

COMMENT

A HITCHHIKER'S GUIDE TO CARBON CAPTURE AND SEQUESTRATION REGULATION IN TEXAS AND BEYOND*

ABSTRACT

Carbon capture and sequestration (CCS), a decades-old concept, has recently garnered significant support and investment as a leading method for decarbonizing the atmosphere. However, regulation of CCS technology lags behind its rapid development. In most cases, primary regulatory control belongs to the Environmental Protection Agency, though state regulations also play a role. However, an increasing number of states seek control over their own CCS programs through a process known as primacy. This Comment provides an overview of CCS regulation within states that already have or are currently seeking primacy over CCS from the Environmental Protection Agency.

* University of Houston Law Center, J.D. Candidate 2024, and Chief Notes & Comments Editor of Board 61 of the *Houston Law Review*. This Comment received the Jackson Walker Award for the Best Paper in the Area of Natural Resources Law. The Author would like to thank Conner Thompson, a Research Scholar for the Environment, Energy, and Natural Resources Center at the University of Houston Law Center, for sharing his insight into the world of carbon capture. Additionally, Zain Hassan and Professor Tracy Hester provided invaluable mentorship that extends well beyond the writing of this piece. The Author would also like to thank the members of Boards 61 and 62 of the *Houston Law Review* for their excellent editorial work.

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I. INTRODUCTION

Carbon capture and injection is not a new concept.¹ In fact, this technology has existed for more than forty years, and it is regularly implemented in enhanced oil recovery (EOR) operations in the United States and around the world.² The process involves injecting carbon dioxide (CO₂) into existing oil fields to increase the pressure in the reservoir and drive the oil towards a producing well.³ One report estimates that nearly 300,000 barrels of oil are produced each day from EOR projects around the world.⁴ As part of the EOR process, most of the injected CO₂ remains in the reservoir.⁵ Carbon capture and sequestration (CCS) projects seek to build on this concept and permanently inject CO₂ into reservoirs on a much larger scale.

Despite the lengthy history of CO₂ injection for EOR, the regulatory scheme for CCS (or storage) is a relatively new area of law.⁶ In most of the United States, the Environmental Protection Agency (EPA) enforces the regulations surrounding the process.⁷ However, as CCS technology gains prevalence and the demands for CCS permits increase, states are beginning to seek primacy from the EPA to control their own CCS regulatory programs.⁸ Texas is among the states currently seeking primacy over its CCS wells from the EPA.⁹

1. See *A Brief History of CO₂ EOR, New Developments and Reservoir Technologies for CO₂ EOR in Conjunction with Carbon Capture, Utilization and Storage (CCUS)*, MELZER CONSULTING 2 (2020) [hereinafter *A Brief History*], <https://www.co2conference.net/wp-content/uploads/2021/01/Melzer-CO2-EOR-History-New-Developments-forweb.pdf> [https://perma.cc/54DS-QSYU].

2. *Id.*

3. Christophe McGlade, *Can CO₂-EOR Really Provide Carbon-Negative Oil?*, INT'L ENERGY AGENCY (Apr. 11, 2019), <https://www.iea.org/commentaries/can-co2-eor-really-provide-carbon-negative-oil> [https://perma.cc/D8XN-6WJD].

4. *A Brief History*, *supra* note 1.

5. *Id.*

6. *Id.*; 40 C.F.R. § 146.91(e) (2022).

7. See *Primary Enforcement Authority for the Underground Injection Control Program*, U.S. ENV'T PROT. AGENCY [hereinafter *Primary Enforcement Authority*], <https://www.epa.gov/uic/primary-enforcement-authority-underground-injection-control-program-0#> [https://perma.cc/8NHL-CTN5] (last updated Feb. 2, 2024).

8. Philip K. Lau et al., *Carbon Capture, Utilization, and Storage: Class VI Wells and US State Primacy*, MAYER BROWN (June 9, 2022), <https://www.mayerbrown.com/en/perspectives-events/publications/2022/06/carbon-capture-utilization-and-storage-class-vi-wells-and-us-state-primacy> [https://perma.cc/N43X-Y35L]; see *Primary Enforcement Authority*, *supra* note 7 (“Primary enforcement responsibility, often called primacy, refers to state, territory, or tribal responsibilities associated with implementing EPA approved UIC programs.”).

9. *Primary Enforcement Authority*, *supra* note 7.

For decades, Texas oil-producing facilities have captured CO₂ and injected it into the ground for EOR.¹⁰ Despite the active role Texas has played in CO₂ capture and use, it has only recently taken steps towards seeking primacy over CCS injection wells.¹¹ In June 2021, Texas enacted House Bill (H.B.) 1284, which gave the Railroad Commission of Texas (RRC) sole jurisdiction over carbon storage wells.¹² This constituted an important step in the process of seeking primacy over carbon storage wells because, until the bill's passage, jurisdiction had been shared by the RRC and the Texas Commission on Environmental Quality (TCEQ).¹³ This change in jurisdiction was meant to simplify and streamline the process for seeking primacy from the EPA.¹⁴ In addition to granting sole jurisdiction to the RRC, H.B. 1284 also requires the RRC to “seek primacy to administer and enforce the program for the geologic storage and associated injection of anthropogenic carbon dioxide . . . including onshore and offshore geologic storage and associated injection.”¹⁵ Since the passage of H.B. 1284, the RRC has submitted to the EPA a pre-application for carbon storage well primacy and has requested that the governor of Texas formally ask the EPA for primacy.¹⁶ Despite these actions, it could still be several years until the EPA grants primacy over carbon storage wells to Texas.¹⁷ Until Texas receives primacy, any facility seeking a permit for geologic storage of CO₂ will need to submit applications to both the EPA and the RRC.¹⁸

Despite conquering the preliminary regulatory requirements involved with seeking primacy, several issues related to CCS remain unsettled in Texas. First, the state must establish a clear policy regarding pore space ownership. Second, safety must be incentivized through an unambiguous chain of liability, which would clarify who is ultimately responsible for the stored CO₂ after

10. *Enhanced Oil Recovery*, OFF. FOSSIL ENERGY & CARBON MGMT., <https://www.energy.gov/fecm/science-innovation/oil-gas-research/enhanced-oil-recovery> [https://perma.cc/C8CQ-XVNM] (last visited Feb. 3, 2024).

11. Lau et al., *supra* note 8.

12. *Id.*; H.B. 1284, 87th Leg., Reg. Sess. (Tex. 2021).

13. Lau et al., *supra* note 8.

14. Liskow & Lewis, *New Legislation Signals Strong Support for CCUS in Texas*, ENERGY L. BLOG (June 21, 2021), <https://www.theenergylawblog.com/2021/06/articles/energy/energy-natural-resources/new-legislation-signals-strong-support-for-ccus-in-texas/> [https://perma.cc/WK8H-V3HE].

15. H.B. 1284 § 13, 87th Leg., Reg. Sess. (Tex. 2021); Lau et al., *supra* note 8.

16. Lau et al., *supra* note 8.

17. *Id.*

18. *Geologic Storage of Anthropogenic CO₂*, RRC LEADING TEX. ENERGY, <https://www.rrc.texas.gov/oil-and-gas/applications-and-permits/injection-storage-permits/co2-storage/> [https://perma.cc/QD3X-MFQH] (last visited Feb. 3, 2024).

injection is completed. Third, environmental justice communities must be adequately protected, educated, and involved in the CCS facility siting and permitting process.

This Comment provides an overview of the state of CCS regulation in Texas and other states that have primacy or are currently seeking primacy over CO₂ injection wells. This Comment also highlights potential issues in the development and implementation of CCS technology. Part II presents an introduction to the concept of CCS along with a basic overview of the process of capturing and storing carbon. It provides the necessary background for understanding why governments and corporations are pursuing CCS implementation. Part III discusses the environmental and economic benefits of CCS as well as concerns regarding safety and the inevitable prolongment of the world's dependency on fossil fuels due, in part, to CCS technology. Part IV provides a brief introduction to the federal regulatory program and introduces the states that already have or are seeking primacy over their own regulatory programs. Part V discusses pore space ownership and the conflict between surface estate owners and mineral estate owners, which is particularly contentious in Texas. Part VI explores liability and considers the various ways that states have allocated liability between operators and the states themselves. It then explores the possibility of creating, or building on already existing, liability trust funds in a system that could mirror successful programs already in place for oil spills and hazardous substance cleanup. Part VII addresses environmental justice concerns and the Biden administration's emphasis on education and community involvement. It considers the environmental justice measures already incorporated into state primacy applications and highlights concerns raised by Texas organizations in response to proposed CCS regulations in Texas. Part VIII raises the question of whether offshore CCS projects would solve many of the concerns regarding pore space ownership, liability, and environmental justice. Part IX concludes by summarizing the issues addressed in this Comment and their possible resolutions.

