Flaws in EPA's Monitoring and Verification of Carbon Capture Projects

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Carbon capture and sequestration (CCS) is a major focus of President Biden's environmental agenda. The federal government has allocated billions of dollars to subsidize this expensive and controversial technology in an attempt to make it a viable option to combat climate change. In theory, the process captures carbon dioxide (CO_2) from industry and injects it into underground rock formations, permanently removing the gas from the atmosphere. But there are very good reasons to remain skeptical about whether sequestered carbon will remain out of the atmosphere in the long term. One reason is that the laws and regulations governing the technology are still being developed, and the existing framework is too weak to ensure that large-scale sequestration projects – which will be heavily subsidized by taxpayers – will deliver on the carbon reductions they promise.

The Environmental Integrity Project (EIP) examined one central component of carbon capture and sequestration regulation in the U.S.: monitoring, reporting, and verification (MRV) plans required by the EPA's Greenhouse Gas Reporting Program. These plans describe the monitoring strategies in place at each site to validate that the carbon dioxide is securely stored underground and is not leaking or migrating in an unexpected manner. If approved by EPA, the plans can also be used to qualify for tax subsidies. However, the 21 plans that EPA approved as of October 31, 2023, are ambiguous and lack key elements to ensure safe and long-term carbon sequestration. Specifically, these plans:

- **Are not required to include specific monitoring strategies or technologies**, allowing companies to write their own rules.
- **Often contain ambiguous language** that does not commit to explicit monitoring timelines or activities. Several plans lack specific timelines for monitoring and testing, state they will only continue with the monitoring actions described in the plan "if beneficial,"[1] or even promise to "determine the most appropriate method" to quantify leaks in the event a leak occurs,[2] instead of describing quantification strategies within the plan itself.
- **Are difficult to enforce**, with no third-party verification of the data.

This report discusses these weaknesses and the tax incentives at stake. With billions available in grants and tax subsidies, companies have moved quickly to announce additional carbon capture and sequestration projects, especially in the oil and

The Petra Nova carbon capture and storage project, southwest of Houston, is one of the largest in the world. It collects carbon dioxide from the burning of coal at the W. A. Parish power plant and pipes the carbon underground for injection into aging oil fields, to increase oil output. The system restarted in September after being shut down for more than three years.

gas industry. Sixteen of the 21 approved monitoring plans were submitted by oil and gas companies, which stand to benefit the most from the push for carbon sequestration. The expanded tax credit is estimated to result in over $30 billion going from taxpayers to industry by 2032.[3] Before this flood of CCS projects becomes operational, EPA needs to enact strong industry regulations that can protect the environment while combating climate change. EPA must ensure the monitoring plans contain comprehensive and clearly defined monitoring strategies that can adequately detect leaks, prevent environmental harm, and confirm that carbon is successfully stored long-term.

Tax Credits Spurring Additional CCS Project Announcements

Congress created a tax credit for carbon sequestration in 2008. Lawmakers then expanded it in 2018 and again in September 2022 with the Inflation Reduction Act. The expanded tax credit now allows companies that meet certain wage, hiring, and operation date requirements to claim up to $85 per metric ton of geologically sequestered CO_2 and up to $60 per metric ton of CO_2 used with a qualifying method, such as enhanced oil recovery. This increases to $180 per metric ton of CO_2 captured from the atmosphere (direct air capture).[4] According to EPA data, the oil and gas and ethanol industries sequestered nearly 8 million metric tons of CO_2 in 2022,[5] an amount worth an estimated $213 million in tax credits that year.[6] Sequestering the same amount in 2023 could be worth up to $504 million, thanks to a sharp increase in the value of tax credits (Table 1).[7]

Table 1. Estimated Maximum Tax Credits Available to Companies That Sequestered Carbon in 2022

Company	Number of Projects	Project Type	Well Type	Metric Tons of CO_2 Sequestered in 2022	Potential Value of Tax Credits in 2022	Potential Value of Tax Credits in 2023
Occidental Petroleum/Oxy	3	Enhanced Oil Recovery	II	5,894,969	$148,258,470	$353,698,140
Perdure Petroleum/ CapturePoint	2	Enhanced Oil Recovery	II	744,631	$18,727,470	$44,677,860
Archer Daniels Midland Co.	1	Ethanol Plant Long-Term Carbon Storage	VI	428,580	$16,221,753	$36,429,300
ExxonMobil	1	Gas Processing Waste Disposal (Acid Gas)	II	395,332	$14,963,316	$33,603,220
Core Energy	1	Enhanced Oil Recovery	II	311,308	$7,829,396	$18,678,480
Red Trail Energy, LLC	1	Ethanol Plant Long-Term Carbon Storage	VI	81,964	$3,102,337	$6,966,940
Stakeholder Gas Services, LLC	2	Gas Processing Waste Disposal (Acid Gas)	II	89,013	$3,369,142	$7,566,105
Lucid Energy Delaware, LLC	1	Gas Processing Waste Disposal (Acid Gas)	II	23,775	$899,884	$2,020,875
Petra Nova, LLC[8]	1	Enhanced Oil Recovery	II	-16,815	$0	$0
Total	**13**			**7,952,757**	**$213,371,769**	**$503,640,920**

