THE PATH TO AT-SCALE CARBON CAPTURE, UTILIZATION, AND STORAGE: PORE SPACE OWNERSHIP

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I. INTRODUCTION

Carbon capture, utilization, and storage (CCUS) technologies will need to be widely used across the globe in order to reach global net zero emissions goals.[1] The phrase CCUS refers to a group of technologies that captures carbon dioxide (CO_2) and then transports it for use or storage, either temporarily or permanently.[2] At-scale deployment of CCUS technologies will require legal frameworks that resolve the rights and responsibilities of stakeholders while providing a solid legal foundation for the long-term operation and management of stored CO_2.[3]

While the legal framework for CCUS is developing in the United States, critical questions remain unsolved regarding property rights.[4] In many states, property law does not clearly define who owns the property rights involved in CCUS projects.[5] This paper addresses the impact of surrounding property rights law, particularly pore space ownership, on at-scale deployment of CCUS technologies.

Pore spaces are the "microscopic spaces between particles of rock or sand . . . where oil and natural gas occur."[6] When the surface estate owns the pore space, those seeking to utilize pore space for CCUS need to obtain the permission of the relevant surface estate.[7] This turns pore space ownership into a valuable property right, and the surface estate should receive monetary compensation in exchange for the use of their pore space.[8]

In order to establish a clear framework and remove barriers to CCUS, state legislatures and courts should continue to confer pore space ownership to the surface estate and clarify that the surface estate has the right to lease the use of their pore space because it is in the best interest of landowners, energy companies, and the general public. Continued uncertainty will delay both the rapid growth the CCUS

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1. *Legal and Regulatory Frameworks for CCUS*, INT'L ENERGY AGENCY 7 (July 2022), https://iea.blob.core.windows.net/assets/bda8c2b2-2b9c-4010-ab56-b941dc8d0635/LegalandRegulatoryFrameworksforCCUS-AnIEACCUSHandbook.pdf.

2. *Council on Environmental Quality Report to Congress on Carbon Capture, Utilization, and Sequestration*, WHITE HOUSE 10 (June 30, 2021), https://www.whitehouse.gov/wp-content/uploads/2021/06/CEQ-CCUS-Permitting-Report.pdf.

3. INT'L ENERGY AGENCY, *supra* note 1, at 7.

4. *Getting Ready for CCUS Take-off in the United States*, BAKER BOTTS (June 18, 2021), https://www.bakerbotts.com/thought-leadership/publications/2021/june/getting-ready-for-ccus-take-off-in-the-united-states.

5. INT'L ENERGY AGENCY, *supra* note 1, at 58.

6. John P. Melko, *A "Pore" Explanation: What are Pore Spaces, How To Lease Them, and What To Do With Them?*, FOLEY & LARDNER LLP (Apr. 27, 2022), https://www.foley.com/en/insights/publications/2022/04/a-pore-explanation-spaces-how-to-lease.

7. Austin Lee et al., *The Way Forward: A Legal and Commercial Primer on Carbon Capture, Utilization, and Sequestration*, 16 TEX. J. OIL GAS & ENERGY L. 43, 59 (2021).

8. Ryan M. Newburn, *Pore Space Ownership and Use in the Carbon Capture Industry*, NEWBURN L. (June 22, 2022), https://www.newburnlaw.com/pore-space-ownership-and-use-in-the-carbon-capture-industry.

industry is capable of[9] and the reduction of greenhouse gas emissions for heavy industry sectors that are required to reach net zero emissions goals.[10]

Beyond providing compensation, a clarified legal system that vests pore space ownership in the surface estate will allow energy companies to take greater advantage of federal incentives and reach net zero targets.[11] The ongoing unanswered legal questions surrounding CCUS create a barrier to the potential advantages of the technologies.[12] Energy companies that utilize CCUS to reduce their carbon footprint will also be more attractive to institutional investors.[13] ESG has become an important factor in evaluating investments, and CCUS is a path for oil and gas companies to reduce their own emissions while continuing their core business.[14] Additionally, clear ownership will make it easier for energy companies to protect against liability from claims such as trespass or conversion.[15] Energy companies will be able to mitigate these risks associated with carbon storage projects once they are able to precisely identify the particular rights of each involved party.[16]

Finally, the Intergovernmental Panel on Climate Change asserts that limiting global temperature rises to 1.5 degrees Celsius, and thereby avoiding the worst effects of climate change, may call for geologic sequestration of up to one trillion metric tons of CO_2 by 2050.[17] Thus, arguably most importantly, growth in the CCUS industry, as spurred by a clear legal framework, is critical for succeeding in the decarbonization efforts that aim to protect the public from the effects of further climate change.[18]

This paper argues that a unified and clear legal landscape for pore space ownership will benefit landowners, energy companies, and the public by removing a substantial legal barrier that is preventing CCUS from taking off at-scale. The first part of the paper will discuss the history of CCUS and pore space ownership, and the legal landscape as it stands now. It will also cover the case law and statutes of both states where the law is resolved and those where it is not.

