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Evaluation of State and Regional Resource Needs to Manage Carbon Sequestration through Injection

Environmental Science Division

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for the
Ground Water Protection Council

by
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Prepared for the Ground Water Protection Council

Introduction

Most scientists now agree that global warming is occurring. Members of the public and politicians are poised for action. The first climate change bills in Congress are expected to emerge later this summer. The rate of global warming can be reduced by removing some carbon dioxide (CO₂) from the atmosphere. The method of CO₂ abatement that is most likely to be used on a large scale involves underground injection of CO₂ into stable formations. This process is known by several different names: (e.g., carbon sequestration (our preferred term), carbon geosequestration, and carbon capture and storage). If carbon sequestration is conducted in large enough volumes to have a meaningful impact on global warming, it is likely that thousands or tens of thousands of injection wells will need to be developed and permitted in the United States. This will require state and regional Underground Injection Control (UIC) programs to expand their staff and capabilities.

Purpose

The annual national budget for the UIC program (approximately \$11 million) has remained static for many years, while UIC agencies have been asked to take on additional responsibilities. Furthermore, inflation of salaries and other expenses has eroded the buying power of the unchanging UIC budget. If state and regional agencies are asked to take on the additional workload of CO₂ injection, while ensuring careful scientific review as well as an expeditious processing time, they will require additional trained staff and other resources. Failure to provide sufficient resources will likely create permitting backlogs, resulting in a bottleneck in the overall carbon sequestration effort.

The Ground Water Protection Council (GWPC) asked Argonne National Laboratory to interview representatives of state and regional UIC programs to obtain their estimates of additional resources that would be needed to manage new CO₂ injection programs. The purpose of this task is to gauge the incremental resources that state and regional UIC programs will need to review and permit the potentially large number of new CO₂ injection wells. The information compiled through this task can serve to inform the management of the U.S. Environmental Protection Agency (EPA) and national policymakers about what resources will be needed to embark on a new significant injection program.

Methodology

Argonne worked with GWPC staff to develop a list of questions that would be distributed to UIC agencies. Argonne sent the questions to representatives from key states and EPA regional offices that are likely to permit CO₂ injection wells. In many states, the UIC responsibility is divided between the oil and gas and environmental agencies. Some states have UIC primacy (i.e., EPA has agreed to hand over responsibility to the state to administer the UIC program), while other states follow state injection programs with EPA maintaining the federal UIC authority through direct implementation by the Regional EPA office. Appendix A includes the names and contact information for the recipients of the questionnaire.

Argonne made a presentation about the study at the GWPC Policy and Leadership Meeting in Washington in April. At that time, we had received responses from only California, Illinois, and Ohio. The audience was quite interested in the presentation, which was followed by intense discussion. Comments made during the discussion led to the addition of several new questions being added to the questionnaire (for a total of 19 questions). A later presentation was made at the 6th Annual Conference on Carbon Capture and Sequestration in Pittsburgh in May.

The budget for this project was limited, and the schedule for compiling the information was short. Therefore, we relied on electronic mail for responses with some minimal follow-up by telephone. The information received was reviewed and organized to allow for meaningful extraction of the data.

Overall Survey Statistics

Through May 2007, 25 responses were received from Alabama, Arkansas (two agencies), California, Colorado, Florida, Illinois (two agencies), Indiana, Kentucky, Michigan, Nebraska (two agencies), New Mexico, New York, Ohio (two agencies), Texas, Utah, and Wyoming; and EPA Regions 3, 4, 6, 7, and 9. Figures 1 and 2 display the geographic distribution of state and federal responses.

Figure 1 — Distribution of State Agency Responses

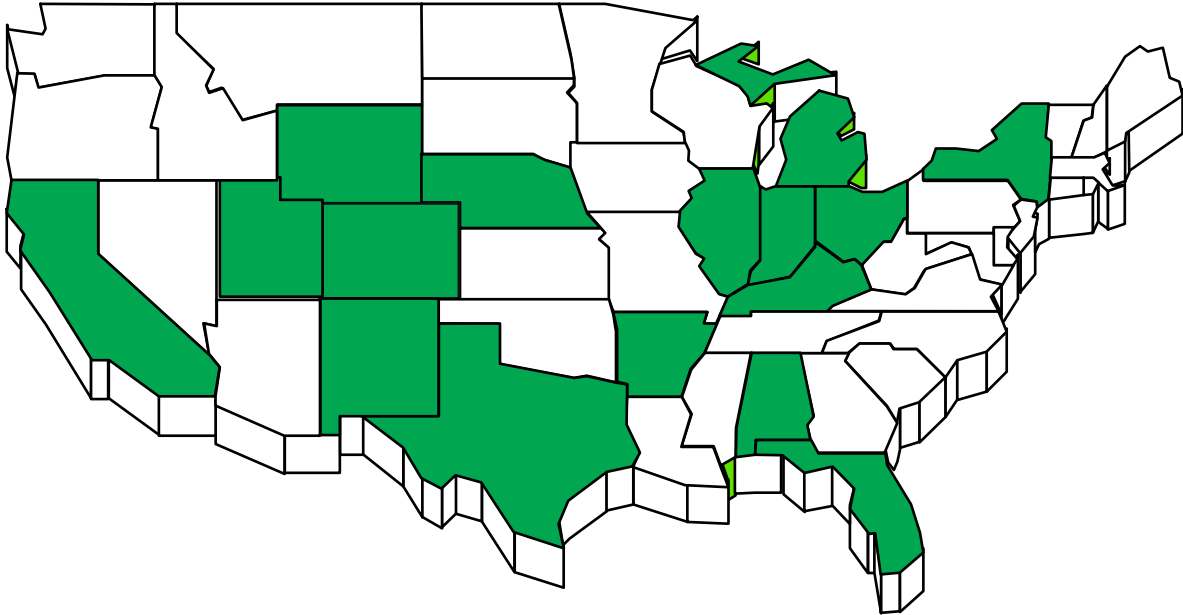
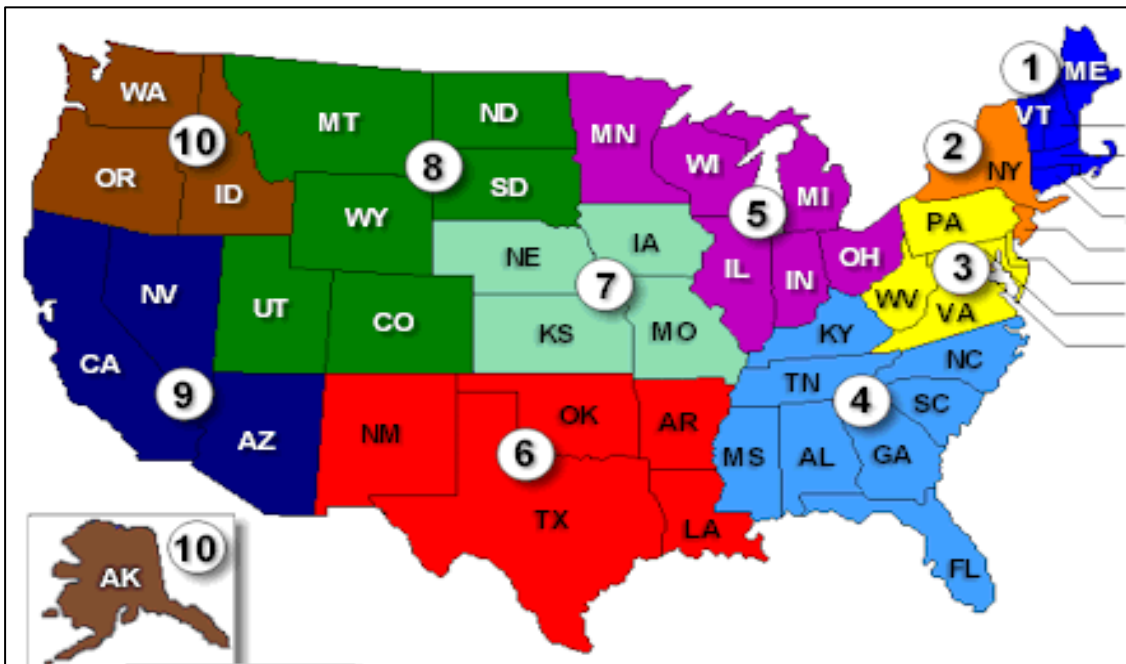


Figure 2 — EPA Regions (responses were received from Regions 3, 4, 6, 7, and 9)



Review of Responses

The remainder of this report consists of the responses received from the agencies. The responses for each question are first summarized in a few sentences. The synopsis is then followed by a table showing all the responses to allow for more ready and detailed comparison. The questions are grouped into four thematic clusters. The responses from the states are placed in a separate section of the table from the EPA regional responses. The completed questionnaires, in lightly edited format, are presented in Appendix B.

The findings are presented in this report subject to the following caveats:

- Different states provided varying degrees of detail and information. This makes it hard to compare the replies on an even basis.
- Not all responders answered all questions.
- Several states with large numbers of existing injection wells did not respond at all (Kansas, Louisiana, and Oklahoma) or offered very brief responses (Texas). The absence of good information from these states limits the data set.
- We received separate responses from the oil and gas and the environmental agencies for just four states (Arkansas, Illinois, Nebraska, and Ohio). Three states (Florida, Michigan, and New Mexico) provided integrated responses. In other states that are likely to have substantial future CO₂ injection, we heard from just one of the two UIC agencies. This also tends to limit the data set.
- The responses were provided as good-faith personal opinions by agency staff. They do not necessarily represent official agency position. Full coordination, including official blessings by agency attorneys general or general counsel, can at times be very time-intensive.

QUESTIONS RELATING TO UIC BACKGROUND

Question 1: Which classes of UIC wells do you currently permit?

Question 2: How many active UIC wells of each class do you regulate?

The agencies regulate various combinations of well classes. Class I, III, and V programs are generally managed by state environmental protection agencies or by the EPA's regions in direct implementation. Class II programs are generally managed by state oil and gas agencies or the regions. The number of wells varies from 1 to more than 50,000.

The replies to these two questions are shown together in Table 1.

Table 1 — Information from Questions 1 and 2 — Existing UIC Programs

	Agency	Class I	Class II	Class III	Class V	Comments
State						
AL	OGB		212			
AR	ADEQ	14			118	
	AOGC		600		75	
CA	DOGGR		>25,000			
CO	OGCC		840			

	Agency	Class I	Class II	Class III	Class V	Comments
State, cont.						
FL	FGS	143			9,000–10,000	
IL	EPA	4			>7,000	
	DOG		7,805			
IN	DOG		1,275			
KY	DOGC					Kentucky is not a primacy state, but has filed for program authorization.
MI	OGS	23	1,246	47	23	Michigan is not a primacy state, and the permits are issued under authority of state law.
NE	NDEQ	1		3,500	>600	
	NOGCC		723			
NM	OCD	4	3,959	17	1,800	
NY	DMR		81	85		
OH	Ohio EPA	10			>11,000	
	DMRM		386	49		
TX	RRC		50,671			10,039 of the Class II wells are permitted for CO ₂ injection, and 9,941 are used for EOR via CO ₂ injection.
UT	DOGM		1,150			
WY	DEQ	50		10,284	1,704	
EPA						
Reg 3			1,600	6	>25,000	
Reg 4		1	3,500		12,000	
Reg 6		1	2,000		several	
Reg 7			2		1,478	
Reg 9		23	380	hundreds	thousands	

Question 3: How many FTEs (full time effort) of staff are employed to run your current UIC program?

The results are highly variable. In addition to small numbers of full-time staff assigned to UIC activities, many other staff members spend part of their time on UIC activities. California provided a detailed answer to this question:

“Not an easy question to answer. We have a UIC budget, but only because we have primacy of the federal UIC program. Prior to primacy, 1983, our oil and gas budget included the permitting, inspection, monitoring, etc. of injection wells. At some point, most all DOGGR employees would have had some involvement with injection wells, i.e., secretaries would type permits, file records, etc., Supervisors would sign permits, orders, etc. Their percentage of time spent on “UIC” would not be as much as a field person. The same with field staff, their work included oil and gas time as well as “UIC” time. Currently, with our federal UIC grant money, we have 5 dedicated UIC field staff, but that number is adjusted annually because our grant remains essentially at the same level while our salaries increase. But this is just for budgeting our grant. Otherwise, we are essentially the same as were prior to primacy. We have 135 employees and the UIC tasks are shared among most of them, just some have more responsibility than others. So it’s

misleading to respond that we only have 5 FTEs to manage over 25,000 injection wells, the responsibility is spread across all DOGGR staff.”