Source: EPA's Facility-Level Information on Greenhouse Gases Tool and the Internal Revenue Service.
Note: Type II wells can be used for enhanced oil recovery and the disposal of gas processing waste. Type VI wells are for long-term carbon sequestration, including by ethanol plants. In 2022, long-term carbon sequestration projects were eligible for up to $37.85 in tax credits per metric ton of CO_2 sequestered, depending on the date the equipment was placed in service. Enhanced oil recovery projects were eligible for up to $25.15 per metric ton. Carbon sequestered from the processing of natural gas (acid gas waste disposal) was assumed to be eligible for the higher credit rate. Please see endnote for more detailed information.[9]

The increased potential pay-out for CCS has spurred a wave of announcements about new carbon capture projects and storage hubs. As of October 31, 2023, EPA had permitted only two wells designed for long-term carbon sequestration (called Class VI wells under EPA's Underground Injection Control Program) and issued draft permits for two more wells.[10] But EPA is also reviewing 58 additional applications for these projects (which include a total of 169 wells.) More than two thirds of these proposed projects were submitted after September 2022, when the IRA became law.[11] These highly complex applications need a thorough review from experts, and in many cases, companies have taken months to submit complete applications or were asked to provide additional information during the technical review. Some of these projects could rack up a lot in tax credits. For example, the proposed Blue Flint ethanol plant in central North Dakota plans to capture and sequester up to 200,000 metric tons of CO_2 annually, making it eligible for up to $17 million in tax credits each year.

Companies can also claim the tax credit for carbon dioxide injected into the ground through wells designed for oil and gas-related underground injection operations (called Class II wells). While Class II wells can be used for a number of purposes, those that can earn tax credits are used for enhanced oil or gas recovery or the disposal of waste from the processing of natural gas (acid gas, which is a mixture of carbon dioxide and hydrogen sulfide). Enhanced recovery facilities employ carbon dioxide injection to dislodge and extract hard-to-reach petroleum from the ground. This process produces both oil and carbon dioxide, but some of the injected carbon dioxide remains underground and is considered sequestered. Acid gas injection facilities inject carbon dioxide along with hydrogen sulfide, a waste product of natural gas processing, as a method of disposal. Many of these facilities have been operating for a long time, especially enhanced oil recovery sites, some of which have been injecting carbon dioxide for decades. Encouraging more of these projects by increasing the tax credits available to them seems unnecessary.

There are many concerns about enhanced oil recovery and acid gas disposal facilities being able to claim the tax credit, especially because it directly subsidizes further oil and gas extraction. Enhanced oil recovery wells are also subject to permits with much less stringent requirements. Unlike carbon waste disposal wells, which have injection permits that specifically regulate carbon sequestration, enhanced oil recovery and acid gas sites are governed by broader permits that regulate "injection related to oil and gas." The number of enhanced oil recovery and acid gas injection projects is expected to increase in the short term. In addition to the projects with approved monitoring plans, there are at least 80 more projects with these permits already injecting carbon dioxide into the ground.[12] If they qualify, they could choose to submit a monitoring plan to EPA and apply for the tax credits.

As mentioned earlier, 13 facilities reported sequestering 8 million metric tons of carbon dioxide to EPA in 2022, roughly equivalent to the greenhouse gas emissions from two coal-fired power plants.[13] This was a fraction of one percent of the 2.7 billion metric tons of greenhouse gases companies reported emitting in the United States in the same year.[14] Of the 13, 11 were of the variety used by the oil and gas industry to produce more fossil fuels or dispose of acid gas (Table 2). About 87 percent of the carbon dioxide was sequestered through enhanced oil recovery. While the tax credits are nominally larger for carbon storage wells, the enhanced oil recovery projects that qualify for the increased tax credits would benefit the most.

