

Whose Pore Space Is It?

Carbon Capture and Storage Prompts New Questions in Property Law

Vanessa A. Silke and Hannes D. Zetsche

Physically, the existence of pore space is nothing new. Any part of the subsurface that is not occupied by solid material constitutes pore space, whether naturally or as a result of fossil fuel or other mineral extraction.

The rise of carbon capture and storage (CCS) has compelled efforts to answer the legal question of who owns pore space. CCS involves the collection of carbon dioxide (CO₂), either directly from the atmosphere or from industrial emissions. Pipelines or trucks then transport the CO₂ and inject it deep into underground pore space for permanent storage or, in some cases, subsequent utilization.

The International Energy Agency (IEA) has estimated that operational CCS projects in North America will store about 25.9 million tons of CO₂ in 2024. *See* IEA, *CCUS Projects Explorer* (2024). The IEA further projects that CCS projects in North America could store up to nearly 200 million tons by 2030. *Id.* Longer term, the U.S. Department of Energy has estimated that by 2050, American emitters will need to capture and store between 400 and 1,800 million tons of CO₂ annually to meet the country's energy transition goals. U.S. Dep't of Energy, *Pathways to Commercial Liftoff: Carbon Management* (Apr. 2023).

Every CCS project needs site control over pore space. This article analyzes the financial drivers, physical factors, and legal considerations for a CCS developer's acquisition of pore space under privately owned land. This article provides only a general overview and is not a substitute for a state-specific or federal analysis of pore-space rights.

Financial Incentives Driving CCS and Pore Space Rights

Major financial incentives have driven CCS's recent growth. First is the recognition that CCS can help emitters of CO₂ offset their emissions. While no federal law currently requires

emitters to track and mitigate CO₂ emissions, some states have instituted mandatory greenhouse gas emissions reduction programs. *See, e.g.,* Cal. Health & Safety Code §§ 38500 *et seq.*; Or. Exec. Order No. 20-04 (2020); Wash. Rev. Code §§ 70A.45.005 *et seq.* Many businesses also have announced voluntary goals of net-zero or net-negative CO₂ emissions. Whether because they are required to under state law or to meet a voluntary goal, emitters contract with CCS developers either to receive emissions reduction credits or to capture and store direct emissions.

Second, state laws offer certain industry-specific tax incentives to incorporate CCS, such as for transportation fuels. Ethanol producers, for instance, receive a credit under California's low-carbon fuel standard for making less CO₂-intensive fuel. CCS further reduces ethanol production emissions, thereby increasing the credit based on the difference in emissions when compared to gasoline production. *See* Cal. Code Regs. tit. 17, § 95480 *et seq.* Beginning in 2027, and ending in 2035, Nebraska's Sustainable Aviation Fuel Credit Act will provide up to \$500,000 total in nonrefundable credits per year, on a first-come, first-served basis, to producers who meet the state standards and apply for the credit. *See* Neb. Rev. Stat. §§ 77-7017 to 77-7022.

Third, federal regulations defining "sustainable aviation fuel" also encourage CCS deployment in ethanol production. Under 26 U.S.C. § 40B, through December 31, 2024, producers qualify for a federal tax credit of \$1.25 for each gallon of sustainable aviation fuel sold or used. Qualifying sustainable aviation fuel must have no more than half the carbon intensity of a reference fossil fuel. *See* 26 U.S.C. § 40B(d)(1). Producers qualify for an additional \$0.01 per gallon, with a maximum of \$0.50, for each percentage point by which the reduction percentage exceeds 50%. *See id.* § 40B(b) (collectively, the 40B Credit). Further guidance from the Department of Treasury and the Internal Revenue Service has provided safe harbors and an

approved model for calculating available credits. See IRS Notice 2024-37. Specifically, Notice 2024-37 provides a safe harbor for use of the 40BSAF-GREET 2024 model, which was developed by the Department of Energy, with Treasury and other federal agencies, to establish limits and controls on taxpayer and background inputs used to calculate the emissions reduction percentage for the 40B Credit. Generally speaking, the 40BSAF-GREET 2024 model accommodates CCS contributions to sustainable aviation fuels by assigning a lower carbon intensity score for land-use changes associated with corn and soybean production.

When the 40B Credit expires, producers can take advantage of another tax credit under 26 U.S.C. § 45Z (the 45Z Credit). The 45Z Credit is funded from 2025 through 2027. Similar to the 40B Credit, 45Z works on a sliding scale, with producers' eligibility for credits increasing with the reduction in their net emissions. It is likely that the 40BSAF-GREET 2024 model will be utilized for 45Z; implementing regulations and guidance are under development. See IRS Notice 2024-49.

To realize the financial benefits of a CCS project, developers must identify an appropriate subsurface geological formation in which to store CO₂.

