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Reporting Carbon Dioxide Injection and Storage: Federal Authorities and Programs

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Angela C. Jones

Analyst in Environmental
Policy

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Carbon capture and storage (CCS) of carbon dioxide (CO₂) emissions is a suite of processes and technologies viewed by some stakeholders as essential for mitigating anthropogenic CO₂ emissions into the atmosphere. Others have raised concerns about CCS technical efficacy and cost-effectiveness. As the application and deployment of these systems evolve, reliable monitoring, measurement, and reporting of carbon dioxide injection and storage could contribute to the assessment of CCS's role in mitigating GHG emissions.

Under Clean Air Act (CAA) authorities, the U.S. Environmental Protection Agency (EPA) has promulgated regulations for mandatory reporting of greenhouse gases (GHGs) and administers the Greenhouse Gas Reporting Program (GHGRP). GHGRP regulations require reporting of GHG emissions from large sources of GHGs and certain other facilities, but do not limit GHG emissions. EPA has established 46 GHG source categories subject to the regulations, with nearly 8,000 facilities in the United States currently reporting GHG data. Facilities report on six GHGs, including CO₂, and are required to follow source-specific requirements for measurement, reporting, and verification. In 2010, EPA issued GHGRP regulations for facilities injecting CO₂ for geologic sequestration or enhanced oil recovery (EOR). Geologic sequestration is the process of storing a fluid, including condensed CO₂, by injecting it deep into an underground geologic formation, where it can be permanently trapped or transformed. In some EOR operations, CO₂ is injected into aging oil reservoirs to produce additional oil; most of the injected CO₂ is pumped out during oil production, but a portion can be stored incidentally in the underground reservoir. Under the GHGRP regulations (40 C.F.R. Part 98, Subpart RR), facilities injecting CO₂ for geologic sequestration must report the amount of CO₂ injected and sequestered and other CO₂ data to EPA annually and have an approved monitoring, reporting, and verification plan, among other requirements. Subpart UU of 40 C.F.R. Part 98 requires that facilities injecting CO₂ for EOR, or for any purpose other than sequestration, report the amount of CO₂ received on an annual basis. In general, Subpart RR requirements are more rigorous and comprehensive compared to Subpart UU requirements. For reporting years 2012-2019, five facilities have reported to EPA under Subpart RR, and 125 facilities have reported under Subpart UU.

EPA also requires certain tracking and reporting of CO₂ through its underground injection control (UIC) authorities provided in the Safe Drinking Water Act (SDWA). Under SDWA, EPA has promulgated UIC regulations and established minimum federal requirements for injection wells, including wells used to inject CO₂ for EOR (classified as Class II wells) and wells used to inject CO₂ for geologic sequestration (Class VI wells). UIC regulations are intended to protect underground sources of drinking water from potential contamination associated with underground injection activity. UIC regulations require owners or operators of Class VI wells to report the quantity of CO₂ injected for sequestration to the UIC program authority, either EPA or a state. EPA has not established comparable UIC CO₂ reporting requirements for Class II wells. Most Class II wells are located in states with UIC Class II program oversight and enforcement authority (also known as *primacy*).

The U.S. Department of the Treasury (Treasury), through the Internal Revenue Code Section 45Q, requires taxpayers claiming the federal tax credit for carbon sequestration to calculate and report CO₂ data. In the 2008 Consolidated Appropriations Act, Congress authorized the tax credit and directed Treasury to develop regulations for “secure geological storage” of CO₂. For CO₂ injected for geologic sequestration, taxpayers must report the amount of CO₂ disposed in underground formations, measured at the source of capture. For CO₂ injected for EOR, taxpayers must report the initial amount of CO₂ injected, measured at the source of capture. In 2021, the Internal Revenue Service promulgated regulations establishing that to be eligible for the Section 45Q tax credit, geologic sequestration facilities must comply with all Subpart RR requirements, including requirements for measuring and verifying the amount of CO₂ sequestered. EOR facilities may fulfill the requirement through compliance with either Subpart RR requirements or designated internationally adopted EOR standards.

Issues for consideration by Congress related to reporting of CO₂ injection and storage include oversight of EPA's implementation of, and the effectiveness of, GHG reporting regulations under the CAA and Treasury's verification of Section 45Q tax credit claims. Other issues that may be of oversight or legislative interest may include whether GHGRP regulations affect the development of commercial-scale CCS projects in the United States; how generally less-stringent federal requirements for EOR facility reporting may influence future CCS project deployment; and the implications of potential increases in the number of GHGRP reporting facilities and Section 45Q tax credit claims on federal agency capacity and resources.

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Introduction

Carbon capture and storage (CCS) is a process designed to capture, store, and utilize carbon dioxide (CO₂) emissions from power plants and other industrial sources.¹ Proponents of CCS expect the process to reduce anthropogenic CO₂ emissions into the atmosphere. Others have expressed concerns about the technical efficacy and cost-effectiveness of CCS projects in trapping and permanently storing CO₂. As Congress continues to debate options to mitigate the impacts of climate change, some Members have shown increasing interest in federal policies and technical standards to track and report the CO₂ injected underground and stored as part of CCS operations.

A CCS system involves complex equipment, infrastructure, and processes to capture and compress CO₂ gas, transport the CO₂ if necessary (usually via pipeline), and in most cases, inject it through wells into an underground geologic formation. Most captured CO₂ is currently used to produce oil from aging oil fields in a process known as *enhanced oil recovery* (EOR). An integrated CCS project can include EOR that uses CO₂ captured from power plants or industrial sources.

EOR, whether or not conducted as part of an integrated CCS system, is accomplished through several different methods, including injecting gas into existing oil wells to extract additional oil from the underground reservoir. CO₂ is the most commonly used gas as an injectant in these projects.² Most EOR projects injecting CO₂ use gas mined from natural underground sources of CO₂ rather than captured from anthropogenic emissions. After the CO₂ is initially injected, a portion of it remains trapped underground, while much of the remainder is recovered and reinjected to recover additional oil. The amount of CO₂ that is stored or recovered as a result of EOR depends on the specific injection operations, geologic characteristics of the site, and other factors. CO₂ injection for EOR is subject to some federal CO₂ reporting requirements, but is not subject to verification or monitoring requirements for the purposes of determining the amount of CO₂ stored underground. According to the Global CCS Institute, in 2020, 11 facilities were injecting captured anthropogenic CO₂ for EOR in the United States as part of CCS operations.³

Captured CO₂ is also injected into underground formations for geologic sequestration—the process of storing or disposing of a fluid, including condensed CO₂, by injecting it deep into an underground geologic formation, where it can be permanently trapped or transformed.⁴ As of early 2021, one project injecting CO₂ for the sole purpose of geologic sequestration was operating in the United States. The facility has injected more than 1 million metric tons of CO₂ into an

¹ CCS is also used to refer to carbon capture and sequestration and is sometimes referred to as CCUS—carbon capture, utilization, and storage (or sequestration).

² Leena Koottungal, “2014 Worldwide EOR Survey,” *Oil & Gas Journal*, April 4, 2014, p. 79. EOR is also conducted using injection of steam (thermal recovery) and chemical injection. In the United States, 60% of EOR production is accomplished using gas recovery (Department of Energy, “Enhanced Oil Recovery,” accessed on January 6, 2021, <https://www.energy.gov/fe/science-innovation/oil-gas-research/enhanced-oil-recovery>).

³ Global CCS Institute, *Global Status Report 2020*, December 1, 2020. Projects include facilities operating for commercial purposes and do not include pilot or demonstration projects. The Global CCS Institute defines a *commercial facility* as a facility capturing CO₂ for permanent storage as part of an ongoing commercial operation that generally has an economic life similar to the host facility whose CO₂ they capture, and that supports a commercial return while operating and/or meets a regulatory requirement. Two additional CCS with EOR projects have operated in the United States, but suspended CCS operations in 2020.

