Secure Geologic Storage: 45Q, The ISO, and State Regulation
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ABSTRACT:
Section 45Q is a federal tax credit for carbon oxide sequestration that is intended to incentivize the capture and utilization of anthropogenic carbon dioxide ("CO_2") for enhanced oil recovery ("CO_2-EOR").[1] To claim the 45Q federal tax credit, the taxpayer must be able to quantify the volume of sequestered CO_2 and demonstrate that injection of CO_2 results in "secure geological storage."[2] Current Department of Treasury and Internal Revenue Service (IRS) regulations provide interim guidance regarding the definition of "secure geologic storage"[3] and "procedures for a taxpayer to determine adequate security measures for the secure geological storage of CO_2 until such regulations are promulgated."[4] These procedures have been criticized on various grounds, arguably resulting in under-utilization of section 45Q.

The IRS and Department of Treasury have indicated that in the near future they anticipate issuing new rules and guidance related to 45Q which may incorporate third-party standards developed by the International Organization for Standardization ("ISO"). In 2019, the IRS and Department of Treasury requested comments "on issues arising under section 45Q" and the availability of "existing guidelines, standards, or regulations that could be used to demonstrate secure geologic storage, such as those developed by the International Organization for Standards."[5] ISO has developed a standard for quantifying associated storage of CO_2 with EOR and demonstrating safe, long-term containment of injected CO_2: ISO standard 27916. This ISO standard contemplates regulation and quantification of injected CO_2 by a competent governmental administrative body with regulatory authority over CO_2-EOR.

State programs and oil and gas regulatory agencies can facilitate taxpayers' quantification of associated storage volumes and verification of secure geologic storage within the meaning of section 45Q. In fact, many states already do so as part of oil and gas regulatory programs for CO_2-EOR state tax exemptions or carbon credit programs. These programs differ, depending on existing EOR operations in the state and state goals with respect to regulation, fossil fuel production, and

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[1] Other legislative goals include promoting investment in carbon capture, utilization and storage technology, and carbon capture project implementation at electric generating plants and industrial facilities. See Michael L. Platner, *Implementation of Recent Amendments to the 45Q Carbon Sequestration Tax Credit*, National Law Review (2019) (available at https://www.natlawreview.com/article/implementation-recent-amendments-to-45q-carbon-sequestration-tax-credit).
[2] 26 U.S.C. §45Q(a) (2019).
[3] Department of the Treasury Internal Revenue Service, Internal Revenue Bulletin No. 2009-44 (2009) (available at https://www.irs.gov/pub/irs-irbs/irb09-44.pdf).
[4] *Id.*
[5] Department of Treasury & Internal Revenue Service, IRS Notice 2019-32, Request for Comments on Credit for Carbon Oxide Sequestration, 8 (2019).

climate programs. This paper evaluates certain states' ability to evaluate secure geologic storage in accordance with the ISO standard. It suggests that state oil and gas regulatory agencies are competent to facilitate utilization of section 45Q to encourage associated storage in furtherance of decarbonization, economic and energy development goals.

INTRODUCTION:

Congress has encouraged the fossil fuel industry to engage in operations that reduce overall carbon emissions into the atmosphere through CO_2-EOR.[6] Enhanced oil recovery operations can include injecting CO_2 underground to increase oil production in suitable reservoirs. CO_2-EOR represents an economic and environmentally friendly opportunity. There are an estimated 80 billion barrels of additional recoverable oil in the United States and offshore Gulf of Mexico that are currently accessible through CO_2-EOR operations and which would require an additional 37 billion metric tons of CO_2 to be injected underground rather than released into the atmosphere.[7] CO_2-EOR advances emissions reduction goals because it creates a closed-loop system that traps CO_2 into the pore space of the underground rock formations, thereby preventing the CO_2 from being released into the atmosphere and thus resulting in a lower-emissions barrel of oil.[8] However, because the current supply of anthropogenic CO_2 available for purchase for utilization in EOR is inadequate, the wide-scale deployment of carbon capture infrastructure and expansion of the current CO_2 pipeline network – or build-out of new pipelines -- would be necessary to meet this potential increased demand for CO_2.[9]

To incentivize oil companies and carbon capture facilities to engage and invest in this tertiary enhanced oil recovery process with CO_2, the United States Congress enacted a tax credit known as section 45Q. The eligible taxpayer under section 45Q, as amended, is the person that "owns the carbon capture equipment and physically or contractually ensures the capture and disposal, utilization, or use as a tertiary injectate of such qualified carbon oxide."[10] However, if the eligible taxpayer so elects, the credit instead may be claimed by the "person [who] utilizes" the CO_2 for CO_2-EOR.[11]

To qualify for the tax credit, operators must prove that the CO_2 that is injected as part of their EOR operations will stay underground long term, a concept referred to as "secure geologic storage."[12] Section 45Q provides that:

> The Secretary [of the Treasury], in consultation with the Administrator of the Environmental Protection Agency, the Secretary of Energy, and the Secretary of

[6] 26 U.S.C.S. §45Q (2019).
[7] Michael Godec, *Establishing a Business Case for* CO_2*-EOR with Storage*, Wyoming Oil and Gas Fair (2018).
[8] See Nicholas A. Azzolina et al., *How Green is my oil? A detailed look at greenhouse gas accounting for* CO_2*-Enhanced oil recovery (COW-EOR) sites*, International Journal of Greenhouse Gas Control, 369, (2016).
[9] Center for Climate and Energy Solutions, *Carbon Dioxide Enhanced Oil Recovery: A Critical Domestic Energy, Economic, and Environmental Opportunity*, National Enhanced Oil Recovery Initiative (2012).
[10] 26 U.S.C. §45Q(f)(3)(A) (2019).
[11] *Id.* §45Q(f)(3)(B).
[12] See Accounting of Carbon Storage Through Enhanced Oil Recovery- Carbon Capture Coalition (2018) (available at https://carboncapturecoalition.org/wp-content/uploads/2018/11/Carbon_Capture_Coalition_Overview_Accounting_CO_2Storage_EOR.pdf-).