II. BACKGROUND

CCS is a promising method for reducing CO₂ emissions, which is a vital element of global efforts to combat global warming.¹⁹ In 2020, the Global CCS Institute hailed CCS as a “game-changer” and an “essential part of the solution” in the fight against climate change.²⁰ While the term CCS appears in the news with increasing regularity, many people might find themselves asking basic questions such as: “What is CCS?” and, “How does CCS work?” To start, CCS is a three-step process.²¹ Step one requires the separation and capture of CO₂ from industrial sources, such as coal-fired power plants or steel and cement manufacturing operations.²² There are several combustion-based systems used for capturing CO₂ from power plants and factories, including post-combustion capture, pre-combustion capture, and oxyfuel combustion.²³ Additionally, CO₂ can be captured from the process of natural gas purification, which does not involve fuel combustion.²⁴

In step two, the captured CO₂ is transported to a storage facility using pipelines, tanker trucks, or tanker ships.²⁵ Pipeline transport offers the most economical system of high-volume, long-distance CO₂ transportation, although road and rail transport provide the best options for transporting smaller quantities of CO₂ across shorter distances.²⁶

19. *What Is Carbon Sequestration?*, NAT'L GRID, <https://www.nationalgrid.com/stories/energy-explained/what-carbon-sequestration> [https://perma.cc/486G-53KB] (last updated Apr. 7, 2022).

20. *Global Status of CCS 2020*, GLOB. CCS INST. 12 (Nov. 2020), <https://www.globalccs.institute.com/wp-content/uploads/2021/03/Global-Status-of-CCS-Report-English.pdf> [https://perma.cc/S2WF-ZRYV].

21. *What Is Carbon Capture and Storage?*, NAT'L GRID, <https://www.nationalgrid.com/stories/energy-explained/what-is-ccs-how-does-it-work> [https://perma.cc/C7A5-W4JC] (last updated Feb. 28, 2023).

22. *Id.*; *Carbon Storage FAQs*, NAT'L ENERGY TECH. LAB'Y, <https://netl.doe.gov/carbon-management/carbon-storage/faqs/carbon-storage-faqs> [https://perma.cc/B57D-K745] (last visited Feb. 3, 2024).

23. INDRANI BHATTACHARYA ET AL., CARBON CAPTURE AND STORAGE: PHYSICAL, CHEMICAL, AND BIOLOGICAL METHODS 9 (Rao Y. Surampalli et al. eds., 2015). “Carbon capture is most effective on large, stationary sources of CO₂ because the capture process exhibits significant economies of scale. It is much easier and cheaper to implement CCS on the smokestacks of power plants and factories than the tailpipe of an automobile or the chimney of a house.” MIT Press, *Understanding Carbon Capture*, MEDIUM (Oct. 25, 2018), <https://medium.com/@mitpress/understanding-carbon-capture-8626cebb09db> [https://perma.cc/PT8M-7TDS].

24. BHATTACHARYA ET AL., *supra* note 23.

25. *Id.*; *What Is Carbon Sequestration?*, *supra* note 19; HOWARD J. HERZOG, CARBON CAPTURE 69 (2018).

26. BHATTACHARYA ET AL., *supra* note 23, at 12.

Step three is the process of permanently storing, or sequestering, the captured CO₂ in deep underground geologic formations.²⁷ Geologic formations include saline formations, such as saline aquifers under the ocean, and depleted oil and natural gas reservoirs.²⁸ Howard Herzog, a senior research engineer at MIT Energy Initiative, identifies four main criteria for a suitable geologic storage formation.²⁹ First, the geologic formation must have good porosity and permeability.³⁰ Second, the formation must occur at a depth below 800 meters to ensure the CO₂ is stored at a safe pressure within the pore space.³¹ Third, the formation must have an “impermeable caprock” to keep the CO₂ trapped in the formation.³² Fourth, the formation must be “thick and continuous over large areas” to store large quantities of CO₂.³³

Essentially, as Herzog writes, “Geologic storage of CO₂ is the mirror image of oil and gas production.”³⁴ In oil and gas production, wells are drilled into the Earth to extract oil and gas.³⁵ When storing CO₂, wells are drilled into the Earth to inject pressurized CO₂ deep into the ground.³⁶ The EPA labels these CO₂ injection wells “Class VI” wells and regulates them as part of its Underground Injection Control (UIC) program.³⁷

27. *What Is Carbon Sequestration?*, *supra* note 19; *What Is Carbon Capture and Storage?*, *supra* note 21; *Carbon Storage FAQs*, *supra* note 22.

28. HERZOG, *supra* note 25, at 73–74.

29. *Howard J. Herzog*, CARBON CAPTURE & SEQUESTRATION TECHS. @ MIT, <https://sequestration.mit.edu/people/hjherzog/> [<https://perma.cc/GZH2-TV DV>] (last visited Feb. 3, 2024); HERZOG, *supra* note 25, at 72.

30. HERZOG, *supra* note 25, at 72. Porosity is the ability of a rock to hold a fluid. “Mathematically, it is the open space in a rock divided by the total rock volume . . .” Permeability is the measure of how easily a fluid flows through a rock. *Porosity and Permeability*, LA. DEP’T ENV’T QUALITY, https://deq.louisiana.gov/assets/docs/Water/DWPP_for_kids_and_educators/Porosity_and_Permeability.pdf [<https://perma.cc/T9QR-A42M>] (last visited Feb. 3, 2024).

31. HERZOG, *supra* note 25, at 72–73; *Carbon Storage FAQs*, *supra* note 22. “Pore space is defined by porosity of a material possessing free space between the mineral grains.” DEVIN ALVAREZ ET AL., MICROBIAL BIODEGRADATION AND BIOREMEDIATION 556 (Surajit Das ed., 2014). Put more simply, “pore spaces are the tiny spaces between mineral grains, often grains of sand compressed over millions of years.” JACQUELINE L. WEAVER & BRET WELLS, TEXAS OIL AND GAS LAW: CASES AND MATERIALS 14 (2d ed. 2021).

32. HERZOG, *supra* note 25, at 73.

33. *Id.*

34. *Id.* at 74.

35. *Id.*

36. *Id.*

37. *Class VI – Wells Used for Geologic Sequestration of Carbon Dioxide*, U.S. ENV’T. PROT. AGENCY, <https://www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-carbon-dioxide> [<https://perma.cc/4ZJJ-W8C6>] (last updated Oct. 2, 2023).

III. BENEFITS AND RISKS OF CARBON CAPTURE

Carbon capture projects often receive bipartisan support because they are hailed as benefiting the environment while creating jobs in the energy sector.³⁸ However, while there is strong overall support for CCS, authorities remain divided as to whether the benefits of CCS outweigh the risks.³⁹

On one hand, the benefits of CCS are clear. The Center for Climate and Energy Solutions estimates that the combination of carbon capture, use, and storage technologies can capture up to 90% of CO₂ emissions from power plants and other industrial facilities.⁴⁰ This estimate is significant because the United Nations asserts that global greenhouse gas emissions must be reduced by 45% by 2030 to attain net zero emissions by 2050, as called for by the Paris Agreement.⁴¹ Carbon capture can account for 14% of the needed greenhouse gas reductions by 2050.⁴² Use of carbon capture technology can also prevent early retirement of gas- and coal-fired power plants.⁴³ Additionally, captured CO₂ can be put to beneficial uses beyond EOR, such as manufacturing.⁴⁴

38. Alejandro de la Garza, *The Inflation Reduction Act Includes a Bonanza for the Carbon Capture Industry*, TIME (Aug. 11, 2022, 6:32 PM), <https://time.com/6205570/inflation-reduction-act-carbon-capture/> [<https://perma.cc/PN7L-UR2X>]; John Thompson, *Bipartisan Support for Carbon Capture Jobs*, CLEAN AIR TASK FORCE (Apr. 21, 2021), <https://www.catf.us/2021/04/bipartisan-support-for-carbon-capture-jobs/> [<https://perma.cc/8TGB-E97R>].

39. *Are Carbon Sequestration Leaks a Potential Health Danger?*, POPULAR MECHS. (Sept. 13, 2011), <https://www.popularmechanics.com/science/environment/a7205/are-carbon-sequestration-leaks-a-health-danger/> [<https://perma.cc/RWW7-VF9U>]; Jonathan O'Callaghan, *Storing CO₂ Underground Can Curb Carbon Emissions, But Is It Safe?*, EUR. COMM'N (Nov. 27, 2018), <https://ec.europa.eu/research-and-innovation/en/horizon-magazine/storing-co2-underground-can-curb-carbon-emissions-it-safe> [<https://perma.cc/8BHR-2T3G>]; see *Carbon Capture*, CTR. FOR CLIMATE & ENERGY SOLS., <https://www.c2es.org/content/carbon-capture/> [<https://perma.cc/6DLN-YG6B>] (last visited Jan. 14, 2024); *Danger Ahead: The Public Health Disaster that Awaits from Carbon Capture and Sequestration (CCS)*, PHYSICIANS FOR SOC. RESP. L.A., <https://www.psr-la.org/stay-informed/blog/danger-ahead-the-public-health-disaster-that-awaits-from-carbon-capture-and-sequestration-ccs> [<https://perma.cc/67SX-QPTX>] (last visited Jan. 9, 2024).

40. *Carbon Capture*, *supra* note 39.

41. *Climate Action*, UNITED NATIONS, <https://www.un.org/en/climatechange/net-zero-coalition> [<https://perma.cc/7KMG-Z3PF>] (last visited Jan. 4, 2024).

42. *Carbon Capture*, *supra* note 39.