⁴ See CRS Report R44902, *Carbon Capture and Sequestration (CCS) in the United States*, for further information.

underground saline formation since 2017.⁵ For context, the United States emits more than 6,000 million metric tons of CO₂ annually.⁶

For CCS to result in permanent storage or sequestration of CO₂, the target underground reservoirs would need to permanently store the vast majority of injected CO₂, keeping the gas isolated from the atmosphere forever. That assumption is untested at this time, although research on the behavior and fate of large quantities of injected CO₂ is being conducted by the Department of Energy in partnership with industry and other entities.⁷

Two federal statutes, the Clean Air Act (CAA) and the Safe Drinking Water Act (SDWA), serve as the foundation for regulations for reporting quantities of CO₂ injected and stored at CCS facilities. The U.S. Environmental Protection Agency (EPA), together with state and local agency partners, implements these regulations and associated requirements through the Greenhouse Gas Reporting Program (GHGRP) and the Underground Injection Control (UIC) Program. The Department of the Treasury (Treasury), through the federal tax code, also requires certain reporting of CO₂ quantities from facilities seeking a tax credit for CO₂ sequestration.

Some policymakers and stakeholders have raised questions regarding the accuracy and scope of regulatory requirements for tracking and reporting CO₂ during the CCS process. They view CO₂ measurement and reporting as key elements in assessing and informing current approaches to reducing greenhouse gas (GHG) emissions and developing future climate change mitigation policy.

This report reviews relevant federal statutory provisions and regulations for measuring and reporting CO₂ data associated with underground injection and storage and analyzes the connections among the authorities. The report also provides information on CO₂ reported from GHGRP-covered facilities since 2011 and trends in reporting over time. Finally, the report identifies potential policy issues related to collecting and reporting CO₂ data for congressional consideration. This report does not review other reporting policies that may apply to CCS facilities, such as state air quality or state UIC regulations.

CAA and SDWA CO₂ Reporting Authorities and Programs

Facilities are required to report the volume of CO₂ they inject underground pursuant to CAA and SDWA authorities. This section reviews these authorities, related agency programs, and general reporting regulations. This section also analyzes the connections and potential overlap among CAA and SDWA CO₂ reporting requirements.

⁵ Global CCS Institute, *Global Status Report 2020*, December 1, 2020. In the United States, four other CCS demonstration projects have injected CO₂ into saline formations for geologic sequestration (CRS discussions with DOE, September 26, 2019, and September 21, 2020).

⁶ See CRS Report R45453, *U.S. Carbon Dioxide Emissions in the Electricity Sector: Factors, Trends, and Projections*, by Jonathan L. Ramseur.

⁷ See, for example, DOE's CarbonSafe program at <https://www.netl.doe.gov/coal/carbon-storage/storage-infrastructure/carbonsafe>.

Clean Air Act Authorities and EPA's Greenhouse Gas Reporting Program

In the Consolidated Appropriations Act, 2008 (P.L. 110-161), Congress provided funding for EPA to develop and publish a rule “to require mandatory reporting of greenhouse gas emissions above appropriate thresholds in all sectors of the economy of the United States.”⁸ The accompanying explanatory statement directed EPA to use its existing authority under the CAA to develop the rule.⁹ In 2009, EPA published the final rule, “Mandatory Reporting of Greenhouse Gases” (referred to as the “Mandatory Reporting Rule” hereinafter in this report), which went into effect on December 29, 2009.¹⁰

The Mandatory Reporting Rule does not regulate GHG emission levels, but requires designated GHG source facilities and specific product suppliers to report annual GHG emissions and establishes monitoring, verification, and recordkeeping requirements for some sources. According to EPA, the mandatory emissions reporting regulations allow the agency to collect information necessary to carry out its responsibilities for addressing air pollution through regulating facilities and encouraging voluntary emissions reductions.¹¹ In the rule, EPA established 41 GHGRP source categories, codified in 40 C.F.R. Part 98, Subparts B-PP, along with specific requirements for 30 of the source categories.¹² EPA's GHGRP is responsible for collecting and managing the GHG data reported under the Mandatory Reporting Rule.

In 2010, EPA issued a rule amending the Mandatory Reporting regulations and established two new GHGRP source categories for facilities that inject CO₂ for sequestration or other purposes. The rule, which went into effect on December 31, 2010, added two new subparts to 40 C.F.R. Part 98 that set out monitoring and reporting requirements for the new source categories.¹³ Subpart RR applies to facilities with wells that inject CO₂ solely for geologic sequestration, while Subpart UU applies to facilities with wells used to inject CO₂ for EOR and other non-sequestration purposes.¹⁴ The agency explained in the preamble to the 2009 rule that subsequent GHGRP regulations for CO₂ injection were needed to collect information from facilities about the CO₂ supplied, emitted, and sequestered in the United States as part of assessing all CO₂ potentially emitted into the atmosphere and for carrying out its CAA responsibilities.¹⁵ In the preamble to the final 2010

⁸ Consolidated Appropriations Act, 2008 (P.L. 110-161), Division F, Title II, enacted December 26, 2007. The act directed EPA to issue a final rule no later than 18 months after the date of enactment.

⁹ Consolidated Appropriations Act, 2008 (P.L. 110-161), Division F, Title II Explanatory Statement.

¹⁰ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases; Final Rule,” 74 *Federal Register* 56259-56519, October 30, 2009, p. 56264.

¹¹ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases; Final Rule,” 74 *Federal Register* 56259-56519, October 30, 2009, p. 56350; and U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases; Proposed Rule,” 75 *Federal Register* 18578-18606, April 12, 2010, p. 18570.

¹² U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases; Final Rule,” 74 *Federal Register* 56259-56519, October 30, 2009. For a few source categories, such as motor vehicle manufacturers and engine manufacturers, the rulemaking added new requirements to existing reporting and monitoring regulations.

¹³ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” 75 *Federal Register* 75060-75089, December 1, 2010.

¹⁴ 40 C.F.R. Part 98, Subparts RR and UU. EPA also created three additional source categories subject to the GHGRP in 2010 in a separate rulemaking (U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases from Magnesium Production, Underground Coal Mines, Industrial Wastewater Treatment, and Industrial Landfills; Final Rule,” 75 *Federal Register* 39736-39777, July 12, 2010).

¹⁵ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases; Final Rule,” 74 *Federal Register* 56259-56519, October 30, 2009, p. 56350.

GHGRP Subpart RR and UU rule, EPA stated that the Subparts RR and UU CO₂ data would provide information on CCS and geologic sequestration needed to evaluate policy options for mitigating GHG emissions.¹⁶

General GHGRP Requirements

EPA's GHGRP regulations apply to (1) direct GHG emissions sources that emit over 25,000 metric tons of CO₂ equivalent (CO₂e) per year; (2) fuel and industrial gas suppliers; and (3) facilities with CO₂ injection wells.¹⁷ The regulations address 46 categories of industrial sources.¹⁸ Facilities with these sources must report data on the following six standard GHGs: CO₂; methane (CH₄); nitrous oxide (N₂O); and hydrofluorocarbons (HFCs), sulfur hexafluoride (SF₆), perfluorinated compounds (PFCs), and other fluorinated gases.¹⁹ Most facilities are required to report total annual facility-level emissions for each source category directly to EPA.²⁰

In the regulations associated with each subpart, EPA established the specific methodology facilities must use to calculate total annual CO₂ emissions for that source category, as well as requirements for monitoring, quality assurance, accounting for missing data, recordkeeping, and reporting.²¹ Owners or operators must submit annual reports to EPA on emissions from the prior calendar year and keep the records for at least three years.²² Annual reports to EPA must include a GHG Monitoring Plan that provides an explanation of emissions data collection processes and descriptions of the procedures and methods used for quality assurance, maintenance, and repair of continuous monitoring systems.²³ Subpart RR regulations require that facilities injecting CO₂ for geologic sequestration also have an EPA-approved monitoring, reporting, and verification (MRV) plan (see the "Reporting Requirements for CO₂ Injection and Sequestration Facilities" section of this report for detailed measurement, monitoring, and planning requirements).²⁴ No similar MRV plan requirements are in place for Subpart UU CO₂ injection facilities.