> the Interior, shall establish regulations for determining adequate security measures for the geological storage of qualified carbon oxide … such that the qualified carbon oxide does not escape into the atmosphere. Such term shall include storage at deep saline formations, oil and gas reservoirs, and unminable coal seams under such conditions as the Secretary may determine under such regulations.[13]

Interim Department of Treasury and IRS regulations rely on the Environmental Protection Agency's ("EPA") Greenhouse Gas Reporting Program to demonstrate "secure geologic storage" in correlation with the federal Clean Air Act ("CAA").[14] Subpart RR of the Greenhouse Gas Reporting Program requires CO_2-EOR operators to: (i) report basic information on CO_2 received for injection; (ii) develop and implement an EPA-approved monitoring, verification and reporting ("MRV") plan; and (iii) report the amount of sequestered CO_2 through a mass balance approach and annual monitoring activities.[15] This program, however, has proven to be under-utilized for purposes of section 45Q despite the requirement to do so.[16] Only five MRV plans have been submitted and approved to date.[17]

Contemporaneously with Congress' enactment of amended section 45Q, ISO developed its own standard for the safe, long-term containment of CO_2 in association with CO_2-EOR and the documentation of the quantity of stored CO_2.[18] The ISO standard is intended to "facilitate the exchange of goods and services related to the increased use and emissions reductions through associated storage by providing methods for demonstrating the safe, long-term containment of, and determining the quantity of CO_2 stored in association with CO_2-EOR."[19] The ISO standard also provides guidance on well construction, monitoring, and overall operations of CO_2-EOR projects.

Recently, the IRS has signaled it is considering incorporating the ISO standard for the quantification of associated storage and demonstration of "secure geologic storage."[20] If so incorporated, there is an opportunity for implementation of the ISO standard through state regulatory agencies or third party certifications.[21] State-driven approaches to implementation of section 45Q could drive additional deployment of CO_2-EOR and satisfy broader objectives related

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[13] 26 U.S.C. §45Q(f)(2) (2019).
[14] Department of the Treasury Internal Revenue Service, Internal Revenue Bulletin No. 2009-44 (2009) (available at https://www.irs.gov/pub/irs-irbs/irb09-44.pdf).
[15] Environmental Protection Agency, *Fact Sheet for Geologic Sequestration and Injection of Carbon Dioxide: Subparts RR and UU* (2010), (available at https://www.epa.gov/sites/production/files/2015-07/documents/subpart-rr-uu-factsheet.pdf).
[16] John Noel, *Carbon Capture and Release*: *Oversight Failures in the Section 45Q Tax Credit for Enhanced Oil Recovery*, Clean Water Action/Clean Water Fund (2018) (available at https://www.cleanwateraction.org/sites/default/files/docs/publications/Carbon%20Capture%20and%20Release%20-%20Clean%20Water%20Action%20-%20May%202018%20-%20Web%20Resolution.pdf).
[17] Environmental Protection Agency, *Subpart RR-Geologic Sequestration of Carbon Dioxide* (2019), (available at https://www.epa.gov/ghgreporting/subpart-rr-geologic-sequestration-carbon-dioxide).
[18] ISO 27916, *Carbon dioxide capture, transportation and geological storage-Carbon dioxide storage using enhanced oil recovery (CO_2-EOR)*, International Standards Organization (2019).
[19] *Id.*
[20] 26 U.S.C.S. §45Q (2019).
[21] Although beyond the scope of this paper, the role of third-party certification in environmental regulation is well established, See, Michael P. Vandenbergh, *Private Environmental Governance*, 99 Cornell L. Rev. 129 (2013).

to emissions reductions, regional economic development and the monetization of carbon storage credits such as section 45Q. State oil and gas regulatory agencies are ideal for oversight of "secure geologic storage" because they already typically have delegated authority to regulate oil and gas operations, and engage in much, if not all, of the fact finding required by the ISO standard as part of administrative approval processes for CO_2-EOR. Should the IRS regulations incorporate the ISO standard, states would have an opportunity to pursue designation of these local oil and gas regulatory agencies as eligible authorities.[22] To do so, state legislatures may be required to assure that statutory frameworks provide oil and gas regulatory agencies with the necessary authority to regulate associated CO_2 storage. If so authorized, state regulatory agencies then could incorporate the ISO standard into their rules through the rulemaking process.

This paper considers opportunities for state agencies to evaluate compliance with the ISO standard for associated storage as part of administrative EOR permitting processes. It assesses the expertise of state oil and gas regulatory agencies with respect to the fact findings required by the ISO standard and the extent to which these findings are already being made. Finally, this paper explores the process by which a state could adopt or incorporate the ISO standard into its current oil and gas regulatory framework or other programs.

THE 45Q TAX CREDIT FOR CO_2-EOR:

To reduce carbon levels in the atmosphere, the United States Congress has encouraged oil and gas operators and carbon producing and capture facilities to work together to increase the amount of CO_2 that is stored underground as part of CO_2-EOR operations. Presently, many EOR owners or operators try to recover and recycle as much CO_2 as possible for reuse in injection operations. However, there is significant additional potential for associated storage. In February of 2018, the United States Congress expanded and enhanced its federal carbon capture "45Q" tax credit[23] that encourages carbon capture, utilization, and storage projects including CO_2-EOR.[24] The new 45Q legislation includes "added eligibility for direct air capture [DAC] and non EOR-CO_2 utilization and conversion, increased incentive levels and a credit extension."[25] Between 2018 to 2026 the tax credit value will increase from $15.30 per ton to $35 per ton of CO_2 used in CO_2-EOR operations that results in 'secure geologic storage.'[26] To qualify, the projects must commence construction by January 1, 2024.[27]

The 45Q legislation did not specify a standard for determining whether the necessary "secure geologic storage" requirement was met.[28] Instead, determination of the standard was delegated to

