

Appendix G:
Burden and Cost for Geologic Sequestration of Carbon
Dioxide
(Subpart RR)

Burden and Cost Estimate for Geologic Sequestration of Carbon Dioxide (Subpart RR)

The objective of this appendix is to summarize estimated burden and cost estimates for subpart RR of the Greenhouse Gas Reporting Program (GHGRP). More detail on the methodology, assumptions, and estimated costs, including costs for potential alternative cost scenarios, are presented in the docket.¹

Subpart RR monitoring and reporting costs are estimated here based on two types of potentially reporting facilities:

- Projects permitted under Class II of EPA's Underground Injection Control (UIC) program (for carbon dioxide enhanced oil recovery ("CO₂-EOR") wells).
- Projects permitted under Class VI of EPA's UIC Program (assumed to be injecting into deep saline formations for purposes of the analysis).

The geologic and project characteristics of the "representative" facility for both the CO₂-EOR case and the deep saline aquifer case are based on a typical CO₂-EOR project in the Permian Basin of West Texas, where the majority of ongoing CO₂-EOR operations in the U.S. exist. This "representative" facility is comparable to that used in previous EPA subpart RR analyses.

Table 1 summarizes the subpart RR unit burden and cost estimates for CO₂-EOR projects. Similarly, Table 2 summarizes the subpart RR unit burden and cost estimates for deep saline formation projects.

For purposes of this analysis, it was assumed that one deep saline formation project would report under subpart RR. It was also assumed that 6 CO₂-EOR projects would report under subpart RR, with 2 in year 1, 4 in year 2, and 6 in year 3.

Based on these estimated numbers of impacted facilities, estimates for the total burden and costs for subpart RR are presented in Table 3.

In summary, the major changes in the burden and cost estimates relative to previous estimates (i.e., EPA ICR No. 2300.10) are as follows:

- The number of projects assumed to hold Class VI well permits, and therefore which were also assumed to report under subpart RR, was updated.
- Costs were updated to account for more recent experience associated with CO₂ storage projects sponsored by the U.S. Department of Energy.
- Additional CO₂-EOR projects are assumed to report under subpart RR.

¹ *Analysis of the Costs Associated with Subpart RR (Geologic Sequestration of Carbon Dioxide) Reporting under the EPA Greenhouse Gas Reporting Program*, paper prepared by Advanced Resources International, Inc., April 2016.