¹⁶ U.S. Environmental Protection Agency, "Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule," 75 *Federal Register* 75060-75089, December 1, 2010, p. 75062.

¹⁷ U.S. Environmental Protection Agency, "Mandatory Reporting of Greenhouse Gases; Final Rule," 74 *Federal Register* 56259-56519, October 30, 2009. CO₂e is the number of metric tons of CO₂ emissions with the same global warming potential (GWP) as one metric ton of another GHG per year. To calculate the tons of CO₂e for each GHG, the GHG is weighted by its GWP and their different impacts on forcing global temperature increase are indexed relative to CO₂, which has a GWP of 1. Some facilities with sources that emit fewer than 25,000 metric tons of CO₂e per year are also covered by the Mandatory Reporting regulations, such as electricity generation facilities; facilities engaged in aluminum production, ammonia manufacturing, and cement production; and some municipal solid waste landfills.

¹⁸ 40 C.F.R. §98.

¹⁹ 40 C.F.R. §98.3.

²⁰ 40 C.F.R. §98.2. GHGRP reporters use the electronic GHG reporting tool (E-GGRT) to report data to EPA, found at <https://ghgreporting.epa.gov/ghg/login.do>.

²¹ State laws and regulations may require facilities to comply with other program and permitting requirements for CO₂ monitoring and reporting.

²² 40 C.F.R. §98.3.

²³ 40 C.F.R. §98.3(g).

²⁴ 40 C.F.R. §98.448.

Safe Drinking Water Act Authorities and UIC Reporting Requirements

SDWA authorizes EPA to regulate underground injection of fluids and serves as the framework for regulating injection of CO₂ for geologic sequestration and EOR. The stated purpose of the act's underground injection control (UIC) provisions is to prevent endangerment of underground sources of drinking water (USDWs) from injection activities. Pursuant to SDWA authority, EPA has promulgated UIC regulations and established minimum federal requirements for injection wells. See CRS Report R46192, *Injection and Geologic Sequestration of Carbon Dioxide: Federal Role and Issues for Congress*, by Angela C. Jones for further information.

Under SDWA, EPA has established six classes of underground injection wells, based on similarity in the fluids injected, and has issued regulations for each well class.²⁵ UIC Class II wells are used to inject fluid associated with oil and gas production, including EOR wells used to inject CO₂ into aging oil reservoirs to recover additional oil. According to one survey, in 2014 (the latest survey data available), 8,728 CO₂-EOR wells were operating across the country as part of 109 CO₂-EOR projects.²⁶ Approximately 80% of the CO₂ used in EOR is derived from naturally occurring underground reservoirs of CO₂, while the remainder is captured from power plants or other industrial sources.²⁷ UIC wells used to inject CO₂ for long-term containment (geologic sequestration) are classified by EPA as Class VI wells.²⁸ Currently, there are two permitted Class VI wells in the United States, both at an Illinois ethanol production facility injecting CO₂ into an underground saline reservoir.²⁹

SDWA authorizes EPA to delegate primary enforcement authority for UIC programs, known as *primacy*, to individual states.³⁰ For Class II wells only, states can assume primacy under either SDWA Section 1422 or Section 1425. States delegated primacy under Section 1422 must meet minimum EPA regulatory requirements promulgated under SDWA. Sixteen states have Section 1422 primacy, two of which have permitted EOR wells.³¹ Section 1425 primacy allows states to administer their own Class II UIC program without meeting EPA's regulatory requirements, provided the state demonstrates that its program meets certain requirements under SDWA and represents an effective program to prevent endangerment of USDWs.³² SDWA does not prohibit states from establishing UIC requirements that are stricter than federal requirements. Twenty-four states and three tribes have Class II primacy under Section 1425.³³ Nearly 99% of Class II EOR

²⁵ *Injection well* means a well into which "fluids" are being injected (40 C.F.R. §144.6). EPA UIC regulations are codified at 40 C.F.R. §§144-148.

²⁶ Leena Koottungal, "2014 Worldwide EOR Survey," 2014. In 2019, EPA estimated that there were 119,467 Class II EOR wells in the United States, including CO₂-EOR wells and wells used in other EOR methods (EPA, *FY19 State UIC Injection Well Inventory*, accessed November 27, 2020).

²⁷ U.S. Environmental Protection Agency, "Federal Requirements Under the Underground Injection Program for Carbon Dioxide (CO₂) Geological Sequestration Wells," 75 *Federal Register* 77230-77303, December 10, 2010, p. 77234.

²⁸ U.S. Environmental Protection Agency, "Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO₂) Geologic Sequestration Wells; Final Rule," 75 *Federal Register* 77230-77303, December 10, 2010.

²⁹ EPA, *FY19 State UIC Injection Well Inventory*, accessed November 27, 2020.

³⁰ SDWA §1422 (42 U.S.C. §300h).

³¹ EPA, *FY19 State UIC Injection Well Inventory*, accessed November 27, 2020.

³² SDWA §1425 (42 U.S.C. §300h).

³³ U.S. Environmental Protection Agency, "Primary Enforcement Authority for the Underground Injection Control Program," accessed January 6, 2021, at <https://www.epa.gov/uic/primary-enforcement-authority-underground->

wells are located in these states and tribal lands; therefore, most CO₂-EOR wells are regulated under state UIC programs rather than EPA regulations.

For Class VI geologic sequestration wells, two states, North Dakota and Wyoming, have primacy. As of early 2021, neither of these states has issued a Class VI permit.

UIC Reporting Regulations and the GHGRP

EPA issued the GHGRP Subparts RR and UU rule and the UIC Class VI rule in tandem, finalizing both in December 2010. In the GHGRP rule preamble, the agency stated its intention to implement the regulations through a coordinated approach to ensure both USDW protection and reporting of CO₂ emissions.³⁴

As noted, SDWA authorizes EPA to issue UIC regulations to protect USDWs from potential contamination associated with underground injection activity.³⁵ In the UIC Class VI regulations (discussed in detail in “UIC Class VI Requirements and Connection with Subpart RR” later in this report), EPA established some requirements for reporting the amount of CO₂ injected.³⁶ EPA has not issued comparable requirements for Class II wells through the UIC program; any federal GHG emissions reporting requirements for these wells would be within the GHGRP framework. The GHGRP regulations for facilities with Class VI wells require these facilities to provide additional CO₂ data and meet additional requirements for monitoring, reporting, and verification of CO₂ sequestered. In certain instances, meeting UIC permit requirements for planning and monitoring fulfills GHGRP requirements.³⁷

Reporting Requirements for CO₂ Injection and Sequestration Facilities

EPA created two different GHGRP source categories for facilities with wells that inject CO₂ into underground formations, depending on whether the CO₂ is injected for geologic sequestration, or for EOR or other purposes.³⁸ The establishment of separate source categories, along with different associated regulations and requirements, reflects various factors, including differences in the primary purposes of injection for EOR and geologic sequestration and variations in the status of EOR and sequestration projects in the United States.