[22] Eligible authority has been defined as "one authorized to have taxes levied for its use as provided by law." See *Jackson Dist. Library v. Jackson Cty.*, 146 Mich. App. 392, 380 N.W.2d 112 (1985).
[23] 26 U.S.C.S. §45Q (2019).
[24] Ryan W. J. Edwards & Michael A. Celia, *Infrastructure to enable deployment of carbon capture, utilization, and storage in the United States*, Proceedings of the National Academy of Sciences, Vol 115, No. 38 (2018).
[25] Xiaoliang Yang, Kevin Kennedy, & Karl Hausker, *Insider: Guiding Implementation of Carbon Capture Tax Credits: Responses to the IRS Request for Comments*, World Resources Institute (2019).
[26] Edwards & Celia, *Infrastructure to enable deployment of carbon capture, utilization, and storage in the United States* (2018).
[27] *Id.*
[28] 26 U.S.C.S. §45Q (f)(2).

the EPA.[29] The statute states the IRS will establish a standard for secure geologic storage in consultation with the EPA, Secretary of Energy, and Secretary of Interior. [30] The IRS ultimately exclusively relied on the EPA's subpart RR rule. The current reporting process for assessing "secure geologic storage" is through The Department of the Treasury, IRS Form 8933, "Carbon Oxide Sequestration Credit."[31] This requires an MRV plan approved by the EPA under subpart RR of its Greenhouse Gas Reporting Program rules.[32] This path has been criticized by operators as too stringent and arduous due to long delays in the approval process, requirements to commence the review and approval process upon any material change in operations (which may be a routine occurrence in EOR operations), increased litigation, and general uncertainties in the regulation implementation.[33]

Critics of the Subpart RR requirement have advocated that the ISO standard already has set forth a methodology for demonstrating the safe, long-term containment of CO_2 in association with CO_2-EOR and documenting the quantity of associated stored CO_2.[34] The IRS recently requested comment regarding implementation of 45Q through Notice 2019-32.[35] It specifically asked whether or not this ISO standard could be used to evaluate 'secure geologic storage.'[36] There were 98 comments, approximately 30 of which addressed questions related to secure geological storage.[37] These comments advocated for a clear framework for demonstrating "secure geologic storage," acknowledged the potential for using the ISO standard, and called for clarification on standards for recapture of credits.[38]

ISO STANDARD:

Like the section 45Q tax credit, the ISO standard requires an operator to establish, monitor and verify that CO_2 is securely stored. However, unlike the section 45Q interim guidance, the ISO standard describes the findings and procedures necessary to verify "secure geologic storage" of injected CO_2. Accordingly, the industry has identified ISO standard 27916 as a potential pathway for demonstration of "secure geologic storage." The standard's goal is to "facilitate the exchange of goods and services related to the increased use and emissions reductions through associate storage by providing methods for demonstrating the safe, long-term containment of, and determining the quantity of CO_2 stored in association with CO_2-EOR."[39] While the document was

[29] 26 U.S.C.S. §45Q (f)(2).
[30] *Id.*
[31] Department of the Treasury Internal Revenue Service, Carbon Dioxide Sequestration Credit, Form 8933 (2016) (available at https://www.irs.gov/pub/irs-prior/f8933--2016.pdf).
[32] Yang, Kennedy, & Hausker, Insider: *Guiding Implementation of Carbon Capture Tax Credit*s (2019).
[33] Robert F. Van Voorhees, *Crediting carbon dioxide storage associated with enhanced oil recovery*, Energy Procedia 114 (2017).
[34] ISO 27916 (2019).
[35] Proposed Collection; Comment Request for Notice 2009-83, 84 Fed. Reg. 39890, 39890 (Aug. 12, 2019).
[36] Department of Treasury & Internal Revenue Service, IRS Notice 2019-32, Request for Comments on Credit for Carbon Oxide Sequestration (2019).
[37] Yang, Kennedy, & Hausker, *Insider: Guiding Implementation of Carbon Capture Tax Credits* (2019).
[38] *Id.*
[39] ISO 27916 (2019).

not made with section 45Q directly in mind, it provides relevant procedures and mechanisms for assessing the containment and quantity of stored CO_2.[40]

The ISO standard requires operators to provide detailed information regarding the technical details of EOR operations including well construction, operation, quantification, and monitoring. An operator must describe any area in which they desire to conduct EOR operations[41] and prove with certainty that the site and operations are "designed, constructed, and tested to provide safe, long-term containment of CO_2."[42] Much like many current state permitting requirements, the ISO standard requires:

- verifications and descriptions of general lithologic description of the stratigraphic column above the EOR complex;
- depth to the top of the EOR complex;
- thickness of the defined stratigraphy within the EOR complex;
- structural and geophysical properties;
- lateral boundaries and any spill points relevant to containment;
- hydraulic/petrophysical/geochemical/geomechanical properties;
- associate storage capacity of CO_2 in the project reservoir; and
- engineering data.[43]

Under the ISO standard operators are also required to provide periodic documentation *at least* annually regarding:

- the quantity of associated storage in specified units of CO_2 mass, or volumetric units convertible to mass, during the period covered by the documentation;
- the cumulative quantity of associated storage in specified units of CO_2 mass, or volumetric units convertible to mass, since the beginning of the quantification period;
- the formula and date used to quantify the mass of associated storage, including the mass of CO_2 delivered to the CO_2-EOR project and losses during the period covered by the documentation;
- the methods used to estimate missing data and the amounts estimated;
- the approach and method for quantification utilized by the operator, including accuracy, precision and uncertainties;
- a statement describing the nature of validation or verification of the statement including the date of review, process, findings, and responsible person or entity; and
- the source of each CO_2 stream quantified as associated storage.[44]

[40] The Carbon Capture Coalition and the Carbon Utilization Research Council expressed their belief the ISO has the proper capabilities of verifying secure geologic storage for the purposes of section 45Q. See Yang, Kennedy, & Hausker, *Guiding Implementation of Carbon Capture Tax Credits* (2019). The document does not provide requirements for the selection, characterization or permitting sites because they are already governed by current oil and gas exploration and production standards.
[41] ISO 27916, §8.4.
[42] ISO 27916, §7.1.
[43] ISO 27916, §5.2
[44] ISO 27916, §4.4.