The second part of the paper will focus on the pros and cons of a clarified legal landscape that resolves pore space ownership as

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9. BAKER BOTTS, *supra* note 4.
10. INT'L ENERGY AGENCY, *supra* note 1, at 7.
11. *See* Kit Norton, *Fueling Carbon Capture in the Oil Industry: Production, Net Zero And ESG*, INV.'S BUS. DAILY (July 29, 2022, 12:21 PM), https://www.investors.com/news/carbon-capture-oil-industry-production-net-zero-esg.
12. BAKER BOTTS, *supra* note 4.
13. Norton, *supra* note 11.
14. *Id.*
15. Lee et al., *supra* note 7, at 60.
16. *Id.*
17. WHITE HOUSE, *supra* note 2, at 11.
18. *Id.* at 6.

belonging to the surface estate. This part will focus on the benefits to landowners, energy companies who use (or would like to use) CCUS, and the public at large. Additionally, the paper will examine *Northwest Landowners Ass'n v. State*, a recent case decided by the North Dakota Supreme Court on the meaning of the state's pore space statute.[19] It will also take into account that resolving ownership in favor of the surface estate raises concerns about potential drawbacks regarding the cost of energy, safety concerns regarding storage and transport, and environmental concerns.

Finally, this paper will argue that the best solution for long-term success is to establish a clear legal framework that gives the surface estate ownership and the right to lease the pore spaces below their land. This approach will benefit most stakeholders by allowing CCUS to take off and reach at-scale deployment.

II. HOW THE HISTORY OF CCUS DEVELOPMENT, PROPERTY LAW, AND THE CURRENT PORE SPACE OWNERSHIP LANDSCAPE INFORM THE WAY FORWARD

A. CCUS's Potential To Be A Climate Game-Changer

Excitement surrounding CCUS has dramatically increased in the past few years.[20] In the United States, there are about forty-five CCUS facilities operating or in development, and "there is growing scientific consensus that [CCUS] . . . will likely play an important role in decarbonization efforts globally."[21]

Analyses from domestic and global organizations, such as the Intergovernmental Panel on Climate Change, National Academies of Sciences Engineering and Medicine, and the Net Zero America Project, utilize CCUS when determining methods to achieve climate goals.[22] Due to the importance of CCUS, the United States Department of Energy is developing and implementing policies to garner additional investments in CCUS.[23] The significance of CCUS lies in the ability of these technologies to reduce the pollution of already existing emitters as opposed to reducing the demand for processes that create pollution, especially in the energy and industrial sectors.[24] According to the

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19. Nw. Landowners Ass'n v. State, 2022 ND 150, 978 N.W.2d 679, *reh'g denied* (2022).

20. Deanne Barrow & Keith Martin, *Carbon Capture Terms*, NORTON ROSE FULBRIGHT (June 23, 2022), https://www.projectfinance.law/publications/2022/june/carbon-capture-terms/.

21. WHITE HOUSE, *supra* note 2, at 6, 10.

22. *Id.* at 11-12.

23. The Future Direction of CCUS in the Oil and Gas Industry, OFF. OF FOSSIL ENERGY AND CARBON MGMT. (Feb. 6, 2020), https://www.energy.gov/fecm/articles/future-direction-ccus-oil-and-gas-industry.

24. Alex Dewar & Bas Sudmeijer, *The Business Case for Carbon Capture*, BOSTON CONSULTING GRP. (Sept. 24, 2019), https://www.bcg.com/publications/2019/business-case-carbon-capture.

International Energy Association, to meet its Net Zero Emissions by 2050 Scenario, CCUS usage must increase by a factor of almost 200, so as to capture 7.6 billion tons of CO_2 in 2050.[25]

However, the cost of using CCUS technology has been a barrier to at-scale usage because it has not been commercially viable.[26] If given the ability to become commercially viable, CCUS could become a global industry worth $90 billion within the next ten years.[27] Supporting the development of CCUS can also reduce the costs of emissions reduction goals.[28]

The carbon capture portion of CCUS refers to the capture of CO_2 from point sources or directly from the atmosphere.[29] Point sources may include the exhaust stacks of industrial manufacturing, power, or processing plants.[30] Currently, technologies are being developed to capture CO_2 directly from the atmosphere.[31] Carbon capture can be employed in both the power and industrial sectors.[32] Some industrial processes, such as natural gas processing or fossil-fuel-based hydrogen production, already capture CO_2 as a part of their normal processes.[33]

The utilization portion of CCUS refers to the multitude of ways that CO_2 can be recycled into new uses after being captured.[34] This includes being used to make products such as concrete or plastics, and as a key ingredient of enhanced oil recovery (EOR).[35] EOR is the third level of oil development where heat, gas, or chemicals are injected into wells to increase pressure and recover as much of the remaining oil as possible.[36] The use of CO_2 EOR can increase the amount of oil recovered from wells by ten to twenty-five percent.[37] To date, the majority of CO_2 EOR projects have used naturally-occurring underground CO_2 deposits.[38] However, the prevalence of using naturally-occurring CO_2 has been constrained by limited supply due to the "depletion, scarcity, and remoteness of source fields."[39]

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25. INT'L ENERGY AGENCY, *supra* note 1, at 7.
26. Dewar & Sudmeijer, *supra* note 24.
27. *Id.*
28. WHITE HOUSE, *supra* note 2, at 6.
29. *Id.* at 10.
30. Lee et al., *supra* note 7, at 44.
31. *Id.*
32. WHITE HOUSE, *supra* note 2, at 10.
33. *Id.*
34. *Id.*
35. *Id.*
36. *Enhanced Oil Recovery*, OFF. OF FOSSIL ENERGY AND CARBON MGMT., https://www.energy.gov/fecm/science-innovation/oil-gas-research/enhanced-oil-recovery.
37. Lee et al., *supra* note 7, at 52-53.
38. *Id.* at 55.
39. *Id.* at 57.