In EOR, a portion of the CO₂ injected is stored incidentally during oil production operations—permanent storage is not the main purpose of injection. EOR operations are generally well

injection-control-program.

³⁴ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75064.

³⁵ EPA and state UIC regulations may include other provisions that may play a role in tracking and reporting CO₂ data and emissions, such as operating standards, requirements for testing and monitoring of equipment, and requirements for data reporting and recordkeeping.

³⁶ U.S. Environmental Protection Agency, “Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO₂) Geologic Sequestration Wells; Final Rule,” *75 Federal Register* 77230-77303, December 10, 2010.

³⁷ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75063.

³⁸ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010.

established, as the oil and gas industry has been conducting EOR since the 1970s, and many EOR wells predate EPA UIC Class II regulations.³⁹ EOR also uses the existing oil production wells and related infrastructure to inject CO₂; thus, the practice does not require new development, construction, or major operational changes from existing oil and gas operations. EOR facilities also typically pay by the ton for the CO₂ used in injection, providing incentives to track and minimize leakage of CO₂ so it is able to be reinjected for additional oil recovery. For these and other reasons, EPA generally established fewer regulations and less-stringent monitoring and reporting standards for Subpart UU facilities with CO₂ EOR wells.

In contrast, the purpose of projects injecting CO₂ for geologic sequestration is permanent underground storage of large amounts of CO₂ (i.e., over 1 million tons). Injection for long-term containment typically involves larger volumes of CO₂ at higher pressures than injection for EOR, and particular physical and chemical properties of the injected CO₂ that require unique regulations, according to EPA.⁴⁰ In the 2010 GHGRP rulemaking, EPA stated that geologic sequestration of CO₂ is a newer process that is still being tested for its potential for large-scale deployment in the United States.⁴¹ As of 2021, one CCS project has injected a large amount of CO₂ for geologic sequestration in the United States. Prior to the GHGRP rules, no federal regulatory framework existed for measuring or reporting emissions and sequestration amounts associated with geologic sequestration. Subpart RR contains detailed requirements for calculating CO₂ amounts sequestered or vented or leaked from surface equipment, as well as monitoring, planning, and reporting requirements, all designed to support the agency's efforts to assess the use of geologic sequestration as a GHG mitigation option and inform policy decisions.⁴²

Specific Subpart RR and Subpart UU requirements are described in the following sections, along with an analysis of the relationship between Subpart RR and UIC Class VI regulations.

Subpart RR: Geologic Sequestration Facilities

The Subpart RR source category applies to any well or group of wells that inject CO₂ into a subsurface geologic formation for sequestration and applies to all UIC Class VI wells.⁴³ There is no emissions quantity threshold—any facility injecting CO₂ into subsurface formations for geologic sequestration must report the amount of injected CO₂ to EPA.⁴⁴ Certain research and development projects may be exempt from compliance with Subpart RR if the projects meet EPA eligibility requirements.⁴⁵

³⁹ EPA promulgated regulations for Class II wells initially in 1983 (48 *Federal Register* 14189, April 1, 1983).

⁴⁰ EPA explained in the preamble to its 2010 UIC rule that regulations of injection of CO₂ for geologic sequestration is necessary because of the relative buoyancy of CO₂ in underground geologic formations, the mobility of CO₂ within subsurface formations, the corrosive properties of CO₂ in the presence of water that can affect well materials, and the potential presence of impurities in the injected CO₂ stream (U.S. Environmental Protection Agency, “Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO₂) Geologic Sequestration Wells; Final Rule,” 75 *Federal Register* 77230-77303, December 10, 2010, p. 77233).

⁴¹ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” 75 *Federal Register* 75060-75089, December 1, 2010, p. 75062.

⁴² U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” 75 *Federal Register* 75060-75089, December 1, 2010, p. 75062.

⁴³ 40 C.F.R. §98.440.

⁴⁴ 40 C.F.R. §98.441.

⁴⁵ Exemptions include projects that investigate practices, monitoring techniques, or injection verification, or that conduct applied research on long-term containment of CO₂ in geologic formations. For example, some Department of Energy Regional Carbon Sequestration Partnership Projects have qualified for the research and development exemption

Reporting Requirements

Facilities with Class VI wells are required to calculate and report several types of CO₂ data to EPA in accordance with specific instructions and formulas in the regulations. The facilities are required to report

- the mass of CO₂ received;
- the mass of CO₂ injected into the subsurface;
- the mass of CO₂ produced (mixed with produced oil, gas, or other fluids);
- the mass of CO₂ emitted by surface leakage;
- the mass of CO₂ emitted as equipment leakage or vented from surface equipment;
- the mass of CO₂ sequestered in subsurface geologic formations; and
- the cumulative mass of CO₂ sequestered since the start of required reporting.⁴⁶

Subpart RR regulations also require facilities to use a mass balance equation to calculate the mass of sequestered CO₂, subtracting the CO₂ emitted from leaks or vented emissions from the CO₂ injected to calculate the mass of CO₂ sequestered.

Monitoring, Reporting, and Verification Requirements

Under Subpart RR, covered facilities must follow specific procedures for measuring the CO₂ received, injected, and produced.⁴⁷ Facilities must also monitor equipment for leaked and vented CO₂.⁴⁸ As noted above, EPA explained in the Subpart RR and UU rulemaking that the specific requirements for calculating and reporting CO₂ quantities are necessary to validate these data and evaluate geologic sequestration.⁴⁹

Subpart RR regulations also require geologic sequestration facilities to develop a proposed monitoring, reporting, and verification (MRV) plan and submit the plan to EPA. According to EPA, the plan is intended in part to help the agency verify CO₂ sequestration quantities and assist in developing GHG emission reduction strategies.⁵⁰ The MRV plan must include the following elements:

- delineation of the maximum monitoring and active monitoring areas;
- identification of potential CO₂ leakage pathways in the maximum monitoring area and the likelihood, magnitude, and timing of surface leakage through these pathways;
- strategy to detect and quantify CO₂ surface leakage;
- strategy to establish the expected baselines for monitoring CO₂ surface leakage;

(U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75064).

⁴⁶ 40 C.F.R. §98.442.

⁴⁷ 40 C.F.R. §98.444.

⁴⁸ 40 C.F.R. §98.444.

⁴⁹ U.S. Environmental Protection Agency, *Mandatory Greenhouse Gas Reporting Rule: EPA’s Response to Public Comments; Geologic Sequestration and Injection of Carbon Dioxide: Subparts RR and UU*, December 1, 2010, p. 79.

⁵⁰ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75063.

- summary of the considerations to be used to calculate site-specific variables in the mass balance equation;
- UIC well number; and
- proposed date to begin collecting data for calculating the total amount of CO₂ sequestered.⁵¹

Once EPA determines that the MRV plan meets all requirements, the agency announces its approval and issues a final MRV plan.⁵² Facilities must submit a revised plan to EPA under certain conditions, such as if they make an unanticipated “material change” to the monitoring and operating procedures in the MRV plan (e.g., changes in injection volume, addition of injection wells, equipment failure, or a change in the predicted underground CO₂ plume).⁵³ EPA also requires plan resubmission if the agency determines it is necessary following a review of the facility’s annual report, or if the UIC class of an injection well at the facility changes.⁵⁴

UIC Class VI Requirements and Connection with Subpart RR

In the preamble to the GHGRP Subparts RR and UU rule, EPA addressed overlap with UIC requirements for injection facilities, noting that the agency “designed the reporting requirements under 40 CFR part 98, subpart RR with careful overlap between the two programs.”⁵⁵ For example, both Subpart RR and UIC Class VI regulations require reporting of the quantity of CO₂ injected. UIC Class VI regulations require owners and operators to report the quantity of CO₂ injected over the annual reporting period and the total volume of CO₂ injected over the life of the injection project.⁵⁶ Under Subpart RR regulations, facilities must include these data in their annual report to EPA.⁵⁷

Both Subpart RR and UIC Class VI regulations also address air monitoring requirements for geologic sequestration wells. Subpart RR requires facilities to have a monitoring plan for quantifying air emissions as part of the MRV plan.⁵⁸ Under UIC Class VI regulations, the UIC program director can require an air monitoring detection plan covering the surface overlying the injection field or CO₂ plume to detect the movement of CO₂ that could endanger a USDW.⁵⁹ Owners and operators can satisfy the UIC Class VI monitoring requirement by demonstrating compliance with all Subpart RR requirements and the UIC Class VI regulatory requirement to report any release of CO₂ into the atmosphere within 24 hours.⁶⁰

⁵¹ 40 C.F.R. §98.448.