Associated CO_2 storage under the ISO standard must be quantified through the calculation of CO_2 losses, whether incidental or operational (e.g., related to venting and flaring and/or transfers).[45] Proof of secure geologic storage under the ISO standard requires that all losses of CO_2 must be detailed and documented thoroughly. In addition, the ISO standard gives discretionary authority to an agency, allowing it to require additional information related to project CO_2 emissions such as emissions related to electricity generation.[46]

The ISO standard further provides guidance that includes post-drilling operational containment of CO_2. Operators are required to demonstrate:

- the absence of detectable leakage or open conduits to the surface from the EOR complex, and that the injected CO_2 is, at the time of project termination, safely contained;
- compliance with all well decommissioning and plugging requirements for all CO_2-EOR project wells, that wells do not allow fluid movement out of the EOR complex, and that the CO_2-EOR project wells do not pose a leakage risk;
- the injected CO_2 is safely contained with sufficient documentation of the characteristics of the EOR complex and operational history of the CO_2-EOR project to demonstrate long-term stability and predictability of associated storage;
- risks and uncertainties relating to the associated storage of CO_2 were managed throughout the EOR project life; and
- facilities and ancillary equipment associated with CO_2-EOR project have been removed, except those required to be retained by lease or contractual obligations, integral to other operations, or intended for different uses which may be left in place with approval of the authority.[47]

INCORPORATING THE ISO STANDARD INTO LAW:

State oil and gas regulatory agencies in many states are already well positioned to verify secure geological storage of CO_2 in association with EOR. Already, all oil and gas regulatory agencies in states where CO_2-EOR operations are underway, make the findings consistent with the requirements of the ISO standard in association with administration of the related federal Underground Injection Control ("UIC Program"),[48] permitting of oil and gas operations, or regulation of the underground injection of CO_2. State oil and gas regulatory agencies are empowered to enact rules regulating the production of oil and gas consistent with their enabling acts. Where delegated authority already includes CO_2-EOR and associated storage, a state agency could promulgate rules incorporating the ISO standard pursuant to the state's administrative procedure act requirements for notice and comment. Doing so could create new or parallel regulatory pathways for operators desiring to claim credits pursuant to section 45Q.

[45] ISO 27916, §8.1.
[46] ISO 27916, §8.1.
[47] ISO 27916, §14.
[48] CO_2-EOR operations are conducted under UIC Class II wells. Nearly all states have primacy over the Class II program, see, Environmental Protection Agency, Primary Enforcement Authority for the Underground Injection Control Program.

Incorporation of independent standards through rulemaking is widely used by the federal government.[49] Indeed, both the National Technology Transfer and Advancement Act, and OMB Circular A-119, encourage federal regulatory agencies to increase their reliance on voluntary consensus standards such as the ISO standard at issue here.[50] Incorporation by reference is the "practice of codifying material published elsewhere by referring to the published standard in the text of a regulation." [51] These standards have the same effect as if they were set out fully in the regulation.[52] Should the Department of the Treasury and IRS adopt or incorporate by reference the ISO standard as demonstration of secure geologic storage, state regulatory agencies could thereafter incorporate the ISO standard into oil and gas rules governing CO_2-EOR.

The requirements of the ISO standard can be incorporated as either a mandatory or voluntary process in state agency rules regarding fluid injection for CO_2-EOR. Prior to initiating rulemaking, state agencies should evaluate whether demonstration of secure geologic storage and quantification of associated storage should be required of all operators engaged in CO_2-EOR operations, or only for those seeking the tax credit. Although all operators incidentally store some amount of CO_2 during tertiary recovery operations, some may not intend to claim a credit and therefore may not desire to participate in the potentially more extensive subpart RR MRV requirements associated with section 45Q. For small operations, the cost of additional administrative processes may outweigh the available tax benefit. To allow voluntary participation, the state may need to incorporate the ISO standard into a rule specific to section 45Q rather than the underground injection rules.

As an alternative, the Department of Treasury and IRS could adopt the ISO standard into its rules and provide for federal implementation of the standard. Federal implementation would create uniformity across all projects but may require duplicative administrative processes that mirror what is already required by state agencies and potentially requiring additional operator expense. Alternatively, federal regulations could allow CO_2-EOR operators to choose between proof of storage which is under subpart RR or a third party or state certification.

STATE IMPLEMENTATION

State oil and gas regulatory agencies already regulate CO_2-EOR unitization and permitting, and thus are a logical choice for implementation of the ISO standard. The ISO standard anticipates regulation and quantification of associated storage by a "competent governmental entity or entities with legal power to regulate or permit CO_2-EOR, to regulate storage of CO_2 in association with a CO_2-EOR operation, or to regulate quantification of the storage of CO_2 in association with a CO_2-EOR operation."[53] To make the findings required by the ISO standard, an agency would need to handle initial site characterization and well design as well as long term monitoring, verification,

[49] Peter L. Strauss, *Private Standards Organizations and Public Law*, William & Mary Bill of Rights Journal, Vol. 22, p. 497, 2013; Columbia Public Law Research Paper No. 13-334 (2012).
[50]National Institute of Standards and Technology, *Key Federal Law and Policy Documents: NTTAA & OMB A-119 (2019) (available at* https://www.nist.gov/standardsgov/what-we-do/federal-policy-standards/key-federal-directives).
[51] Emily Bremmer, *Incorporation by Reference in an Open-Government Age*, 36 Harv. J.L. & Pub. Pol'y 131 (2013).
[52] *Id.*
[53] ISO 27916, §3.3.

and reporting. Although many state oil and gas regulatory agencies already have statutory authority and rules regarding CO_2-EOR, the majority of these rules do not provide for quantification of stored CO_2 or reporting of CO_2 losses. Accordingly, state agency implementation of the ISO standard may require expansion of current underground injection rules and verification capabilities.