Table 2. Geologic Sequestration of Carbon Dioxide Reported to EPA in 2022

Project Type	Number of Projects	Metric Tons of CO_2 Sequestered in 2022
Enhanced Oil Recovery	7	6,934,093
Disposal of Gas Processing Waste (Acid Gas)	4	508,120
Ethanol Plant Long-Term Carbon Sequestration	2	510,544

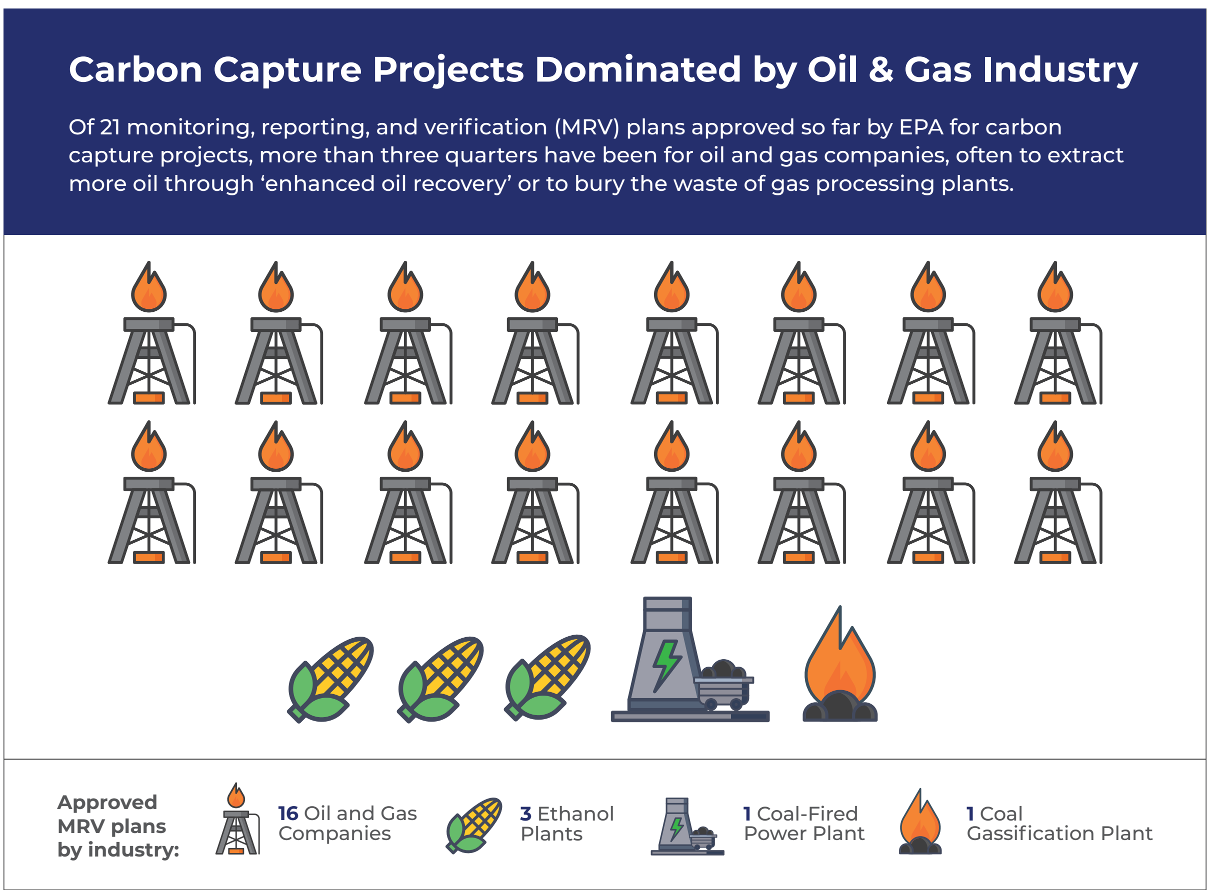
Source: EPA's Facility-Level Information on Greenhouse Gases Tool.

To qualify for the tax credits, companies must have and implement an EPA-approved monitoring, reporting, and verification plan (MRV) or meet an international standard.[15] The plans aim to ensure that companies are accurately accounting for the carbon they inject underground. However, between 2010 and 2019, companies without approved monitoring plans tried to claim nearly $900-million worth of tax credits.[16] Monitoring is critical to accurately account for the amount of carbon sequestered and to prevent its subsequent release into the atmosphere or underground sources of drinking water through either slow and steady leaks or catastrophic releases.