43. *Technical Summary, Climate Change 2022: Mitigation of Climate Change*, THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE 53 (2022), https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_TS.pdf [<https://perma.cc/RGK5-CVEU>] (“Scenario evidence suggests that without carbon capture, the worldwide fleet of coal and gas power plants would need to retire about 23 and 17 years earlier than expected lifetimes, respectively to limit global warming to 1.5°C and 2°C.”).

44. *Carbon Capture*, *supra* note 39. “CO₂ has been successfully transformed into methanol, synthesis gas, and synthetic hydrocarbon fuels to compete with petroleum products. . . . CO₂ also has great potential as a feedstock for industrially important

Apart from the benefits stemming from its positive impact on the world's climate, carbon capture also benefits the companies engaged in CCS projects.⁴⁵ The Inflation Reduction Act of 2022 places a high value on captured carbon by raising the 45Q tax credit by as much as \$180 USD per ton of captured carbon, depending on the method of capture.⁴⁶ Tax credits add up quickly for companies employing CCS technology. For example, a facility capturing and storing 1 million tons of CO₂ per year could enjoy a tax credit of \$180 million USD. The Act also extends the projects' commencement construction window to 2033, giving companies that wish to expand into the carbon capture market additional time to develop and initiate projects.⁴⁷

While emphasis was recently placed on CCS through U.S. legislation and worldwide initiatives, CO₂ has been successfully captured and stored off the coast of Norway for nearly thirty years.⁴⁸ The Sleipner CCS Project was the first facility in the world to inject CO₂ into a geologic setting solely to permanently store the CO₂.⁴⁹ Located in the North Sea, roughly 240 kilometers off the coast of Norway, the facility has operated since October 1996.⁵⁰ Sleipner captures CO₂ from local gas developments and injects it into an offshore sandstone reservoir located one kilometer below the North Sea.⁵¹ Since beginning operations, the facility has stored nearly 1 million tons of CO₂ per year.⁵² Sleipner is majority-owned

chemicals such as formic acid . . . [and] other hydrogenation products . . .” BHATTACHARYA ET AL., *supra* note 23, at 211. However, carbon capture and utilization are viewed by some as a “sideshow.” HERZOG, *supra* note 25, at 91, 94.

45. Matt Bright, *The Inflation Reduction Act Creates a Whole New Market for Carbon Capture*, CLEAN AIR TASK FORCE (Aug. 22, 2022), <https://www.catf.us/2022/08/the-inflation-reduction-act-creates-a-whole-new-market-for-carbon-capture/> [<https://perma.cc/62PG-DC74>].

46. *Id.*

47. *Id.* Facilities eligible to receive the tax credit must commence construction before January 1, 2033. 26 U.S.C. § 45Q(d). According to the U.S. Code, the 45Q tax credit is available for “carbon oxide sequestration” rather than limiting the tax credit to carbon dioxide sequestration. 26 U.S.C. § 45Q(a).

48. *Facilities Database*, GLOB. CCS INST., <https://co2re.co/FacilityData> [<https://perma.cc/T89D-M492>] (last visited Jan. 19, 2024); HERZOG, *supra* note 25, at 95; *Carbon Capture*, *supra* note 39.

49. *Facilities Database*, *supra* note 48 (discussing how other facilities captured carbon dioxide prior to the opening of the Sleipner facility, but the CO₂ from these facilities was primarily transported to oil fields for use in enhanced oil recovery); HERZOG, *supra* note 25, at 95–96.

50. HERZOG, *supra* note 25, at 95.

51. *Id.*; *Facilities Database*, *supra* note 48.

52. *Facilities Database*, *supra* note 48; HERZOG, *supra* note 25, at 95. For comparison, the EPA asserts that “[a] typical passenger vehicle emits about 4.6 metric tons of carbon dioxide per year.” *Greenhouse Gas Emissions from a Typical Passenger Vehicle*, U.S. ENV'T

by the Norwegian national oil company, Equinor (previously called Statoil), and was created to avoid a carbon tax as well as to showcase Norway's commitment to combatting climate change.⁵³ In addition to Sleipner, many other CCS facilities are currently operating around the world, including facilities in Germany, Iceland, and the United States.⁵⁴

Despite the success of these facilities, some organizations remain worried about the long-term safety of CCS projects.⁵⁵ A major concern is that stored CO₂ could leak out of underground reservoirs and contaminate the surrounding air or water supplies.⁵⁶ Leaking CO₂ could have devastating consequences, such as adverse health effects and death.⁵⁷ An example illustrating the catastrophic consequences of large-scale CO₂ leakage is the Cameroon disaster of 1986, in which the sudden release of CO₂ from a volcanic lake killed over 1,200 people during the night.⁵⁸ The limited number of CCS facilities and the complications involved with studying potentially deadly CO₂ releases make it difficult to investigate the risks of commercial-scale CCS.⁵⁹ However, researchers have conducted studies on natural CO₂ seeps in Italy, which is home to a heavy concentration of natural CO₂ seeps.⁶⁰ These seeps generally result from the presence of volcanic edifices, natural CO₂ reservoirs, and CO₂-rich aquifers.⁶¹ Researchers from the University of Edinburgh concluded that

PROT. AGENCY, <https://www.epa.gov/greenvehicles/greenhouse-gas-emissions-typical-passenger-vehicle#> [<https://perma.cc/HEC2-GBNS>].

53. HERZOG, *supra* note 25, at 96, 98. The Norwegian government's influential position as majority shareholder in Statoil allowed it to propel the Sleipner project. *Id.* at 98; *Our History*, EQUINOR, <https://www.equinor.com/about-us/our-history> [<https://perma.cc/CML8-8H4M>] (last visited Jan. 3, 2024).

54. *Facilities Database*, *supra* note 48.

55. *See supra* note 39 and accompanying text.

56. O'Callaghan, *supra* note 39; PHYSICIANS FOR SOC. RESP. L.A., *supra* note 39; Frederick R. Eames & Brent Fewell, *Capturing and Storing Carbon: Risks and Liabilities*, HUNTON ANDREWS KURTH 50 (Sept.–Oct. 2008), <https://www.huntonak.com/images/content/3/6/v3/3632/Capturing-and-Storing-Carbon.pdf> [<https://perma.cc/HC47-W2MT>].

57. PHYSICIANS FOR SOC. RESP. L.A., *supra* note 39.

58. Bryan Walsh, *Carbon Capture Isn't Dangerous. But Is It Worth It?*, TIME (Sept. 13, 2011), <https://science.time.com/2011/09/13/carbon-capture-isnt-dangerous-but-is-it-worth-it/> [<https://perma.cc/7UJT-FE53>].

59. Jennifer A. Roberts et al., *Assessing the Health Risks of Natural CO₂ Seeps in Italy*, 108 PNAS 16545, 16545, 16547 (2011), <https://www.pnas.org/doi/epdf/10.1073/pnas.1018590108> [<https://perma.cc/8HQN-3KGJ>].

60. *Id.* at 16545. CO₂ seeps occur when CO₂ rises to the surface of the Earth and escapes into the air. Christa Marshall, *Fatal Risk from Stored CO₂ Leakage Appears Remote*, SCI. AM. (Sept. 14, 2011), <https://www.scientificamerican.com/article/fatal-risk-from-stored-co2-leakage-appear-remote/> [<https://perma.cc/H7P9-YU2B>].

61. Roberts, *supra* note 59, at 16545.

while CO₂ seeps in Italy have killed nineteen people and hundreds of animals over the past fifty years, the risk posed by Italian gas seeps is actually quite low—around 1 in 36 million.⁶² This suggests that minor leaks from CCS projects would pose very little threat to the area surrounding the project, but nevertheless, an element of threat remains.⁶³

One example of a CCS facility that struggled to contain its sequestered CO₂ was the In Salah CCS project, which was located in central Algeria and commenced operations in 2004.⁶⁴ During its lifespan, the facility captured and stored 3.8 million tons of CO₂, but injection operations halted in 2011 when concerns arose regarding the integrity of the seal.⁶⁵

Another concern regarding CCS projects is the risk of man-made tremors, known as induced seismicity, caused by the buildup of underground pressure from CO₂ injection.⁶⁶ There are very few recordings of induced seismicity that resulted from CO₂ storage, but detailed monitoring is uncommon and not widely tested.⁶⁷ A European project called ENOS is currently developing methods for monitoring and managing risks from induced seismicity.⁶⁸ ENOS hopes that improved modeling and monitoring will enhance our understanding of the causes of induced seismicity and will lead to prevention and increased safety.⁶⁹ Herzog asserts that the risk of “triggering large seismic events can be managed by selecting and properly characterizing appropriate formations and controlling pressure changes.”⁷⁰ However, according to Herzog, this method is not without problems.⁷¹

Even if CCS is completely safe, some people worry that it is a “costly distraction” from emission cuts and the transition to clean energy.⁷² The Inflation Reduction Act’s tax credit hike rewards the

62. *Id.* at 16545, 16547.

63. *Id.* at 16547.

64. *Locked Away—Geological Carbon Storage*, ROYAL SOC’Y 24 (Sept. 2022), <https://royalsocietypublishing.org/doi/10.1098/rsos.220100> [https://perma.cc/5JZN-QWSC].

65. *Id.*

66. O’Callaghan, *supra* note 39.

67. *Induced Seismicity: Monitoring, Control, and Hazard Mitigation*, ENOS, <http://www.enos-project.eu/activities/storage-operations/induced-seismicity-monitoring-control-and-hazard-mitigation/> [https://perma.cc/P43Q-8XH7] (last visited Jan. 11, 2024).