Many state rules regarding underground injection well permitting and CO_2-EOR operations reference most but not all requirements provided by the ISO standard. Thus, new rules may be required regarding well descriptions, operation, and project decommissioning. As demonstrated in the Table 1 below, the level and extent of additional rules required will vary significantly based on the extent of current application regulations in the state.

ISO STANDARD	TX	WY	CO	ND	CA
General characterization of the EOR complex (e.g., proof of containment of all likely subsurface locations to which the CO_2 could reasonably move beyond the project reservoir & evidence of well integrity)	16 T.A.C. 3.46(j)	W.S. 30-5-110	COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 3.1
Description of the facilities within the CO_2-EOR project (e.g., overview of equipment, downstream of the CO_2 custody transfer meter, used to handle CO_2 production, including design specifications)	16 T.A.C. 3.46(k)(4)(C)	W.S. 30-5-110(c)	COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 3.1
Description of all wells and other engineered features in the CO_2-EOR project	16 T.A.C. 3.46(h)	WOGCC Ch. 4 Sec. 7	COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 3.1
The operational history of the project reservoir	16 T.A.C. 3.46(k)	W.S. 30-5-110(c)		N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 1.1.2
General lithologic description of the stratigraphic column above the EOR complex	16 T.A.C. 3.46(b)	WOGCC Ch. 4 Sec. 7	COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 2.3
Depth to the top of the EOR complex	16 T.A.C. 3.46(k)(1)(F)	WOGCC Ch. 4 Sec. 7	COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 2.1
Thickness of the defined stratigraphy within the EOR complex	16 T.A.C. 3.13(a)(C)		COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 2.3
Structural and geophysical properties	16 T.A.C. 3.46(b)	WOGCC Ch. 4 Sec. 7		N.D.A.C. 43-02-05-07	C.A.R.B. CCS Protocol 2.3
Lateral boundaries and any spill points relevant to containment	16 T.A.C. 3.46(b)	WOGCC Ch. 4 Sec. 7	COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 2.2
Hydraulic / petrophysical / geochemical / geomechanical properties	16 T.A.C. 3.13	WOGCC Ch. 4 Sec. 7	COGCC Rule 401	N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 2.3
Associated storage capacity of CO_2 in the project reservoir, recognizing that EOR operations are typically designed for maximum economic hydrocarbon production				N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 2.1
Engineering data (e.g., injection-withdrawal ration monitoring, well integrity monitoring, pressure monitoring, monitoring of CO_2 movement within leakage pathways identified in the initial containment assurance and monitoring of pressure response within the boundary of the EOR complex)	16 T.A.C. 3.46(i)	W.S. 30-5-110(c)		N.D.A.C. 43-02-05-04(1)	C.A.R.B. CCS Protocol 1.1.3.3.

Table 1. Comparison of ISO Standard with Samples of Relevant State Regulations/Methodologies

The following section describes regulations and potential implementation pathways in four states with existing CO_2-EOR operations and/or potential for the same: Wyoming, Texas, North Dakota, and Colorado.[54] California is included to show a unique pathway in which a state has provided standards for CO_2-EOR but does not have known ongoing commercial operations. California's approach is anticipated to influence other states that already have adopted, or are likely to adopt in the future, mid-century (or earlier) decarbonization goals for transportation fuels and electricity generation.

OIL AND GAS REGULATORY AGENCIES:

Wyoming:

The Wyoming legislature already has provided the Wyoming Oil and Gas Conservation Commission ("WOGCC") with statutory authority to enact rules relative to the associated storage of CO_2. Governance and regulation of CO_2-EOR operations in Wyoming are shared between the WOGCC and the Wyoming Department of Environmental Quality ("WYDEQ"). Wyo. Stat. Ann. § 30-5-502 provides that "the [WOGCC] shall, in consultation with [WYDEQ], promulgate rules establishing standards and procedures for the certification of incidental storage of carbon dioxide and the certification of quantities of carbon dioxide incidentally stored."[55] Although WOGCC has not yet issued these rules, an overhaul of jurisdictional authority and delegation is not required in order for Wyoming state agencies to adopt rules consistent with the ISO standard and the requirements of section 45Q.

The state of Wyoming has delegated regulation of oil and gas activities to the WOGCC.[56] Water-flooding, CO_2 injection and other enhanced oil and gas recovery operations are regulated by the WOGCC pursuant to Wyo. Stat. Ann. § 30-5-110.[57] This statute, and the associated rules, create a permitting process for CO_2-EOR operations in the state and require operators to provide information that already overlaps with the ISO standard, including a description of the proposed area and a proposed operating plan. Chapter 3 Section 42 of the WOGCC Rules requires any person desiring to obtain the benefits of Wyo. Stat. Ann. § 30-5-110 to file an application with the Supervisor for approval of such agreement.[58] Chapter 3 Section 43 further elaborates that all applications must comply with Wyo. Stat. Ann. § 35-11-315, which requires a statement of the type of operations contemplated and compliance with environmental requirements, the proposed plan of unitization and proposed plan for determining the quantity of pore space storage capacity, and how the operation will be supervised and managed.[59]

WOGCC rules separately require verification of compliance with the Wyo. Stat. Ann. § 39-14-205 severance tax exemption for tertiary production. Wyoming law permits an operator to deduct

[54] It is noteworthy that many of these projects span more than one jurisdiction and thus various aspects of the project could be subject to overlapping jurisdiction as seen in Oxy's current proposed project in both Colorado and Texas. See *Oxy and Total Team Up in Colorado for Carbon Sequestration Project*, Journal of Petroleum Technology (2020) (available at https://pubs.spe.org/en/jpt/jpt-article-detail/?art=6440).
[55] Wyo. Stat. Ann. §30-5-502(b).
[56] Wyo. Stat. Ann. §30-5-104.
[57] Wyo. Stat. Ann. §30-5-110.
[58] Wyoming Oil and Gas Conservation Commission Chapter 3. Section 42.
[59] Wyoming Oil and Gas Conservation Commission Chapter 3 Section 43.

severance taxes paid on CO_2 from those owed on oil produced through CO_2-EOR operations. The severance tax exemption states: "in the case of tertiary production of crude oil resulting from injection of carbon dioxide gas, all Wyoming severance taxes paid on the carbon dioxide gas injected shall be deducted from and allowed as a credit against the severance taxes imposed on the oil produced by the injection."[60] To be certified as a tertiary enhanced recovery project, the regulation requires that the operator present evidence of production history, reservoir and production characteristics and the evidence of generally accepted petroleum engineering practices.[61] Although the Department of Revenue has jurisdiction over taxes, the WOGCC verifies compliance.