Question 4: What is the current budget for your UIC program?

Generally, the EPA UIC grant covers only a small portion of the total budget. Some states do not have specific UIC budgets in place; the costs for conducting UIC activities come from other budget line items.

Question 5: Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

There are not enough data to draw any clear conclusions.

The replies to questions 3–5 are shown together in Table 2.

Table 2 — Information from Questions 3-5 — Existing UIC Resources

	Agency	FTEs	UIC Budget	Annual \$/Well	Comments
State					
AL	OGB	0.82	\$89K total; \$67K federal and \$22K state		The state share requires 150–200% overage
AR	ADEQ	0.5-1.0	\$86K federal		
	AOGC	2.25	Part of overall budget		The budget for UIC Class II activities is not separately indicated. It is part of the overall budget.
CA	DOGGR	Total of 135; 5 funded by federal funds	\$4,500K; \$468K federal	\$180	See quote under question 3 above. Also, regarding the cost/well, cyclic steam wells do not require as much oversight as other UIC wells, and some UIC wells may need more attention than others depending on location, downhole conditions, commercial/noncommercial.
CO	OGCC	2.5	\$265K		
FL	FGS	20	\$2,048K		The FTE total counts all who charge to program — not only those handling permitting, compliance, and enforcement.
IL	EPA	See comments	\$100K		One FTE is dedicated for UIC; 2 permit reviewers and 2 field staff are borrowed from other programs to cover the permitting and inspection needs of the UIC program.
	DOG	See comments	\$1,500K		They have no staff with 100% UIC work. Three staff are over 50% UIC. The other 25 on the staff have 25% or less UIC time.
IN	DOG	2	\$126K	\$100	The cost per well is the budgeted cost. However, this does not cover the total costs for implementing the Class II program.
KY	DOGC	5	\$200K		

	Agency	FTEs	UIC Budget	Annual \$/Well	Comments
State, cont.					
MI	OGS	See comments	No separate budget for UIC	\$2,250	The program regulating Class I, III, and V wells currently employs 1 FTE; field and other Lansing staff are used as necessary. The program regulating Class II wells is the primary responsibility of approximately 30 field staff and 20 Lansing staff. However, these staff also deal with oil and gas drilling, production, plugging and remediation.
NE	NDEQ	1.75	\$76K		
	NOGCC	2.5	\$124K		
NM	OCD	6.27	\$533K	\$133	
NY	DMR	0			No funds are specifically earmarked for UIC.
OH	EPA	3.7	\$420K total; \$130K federal		Operators must pay a fee to cover the costs of Class I wells.
	DMRM	1 full time plus several part time	\$190K federal share.		The actual program costs are considerably larger than the federal grant.
TX	RRC				
UT	DOGMD	1.3	\$172K		
WY	DEQ	5	\$475K		
EPA					
Reg 3		7.5	\$235K PA; \$137K VA; \$39K DC		EPA also employs 4 Senior Employees to conduct inspections and assist in managing compliance.
Reg 4		4			Region 4 has 10 FTEs for the UIC and GW program. However, most of the FTEs conduct grant oversight work as opposed to technical work. On the technical side there are 4 FTEs doing the work.
Reg 6		See comments			They have just the permitting side of the program, which takes about 1 FTE. Including enforcement and admin staff would require a total of 7 FTEs.
Reg 7		1	\$78K		They also employ 2 Senior Environmental employees.
Reg 9		8	\$300K		

QUESTIONS RELATING TO CURRENT CO₂ INJECTION PROGRAM

Question 6: Do you currently issue permits for any CO₂ injection wells?

Six states and two regions have issued CO₂-EOR permits, but only Ohio has issued a permit for a non-EOR well. New Mexico has a CO₂ pilot project underway that involves two Class V wells.

Question 7: How many CO₂ injection well permits have you issued?

Texas has issued >10,000 CO₂-EOR permits and New Mexico has issued nearly 400 such permits. None of the other agencies have issued more than 50 CO₂ EOR permits. Most have issued none.

Question 8: What class of wells are they?

All of the EOR wells have been permitted as Class IIR. Several states indicated that if they received applications for CO₂ injection wells other than EOR wells, they would treat the permits as Class V Experimental or Class I. Several of the agencies that indicated they would use a Class V permit noted that they might include the rigorous requirements normally associated with Class I permits.

The replies to questions 6–8 are shown together in Table 3.

Table 3 — Information from Questions 6-8 — Experience with CO₂ Wells

	Agency	Currently Issuing Permits	Number of CO ₂ Well Permits Issued	Well Class — Actual Class or Most Likely Class for Agencies That Have Not Permitted Any CO ₂ Wells Yet
State				
AL	OGB	Y	10	Class IIR
AR	ADEQ	N		Class V, but use Class I requirements
	AOGC	N		
CA	DOGGR	Y	<50	Class IIR
CO	OGCC	N		Class IIR
FL	FGS	N		Class I, or Class V with Class I requirements
IL	EPA	N		
	DOG	N		Class IIR
IN	DOG	N		Class IIR
KY	DOG	N		Class IIR
KY	DOG	N		Class IIR
MI	OGS	Y	4	Class IIR
NE	NDEQ	N		Class V
	NOGCC	N		
NM	OCD	Y	382 Class II EOR wells and 5 Class II acid gas wells with CO ₂	No designated Class V CO ₂ wells have been permitted, but currently there is one pilot CO ₂ geosequestration project underway in SE NM that involves 2 Class V Wells.
NY	DMR	N		V
OH	EPA	N	1 proposed	Class I or Class V
	DMRM	N		Class IIR
TX	RRC	Y	10,039	Class IIR
UT	DOG	N		Class IIR
WY	DEQ	N		
EPA				
Reg 3		N	1	Class IIR
Reg 4		N		Class IIR

	Agency	Currently Issuing Permits	Number of CO ₂ Well Permits Issued	Well Class — Actual Class or Most Likely Class for Agencies That Have Not Permitted Any CO ₂ Wells Yet
EPA, <i>cont.</i>				
Reg 6		N		
Reg 7		N		
Reg 9		Y	1 area permit	Class IIR

QUESTIONS RELATING TO FUTURE CO₂ INJECTION WELL PROGRAM DEVELOPMENT

Question 9: If you received an application for a non-EOR CO₂ injection well, would your existing regulations allow you to approve it?

Most states and regions responded that they could use their existing regulations, although some of the oil and gas agencies indicated that they would not be able to permit wells under their own regulations. Instead, they would send the application to their sister environmental agency.

Two states noted that if the CO₂ injectate originated from natural gas storage operations or oil or natural gas production then they could handle these as Class II wells.

Question 10: If yes, what class of well would it be?

Many agencies indicated that they would follow the recent EPA guidance to treat the pilot projects as Class V experimental wells, but would also possibly use Class I requirements in those permits. Others responded that they would use either Class I or Class V. Several agencies noted that they would use only Class I wells. Two states (California and New Mexico) offered that they would permit these projects as Class II wells.

Question 11: Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?

About half of the responding states and regions felt that they have enough experience to develop permit conditions, although many indicated that they would benefit from training. Several of the agencies indicating that they do not have enough experience noted that they could gain the experience readily.

Question 12: If not, what type of information or training would be needed?

Table 5 lists the training topics suggested by the states and the regions. It also shows how often each topic was mentioned by the states.

Question 13: Does your agency have experience with permitting underground natural gas storage facilities?

Only 16 of the responding agencies replied to this question. Six of the states said “yes,” while five others responded with “no.” All five regions said “no.”

Question 14: Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)?

Only 16 of the responding agencies replied to this question. Eight of the states said “yes,” while three others responded with “no.” All five regions said “yes.”

Question 15: To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights?

Only 16 of the responding agencies replied to this question. Five of the states said “yes,” while five others responded with “no,” and one was unsure. All five regions said “no.”

Indiana noted:

“Yes, but only in the context of established oil and gas well spacing rules. We do require permittees to demonstrate they have 100% rights to produce the oil and gas. In the event they don’t, we would be involved with the review of forced pooling or compulsory integration petitions and making a ruling thereon. Without clear policy on these complex issues as they relate to CO₂, we would not have any specific experience to offer and would need to leave that up to those who are much more knowledgeable in such matters.”

The replies to questions 9–11 and 13–15 are displayed in Table 4. The replies to question 12 are shown in Table 5. Table 5 follows a different format. Instead of providing agency-specific responses, it summarizes the training needs for all states and regions sorted by the number of times a topic was mentioned.

Table 4 — Information from Questions 9–11 and 13–15 — Agency Experience

	Agency	Do Existing Regs Cover Non-EOR CO ₂ Permits?	Well Class	Adequate Permitting Experience?	Experience with Gas Storage?	Experience with Multiple Well Projects?	Experience with Underground Rights?
State							
AL	OGB	Not clear	?	uncertain			
AR	ADEQ	Y	I	Y	N	N	N
	AOGC						
CA	DOGGR	Y	II	Y			
CO	OGCC	N		Y	Y	Y	Y
FL	FGS	Y	I, V	Y	N	Y	N
IL	EPA	Y	I	Unknown	N	N	N
	DOG	N	I, V	N			
IN	DOG	N		Y but just for EOR	Y	Y	Y
KY	DOGC	N		N	Y	Y	Y
MI	OGS	Y	I	Y			
NE	NDEQ	Y	V	N	Y	Y	unsure
	NOGCC	N		N	Y	Y	Y
NM	OCD	Y	II	Y			

	Agency	Do Existing Regs Cover Non-EOR CO ₂ Permits?	Well Class	Adequate Permitting Experience?	Experience with Gas Storage?	Experience with Multiple Well Projects?	Experience with Underground Rights?
State, cont.							
NY	DMR	Maybe	V	N	Y	Y	Y
OH	EPA	Y	I, V	Y	N	N	N
	DMRM	Send to OEPA	I	Y			
TX	RRC						
UT	DOGM	N		Y			
WY	DEQ	Y	I or V	N	N	Y	N
EPA							
Reg 3		Y	V	Y	N	Y	N
Reg 4		Y	V	N	N	Y	N
Reg 6		Y	V, I	N, but they have expertise	N	Y	N
Reg 7		Y	V	N	N	Y	N
Reg 9		Y	V	Y	N	Y	N

Table 5 — Information from Question 12 — Training Needs Expressed by States and Regions to Become Prepared to Permit CO₂ Injection Wells

Training Topic	Number of Times Mentioned by a State Agency	Number of Times Mentioned by a Region
Monitoring, leak detection, and other testing	4	3
Well construction	3	3
CO ₂ -resistant cement and tubulars	3	2
Modeling of behavior of CO ₂ in the subsurface and compatibility with the formations	3	3
Safety issues	3	1
Evaluating pressure build-up	2	1
Subsurface data on formations and how to evaluate formations	2	1
Examples of good permit conditions or model regulations	2	0
Site visits to existing projects and interviews with other states	1	0
Expected life of project and closure time	1	0
Area of review guidance	1	0

QUESTIONS RELATING TO RESOURCES FOR FUTURE CO₂ INJECTION WELL PROGRAM

Question 16: Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications per year: 1, 5, 10, 25, 50, 100

Most agencies indicated that they could manage 1 or 5 new applications per year with their existing staff. Several states said that they could handle at least 100 new EOR wells but did not indicate how many non-EOR wells they could handle. Several states and one region said that they could not take on any additional workload without increased resources. The replies to question 16 are shown in Table 6.

The Ohio EPA offers the following thoughts:

“If the proposed well is a Class V well, then Ohio EPA could only handle one permit a year due to the small level of funding in the federal grant. If the well is classified as a Class I well and Ohio EPA could bill the Ohio UIC fee account for Class I activities, then we could review up to 3 applications per year based on current staff levels. As more wells are approved and more funding is available through Class I fees paid by the owners of the new CO₂ Class I wells, then additional staff could be hired and more applications reviewed. If CO₂ wells are classified something other than Class I or V, like a Class VI, then Ohio EPA would have to rely on the federal grant and we would be limited to being able to review 1 permit application per year due to lack of resources.”