⁵² U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75066.

⁵³ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75066.

⁵⁴ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75066.

⁵⁵ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75063.

⁵⁶ 40 C.F.R. §146.91(a).

⁵⁷ 40 C.F.R. §98.442.

⁵⁸ 40 C.F.R. §98.448(3).

⁵⁹ 40 C.F.R. §146.90(h).

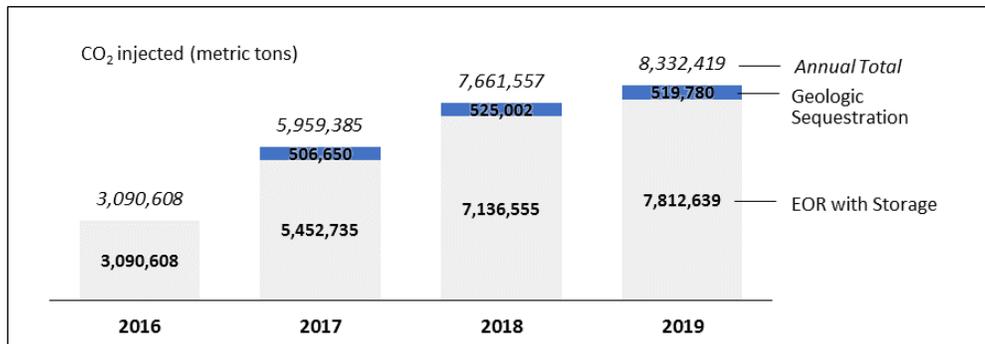
⁶⁰ 40 C.F.R. §146.90(h). The reporter must include additional information describing how monitoring will achieve surface detection and quantification of CO₂.

General MRV plan requirements are linked in the regulations. In the preamble to the GHGRP Subparts RR and UU rulemaking, EPA explained that UIC permit requirements for Class VI wells “can provide the basis for the MRV plan submitted to EPA.”⁶¹ In other words, the Subpart RR regulations allow owners and operators to satisfy certain Subpart RR MRV plan requirements with a UIC Class VI permit.⁶²

Subpart RR Data Reported

Currently, Subpart RR applies to one facility in the United States. This facility, located in Illinois, is operating with EPA UIC Class VI permits and is injecting CO₂ from an ethanol plant into a saline aquifer. From 2016 through 2019 (the most recent year for which data are available), the facility reported that a total of 1,551,431 metric tons of CO₂ had been sequestered at the site.⁶³ As of 2020, four other facilities injecting CO₂ through UIC Class II wells for EOR, with some CO₂ storage, have voluntarily reported under Subpart RR.⁶⁴ Although it is not required for the facilities with EOR wells, all five facilities have EPA-approved MRV plans. See **Figure 1** for CO₂ reported under Subpart RR since 2016 and **Figure 2** for the locations of facilities that have reported under Subpart RR to date.

Figure 1. CO₂ Injected for Sequestration and EOR Reported Under Subpart RR



Source: CRS, from EPA FLIGHT database, accessed November 16, 2020.

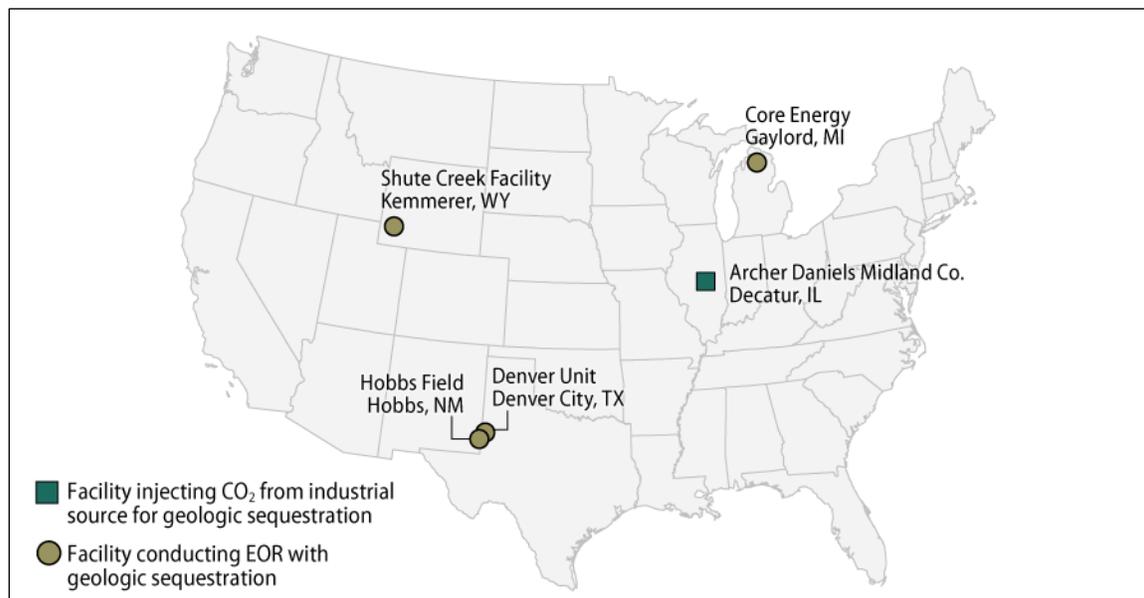
Notes: “EOR with Storage” amount is the amount of CO₂ incidentally stored during oil production, as reported to EPA by the facilities. These volumes were reported by four facilities conducting EOR that voluntarily reported under Subpart RR.

⁶¹ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75063.

⁶² U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide; Final Rule,” *75 Federal Register* 75060-75089, December 1, 2010, p. 75063.

⁶³ EPA FLIGHT database, accessed November 16, 2020. For comparison, that facility reported emitting 17,467,428 tons of covered GHGs for that same period.

⁶⁴ EPA FLIGHT database, accessed November 16, 2020.

Figure 2. Subpart RR Reporting Facilities, 2016-2019

Source: CRS, from EPA FLIGHT database, accessed November 16, 2020.

Note: Alaska and Hawaii are not shown on this map; no Subpart RR facilities are located in these states.

Subpart UU: CO₂ Injection (EOR) Facilities

Subpart UU applies to GHG source facilities with a well or wells used to inject CO₂ during EOR operations or for any purpose other than geologic sequestration.⁶⁵ As noted earlier in this report, the CO₂ can be mined from natural sources or be captured from a power plant or industrial facility. All EOR wells at Subpart UU facilities are UIC Class II wells.⁶⁶

Under Subpart UU, there is no minimum threshold for reporting—facilities are required to report CO₂ data if they inject any amount of CO₂.⁶⁷ These facilities are required to report the quantity of CO₂ “received for injection” and its origin, if known.⁶⁸ The CO₂ received includes CO₂ streams from the facility’s own production processes and any CO₂ transferred from another facility for injection.