The federal Safe Drinking Water Act mandates that the EPA develop program requirements that protect underground source drinking water from underground injection operations.[62] The EPA has authority over injection wells, unless a state seeks to take over "primary" authority of the wells within their state. Class II well certification encompasses injection for enhanced oil recovery.[63] Wyoming has obtained such "primary" authority over CO_2-EOR injection wells, and, such authority, including the construction and testing of injection wells for CO_2-EOR, has been delegated and is regulated by the WOGCC. Thus, the WOGCC has primacy[64] for implementation of EPA's Class II injection program.[65]

Incorporation and verification of the ISO standards in Wyoming would require coordination between the WOGCC and WYDEQ. These Wyoming agencies already have statutory authority to promulgate rules regarding quantification and verification of associated CO_2 storage, either via the ISO standard or other mechanism adopted in Treasury Rules. As evidenced by the state's primacy over the Class II injection program, existing comprehensive regulatory framework for CO_2-EOR, and existing requirements for the verification of production and reservoir engineering associated with state severance tax exemptions, the capabilities required for implementation of the ISO standard are already well developed within the state of Wyoming.

Texas

In Texas, oil and gas operations and Class II injection wells are regulated by the Texas Railroad Commission ("RRC"). [66] Like Wyoming, Texas has a comprehensive framework for enhanced oil recovery and primacy over Class II wells.[67] 16 Tex. Admin. Code § 3.46 outlines the permitting

[60] Wyo. Stat. Ann. §39-14-205(d).
[61] Wyoming Oil and Gas Conservation Commission Chapter 3. Section 40.
[62] Environmental Protection Agency, *Geologic Sequestration of Carbon Dioxide, Underground Injection Control (UIC) Program Class VI Primacy Manual for State Directors,* (2014).
[63] Environmental Protection Agency, *Class II Oil and Gas Related Injection Wells* (2019), (available at https://www.epa.gov/uic/class-ii-oil-and-gas-related-injection-wells).
[64] Wyoming Department of Environmental Quality, *Underground Injection Control* (2019) (available at http://deq.wyoming.gov/wqd/underground-injection-control/).
[65] Wyoming is in the process of obtaining primacy over the UIC Class VI program to obtain regulatory authority non-EOR geologic storage injections – e.g., into deep saline formations.
[66] Classification of Injection Wells, 30 Tex. Admin. Code § 331.11 (2019); Fluid Injection into Productive Reservoirs, 16 Tex. Admin. Code §3.46 (2019).
[67] Environmental Protection Agency, *Primary Enforcement Authority for the Underground Injection Control Program* (2019) (available at https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program#what_states).

process for fluid injection into productive reservoirs.[68] The permit process authorizes the RRC to require proof of operational specifics, including cement casing, extensive well records, monitoring and reporting on a minimum of a monthly basis, testing of well integrity, and specified plugging requirements.[69] This process is in conjunction with Class II mechanical integrity testing process for disposal wells.[70] These fluid injection permitting requirements already substantially overlap with the ISO standard. However, there is a notable gap in the lack of an explicit requirement for associated storage capacity. Overall, the state would not be required to substantially overhaul existing regulations or increase expertise in the implementation process if it were to be tasked by the IRS with determining and regulating "secure geologic storage"' under the ISO standard and the requirements of section 45Q.

In fact, and in addition to regulation of fluid injection operations, Texas already has a framework to ensure compliance with secure geological storage in association with CO_2-EOR. This is because in addition to the federal 45Q credit, Texas provides a state tax incentive for enhanced oil recovery projects using anthropogenic CO_2.[71] To qualify for the state tax incentive, an operator must provide the RRC with extensive information, including:

- plats showing the proposed project area and all wells within the area;
- production and injection history including volume of anthropogenic CO_2;
- planned enhanced oil recovery procedures;
- information to demonstrate that the CO_2 to be injected is anthropogenic and a description of the method(s) of capturing and measuring the captured CO_2 at the source;
- a description of the planned sequestration program reasonably expected to ensure that at least 99% of the sequestered CO_2 will remain sequestered for at least 1,000 years;
- planned monitoring and verification measures, including the planned duration of such measures, that will be employed to demonstrate that the sequestration program is performing as expected; and
- any other pertinent information requested by the Commission. [72]

Thus, the Texas RRC has already been making findings regarding secure geological storage of CO_2. Verification for the federal tax credit could easily be duplicated in terms of the ISO standard. Although the state tax incentive applies only to anthropogenic CO_2, the RRC has explicit rulemaking authority that could be utilized to specifically extend findings to EOR operations using natural CO_2 if the state were to seek such route.[73] This anthropogenic/natural CO_2 consideration could be relevant in the DAC context, given that the regulatory status of CO_2 removed from the ambient air arguably is uncertain under the federal CAA.[74]

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[68] Fluid Injection into Productive Reservoirs, 16 Tex. Admin. Code §3.46 (2019).
[69] *Id.*
[70] See Texas Railroad Commission, *Injection and Disposal* (2019) (available at https://www.rrc.texas.gov/about-us/resource-center/faqs/oil-gas-faqs/faq-injection-and-disposal-wells/).
[71] Enhanced Oil Recovery Projects-Approval and Certification for Tax Incentive, 16 Tex. Admin. Code § 3.50 (2019).
[72] *Id. at* (k)(4)(B)
[73] Petition for Adoption of Rules, 16 Tex. Admin. Code §1.301 (2019).
[74] Kipp Coddington, *The Relationship Between Direct Air Capture (DAC) & Carbon Capture Utilization & Storage (CCUS) as GHG Mitigation Technologies* (2019) (available at https://www.linkedin.com/pulse/informal-observations-relationship-any-between-direct-kipp-coddington/).

