage of CO_2, expected in late 2010 or early 2011, is promulgated.

Recommendation: In states with agencies that regulate oil and gas operations and have UIC primacy, the oil and gas agencies should be given authority to regulate CO_2 injection into saline formations for non-EOR projects.

Challenge #4: Cooperation and Coordination among Regulatory Entities (state/state, state/federal, state/local, federal/federal)

The partnerships experienced a number of instances where cooperation or coordination among federal, state, and/or local authorities (with a role to play in the process of license/permit issuance) was lacking, resulting in a delay in permit/license issuance.

In the course of securing licenses and permits for their validation phase CO_2 pilot projects, the partnerships often had to deal with multiple layers of government, all with a role to play before a license or permit could be issued. There was also the potential for the involvement of more than one agency at each level of government (federal or state), each operating under its own statutory authority. As noted earlier, because of the fact that all of the partnership pilot projects were federally funded, there was always the necessity of complying with NEPA. State NEPA equivalents also potentially came into play. Given the particular circumstances, there also could be issues pertaining to endangered species, fish and wildlife, cultural and heritage sites, wetlands, and air emissions, all potentially requiring the involvement of different federal and state agencies. In some cases there was the need to work with local (municipal or county) agencies on issues such as building codes, storm water runoff and noise.[16] If the project was on tribal lands, there were tribal authorities with which the partnerships had to work.

The problem was that there rarely was coordination or cooperation among the various regulatory entities involved. This translated into delay in securing the ultimate approval to drill or inject.

Among the lessons learned by the partnerships from their experiences was that they needed to be much more proactive in communicating with and encouraging communication and cooperation among the government agencies and affected stakeholders. Additionally, it was clear to the partnerships that this work needed to begin early --- as early as the planning process.

Recommendation: Efforts should be undertaken to encourage standardization of permit response times at state and federal levels.

Recommendation: Joint task forces should be formed to encourage interagency collaboration and streamlining of permit processes with the aim of developing a “one-stop-shopping” approach where feasible.

Recommendation: States should be encouraged to designate a single state agency to act as the lead agency for CO_2 storage-related licenses and permits.

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[16] In California, neither the state’s environmental agency nor its oil and natural gas regulator regulate saline injection. Rather this is the responsibility of municipalities.

Recommendation: Encourage state and federal agencies to incorporate into their processes and systems expedited permitting/licensing procedures for small-scale research projects. Agency personnel need to better understand the goal of such research projects in the timely collection of knowledge so as to better educate federal and state policymakers.

Recommendation: Partnerships going forward should establish timelines and communicate expectations as to those timelines with government counterparts.

Challenge #5: Achieving Stakeholder Buy-In

Lack of stakeholder buy-in has the potential to delay or prevent the permitting and/or licensing of an underground CO_2 storage project.

In both its Phase I[17] and Phase II[18] CO_2 reports, the IOGCC CCGS Task Force noted the importance of active public and other stakeholder involvement in the process of developing both the laws and the regulations for CO_2 geologic storage and throughout the CCGS regulatory process.[19] The experience of the RCSPs in the validation phase work continues to make clear that lack of public education, knowledge, and acceptance will continue to pose significant barriers to CCGS development nationally. It is a clear lesson-learned or at least "lesson-reiterated" that stakeholders need to be included in the process from development of the legislation through implementation of the projects. Without adequate efforts in this regard, even small-scale research projects can be delayed or "vetoed" by an unsupportive public.

Recommendation: Incorporate stakeholder input in statute, rule, and regulation development and throughout the development of CCGS projects.

Recommendation: Even if there is no formal process, stakeholders need to be engaged from the earliest stages in the planning of even small-scale research projects. This will certainly be true of the Phase III development phase projects.

Recommendation: Stakeholder education is essential in building knowledge and acceptance. Misinformation needs to be neutralized with unbiased, scientifically based information. The participation of public utilities and public utility commissions in the dialogue needs to be encouraged.

Section 3: Recommendations and Conclusions of the IOGCC Carbon Capture and Geologic Storage Task Force

This section takes the recommendations and lessons learned by the partnerships in Section 2 and synthesizes those recommendations and lessons into recommendations of the IOGCC CCGS Task Force.

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[17] A copy of IOGCC's Phase I Report can be found at: http://groundwork.iogcc.org/sites/default/files/09IOG5571_CO2_GeologicalSequestrationTaskForce.pdf

[18] *Supra* note 3.

[19] *See supra* note 3.