Review of Monitoring, Reporting, and Verification Plans

EPA's Greenhouse Gas Reporting Program requires all carbon storage (Class VI well) permit holders to report data on carbon sequestration each year. To do so, each operator must first submit and have approved a monitoring, reporting, and verification (MRV) plan that demonstrates that the facility is able to accurately report the amount of carbon dioxide sequestered. Enhanced oil recovery or acid gas well (Class II well) permit holders may choose to submit a plan and report data, in addition to their existing reporting requirements, in order to qualify for the tax credit.

In this report, EIP reviewed all 21 monitoring, reporting, and verification plans approved by EPA as of October 31, 2023, which are publicly available on EPA's website.[17] For a spreadsheet with details on all 21 plans, click here. Of these, only five sites are primarily injecting carbon dioxide for long-term geologic sequestration. Ten of the sites are using carbon dioxide for enhanced oil recovery, and six are injecting acid gas to dispose of waste from gas processing plants (see Appendix). Thirteen of these 21 sites have already implemented their monitoring plans and begun reporting to EPA. Four additional facilities are already operating oil recovery fields that will likely begin reporting carbon sequestration data next year, while the rest have not yet started operating.



Regulations Allow Companies to Write Their Own Rules

Monitoring, reporting, and verification (MRV) plans are prepared by Class VI carbon storage permit holders or companies reporting sequestered carbon to the Greenhouse Gas Reporting Program. The plans are submitted to EPA for approval and must contain certain components at a minimum. However, as written in the regulations, these minimum components read as open-ended questions with no right or wrong answers. EPA does not set any minimum monitoring requirements, nor are any specific technologies or methods required. The regulations allow companies to define their own strategies for detecting and quantifying surface leakage of CO_2 and establishing their own baselines for monitoring leakage. Monitoring plans only need to contain a few elements in addition to those strategies, including outlining the monitoring area, identifying, and evaluating potential pathways for CO_2 to leak to the surface, and a list of well identification numbers.[18]

EPA approves each plan through a technical review process. However, these regulations leave considerable room for interpretation, and the approved MRV plans vary quite a bit in how they design and implement monitoring at the site. Companies can also amend the plans at any time, for any reason, and are required to update their plans under certain circumstances.[19]

Inconsistent Monitoring and Testing

Since EPA does not require operators to use any specific monitoring methods or technologies, the monitoring plans vary significantly in how they address potential leaks at a site. These variations may be expected due to differing geological features and monitoring needs, but there needs to be some assurance that the plans will accurately and adequately detect leaks.

Many plans are vague about which monitoring actions will be performed and when. At the Wasson San Andres field in West Texas, for example, mechanical integrity tests will be used to ensure that there are no leaks from the injection well structure, but the monitoring plan does not state how often these tests will be performed.[20] Other sites plan to perform mechanical integrity tests annually, or once every 5 years, which makes a considerable difference in how quickly leaks would be found. Groundwater sampling is another common method used to identify carbon dioxide that may have migrated out of the injection zone. Many companies perform quarterly or annual groundwater sampling, even if the plan states that CO_2 migration into groundwater is unlikely, such as the acid gas injection site at 30-30 Gas Plant in West Texas.[21] However, Camrick Unit, an enhanced oil recovery field on the border between Oklahoma and Texas, claims that there is minimal risk of groundwater contamination at the site, and therefore, there is no need for further groundwater sampling.[22]

Many of the MRV plans claim that there is little to no danger of seismic activity at the storage sites because there are no faults or fractures in the underground formations or earthquakes aren't known to occur in the area. However, oil and gas operations have been known to induce earthquakes, especially from wastewater disposal through produced water disposal wells (also regulated as Class II injection wells).[23] While there are risk factors known to increase the likelihood of induced quakes, there is no way to definitively predict whether injection activities will induce earthquakes.[24] If there is no evidence of induced quakes in the past, that does not mean that continued activity at the site could not lead to one in the future. Monitoring plans need to adequately address seismic activity. But, for example, Blue Flint Sequestration, a carbon sequestration (Class VI) permitted site in central North Dakota, plans to perform seismic surveys of the monitoring area to detect potential leaks caused by seismic activity during the first and fourth years of operation at the site, but will "reevaluate" the timing of the seismic surveys after that.[25]