Table 6 — Information from Question 16 — Adequacy of Existing Resources

State	Agency	Adequate Staff and Resources to Handle This Many New CO ₂ Applications?					
		1/year	5/year	10/year	25/year	50/year	100/year
AL	OGB	Y	Y	Y	Y	?	N
AR	ADEQ	Y	N	N	N	N	N
	AOGC						
CA	DOGGR	Y for EOR	Y for EOR	Y for EOR	Y for EOR	Y for EOR	Y for EOR
CO	OGCC	Y	Y	Y	N	N	N
FL	FGS	Y	N	N	N	N	N
IL	EPA	N	N	N	N	N	N
	DOG	N	N	N	N	N	N
IN	DOG						
KY	DOG	Y	Y	Y	N	N	N
MI	OGS	Y	Y	Y	Y	Y	Y
NE	NDEQ	N	N	N	N	N	N
	NOGCC				N	N	N
NM	OCD	Y	Y	N	N	N	N
NY	DMR	Y	N	N	N	N	N
OH	EPA	Y	N	N	N	N	N
	DMRM	Y	Y	N	N	N	N
TX	RRC						
UT	DOGM	Y	Y	?	?	?	?
WY	DEQ	N	N	N	N	N	N
EPA							
Reg 3		Y	Y	N	N	N	N
Reg 4		Y	?	N	N	N	N

	Agency	Adequate Staff and Resources to Handle This Many New CO ₂ Applications?					
		1/year	5/year	10/year	25/year	50/year	100/year
EPA, <i>cont.</i>							
Reg 6		Y	N	N	N	N	N
Reg 7		Y	Y	?	N	N	N
Reg 9		Y	Y	N	N	N	N

Question 17: If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

Most states that responded asked for 1–2 more FTEs to cover additional permit writers and field inspectors. Several states and most of the regions felt that significantly higher numbers of FTEs would be needed. The cost estimate ranged from \$50K–\$120K per FTE. The replies to question 17 are shown in Table 7.

Table 7 — Information from Question 17 — Additional Resource Needs

State	Agency	Comments on Funding Needs
AL	OGB	For 50–100 applications/yr would need 1 FTE, \$75K (estimate).
AR	ADEQ	Up to 10/year would require at least 1 FTE solely devoted to CO ₂ . Anything above that would require up to 3 FTEs, and possibly more. The 2 ADEQ UIC staff members also conduct all inspections, witness all MITs, and do compliance & enforcement, as necessary; so additional inspectors and geologists would be necessary to take care of the existing UIC program, and deal with the new work load resulting from CO ₂ .
	AOGC	
CA	DOGGR	
CO	OGCC	For 25 to 100 permits/yr we would need to add 1 FTE at a cost of \$120K/yr.
FL	FGS	Unknown as we have no idea how difficult these wells would be to permit – but many more FTEs than are currently assigned to the UIC Program.
IL	EPA	Currently only 1 UIC staff is paid. 2 permit reviewers and 2 field staff are borrowed from other programs to cover the permitting and inspection needs of the UIC program. 5 FTEs would be required to address the present UIC program workload and 1 new CO ₂ permit application.
	DOG	Would need two additional fulltime technicians in permitting, and 4 more field inspectors.
IN	DOG	
KY	DOGCC	For 25/yr, would need 1 additional FTE (\$65K additional costs). For 50–100 /yr, would need 2 additional FTEs (\$130K additional costs). If CO ₂ projects develop in areas other than current oil and gas areas of the state, then additional field inspectors would be required at an annual cost of an additional \$45,000 per inspector per year.
MI	OGS	
NE	NDEQ	For 0–10/yr, need at least 2 additional FTEs; for 25-50/yr, add 2 more FTEs.
	NOGCC	One additional permitting FTE per 25 applications at \$ 100K. One additional field inspector per 50 applications at \$100K.
NM	OCD	2 FTE and \$100,000 per every addition 10 applications.
NY	DMR	

	Agency	Comments on Funding Needs
State, cont.		
OH	EPA	If staff are doing nothing else (no MITs, no well inspections, etc.) other than permit reviews, then I could see about 4 to 5 permits per staff given the current federal and Ohio laws and rules. If they are not dedicated to just permit reviews (as Ohio is set up currently), then probably about 1–2 permits per year per staff.
	DMRM	Would need several full-time geologists/permit writers and field inspectors (approximately \$270K) if we started receiving between 25 to 100 CO ₂ permits/yr.
TX	RRC	
UT	DOGM	
WY	DEQ	1/year: 1 FTE — \$75K; 5/year: 2 FTE — \$150K; 10/year: 4 FTE — \$300K; 25/year: 12 FTE — \$750K; 50/year: 25 FTE — \$1.5M; 100/year: 50 FTE — \$3M.
EPA		
Reg 3		10/yr: 2 FTEs; 25/yr: 4 FTEs; 50/yr: 8 FTEs; 100/yr 16 FTEs.
Reg 4		10/yr: 1 more experienced technical permit writer; 25/yr: 2 more experienced technical permit writers plus additional support staff; 50/yr: 4 more experienced technical permit writers plus additional support staff; 100/yr: 10 more experienced technical permit writers plus additional support staff.
Reg 6		To process any significant number of these applications, it would be highly advisable to have training in the various software packages which would be required in a permit application like this. To process dozens or more permits as described would take significant increases in staff with highly specialized reservoir engineering experience.
Reg 7		An additional 2–3 FTEs would be required to meet the workload.
Reg 9		10/yr: 2 FTE; 25/yr: 5 FTE; 50/yr: 10 FTE; 100/yr 20+ FTE.

Question 18: What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (please rank from most significant to least significant)?

The priorities differ somewhat among the states and the regions, as shown by the average rankings calculated separately for each group. For both groups, application review is the highest priority and permit writing is the second-highest priority. For the states, site inspections and reviewing monitoring data and reports are the next-highest priority. Public hearings and training rank as the lowest priorities. For the regions, however, the public hearings and training are the third- and fourth-highest priorities. However, to some extent, the numbers are skewed because Alabama, Colorado, and Region 9 ranked several options with equal priority. In particular, Region 9 ranked five cost components as high priority and the other three as low priority. We did not employ any statistical techniques to adjust or weigh these agency opinions; rather, we entered the rankings as they were reported. The replies to question 18 are shown in Table 8.

Table 8 — Information from Question 18 — Priority of Resource Needs by Cost Component (ranked with 1 as the highest priority)

	Agency	Application Review	Permit writing	Site inspections	Reviewing monitoring data & reports	Compliance & enforcement	Equipment	Public hearings	Training
State									
AL	OGB	5	5	2	6	3	1	7	4
AR	ADEQ	1	2	6	3	5	8	7	4
	AOGC								
CA	DOGGR								
CO	OGCC	3	3	1	4	4	2	5	5
FL	FGS	1	2	4	3	5	8	7	6
IL	EPA	1	3	5	7	6	8	4	2
	DOG	1	2	3	5	4	6	7	8
IN	DOG								
KY	DOGC	1	2	4	3	7	6	5	8
MI	OGS	2	6	1	3	5	4	8	7
NE	NDEQ	1	2	5	3	4	7	6	8
	NOGCC	1	6	4	7	8	3	2	5
NM	OCD	1	5	7	2	8	4	3	6
NY	DMR								
OH	EPA								
	DMRM	1	2	3	5	4	6	8	7
TX	RRC								
UT	DOGM	1	2	3	4	5	8	6	7
WY	DEQ	1	7	2	3	4	8	5	6
Average ranking for states		1.5	3.5	3.6	4.1	5.1	5.6	5.7	5.9
EPA									
Reg 3		1	2	3	4	5	7	6	8
Reg 4									
Reg 6		1	5	7	6	8	4	2	3
Reg 7		2	4	7	5	6	8	3	1
Reg 9		1	1	1	1	1	2	2	2
Average ranking for regions		1.3	3.0	4.5	4.0	5.0	5.3	3.3	3.5
Average overall ranking		1.4	3.4	3.8	4.1	5.1	5.6	5.2	5.4

Question 19: What other thoughts do you have relating to CO₂ injection wells in your state?

The additional comments and thoughts expressed by the agencies covered a wide range of subjects. They are shown in Table 9.

Table 9 — Information from Question 19 — Other Thoughts

	Agency	Other Thoughts
State		
AL	OGB	The Board's staff is currently involved in a project being administered by the Geological Survey of Alabama that will demonstrate the potential for enhanced recovery of methane gas from coal beds via CO ₂ injection.
AR	ADEQ	
	AOGC	The AOGC currently does not receive funding from EPA for implementation of the Class II UIC Program. At the present time a grant is not expected to be requested for the current UIC program or an expansion of a future UIC program which would include CO ₂ storage. Any increased work load due to CO ₂ storage projects would be covered by state fees that would be established as the program needs development.
CA	DOGGR	<p>CO₂ enhanced recovery operation projects fall under the DOGGR's UIC program, in which we regulate injection of all fluids — liquid, gas, or slurry — that are injected in an oil and gas reservoir. The program covers injection of wastes and commodities (e.g., liquid hydrocarbons, water). Although DOGGR's existing regulatory program for using CO₂ injection in enhanced recovery operations is well established, the expanded use of CO₂ injection for long-term geosequestration in the absence of enhanced recovery and into deep saline formations is currently raising a number of questions regarding how such injection operations should be addressed under existing regulatory programs. One key question will be to determine when an enhanced recovery operation ceases to be enhanced recovery and becomes an operation for CO₂ geosequestration and whether such a change should trigger the application of a different regulatory regime notwithstanding that CO₂ will still be the fluid injected. Such changes should only occur if truly warranted by the scientific and technical demands for monitoring, maintenance, and verification of the projects.</p> <p>DOGGR believes that from a scientific and technical standpoint, natural gas injection operations (including natural gas storage and CO₂ enhanced oil recovery) provide an analogue for CO₂ geosequestration.</p> <p>Although some uncertainties with respect to the potential risks of CO₂ geosequestration and monitoring technologies still may exist, our goal is to utilize the DOGGR regulatory framework and 60-plus years of regulatory experience with underground injection to ensure success. DOGGR's UIC program is well equipped to regulate CO₂ geosequestration, including operational plans for addressing public health and safety, as well as release or leakage mitigation procedures.</p> <p>Expanding DOGGR's authority to include saline formations or injection of CO₂ from non-oil and gas integrally associated sites, i.e., FutureGens or refineries, would require a fee structure for administrative costs, long-term bonding requirements, long-term financial liability requirements, etc.</p>
CO	OGCC	
FL	FGS	The first applications would be very difficult to deal with because the Florida Class I/Class V program has no similar types of wells from which to draw any knowledge. Also it may not be possible to permit these wells into intervals that are normally used for Class I (or deep Class V) injection wells in Florida. Public response to a major new type of injection well is always unpredictable at best — the best example of this might be some of the negative public perception of the large aquifer storage and recovery (ASR) projects proposed as part of the Everglades restoration project. The public generally is favorable to restoration; however, there has been much negativity concerning the use of ASR.