These recommendations identify actions that should be taken in the coming months and years that the task force believes offer the most potential to make the licensing and permitting process run more smoothly in developing phase projects on to commercialization.

Recommendation 1: Technical Training and Expertise is Key to CCGS

Training programs should be created and conducted at the local, state, and federal levels where regulators do not possess the necessary technical expertise to permit CO_2 geologic storage wells in an efficient and timely manner. The task force suggests that the IOGCC consider working with one or more partnerships to establish training programs making use of personnel from state and federal regional offices where expertise and experience already reside. These programs could be conducted regionally to facilitate participation from the widest number of participants.

Recommendation 2: To Facilitate Early Development of CCGS, States Should Utilize the IOGCC Model Framework

The task force recommends that states should continue to pursue the adoption of legislation and the promulgation of regulations for the geologic storage of CO_2 utilizing the IOGCC model regulatory framework issued in 2007 and updated in 2009. Additionally, once the EPA releases a final rule for the underground storage of CO_2 under the UIC program, states that agree to such storage should take immediate steps to amend their internal regulations accordingly. To facilitate this effort the IOGCC CCGS Task Force in the 2nd Biennial Report will conform the model rules and regulations to the new EPA rule. In the interim, the IOGCC should continue to advocate for state and, where appropriate, federal implementation of principle or performance-based regulatory frameworks utilizing resource management as opposed to "waste-disposal" approaches to regulatory frameworks as enunciated in the IOGCC publication Road to a Greener Energy Future[20]

Recommendation 3: Regulatory Streamlining is Critical

With respect to research projects, state and federal agencies should incorporate expedited permitting/licensing procedures for small-scale research projects. Regulatory agency personnel need to better understand that the goal of research projects is timely collection of knowledge necessary to facilitate further development of commercial CCGS projects and to better educate federal and state policymakers. Following release of the new-EPA CO_2 rules, states should make every effort to clarify which state agency has primary authority and which agencies have secondary authority for the permitting of CO_2 storage wells.

Recommendation 4: Stakeholder Buy-in is Vital to the Acceptance and Success of CCGS

The task force encourages the incorporation of stakeholder input in statute, rule, and regulation development and throughout the development of CCGS projects. Even if there is no formal process, stakeholders need to be engaged from the earliest stages in the planning of even a small-scale research

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[20] Interstate Oil and Gas Compact Commission – CO_2 Storage: A Legal and Regulatory Guide for States, *available at:* http://iogcc.publishpath.com/Websites/iogcc/pdfs/Road-to-a-Greener-Energy-Future.pdf.

project. This will certainly be true of the Phase III development projects. Stakeholder education will be essential in building knowledge and acceptance. Misinformation needs to be neutralized with unbiased, scientifically based information. The participation of public utilities and public utility commissions in the dialogue should also be encouraged.

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LIST OF ACRONYMS AND ABBREVIATIONS

CCGS	Carbon Capture and Geological Storage
CO_2	Carbon Dioxide
EOR	enhanced oil recovery
EPA	U.S. Environmental Protection Agency
IOGCC	Interstate Oil and Gas Compact Commission
NEPA	National Environmental Policy Act
RCSPs	Regional Carbon Sequestration Partnerships
SDWA	Safe Drinking Water Act
UIC	Underground Injection Control

APPENDICES

Appendix A: Regional Carbon Sequestration Partnerships
Appendix B: Bibliography of Best Practice Manuals Prepared by the RCSPs
Appendix C: Survey Results

Appendix A: Regional Carbon Sequestration Partnerships

The U.S. DOE NETL has formed a nationwide network of regional partnerships to help determine the best approaches for capturing and permanently storing gases that can contribute to global climate change. The Regional Carbon Sequestration Partnerships (RCSPs) are a government/ industry effort tasked with determining the most suitable technologies, regulations, and infrastructure needs for carbon capture, storage, and sequestration in different areas of the country.