Table 1. Unit Burden and Cost Estimates for CO₂-EOR Projects

Up Front Costs; Planning and Permitting, Existing Well P&A	Labor Hours	Labor Dollars	Capital Dollars	TOTAL
Site Characterization and Preparation	62	\$8,713	\$533,522	\$542,235
Convert Existing Wells to Monitoring Wells	13	\$1,821	\$240,953	\$242,775
Install New Shallow Monitoring Wells	0	\$0	\$0	\$0
Develop MRV Plans	26	\$3,642	\$0	\$3,642
Baseline Soil and Vadose Monitoring Installation	13	\$1,821	\$12,249	\$14,070
Micro-Seismic Monitoring Installation	0	\$0	\$0	\$0
Special-Case P&A	0	\$0	\$0	\$0
Drill New Monitoring Wells	2	\$273	\$242,444	\$242,717
Perform Baseline 3D Seismic	0	\$0	\$0	\$0
Perform Baseline Vertical Seismic Profiling (VSP)/Cross-Well Seismic	0	\$0	\$0	\$0
Install and Perform Baseline Eddy Covariance/CIR Monitoring	8	\$1,155	\$37,876	\$39,031
Injection Wells	0	\$0	\$0	\$0
Replace Tubulars/Wellhead/Packers in Existing Wells	0	\$0	\$0	\$0
Drill New Class VI Injectors	0	\$0	\$0	\$0
Conduct Baseline Cased Hole Logging	0	\$0	\$0	\$0
Conduct Baseline MIT Program	0	\$0	\$0	\$0
Testing and Monitoring	36	\$5,077	\$158,288	\$163,364
Monitor Surface Pressure, Temperatures, Rates, Gas Composition, and Corrosion	20	\$2,800	\$115,819	\$118,619
Monitor Subsurface Pressure and Fluid Sampling	8	\$1,184	\$32,476	\$33,660
Perform Baseline Soil Flux/Vadose Zone Monitoring	8	\$1,093	\$9,993	\$11,085
TOTAL	98	\$13,790	\$691,810	\$705,600
Injection/Monitoring Phase (Annual)	Labor Hours	Labor Dollars	O&M Dollars	TOTAL
RR Reporting	240	\$33,899	\$0	\$33,899
Update Models	160	\$22,600	\$0	\$22,600
Report per Subpart RR Requirements	80	\$11,300	\$0	\$11,300
Conduct Cased Hole Logging	0	\$0	\$0	\$0
Conduct MIT Program	0	\$0	\$0	\$0
Testing and Monitoring	472	\$66,679	\$524,150	\$590,829
Monitor Surface Pressure, Temperatures, Rates, Gas Composition, and Corrosion	194	\$27,402	\$148,400	\$175,802
Monitor Subsurface Pressure and Fluid Sampling	104	\$14,690	\$175,500	\$190,190
Perform Baseline Soil Flux/Vadose Zone Monitoring	96	\$13,560	\$124,000	\$137,560
Perform Micro-Seismic Monitoring	0	\$0	\$0	\$0
Perform 3D Seismic	0	\$0	\$0	\$0
Perform Vertical Seismic Profiling (VSP)/Cross-Well Seismic	0	\$0	\$0	\$0
Perform Eddy Covariance/CIR Monitoring	78	\$11,027	\$76,250	\$87,277
TOTAL	712	\$100,578	\$524,150	\$624,728
Post Injection (Annual)	Labor Hours	Labor Dollars	O&M Dollars	TOTAL
RR Reporting	160	\$22,600	\$0	\$22,600
Update Models	80	\$11,300	\$0	\$11,300
Report per Subpart RR Requirements	80	\$11,300	\$0	\$11,300
Testing and Monitoring	139	\$19,638	\$187,875	\$207,513
Monitor Subsurface Pressure and Fluid Sampling	52	\$7,345	\$87,750	\$95,095
Perform Baseline Soil Flux/Vadose Zone Monitoring	48	\$6,780	\$62,000	\$68,780
Perform Micro-Seismic Monitoring	0	\$0	\$0	\$0
Perform 3D Seismic	0	\$0	\$0	\$0
Perform Vertical Seismic Profiling (VSP)/Cross-Well Seismic	0	\$0	\$0	\$0
Perform Eddy Covariance/CIR Monitoring	39	\$5,514	\$38,125	\$43,639
	0	\$0	\$0	CCS P&A
Well Plugging	0	\$0	\$0	\$0
Plug Injectors	0	\$0	\$0	\$0
Plug Monitoring Wells	0	\$0	\$0	\$0
Plug USDW Wells	0	\$0	\$0	\$0
TOTAL	299	\$42,238	\$187,875	\$230,113
Weighted Average O&M (based on years in category)	574	\$81,131	\$412,057	\$493,189
Plus Total Annualized Costs (inc. Capital Costs) of	\$55,750			\$548,939