	Agency	Other Thoughts
State, cont.		
IL	EPA	Illinois EPA understands the importance of injection of CO ₂ and will borrow resources as necessary to address this issue. However, under existing funding, the Illinois EPA will be forced to pull all resources presently devoted to the UIC program to address the needs of CO ₂ injection. As a result, maintaining the existing UIC program activities will be difficult, if not impossible.
	DOG	
IN	DOG	Indiana has a large number of old fields containing unplugged or, by today's standards, inadequately plugged wells that result in "holes" in confining zones. In addition, many wells were drilled at the end of the 19th and beginning of the 20th century that were not permitted and were never reported to the state. This results in the question of successful confinement of CO ₂ in those areas. The type of casing used for old wells is subject to deterioration in a normal oil/brine environment. The carbonic acid formed when the CO ₂ is injected has been reported to accelerate deterioration of standard steel casing. This deterioration may severely jeopardize the integrity of existing wells that have not been cemented across the storage zone in fields where old wells exist.
KY	DOGC	
MI	OGS	
NE	NDEQ	Detailed information on potential non-oil-and-gas related reservoir targets is generally not available. Prior to any project, a vast amount of subsurface data will be required to be collected to assess the potential holding capacity for reservoirs. Detailed subsurface stratigraphic and structural information needs to be compiled now to pre-identify the best potential reservoir target zones. We have addressed this issue with our EPA regional contacts, and they agree that 1) there is a complete lack of subsurface information; 2) that we are not currently staffed for this effort; 3) at the moment, they do not know how we are supposed to deal with these issues.
	NOGCC	
NM	OCD	<ul style="list-style-type: none"> • CO₂ wells can damage water quality and producing formations if not constructed and monitored properly. • Metallurgy or engineering design and cost of CO₂ wells may need to be different based on the type and % of gases injected into the well. • What is the cost of lifetime monitoring going to be for these wells? • What is the amount of pollution and cost going to be from parasitic burning of fossil fuels or energy to pump gas into formations? • Pollution Prevention research should be instituted to develop cost effective measure to capture, reduce, reuse (i.e., biomass.) and recycle (biomass...) greenhouse gases.
NY	DMR	Geologic and field studies would have to be undertaken to establish which formations are suitable for CO ₂ injection/sequestration.
OH	EPA	
	DMRM	Recently, we permitted a stratigraphic test well for the Ohio MRCSP CO ₂ project. The well was drilled and reached total depth several weeks ago. After some initial injectivity testing, the applicant will apply to Ohio EPA to convert the well to a Class V experimental injection well.
TX	RRC	
UT	DOGM	
WY	DEQ	
EPA		
Reg 3		Site/location issues with the wells and financial responsibility liability.
Reg 4		
Reg 6		Public participation itself may require substantial FTEs and time (responding to comments).
Reg 7		Given the current state rules it is unlikely that we will see much CO ₂ sequestration activity in Iowa.

	Agency	Other Thoughts
EPA, <i>cont.</i>		
Reg 9		<p>CO₂ injection in existing oil and gas fields raises questions of existing wellbore integrity that could be a huge cost component in preparing the field for CO₂ injection into saline aquifers in those fields.</p> <p>Regulation development is essential to the CO₂ sequestration effort in that it will "level the playing field" of all affected operators and potential operators. The regulations especially need careful consideration of operator concerns so as not to be restrictive to newly emerging technologies and/or techniques while addressing present assumptions of how projects will be implemented. The composing of the regulations and their implementation will have a direct bearing on the anticipated work load applicable to the regulatory agencies.</p> <p>Regulations need to reflect careful consideration of the scientific community's concerns. The science community needs reliable, consistent data and information to address a number of concerns. One such important concern is the ability to identify and verify an atmospheric response (of CO₂ concentration) to the global CO₂ Geologic sequestration effort. It is important to be able to anticipate such successes attributed to the responsibility of the UIC program. In order to confirm success of the UIC component of CO₂ sequestration, much of this data and information should be collected by the regulatory agencies worldwide and made available in a consistent manner/format/quality.</p> <p>The regulatory effort will impact every regulatory body/agency regardless of how encompassing the basic regulations will be. Besides the effort of composing the regulations themselves, the permitting and subsequent evaluation of those permits is expected to compound the technical requirements and demand of the staff.</p>

Conclusions

The responses to these questions represent the most comprehensive body of information collected on the capacity of state and regional UIC programs to accommodate a new workload associated with CO₂ injection wells. Although the data are far from complete (as noted in the caveats presented earlier), they still tell a compelling story. If the nation is serious about controlling CO₂ through underground injection, significant additional resources will need to be made available to hire new permitting staff and field inspectors. Those new staff, along with the existing cadre of UIC staff and managers, must be trained in subjects that will enable them to make prudent permitting, management, and oversight decisions. As momentum grows to begin sequestering CO₂ underground, EPA and states will need to develop new regulatory requirements for CO₂ wells and prepare to review applications and make permitting decisions. Failure to provide adequate resources for UIC programs will create a bottleneck in the nation's efforts to mitigate atmospheric CO₂ levels and their climate impacts.

Appendix A – Agency Contacts Who Responded to Questions

	Agency	Contact Name	Contact Phone	Contact E-Mail
State				
AL	OGB (State Oil and Gas Board of Alabama)	Richard Raymond	205-247-3580	rraymond@ogb.state.al.us
AR	AOGC (Arkansas Oil and Gas Commission)	Gary Looney	870-862-4965	Gary.Looney@aogc.state.ar.us
	ADEQ (Arkansas Department of Environmental Quality)	Laura Stuart-Leslie	501-682-0642	STUART@adeq.state.ar.us
CA	DOGGR (Division of Oil, Gas, and Geothermal Resources)	Michael Stettner	916-323-1781	Michael.Stettner@conservation.ca.gov
CO	OGCC (Oil and Gas Conservation Commission)	David K. Dillon	303-894-2100 x 104	David.Dillon@state.co.us
FL	FGS (Florida Geological Survey)	Richard Deuerling	850-245-8653	richard.deuerling@dep.state.fl.us
IL	DOG (Division of Oil and Gas)	Doug Shutt	217-782-7756	doug.shutt@illinois.gov
	IEPA (Illinois Environmental Protection Agency)	Bur Filson	217/782-6070	Bur.Filson@illinois.gov
IN	DOG (Division of Oil and Gas)	Mona Nemecek	317-232-0045	MNemecek@dnr.IN.gov
KY	DOGC (Division of Oil and Gas Conservation)	Rick Bender	502-573-0147	Rick.Bender@ky.gov
MI	OGS (Office of Geological Survey)	Ray Vugrinovich	517-241-1532	vugrinov@michigan.gov
NE	NDEQ (Nebraska Department of Environmental Quality)	Steven Fischbein	402-471-4290	Steven.Fischbein@ndeq.state.ne.us
	NOGCC (Nebraska Oil and Gas Conservation Commission)	Stan Belieu	308-254-6919	sbelieu@nogcc.ne.gov
NM	EMNRD (Energy, Mineral and Natural Resources Department)	Daniel Sanchez	505-476-3493	daniel.sanchez@state.nm.us
NY	DMR (Division of Mineral Resources)	Donald Drazan	518-402-8072	djdrazan@gw.dec.state.ny.us
OH	EPA (Environmental Protection Agency)	Lindsey Taliaferro	614-644-2752	Lindsay.Taliaferro@epa.state.oh.us
	DMRM (Division of Mineral Resources Management)	Tom Tomastik	614-265-1032	Tom.Tomastik@dnr.state.oh.us
TX	RRC (Railroad Commission)	Fernando De Leon	512-463-6814	fernando.deleon@rrc.state.tx.us
UT	DOGM (Division of Oil, Gas, and Mining)	Dan Jarvis	801-538-5338	danjarvis@utah.gov
WY	DEQ (Department of Environmental Quality)	Kevin Frederick	307-777-7781	kfrede@wy.gov
EPA				
	Region 3	Steven Platt	215-814-5464	Platt.Steve@epamail.epa.gov
		Dave Rectenwald	814-827-1952	Rectenwald.Dave@epamail.epa.gov
	Region 4	Bill Mann	404-562-9452	Mann.Bill@epamail.epa.gov
		Nancy Marsh	404-562-9450	marsh.nancy@epa.gov
	Region 6	Brian Graves	214-665-7193	Graves.Brian@epamail.epa.gov
		Phil Dellinger	214-665-7165	Dellinger.Philip@epamail.epa.gov
	Region 7	Kurt Hildebrandt	913-551-7413	Hildebrandt.Kurt@epamail.epa.gov

	Agency	Contact Name	Contact Phone	Contact E-Mail
EPA, <i>cont.</i>				
	Region 9	George Robin	415-972-3532	Robin.George@epamail.epa.gov
		Jim Walker	505-599-6317	Walker.Jim@epamail.epa.gov

Appendix B – State and Regional Responses to Questions

Argonne Proposed Questions for CO₂ Cost Interview Alabama Oil and Gas Board

UIC Background

1. Which classes of UIC wells do you currently permit? Class II
2. How many active UIC wells of each class do you regulate? 212 Class II
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? .82 work year budgeted for Fiscal Year 2007.
4. What is the current budget for your UIC program? \$88,667 (75% Fed. \$66,500; 25% State \$22,167)
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? No, however actual state share expended traditionally requires 150-200% overage.

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? Permits can be issued per compliance with UIC regulations.
7. How many CO₂ injection well permits have you issued? 10
8. What class of wells are they? Class II ER

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? It appears that such an application could be approved provided the CO₂ is brought to the surface in connection with natural gas storage operations or oil or natural gas production.
10. If yes, what class of well would it be. Class II SWD
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? Uncertain at this time.
12. If not, what type of information or training would be needed? Safety, environmental effects, compatibility with host formation, wellbore/facility corrosion inhibition.

Resources for Future CO₂ Injection Well Program

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

yes- 1/year
yes- 5/year
yes- 10/year
yes- 25/year
?- 50/year
no- 100/year

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. @ 50-100/yr.: 1 FTE, \$75,000 (estimate).

15. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant(1) to least significant(7)):

5- reviewing applications/permitting

4- training

1- equipment, including vehicles and computers

- ~~permit writing~~

7- public hearings and other participation

2- site inspections

6- reviewing monitoring data and reports

3- compliance and enforcement

- other

16. What other thoughts do you have relating to CO₂ injection wells in your state? The Board's staff is currently involved in a project being administered by the Geological Survey of Alabama that will demonstrate the potential for enhanced recovery of methane gas from coal beds via CO₂ injection.

Questions for CO₂ Cost Interview Arkansas Dept of Environmental Quality

UIC Background

1. Which classes of UIC wells do you currently permit?

If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person

ADEQ has primacy for Class I, III, IV and V (except Class V Bromine). The Arkansas Oil and Gas Commission (AOGC) has authority over Class II and the Class V Bromine wells. You may contact Gary Looney of AOGC at 870-862-4965 or Gary.Looney@aogc.state.ar.us.

2. How many active UIC wells of each class do you regulate?

There are 14 Class I [active, temporarily abandoned (i.e., shut-in) and under construction].

There are no Class III or IV wells.

There are 118 permitted Class Vs. Inventory of more Class Vs is ongoing.

3. How many FTEs (full time effort) of staff are employed to run your current UIC program?

There are 0.5 FTEs for the program. There are two staff members, so ideally, it should be closer to 1.0 FTE, however, state (i.e., non-UIC) responsibilities take more of our time.

4. What is the current budget for your UIC program?

The FY 2007 grant award from EPA was \$86,200

5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

No cost estimates have been made at this time.

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?

No applications have been received yet.

7. How many CO₂ injection well permits have you issued?

No permits have been issued for CO₂ injection/disposal wells.

8. What class of wells are they?

ADEQ anticipates issuing CO₂ injection wells under Class V experimental technology, but with Class standards, therefore, we would most likely issue the permit similar to an existing Class I permit.

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it?

Yes, UIC is regulated under the Arkansas Pollution Control and Ecology Commission (APCEC) Regulation No. 17. Although CO₂ is not specifically listed, because ADEQ is already granted authority for Class I and V, however, specific CO₂ rules would most likely be necessary.

10. If yes, what class of well would it be.

ADEQ would permit as Class I.

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?

Yes, however, both staff members would need additional training, and would call upon the AOGC staff for some assistance to draw on their EOR experience.

12. If not, what type of information or training would be needed?

Any EOR and EGR related permits, data on evaluating pressure build-up and fluid/gas migration, and suggestions for compliance monitoring.

13. Does your agency have experience with permitting underground natural gas storage facilities? No

14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? No

15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? No

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year Yes
- 5/year No
- 10/year No
- 25/year No
- 50/year No
- 100/year No

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

Up to 10/year would require at a minimum, 1 FTE, solely devoted to CO₂. Anything above that would require up to 3 FTEs, and possibly more. The 2 ADEQ UIC staff members also conduct all inspections, witness all MITs and do compliance & enforcement, as necessary, so additional inspectors and geologists would be necessary to take care of the existing UIC program, and deal with the new work load resulting from CO₂.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant): (I've ranked these from 1 to 8, from most important to lowest importance)

- reviewing applications 1
- training 4
- equipment, including vehicles and computers 8
- permit writing 2
- public hearings and other participation 7
- site inspections 6
- reviewing monitoring data and reports 3
- compliance and enforcement 5
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Questions for CO₂ Cost Interview Arkansas Oil and Gas Commission

UIC Background

1. Which classes of UIC wells do you currently permit? **Class II and V(spent-brine return)**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person
2. How many active UIC wells of each class do you regulate? **600 (II) and 75 (V)**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program?
2.25
4. What is the current budget for your UIC program? **Not specific, part of overall budget**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **No**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No, none have been applied for**
7. How many CO₂ injection well permits have you issued?
8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it?
10. If yes, what class of well would it be.
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?
12. If not, what type of information or training would be needed?
13. Does your agency have experience with permitting underground natural gas storage facilities?
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)?
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights?