The seven partnerships that comprise the RCSPs represent more than 350 organizations in 40 states, three Indian nations, and four Canadian provinces.[1]

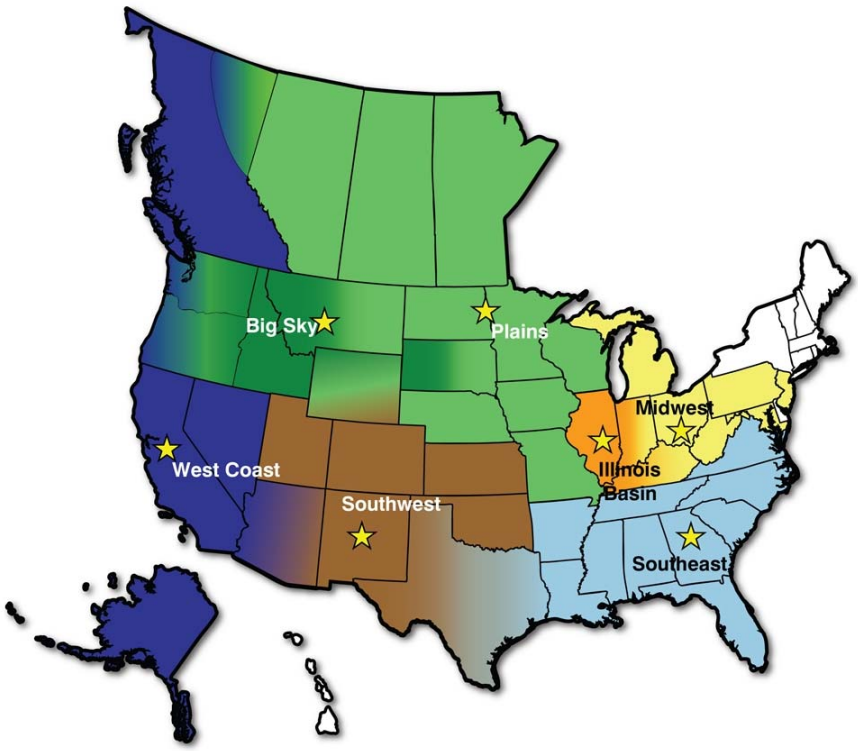

Figure 1. US DOE NETL's Regional Carbon Sequestration Partnerships

[1] NETL: Regional Carbon Sequestration Partnerships. (n.d.). *DOE - National Energy Technology Laboratory: Home Page*. Retrieved July 28, 2010, from http://www.netl.doe.gov/technologies/carbon_seq/partnerships/partnerships.html

Table 5. Table of Phase II "Validation" Projects by Regional Carbon Sequestration Partnerships[2]

Partnership	Geologic Province/ Location	Geologic	
		Total CO_2 Injection (metric tons)	Approximate Depth (feet)
Big Sky Regional Carbon Sequestration Partnership (Big Sky) **Montana State University** **http://www.bigskyCO_2.org/**	Columbia Basin	0"	2,500 – 4,000
Midwest Geological Sequestration Consortium (MGSC) **University of Illinois,** **Illinois State Geological Survey** **http://www.sequestration.org/**	Loudon Oil Field Mumford Hills Oil Field Sugar Creek Oil Field Illinois Basin Illinois Basin	39 2,850* 5,850* 0* 91	1,550 1,551 1,548 6,650 – 7,050 1,000
Midwest Regional Carbon Sequestration Partnership (MRCSP) **Battelle Memorial Institute** **http://www.mrcsp.org**	Appalachian Basin Cincinnati Arch Michigan Basin	<50 1,000 60,000	5,900 – 8,300 3,200 – 3,500 3,200 – 3,500
Plains CO_2 Reduction Partnership (PCOR) **University of North Dakota,** **Energy & Environmental Research Center** **http://www.undeerc.org/pcor/**	Zama Oil Field Williston Basin Williston Basin – Coal Seam	25,400 400 80	5,000 10,000 – 10,500 1,600 – 1,800
Southeast Regional Carbon Sequestration Partnership (SECARB) **Southern States Energy Board** **http://www.secarbon.org/**	Gulf Coast Gulf Coast Mississippi Coastal Plain Central Appalachian Black Warrior Basin	1,355,385 2,740 907 0*	10,304 10,400 8,600 1,600 – 2,300 1,500 – 2,500
Southwest Regional Partnership on Carbon Sequestration (SWP) **New Mexico Institute of Mining and Technology** **http://www.southwestcarbonpartnership.org/**	Paradox Basin-Aneth Field Permian Basin San Juan Basin	630,000 86,000 16,700	5,600 – 5,800 5,800 3,000
West Coast Regional Carbon Sequestration Partnership (WESTCARB) **California Energy Commission** **http://www.westcarb.org/**	Sacramento Basin Colorado Plateau	0* 0	8,000 4,000

***Currently injecting or will begin injecting in 2010**

[2] U.S. DOE NETL

Appendix B: Bibliography of Best Practice Manuals Prepared by the Regional Carbon Sequestration Partnerships

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Appendix C: Survey Results

1. Of the applications made by your partnership for permits to drill and/or inject, please indicate:

a. To which agencies, federal and state, the applications were made and from which agencies were the permits subsequently granted.