Lastly, 26 U.S.C. § 45Q allows CCS developers to claim a base credit of \$17 per metric ton of CO₂ sequestered (or \$36 if using direct-air-capture technology). That credit can increase to \$85 per metric ton (or \$180 per metric ton for direct-air capture) if CCS developers meet certain labor and apprenticeship requirements. See also 26 C.F.R. § 1.45Q-1.

Physical Pore-Space Requirements for CCS Projects

To realize the financial benefits of a CCS project, developers must identify an appropriate subsurface geological formation in which to store CO₂. A CCS project's pore-space requirements depend initially on the storage site's geology. Some subsurface rock formations are more suitable for CO₂ storage than others. The site-specific physical analysis is undertaken by geologists, engineers, and associated consultants.

At a minimum, a CCS project developer must obtain rights to use enough pore space to contain the anticipated CO₂ plume. Depending on geology, underground pressure may cause the CO₂ to migrate under multiple landowners' properties. Securing the rights necessary to contain the initial CO₂ plume not only is required by law, but also is necessary to limit legal claims of trespass or other torts.

Against that baseline, two other factors also affect the requisite area of physical pore-space ownership. First is the Area of Review (AoR) requirement under federal law. While there are no federal CCS-specific laws, the principal federal law regulating CCS is the Safe Drinking Water Act (SWDA), 42 U.S.C. §§ 300f *et seq.* The Underground Injection Control (UIC) program under the SWDA establishes minimum requirements for six classes of injection wells, with Class VI regulating the underground injection of CO₂ to ensure that it will not jeopardize underground sources of drinking water. 40 C.F.R. §§ 146.81–146.95. Although the U.S. Environmental Protection Agency (EPA) may delegate “primacy” over this permitting authority to states, it has so far only done so for Louisiana, North Dakota, and Wyoming. Several other states have either considered or applied for primacy. See, e.g., Angela C. Jones, Cong. Rsch. Serv., *Class VI Carbon Sequestration Wells: Permitting and State Program Primacy*, R48033 (Apr. 16, 2024) (West Virginia, Arizona, and Texas in pre-application phase).

Class VI permitting largely focuses on AoR. EPA regulations define the AoR as “the region surrounding the geologic sequestration project where [underground sources of drinking water] may be endangered by the injection activity.” 40 C.F.R. § 146.81(d). To protect these underground drinking water sources, the AoR encompasses the furthest extent of the combined CO₂ plume and pressure front. Consultants utilize predictive modeling to determine the reach of the AoR for a project.

Because the AoR contains the CO₂ plume and delineates the area for required monitoring, a CCS developer must obtain pore space rights within the AoR during project development and throughout injection operations and storage. Such rights include the right to permanently store CO₂ in pore space and to access the surface for monitoring the AoR and performing corrective action on artificial penetrations within the AoR. See 40 C.F.R. § 146.84.

The second factor impacting physical pore-space requirements, in some circumstances, is eminent domain. Because a developer may need to obtain pore space rights from multiple owners, several states have adopted forced “amalgamation” statutes. Nebraska, for instance, anticipates that a CCS developer may not obtain the consent of all pore space owners within an anticipated reservoir. See Neb. Rev. Stat. § 57-1612. To encourage CCS development in the state, Nebraska instead allows the developer to contract for 60% ownership of all the necessary pore space. After a “good-faith effort to obtain the consent of all persons who own reservoir estates,” the Nebraska Oil and Gas Commission may approve condemnation of the rest on the condition that such owners must be “equitably compensated.” *Id.* §§ 57-1610(12), (13), (15), 57-1612.

Other states have similar statutes. See, e.g., Wyo. Stat. Ann. § 35-11-316. Even in states that do not have a pore-space-specific amalgamation statute, general statutes permitting eminent domain may apply. Eminent domain statutes vary significantly across states, and most require the condemned property to be utilized for some public purpose. See, e.g., *Denbury Green Pipeline-Tex., LLC v. Tex. Rice Land Partners, Ltd.*, 510 S.W.3d 909, 915 (Tex. 2017) (holding that a carbon

pipeline was a public use that could constitutionally exercise eminent domain); *see also Transcon. Gas Pipe Line Corp. v. 118 Acres of Land*, 745 F. Supp. 366 (E.D. La. 1990) (holding that a taking of gas storage rights by a private natural gas company was a “public purpose”).

Ownership of Pore Space for CCS Projects

The final issue affecting CCS projects may be the most complicated and unsettled one. Pore-space rights on privately owned lands are generally considered to be the domain of state law. Historically, under the common-law *ad coelum* doctrine, a fee-simple landowner owned the entire tract “from the heavens to the depths.” Courts have recognized this to mean that, absent a separate subsurface conveyance, a surface estate owner presumptively owns the subterranean estate, including underlying minerals and pore space. *See generally United States v. Causby*, 328 U.S. 256 (1946). This ownership allows the subsurface mineral rights to be separated from the surface estate and sold or leased separately from the land. As a result, mineral estates in many parts of the country have been severed from the surface estate.