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:
 - 1/year
 - 5/year
 - 10/year
 - 25/year
 - 50/year

- 100/year

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications
- training
- equipment, including vehicles and computers
- permit writing
- public hearings and other participation
- site inspections
- reviewing monitoring data and reports
- compliance and enforcement
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

The Arkansas Oil and Gas Commission currently does not receive funding from the USEPA for implementation of the Class II UIC Program. At the present time a grant is not expected to be requested for the current UIC program or an expansion of a future UIC program which would include CO₂ storage. Any increased work load due to CO₂ storage projects would be covered by state fees which would be established as the program needs development.

Proposed Questions for CO₂ Cost Interview California Division of Oil, Gas, and Geothermal Resources

UIC Background

1. Which classes of UIC wells do you currently permit? **Class II**
2. How many active UIC wells of each class do you regulate? **25,000 plus**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **Not an easy question to answer. We have a UIC budget, but only because we have primacy of the federal UIC program. Prior to primacy, 1983, our oil and gas budget included the permitting, inspection, monitoring, etc. of injection wells. At some point, most all DOGGR employees would have had some involvement with injection wells, i.e., secretaries would type permits, file records, etc., Supervisors would sign permits, orders, etc. Their percentage of time spent on "UIC" would not be as much as a field person. The same with field staff, their work included oil and gas time as well as "UIC" time. Currently, with our federal UIC grant money, we have 5 dedicated UIC field staff, but that number is adjusted annually because our grant remains essentially at the same level while our salaries increase. But this is just for budgeting our grant. Otherwise, we are essentially the same as were prior to primacy. We have 135 employees and the UIC tasks are shared among most of them, just some have more responsibility than others. So it's misleading to respond that we only have 5 FTEs to manage over 25,000 injection wells, the responsibility is spread across all DOGGR staff. I got a little wordy, but I hope you understand my point.**
4. What is the current budget for your UIC program? **Not enough. I'm assuming this question means our federal grant budget of \$468,000, which is about 13% of our total budget to manage our UIC program. Total DOGGR dollars budgeted for UIC is \$4.5 million.**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **Just doing the math, i.e., \$4.5/25000 wells is about \$180/well. But this is misleading, too. Our cyclic steam wells don't require as much oversight as other UIC wells, and other UIC wells may require more attention than others depending on location, downhole conditions, commercial vs. noncommercial, etc.**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **EOR**
7. How many CO₂ injection well permits have you issued? **Not many, less than 50.**
8. What class of wells are they? **Class II**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes**

10. If yes, what class of well would it be. Class II

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Without a doubt.**

12. If not, what type of information or training would be needed?

Resources for Future CO₂ Injection Well Program

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications: Yes for all if they are EOR.

- 1/year
- 5/year
- 10/year
- 25/year
- 50/year
- 100/year

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

15. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant): They are equally important.

- reviewing applications
- training
- equipment, including vehicles and computers
- permit writing
- public hearings and other participation
- site inspections
- reviewing monitoring data and reports
- compliance and enforcement
- other

16. What other thoughts do you have relating to CO₂ injection wells in your state?

CO₂ enhanced recovery operation projects fall under the DOGGR's UIC program, in which we regulate injection of all fluids – liquid, gas, or slurry – that are injected in an oil and gas reservoir. The program covers injection of wastes and commodities (e.g., liquid hydrocarbons, water). Although DOGGR's existing regulatory program for using CO₂ injection in enhanced recovery operations is well established, the expanded use of CO₂ injection for long-term geosequestration in the absence of enhanced recovery and into deep

saline formations is currently raising a number of questions regarding how such injection operations should be addressed under existing regulatory programs.

One key question will be to determine when an enhanced recovery operation ceases to be enhanced recovery and becomes an operation for CO₂ geosequestration and whether such a change should trigger the application of a different regulatory regime notwithstanding that CO₂ will still be the fluid injected. Such changes should only occur if truly warranted by the scientific and technical demands for monitoring, maintenance, and verification of the projects.

DOGGR believes that from a scientific and technical standpoint, natural gas injection operations (including natural gas storage and CO₂ enhanced oil recovery) provide an analogue for CO₂ geosequestration.

Although some uncertainties with respect to the potential risks of CO₂ geosequestration and monitoring technologies still may exist, our goal is to utilize the DOGGR regulatory framework and 60-plus years of regulatory experience with underground injection to ensure success. DOGGR's UIC program is well equipped to regulate CO₂ geosequestration, including operational plans for addressing public health and safety, as well as release or leakage mitigation procedures.

Expanding DOGGR's authority to include saline formations or injection of CO₂ from non-oil and gas integrally associated sites, i.e., FutureGens or refineries, would require a fee structure for administrative costs, long-term bonding requirements, long-term financial liability requirements, etc.

Questions for CO₂ Cost Interview Colorado Oil and Gas Conservation Commission

UIC Background

1. Which classes of UIC wells do you currently permit?
The Colorado Oil and Gas Commission permits Class II injection wells.
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person
All other classes of injection wells are permitted through the EPA.
2. How many active UIC wells of each class do you regulate?
We currently regulate 840 Class II injection wells.
3. How many FTEs (full time effort) of staff are employed to run your current UIC program?
We currently use the equivalent of 2.5 FTE to operate our injection program.
4. What is the current budget for your UIC program?
Our current budget is \$264,800.
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?
No

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?
We have not issued permits for CO₂ sequestering wells. We could issue permits for CO₂ wells if they were part of a enhanced recovery operation.
7. How many CO₂ injection well permits have you issued?
None
1. What class of wells are they?
N/A

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it?
At this time we do not believe so.
10. If yes, what class of well would it be.
N/A
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?
Yes
12. If not, what type of information or training would be needed?
N/A
13. Does your agency have experience with permitting underground natural gas storage facilities?
We currently permit the drilling and construction of well bores used in underground natural gas storage facilities. We do not permit surface facilities or injection operations.

14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)?

Yes

15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights?

Yes, our current rules and regulations address mineral rights and pore ownership in Class II injection wells.

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year Yes
- 5/year Yes
- 10/year Yes
- 25/year No
- 50/year No
- 100/year No

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

For 25 to 100 permits per year we would need to add 1 FTE at a cost of \$120,000/yr.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications 3
- training 5
- equipment, including vehicles and computers 2
- permit writing 3 – goes with applications
- public hearings and other participation 5
- site inspections 1
- reviewing monitoring data and reports 4
- compliance and enforcement 4
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Questions for CO₂ Cost Interview Florida Geological Survey

UIC Background

1. Which classes of UIC wells do you currently permit? **Class I, II, IV, and V**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person **Class II wells are Direct Implementation by EPA but the Florida Geological Survey also may permit Class II wells.**
Contact at FGS is Ed Garrett (Phone: 850\245-3123; e-mail: Ed.Garrett@dep.state.fl.us)
2. How many active UIC wells of each class do you regulate? **Class I: 143, Class III: none, Class IV: none (banned), Class V: 9000-10,000**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **~20 (counts all who charge to program – not only those dealing with permitting, compliance and enforcement)**
4. What is the current budget for your UIC program? **\$2,048,494**
5. Have you made any estimates of the cost per well for your program? **No** If yes, what are the initial and annual costs/well? **N/A**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No**
7. How many CO₂ injection well permits have you issued? **None**
8. What class of wells are they? **We would treat them as Class I wells, or as Class V wells with up to Class I permitting requirements.**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **The regulations would probably allow such wells however, the geology may not allow us to permit in the normal zones used for Class I injection.**
10. If yes, what class of well would it be. **Class I, or Class V with Class I requirements**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **We could develop conditions but training would be preferable.**
12. If not, what type of information or training would be needed? **General training dealing with this type of well**
13. Does your agency have experience with permitting underground natural gas storage facilities? **No – at least not those dealing with Class I and Class V wells.**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes – largest Class I facility has 17 individual injection wells.**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **No – at least not those dealing with Class I and Class V wells.**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year Yes
- 5/year No – at least not initially since these would be a new type of well for Florida
- 10/year No
- 25/year No
- 50/year No
- 100/year No

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. Unknown as we have no idea how difficult these wells would be to permit – but many more FTEs than are currently assigned to the UIC Program. Class I permits are very involved and time consuming as are major Class V permits.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- 1 - reviewing applications
- 6 - training (initially this may rank higher)
- 8 - equipment, including vehicles and computers
- 2 - permit writing
- 7 - public hearings and other participation
- 4 - site inspections
- 3 - reviewing monitoring data and reports
- 5 - compliance and enforcement
- 9 - other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

The first applications would be very difficult to deal with because the Florida Class I/Class V program has no similar types of wells from which to draw any knowledge from. Also, as stated previously, it may not be possible to permit these wells into intervals that are normally used for Class I (or deep Class V) injection wells in Florida. Public response to a major new type of injection well is always unpredictable at best – the best example of this might be some of the negative public perception of the large aquifer storage and recovery (ASR) projects proposed as part of the Everglades restoration project – the public generally is favorable to restoration however there has been much negativity concerning the use of ASR.

Questions for CO₂ Cost Interview Illinois Environmental Protection Agency

UIC Background

1. Which classes of UIC wells do you currently permit? **IEPA: Class I, III, V. IDNR: Class II**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person
2. How many active UIC wells of each class do you regulate? **4 Class I, 7000 plus Class V**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program?
1 UIC paid. 2 permit reviewers and 2 field staff are borrowed from other programs to cover the permitting and inspection needs of the UIC program.
4. What is the current budget for your UIC program? **\$100,000**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **No**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No, none to date**
7. How many CO₂ injection well permits have you issued?
8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes**
10. If yes, what class of well would it be. **More than likely Class I**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Unknown. We've never permitted a well of this type before**
12. If not, what type of information or training would be needed? **Information specific to CO₂ and the concerns/issues associated with injection of CO₂**
13. Does your agency have experience with permitting underground natural gas storage facilities? **No**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **No**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **No**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:
 - 1/year **No**
 - 5/year
 - 10/year

- 25/year
- 50/year
- 100/year

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

Refer to the answer for Item #3. Using that as a basis, 5 FTE's would be required to address the present UIC program workload and 1 new CO2 permit application.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications: **1**
- training: **2**
- equipment, including vehicles and computers: **8**
- permit writing: **3**
- public hearings and other participation: **4**
- site inspections: **5**
- reviewing monitoring data and reports: **7**
- compliance and enforcement: **6**
- other: **9**

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Illinois EPA understands the importance of injection of CO2 and will borrow resources as necessary to address this issue. However, under existing funding, the Illinois EPA will be forced to pull all resources presently devoted to the UIC program to address the needs of CO2 injection. As a result, maintaining the existing UIC program activities will be difficult, if not impossible.

Proposed Questions for CO₂ Cost Interview Illinois DNR - Division of Oil and Gas

UIC Background

1. Which classes of UIC wells do you currently permit?
Only Class II
2. How many active UIC wells of each class do you regulate?
7805 Wells
3. How many FTEs (full time effort) of staff are employed to run your current UIC program?
We have no staff with 100% UIC Work. I have two staff plus myself that are over 50% UIC. The 25 on the staff have 25% or less.
4. What is the current budget for your UIC program?
1.5 Million
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?
We have not made an estimate, but I know that the inspection staff spends well more than the allotted time (25%) on UIC inspections.

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?
It would be within our jurisdiction as Class II. We do have gas injection wells in the system, but I do not believe that any are CO₂.
7. How many CO₂ injection well permits have you issued?
None
8. What class of wells are they?
They will be Class II

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it?
No that would fall under Illinois EPA.
10. If yes, what class of well would it be.
Class I or Class V

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?

No

12. If not, what type of information or training would be needed?

Our modeling to determine rate and pressure is based on barrel volume; we are not sure about the conversion to gas values.

Resources for Future CO₂ Injection Well Program

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year
- 5/year
- 10/year
- 25/year
- 50/year
- 100/year

We do not have adequate staff to operate as is. The added CO₂ load will be bad even if it is just 1 permit.