Finally, the storage portion of CCUS refers to the geologic storage or sequestration of CO_2.[40] CO_2 requires deep rock formations to ensure safe and secure storage.[41] Once in the geologic formation, the CO_2 can be stored there permanently or later withdrawn for use in products such as fertilizer.[42]

B. Real Property Law and Pore Space Ownership

Under the common-law *ad coelum* doctrine, landowners own everything above their land up to the sky and below their land to the earth's core.[43] A landowner can sever their ownership into two distinct estates (surface estate and mineral estate) by either conveying or reserving the mineral estate.[44] The owner of the minerals, generally the mineral estate after severance, may lease the rights to use the mineral estate to produce and develop minerals such as oil and gas.[45]

However, which estate owns the mineral substances and which owns the underground geologic structures (also known as pore spaces), where the mineral substances are found, depends on jurisdiction.[46] Once oil, gas, or both are discovered and produced, the pore spaces are an empty and safe storage space for CO_2.[47] Pore space ownership is important in determining who should be compensated for the use of the space when storing CO_2 underground.[48] Unfortunately, property rights questions around CCUS are complicated and unresolved matters of state law.[49]

In general, oil and gas leases include provisions that allow the use of water or gas for EOR, but do not usually include the use of the subsurface for reasons other than producing the minerals.[50] States who have settled law on pore space ownership have awarded ownership to the surface estate unless the parties expressly contract to the contrary in writing.[51] However, surface ownership of the pore space is "subject to a right of the mineral estate to make reasonable use of the surface estate as necessary to produce minerals."[52] This means the surface estate may need to wait until the mineral estate has extracted all the minerals

40. Lee et al., *supra* note 7, at 44.
41. WHITE HOUSE, *supra* note 2, at 10.
42. Melko, *supra* note 6.
43. *Ad Coelum Doctrine*, BLACK'S LAW DICTIONARY (11th ed. 2019).
44. Lee et al., *supra* note 7, at 59.
45. Melko, *supra* note 6.
46. Lee et al., *supra* note 7, at 59.
47. Melko, *supra* note 6.
48. Newburn, *supra* note 8.
49. BAKER BOTTS, *supra* note 4.
50. Melko, *supra* note 6.
51. BAKER BOTTS, *supra* note 4.
52. *Meeting the Dual Challenge: A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage: Chapter 3 – Policy, Regulatory, and Legal Enablers,* NAT'L PETROLEUM COUNCIL 3-1, 3-13 (March 12, 2021), https://dualchallenge.npc.org/files/CCUS-Chap_3-030521.pdf.

underground prior to utilizing the pore space.[53] Given the many property rights involved, determining who holds the rights to the pore space is a new and difficult issue for the law.[54]

C. The Importance of Pore Space Ownership to CCUS Projects and Stakeholders

The Fifth Amendment of the Constitution of the United States guarantees that private property will not "be taken for public use, without just compensation."[55] This clause, known as the Takings Clause, applies to the states via Fourteenth Amendment incorporation.[56] As a result of the *ad coelum* doctrine, ownership of the pore space is considered a private property right[57] and is a valuable one due to the emergence of CCUS.[58]

To avoid liability, those who engage in CCUS operations must have the right to access and possess the pore space they intend to use.[59] As a first step, operators will need to know whether the surface or mineral estate owns the rights to the pore space.[60] Determining who owns the right to use the pore space is made difficult by the fact that questions around CCUS property rights are exceedingly complex and widely unsettled in the United States.[61]

The at-scale deployment of carbon storage is delayed by the threshold questions regarding property rights, specifically pore space ownership.[62] When it is unclear from whom an energy company needs to obtain the pore space usage rights, the company may need to reach agreements with multiple interest owners to avoid civil liability, such as trespass and conversion, thereby driving up project costs and time.[63] In order to be commercially viable, the cost of CCUS projects must decrease.[64]

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53. 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=314015a52e4b.

54. Newburn, *supra* note 8.

55. Nw. Landowners Ass'n v. State, 2022 ND 150, ¶ 16, 978 N.W.2d 679 (2022).

56. *Id. (quoting* Wild Rice River Estates, Inc. v. City of Fargo*, 2005 ND 193, ¶ 12, 705 N.W.2d 850 (2005)).*

57. BAKER BOTTS, *supra* note 4.

58. Newburn, *supra* note 8.

59. Lee et al., *supra* note 7, at 58.

60. *Id.* at 60.

61. BAKER BOTTS, *supra* note 4.

62. *Id.*

63. Tracy Hester & Elizabeth George, *The Top Five Legal Barriers to Carbon Capture and Sequestration in Texas*, FORBES (Nov. 19, 2019, 1:46 PM), https://www.forbes.com/sites/uhenergy/2019/11/19/the-top-five-legal-barriers-to-carbon-capture-and-sequestration-in-texas/?sh=4851ed5a7508.