Subpart UU regulations specify how facilities must calculate the mass of CO₂ received for injection.⁶⁹ The regulations also require that owners and operators use certain procedures to measure the CO₂ flow rate and follow quality assurance/quality control procedures for measurement devices, including continuous operation of flow meters.⁷⁰ Subpart UU facilities must complete the monitoring plans required under general GHGRP requirements.⁷¹ These must

⁶⁵ 40 C.F.R. §98.470.

⁶⁶ In states with UIC Class II primacy, Class II EOR wells are subject to state regulations and requirements. In other states, EPA directly administers the Class II programs and associated regulations. Reporting under UIC regulations and requirements vary by state. Under the GHGRP requirements, all facilities report information directly to EPA.

⁶⁷ 40 C.F.R. §98.471.

⁶⁸ 40 C.F.R. §98.472.

⁶⁹ 40 C.F.R. §98.473.

⁷⁰ 40 C.F.R. §98.474.

⁷¹ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases: Injection and Geologic

be retained for EPA review, but do not have to be submitted to EPA. In addition to general GHGRP recordkeeping requirements, Subpart UU facilities are required to keep quarterly records of the quantity of CO₂ received.⁷² An MRV plan is not required, but facilities may choose to submit a plan. Unlike Subpart RR, Subpart UU facilities are not required to measure or report the amount of CO₂ injected or sequestered as part of GHGRP reporting.⁷³

Subpart UU facilities report CO₂ information at a facility level, which includes the total amount of CO₂ received for injection. The facilities do not report data associated with individual EOR (UIC Class II) wells—the CO₂ received may be injected through one or more wells located within the facility.

Subpart UU Data Reported

Since 2012 (the first year of required reporting) through 2019, 125 facilities in 15 states have reported quantities of CO₂ received (see **Figure 3**).⁷⁴ EPA treats the quantity reported as confidential business information and does not make this information publicly available.⁷⁵ Three of the reporting facilities have received research and development exemptions from Subpart RR and have reported under Subpart UU.⁷⁶ Combined, these three facilities reported a total of 1,443,517 tons of CO₂ received for injection through 2019.⁷⁷

Sequestration of Carbon Dioxide; Final Rule,” 75 *Federal Register* 75060-75089, December 1, 2010, p. 75088.

⁷² 40 C.F.R. §98.477.

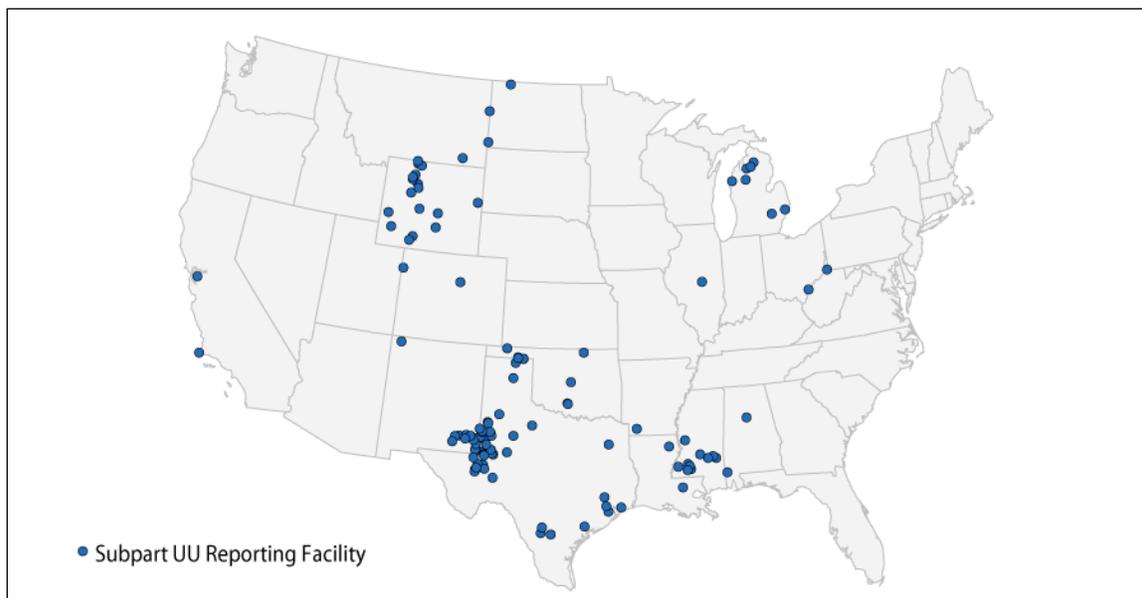
⁷³ Facilities typically conduct measurements for their own business purposes. Some CO₂ tracking and reporting is required by EPA for well owners and operators in states where EPA directly administers the UIC Class II program and in states granted enforcement authority under SDWA §1422. In other states, reporting requirements may vary, depending on state UIC regulations and requirements.

⁷⁴ EPA FLIGHT database, accessed November 16, 2020.

⁷⁵ In 2012, EPA published a final rule that included CBI determinations for Subpart RR and UU data (U.S. Environmental Protection Agency, “Final Confidentiality Determinations for Regulations under the Mandatory Reporting of Greenhouse Gases Rule,” 77 *Federal Register* 48072-48089, August 13, 2012).

⁷⁶ EPA FLIGHT database, accessed November 16, 2020.

⁷⁷ EPA FLIGHT database, accessed November 16, 2020.

Figure 3. Subpart UU Reporting Facilities, 2011-2019

Source: CRS, from EPA FLIGHT database, accessed November 16, 2020.

Note: Alaska and Hawaii are not shown on this map; no Subpart UU facilities are located in these states.

Internal Revenue Code Section 45Q Authorities

Section 45Q of the Internal Revenue Code, enacted as part of the Energy Improvement and Extension Act of 2008 (P.L. 110-343, Division B), requires facility owners or operators to report CO₂ data in order to claim the federal tax credit for carbon sequestration. Under Section 45Q, taxpayers can claim the tax credit for the disposal or utilization of CO₂ and other carbon oxides, providing they meet thresholds for the amount of CO₂ captured or sequestered and begin construction before January 1, 2026.⁷⁸ The tax credit can be claimed for the amount of CO₂ (1) captured from an industrial source and disposed of in an underground geologic formation; (2) captured from an industrial source and disposed of in underground geologic formations during EOR operations; or (3) used in a qualified manner determined by Treasury (e.g., utilized as an input into an industrial or manufacturing process).⁷⁹ For EOR operations, taxpayers may claim credit for the initial amount of CO₂ injected but cannot claim the credit for CO₂ that is recaptured, recycled, or reinjected during the EOR process.⁸⁰ For taxable year 2021, Section 45Q provides tax credits of \$34.81 per ton for CO₂ that is geologically sequestered and \$22.68 per ton for CO₂ that is disposed of during EOR or utilized in a qualified manner.⁸¹ These tax credits increase to \$50 and \$35 per ton, respectively, by 2026.⁸² See CRS In Focus IF11455, *The Tax Credit for Carbon Sequestration (Section 45Q)*, by Angela C. Jones and Molly F. Sherlock, for additional information.

⁷⁸ 26 U.S.C. §45Q. *Carbon oxide* refers to any of the three oxides of carbon: carbon dioxide, carbon monoxide, and carbon suboxide.

⁷⁹ 26 U.S.C. §45Q(a).

⁸⁰ 26 U.S.C. §45Q(c)(2).

⁸¹ 26 U.S.C. §45Q. Credit amounts apply to equipment placed in service on February 9, 2018, or later.