North Dakota

The state of North Dakota regulates oil and gas operations through the North Dakota Industrial Commission ("NDIC").[75] Much like Wyoming, North Dakota has a regulatory framework for UIC for EOR.[76] The application process for an underground injection permit is extensive, requiring, for example, data regarding average and maximum daily rate of fluids to be injected, geologic name and depth to base of the lowermost underground sources of drinking water which may be affected by the injection, existing or proposed casing, tubing, and packer data, a proposed injection program, and schematic drawings of the injection system.[77] As highlighted above in Table 1, these requirements are similar to the ISO standard, which likewise requires general characterization of the EOR complex, a description of the wells including structural and geophysical properties, and engineering data that includes injection plans and monitoring.[78]

North Dakota also recently passed a bill providing for state tax incentives for CO_2-EOR.[79] The bill amends Section 57-51.1-03 of the North Dakota Century Code and provides that "[T]he incremental production for a tertiary recovery project that injects more than fifty percent carbon dioxide produced from coal" is exempt for oil extraction tax for a period of twenty years from the date the incremental production begins or from the date the project is certified by the industrial commission as meeting the fifty percent or more carbon dioxide produced from coal injection requirement.[80] While this state tax incentive provided for in the recently adopted bill does not require actual proof of secure geologic storage, the tax credit does require proof of how much CO_2 is being injected and the source of the CO_2.

North Dakota has both the framework, authority, and expertise to implement the ISO standard or other IRS requirement regarding the verification of secure geologic storage. The state and the NDIC are well positioned to make the necessary findings for secure geologic storage that operators could use to receive the tax incentive (if transferred from the owner/operator of the capture facility). This is evidenced through North Dakota's primacy status over both Class II and Class VI operations, implementation of the state tax credit, and extensive current well-permitting process for underground injection associated with CO_2-EOR.

Colorado

In Colorado, enhanced recovery projects and the subsequent storage of liquid hydrocarbons are regulated by the Colorado Oil and Gas Conservation Commission ("COGCC"). Enhanced recovery operations are permitted according to Rule 401 of the COGCC. Rule 401 requires operators to provide additional information beyond that which is required of initial recovery operations. This includes: (i) the name and depth of all underground sources of drinking water; (ii) a resistivity log; (iii) a description of the casing of the injection well or wells; and (iv) a statement specifying the type of fluid to be injected, including chemical analysis, source, estimated

[75] N.D. Admin. Code §43-01-01-01 (2019).
[76] The North Dakota Industrial Commission also has primary regulatory authority over Class VI injection well activities in the State of North Dakota. See Environmental Protection Agency Primary Enforcement Authority.
[77] Underground Injection Control N.D. Admin. Code §43-02-05 (2006).
[78] *Id.*
[79] N.D H.B. No. 1439 (2019).
[80] *Id.*

amounts to be injected dialing, and anticipated injection pressures.[81] The state regulatory rules further require adequate casing and cementing of injection wells and specified notice of commencement and discontinuance of injection operations.[82] In addition, Colorado currently has primary authority over Class II wells.[83]

However, there is uncertainty about Colorado's implementation and regulation of oil and gas operations going forward. Colorado recently overhauled its conservation law, including the objective and purpose of oil and gas regulation. One of the fundamental changes is that the goal of the COGCC is no longer to "foster" the oil and gas industry, but to instead "regulate" it. This includes a priority shift to public health, safety, and environmental concerns.[84] The law also statutorily waives preemption of local regulation of certain aspects of oil and gas operations.[85] Although the commission has initiated rulemakings regarding implementation of the new law, it is currently unclear how the state will address shared governance of oil and gas operations with the localities. Additionally, the new law tasks the Colorado Air Quality Control Commission with adopting additional air quality rules to minimize emissions from oil and gas activities.[86] Finally, the law reconfigured the makeup of the oil and gas commission, and it is currently unclear how the agency's new makeup will affect the agency's ability to evaluate technical aspects associated with secure geologic storage.

Although Colorado has traditionally regulated CO_2-EOR operations in a manner that is consistent with the requirements of the ISO standard for secure geologic storage, recent changes in the state conservation law may complicate state approaches to implementation of section 45Q. Until the COGCC finishes its rulemaking processes implementing the new law, it will remain unclear whether the COGCC is an appropriate agency for implementation of the ISO standard and the requirements of section 45Q.

California:
In contrast to North Dakota and Texas, which encourage CO_2-EOR through state severance tax credits, California has encouraged associated storage through a credit program available to CO_2-EOR operators. Administered by the California Air Resources Board ("CARB"), the program Low Carbon Fuel Standard ("LCFS"), a "market-based policy that sets annual carbon intensity benchmarks on transport fuels sold, supplied or offered for sale in California."[87] The program uses a lifecycle assessment and quantification methodology in regard to carbon storage.[88] Fuels with a

[81] Unit Operations, Enhanced Recovery Projects, and Storage of Liquid Hydrocarbons, Colorado Oil and Gas Conservation Commission §401(b)(4) (2014).
[82] *Id.* at §§404 & 405.
[83] Environmental Protection Agency, *Primary Enforcement Authority for the Underground Injection Control Program* (2019) (available at https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program).
[84] State of Colorado, *What's Next for Colorado's New Oil and Gas Law* (2019) (available at https://cogcc.state.co.us/documents/sb19181/Overview/Whats_Next_for_Colorados_New_Oil_and_Gas_Law.pdf).
[85] *Id.*
[86] *Id.*
[87] *Id.*
[88] Michael Godec, Steven Carpenter, & Kipp Coddington, *Evaluation of Technology and Policy Issues Associated with the Storage of Carbon Dioxide via Enhanced Oil Recovery in Determining the Potential for Carbon Negative Oil*, 114 Energy Procedia 6563, 6565 (2017).