64. Dewar & Sudmeijer, *supra* note 24.

D. The Current Legal Landscape of Pore Space Ownership and the Right to Lease

There are a few states with legislation, case law, or both that attempt to clarify pore space ownership. Where pore space ownership law exists, states generally vest title in the surface owner of the land above the pore space.[65]

In regard to legislative law, Indiana, Kentucky, Montana, Nebraska, Oklahoma, and Wyoming statutes confer ownership rights to the pore spaces on the surface owner unless the pore space has been severed from the surface estate and separately conveyed.[66] Indiana, Kentucky, and Mississippi even reference CO_2 storage in the sections of their legislation where title to pore space is defined.[67] Utah leaves title to pore space "in the owner of the surface estate" and doesn't seem to specify further.[68]

However, other state statutes vary in their pore space provisions, which can add complexities. For example, instead of a statute on title to pore space, Mississippi code provides that approval of geologic sequestration facilities is effective only when approved "by a majority interest of the surface interest . . . and, if separately owned, a majority interest of all rights in the underground reservoir."[69] North Dakota's statute vests title to pore space in the surface owner, but also specifies that the title cannot be severed from the surface estate above the pore space.[70] Nonetheless, North Dakota's statute does specifically allow for leasing of the pore space.[71]

There are also a couple of states that have declared that the title to pore space belongs to the surface estate owner through case law. For example, in *Southern Natural Gas Co. v. Sutton*, the Second Circuit Court of Appeals of Louisiana held that surface ownership "includes the right to the use of the reservoir underlying . . . for storage purposes."[72] Additionally, in *Department of Transportation v. Goike*, the Michigan Court of Appeals held that "the storage space, once it has been evacuated of the minerals and gas, belongs to the surface owner."[73]

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65. INT'L ENERGY AGENCY, *supra* note 1, at 58.

66. IND. CODE § 14-39-2-3 (2022); KY. REV. STAT. ANN. § 353.800(8) (West 2021); MONT. CODE ANN. § 82-11-180(3) (2021); NEB. REV. STAT. § 57-1604(1) (2021); OKLA. STAT. TIT. 60, § 6(B)(2) (2021); WYO. STAT. ANN. § 34-1-152(a) (2021).

67. IND. CODE § 14-39-2-3 (2022); KY. REV. STAT. ANN. § 353.800(8) (West 2021); MISS. CODE ANN. § 53-11-11(4) (2022).

68. UTAH CODE ANN. § 40-6-20.5(1) (2022).

69. MISS. CODE Ann. § 53-11-11(4) (2022).

70. N.D. CENT. CODE ANN. § 47-31-05(West 2009).

71. *Id.;* N.D. CENT. CODE ANN. § 47-31-06 (West 2009).

72. S. Nat. Gas Co. v. Sutton, 406 So. 2d 669, 671 (La. Ct. App. 1981).

73. Dep't of Transp. v. Goike, 560 N.W.2d 365, 615–16 (Mich. Ct. App. 1996).

The oil and gas producing states of Colorado, Ohio, and Pennsylvania do not have statutes regarding title to pore space.[74] While these states do have case law that touches on pore space ownership, the case law does not provide adequate clarity.[75] For example, the Superior Court of Pennsylvania in *Pomposini v. T.W. Phillips Gas and Oil Company* held that an oil and gas lease does not include the right to store gas underground unless the parties intended to confer that right.[76] However, the court did not clarify which party had storage rights in the first place.[77] The court specified that the production of gas does "not include the right to use the cavernous spaces owned by the lessor,"[78] thereby implying that the mineral interest holder, and not the surface estate, owns the pore spaces. The implication goes against the majority of states' laws in the U.S., and the uncertainty creates ample room for confusion.

Texas, despite being the largest producer of greenhouse gases in the U.S. and having the largest potential for carbon storage underground, does not have a statute or clear case law regarding pore space ownership.[79] The Supreme Court of Texas held in *Lightning Oil v. Anadarko* that although the surface owner "owns and controls" the pore space, that doesn't "necessarily mean [they are] entitled to make physical intrusions into formations where minerals are located," and the cases cited by the court of appeals do not provide an answer.[80]

The case decided whose permission is required for an oil and gas operator to drill horizontally through an adjoining mineral estate (where they do not have a lease) to reach the mineral estate on which they do have a lease.[81] The operator had permission to extract minerals from below a wildlife conservation area, but had to drill from off the conservation area and through a separate mineral estate to reach the minerals under the reserve.[82] The court held that "an unauthorized interference with the *place* where the minerals are located constitutes a trespass as to the mineral estate only if the interference infringes on the mineral lessee's ability to exercise its rights."[83]

Therefore, while specifying that the surface owner owns the formations surrounding the minerals underground, *Lightning Oil Co.* does not decide who may lease the pore space for storage purposes or

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74. Stefanie L. Burt, *Who Owns the Right to Store Gas: A Survey of Pore Space Ownership in U.S. Jurisdictions*, 4 JOULE DUQ. ENERGY & ENV'T. L.J. [i], [vii-ix] (2016).

75. *Id.*

76. Pomposini v. T.W. Phillips Gas & Oil Co., 397 Pa. Super. 564, 568-69 (1990).

77. See *id.*

78. *Id.* at 569.

79. George, *supra* note 53.

80. Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39, 47 (Tex. 2017).

81. *Id.* at 43.

82. *Id.*

83. *Id.* at 49.

how that process would work.[84] Given that the surface and mineral estate are often severed, ownership of the pore space must be clarified for Texas (and other states) to take advantage of its available underground resources.[85] Leaving the question of who has the right to lease the pore space "poses a stumbling block that could delay or even cripple efforts to capture market share" in CCUS.[86]

III. THE NET POSITIVE EFFECTS OF WELL-DEFINED PORE SPACE OWNERSHIP LAW DEMONSTRATE THE IMPORTANCE OF CLARIFYING THE LAW

A. Benefits to Landowners: A New Stream of Income

With the right incentives, such as valuable tax credits, selling rights to utilize pore space could become a large, thriving industry.[87] CCUS has the potential to grow into a fully developed industry worth around ninety billion dollars in the next ten years.[88] The skyrocketing interest in CCUS in the U.S., due to updated tax incentives which make CCUS projects economically viable,[89] will likely lead the market to develop standard terms for CCUS projects.[90] The correct legal framework is to confer title and control rights of the pore space to the surface estate, because it positions landowners to benefit from the growing CCUS industry through monetary compensation in exchange for the use of their pore space.