Table 2. Unit Burden and Cost Estimates for Deep Saline Formation Projects

Up Front Costs; Planning and Permitting, Existing Well P&A	Labor Hours	Labor Dollars	Capital Dollars	TOTAL
Site Characterization and Preparation	59	\$8,295	\$77,345	\$85,640
Convert Existing Wells to Monitoring Wells	0	\$0	\$0	\$0
Install New Shallow Monitoring Wells	0	\$0	\$0	\$0
Develop MRV Plans	45	\$6,356	\$0	\$6,356
Baseline Soil and Vadose Monitoring Installation	0	\$0	\$0	\$0
Micro-Seismic Monitoring Installation	0	\$0	\$0	\$0
Special-Case P&A	0	\$0	\$0	\$0
Drill New Monitoring Wells	0	\$0	\$0	\$0
Perform Baseline 3D Seismic	0	\$0	\$0	\$0
Perform Baseline Vertical Seismic Profiling (VSP)/Cross-Well Seismic	0	\$0	\$0	\$0
Install and Perform Baseline Eddy Covariance/CIR Monitoring	14	\$1,938	\$77,345	\$79,283
Injection Wells	0	\$0	\$0	\$0
Replace Tubulars/Wellhead/Packers in Existing Wells	0	\$0	\$0	\$0
Drill New Class VI Injectors	0	\$0	\$0	\$0
Conduct Baseline Cased Hole Logging	0	\$0	\$0	\$0
Conduct Baseline MIT Program	0	\$0	\$0	\$0
Testing and Monitoring	2	\$318	\$11,250	\$11,568
Monitor Surface Pressure, Temperatures, Rates, Gas Composition, and Corrosion	2	\$318	\$11,250	\$11,568
Monitor Subsurface Pressure and Fluid Sampling	0	\$0	\$0	\$0
Perform Baseline Soil Flux/Vadose Zone Monitoring	0	\$0	\$0	\$0
Perform Micro-Seismic Monitoring	0	\$0	\$0	\$0
Perform Baseline 3D Seismic	0	\$0	\$0	\$0
Perform Vertical Seismic Profiling (VSP)/Cross-Well Seismic	0	\$0	\$0	\$0
Install and Perform Baseline Eddy Covariance/CIR Monitoring	0	\$0	\$0	\$0
TOTAL	61	\$8,612	\$88,595	\$97,208
Injection/Monitoring Phase (Annual)	Labor Hours	Labor Dollars	O&M Dollars	TOTAL
RR Reporting	720	\$101,698	\$0	\$101,698
Update Models	640	\$90,398	\$0	\$90,398
Report per Subpart RR Requirements	80	\$11,300	\$0	\$11,300
Conduct Cased Hole Logging	0	\$0	\$0	\$0
Conduct MIT Program	0	\$0	\$0	\$0
Testing and Monitoring	188	\$26,520	\$152,250	\$178,770
Monitor Surface Pressure, Temperatures, Rates, Gas Composition, and Corrosion	16	\$2,260	\$16,000	\$18,260
Monitor Subsurface Pressure and Fluid Sampling	0	\$0	\$0	\$0
Perform Baseline Soil Flux/Vadose Zone Monitoring	0	\$0	\$0	\$0
Perform Micro-Seismic Monitoring	0	\$0	\$0	\$0
Perform Baseline 3D Seismic	0	\$0	\$0	\$0
Perform Vertical Seismic Profiling (VSP)/Cross-Well Seismic	0	\$0	\$0	\$0
Install and Perform Baseline Eddy Covariance/CIR Monitoring	172	\$24,260	\$136,250	\$160,510
TOTAL	908	\$128,218	\$152,250	\$280,468
Post Injection (Annual)	Labor Hours	Labor Dollars	O&M Dollars	TOTAL
RR Reporting	400	\$56,499	\$0	\$56,499
Update Models	320	\$45,199	\$0	\$45,199
Report per Subpart RR Requirements	80	\$11,300	\$0	\$11,300
Conduct Cased Hole Logging	0	\$0	\$0	\$0
Conduct MIT Program	86	\$12,130	\$68,125	\$80,255
Monitor Subsurface Pressure and Fluid Sampling	0	\$0	\$0	\$0
Perform Baseline Soil Flux/Vadose Zone Monitoring	0	\$0	\$0	\$0
Perform Micro-Seismic Monitoring	0	\$0	\$0	\$0
Perform 3D Seismic	0	\$0	\$0	\$0
Perform Vertical Seismic Profiling (VSP)/Cross-Well Seismic	0	\$0	\$0	\$0
Perform Eddy Covariance/CIR Monitoring	86	\$12,130	\$68,125	\$80,255
TOTAL	486	\$68,629	\$68,125	\$136,754
Weighted Average O&M (based on years in category)	787	\$111,176	\$128,190	\$239,366
Plus Total Annualized Costs (inc. Capital Costs) of	\$6,645			\$246,011