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

I would like to see two additional fulltime technicians in permitting, and 4 more Field Inspectors.

15. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications 1
- training 7
- equipment, including vehicles and computers 6
- permit writing 2
- public hearings and other participation 8 1 is the most
- site inspections 3
- reviewing monitoring data and reports 5
- compliance and enforcement 4
- other

16. What other thoughts do you have relating to CO₂ injection wells in your state?

Questions for CO₂ Cost Interview Indiana DNR - Division of Oil and Gas

UIC Background

1. Which classes of UIC wells do you currently permit? **Class II.**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person. **None**
2. How many active UIC wells of each class do you regulate? **Class II – 1,275 wells.**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **Two.**
4. What is the current budget for your UIC program? **\$126K**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **Our current budgeted cost is approximately \$100/well. This cost however, does not cover the total costs for implementing the Class II program.**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No, but only because none have been requested. We would review and issue CO₂ injection permits for EOR purposes.**
7. How many CO₂ injection well permits have you issued? **None.**
8. What class of wells are they? **N/A.**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **No. Unless these wells would be classified as Class II wells in which case, we might have to develop regulations to better address these types of CO₂ injection wells.**
10. If yes, what class of well would it be.
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **To the extent that CO₂ wells were proposed for EOR purposes, maybe. We would definitely be interested in some additional training to better understand issues that might arise from CO₂ injection.**
12. If not, what type of information or training would be needed? **Data is needed on specialized well construction for CO₂ wells. Safety training for the field inspectors.**
13. Does your agency have experience with permitting underground natural gas storage facilities? **Yes.**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes.**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **Yes, but only in the context of established oil and gas well spacing rules. We do require permittees to demonstrate they have 100% rights to produce the oil and gas. In the event they don't, we would be involved with the review of forced pooling or compulsory integration petitions and making a ruling**

thereon. Without clear policy on these complex issues as they relate to CO₂, we would not have any specific experience to offer and would need to leave that up to those who are much more knowledgeable in such matters.

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications: **At this time, staff would need training for permit evaluation and well inspection.**

- 1/year
- 5/year
- 10/year
- 25/year
- 50/year
- 100/year

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications
- training
- equipment, including vehicles and computers
- permit writing
- public hearings and other participation
- site inspections
- reviewing monitoring data and reports
- compliance and enforcement
- other

Without any experience in dealing with CO₂ wells, it is difficult to determine what cost increases may result from adding that well type to our program. Certainly all aspects of our regulatory program would be affected incrementally. However, the supplementary training for staff and the time needed for rule development are the most significant additions.

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Indiana has a large number of old fields containing unplugged or, by today's standards, inadequately plugged wells that result in "holes" in confining zones. In addition, many wells were drilled at the end of the nineteenth and beginning of the twentieth century that were not permitted and were never reported to the state. This results in the question of successful confinement of CO₂ in those areas.

The type of casing used for old wells is subject to deterioration in a normal oil/brine environment. The carbonic acid formed when the CO₂ is injected has been reported to accelerate deterioration of standard steel casing. This deterioration may severely jeopardize the integrity of existing wells that have not been cemented across the storage zone in fields where old wells exist.

Questions for CO₂ Cost Interview Kentucky DNR – Division of Oil and Gas Conservation

UIC Background - Kentucky (currently DI state, however DOGC is developing primacy application for Class II)

1. Which classes of UIC wells do you currently permit? **None yet.**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person
2. How many active UIC wells of each class do you regulate? **None yet.**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **5 estimated**
4. What is the current budget for your UIC program? **\$200,000 estimated**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No**
7. How many CO₂ injection well permits have you issued? **None yet.**
8. What class of wells are they? **They will be Class II if used for EOR**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Probably not.**
10. If yes, what class of well would it be. **No regulations yet for CO₂**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Currently no, but could in relative short time.**
12. If not, what type of information or training would be needed? **Monitoring training.**
13. Does your agency have experience with permitting underground natural gas storage facilities? **Yes**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **Yes**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:
 - 1/year **Yes**
 - 5/year **Yes**
 - 10/year **Yes**
 - 25/year **No -1 additional FTE (\$65,000 additional costs)**

- 50/year No – 2 additional FTE (\$130,000 additional costs)
- 100/year No – 2 additional FTE (\$130,000 additional costs)

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- 1 - reviewing applications
- 8 - training
- 6 - equipment, including vehicles and computers
- 2 - permit writing
- 5 - public hearings and other participation
- 4 - site inspections
- 3 - reviewing monitoring data and reports
- 7 - compliance and enforcement
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

If CO₂ projects develop in areas other than current oil and gas areas of the state, then additional field inspectors would be required at a annual costs of an additional \$45,000 per inspector per year.

Questions for CO₂ Cost Interview Michigan Office of Geological Survey

UIC Background

1. Which classes of UIC wells do you currently permit?

OGS permits classes 1, 2, 3G and 5X16; other Class 5 wells have been permitted, but not commonly. Please note Michigan is not a primacy state and the permits are issued under authority of state law. All Class 2 wells are permitted under Part 615 of the Natural Resources and Environmental Protection Act (NREPA). All other classes of wells are permitted under Part 625 of the NREPA. Michigan does not use the USEPA scheme to classify wells for administrative and record-keeping purposes.

2. How many active UIC wells of each class do you regulate?

Class 1I: 15; Class 1W: 8; Class 2: 742 brine disposal wells, 504 secondary recovery injection wells; Class 3G: 47; Class 5X16: 23

3. How many FTEs (full time effort) of staff are employed to run your current UIC program?

The program regulating Class 1,3 and 5 wells currently employs 1 FTE; field and other Lansing staff are used as necessary. The program regulating Class 2 wells is the primary responsibility of approximately 30 field staff and 20 Lansing staff.

Please note that the OGS does not have a separate UIC program; the duties of the Lansing and field staff also encompass oil and gas drilling, production, plugging and remediation.

4. What is the current budget for your UIC program?

OGS does not budget or separately track funds used to regulate injection wells.

5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

About \$2,250.00 per well per year

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?

Yes - all are for enhanced recovery

7. How many CO2 injection well permits have you issued?

→ 4

8. What class of wells are they?

→ Class 2

Future CO2 Injection Well Program Development

9. If you received an application for a non EOR CO2 injection well, would your existing regulations allow you to approve it?

→ Yes

10. If yes, what class of well would it be.

The class will depend on the source of CO2. CO2 generated by oil and gas operations will be disposed in a Class 2 well. CO2 generated from a non-oil-and-gas process will be disposed in a Class 1I well.

11. Do you feel that you and your permit writers have enough experience with CO2 wells to develop permit conditions?

→ Yes

12. If not, what type of information or training would be needed?

Resources for Future CO2 Injection Well Program

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO2 applications:

- 1/year
- 5/year
- 10/year
- 25/year
- 50/year
- 100/year

→ Yes to all

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

15. What are the most significant cost components that make up your total resource needs to manage new CO2 wells (Please rank from most significant to least significant):

- reviewing applications 2
- training 7
- equipment, including vehicles and computers 4
- permit writing 6
- public hearings and other participation 8
- site inspections 1
- reviewing monitoring data and reports 3
- compliance and enforcement 5
- other

16. What other thoughts do you have relating to CO2 injection wells in your state?

Questions for CO₂ Cost Interview Nebraska Dept of Environmental Quality

UIC Background

1. Which classes of UIC wells do you currently permit?

Class I, III and V

If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person

NOGCC, Bill Sydow, Stan Belieu

2. How many active UIC wells of each class do you regulate?

Class I = 1; Class III = ~3500; Class V = 600 +

3. How many FTEs (full time effort) of staff are employed to run your current UIC program?

1.75

4. What is the current budget for your UIC program?

75,750.00

5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

No

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?

Yes

7. How many CO₂ injection well permits have you issued?

No Applications Yet

8. What class of wells are they?

Class V experimental

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it?

Yes

10. If yes, what class of well would it be.

Class V Experimental

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?

No

12. If not, what type of information or training would be needed?

Detailed subsurface data on reservoir and cap characteristics.

13. Does your agency have experience with permitting underground natural gas storage facilities?

Yes

14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)?

Yes

15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights?

Unsure

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year No
- 5/year No
- 10/year No
- 25/year No
- 50/year No
- 100/year No

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

Minimum two additional; incrementally add 2 more in the 25-to-50/yr load.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- 1- reviewing applications
- 8- training
- 7- equipment, including vehicles and computers
- 2- permit writing
- 6- public hearings and other participation
- 5- site inspections
- 3- reviewing monitoring data and reports
- 4- compliance and enforcement
- 9- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Detailed information on potential non-oil-and-gas related reservoir targets is generally not available. Prior to any project, a vast amount of subsurface data will be required to be collected to assess the potential holding capacity for reservoirs. Detailed subsurface stratigraphic and structural information needs to be compiled now to pre-identify the best potential reservoir target zones. We have addressed this issue with our EPA regional contacts, and they agree that 1) there is a complete lack of subsurface information; 2) that we are not currently staffed for this effort; 3) at the moment, they do not know how we are supposed to deal with these issues

Questions for CO₂ Cost Interview Nebraska Oil and Gas Conservation Commission

UIC Background

1. Which classes of UIC wells do you currently permit? **Class II**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person **NDEQ, David Miesbach or Steve Fischbein**
2. How many active UIC wells of each class do you regulate? **723**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **2.5**
4. What is the current budget for your UIC program? **\$124, 000**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No**
7. How many CO₂ injection well permits have you issued? **NA**
8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **No**
10. If yes, what class of well would it be. **????**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **No**
12. If not, what type of information or training would be needed? **Model Regulations, Model Permits, Site Visits of existing projects, and interviews with states that have existing CO₂ projects**
13. Does your agency have experience with permitting underground natural gas storage facilities? **Yes**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **Yes**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:
 - 1/year
 - 5/year
 - 10/year

- 25/year **no**
- 50/year **no**
- 100/year **no**

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. **One additional permitting FTE per 25 applications @ \$ 100 K. One additional field inspector per 50 applications @ \$ 100 K .**

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- 1- reviewing applications
- 5- training
- 3- equipment, including vehicles and computers
- 6- permit writing
- 2- public hearings and other participation
- 4- site inspections
- 7- reviewing monitoring data and reports
- 8- compliance and enforcement
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Proposed Questions for CO₂ Cost Interview New Mexico Oil Conservation Division

UIC Background

1. Which classes of UIC wells do you currently permit? **Class I, II, III & V**
2. How many active UIC wells of each class do you regulate?
Class I: 4
Class II: 3959
Class III: 17
Class V: We estimate 1800 Class V wells, but most are not oilfield related
3. How many FTEs (full time effort) of staff are employed to run your current UIC program?
6.27 FTE
4. What is the current budget for your UIC program?
\$533,333
5. Have you made any estimates of the cost per well for your program?
No, but we could...
If yes, what are the initial and annual costs/well?
Annual: \$533,333/4000wells = \$133/well/year

Current CO₂ Injection Well Program

(Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?
Yes, only for Class II EOR and Acid Gas injection wells.
No designated Class V CO₂ wells have been permitted, but currently there is one pilot CO₂ geosequestration project underway in SE NM that involves 2 Class V Wells.
7. How many CO₂ injection well permits have you issued?
Class II acid gas with CO₂ = 5 wells
Class II EOR = 382
Class V carbonsequestration = 0
8. What class of wells are they? **See question 7**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes, after notice and examiner hearing.**

10. If yes, what class of well would it be. **Class II EOR**

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Yes – at hearing we ask the appropriate experts be provided.**

12. If not, what type of information or training would be needed?

Expected life of project and closure time

We need expert testimony as to phase in the reservoir and mobility.