carbon intensity that is higher than the relevant benchmark generate deficits.[89] Operators must have enough credits to compensate for any deficits created by the sale of carbon intensive fuels.[90] Credits can be obtained through the purchase from another regulated party in California, or a provider of clean, alternative fuels that have opted into the LCFS.[91] In September of 2018, CARB voted to include CO_2 reductions from carbon capture and sequestration under the LCFS.[92] Projects that qualify to generate credits specifically include CO_2-EOR.[93] CO_2-EOR projects can be conducted anywhere in the world and receive the credits so long as the transportation fuel is sold in California.[94] The credits under this program could be stacked with the section 45Q tax credit that makes carbon reductions worth $200 per metric ton currently.[95] This is a floating market rate that allows the credit to increase based upon current market conditions.

To obtain this credit, operators must complete a Quantification Methodology and Permanence Protocol. For CO_2-EOR operations there are extensive reporting requirements for well monitoring, verification, and description similar to the ISO.[96] This includes a site that is "of sufficient volume, porosity, permeability and injectivity to receive the total anticipated volume of CO_2, have a minimum injection depth of 800m or depth corresponding to the conditions where CO_2 exists in a supercritical state, and have a confining system free from transmissive faults or fractures."[97] Operators must also submit annual reports that include mechanical well integrity and pressure tests, evaluation of the geological and hydrological characteristics, wells logs, regional geological information, and well plugging that assures no leaks.[98] In the event of a loss of mechanical integrity or suspected leak, the operator must implement an emergency plan that requires the cessation of injection in the affected wells and the operator must take all reasonable steps to determine whether there has been any leakage.[99] All projects, whether they are CO_2-EOR or geologic storage, must perform monitoring and leak detection for 100 years after CO_2 injection has ended regardless of the type of project and risk profile.[100] This means that site closure is not even possible until 100 years after any injection has been completed to ensure secure storage. This provides assurances that carbon is properly stored from the beginning of operations to well after the cessation of operations. All permanence certification applications must be submitted jointly by the capture and storage operator and must be verified by a CARB-approved third party prior to submission.[101] All data submitted as part of the site certification must be certified by a professional geologist as true

[89] Townsend & Havercroft, *The LCFS and CCS Protocol* (2019).
[90] *Id.*
[91] *Id.*
[92] Deepika Nagabhushan, *California's CO_2 Reduction Program Opens Doors to CCS* (2018), (available at https://www.catf.us/2018/11/californias-CO_2-reduction-program/).
[93] Townsend & Havercroft, *The LCFS and CCS Protocol* (2019).
[94] *Id.*
[95]California Air Resources Board, Weekly LCFS Credit Transfer Activity Reports (2019), (available at https://ww3.arb.ca.gov/fuels/lcfs/credit/lrtweeklycreditreports.htm).
[96] See California Air Resources Board, *Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard* (2018).
[97] Townsend & Havercroft, *The LCFS and CCS Protocol* (2019).
[98] See California Air Resources Board, *Carbon Capture and Sequestration Protocol under the Low Carbon Fuel Standard* (2018).
[99] Townsend & Havercroft, *The LCFS and CCS Protocol* (2019).
[100] Nagabhushan, *California's CO_2 Reduction Program Opens Doors to CCS* (2018).
[101] Townsend & Havercroft, *The LCFS and CCS Protocol* (2019).

and complete.[102] The geologist must also certify that the risks that were identified in the risk assessment have been sufficiently monitored or remediated.[103] Finally, a professional engineer must certify that all information submitted under the CCS Project Certification is "sufficiently robust and that, in their professional judgement, the CCS project is able to meet the permanence requirements of the CCS Protocol."[104] These thorough guidelines ensure that carbon is stored and remains stored permanently.

While addressing all aspects of the ISO standard, as seen above in Table 1, California's program has been criticized for being more stringent and onerous than the existing verification pathway under Subpart RR. California already has rigorous standards in place for obtaining the program's credits and requirements for secure geologic storage. California's CCCS methodology, however, generally exceeds the requirements of the federal Class VI program.[105] This is seen, for example, in the 100-year post injection period requirement as compared to 50 years for Class VI wells.[106] And while the federal Class VI program alone is not directly relevant for CO_2-EOR operations, the California approach arguably potentially complicates related considerations for commercial CO_2-EOR operations.[107]

Should the IRS implement or incorporate by reference the ISO standard, California would be well situated to assist operators claiming credits under section 45Q in addition to the LCFS credits. Like Texas, California's state tax credit certifications might serve a dual state and federal purpose. As for operators, however, the stringent requirements posed by California could discourage CO_2-EOR operations. This forebodes the possible necessity of an either/or option of state or third-party implementation of the ISO standard to ensure operations and to preserve the opportunity to qualify for section 45Q.

CONCLUSION:

By facilitating utilization of section 45Q through verification of "secure geologic storage," states can encourage oil and gas operators and carbon production and capture facilities to engage in CO_2-EOR operations. While the IRS has yet to issue guidance identifying the ISO standard as a pathway for demonstrating secure geologic storage, this paper demonstrates that many state agencies already have authority and are already making findings related to secure geologic storage as part of current oil and gas regulations, permitting of UIC wells or as part of state tax waiver or carbon credit programs. By incorporating the ISO standard requirements into state oil and gas regulatory frameworks, states have an opportunity to be frontrunners in CO_2-EOR verification processes required by the section 45Q tax credit. In so doing, states can advance decarbonization goals, promote economic development, and encourage lower-carbon oil production and utilization.

[102] *Id.*
[103] *Id.*
[104] *Id.*
[105] *Id.*
[106] *Id.*
[107] For example, federal regulations currently provided a mechanism by which Class II wells must transition to Class VI operations under certain conditions. 40 C.F.R. §144.19 (2019).