

# **Appendix G:**

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

**June 2019**

The objective of this appendix is to summarize updated 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.<sup>1</sup>

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

- Projects permitted under Class II of EPA’s Underground Injection Control (UIC) program (primarily for carbon dioxide enhanced oil recovery (“CO<sub>2</sub>-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 CO<sub>2</sub>-EOR and the deep saline aquifer case are based on a typical CO<sub>2</sub>-EOR project in the Permian Basin of West Texas, where the majority of ongoing CO<sub>2</sub>-EOR operations in the U.S. exist. This “representative” facility is comparable to that used in previous EPA subpart RR analyses.

This update takes into consideration activities and events occurring since the last estimate in 2016. Specifically, monitoring, reporting, and verification (MRV) plans for CO<sub>2</sub>-EOR and deep saline CO<sub>2</sub> storage projects have been approved by EPA.<sup>2</sup> Cost estimates have been updated based on the activities reflected in the approved plans.

CO<sub>2</sub>-EOR projects that have submitted MRV plans to EPA operate with rigorous monitoring already in place, to ensure efficient and economically viable operation. Based on the approved MRV plans for Class II/CO<sub>2</sub>-EOR operations, the incremental costs are assumed to be associated with the development of an MRV plan and reporting and recordkeeping costs to meet subpart RR requirements (e.g., submission of annual reports). It is assumed that models are updated every other year during the injection phase, and every four years during post-injection. This results in incremental annual costs of \$35,960 during the injection phase. No reporters are assumed to be in the post-injection phase over the time frame of these estimates.

Table 1 summarizes the MRV activities assumed for a MRV plan for a deep saline formation project, *which are assumed to be incremental to activities that may be associated with a Class VI permit*. Table 2 summarizes the incremental unit burden and cost estimates under subpart RR for a deep saline formation project based on these assumed activities.

In addition, in February 2018, the Bipartisan Budget Act of 2018 extended and enhanced the federal Internal Revenue Code (IRC), Section 45Q tax credits.<sup>3</sup> It is anticipated that the tax credit enhancements will stimulate additional geologic sequestration projects.

For purposes of this analysis, it is assumed that one deep saline formation CO<sub>2</sub> storage project would report under subpart RR in year 1 (2019), year 2 (2020), and year 3 (2021). It is also assumed that four CO<sub>2</sub>-EOR projects would report under subpart RR in year 1, seven in year 2, and ten in year 3.

Taking into consideration the unit cost and burden estimates for CO<sub>2</sub>-EOR and deep saline formation facilities, and the estimated number of impacted facilities stated above, estimates for the incremental burden and associated costs for subpart RR are presented in Table 3.

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<sup>1</sup> *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., May 2018.

<sup>2</sup> <https://www.epa.gov/ghgreporting/subpart-rr-geologic-sequestration-carbon-dioxide>

<sup>3</sup> <https://www.congress.gov/bill/115th-congress/house-bill/1892/text>

**Table 1. Deep Saline Formation: Subpart RR Baseline Scenario**

<b>MRV Activity</b>	<b>Deep Saline Formation Operation</b>
Develop MRV plans and update models	YES
Report per subpart RR requirements	YES
Convert some existing wells to monitoring wells	IN PLACE
Install shallow monitoring wells	IN PLACE
Perform soil flux/vadose zone monitoring	IN PLACE
Perform micro-seismic monitoring	IN PLACE
Special-case P&As	IN PLACE
Drill new deep monitoring wells	IN PLACE
Perform 3D seismic	IN PLACE
Perform eddy covariance/CIR monitoring	YES
Conduct cased hole logging	IN PLACE
Conduct MIT program	IN PLACE
Monitor surface pressure, temperatures, rates, gas composition, and corrosion	IN PLACE
Monitor subsurface pressure and fluid sampling	IN PLACE
YES = will be in MRV Plan IN PLACE = already in place	