68. *Id.*

69. *See id.*

70. HERZOG, *supra* note 25, at 84.

71. *Id.*

72. De la Garza, *supra* note 38.

capture of emitted CO₂, but it also incentivizes the extraction of oil because the tax credit is available for CO₂ that is injected into the ground for EOR operations as well as for permanent storage unassociated with EOR.⁷³ Michael Mann, the director of the Earth Science System Center at Pennsylvania State University, fears that relying on CCS will “prolong our collective dependency on fossil fuels.”⁷⁴ Whether or not CCS is the answer to climate change, many projects are currently under development and fundamental questions regarding safety and liability will need answers in the near future.

IV. EPA REGULATION OF CLASS VI WELLS

Although CCS projects have operated around the world for nearly thirty years, U.S. federal regulation of CO₂ injection wells has been a recent development.⁷⁵ In 2010, the EPA issued a final rule entitled Federal Requirements Under the Underground Injection Control Program for CO₂ Geologic Sequestration (GS) Wells.⁷⁶ This rule, known as the Class VI Rule, protects underground sources of drinking water by establishing minimum criteria for siting, construction, operation, monitoring, testing, and closure of Class VI CO₂ storage wells.⁷⁷ The rule went into effect in September of 2011, after a 270-day period during which states had the opportunity to apply for primary enforcement responsibility, known as “primacy.”⁷⁸ Most states hold primacy over some classes of injection wells, but currently, North Dakota, Wyoming, and most recently, Louisiana are the only states with primacy over Class VI wells.⁷⁹ North Dakota received primacy in April of 2018, and Wyoming received primacy in September of

73. *Id.*

74. Michael Buchsbaum, *When a Climate Solution Is Used to Produce More Oil*, DEUTSCHE WELLE (June 9, 2021), <https://www.dw.com/en/carbon-capture-climate-solution-or-prolonging-humanitys-fossil-fuel-dependency/a-57767082> [<https://perma.cc/4UJA-3C98>].

75. HERZOG, *supra* note 25, at 95; *Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO₂) Geologic Sequestration (GS) Wells Final Rule*, U.S. ENV'T PROT. AGENCY [hereinafter *Federal Requirements*], <https://www.epa.gov/uic/federal-requirements-under-underground-injection-control-uic-program-carbon-dioxide-co2> [<https://perma.cc/BVS3-KE3V>] (last updated Sept. 11, 2023).

76. *Federal Requirements*, *supra* note 75.

77. *Id.*

78. *Id.*

79. *Id.*; *Primary Enforcement Authority*, *supra* note 7; Liskow & Lewis, *supra* note 14. Other classes of injection wells cover activities such as injecting hazardous and nonhazardous wastes and injecting fluids for mineral extraction and EOR. *Underground Injection Control Well Classes*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/uic/underground-injection-control-well-classes> [<https://perma.cc/5J6Q-H3UE>] (last updated Apr. 5, 2023).

2020.⁸⁰ The small number of states that have applied for Class VI well primacy is due to low demand for Class VI permits, but the effort needed from states to obtain primacy is high.⁸¹

Texas, Arizona, and West Virginia are in the process of applying to the EPA for primacy over Class VI wells.⁸² All three states are still in the pre-application process.⁸³ The EPA implements the Class VI program in all states, tribes, and territories that do not have primacy.⁸⁴ Regardless of whether states have primacy over Class VI wells, owners and operators of Class VI wells must regularly submit CCS project data to the EPA.⁸⁵ The EPA also maintains a public record of all federally permitted Class VI wells and wells with pending permits.⁸⁶

V. PORE SPACE OWNERSHIP

While the EPA provides regulations regarding the siting, construction, and operation of CO₂ storage facilities, land use and ownership laws have historically been the domain of the states.⁸⁷ Sequestering CO₂ in the pore space of geologic formations poses an interesting legal issue regarding pore space ownership.⁸⁸ This issue is consequential because the plume from CO₂ storage operations can travel away from the injection site through the pore space.⁸⁹ While the issue of pore space ownership appears to be resolved in some parts of the world, the question remains unsettled in much of the United

80. *Class VI – Geologic Sequestration Wells*, N.D. MIN. RES., <https://www.dmr.nd.gov/dmr/oilgas/ClassVI> [<https://perma.cc/D9NR-TEXV>] (last visited Jan. 3, 2024); *Class VI*, WYO. DEP'T ENV'T QUALITY, <https://deq.wyoming.gov/water-quality/groundwater/uic/class-vi> [<https://perma.cc/UNW4-2SDN>] (last visited Jan. 14, 2024).

81. Sheila McCafferty Harvey & Robert A. James, *State-Level Permitting Primacy May Boost Carbon Capture and Storage*, PILLSBURY AW.COM/EN/NEWS-AND-INSIGHTS/state-level-permitting-primacy-carbon-capture-and-storage.html [<https://perma.cc/72AT-NRE9>].

82. *Primary Enforcement Authority*, *supra* note 7.

83. *Id.*

84. *Federal Requirements*, *supra* note 75.

85. *Class VI – Wells Used for Geologic Sequestration of Carbon Dioxide*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-carbon-dioxide> [<https://perma.cc/3Y6Z-K79A>] (last updated Oct. 2, 2023); 40 C.F.R. § 146.91(e) (2022).

86. *Table of EPA's Draft and Final Class VI Well Permits*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/uic/table-epas-draft-and-final-class-vi-well-permits> [<https://perma.cc/FQK5-QRH6>] (last updated Dec. 20, 2023).

87. *Federal Requirements*, *supra* note 75; *The Governance of Land Use*, ORG. FOR ECON. COOP. & DEV., <https://www.oecd.org/regional/regional-policy/land-use-United-States.pdf> [<https://perma.cc/5H36-ANJD>] (last visited Jan. 4, 2024).

88. Ruth Ivory-Moore, *Pore Space Rights – U.S. Overview*, GLOB. CCS INST. 1 (May 2022) [hereinafter CCS Brief], <https://www.globalccsinstitute.com/wp-content/uploads/2022/05/Brief-Pore-Space-Rights-5.25.pdf> [<https://perma.cc/KGB2-93H8>].

89. *Locked Away – Geological Carbon Storage*, *supra* note 64, at 10–12.

States.⁹⁰ Two basic rules have emerged, the American Rule and the English Rule.⁹¹ The American Rule, which will likely be followed by most states, holds that the surface owner owns the pore space.⁹² This means that under the American Rule, the mineral estate owner owns the minerals but not the geologic formation that holds the minerals.⁹³ Thus, the surface owner holds the storage rights.⁹⁴ Under the English Rule, the mineral estate holder owns both the natural resources and the pore space surrounding the natural resources.⁹⁵

Texas has not resolved the issue of pore space ownership.⁹⁶ Conflicting case law exists on the topic, but in 2011, the Texas Supreme Court concluded that wastewater injection permit holders were not shielded from civil tort actions brought by surface estate owners.⁹⁷ This suggests that Texas may choose to follow the American Rule in the future because the court assumed that the surface estate owner also owned the pore space.⁹⁸ This line of thinking is consistent with cases such as *Humble Oil & Refining Co. v. West*, a 1974 Texas Supreme Court case stating that a fee simple owner's dominion "include[d] not only the surface and mineral estates, but also the matrix of the underlying earth, i.e., the reservoir storage space."⁹⁹ This idea was echoed in *Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, where the Texas Supreme Court "generally agree[d]" with the court of appeals' stance that the surface owner's rights included ownership of "the geologic structures beneath the surface."¹⁰⁰ However, neither case law nor legislation has definitively resolved the issue of pore space ownership.

A potential reason for the lack of clarity in Texas pore space ownership law may be the fact that there are powerful forces on each side of the argument. On one side, Texas is home to some of the largest oil and gas companies in the United States, such as

90. CCS Brief, *supra* note 88, at 1. "Currently, there is little to no federal or state statutory authority governing subsurface property rights issues in the context of CO₂ sequestration." R. Lee Gresham & Owen L. Anderson, *Legal and Commercial Models for Pore-Space Access and Use for Geologic CO₂ Sequestration*, 72 U. PITT. L. REV. 701, 707 (2011).

91. CCS Brief, *supra* note 88, at 1.

92. *Id.*

93. *Id.*

94. *Id.*

95. *Id.*

96. *Understanding Pore Space Law in Oil and Gas Litigation*, BURFORD PERRY, <https://burfordperry.com/news-and-insights/understanding-pore-space-law-in-oil-and-gas-litigation/> [<https://perma.cc/B8QT-7EUU>] (last visited Jan. 3, 2024).

97. *Id.*; *FPL Farming Ltd. v. Env't Processing Sys., L.C.*, 351 S.W.3d 306, 314 (Tex. 2011).

98. *Understanding Pore Space Law in Oil and Gas Litigation*, *supra* note 96.

99. *Humble Oil & Refin. Co. v. West*, 508 S.W.2d 812, 815 (Tex. 1974).

100. *See Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, 520 S.W.3d 39, 46–47 (Tex. 2017).