⁸² 26 U.S.C. §45Q. Credit amounts apply to equipment placed in service on February 9, 2018, or later.

Section 45Q(f)(2) of P.L. 110-343 required Treasury, in consultation with EPA, the Department of Energy, and the Department of the Interior, to establish regulations for the *secure geological storage* of qualified carbon oxide to prevent release into the atmosphere. Secure geological storage is required whether the taxpayer is claiming the credit for carbon oxides used as an injectant and stored during EOR operations, or injected into underground formations solely for geologic sequestration. As explained in the section below, these regulations establish a direct connection between Section 45Q and GHGRP requirements.

CO₂ Measurement and Reporting Requirements

To claim the Section 45Q tax credit, facilities must measure and report to the Internal Revenue Service (IRS) the quantity of “qualified carbon oxide” disposed of in underground formations or utilized.⁸³ Section 45Q(c) defines “qualified carbon oxide” as that which “is measured at the source of capture and verified at the point of disposal, injection, or utilization.”⁸⁴ Section 45Q also provides that, in claims for utilization of qualified carbon oxide, taxpayers are required to use a lifecycle GHG analysis to determine the amount of CO₂ captured or prevented from being emitted into the atmosphere.⁸⁵

In January 2021, the IRS promulgated regulations to implement Section 45Q, including requirements for secure geological storage.⁸⁶ The requirements in the regulations are generally consistent with the provisions for demonstrating secure geological storage set out in 2009 IRS Section 45Q guidance.⁸⁷ The 2021 Section 45Q rule adds a new Section 1-45Q-3 to 29 C.F.R. Part 1 to require that to meet the conditions of secure geological storage, geologic sequestration facilities must comply with GHGRP Subpart RR reporting requirements.⁸⁸ As explained earlier, Subpart RR requirements include reporting the mass of CO₂ injected (calculated using a mass balance equation) and having an approved MRV plan. By comparison, for EOR operations, taxpayers can meet the requirements by either (1) storing carbon oxides in compliance with Subpart RR requirements or (2) storing carbon oxides in compliance with the EOR standard adopted by the International Organization for Standardization (ISO) and endorsed by the American National Standards Institute (CSA/ANSI ISO 27916:19).⁸⁹ IRS stated in the preamble to the proposed Section 45Q rule that many stakeholders suggested the option of the CSA/ANSI ISO standard, which provides specific methodologies and processes for quantifying CO₂ stored during EOR operations.⁹⁰ For taxpayers claiming amounts of CO₂ utilized, the rule adds a new Section 1-45Q-4 that codifies provisions in previous IRS guidance for measuring the amount of CO₂ utilized using lifecycle GHG emissions analysis.⁹¹ While not included in the new regulations, IRS’s 2009 guidance, which preceded EPA’s establishment of Subpart RR, required that the

⁸³ 26 U.S.C. §45Q.

⁸⁴ 26 U.S.C. §45Q(c)(1).

⁸⁵ 26 U.S.C. §45Q(f)(5).

⁸⁶ Internal Revenue Service, “Credit For Carbon Oxide Sequestration,” 86 *Federal Register* 4728-4773, January 15, 2021.

⁸⁷ Internal Revenue Service Notice 2009-83, “Credit for Carbon Dioxide Sequestration Under Section 45Q,” November 2, 2009, §5.02(a).

⁸⁸ 29 C.F.R. Part 1 §1-45Q-3.

⁸⁹ Internal Revenue Service, “Credit For Carbon Oxide Sequestration,” 86 *Federal Register* 4728-4773, January 15, 2021, p. 4769.

⁹⁰ Internal Revenue Service, “Credit For Carbon Oxide Sequestration,” 85 *Federal Register* 34050-34075, June 2, 2020, p. 34055.

⁹¹ 29 C.F.R. Part 1 §1-45Q-4.

amount of CO₂ reported for purposes of the Section 45Q tax credit be consistent with the amount reported under the 2009 Mandatory Reporting Rule.⁹²

The 2021 Section 45Q rule also establishes reporting requirements, requiring the taxpayer to report the amount of CO₂ sequestered on IRS Form 8933 and be submitted with the taxpayer's federal income tax return or reported on IRS Form 1065.⁹³

Table 1 compares Section 45Q, GHGRP, and UIC requirements for reporting CO₂ injection and sequestration.

⁹² Internal Revenue Service Notice 2009-83, "Credit for Carbon Dioxide Sequestration Under Section 45Q," November 2, 2009, §5.02(a).

⁹³ 29 C.F.R. Part 1 §1-45Q-3.

Table I. Federal CO₂ Injection and Sequestration Reporting Requirements

	Mandatory Greenhouse Gas Reporting Subparts RR and UU	Underground Injection Control Class II and Class VI (Applies to injection wells under direct EPA enforcement authority or in states with Section 1422 primacy for Class II wells) ^a	Section 45Q
Federal Statutory Provisions and Regulations	Clean Air Act Section 114 and other CAA provisions ^b 40 C.F.R. §98 Subparts RR and UU	Safe Drinking Water Act, Subtitle C 40 C.F.R. §§144 and 148	Internal Revenue Code Section 45Q 29 C.F.R. Part 1 §1-45Q-3
CO₂ Data Reporting Requirements	<p><u>EOR (Subpart UU)</u> Required to report annually:</p> <ul style="list-style-type: none"> amount of CO₂ received for injection <p><u>Geologic Sequestration (Subpart RR)</u> Required to report annually:</p> <ul style="list-style-type: none"> mass of CO₂ received mass of CO₂ injected into the subsurface mass of CO₂ produced (mixed with produced oil, gas, or other fluids) mass of CO₂ emitted by surface leakage mass of CO₂ emitted as equipment leakage or vented from surface equipment mass of CO₂ sequestered in subsurface geologic formations cumulative mass of CO₂ sequestered since the start of required reporting 	<p><u>EOR (Class II)</u> Required to report annually:</p> <ul style="list-style-type: none"> monthly CO₂ injection volume, (included in monitoring results)^c <p><u>Geologic Sequestration (Class VI)</u> Required to report semi-annually:</p> <ul style="list-style-type: none"> monthly volume and/or mass of the CO₂ stream and the cumulative volume injected over the life of the project 	<p><u>EOR</u></p> <ul style="list-style-type: none"> Initial injection amount of “qualified carbon oxide” disposed of in underground formations, measured at the source of capture and verified at the point of disposal, injection, or utilization <p><u>Geologic Sequestration</u></p> <ul style="list-style-type: none"> Amount of “qualified carbon oxide” disposed of in underground formations, measured at the source of capture and verified at the point of disposal, injection, or utilization Must comply with GHGRP Subpart RR requirements <p>Taxpayers seeking tax credit are required to report annually on IRS Form 8933 or 1065</p>

CO₂ Monitoring Plan for Quantifying or Detecting Emissions/Secure Geological Storage Requirements

EOR (Subpart A general requirements)

Must maintain a written GHG emissions monitoring plan containing

- persons responsible for data collection
- explanation of methods used to collect data for GHG calculations
- description of procedures for maintaining GHG monitoring equipment

Monitoring, reporting, and verification plan is not required to be submitted or approved by EPA

Geologic Sequestration (Subpart RR)

EPA-approved MRV Plan required that includes

- delineation of the maximum monitoring and active monitoring areas
- identification of potential CO₂ leakage pathways in the maximum monitoring area and the likelihood, magnitude, and timing of surface leakage through these pathways
- strategy to detect and quantify CO₂ surface leakage
- strategy to establish the expected baselines for monitoring CO₂ surface leakage
- summary of the considerations to be used to calculate site-specific variables in the mass balance equation

EOR (Class II)

No monitoring plan required

Geologic Sequestration (Class VI)