Monitoring Areas with Thousands of Wells

This need for comprehensive, accurate monitoring is compounded by the large number of old wells present at some of these sites, especially oil fields which have been actively extracting petroleum for decades. These wells present a huge challenge, as they are essentially holes through which CO_2 can leak. While operators promise to comply with applicable regulations for well construction, operation, and abandonment to reduce the risk of surface leakage, this is not always guaranteed, especially for sites which have very old wells that may have been drilled before the regulations took effect. There are 120,000 documented "orphan" wells in the United States which have not been properly plugged, including over 7,000 in Texas alone, where many existing and proposed carbon capture and storage projects are located.[26] There are even more orphan wells that have not yet been identified; EPA estimates that there are over 3 million abandoned wells in the United States.[27]

The sheer number of documented wells poses a significant challenge for monitoring. The Wasson San Andres Field in West Texas, where oil production has been ongoing for at least 50 years, has nearly 4,700 known wells within the monitoring area, about 1,300 of which are inactive, shut-in, or temporarily or permanently abandoned. The regulations require the company to evaluate these wells as potential leakage pathways in the MRV plan, but Oxy claims the risk of leakage is low, and that they are all in "material compliance" with Texas Railroad Commission rules.[28] Even if all these wells are in compliance at the time of the evaluation, they still need to be monitored for any leaks that may develop.

Oxy uses visual inspections and hydrogen sulfide monitors worn by personnel on site to detect surface leakage. The monitors are used as a proxy for detecting CO_2 leakage, as the injection stream contains an "insignificant" amount of hydrogen sulfide.[29] In some cases, visual inspections could detect the white vapor or ice that often forms when cold carbon dioxide in its supercritical form escapes through pipes and wells. But these methods need to be sensitive enough to detect even small leaks across a huge monitoring area. While the site also continuously monitors injection and wellbore pressures for any abnormalities, these methods must be able to detect small, continuous leaks that may not significantly impact pressure.

Leak Repair

In addition, monitoring plans outline strategies to detect and quantify leaks, but not leak prevention or repair. Some plans do set general time limits for how quickly problems must be fixed. For example, in Texas, the West Seminole San Andres Unit promises to address issues "within days."[30] However, the nearby Seminole San Andres Unit simply promises that leaks will be fixed "in a timely manner."[31] If carbon dioxide is allowed to leak from the storage site for an extended period of time, it defeats the purpose of sequestering the carbon in the first place. This limits the benefits of CCS as a decarbonization strategy, while still taking on all the risks of underground carbon injection.

Monitoring Timelines

Carbon is supposed to be stored long-term, and ideally, permanently. However, the regulations for monitoring plans leave it up to companies to decide how long they want to monitor as long as it's greater than one year.[32] Class VI carbon storage permits require that sequestered carbon stay underground. By default, companies with these permits must monitor the mass of CO_2 sequestered for 50 years, unless they can prove that a shorter timeframe would be sufficient.[33] Monitoring plans from the five Class VI enhanced oil recovery sites EIP reviewed all commit to monitoring the site for 10 years after injection.

Class II enhanced oil recovery or acid gas disposal permits do not have the same requirements. MRV plans from these facilities only promise to continue monitoring until they can establish that the sequestered carbon is not "expected to migrate in the future in a manner likely to result in surface leakage." Many sites claim that this will be possible within two to three years, or even less. West Seminole San Andres Unit expects to be able to demonstrate this "almost immediately" after injection is concluded.[34]

Plans to Make Plans

The plans don't always set specific guidelines for how leaks will be quantified, but instead say that the "most appropriate" method will be chosen depending on the type and variety of leak, with little elaboration. While operators do need flexibility to be able to address problems as they come up, this cannot come at the expense of good methodology. The monitoring plan for Seminole San Andres Unit in Texas states, "In the event CO_2 Surface Leakage is confirmed, the most appropriate methods for quantifying the mass of CO_2 Surface Leakage will be determined, and the information will be reported as part of the required annual Subpart RR submission."[35] In this case, this "plan" is simply a commitment to develop an actual plan once a leak has occurred. There needs to be some guarantee that the chosen method will be as accurate as possible and will not underestimate emissions. In contrast, the monitoring plan for Barnett RDC #1, a Class II waste disposal well in north Texas, also states that they may use several methods for quantification depending on the nature of the leak but additionally includes examples of potential methods and what kinds of leaks they would be used for.[36]

MRV Plan Enforcement and Verification

For the monitoring plans to have meaning, EPA must have a clear enforcement strategy in place. EPA can pursue enforcement actions against operators who misreport their emissions to its Greenhouse Gas Reporting Program, but it is not clear what actions will be taken to ensure the monitoring plan is being followed and is working to detect and fix leaks. In addition to sequestration data, each operator also must submit annual monitoring reports, which describe all the monitoring actions taken at the site during the reporting year and note any leakage events or monitoring anomalies. These annual monitoring reports are short summaries, usually only a few pages long. EPA should take strict action if a company's monitoring report does not follow through with the monitoring actions outlined in an MRV plan.