ConocoPhillips and ExxonMobil.¹⁰¹ This means that the state has a significant interest in developing laws that are favorable to operators. However, Texas is also home to some of the largest ranches in the United States, such as the King Ranch.¹⁰² This suggests that the state will need to balance competing interests to keep powerful surface estate owners happy. Due to the increased interest in CCS projects, it is essential for Texas to clarify its pore ownership laws so that companies and landowners know who holds the right to lease pore space.¹⁰³

Two variations of pore space ownership have emerged within the American Rule. These variations are exhibited by the North Dakota and Wyoming regulations regarding pore space ownership, which are similar in some respects but contain key differences. On one hand, North Dakota statutorily recognizes that pore space ownership is vested in the surface owner, which is consistent with the American Rule.¹⁰⁴ This right was confirmed in a recent North Dakota Supreme Court case titled *Northwest Landowners Ass'n v. State*, which struck down portions of a North Dakota senate bill authorizing oil and gas operators to use subsurface pore space without permission from and without compensation to the surface owner.¹⁰⁵ North Dakota is currently one of only two states with primacy over Class VI wells,¹⁰⁶ so it is possible that Texas will follow North Dakota's lead on this issue.¹⁰⁷

Wyoming has also codified pore space ownership as belonging to the surface owner.¹⁰⁸ However, Wyoming allows for the severance of the pore space from the surface estate and separate transference.¹⁰⁹ If severed, pore space ownership can be

101. Sky Ariella, *15 Largest Energy Companies in the United States*, ZIPPAA (Apr. 10, 2023), <https://www.zippia.com/advice/largest-energy-companies/> [<https://perma.cc/U5BC-8PQ7>].

102. Cari Scribner, *Top 12 Largest Ranches in the US in 2023*, FARMLAND RICHES (Jan. 12, 2023), <https://www.farmlandriches.com/largest-ranches-usa/> [<https://perma.cc/3D7R-TBC2>].

103. Elizabeth George, *Carbon Storage in Texas: Who Owns the Underground Pore Space?*, FORBES (Oct. 29, 2019, 1:42 PM), <https://www.forbes.com/sites/uhenergy/2019/10/29/carbon-storage-in-texas-who-owns-the-underground-pore-space/?sh=322be5f42e4b> [<https://perma.cc/C74D-VSF4>] (“[I]n many areas of Texas . . . it is common for the mineral estate and surface estate to be owned by different people.”).

104. N.D. CENT. CODE § 47-31-03 (2023), <https://ndlegis.gov/cencode/t47c31.pdf> [<https://perma.cc/VMX7-ZUSM>] (“Title to pore space in all strata underlying the surface of lands and waters is vested in the owner of the overlying surface estate.”); CCS Brief, *supra* note 88, at 1.

105. *Nw. Landowners Ass'n v. State*, 978 N.W.2d 679, 685, 692 (N.D. 2022).

106. *See supra* note 79 and accompanying text.

107. *See* George, *supra* note 103.

108. WYO. STAT. ANN. § 34-1-152(a) (2023).

109. *Id.* § 34-1-152(b).

transferred in the same manner as the mineral estate.¹¹⁰ This may be a happy middle course for Texas as the state considers pore space ownership rights in the context of preserving the balance between energy companies and ranch owners.

Despite the uncertainty of Texas pore space ownership, it is clear that in Texas, regardless of whether the surface estate and the mineral estate have been severed, the mineral estate is dominant.¹¹¹ This has some interesting effects for CO₂ storage because well operators are allowed to dispose of water used in EOR in the pore space even though it belongs to the surface owner.¹¹² CO₂ is also used in EOR operations, and most of the CO₂ that is injected for this purpose stays in the ground.¹¹³ This means that if Texas adopts the American Rule, which assigns pore space ownership to the surface estate, the right to use the pore space will depend on the purpose for which the pore space is being used. If the pore space is being used as part of an EOR operation, the mineral estate holder will have the right to store CO₂ in the pore space without permission from the owner because it is incidental to the EOR operation. But, if the pore space is used solely to store CO₂, perhaps long after a drilling operation is complete, the surface owner will have the right to lease the pore space to the injector. This could create complications if a CO₂ storage operation begins before a drilling operation is completed in the same general location. Because of the existing EOR operations in Texas, it could be simpler for the state to follow the English Rule, which assigns ownership of the pore space to the holder of the mineral estate, if the surface and mineral estates are severed. However, this seems unlikely because it would go against case law suggesting that the surface estate owner owns the pore space.¹¹⁴ Regardless of which rule prevails, the issue of pore space ownership in Texas will need to be resolved soon so that companies with CCS projects in the planning stage can accurately assess their situation.

110. *Id.*

111. *Exploration and Surface Ownership*, RRC LEADING TEX. ENERGY, <https://www.rrc.texas.gov/about-us/faqs/oil-gas-faq/oil-gas-exploration-and-surface-ownership/> [<https://perma.cc/27G4-TJHC>] (last visited Jan. 2, 2024).

112. *See id.*

113. *Enhanced Oil Recovery*, *supra* note 10; David Roberts, *Could Squeezing More Oil out of the Ground Help Fight Climate Change?*, VOX (Dec. 6, 2019, 7:56 AM), <https://www.vox.com/energy-and-environment/2019/10/2/20838646/climate-change-carbon-capture-enhanced-oil-recovery-eor> [<https://perma.cc/ET6M-K95P>].

114. George, *supra* note 103.

VI. LIABILITY

Another issue at stake regarding CCS projects is liability. Traditionally, operators of wells and facilities have been held responsible for catastrophes caused by their oil recovery operations in a “you break it, you pay for it” system.¹¹⁵ This system incentivizes operators to act responsibly and prevent liability for the operator down the road.¹¹⁶ However, liability for CCS projects exceeds traditional liability for oil and gas because the goal of CCS is permanent storage rather than short-term resource development.¹¹⁷ “[B]road, open-ended long-term liabilities [have] been highlighted as problematic for [the] industry,” and the issue was deemed “critical to the technology’s deployment.”¹¹⁸ Some consider the uncertainty surrounding the liability of CCS operations among the top impediments to building power plants that employ CCS technology.¹¹⁹ With responsible site selection and engineering, there should be little risk of a catastrophic event associated with the operation of a CO₂ storage facility.¹²⁰ This risk should decline over time, but the fact remains that a catastrophic event involving a CO₂ storage facility could “stretch beyond the capacity of risk management tools currently available in the markets, such as insurance and bonds.”¹²¹

It is perhaps in response to these concerns that some states have relaxed their systems of total operator liability.¹²² Wyoming recently passed legislation absolving operators of liability once a “closure certificate” has been issued.¹²³ Scott Anderson, the previous Senior Director of the Energy Program for the Environmental Defense Fund (EDF), asserts that this “[s]o-called liability relief for CCS upends a century of legal practice relating to oil and gas [projects]” and “puts the very potential of CCS projects at risk.”¹²⁴ Wyoming’s recent legislation is in direct

115. Scott Anderson, *States Should Not Weaken Liability Laws for CCS Projects*, ENV’T DEF. FUND: ENERGY EXCH. (May 3, 2022), <https://blogs.edf.org/energyexchange/2022/05/03/states-should-not-weaken-liability-laws-for-ccs-projects/> [<https://perma.cc/NXS2-YHCW>].

116. *Id.*

117. Ian Havercroft, *Lessons and Perceptions: Adopting a Commercial Approach to CCS Liability*, GLOB. CCS INST. (2019), https://www.globalccsinstitute.com/wp-content/uploads/2020/04/Hought-Leadership-Liability-Study_FINAL_Digital.pdf [<https://perma.cc/XH8E-6NCD>].

118. *Id.*

119. Eames & Fewell, *supra* note 56.

120. *Id.*

121. *Id.*

122. Anderson, *supra* note 115.

123. *Id.*; WYO. STAT. ANN. § 35-11-319(d)(i)–(iii) (2023).

124. Anderson, *supra* note 115; Scott Anderson, J. PETROL. TECH., <https://jpt.spe.org/author/scott-anderson> [<https://perma.cc/QU58-GKLJ>] (last visited Jan. 11, 2024).

contrast to legislation enacted by the state in 2009, which served to limit Wyoming's long-term liability by assigning ownership of injected CO₂ to the injector.¹²⁵

Louisiana, which recently obtained primacy for Class VI wells, also allows ownership and liability to transfer to the state upon the issuance of a certificate of completion.¹²⁶ Certificates of completion are generally issued fifty years after injection operations are completed and require a showing that the “reservoir is reasonably expected to retain mechanical integrity” and the “carbon dioxide will reasonably remain emplaced.”¹²⁷ At the time of writing, twenty-two Louisiana-based projects are awaiting permitting from the EPA—more than a third of the pending applications in the United States.¹²⁸ This indicates that operators appreciate Louisiana's efforts to limit long-term liability and are potentially more likely to invest in CCS operations in states that are willing to partially shoulder the liability burden.