It is clear with the growth in interest and resulting investment in CCUS projects that title to pore space is now a valuable property right.[91] A growing number of energy companies are looking for land with pore space suitable for carbon sequestration.[92] In order to gain the rights to use pore space for CCUS, those energy companies are entering into pore space leases with landowners.[93] For example, Denbury, an oil and gas company focused on CO_2 EOR, announced three new lease agreements for carbon sequestration projects with private landowners in Louisiana

84. *See* Lightning Oil Co., 520 S.W.3d 39.

85. George, *supra* note 53.

86. *Id.*

87. Pam Boschee, *Pore Space Gains Value as CCS Picks Up Traction*, J. PETROLEUM TECH. (Sept. 1, 2022), https://jpt.spe.org/pore-space-gains-value-as-ccs-picks-up-traction.

88. Dewar & Sudmeijer, *supra* note 24.

89. Greg Matlock, *Why carbon capture just became an economic fastball*, ERNST & YOUNG (Nov. 15, 2022), https://www.ey.com/en_us/energy-resources/why-carbon-capture-just-became-an-economic-fastball.

90. Barrow & Martin, *supra* note 20.

91. John B. McFarland, *Ownership of Pore Space – North Dakota Supreme Court Opinion Protects Surface Owners' Rights*, GRAVES DOUGHTERY HEARON & MOODY (Aug. 8, 2022), https://www.oilandgaslawyerblog.com/ownership-of-pore-space-north-dakota-supreme-court-opinion-protects-surface-owners-rights/.

92. Newburn, *supra* note 8.

93. McFarland, *supra* note 91.

in March of 2022.[94] Two of the leases cover 84,000 acres with the potential to sequester more than 500 million metric tons of CO_2.[95]

All CCUS projects will need multiple contractual arrangements with various stakeholders to coordinate the stages of the project and address any associated risks.[96] Pore space leases are an outcome of the surface estate's expectation of compensation for the use of their pore space in states where title to the pore space has been clearly vested in them.[97] A lease with the surface estate will result because in order to sequester carbon, the company is required to reach an agreement with the surface owner to gain the right to possess and use the pore space.[98] Without this agreement, the operators of the sequestration project may expose themselves to trespass or conversion claims from the surface estate owner.[99]

For CCUS project agreements, some stakeholders are recycling contract concepts from coal and natural gas deals.[100] Pore space leases include many of the same issues as leases that are already well established, such as leases for natural gas storage fields and water disposal wells.[101] Similar to oil and gas projects, carbon sequestration projects include costs for use agreements, such as royalty-based use agreements.[102] Typically, landowners are paid both a fixed pore space lease or easement fee and a royalty based on sequestration volumes.[103] The potential for landowner income is huge when pore space leases, such as the above-referenced Denbury leases, have the capacity to sequester hundreds of millions of metric tons of CO_2, and lease royalties are tied to sequestration volume. In states with oil and gas, mineral estates benefit greatly from producing mineral leases, while surface estates are usually damaged aesthetically, economically, and physically. Conferring pore space rights to the surface estate follows the *ad coelum* doctrine and provides a new stream of income for landowners that have historically been left behind by the energy industry.

The Supreme Court of North Dakota's clarification of the pore space ownership legal framework in *Northwest Landowners Ass'n v. State*, No. 20210148 (N.D. Aug. 4, 2022) is a clear example of when

94. Petya Trendafilova, *Denbury Signs Three New Lease Agreements for Carbon Capture and Storage*, CARBON HERALD (Aug. 15, 2022), https://carbonherald.com/denbury-signs-three-new-lease-agreements-for-carbon-capture-and-storage/.

95. *Id*.

96. Lee et al., *supra* note 7, at 67.

97. Melko, *supra* note 6.

98. Lee et al., *supra* note 7, at 60.

99. *Id*.

100. Barrow & Martin, *supra* note 20.

101. Melko, *supra* note 6.

102. *Id.*

103. Barrow & Martin, *supra* note 20.

vesting ownership in the surface estate benefits landowners.[104] In 2019, the North Dakota Legislative Assembly passed Senate Bill 2344, which:

> (1) allowed unrestricted use of pore space by oil and gas operators, (2) excluded pore space from the definition of "land" in [an already existing Act], such that landowners were not automatically entitled to compensation for . . . use of subsurface pore space, and (3) barred tort claims altogether for injection or migration of substances into pore spaces.[105]

The Northwest Landowners Association responded with a lawsuit alleging that the bill was an unconstitutional taking of the ability of surface owners to seek compensation for losses of their valuable pore space or related tort damages.[106]

First, the North Dakota Supreme Court held that surface owners had a property interest in their tract's corresponding pore space and were entitled to compensation for the use of it.[107] The Court also concluded that, by allowing operators to inject substances into the pore space, the bill "constituted a per se physical-invasion taking" of landowners' property.[108]