**Table 2. Baseline Unit Burden and Cost Estimates for Deep Saline Formation Projects:  
Subpart RR Baseline Scenario**

<b>CO<sub>2</sub> Storage Project - Moderate Cost RR Monitoring Case</b>				
<b>Up Front Costs; Planning and Permitting, Existing Well P&amp;A</b>	<b>Labor Hours</b>	<b>Labor Dollars</b>	<b>Capital Dollars</b>	<b>TOTAL</b>
<b>Site Characterization and Preparation</b>	<b>840</b>	<b>\$89,882</b>	<b>\$0</b>	<b>\$89,882</b>
Convert Existing Wells to Monitoring Wells	0	\$0	\$0	\$0
Install New Shallow Monitoring Wells	0	\$0	\$0	\$0
Develop MRV Plans	640	\$68,482	\$0	\$68,482
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/CR Monitoring	200	\$21,401	\$0	\$21,401
<b>Injection Wells</b>	<b>0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
Replace Tubulars/Wellhead/Packers in Existing Wells	0	\$0	\$0	\$0
Drill New Class VI Injectors	0	\$0	\$0	\$0
<b>Conduct Baseline Cased Hole Logging</b>	<b>0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Conduct Baseline MIT Program</b>	<b>0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Testing and Monitoring</b>	<b>32</b>	<b>\$3,424</b>	<b>\$37,432</b>	<b>\$40,856</b>
Monitor Surface Pressure, Temperatures, Rates, Gas Composition, and Corrosion	32	\$3,424	\$37,432	\$40,856
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/CR Monitoring	0	\$0	\$0	\$0
<b>TOTAL</b>	<b>872</b>	<b>\$93,306</b>	<b>\$37,432</b>	<b>\$130,738</b>
<b>Injection/Monitoring Phase (Annual)</b>	<b>Labor Hours</b>	<b>Labor Dollars</b>	<b>O&amp;M Dollars</b>	<b>TOTAL</b>
<b>RR Reporting</b>	<b>816</b>	<b>\$87,314</b>	<b>\$0</b>	<b>\$87,314</b>
Update Models	640	\$68,482	\$0	\$68,482
Report per Subpart RR Requirements	176	\$18,832	\$0	\$18,832
<b>Conduct Cased Hole Logging</b>	<b>0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Conduct MIT Program</b>	<b>0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Testing and Monitoring</b>	<b>192</b>	<b>\$20,545</b>	<b>\$16,000</b>	<b>\$36,545</b>
Monitor Surface Pressure, Temperatures, Rates, Gas Composition, and Corrosion	16	\$1,712	\$16,000	\$17,712
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/CR Monitoring	176	\$18,832	\$0	\$18,832
<b>TOTAL</b>	<b>1,008</b>	<b>\$107,859</b>	<b>\$16,000</b>	<b>\$123,859</b>
<b>Post Injection (Annual)</b>	<b>Labor Hours</b>	<b>Labor Dollars</b>	<b>O&amp;M Dollars</b>	<b>TOTAL</b>
<b>RR Reporting</b>	<b>496</b>	<b>\$53,073</b>	<b>\$0</b>	<b>\$53,073</b>
Update Models	320	\$34,241	\$0	\$34,241
Report per Subpart RR Requirements	176	\$18,832	\$0	\$18,832
<b>Conduct Cased Hole Logging</b>	<b>0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>
<b>Conduct MIT Program</b>	<b>88</b>	<b>\$9,416</b>	<b>\$68,125</b>	<b>\$77,541</b>
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/CR Monitoring	88	\$9,416	\$68,125	\$77,541
<b>TOTAL</b>	<b>584</b>	<b>\$62,490</b>	<b>\$68,125</b>	<b>\$130,615</b>
<b>Weighted Average O&amp;M (based on years in category)</b>	<b>887</b>	<b>\$94,883</b>	<b>\$30,908</b>	<b>\$125,791</b>

**Table 3. Total Burden and Cost Estimates for Subpart RR**

Year 1 (2019)											
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, inc. Labor (\$)	Total Cost (\$)
1	varies	varies	685	202	71	50	1,008	\$107,866	\$0	\$123,866	\$123,866
4	varies	varies	914	269	94	67	1,344	\$143,841	\$0	\$143,841	\$143,841
5			1,599	471	165	117	2,352	\$251,706	\$0	\$267,706	\$267,706
			229	67	24	17	336				
Year 2 (2020)											
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, inc. Labor (\$)	Total Cost (\$)
1	varies	varies	685	202	71	50	1,008	\$107,866	\$0	\$123,866	\$123,866
7	varies	varies	1,599	470	165	118	2,352	\$251,678	\$0	\$251,678	\$251,678
8			2,284	672	236	168	3,360	\$359,544	\$0	\$375,544	\$375,544
Year 3 (2021)											
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, inc. Labor (\$)	Total Cost (\$)
1	varies	varies	685	202	71	50	1,008	\$107,866	\$0	\$123,866	\$123,866
10	varies	varies	2,285	672	235	168	3,360	\$359,587	\$0	\$359,587	\$359,587
11			2,970	874	306	218	4,368	\$467,453	\$0	\$483,453	\$483,453
Annual Average (3-year ICR Period)											
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, inc. Labor (\$)	Total Cost (\$)
1	varies	varies	685	202	71	50	1008	\$107,866	\$0	\$123,866	\$123,866
7	varies	varies	1,599	470	165	118	2,352	\$251,702	\$0	\$251,702	\$251,702
8			2,284	672	236	168	3,360	\$359,568	\$0	\$375,568	\$375,568
			Unloaded Labor		Loaded Labor						
Technical =	Middle Mgr =		\$64.24 /hour	\$102.78 /hour							
Managerial =	Senior Mgr =		\$86.04 /hour	\$137.66 /hour							
Clerical =	Technician =		\$36.91 /hour	\$59.06 /hour							
	Legal =		\$68.22 /hour	\$109.15 /hour							