To date, Texas has not changed its liability rules surrounding the injection and storage of CO₂.¹²⁹ In fact, Texas's Natural Resources Code explicitly states that stored CO₂ is the property of the storage operator, though the Code allows for exceptions to this general rule.¹³⁰ Beyond the Natural Resources Code, there is precedent in Texas for gas stored in underground storage facilities to remain the injectors' personal property. This concept was first established in the 1962 case *Lone Star Gas Co. v. Murchison*, which held that non-native natural gas (or extraneous gas) that was injected for storage into underground reservoirs remained the property of the injector.¹³¹ Additionally, the Texas Underground Storage Act states that “[a]ll natural gas . . . which is not native gas, and which is subsequently injected into storage facilities is personal property and is the property of the injector”¹³²

125. Allen Ingelson et al., *Long-Term Liability for Carbon Capture and Storage in Depleted North American Oil and Gas Reservoirs – A Comparative Analysis*, 31 ENERGY L.J. 431, 441 (2010).

126. *Primary Enforcement Authority*, *supra* note 7; LA. STAT. ANN. § 30:1109(A)(1)–(2) (2024).

127. LA. STAT. ANN. § 30:1109(A)(1).

128. Samuel Pickerill et al., *EPA Approves Class VI Primacy in Louisiana*, ARNOLD & PORTER: ENV'T EDGE (Jan. 5, 2024), <https://www.arnoldporter.com/en/perspectives/blogs/environmental-edge/2024/01/epa-approves-class-vi-primacy-in-louisiana> [https://perma.cc/H4ZW-W94S].

129. Anderson, *supra* note 115.

130. TEX. NAT. RES. CODE ANN. § 121.002(b) (“Unless otherwise expressly provided by a contract, bill of sale, deed, mortgage, deed of trust, or other legally binding document or by other law, anthropogenic carbon dioxide stored in a geologic storage facility is considered to be the property of the storage operator or the storage operator's heirs, successors, or assigns.”).

131. *Lone Star Gas Co. v. Murchison*, 353 S.W.2d 870, 879 (Tex. App.—Dallas 1962, writ ref'd n.r.e.).

132. TEX. NAT. RES. CODE ANN. § 91.182. Native gas is defined as “gas which has not been previously withdrawn from the earth.” *Native Gas Definition*, L. INSIDER, <https://www.lawinsider.com/dictionary/native-gas> [https://perma.cc/8L73-DCSF] (last visited Dec. 30, 2023).

Natural gas is, of course, different from CO₂, but the principal established in *Murchison* and codified in the Texas Natural Resource Code creates strong precedent for ownership of stored CO₂ to remain with the storage facility operator rather than being transferred to the state. While liability issues may slow the development of CCS projects in Texas, it does not appear that these issues create insurmountable obstacles because there are several CCS projects under development in Texas.¹³³ One Texas-based project is already awaiting permitting from the EPA.¹³⁴

A potential safeguard against the possibility of catastrophic events caused by CCS operations could be the creation of a trust fund for the purpose of addressing damage caused by potential leaks, seismic activity, or other hazardous events. Trust funds of this kind are already in use for oil spills as well as for the cleanup of hazardous substances.¹³⁵ The Oil Spill Liability Trust Fund, established as part of the Oil Pollution Act of 1990, is available to clean up oil spills “when the responsible party is incapable or unwilling to do so.”¹³⁶ This \$1 billion fund is financed by a tax on oil, and it is used to pay for cleanup costs that exceed the liability limit.¹³⁷ Another emergency response fund is the Hazardous Substance Superfund, created in 1980 by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund).¹³⁸ This fund finances cleanup of hazardous waste sites and environmental emergencies.¹³⁹ The Superfund was originally funded by taxes on crude oil and chemicals, but those taxes expired in 1995.¹⁴⁰ Now, the Superfund is financed by general revenue.¹⁴¹

133. Anderson, *supra* note 115.

134. *Current Class VI Projects Under Review at EPA*, U.S. ENV'T PROT. AGENCY (Jan. 1, 2024), <https://www.epa.gov/uic/current-class-vi-projects-under-review-epa> [<https://perma.cc/2A4D-8QJS>].

135. 26 U.S.C. § 9509(a), (c)(1); 26 U.S.C. § 9507(a), (c)(1).

136. § 9509; *Summary of the Oil Pollution Act*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/laws-regulations/summary-oil-pollution-act> [<https://perma.cc/4THB-GFHQ>] (last updated Sept. 6, 2023).

137. ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 146 (9th ed. 2021).

138. *Superfund History—Printable Version*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/superfund/superfund-history-printable-version> [<https://perma.cc/UAD6-Y5SN>] (last updated Oct. 30, 2023).

139. *Id.*

140. *Superfund: Funding and Reported Costs of Enforcement and Administrative Activities*, U.S. GOV'T ACCOUNTABILITY OFF. (July 18, 2008), <https://www.gao.gov/products/gao-08-841r> [<https://perma.cc/GZ5D-ECNT>].

141. *Federal Superfund Program*, TEX. COMM'N ON ENV'T QUALITY, <https://www.tceq.texas.gov/remediation/superfund/federal> [<https://perma.cc/NXF5-HEAQ>] (last updated Aug. 24, 2023).

The feasibility of a CO₂ storage trust fund is demonstrated by the fact that one already exists, though its uses are limited.¹⁴² The Anthropogenic Carbon Dioxide Storage Trust Fund is financed by fees collected by the RRC for permitting, monitoring, and inspecting CO₂ injection wells as well as for the enforcement of regulations.¹⁴³ However, this fund is only available for long-term monitoring, remediating mechanical problems, repairing mechanical leaks, plugging abandoned wells, and various training and compliance activities.¹⁴⁴ There is no indication that the fund may be used to address issues other than the listed uses, or to provide assistance or compensation to parties who would be adversely affected by a major leak, seismic activity or other hazardous events.¹⁴⁵

An emergency fund for CCS disasters could be financed by a minimal tax on energy produced by facilities that store their CO₂ underground. Another source of funding could be a tax on energy sources such as coal, natural gas, gasoline, and propane, all of which produce substantial amounts of CO₂ during the combustion process.¹⁴⁶ A third option could be that CCS facilities contribute to an emergency response fund as part of the cost of their facility permit. Of course, all three of these options could be combined to minimize the tax impact and CCS project costs while still creating a disaster remediation fund. A national trust fund of this kind could also be important if escaped CO₂ crosses a national border into Canada or Mexico and causes transboundary damage.¹⁴⁷

Overall, assignment of liability for CCS projects in states with primacy over Class VI wells is varied and still under development. Though states may attempt to attract carbon storage facility operators through favorable liability laws, Texas's commitment to the standard principles of well-operator liability demonstrates that this kind of liability shifting may not be necessary.

142. TEX. NAT. RES. CODE ANN. § 121.003(a), (d).

143. TEX. WATER CODE ANN. § 27.045; NAT. RES. § 121.003(c).

144. NAT. RES. § 121.003(d)(1)–(7).

145. *Id.*

146. *How Much Carbon Dioxide Is Produced when Different Fuels Are Burned?*, AM. GEOSCIENCES INST., <https://www.americangeosciences.org/critical-issues/faq/how-much-carbon-dioxide-produced-when-different-fuels-are-burned> [<https://perma.cc/GLG4-QUE3>] (last visited Jan. 3, 2024).

147. “It is possible that CO₂ could leak from its storage area to cross jurisdictional boundaries.” Yvette Carr, *The International Legal Issues Relating to the Facilitation of Sub-Seabed CO₂ Sequestration Projects in Australia*, 14 AUSTRALIAN INT’L L.J. 137, 140 (2007). For another interesting discussion on transboundary liability, see MoonSook Park’s article, MoonSook Park, *Study on Legal Systems for Transboundary CCS Implementation and Transboundary Environmental Liability Regarding CCS*, 16 LOY. U. CHI. INT’L L. REV. 45, 63 (2020).

Additionally, precedent exists for the creation of disaster response trust funds to safeguard against potential hazardous events. This system has proved successful in the past, and it would provide resources that could be called upon if a well operator is unable or unwilling to finance remediation and damages.

VII. ENVIRONMENTAL JUSTICE CONCERNS REGARDING CLASS VI WELLS

Environmental justice (EJ) concerns have risen to the forefront of national regulatory policy with the issuance of Executive Order 14,008 on January 27, 2021, which identifies environmental and economic justice as an important element of national policy.¹⁴⁸ The EPA defines EJ as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.”¹⁴⁹ According to the EPA, two indicators for the achievement of this goal are when everyone enjoys “[t]he same degree of protection from environmental and health hazards” and “[e]qual access to the decision-making process to have a healthy environment in which to live, learn, and work.”¹⁵⁰

In 2018, research conducted by EPA scientists found that low-income and minority populations are “disproportionately affected by air pollution relative to the overall population.”¹⁵¹ These disparities were present nationally, with African Americans bearing the brunt of the burden of pollution.¹⁵² Other studies tell the same story, and data shows that “African Americans are 75% more likely than [w]hite people to live in ‘fence-line’ communities.”¹⁵³ This data supports the idea that if there are CO₂

148. Exec. Order No. 14,008, 86 Fed. Reg. 7619, 7629 (Jan. 27, 2021) (“To secure an equitable economic future, the United States must ensure that environmental and economic justice are key considerations in how we govern.”).

149. *Environmental Justice*, U.S. ENV'T PROT. AGENCY, <https://www.epa.gov/environmentaljustice> [https://perma.cc/CP3S-YMET] (last updated Dec. 13, 2023).

150. *Id.*

151. Miranda Green, *EPA Scientists Find Black Communities Disproportionately Hit by Pollution*, HILL (Feb. 23, 2018, 12:50 PM), <https://thehill.com/policy/energy-environment/375289-epa-scientists-find-emissions-greater-impact-low-income-communities/> [https://perma.cc/J645-GWSH].