Enforcement also becomes even more uncertain when the plans themselves are ambiguous about their monitoring activities. If the monitoring plan itself doesn't define how often a monitoring action will be performed, how can EPA ensure that the monitoring is taking place as planned? For example, at Great Plains Synfuels Plant in North Dakota, one of the methods used to detect leakage from seismicity is a survey method called a vertical seismic profile. Great Plains only commits to performing this survey once, in the first year of injection, and will continue with the profiles "if beneficial."[37] When the plan itself does not commit to continuing with the monitoring actions, how can monitoring be properly enforced?

The data is also all self-reported by operators. While the Greenhouse Gas Reporting Program does not generally require any third-party verification, carbon sequestration is a relatively new field where several projects are being rushed into development, and at great cost to taxpayers. Operators are allowed to devise their own monitoring plans because the sites have unique geologies and requirements. However, EPA and taxpayers need some assurance that the monitoring plan is effective and that any leaks are being detected.

According to EPA data, the oil and gas and ethanol industries sequestered nearly 8 million metric tons of CO_2 in 2022, an amount worth an estimated $213 million in tax credits that year. Pictured above is the Poet ethanol refinery in Chancellor, South Dakota.

EPA Must Strengthen MRV Requirements

If the Federal government wants to wager our tax dollars and climate futures on a costly and energy-intensive technology, at a minimum it must be conducted in a manner protective of human health and the environment. Proper parameters need to be put in place to ensure the carbon is being sequestered safely in the long term. To do that, the monitoring plans need to be specific, enforceable, and comprehensive.

While companies need flexibility to develop appropriate, site-specific monitoring plans, there are ways to allow for flexibility while ensuring the plans are rigorous. EPA could, for example, identify specific types of monitoring that are required (such as atmospheric monitoring, seismicity, etc.), with a list of preferred monitoring methods and technologies for each, similar to the California Air Resources Board's Carbon Capture and Sequestration Protocol.[38] EPA should not accept industry assertions that the carbon dioxide will not leak or migrate. Subsurface studies are not infallible, as shown by an offshore carbon sequestration field in Norway, where, despite conducting pre-operational field assessments and geological studies, carbon dioxide began to migrate in an unexpected direction.[39] Even if companies conclude that CO_2 leakage would be unlikely (as most would, for any proposed carbon sequestration project), they should be required to plan to detect the unexpected and address any leaks immediately.

EPA should also have longer-term monitoring requirements that apply to all plans. Class VI carbon storage wells are already required to continue monitoring the site after injection. EPA's MRV plans should set equivalent requirements for Class II enhanced recovery and acid gas wells, especially if these operations continue to be allowed to claim credit for carbon stored underground. EPA cannot simply accept that the carbon dioxide will not migrate after only two or three years of monitoring. If carbon dioxide escapes from its underground reservoir into the atmosphere years after injection, companies must be able to account for that and report it to the EPA. The monitoring plans should also include some contingency for companies that go out of business or are unable to fulfill longer-term monitoring, reporting, and verification requirements.

Enhanced oil recovery and acid gas projects should not be eligible for tax credits. While these wells should still be required to have and implement an approved monitoring plan to ensure accurate reporting of greenhouse gas emissions, the carbon injection at these sites is secondary to the production of more fossil fuels, which, when used or processed, will emit more carbon dioxide into the atmosphere. This undermines the primary goal of carbon sequestration, which endeavors to reduce carbon dioxide emissions and mitigate climate change.

EPA should also require plan revisions every time monitoring or operational practices change. As is, companies are required to revise their plans if "a material change was made to monitoring and/or operational parameters that was not anticipated in the original MRV plan".[40] This leaves a grey area for companies that plan to reevaluate how often or when specific monitoring actions are performed. Instead, if the company decides that one of their monitoring strategies is not providing any useful information, the company should have to submit a revised plan for EPA approval that explains why this decision was made.

EPA also needs to establish a clear and consistent framework through which companies can be held responsible for monitoring and reporting carbon sequestration data. Companies will also be more likely to prioritize monitoring if the consequences of non-compliance are explicitly stated. Clear expectations help to ensure compliance and accountability.

As is, monitoring, reporting, and verification plans allow for too much leeway that could lead to inadequate monitoring and allow significant carbon leaks to remain undetected and go unaddressed. Accurate and comprehensive monitoring strategies are crucial to evaluating the efficacy and the environmental impacts of carbon sequestration. EPA must address the weaknesses in these monitoring plans before more carbon sequestration projects begin operating.