WESTCARB	EPA Region 9 DOE for NEPA Arizona Department of Environmental Quality (ADEQ) Arizona Oil & Gas Conservation Commission (AZOGCC)
BIG SKY	With regards to the "Basalt Field Validation Test" ("Phase 2" work), a UIC Class-V Well Registration Packet was prepared and submitted to the Washington Department of Ecology. A mix of in-team and out-of-team stakeholders was involved in securing the permit. Securing the permit itself as a procedural process was not complicated compared to the negotiations over the actual scope of work and site selection. With regards to "Phase 3" work, BSCSP is still negotiating with an industry partner and so cannot begin application procedures until those negotiations are finalized.
SECARB	Project 1: Injection Permits: EPA Region III (They have primacy in Virginia), Drilling Permits for Monitor Wells: Virginia Division of Gas and Oil Project 2: Mississippi Oil and Bas Board for class II injection and production wells; NEPA questionnaire and Environmental Assessment
MGSC	Illinois Environmental Protection Agency
PCOR	Permits to drill and inject were made to and received from the North Dakota Industrial Commission, Department of Mineral Resources, Oil and Gas Division (NDIC DMR OGD). An aquifer exemption was requested and received from the United States Environmental Protection Agency (US EPA). An aquifer exemption was required because injection was to occur in an unmineable coal seam which could be presumed to be a fresh water aquifer.
MRCSP	The following responses are in reference to a recent pilot-scale (1,000 tons) CO2 injection test conducted at the Duke Energy East Bend generating station, located in Boone County, Kentucky. USEPA Region 4 (Atlanta) for the UIC permit; Kentucky Oil and Gas for the drilling permit.
SWP	BLM: EA from Price Field Office Cooperating agencies would have included a broad segment of State of Utah, federal and county participation Injection

Permit State of Utah, Division of Water Quality (UDWQ), Groundwater Protection Section, State of Utah School and Trust Lands Administration. Note: SWP has written a Best Practices Manual that outlines needed permitting activities, agency contacts, etc. This document will prove useful for future permitting efforts.

b. The class of permit (UIC) for which the applications were made.

WCRCSP	EPA UIC – Class V, Experimental Injection Well Permit DOE NEPA– Categorical Exclusion ADEQ – Aquifer Protection Permit AZOGCC – Permit to Drill
SECARB	Project 1: Class V Project 2: Class II
MGSC	Class I Nonhazardous
PCOR	A Class II application was made along with an aquifer exemption request.
MRCSPO	Class V Experimental
SWP	Class V??

c. The class of permit you ultimately received and the length of time it took to receive it.

WCRCSP	EPA UIC – Class V, Experimental Injection Well Permit – 5 months DOE NEPA– Categorical Exclusion – 2 months ADEQ – Aquifer Protection Permit – 5 months AZOGCC – Permit to Drill – 3 weeks
SECARB	Project 1: Class V, 5 months Project 2: Class II, less then 1 month
MGSC	Class I Nonhazardous 12 months
PCOR	A Class II permit and an aquifer exemption were received. It took approximately 8 months to receive them.
MRCSPO	Class V Experimental – about 1 year
SWP	I presume Utah Division of Water Quality ultimately issued a Class V permit, but am not sure of this.

d. The kind of information that you were requested to provide by the regulatory agencies and the level of detail that was required.

WCRCSP EPA – Extensive data on regional and local geology, extensive description of well design and drilling operations (casing program, cementing program) extensive description of all logging and testing, detailed modeling of injection
DOE Environmental Questionnaire – Evaluation of all potential environmental impacts. We hired a consulting firm to prepare this.
ADEQ – Most of the info provided to EPA, plus water sampling and testing, info on purity of CO2 to be injected, estimate of point of compliance (distance at which reservoir conditions would return to background)
AZOGCC – Simple application describing location, purpose, plugging & abandonment plan, and depth of well. Required a bond.

SECARB Project 1: Geology and Hydrology of the site, including Freshwater Aquifers in the area, monitoring program details and information on all wells in the Area of Review, including specifics on the injection well (stimulation records, casing records, cementing records, cement bond log).

Project 2: Location plat, depth, formation, well design

MGSC Extensive detail on all aspects of the site, well construction, and the characteristics CO_2 to be injected, as much as for any Class I well.