152. *Id.*

153. Aneesh Patnaik et al., *Racial Disparities and Climate Change*, PRINCETON STUDENT CLIMATE INITIATIVE (Aug. 15, 2020), <https://psci.princeton.edu/tips/2020/8/15/racial-disparities-and-climate-change> [https://perma.cc/XNF6-B9AP]; Tara Failey, *Poor*

leaks from storage operations, or if CO₂ is vented rather than stored, low-income and minority populations will face the greatest danger.¹⁵⁴

The heightened national concern regarding EJ is reflected in the comments received by the RRC in response to the proposed amendments to the Texas regulations for geologic storage and associated injection of anthropogenic CO₂, codified in Chapter 5 of Title 16 of the Texas Administrative Code (TAC).¹⁵⁵ Currently, the only mention of EJ found in Texas's CCS regulations is contained in the section regarding notice to certain communities, which includes EJ and "Limited English-Speaking Household communit[ies]."¹⁵⁶ A comment responding to the RRC's proposed amendments to 16 TAC Chapter 5, and submitted by a combined thirty-seven Texas-based organizations and individuals calls for the RRC to give further consideration to EJ and provide a "robust substantive environmental justice review."¹⁵⁷ Other comments submitted by the EDF and the Permian Basin Petroleum Association (PBPA) echo this sentiment.¹⁵⁸ The EDF notes that the EPA will likely begin requiring states to address EJ as a condition of receiving primacy for Class VI wells, though it is unclear what exactly the EPA will require.¹⁵⁹ The PBPA's letter, while supportive of the RRC's proposed regulations, commented that the association's members "live, work and raise their families in the Permian Basin," and supported a "robust definition" of how the RRC would use its EJ efforts to best serve communities in the

Communities Exposed to Elevated Air Pollution Levels, NAT'L INST. ENV'T HEALTH SCIS. (Apr. 2016), https://www.niehs.nih.gov/research/programs/geh/geh_newsletter/2016/4/spotlight/poor_communities_exposed_to_elevated_air_pollution_levels [https://perma.cc/S2R2-X8CU]. Fence-line communities are defined as communities that live "immediately adjacent to highly polluting facilities . . . and [are] directly affected by the traffic, noise, operations, and . . . chemical and fossil fuel emissions of the operation." *Frontline and Fenceline Communities*, CLIMATE REALITY PROJECT, <https://www.climaterealityproject.org/frontline-fenceline-communities> [https://perma.cc/T9NL-XF47] (last visited Jan. 3, 2024).

154. The Gorgon CCS facility in Australia experienced issues in its storage operations that caused 70% of the captured carbon dioxide to be vented rather than stored while the problem was addressed. *Locked Away – Geological Carbon Storage*, *supra* note 64, at 25.

155. 16 TEX. ADMIN. CODE § 5.101 (R.R. Comm'n of Tex.); *see* Letter from the Env't Def. Fund to the R.R. Comm'n of Tex. (July 1, 2022) (on file with the Texas Railroad Commission) [hereinafter EDF Letter]; *see* Letter from Thirty-Seven Tex.-Based Orgs. & Individuals to the R.R. Comm'n of Tex. (July 1, 2022) (on file with the Texas Railroad Commission) [hereinafter Benevides Letter]; *see* Letter from the Permian Basin Petrol. Ass'n to the R.R. Comm'n of Tex. (July 1, 2022) (on file with the Texas Railroad Commission) [hereinafter PBPA Letter].

156. 16 TEX. ADMIN. CODE § 5.204(a)(6).

157. Benevides Letter, *supra* note 155.

158. *See* EDF Letter, *supra* note 155; PBPA Letter, *supra* note 155.

159. EDF Letter, *supra* note 155.

Permian Basin and across the state.¹⁶⁰ The RRC responded to these comments by agreeing that it is unclear what the EPA will require regarding EJ and noting that, despite concerns that CCS projects will burden disadvantaged communities, CCS will be “beneficial to society at large . . . including disadvantaged communities.”¹⁶¹ The RRC added that the Chapter 5 regulations only address injection and geologic storage of CO₂ and that potential impacts on EJ communities with regard to the capture and transport of CO₂ will be addressed during the permitting process for capture and transport.¹⁶² The RRC Memorandum provides assurance that the RRC is following the EPA’s efforts to develop guidelines pertaining to EJ, but until those guidelines are in place, the RRC concludes that enhanced public outreach and engagement will help the RRC and Class VI well-permit applicants educate EJ communities and hear their concerns.¹⁶³

Louisiana’s application for primacy also contains EJ requirements for permit seekers, but it is not entirely clear whether its requirements are more or less extensive than the Texas requirements.¹⁶⁴ Louisiana submitted its application for primacy over Class VI wells near the beginning of 2021 and has received approval from the EPA.¹⁶⁵ The program description submitted by the state as part of its primacy application details a requirement for the owner or operator of the Class VI well to “conduct an . . . [EJ] review and submit a report as part of the application process.”¹⁶⁶ If a proposed well site is located in an EJ community, the Louisiana Commission of Conservation has the option of extending the public comment period and requiring targeted public outreach using “approachable language.”¹⁶⁷ In addition to the potential for enhanced public outreach, there must be a “weighing of siting, environmental effects, and a cost-benefit analysis.”¹⁶⁸ This balanced review requirement stems from the 1984 Louisiana Supreme Court ruling in *Save Ourselves, Inc. v. Louisiana Environmental Control*

160. PBPA Letter, *supra* note 155.

161. Memorandum from the Off. of Gen. Couns. of the R.R. Comm’n of Tex. 43 (Aug. 30, 2022) (on file with the Texas Railroad Commission) [hereinafter RRC Memorandum].

162. *Id.*

163. *Id.*

164. STATE OF LA. DEP’T OF NAT. RES. OFF. OF CONSERVATION INJECTION & MINING DIV., IMD-2021-02, CLASS VI USEPA PRIMACY APPLICATION: UNDERGROUND INJECTION CONTROL PROGRAM 6 (2021) [hereinafter STATE OF LA. DEP’T OF NAT. RES. OFF.].

165. *Id.*; see *Primary Enforcement Authority*, *supra* note 7.

166. STATE OF LA. DEP’T OF NAT. RES. OFF., *supra* note 164.

167. *Id.*

168. *Id.*

Commission.¹⁶⁹ Though Louisiana's primacy application program description lays out requirements for an EJ review, these requirements are not codified in the permit requirements detailed in the application.¹⁷⁰

Neither the Wyoming nor the North Dakota CCS regulations specifically reference EJ concerns.¹⁷¹ North Dakota's regulations state that permit applicants must provide information to the permitting commission regarding whether the CCS facility is located on "Indian lands" or "historic or archaeological sites," but offers no insight as to whether these sites would be allowed as CCS facility locations.¹⁷² The lack of attention to EJ concerns in the Wyoming and North Dakota statutes can probably be explained by the fact that EJ only recently returned to a place of prominence on the national level with President Biden's Executive Order 14,008, which states that "[a]gencies shall make achieving environmental justice part of their missions."¹⁷³ North Dakota received primacy over Class VI wells in 2018, and Wyoming received primacy in 2020, both of which predate the order's 2021 date of issuance.¹⁷⁴

VIII. ARE OFFSHORE CCS FACILITIES THE ANSWER?

The combination of pore space ownership issues, liability, EJ, and safety concerns have caused some experts to conclude that offshore CCS projects are more appealing than their onshore counterparts.¹⁷⁵ Daniel Schrag, a professor of geology at Harvard University, proffers several reasons why offshore sites should be considered more closely.¹⁷⁶ First, there is "enormous storage potential" in sandstones located deep beneath the ocean.¹⁷⁷ Second, the rock that the CO₂ is injected into offshore does not

169. *Id.*; *Save Ourselves, Inc. v. La. Env't Control Comm'n*, 452 So. 2d 1152, 1157 (La. 1984) (concluding that the Environmental Control Commission had failed to conduct the necessary analysis when permitting a hazardous waste disposal facility).

170. This assertion is evidenced by the fact that the term "environmental justice" does not appear in the relevant parts of the Louisiana Administrative Code. LA. ADMIN. CODE tit. 43, §§ 3601–3633 (2022).

171. WYO. STAT. ANN. § 35-11-313 (2023); N.D. ADMIN. CODE 43-05-01-07.1(3)(e) (2013).

172. N.D. ADMIN. CODE 43-05-01-07.1(3)(e) (2013).

173. Exec. Order 14,008, *supra* note 148, at 7629.

174. *Class VI – Geologic Sequestration Wells*, *supra* note 80; *Class VI*, WYO. DEPT OF ENV'T QUALITY, *supra* note 80; Exec. Order 14,008, *supra* note 148.

175. Daniel P. Schrag, *Storage of Carbon Dioxide in Offshore Sediments*, 325 SCI. 1658, 1659 (2009).

176. *Department of Earth and Planetary Sciences*, HARV. UNIV., <https://eps.harvard.edu/people/daniel-schrag> [<https://perma.cc/E83L-BPBC>] (last visited Jan. 10, 2024); Schrag, *supra* note 175.