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Endnotes

[1] Dakota Gasification Company, LLC. "Great Plains CO_2 Sequestration Project Monitoring, Reporting and Verification (MRV) Plan" August 10, 2022. Link: https://www.epa.gov/system/files/documents/2023-01/gpspmrvplan.pdf p. 18

[2] Oxy USA Inc. "Oxy Seminole San Andres Unit Subpart RR Monitoring, Reporting and Verification (MRV) Plan." July 2023. Link: https://www.epa.gov/system/files/documents/2023-08/seminolesanandresunit_mrv.pdf p. 24

[3] There is uncertainty about how much of these costs will actually be realized. These budget estimates assume that tax credit claims will increase in the future, but that ultimately depends on how many of the proposed CCS projects become operational. Congressional Research Service. "The Section 45Q Tax Credit for Carbon Sequestration," Updated August 25, 2023. Link: https://sgp.fas.org/crs/misc/IF11455.pdf

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[6] This is an estimate of potential tax credit claims based on 2022 data. This calculation assumes that the company meets all the eligibility criteria and completes all the formalities to apply for the credit. See endnote 8. Internal Revenue Service Department of the Treasury. "Instructions for Form 8933." Rev. December 2022. Link: https://www.irs.gov/pub/irs-pdf/i8933.pdf

[7] This is an estimate of potential tax credit claims based on 2022 data. This calculation assumes that the company meets all the eligibility criteria and completes all the formalities to apply for the credit. See endnote 9. Internal Revenue Service Department of the Treasury. "Instructions for Form 8933." Rev. December 2022. Link: https://www.irs.gov/pub/irs-pdf/i8933.pdf

[8] Petra Nova, which emitted more carbon than it sequestered in 2022, is not expected to receive any 45Q tax credits in 2022. If the facility received tax credits for carbon sequestration in the past, the company may have to repay some of that amount. This is called credit "recapture." Congressional Research Service. "The Section 45Q Tax Credit for Carbon Sequestration," Updated August 25, 2023. Link: https://sgp.fas.org/crs/misc/IF11455.pdf

[9] These dollar amounts are calculated using 2022 sequestration data and the highest possible tax credit available in the applicable tax year according to the IRS. We assume that that the company meets all the eligibility criteria, including the new hiring, wage, and operation date requirements established by the Inflation Reduction Act, and applies for the tax credit. However, many of the already operating facilities may not meet all the requirements for the expanded tax credit. In 2022, facilities with carbon capture equipment placed in service on or after February 9, 2018 were eligible for $35.85 per metric ton of carbon sequestered and $25.15 per metric ton of carbon utilized in enhanced oil recovery or another qualifying method. If the equipment was placed in service before that date, the rate is reduced to $25.07 and $12.53 respectively. However, placed-in-service dates for the equipment at these facilities are not known, so not all these facilities may qualify for the higher rate. In addition, these calculations do not account for tax credits that may need to be repaid (see endnote 8). The estimated credit amount for 2023 assumes that each company will sequester the same amount of carbon each year. This is also not an exhaustive list of tax credits that could be claimed in 2023; the 2023 tax year has not yet closed, and additional companies may apply for and receive the tax credit in 2023. Internal Revenue Service Department of the Treasury. "Instructions for Form 8933." Rev. December 2022. Link: https://www.irs.gov/pub/irs-pdf/i8933.pdf

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[13] EPA. "Greenhouse Gas Equivalencies Calculator." Accessed November 29, 2022. Link: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

[14] EPA. "Facility Level Information on Greenhouse Gases Tool (FLIGHT)." Accessed October 31, 2023. Link: https://ghgdata.epa.gov/ghgp/main.do?site_preference=normal

[15] The other method to qualify for the tax credit is to comply with geological storage standards set by the International Organization for Standardization, which have been endorsed by the American National Standards Institute (CSA/ANSI ISO 27916:19). This international standard has similar requirements to Subpart RR, but, to receive the tax credit, the documentation must be also certified by a qualified engineer or geologist. Congressional Research Service. "Carbon Storage Requirements in the 45Q Tax Credit," Updated June 28, 2021. Link: https://crsreports.congress.gov/product/pdf/IF/IF11639

[16] J. Russell George, Inspector General for Tax Administration, Department of the Treasury, Memo to Senator Rober Menendez, on April 15, 2020. Link: https://www.menendez.senate.gov/imo/media/doc/TIGTA%20IRC%2045Q%20Response%20Letter%20FINAL%2004-15-2020.pdf