PCOR The injection application included the following:

- Surface and bottom hole location.
- Appropriate geologic data on the injection zone and the confining zones including geologic names, litho logic descriptions, thicknesses and depths.
- Estimated bottom hole fracture pressure of the top confining zone. Average and maximum daily rate of fluids to be injected.
- Average and maximum requested surface injection pressure.
- Geologic name and depth to base of the lowermost underground source of drinking water which may be affected by injection.
- Existing or proposed casing, tubing, and packer data.

In addition, a plat depicting the area of review (1/4-mile radius) detailing the location, well name, and operator of all wells in the area of review including: injection wells, producing wells, plugged wells, abandoned wells, drilling wells, dry holes, and water wells was included.

A quantitative water analysis from the two nearest fresh water wells was required.

A legal description of land ownership within the area of review and an affidavit of mailing certifying that all landowners within the area of review were notified of the proposed injection well were required as part of the injection application.

Schematic drawings of the injection system including current and proposed well bore construction and surface facility construction as well as the proposed injection procedure were included in the injection application.

A public hearing was required.

The aquifer exemption request required information regarding the following:

- The current and future use of the aquifer.
- Aquifer water quality and potential influence of the injectate on water quality.
- The radius of influence and distance of the requested exempted aquifer from public water supplies.
- Analysis of future water supply needs within the area.

SWP — Standard Class V permit application. A moderately rigorous application dealing with regional and local geology, surface and ground water, casing program, etc.

e. The level of experience on your partnership regulatory team with securing permits or working with state and federal regulatory agencies or processes.

WCRCSP — Three consulting firms on the project team were necessary to provide the extensive amount of required information:

1. Geology/hydrology – local company dealing with groundwater and hydrology in the state. Also, had experience working with the state regulators.
2. Drilling and site operations manager – developed all detailed drilling and operations plans. Also, had experience obtaining UIC permits from EPA.
3. Environmental firm had experience with NEPA applications.

SECARB — Project 1: Some experience on UIC permits for disposal wells in Virginia.

Project 2: Denbury Onshore LLC applied for and holds the permits on behalf of the SECARB. It is routine for them

MGSC	We have gained extensive experience through this process, but this was the first permit of this type for the team. Had assistance from Archer Daniels Midland Company, our project partner, who actually holds the permit, because they own the site we are working at.
PCOR	Our partnership regulatory team had substantial experience in securing permits of this type; in addition our team had a great deal of experience working with state and federal regulatory agencies and processes.
MRCSPO	Medium to high
SWP	My impression is that permitting was assigned a low priority early in SWP's Utah activities, and the early inability to understand the complexities of dealing with diverse requirements of tribal, federal, state and county entities cost SWP time in the early phases of the project. Of course the involved agencies were equally inexperienced with the specific regulatory requirements for experimental CO2 injection, but experienced permitting staff at the inception of Utah activity could have greatly reduced the lead time for the various activities proposes by SWP in Utah. When SWP began to concentrate on the Farnam Dome SWP initially planned to drill the experimental well on State lands, and had not investigated NEPA actions that BLM would require on surrounding lands. When the decision was made to site the well on BLM lands the time line was further extended.

f. Once the permit was obtained, please detail what, if any, additional information was required by the regulatory agencies in order for you to actually begin injection.

WCRCSP	ADEQ – required detailed water sampling and analysis plan. The well found no permeability in the intended reservoir formations, so the project was stopped before anything was injected.
SECARB	Project 1: Mechanical Integrity Test on the well was performed and documented and submitted to EPA for approval prior to injection. Information on the amount of CO2 injected per month, maximum injection pressure and pressure of annulus of the injection wellbore was submitted to EPA. Project 2: None
MGSC	We are asking now for a permit modification to drill and observation well with a novel fluid and pressure sampling regime that requires a major modification to our permit. That is taking substantial additional time. The IEPA is extensively concerned with well construction details and sampling processes.
PCOR	The North Dakota Industrial Commission Field Inspector needed to be notified 24 hours prior to injection. Additionally, the injection well had to comply with all North Dakota Administrative Code injection well requirements.

MRCSPO It was necessary to submit a well completion report that described the data collected during drilling and the well construction as built.

It was also necessary to conduct a fracture test to demonstrate fracture pressure of the injection formation because the permit prohibited injecting CO2 at pressures above fracture pressure.

It was also necessary to conduct an annulus pressure test once the well was completed to demonstrate that there were no internal leaks that could potentially impact USDWs. This test had to be witnessed by the regulator.