177. Schrag, *supra* note 175, at 1658.

need to be as permeable as rock onshore due to the low temperatures and high pressure found at the bottom of the ocean.¹⁷⁸ Third, offshore CCS projects “are in nobody’s backyard” and avoid heavily populated areas that might spark public controversy and resistance to the project.¹⁷⁹ Offshore storage facilities would also help avoid environmental injustice issues associated with the siting of the facility and pipelines. Additionally, the possibility of contaminated drinking water is no longer an issue with offshore storage.¹⁸⁰ Beyond the benefits listed above, seabed storage eliminates concerns over pore space ownership because federal waters begin nine nautical miles off the coast of Texas and three miles off the coast of Louisiana.¹⁸¹ Whether a CCS facility is located in state or federal waters, the operator would only need to work with one owner, either the state or the federal government, rather than navigating the friction between surface and mineral estate rights. Though offshore sites are more expensive to build and operate, the cost might be justified because they eliminate many of the issues faced by land-based operations.¹⁸²

Some companies have already seen the potential in offshore storage sites and are in the process of developing plans for offshore facilities.¹⁸³ In 2021, ExxonMobil proposed a CCS “Innovation Zone” in the Houston area that would “safely capture and permanently store about 50 million metric tons of CO₂ annually by 2030,” with the possibility of doubling that amount by 2040.¹⁸⁴ The plan is to permanently store the CO₂ deep under the Gulf of Mexico seabed in porous rock formations.¹⁸⁵ While many companies have signed on to this project, some critics remain skeptical and see the

178. *Id.*

179. *Id.* at 1659.

180. *Id.*

181. *Id.*; *Boundaries (Saltwater/Freshwater and State/Federal)*, LA. DEP’T WILDLIFE & FISHERIES, <https://www.wlf.louisiana.gov/page/boundaries> [<https://perma.cc/Z3FY-K74U>] (last visited Jan. 11, 2024); *Outer Continental Shelf*, BUREAU OCEAN ENERGY MGMT., <https://www.boem.gov/oil-gas-energy/leasing/outer-continental-shelf> [<https://perma.cc/EU7R-2U33>] (last visited Jan. 11, 2024).

182. Schrag, *supra* note 175, at 1659.

183. Nicholas Kusnetz, *Exxon’s Long-Shot Embrace of Carbon Capture in the Houston Area Just Got Massive Support from Congress*, INSIDE CLIMATE NEWS (Sept. 25, 2022), <https://insideclimatenews.org/news/25092022/exxon-houston-ship-channel-carbon-capture/> [<https://perma.cc/59Z9-TKY6>].

184. *Id.*; *The Promise of Carbon Capture and Storage, and a Texas-Sized Call to Action*, ENERGYFACTOR EUR. (Apr. 30, 2021), <https://energyfactor.exxonmobil.eu/perspectives/houston-ccs-hub/> [<https://perma.cc/LUD9-HE67>].

185. Kusnetz, *supra* note 183.

project as a “disingenuous gesture toward lowering emissions serving as a cover for the real investments in oil and gas.”¹⁸⁶

In addition to the Gulf of Mexico, other bodies of water are being considered for offshore CCS projects.¹⁸⁷ A promising test project was conducted in the seabed off of Japan’s Hokkaido Island.¹⁸⁸ The test resulted in the storage of 300 thousand tons of CO₂ in three years and eight months.¹⁸⁹ Additionally, the CO₂ injection did not cause any microseismicity or natural earthquakes in the vicinity of the injection site.¹⁹⁰ The Tomakomai site developers told Reuters that they had managed to cut energy costs significantly while increasing CO₂ capture efficiency, though these claims were not tested commercially.¹⁹¹ Overall, the site shows promise and the possibility of continued offshore storage.¹⁹²

The North Sea has been home to the Sleipner project for nearly thirty years but may soon host another offshore CCS project.¹⁹³ The Port of Rotterdam CO₂ Transport Hub and Offshore Storage (Porthos) project is a combined effort by Air Liquide, Air Products, ExxonMobil, and Shell to store 2.5 million tons of CO₂ under the North Sea seabed.¹⁹⁴ The project is expected to reduce the emissions of Rotterdam’s industry by around 10%, which would result in a reduction of emissions of around 2% for the Netherlands.¹⁹⁵ Storage was scheduled to begin in 2024, but in late 2022, the Netherlands’ highest court ruled that the project violated European environmental guidelines due to the “exclusion

186. *Industry Support for Large-Scale Carbon Capture and Storage Continues to Gain Momentum in Houston*, EXXONMOBIL (Jan. 20, 2022), https://corporate.exxonmobil.com/news/newsroom/news-releases/2022/0120_industry-support-for-large-scale-carbon-capture-and-storage-gains-momentum-in-houston [<https://perma.cc/Z4SZ-URA8>]; Kusnetz, *supra* note 183.

187. Aaron Sheldrick, *Japan Carbon Capture Site Shows Promise for Industrial Use*, REUTERS (Apr. 19, 2018, 2:53 AM), <https://www.reuters.com/article/us-japan-carbon-storage/japan-carbon-capture-site-shows-promise-for-industrial-use-idUSKBN1HQ0WZ> [<https://perma.cc/TAR3-RSUR>]; Sanja Pekic, *Dutch Energy Companies Sign Contract for Porthos CO₂ Project*, OFFSHORE ENERGY (Dec. 20, 2021), <https://www.offshore-energy.biz/dutch-energy-companies-sign-contract-for-porthos-co2-project/> [<https://perma.cc/LGJ2-DLN4>].

188. Sheldrick, *supra* note 187.

189. MINISTRY OF ECON., TRADE & INDUS. ET AL., REPORT OF TOMAKOMAI CCS DEMONSTRATION PROJECT AT 300 THOUSAND TONNES CUMULATIVE INJECTION 1 (2020), https://www.meti.go.jp/english/press/2020/pdf/0515_004a.pdf [<https://perma.cc/F5XA-7CYN>].

190. *Id.* at 9.

191. Sheldrick, *supra* note 187.

192. *See id.*

193. *Supra* notes 48–49 and accompanying text; Pekic, *supra* note 187.

194. Pekic, *supra* note 187.

195. *Id.*; Violet George, *Dutch Court Threatens Europe’s Largest Carbon Capture Project Porthos*, CARBON HERALD (Nov. 3, 2022), <https://carbonherald.com/dutch-court-threatens-europes-largest-carbon-capture-project-porthos/> [<https://perma.cc/G3FJ-RZWR>].

of nitrogen emissions from the assessment of the project.”¹⁹⁶ The court’s decision came as a surprise because the exclusion was based on an exemption granted by the Dutch government.¹⁹⁷ The ruling may delay the project while environmental regulations are met.¹⁹⁸ However, the project shows promise and is close to implementation if the legal hurdles can be overcome.

IX. CONCLUSION

The rapid development of CCS projects in the United States has outpaced regulatory developments. For CCS project developers in Texas to understand the full scope of their projects, they will need answers regarding pore space ownership, liability, and EJ requirements. It seems likely that Texas will follow the precedent set by Wyoming and North Dakota by adopting the American Rule, which assigns pore space ownership to the surface estate. However, in some ways, the English Rule aligns more closely with the practices already in place surrounding EOR and the rights of oil producers to use the pore space incidental to the development of the resource. This seems unlikely given case law regarding subsurface ownership, but it will be interesting to see how this issue is resolved. Additionally, questions remain as to whether, under the American Rule, the surface estate owner will be able to sever and transfer pore space ownership in Texas.

From a liability standpoint, it seems clear that storage facility operators in Texas will retain ownership of stored CO₂. However, despite precedent dating back to the 1960s, this could be statutorily changed to reflect the regulations in Louisiana and Wyoming, which allow the states to assume liability for the CO₂ after certain conditions are met. While it is unclear how much liability for the stored CO₂ will affect the CCS facilities’ locations, it could induce operators to focus on states with favorable liability laws or offshore storage solutions. The creation of a trust fund to address potential hazardous events would go a long way toward creating long-term security for stored CO₂ and providing resources in case of an emergency.

Although EJ concerns recently became a national regulatory priority, the disparity between the pollution burdens born by different racial and socioeconomic groups should be addressed by

196. Pekic, *supra* note 187; George, *supra* note 195.

197. George, *supra* note 195.

198. *Id.*

states and the EPA. This requires the development of guidelines and criteria for the siting of facilities and pipelines. States can take the lead on this front because the EPA has not yet promulgated requirements that must be met by the states. Apart from addressing the systematic inequality of pollution burdens in the United States, a strong commitment to EJ would signal that CCS is intended as a solution to environmental issues rather than a desperate attempt by energy companies and the government to prolong the nation's dependency on fossil fuels.

While these issues remain unresolved, offshore storage is an attractive solution to the uncertainty and controversy surrounding land-based storage. It eliminates concerns about pore space ownership because the seabed is owned by either the state or the federal government, rather than by private citizens. Additionally, there may be fewer risks associated with injecting CO₂ offshore because it is far away from heavily populated areas and sources of drinking water. Offshore injection also limits the potential EJ issues because the facility and much of the pipeline would be located away from vulnerable communities. Though questions remain regarding all viable CCS projects, it seems likely that impactful regulations and case law are on the horizon, which will answer many of these questions and advance CCS development both onshore and offshore.

Muriel Hague