Table 3. Total Burden and Cost Estimates for Subpart RR

Year 1												
Source Category	No. of Respondents	Responses/ Respondent	Total Responses	Burden - Technical (hrs)	Burden - Managerial (hrs)	Burden - Clerical (hrs)	Burden - Legal (hrs)	Total Burden (hours)	Total Labor Cost (\$)	Annualized Capital Cost (\$)	O&M Cost (\$)	Total Cost (\$)
Subpart RR												
Deep Saline Formation (Class VI)	1	varies	varies	558	24	197	8	787	\$111,173	\$6,645	\$128,190	\$246,009
EOR (Class II)	2	varies	varies	817	34	287	11	1,149	\$162,255	\$111,501	\$824,115	\$1,097,871
Total	3			1,375	58	484	19	1,936	\$273,428	\$118,146	\$952,305	\$1,343,879
Year 2												
Source Category	No. of Respondents	Responses/ Respondent	Total Responses	Burden - Technical (hrs)	Burden - Managerial (hrs)	Burden - Clerical (hrs)	Burden - Legal (hrs)	Total Burden (hours)	Total Labor Cost (\$)	Annualized Capital Cost (\$)	O&M Cost (\$)	Total Cost (\$)
Subpart RR												
Deep Saline Formation (Class VI)	1	varies	varies	558	24	197	8	787	\$111,173	\$6,645	\$128,190	\$246,009
EOR (Class II)	4	varies	varies	1,632	69	574	23	2,298	\$324,556	\$223,002	\$1,648,229	\$2,195,788
Total	5			2,190	93	771	31	3,085	\$435,729	\$229,647	\$1,776,420	\$2,441,796
Year 3												
Source Category	No. of Respondents	Responses/ Respondent	Total Responses	Burden - Technical (hrs)	Burden - Managerial (hrs)	Burden - Clerical (hrs)	Burden - Legal (hrs)	Total Burden (hours)	Total Labor Cost (\$)	Annualized Capital Cost (\$)	O&M Cost (\$)	Total Cost (\$)
Subpart RR												
Deep Saline Formation (Class VI)	1	varies	varies	558	24	197	8	787	\$111,173	\$6,645	\$128,190	\$246,009
EOR (Class II)	6	varies	varies	2,447	103	862	34	3,446	\$486,737	\$334,503	\$2,472,344	\$3,293,584
Total	7			3,005	127	1,059	42	4,233	\$597,910	\$341,148	\$2,600,534	\$3,539,593
Annual Average (3-year ICR Period)												
Source Category	No. of Respondents	Responses/ Respondent	Total Responses	Burden - Technical (hrs)	Burden - Managerial (hrs)	Burden - Clerical (hrs)	Burden - Legal (hrs)	Total Burden (hours)	Total Labor Cost (\$)	Annualized Capital Cost (\$)	O&M Cost (\$)	Total Cost (\$)
Subpart RR												
Deep Saline Formation (Class VI)	1	varies	varies	558	24	197	8	787	\$111,173	\$6,645	\$128,190	\$246,009
EOR (Class II)	4	varies	varies	1,632	69	574	23	2,298	\$324,516	\$223,002	\$1,648,229	\$2,195,747
Total	5			2,190	93	771	31	3,085	\$435,689	\$229,647	\$1,776,420	\$2,441,756
Rate Assumptions:	Technical =	Engineer =	Unloaded Labor									
	Managerial =	Middle Mgr	Loaded Labor									
	Clerical =	Technician	\$99.18 /hour	\$158.69 /hour								
	Legal =	Legal =	\$118.86 /hour	\$190.18 /hour								
			\$52.84 /hour	\$84.54 /hour								
			\$108.61 /hour	\$173.78 /hour								