UIC program director can require air monitoring detection at the surface overlying the injection field or CO₂ plume to detect the movement of CO₂ that could endanger a USDW^d

EOR

Meet secure geological storage requirements by either

- (1) storing carbon oxides in compliance with Subpart RR requirements; or
- (2) storing carbon oxides in compliance with EOR standard CSA/ANSI ISO 27916:19

Geologic Sequestration

To meet secure geological storage requirements, must comply with GHGRP Subpart RR requirements

	<p align="center">Underground Injection Control Class II and Class VI</p> <p align="center">(Applies to injection wells under direct EPA enforcement authority or in states with Section 1422 primacy for Class II wells)^a</p>	<p align="center">Section 45Q</p>
<p align="center">Mandatory Greenhouse Gas Reporting Subparts RR and UU</p>	<ul style="list-style-type: none"> • UIC well number • proposed date to begin collecting data for calculating the total amount of CO₂ sequestered 	

Sources: CAA §114; 40 C.F.R. §98 Subparts RR and UU; SDWA Subtitle C; 40 C.F.R. §§144 and 148; Internal Revenue Code §45Q; 29 C.F.R. Part 1 §1-45Q-3.

- a. In P.L. 110-161, Congress provided funding for EPA to develop and publish a rule “to require mandatory reporting of greenhouse gas emissions above appropriate thresholds in all sectors of the economy of the United States.” The accompanying explanatory statement directed EPA to use its existing authority under the Clean Air Act to develop the rule.
- b. 40 C.F.R. §144.28 (for wells authorized by rule; applies to EPA administered UIC programs and in states with §1422 primacy); §144.54; and §146.23 (applies to EPA administered UIC programs and in states with §1422 primacy). Owners and operators of EOR wells can monitor and report on a field or project basis rather than for individual wells.
- c. EPA UIC Class II regulations require monthly observation of CO₂ injection volumes (§144.28).
- d. Owners and operators can satisfy the UIC Class VI monitoring requirement by demonstrating compliance with all Subpart RR requirements and the UIC Class VI regulatory requirement to report any release of CO₂ into the atmosphere within 24 hours.

Issues for Congress

Many analysts expect CCS to expand in the United States over the next few decades, resulting in more facilities handling increasing amounts of CO₂ for injection and storage.⁹⁴ According to the Global CCS Institute, in addition to the 12 commercial CO₂ injection and storage projects currently operating in the United States, 10 new projects are in the advanced development stage.⁹⁵ Growth in the number and size of geologic sequestration and EOR projects using captured CO₂ could increase attention on CO₂ reporting issues, including the scope of mandatory data collection and verification of data reported.

Issues for consideration by Congress related to reporting of CO₂ injection and storage include oversight of EPA's implementation of GHG reporting regulations under the CAA and oversight of both Treasury's verification of Section 45Q tax credit claims and implementation of Section 45Q regulations. Other issues that may be of oversight or legislative interest may include whether GHGRP regulations affect the development of commercial-scale CCS projects in the United States; how generally less-stringent federal requirements for EOR facility reporting may influence future CCS project deployment; and the implications of potential increases in the number of GHGRP reporting facilities and Section 45Q tax credit claims on federal agency capacity and resources.

One issue of potential oversight interest to Congress is verification of Section 45Q tax credit claims and CO₂ sequestration amounts. In recent years, some Members of Congress have raised concerns regarding potentially fraudulent Section 45Q tax credit claims.⁹⁶ In 2021, the IRS issued Section 45Q regulations to address the issue of secure geological storage, among other requirements. Congress may consider whether the IRS has adequately addressed concerns about improper claims through its responses to Congress, Section 45Q guidance, and its new regulations on secure geological storage for purposes of Section 45Q.

Another issue that may be of oversight or legislative interest is whether GHGRP regulations affect the development of commercial-scale CCS projects in the United States. In its oversight role, Congress may consider the implications of GHGRP regulatory requirements for overall CCS project development. Some stakeholders have raised concerns regarding the mandatory requirements in GHGRP Subpart RR regulations for CO₂ injection for geologic sequestration and their potential impacts on development and deployment of CCS projects in the United States.⁹⁷ In their view, monitoring, verification, and reporting of CO₂ quantities could be burdensome for the development of geologic sequestration projects and the utilization of CO₂ by industry.⁹⁸

⁹⁴ See, for example, Intergovernmental Panel on Climate Change, *Carbon Dioxide Capture and Storage, A Special Report of Working Group III*, 2005; and Global CCS Institute, *Global Status Report 2020*, 2020.

⁹⁵ Global CCS Institute, *Global Status Report 2020*, 2020. Four of these projects anticipate injecting CO₂ for geologic sequestration, while six plan to inject for EOR. The Global CCS Institute defines a *commercial facility* as a facility capturing CO₂ for permanent storage as part of an ongoing commercial operation that generally has an economic life similar to the host facility whose CO₂ they capture, and that supports a commercial return while operating and/or meets a regulatory requirement.

⁹⁶ Letter from Sen. Robert Menendez to Russell George, Treasury Inspector General for Tax Administration, November 19, 2019.

⁹⁷ See for example, public comments on pp. 77, 87-89, and 137 in U.S. Environmental Protection Agency, *Mandatory Greenhouse Gas Reporting Rule: EPA's Response to Public Comments; Geologic Sequestration and Injection of Carbon Dioxide: Subparts RR and UU*, December 1, 2010.

⁹⁸ See, for example, public comments on pp. 77, 87-89, and 137 in U.S. Environmental Protection Agency, *Mandatory Greenhouse Gas Reporting Rule: EPA's Response to Public Comments; Geologic Sequestration and Injection of Carbon Dioxide: Subparts RR and UU*, December 1, 2010.

In its oversight role, Congress may consider how generally less-stringent federal requirements for EOR facility reporting on CO₂ injection and storage may influence future CCS project deployment. Some analysts have noted that federal statutes and regulations, along with economics and technology innovation, play a role in driving industry decisions of whether to inject CO₂ for EOR projects or for geologic sequestration only. Most CO₂ is currently injected for oil production rather than for geologic sequestration purposes. As Section 45Q tax credits are available for both types of projects, an oversight issue for Congress is whether different, and generally less burdensome, federal requirements for CO₂ reporting from EOR facilities, in combination with the tax credit, influence the development of more CO₂-EOR projects compared to geologic sequestration projects.

Another potential issue for Congress in its oversight and appropriations role is the potential implications of projected increases on agency capacity and resources and the potential need for enhanced coordination between agencies and programs. EPA, in the preamble to the proposed Mandatory Subparts RR and UU, notes that “CCS is poised to play a sizable role in mitigating U.S. GHG emissions” and that many CCS-related technologies currently commercially available “will be more widely demonstrated over the next 10 to 15 years.”⁹⁹ In addition, Treasury’s Section 45Q tax expenditure estimates, published in February 2020, are \$0.6 billion over the 2019-2023 five-year period and \$2.3 billion from 2020 to 2029, suggesting an increase in tax credit claims in future years.¹⁰⁰ Congress may consider the effects of potential increases in reporting on EPA and IRS program responsibilities for collecting and verifying GHGRP data and Section 45Q tax claims.

Author Information

Angela C. Jones
Analyst in Environmental Policy

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⁹⁹ U.S. Environmental Protection Agency, “Mandatory Reporting of Greenhouse Gases; Proposed Rule,” *75 Federal Register* 18578-18606, April 12, 2010, pp. 18578-18579.

¹⁰⁰ U.S. Department of the Treasury, “FY2020 Tax Expenditures,” accessed September 11, 2020, at <https://home.treasury.gov/policy-issues/tax-policy/tax-expenditures>.