The North Dakota Supreme Court also addressed and rejected the State's argument that the dominance of the mineral estate protected the bill from the Takings Clause.[109] The Court acknowledged that the mineral estate does have an implied easement, that allows the mineral owner to use the surface estate for production of minerals, as is reasonably necessary.[110] However, the Court rejected the argument because the bill went further and blocked landowners from seeking compensation through tort for operations that went beyond the reasonably necessary use given by the implied easement.[111] Overall, the Court enshrined pore space ownership as belonging to the surface estate according to precedent, and struck down portions of the bill that violated that ownership as an unconstitutional taking.[112]

As a result of *Northwest Landowners Ass'n v. State*, it is clear in North Dakota that surface owners, as owners of the underground

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104. See *North Dakota Supreme Court Strikes Down Portions of Pore Space Law as an Unconstitutional Taking*, BAKER BOTTS (Aug. 8, 2022), https://www.bakerbotts.com/thought-leadership/publications/2022/august/north-dakota-supreme-court-decision.

105. Scheffler et al., *North Dakota Supreme Court Solidifies Surface Owners' Rights to Profit from and Seek Damages for Unauthorized Use of Pore Space*, HAYNES BOONE (Aug. 10, 2022), https://www.haynesboone.com/news/alerts/north-dakota-pore-space.

106. *Id.*

107. *Id.*

108. *Id.*

109. BAKER BOTTS, *supra* note 104.

110. Nw. Landowners Ass'n v. State, 2022 ND 150, ¶ 21,978 N.W.2d 679, 689-90, *reh'g denied* (2022).

111. Scheffler et. al., *supra* note 105.

112. *Id.*

geologic formations, are entitled to compensation for pore space use.[113] This clarification "emphasizes that surface owners will be stakeholders [in CCUS projects] due to their vested property rights in the pore space."[114] As a result, companies seeking to sequester CO_2 underground will need to pursue pore space leases with landowners to adequately compensate them for the right to use their valuable property.[115] With a clear legal framework, North Dakota landowners will now profit from the desire of companies to use their pore space for CCUS projects and more. North Dakota serves as an excellent example of the economic benefits that will result for landowners should other states confer the title and leasing rights of the pore space to landowners.

B. Benefits to Energy Companies: Less Risk, Less Costs, Increased Investment

For energy companies, mainly oil and gas companies participating in carbon storage, clear law defining pore space ownership would reduce potential liability associated with carbon storage projects, increase efficiency, reduce costs of these projects, attract investors, and provide a clear path to take advantage of the related tax incentives. Many oil and gas industry leaders are entering the carbon capture and storage race with billions of dollars, including: Occidental Petroleum, Exxon Mobil, Talos Energy, and Denbury.[116] While maybe for different reasons, energy companies join environmental groups in supporting the efforts to scale carbon sequestration.[117]

Currently, there are a variety of legal issues that can create liability for energy companies who seek to sequester carbon in pore spaces.[118] These issues vary from "threshold questions of what property rights are needed . . . , and who has those rights, to the process for and cost of securing and protecting the necessary rights."[119]

A clear understanding of the rights and obligations of the parties is crucial to ensure the energy companies operating these projects avoid the liability and financial costs associated with potential trespass and conversion claims, and other property rights and contract issues.[120] Understanding the rights and obligations of the parties requires that the

113. BAKER BOTTS, *supra* note 104.

114. *Id.*

115. *Id.*

116. Norton, *supra* note 11.

117. Justin Worland, *Oil Companies Agree on a Climate Change Solution That Would Help Their Bottom Line*, TIME (Mar. 8, 2018, 1:46 PM), https://time.com/5189173/carbon-capture-climate-change-oil-gas/.

118. BAKER BOTTS, *supra* note 4.

119. *Id.*

120. Lee et al., *supra* note 7, at 60.

operator receives the right to access and possess the subsurface geologic structures.[121]

If the law does not clarify who owns and has the right to lease the pore space for storage, the operator will have a harder time guarding against liability from claims rooted in property rights.[122] Without clarity, the safest approach becomes obtaining permission from all parties with interest in the surface estate and mineral estate.[123] Multiple agreements with multiple parties will likely be costly due to leasing fees, legal fees, room for error, and time. Clarification of pore space law, resulting in the reduction of potential liability and associated costs, and an increase in efficiency in mitigating those risks, is necessary to foster commercial-scale deployment of CCUS.[124]

Further, if CCUS projects become easier to implement, energy companies can utilize the positive environmental results from CCUS to raise more money from investors. Investment in and lending to the oil and gas industry has reduced in recent years.[125] Analysts credit the drop in investment to increased investor interest in low carbon products and environmental, social, and governance (ESG) ratings.[126] In fact, investors are pushing oil and gas companies on their emission reduction plans.[127] Carbon storage removes carbon from the atmosphere and reduces the environmental footprint of energy companies while allowing them to continue their core operations.[128]

Finally, resolving the question of pore space ownership removes one of the barriers hindering energy companies from pursuing CCUS projects and obtaining the resulting tax incentives.[129] The relevant tax incentive for carbon sequestration is outlined in Section 45Q of the Internal Revenue Code.[130] Section 45Q was enacted to incentivize the sequestration of carbon and provides a tax credit per metric ton of qualified carbon captured and securely stored underground.[131] The combination of tax incentives and a clear legal framework position CCUS

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121. Lee et al., *supra* note 7, at 58.

122. *See* BAKER BOTTS, *supra* note 4.