[17] EPA. "Subpart RR – Geologic Sequestration of Carbon Dioxide," Accessed November 2, 2023. Link: https://www.epa.gov/ghgreporting/subpart-rr-geologic-sequestration-carbon-dioxide#decisions

[18] The regulations also require a start date for data collection and a summary of the considerations used to calculate the reported data elements. 40 CFR 98.448(a)
[19] 40 CFR 98.448(d)(4)
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Appendix: Summary of Carbon Capture Projects with EPA-Approved Monitoring, Reporting and Verification (MRV) Plans

Project Name	Company	County/ State	Industry	Planned Injection or Storage Volumes (Metric Tons of CO_2 Per Year)*	Operating Status
Wasson San Andres Field (prev. Denver Unit)	OXY USA, INC	Yoakum, Gaines, TX	Oil & Gas	3,500,000 stored	Operating (as Denver Unit)
Seminole San Andres Unit	OXY USA, INC	Gaines, TX	Oil & Gas	5,300,000 stored	Operating (not yet reporting)
Kinder Morgan CCS Complex	Kinder Morgan Permian CCS, LLC	Stonewall, TX	Oil & Gas	Up to 1,200,000 injected	Injection expected to begin June 2024
Barnett RDC Well No. 1	BKV dCarbon Ventures, LLC	Wise, TX	Oil & Gas	Up to 280,000 injected	Injection expected to begin Dec. 2023
Blue Flint CO_2 Storage Project	Blue Flint Sequester Company, LLC	McLean, ND	Biofuels	200,000 injected	Injection expected to begin 2024
Great Plains CO_2 Sequestration Project	Dakota Gasification Company, LLC	Mercer, ND	Coal Gasification	Up to 2,700,000 injected	Not yet operating
Camrick Unit	CapturePoint, LLC	Beaver and Texas (OK), Ochiltree (TX)	Oil & Gas	230,000 stored	Operating (not yet reporting)
30-30 Gas Plant	Stakeholder Gas Services, LLC	Yoakum, TX	Oil & Gas	Up to 2,170,000 injected	Operating
Seminole East Field (SEF)	CapturePoint, LLC	Gaines, TX	Oil & Gas	225,000 stored	Operating (not yet reporting)
Campo Viejo Gas Processing Plant	Stakeholder Gas Services, LLC	Yoakum, TX	Oil & Gas	340,000 injected	Operating
Red Trail Energy, LLC	Red Trail Energy, LLC	Stark, ND	Biofuels	180,000 injected	Operating
Tundra SGS LLC	Minnkota Power Cooperative, LLC	Oliver, ND	Coal Power Plant	4,000,000 injected + 1,200,000 through potential third well	Injection expected to begin 2024-2025
Red Hills Gas Processing Plant	Lucid Energy Delaware, LLC	Lea, NM	Oil & Gas	Up to 500,000 injected	Operating
Petra Nova West Ranch	Petra Nova, LLC	Jackson, TX	Oil & Gas	1,500,000 stored	Operating
Farnsworth Unit CO_2 Flood	Perdure Petroleum, LLC	Ochiltree, TX	Oil & Gas	860,000 injected	Operating
West Seminole San Andres Unit	OXY USA WTP LP	Gaines, TX	Oil & Gas	780,000 injected	Operating
North Burbank Unit	Perdure Petroleum, LLC	Osage, OK	Oil & Gas	800,000 stored	Operating
Shute Creek Facility	ExxonMobil	Lincoln, WY	Oil & Gas	1,925,000 stored	Operating
Core Energy Otsego County EOR Operations	Core Energy	Otsego, MI	Oil & Gas	100,000 injected	Operating
Illinois Industrial Carbon Capture and Sequestration Project	Archer Daniels Midland Co.	Macon, IL	Biofuels	1,100,000 injected	Operating
Hobbs Field	Occidental Permian Ltd, Occidental Petroleum Corporation, and affiliates	Lea, NM	Oil & Gas	1,200,000 stored	Operating

Source. EPA Subpart RR Final Decisions as of October 1, 2023.
*These values are estimates based on project forecasts, historical operating levels, and permit capacities as discussed in the relevant MRV plans. For permit capacities expressed in standard cubic feet, the proportion of CO_2 in the injection stream was assumed to be constant. For project forecasts or previous operational data that estimated an amount sequestered over a period of several years, the average annual injection or storage rate was calculated.