SWP I am not sure if an injection permit was actually approved by the state of Utah, nor am I sure what the final decision by BLM was with respect to the EA that analyzed environmental ramifications of SWP's various proposals.

g. The regulatory agencies (federal and/or state) with which you worked and the degree of familiarity within those regulatory agencies with the UIC program and specifically the classes under which the partnership was seeking permission to drill and/or inject.

WCRCSP All agencies were familiar with UIC classifications and agreed with the Class V application. However, ADEQ regulations are different from DOE regulations – Arizona protects all groundwater, regardless of TDS.

SECARB Project 1: EPA Region III, some familiarity with the agency, Class V.

Project 2: Mississippi Oil and Bas Board for class II injection and production wells, routine

MGSC IEPA has extensive agency experience with the UIC program but not with CO_2 as an injectant. Staff is only generally familiar with sequestration site issues and we needed to provide much supporting information.

PCOR The NDIC DMR OGD had a great deal of familiarity with the UIC program and the classes under which we were seeking permission for injection. The US EPA seemed to be unsure of the procedure required in order for us to receive an aquifer exemption.

MRCSPO USEPA Region 4 (Atlanta) for the UIC permit – seemed to have low level of familiarity with UIC (esp. CO2) permitting

Kentucky Oil and Gas for the drilling permit – seemed to have high level of familiarity with drilling permits

SWP See question 1, above. Normally oilfield UIC activities are regulated by the Utah Division of Oil, Gas and Mining, while other UIC activities fall under the authority of the Utah Division of Water Quality. Since the proposed experimental injection well did not involve activity normally permitted by DOGM, it was logical for

UDWQ to assume responsibility for this particular UIC permit. Good communication exists between the 2 state agencies, and I don't think the ultimate class of permit proved to be a major issue in SWP's application process.

2. In your opinion, assuming that EPA approves a new "Class VI" for the injection of carbon dioxide, which regulatory entities in your state(s) will likely be tasked with regulatory responsibility (DEQ, Oil and Gas Regulator, EPA, etc.)?

WCRCSP	In California, the Division of Oil, Gas and Geothermal Resources (DOGGR) may take regulatory responsibility.
Big Sky	Since BSCSP is still negotiating with an industry partner (location in terms of which State is TBD) and so cannot begin application procedures until those negotiations are finalized, BSCSP is not yet in a position to respond to the query for "Phase 3" work.
SECARB	Project 1: In my opinion, EPA Region III will still have primacy in Virginia for approving Class VI wells. Project 2: In Texas, it has no been determined. I have no information on Mississippi's plans
MGSC	Illinois EPA, because they now do UIC wells, everything except Class II.
PCOR	The oil and gas regulators will likely be tasked with regulatory responsibility in PCOR Partnership states with oil & gas production (excepting WY – DEQ for non-EOR), while it is less clear in those states without oil & gas production. However, should US EPA adopt the waiver process for injection depth requirements as proposed in their Notice of Data Availability dated August 31, 2009, additional state regulatory agencies would be involved in that process.
MRCSPO	I live in Ohio, so I will answer for that state. Ohio EPA will have responsibility.
SWP	I believe the location of the Regulatory Authority for geologic sequestration of C02 in Utah is currently under discussion. Given the longstanding authority for the Division of Oil, Gas and Mining (DOGM) for oilfield UIC, and its staff familiarity with the technical aspects of this activity this division may ultimately become the RA. DOGM and UDWQ have discussed the ultimate assignment informally, and have been involved with discussions re how to promulgate rules for a Utah C02 program.

3. With respect to the permits that were issued, what pore space ownership issues were encountered, if any, and how were they resolved in order to begin injection.

WCRCSP	The surface owner also owned the pore space, and models showed that the CO2 plume would not extend beyond the property, so it did not come up as an issue.
Big Sky	For "Phase 2" work, the State of Washington claimed pore space ownership.
SECARB	Project 1: The landowner, mineral owner and gas lessee signed an agreement to allow for the injection at the site. Project 2: The injection was handled under normal oil field flood rules with royalties paid to mineral owners and access fees paid for surface site use.
MGSC	Pore space ownership is not an issue because the plume is expected to stay on the property of Archer Daniels Midland Company who owns the site and is our partner in the project
PCOR	No pore space issues were encountered.
MRCSPO	No pore space issues were encountered because the CO2 was contained entirely on the power plant property.
SWP	I have made some inquiries, but no response to date.