123. Claire Juneau, *CCUS and Property Rights: Considerations Facing Potential Storage Operators in Louisiana*, KEAN|MILLER (Sept. 29, 2021), https://www.louisianalawblog.com/environmental-litigation-and-regulation/ccus-and-property-rights-considerations-facing-potential-storage-operators-in-louisiana/.

124. *See* BAKER BOTTS, *supra* note 4.

125. Norton, *supra* note 11.

126. *Id.*

127. Chantal Beck et al., *The future is now: How oil and gas companies can decarbonize*, MCKINSEY & COMPANY (Jan. 7, 2020), https://www.mckinsey.com/industries/oil-and-gas/our-insights/the-future-is-now-how-oil-and-gas-companies-can-decarbonize.

128. Norton, *supra* note 11.

129. *See* BAKER BOTTS, *supra* note 4.

130. I.R.C. § 45Q.

131. Lee et al., *supra* note 7, at 45.

to reach at-scale deployment.[132] Without tax incentives, CCUS projects are too costly to be commercially viable.[133]

The Inflation Reduction Act of 2022 (IRA), signed into law by President Biden, greatly increased the tax incentive under Section 45Q.[134] Section 45Q's boost from the IRA may result in increased investment in CCUS, spur new investors to join the CCUS industry, and solidify a starring role for CCUS in the race to reduce carbon emissions in the U.S.[135]

The IRA raised the dollar amount of the credit per ton for carbon sequestration and geologic storage from $50 per metric ton to $85 per metric ton.[136] Additionally, the IRA allows the receiver of the tax incentive to sell that incentive to a third party for cash, without the receipt of that cash being treated as taxable income.[137] The additional benefits that the IRA added to the 45Q incentive mean that CCUS projects for industrial facilities with lower concentrations of CO_2 could be financially viable.[138] With legal barriers out of the way, energy companies can make the most of the tax incentives and profit from CCUS projects.

C. Benefits to the Public: CCUS as a Main Method for Stopping Climate Change and Creating New, Well-Paying Jobs

If the states provide clear law regarding pore space ownership, the increase in CCUS projects will benefit the public by reducing the carbon in the air that exacerbates climate change and providing new, well-paying jobs. At-scale deployment of CCUS is required to meet global net zero environmental goals[139] and President Biden's domestic net-zero environmental goals.[140] To meet the United States' goal, CCUS deployment must increase tenfold.[141] "CCUS is the only group of technologies that can contribute to deep emission reductions in key sectors, including heavy industry, while also supporting the removal of CO_2 from the atmosphere."[142]

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132. *See* BAKER BOTTS, *supra* note 4.

133. Dewar & Sudmeijer, *supra* note 24.

134. Michael P. Darden et al., *The Inflation Reduction Act Includes Significant Benefits for the Carbon Capture Industry*, GIBSON DUNN (Aug. 16, 2022), https://www.gibsondunn.com/the-inflation-reduction-act-includes-significant-benefits-for-the-carbon-capture-industry/.

135. *Id.*

136. *Id.*

137. *Id.*

138. 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/.

139. INT'L ENERGY AGENCY, *supra* note 1, at 7.

140. WHITE HOUSE, *supra* note 2, at 6.

141. *Id.* at 7.

142. INT'L ENERGY AGENCY, *supra* note 1, at 7.

As a result, CCUS is a critically important path to reducing the impacts of climate change on the public. Climate change causes increases in global temperatures, the frequency and intensity of extreme weather, and rising sea levels.[143] The impacts of climate change negatively affect things humans depend on for survival, such as mental and physical health, food production, access to water, transportation, and shelter.[144] Removing CO_2 is necessary to mitigate the severe impacts of climate change.[145] Therefore, if states clearly define who owns and has the right to lease pore spaces, the resulting increase in CCUS projects will benefit the public by providing crucial climate change mitigation.

From a more immediate but still important perspective, the Biden Administration sees the growth of the CCUS industry as a way to create additional well-paid union jobs for the public.[146] As with any growing industry, more labor will be required to deploy an increasing amount of CCUS projects which will lead to the creation of new jobs in the energy industry. The public stands to benefit from the widespread use of CCUS both environmentally and economically.

D. Potential Drawbacks: Concerns Surrounding Cost, Safety, and the Environment

While many benefits stem from well-defined pore space ownership law, the resulting increase in CCUS projects may include a number of potential drawbacks. This includes concerns about CCUS impact on cost, safety, and the environment. Critics view these concerns as reasons to avoid using CCUS as a method for reducing greenhouse gas emissions.[147]

First, due to the cost of CCUS technologies, costs to implement carbon storage may be passed through to the consumer by increasing the cost of what the heavy industries produce: energy and electricity.[148] These costs may include significant additional infrastructure, such as pipelines to transport the CO_2.[149] A study done by researchers at the University of Utah estimates that without subsidies, the cost of electricity could increase by more than 50% to pay for CCUS.[150] Critics

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143. *Climate Change Impacts: Climate Impacts on Human Health*, U.S. ENV'T PROT. AGENCY, https://climatechange.chicago.gov/climate-impacts/climate-impacts-human-health (last visited Jan. 22, 2023).

144. *Climate Change Impacts*, NAT'L OCEANIC AND ATMOSPHERIC ADMIN., https://www.noaa.gov/education/resource-collections/climate/climate-change-impacts (last updated Aug. 13, 2021).

145. WHITE HOUSE, *supra* note 2, at 11.

146. *Id.* at 7-8.