Resources for Future CO₂ Injection Well Program

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year Yes
- 5/year Yes
- 10/year No
- 25/year No
- 50/year No
- 100/year No

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

Estimate 2 FTE and \$100,000 per every addition 10 applications

15. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- *reviewing applications 1*
- *training 6*
- *equipment, including vehicles and computers 4*
- *permit writing 5*
- *public hearings and other participation 3*
- *site inspections 7*
- *reviewing monitoring data and reports 2*
- *compliance and enforcement 8*
- *other 9*

16. What other thoughts do you have relating to CO₂ injection wells in your state?

- **CO₂ can damage water quality and producing formations if not constructed and monitored properly**
- **Metallurgy or engineering design and cost of CO₂ wells may need to be different based on the type and % of gases injected into the well.**
- **What is the cost of lifetime monitoring going to be for these wells?**

- **What is the amount of pollution and cost going to be from parasitic burning of fossil fuels or energy to pump gas into formations?**
- **Pollution Prevention research should be instituted to develop cost effective measure to capture, reduce, reuse (i.e., biomass....) and recycle (biomass...) greenhouse gases.**

Questions for CO₂ Cost Interview
New York Dept of Environmental Conservation – Division of Mineral Resources

UIC Background

1. Which classes of UIC wells do you currently permit? **New York does not have primacy for UIC well program but does issue permits for Class 2 & 3 wells.**

If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person **Unknown**

2. How many active UIC wells of each class do you regulate? **Class 2 – 81, Class 3 - 85**

3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **0**

4. What is the current budget for your UIC program? **No monies designated specifically for UIC.**

5. Have you made any estimates of the cost per well for your program? **No**

If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No**

7. How many CO₂ injection well permits have you issued? **0**

8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Possibly**

10. If yes, what class of well would it be? **5**

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **No**

12. If not, what type of information or training would be needed? **Well construction, corrosion problems and safety information/training would be needed.**

13. Does your agency have experience with permitting underground natural gas storage facilities? **Yes**

14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes**

15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **Yes**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year - **Yes**

- 5/year – **No for this number and all others listed below.**

- 10/year
- 25/year
- 50/year
- 100/year

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications
- training
- equipment, including vehicles and computers
- permit writing
- public hearings and other participation
- site inspections
- reviewing monitoring data and reports
- compliance and enforcement
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state? **Geologic and field studies would have to be undertaken to establish which formations are suitable for CO₂ injection/sequestration.**

Questions for CO₂ Cost Interview Ohio Environmental Protection Agency

UIC Background

1. Which classes of UIC wells do you currently permit? **The Ohio Environmental Protection Agency-Division of Drinking and Ground Waters (Ohio EPA-DDAGW) regulates Class I, IV, and V wells.**

If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person Ohio Department of Natural Resources – **Division of Mineral Resources (Ohio DNR-DMR) regulates Class II and III injection wells. Tom Tomastik is the contact person for these wells at Ohio DNR-DMR.**

2. How many active UIC wells of each class do you regulate? **There are currently 10 Class I injection wells in Ohio and over 11,000 inventoried active Class V wells. There are no active Class IV wells in Ohio.**

3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **There are currently 3.7 FTEs budgeted for UIC work (Three staff and .07 FTEs for Manager).**

4. What is the current budget for your UIC program? **The total UIC budget at Ohio EPA is about 420,000 dollars. The federal grant with state match is currently about 130,000 dollars and is used for regulation of Class V and Class IV wells. Ohio requires the Class I operators to pay a fee for the regulation of Class I wells only. This regulation of the Class I wells in Ohio costs about 290,000 dollars.**

5. Have you made any estimates of the cost per well for your program? **No.** If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **Yes.**

7. How many CO₂ injection well permits have you issued? **None to date, but there is an experimental well that has been drilled for the Midwest Regional Carbon Sequestration Partnership in Belmont County Ohio and we anticipate that they will submit a permit in early Fall.**

8. What class of wells are they? **For temporary experimental wells, we consider them to be Class V Experimental per US EPA guidance, but for permanent wells we would use the definitions in the rules to classify them either Class I or Class V.**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes, as either a Class V injection well for a shallow well or a Class I injection well for a deep injection well.**

10. If yes, what class of well would it be. **That would depend on the formation injected into and its relation to the USDW. It could either be a Class V injection well for a shallow well into or above the USDW or a Class I injection well for a deep injection well that is below the USDW.**

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Currently, Ohio EPA's UIC permit writers have experience with only one potential CO₂ injection well. The owner of that well is in the process of putting a permit application together and Ohio EPA UIC staff have discussed requirements with the owner and provided technical assistance.**

12. If not, what type of information or training would be needed? **A lot of training is needed including the behavior of CO₂ in the subsurface, construction of wells handling CO₂, MIT procedures, etc.**

13. Does your agency have experience with permitting underground natural gas storage facilities? **Ohio EPA's UIC unit does not regulate this kind of activity.**

14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Ohio EPA's UIC unit currently has staff that has performed a water flood while working for a private oil firm.**

15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **No.**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year - **yes**
- 5/year – no under current funding
- 10/year - no
- 25/year - no
- 50/year – no
- 100/year - no

If the proposed well is a Class V well, then Ohio EPA could only handle one permit a year due to the small level of funding in the federal grant.

If the well is classified a Class I well and Ohio EPA could bill the Ohio UIC fee account for Class I activities, then we could review up to 3 applications per year based on current staff levels. As more wells are approved and more funding is available through Class I fees paid by the owners of the new CO₂ Class I wells, then additional staff could be hired and more applications reviewed.

If CO₂ wells are classified something other than Class I or V, like a Class VI, then Ohio EPA would have to rely on the federal grant and we would be limited to being able to review 1 permit application per year due to lack of resources.

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. **See discussion above. If staff are doing nothing else (no MITs, no well inspections, etc) other than permit reviews, then I could see about 4 to 5 permits per staff given the current federal and Ohio laws and rules. If they are not dedicated to just permit reviews (as Ohio is set up currently) then probably about 1-2 permits per year per staff.**

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications -
- training -
- equipment, including vehicles and computers -
- permit writing -
- public hearings and other participation -
- site inspections -
- reviewing monitoring data and reports
- compliance and enforcement
- other

This is a tough one to answer because the activities above fall into two categories: permitting and compliance. The big cost associated with those two categories is personnel. It could be argued that both compliance activities and permitting activities take about the same amount of staff time and as such are about equal in total cost. Both are necessary and both need equal emphasis and funding.

19. What other thoughts do you have relating to CO₂ injection wells in your state?

QUESTIONS FOR CO₂ INTERVIEW

Ohio DNR – Division of Mineral Resources Management

UIC Background

1. Which classes of UIC wells do you currently permit? **Class II and Class III injection wells. We also review and comment on Class I PTOs and new Class V applications (Class I and V are regulated by Ohio EPA).**
2. How many active UIC wells of each class do you regulate? **Class II = 386 wells and Class III = 49 wells**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **One full-time person – Geologist 4 – Tom Tomastik. We have a number of other personnel who are part time (administrators and inspectors).**
4. What is the current budget for your UIC program? **The grant is approximately \$190,000 plus the state’s cost share, which normally well exceeds the grant funding.**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **Ohio has not made any cost per well estimates.**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **The Division has regulations in place to issue Class II CO₂ injection well permits, but there has been no CO₂ EOR projects in Ohio as of yet.**
7. How many CO₂ injection well permits have you issued? **None**
8. What class of wells are they? **If we had any wells for EOR, those wells would be Class II.**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **If a non-EOR CO₂ well application (if you did not consider the Experimental Class V guidance) was to be submitted it would need to go to Ohio EPA and current regulations their would require it to be Class I Non-Hazardous (unless you use the Experimental Class V guidance).**
10. If yes, what class of well would it be. **Class I Non-Hazardous**

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Yes, in most cases, however, further training in CO₂-resistant cements and tubular goods would be beneficial.**

12. If not, what type of information or training would be needed? **Training in CO₂-resistant cements, casings, packers, and tubular goods.**

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year
- 5/year
- 10/year
- 25/year
- 50/year
- 100/year

We may be able to handle up to five CO₂ permits per year with existing staff.

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. **I believe we would need several full-time geologists/permit writers and field inspectors (approximately \$270,000) if we started receiving between 25 to 100 CO₂ permits per year.**

15. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

Ranking from Most Significant to least significant:

Reviewing Applications

Permit Writing

Site inspections

Compliance and enforcement

Reviewing monitoring data and reports

Equipment (including vehicles & computers)

Training

Public Hearings and other participation

Other

16. What other thoughts do you have relating to CO₂ injection wells in your state? **Recently, we permitted a stratigraphic test well for the Ohio MRCSP CO₂ project and well was drilled and reached total depth several weeks ago. After some initial injectivity testing, the applicant will apply with Ohio EPA to convert the well to a Class V experimental injection well.**

Proposed Questions for CO₂ Cost Interview Texas Railroad Commission

UIC Background

1. Which classes of UIC wells do you currently permit?

If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person

The Railroad Commission (RRC) regulates the Class II (oil & gas) and part of the Class III (brine mining) programs in Texas. Our legislature has designated the Texas Commission on Environmental Quality as the regulating agency for CO₂ Sequestration.

These CO₂ sequestration wells will be transferred to RRC jurisdiction when the sequestration phase is complete and the long term monitoring phase begins. Since there are no CO₂ sequestration wells at this time, and since the sequestration wells life span is unknown, predicting RRC program costs at some time in the distant future, for an unknown population of wells, is not feasible.

2. How many active UIC wells of each class do you regulate? **50,671 Class II**

3. How many FTEs (full time effort) of staff are employed to run your current UIC program?

4. What is the current budget for your UIC program?

5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?

Our involvement in CO₂ injection is limited to enhanced recovery operations.

7. How many CO₂ injection well permits have you issued?

While our EOR CO₂ program is probably the largest program (with 10,039 currently permitted CO₂ injectors), we do not have jurisdiction over CO₂ Sequestration. 9,491 of the permitted CO₂ wells are injecting for EOR.

8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it?

10. If yes, what class of well would it be.

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?
12. If not, what type of information or training would be needed?

Resources for Future CO₂ Injection Well Program

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year
- 5/year
- 10/year
- 25/year
- 50/year
- 100/year

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

15. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications
- training
- equipment, including vehicles and computers
- permit writing
- public hearings and other participation
- site inspections
- reviewing monitoring data and reports
- compliance and enforcement
- other

16. What other thoughts do you have relating to CO₂ injection wells in your state?

Proposed Questions for CO₂ Cost Interview Utah DNR – Division of Oil, Gas, and Mining

UIC Background

1. Which classes of UIC wells do you currently permit? **Class II, DEQ permits all other classes of injection wells.**
2. How many active UIC wells of each class do you regulate? ~ **350 non Indian country wells and ~ 800 wells in Indian Country**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **1.3**
4. What is the current budget for your UIC program? ~ **\$172,329**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **No**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? We would issue permits for non-Indian Country CO₂ wells. **Currently all CO₂ injection wells are in Indian Country, under EPA jurisdiction.**
7. How many CO₂ injection well permits have you issued? **Since all current CO₂ injection wells are in Indian Country we have not permitted any since the late 80's and early 90's.**
8. What class of wells are they? **Class II**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **No**
10. If yes, what class of well would it be.
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Yes**
12. If not, what type of information or training would be needed?

Resources for Future CO₂ Injection Well Program

13. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year Yes
- 5/year Yes
- 10/year ?
- 25/year ?
- 50/year ?
- 100/year ?

14. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

15. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications 1
- training 7
- equipment, including vehicles and computers 8
- permit writing 2
- public hearings and other participation 5
- site inspections 3
- reviewing monitoring data and reports 4
- compliance and enforcement 6
- other 9

16. What other thoughts do you have relating to CO₂ injection wells in your state?

Questions for CO₂ Cost Interview Wyoming Dept of Environmental Quality

UIC Background

1. Which classes of UIC wells do you currently permit? **I, III and V.**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person **Janie Nelson - Wyoming Oil and Gas Conservation Commission 307-234-7147.**
2. How many active UIC wells of each class do you regulate? **50 (I); 10,284 (III); 1,704 (V)**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **5**
4. What is the current budget for your UIC program? **\$475K**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **No.**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No.**
7. How many CO₂ injection well permits have you issued? **None.**
8. What class of wells are they? **NA**

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes.**
10. If yes, what class of well would it be. **Class I or V.**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **No.**
12. If not, what type of information or training would be needed? **Site characterization; Area of Review determinations; monitoring.**
13. Does your agency have experience with permitting underground natural gas storage facilities? **No.**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes.**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **No.**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:
 - 1/year **No. 1 FTE - \$75K**
 - 5/year **No. 2 FTE - \$150K**
 - 10/year **No. 4 FTE - \$300K**
 - 25/year **No. 12 FTE - \$750K**

- 50/year **No. 25 FTE - \$1.5M**

- 100/year **No. 50 FTE - \$3M**

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- 1 - reviewing applications
- 6 - training
- 8 - equipment, including vehicles and computers
- 7 - permit writing
- 5 - public hearings and other participation
- 2 - site inspections
- 3 - reviewing monitoring data and reports
- 4 - compliance and enforcement
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Questions for CO₂ Cost Interview EPA Region 3

UIC Background

1. Which classes of UIC wells do you currently permit? **All well classes**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person
2. How many active UIC wells of each class do you regulate? **Class II - ~1600, Class III – 6, Class V – 25,000+.**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **7.5 full-time for UIC direct implementation of the PA, VA and DC programs and this includes the enforcement work we do. We also employ 4 Senior Employees to conduct inspections and assist in managing compliance.**
4. What is the current budget for your UIC program? **PA - \$234,700. VA - \$137,000. DC - \$38,600.**
5. Have you made any estimates of the cost per well for your program? **No.** If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No. We issued a IIR permit many years ago for CO₂, but the project was terminated by the company.**
7. How many CO₂ injection well permits have you issued? **One (see above).**
8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes.**
10. If yes, what class of well would it be. **Would be issued as a Class 5X experimental and we would follow the permitting guidance issued by EPA Headquarters.**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Yes.**
12. If not, what type of information or training would be needed?
13. Does your agency have experience with permitting underground natural gas storage facilities? **No. These types of facilities are not regulated under the federal UIC Program unless they are liquid at standard temperature and pressure.**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes.**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **No, this is a State issue and EPA does not get involved under the UIC Program.**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year **Yes**
- 5/year **Yes**
- 10/year **No**
- 25/year **No**
- 50/year **No**
- 100/year **No**

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. **10 – 2FTEs, 25 – 4 FTEs, 50 – 8 FTEs, 100 – 16 FTEs.**

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications **1**
- training **8**
- equipment, including vehicles and computers **7**
- permit writing **2**
- public hearings and other participation **6**
- site inspections **3**
- reviewing monitoring data and reports **4**
- compliance and enforcement **5**
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state? **Site/location issues with the wells and financial responsibility liability.**

Questions for CO₂ Cost Interview EPA Region 4

UIC Background

1. Which classes of UIC wells do you currently permit? *Region 4 is DI for Kentucky, Tennessee and Class II in Florida.*

If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person

2. How many active UIC wells of each class do you regulate? *Approximately 3500 Class II wells, over 12000 Class V (mainly septic systems), 1 Class I well.*
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? *Region 4 has 10 FTEs for the UIC and GW program. However, most of the FTEs do grant over site work as apposed to technical work. On the technical side there are 4 FTEs doing the work.*
4. What is the current budget for your UIC program? *Don't know*
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? *No. But we would for Class IIR*
7. How many CO₂ injection well permits have you issued?
8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? *Region 4 would use the current guidelines of Class V experimental.*
10. If yes, what class of well would it be. *Class V experimental*
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? *No.*
12. If not, what type of information or training would be needed? *Construction, cementing, monitoring guidelines, etc.*
13. Does your agency have experience with permitting underground natural gas storage facilities? *No.*
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? *Yes.*
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? *No.*

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year *Yes*
- 5/year *May be*
- 10/year *No Would need one more experienced technical permit writer*
- 25/year *No Would need two more experienced technical permit writers plus additional support staff*
- 50/year *No Would need four more experienced technical permit writers plus additional support staff*
- 100/year *No Would need ten more experienced technical permit writers plus additional support staff*

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- reviewing applications
- training
- equipment, including vehicles and computers
- permit writing
- public hearings and other participation
- site inspections
- reviewing monitoring data and reports
- compliance and enforcement
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

Questions for CO₂ Cost Interview EPA Region 6

UIC Background

1. Which classes of UIC wells do you currently permit? **1, 2 and 5.**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person.
2. How many active UIC wells of each class do you regulate? **About 2,000 Class IIs and several Class 5 (septics), and 1 Class 1 nonhaz.**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? We **just have the permitting side of the program, which takes about 1 fte. Including enforcement and admin staff would bring the total FTE to about 7 people.**
4. What is the current budget for your UIC program? **EPA DI program, no grant.**
5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well? **No estimates.**

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **No**
7. How many CO₂ injection well permits have you issued? **None**
8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes. We have approved nitrogen ER wells and an ER well that injected flue gas.**
10. If yes, what class of well would it be? For CCS pilot project well – **Class V experimental.** For later CCS commercial-scale wells - **Class I (clarification provided 5/16/07)**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **No experience, but I believe Region 6 currently has the technical expertise to process a permit.**
12. If not, what type of information or training would be needed? **Training would be highly beneficial - simulation of CO₂ behavior in a brine reservoir.**
13. Does your agency have experience with permitting underground natural gas storage facilities? **No.**
14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes.**
15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **No**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year - **Yes**
- 5/year – **No, because of existing workload under the land disposal restrictions.**
- 10/year - **No**
- 25/year – **No**
- 50/year -- **No**
- 100/year -- **No**

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. **To process any significant number of these applications, it would be highly advisable to have training in the various software packages which would be required in a permit application like this. To process dozens or more permits as described would take significant increases in staff with highly specialized reservoir engineering experience.**

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

- 1 - reviewing applications**
- 3 - training**
- 4 - equipment, including vehicles and computers**
- 5 - permit writing**
- 2 - public hearings and other participation**
- 7 - site inspections**
- 6 - reviewing monitoring data and reports**
- 8 - compliance and enforcement**
- other**

19. What other thoughts do you have relating to CO₂ injection wells in your state? **Public participation itself may require substantial FTEs and time (responding to comments).**

Questions for CO₂ Cost Interview EPA Region 7

UIC Background – Iowa Direct Implementation Program

1. Which classes of UIC wells do you currently permit? **Class 2 & some Class 5**
If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person
2. How many active UIC wells of each class do you regulate? **Class 2 – 2 Class 5 – 1,478**
3. How many FTEs (full time effort) of staff are employed to run your current UIC program? **1 EPA & 2 Senior Environmental Employees.**
4. What is the current budget for your UIC program? **\$78,000**
5. Have you made any estimates of the cost per well for your program? **No**
If yes, what are the initial and annual costs/well?

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells? **We haven't had any requests to date.**
7. How many CO₂ injection well permits have you issued?
8. What class of wells are they?

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it? **Yes**
10. If yes, what class of well would it be. **Class 5 Experimental at this time**
11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions? **Not at this time but by working in consultation with other EPA Regions and Headquarters we should be able to gain the knowledge needed to permit CO₂ wells.**
12. If not, what type of information or training would be needed? **Well construction and operating criteria, permitting considerations (monitoring, testing, etc.)**
13. Does your agency have experience with permitting underground natural gas storage facilities? **No**

14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)? **Yes**

15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights? **No**

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

Yes - 1/year

Yes - 5/year

Maybe - 10/year

No - 25/year

No - 50/year

No - 100/year

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload. **An additional 2-3 FTEs would be required to meet the workload.**

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

2 - reviewing applications

1 - training

8 - equipment, including vehicles and computers

4 - permit writing

3 - public hearings and other participation

7 - site inspections

5 - reviewing monitoring data and reports

6 - compliance and enforcement

- other

19. What other thoughts do you have relating to CO₂ injection wells in your state? **Given the current state rules it is unlikely that we will see much CO₂ sequestration activity in Iowa.**

Questions for CO₂ Cost Interview EPA Region 9

UIC Background

1. Which classes of UIC wells do you currently permit?

U.S.E.P.A. Region 9:

Class 1 Non-hazardous, Class II (Navajo Nation), Class III, Class V

If another agency in your state has authority for other well classes that might be used for injecting CO₂, please identify the agency and a contact person

For the California Class II Primacy program, please contact:

Mike Stettner, UIC Program Manager

(916) 323-1781

Michael.Stettner@conservation.ca.gov

2. How many active UIC wells of each class do you regulate?

Class 1 Non-hazardous (23), Class II (Navajo Nation - 380), Class III (hundreds), Class V (thousands)

3. How many FTEs (full time effort) of staff are employed to run your current UIC program?

8 FTE

4. What is the current budget for your UIC program?

\$300,000

5. Have you made any estimates of the cost per well for your program? If yes, what are the initial and annual costs/well?

No, not formally.

Current CO₂ Injection Well Program (Where appropriate, distinguish between sequestration wells and enhanced oil recovery [EOR] wells)

6. Do you currently issue permits for any CO₂ injection wells?

Yes, those used in EOR activities on the Navajo Nation.

7. How many CO₂ injection well permits have you issued?

One Area Permit.

8. What class of wells are they?

Class IIR

Future CO₂ Injection Well Program Development

9. If you received an application for a non EOR CO₂ injection well, would your existing regulations allow you to approve it?

Yes.

10. If yes, what class of well would it be.

Assuming these applications would be for Pilot Projects, the classification would be Class V Experimental

11. Do you feel that you and your permit writers have enough experience with CO₂ wells to develop permit conditions?

Yes

12. If not, what type of information or training would be needed?

Nevertheless, additional training would be helpful in

Pressure Transient Testing,

Deep Well Monitoring: CO₂ Containment & Leak Detection & Mitigation,

CO₂ Safety Standards (drilling, blowout control/prevention, construction materials, etc.),

Cement Evaluation,

CO₂ Miscible Flooding (oilfield applications) and Other Insitu Behavior,

Modeling Basics (pressure & plume behavior, analysis, prediction, etc.),

Well Construction: Various Methods & Strategies,

Formation Evaluation,

... to name a few.

13. Does your agency have experience with permitting underground natural gas storage facilities?

No, Natural Gas Storage operations are exempt from regulation by the US EPA.

14. Does your agency have experience with permitting projects involving multiple injection wells rather than single injection wells (e.g., a waterflood operation)?

Yes

15. To the extent that CO₂ permitting eventually involves issues such as pore ownership, does your agency have experience in dealing with underground mineral rights?

No, this concern is not within the scope of the UIC program.

Resources for Future CO₂ Injection Well Program

16. Based on your experience, do you have adequate existing staff and resources to evaluate the following numbers of new CO₂ applications:

- 1/year Yes

- 5/year Yes

- 10/year No

- 25/year No

- 50/year No

- 100/year No

17. If you answer no for any of the categories, try to estimate the number of FTEs and associated costs that would be needed to evaluate the incremental workload.

- 1/year Yes
- 5/year Yes, for a limited time.
- 10/year No- 2 FTE
- 25/year No - 5 FTE
- 50/year No - 10 FTE
- 100/year No - 20+ FTE

18. What are the most significant cost components that make up your total resource needs to manage new CO₂ wells (Please rank from most significant to least significant):

Virtually Equal Importance as these tasks are integral to the complete program.

The highest ranking from a cost perspective are:

- reviewing applications
- permit writing
- site inspections
- reviewing monitoring data and reports
- compliance and enforcement

The lesser ranking items are:

- training
- equipment, including vehicles and computers
- public hearings and other participation
- other

19. What other thoughts do you have relating to CO₂ injection wells in your state?

- CO₂ injection in existing oil and gas fields raises questions of existing wellbore integrity that could be a huge cost component in preparing the field for CO₂ injection into saline aquifers in those fields.
- Regulation development is essential to the CO₂ Sequestration effort in that it will "level the playing field" of all affected operators and potential operators. The regulations especially need careful consideration of operator concerns so as not to be restrictive to newly emerging technologies and/or techniques while addressing present assumptions of how projects will be implemented. The composing of the regulations and their implementation will have a direct bearing on the anticipated work load applicable to the regulatory agencies.
- Regulations need to reflect careful consideration of the scientific community's concerns. The science community needs reliable, consistent data and information to address a number of concerns. One such important concern is the ability to identify and verify an atmospheric response (of CO₂ concentration) to the global CO₂ Geologic Sequestration effort. It is important to be able to anticipate such successes attributed to the responsibility of the UIC program. In order to confirm success of the UIC component of CO₂ Sequestration, much of this data and information should be collected by the regulatory agencies worldwide and made available in a consistent manner/format/quality.
- The regulatory effort will impact every regulatory body/agency regardless of how encompassing the basic regulations will be. Besides the effort of composing the regulations themselves, the permitting and subsequent evaluation of those permits is expected to compound to the technical requirements and demand of the staff.