147. CTR. FOR INT'L ENV'T L., *Carbon Capture and Storage: An Expensive and Dangerous Plan for Louisiana*, (June 25, 2021), https://www.ciel.org/carbon-capture-and-storage-an-expensive-and-dangerous-proposition-for-louisiana-communities/.

148. Emily Rhode, *Carbon Capture and Storage (CCS) Pros and Cons*, TREEHUGGER (updated Aug. 13, 2021), https://www.treehugger.com/carbon-capture-and-storage-ccs-pros-and-cons-5120005.

149. CTR. FOR INT'L ENV'T L., *supra* note 147.

150. Rhode, *supra* note 148.

point out that the costs of implementing CCUS technologies are higher than the costs of renewable energy projects, which is the better avenue in their eyes.[151]

From a safety perspective, those opposed to CCUS see the transportation of CO_2 as a dangerous threat due to the pressurization of CO_2 within transport pipelines.[152] Leaks of CO_2 in high enough concentrations during transport or at the injection site could be harmful to surrounding life.[153] Leaks of CO_2 out of the storage space underground may also contaminate soil and groundwater.[154] Further, injection of CO_2 into pore spaces could trigger seismic events and cause damage to life and property.[155]

Some critics see CCUS as "entrench[ing] reliance on fossil fuels rather than accelerating the needed transition to cheaper and cleaner renewable energy."[156] They disapprove of the use of captured carbon to develop more oil through EOR as a use that increases climate change.[157] Climate scientists at the Tyndall Centre note that CCUS, which captures emissions from the fossil fuel industry, cannot operate without some emissions.[158] It's likely that critics also do not approve of the increased investment oil and gas companies will receive as a result of CCUS.

The cost, safety, and environmental drawbacks of increased CCUS deployment are worth considering. However, they will not be addressed if the law is left as is. Granting ownership and leasing rights to the surface estate will itself mitigate against the drawbacks. Additionally, there are other avenues, such as greater regulation, which could assist in reducing the impact of any potential drawbacks. Moreover, overwhelming evidence shows that at-scale deployment and widespread use of CCUS is critical to stopping climate change before the worst of its effects occur. That itself is a powerful argument for clearing as many barriers as possible to the use of CCUS, specifically carbon capture and storage.

IV. SOLUTION

The benefits of clarifying the law regarding pore space ownership far outweigh the potential drawbacks and categorically outweigh leaving the law as it is. State legislatures, if they have not done so already, should enact laws that give the surface estate the title to and

151. CTR. FOR INT'L ENV'T L. ET. AL., *supra* note 147.
152. *Id.*
153. Rhode, *supra* note 148.
154. *Id.*
155. *Id*.
156. CTR. FOR INT'L ENV'T L., *supra* note 147.
157. *Id.*
158. *World cannot meet climate targets relying on carbon capture and storage*, GLOBAL WITNESS (Jan. 11, 2021), https://www.globalwitness.org/en/campaigns/fossil-gas/world-cannot-meet-climate-targets-relying-carbon-capture-and-storage/.

the rights to lease the pore space for carbon storage unless otherwise specified in the conveyance or reservation.

This framework creates a clear default law that removes a barrier to the deployment of CCUS by resolving a currently complicated legal issue while also allowing parties to convey or reserve the property rights of their choosing. Beyond just conferring ownership, specifying the right to lease in the statute will ensure that landowners are compensated for their real property interest and that the energy companies operating the project know who to get permission from. This, in turn, will reduce costs and liabilities to energy companies. Further, enacting this framework will build a base for the launch of CCUS so that it can play a significant and critical role in stopping climate change.

If states do not enact this framework, they run the risk of not only hampering at-scale deployment of CCUS but also allowing a network of inconsistent state-based laws to develop. This could lead to energy companies choosing to invest their money in CCUS projects in states with well-defined laws, leaving behind states that do not enact a clear pore space ownership framework. Further, not enacting the framework is likely to create litigation and deplete the resources of the courts when the issue can be solved via statutory law.

Perhaps most importantly, energy companies and governments, including opposing political parties in the U.S., are on the same page regarding the environmental and economic benefits of CCUS. In the climate change world, this level of agreement is hard to come by. Removing the legal barrier would allow the economic tax incentives to further launch CCUS into the environmental impact it has the potential of making. This could change the conversation around climate change and provide an avenue that meets little resistance from big industry players, such as oil and gas companies.

The drawbacks that may result from the at-scale deployment of CCUS are a concern that must be considered during the increased use of the technologies. Governments should manage against the drawbacks by implementing regulations and oversight both locally and federally, in addition to establishing the recommended legal framework.

For example, cost concerns can be addressed through the legal framework, which reduces transaction costs and increases tax incentives through the IRA. Additionally, as more CCUS projects are implemented, companies will likely develop new technologies and processes to bring costs down even more in an effort to increase scale. Regarding safety concerns, the accident rates during transport of CO_2 are already low,[159] but additional measures can be taken to find pore space to store the CO_2 close to the emitting sources to reduce pipelines,

159. Rhode, *supra* note 148.

and the CCUS industry can refer to current hydraulic fracturing technology for ways to mitigate against seismic disturbances. These and most other safety concerns can be addressed by further regulatory oversight on a local and federal level.

Regardless, the economic and environmental benefits to landowners, energy companies, the public, and the world vastly outweigh these drawbacks. Many stakeholders stand to benefit from a takeoff of CCUS, and this framework will provide a clear base from which the industry can launch.