After a severance of mineral rights, the land and underlying mineral estate become separate real property interests, and each respective owner may control and convey their property. Contracts and traditional common-law principles govern subsequent conflicts between severed surface- and mineral-estate owners. But does a conveyance of a mineral interest include the associated pore space? Few jurisdictions have settled this question, and even when they have, different jurisdictions have reached different conclusions.

To date, most courts, particularly in recent opinions, have held the surface owner presumptively also owns the underlying pore space. They have reasoned pore space is not a mineral; thus, a conveyance of minerals does not also convey pore space. Therefore, absent a separate conveyance of the pore space itself, the surface-estate owner is presumed to retain ownership of the underlying pore space. *See, e.g., Lightning Oil Co. v. Anadarko E&P Onshore, LLC*, 520 S.W.3d 39, 48 (Tex. 2017); *Dick Props., LLC v. Paul H. Bowman Tr.*, 221 P.3d 618 (Kan. Ct. App. 2010); *Dep’t of Transp. v. Goike*, 220 Mich. App. 614 (1996); *Tate v. United Fuel Gas Co.*, 71 S.E.2d 65 (W. Va. 1952).

However, several older opinions adopted contrary reasoning. Long before any wide deployment of CCS, the Kentucky Supreme Court decided a case involving a dispute between the owners of a surface and a mineral estate as to which party was entitled to rentals for the subterranean storage of gas. In *Cent. Ky. Nat. Gas Co. v. Smallwood*, 252 S.W.2d 866, 868 (Ky. 1952), *overruled on other grounds by Tex. Am. Energy Corp. v. Citizens Fid. Bank & Tr. Co.*, 736 S.W.2d 25 (Ky. 1987), the court held the “[m]ere ownership of the surface does not confer on the owner the right to explore for and produce native gas merely because it is located beneath the surface which he owns.” At least one other opinion reached the same result. *See, e.g., Mound City Brick & Gas Co. v. Goodspeed Gas & Oil Co.*, 109 P. 1002, 1003 (Kan. 1910) (holding an instrument that conveyed the underlying coal, oil, and gas also conveyed “the stratum in which they are found”).

To be sure, these opinions tying pore space with mineral rights represent a minority view. Nevertheless, in states where a court has not affirmatively established whether a mineral interest includes the rights to associated pore space, there is some risk of a dispute as to whether pore space was retained as part of the surface estate if a mineral interest has been severed.

Contracts and traditional
common-law principles
govern subsequent conflicts
between severed surface-
and mineral-estate owners.
But does a conveyance of a
mineral interest include the
associated pore space?

Some states have addressed this uncertainty by adopting statutes that define pore-space ownership. For example, since 2021, the Nebraska Geologic Storage of Carbon Dioxide Act (the Act) defines pore space as a “reservoir estate,” meaning a “subsurface stratum, formation, cavity, or void, whether natural or artificially created, suitable for or capable of receiving through a well and geologically storing a carbon dioxide stream[.]” Neb. Rev. Stat. § 57-1603(6). Further, the Act states:

A conveyance of the surface ownership of real property shall be a conveyance of the reservoir estate ownership in all strata below the surface of such real property unless the ownership interest in such reservoir estate previously has been severed from the surface ownership or is explicitly excluded in the conveyance. The ownership of reservoir estates may be conveyed in the manner provided by law for the transfer of mineral interests in real property. No agreement or instrument conveying mineral or other interests underlying the surface shall act to convey ownership of any reservoir estate unless the agreement explicitly conveys that ownership interest.

Id. § 57-1604(2).

The Act does not change or alter the common law relating to mineral estates as of August 28, 2021. *Id.* § 57-1604(4). Further, it establishes that a “severed mineral estate is dominant regardless of whether ownership of the reservoir estate is vested in the several owners of the surface or is owned separately from the surface.” *Id.*

As of this writing, no Nebraska cases have addressed a dispute between a pre-2021 mineral interest holder and a surface estate holder over rights to a reservoir estate. Under a majority

view, a mineral estate holder likely does not own the reservoir estate in Nebraska unless expressly granted as part of the mineral interest severance. This issue will continue to evolve as states adopt laws to address pore space.

In jurisdictions where ownership of pore space and priority among estates are not settled law, additional steps should be considered to ensure that rights holders who may be impacted by a CCS project are accounted for as part of the negotiation for pore space.

Key Considerations for Pore Space Acquisitions


The result of all of this pore-space regulatory patchwork is uncertainty. A CCS developer is required to obtain enough pore-space rights to contain the CO₂ plume and AoR. But from whom?

CCS developers should conduct due diligence early in the development process to confirm who holds title within an AoR. This step involves a search for deeds and records associated with real property, mineral interests, groundwater, and oil

and gas interests, which may be recorded or filed with separate state agencies in addition to the county register of deeds. Analysis of state laws governing the treatment of pore space, amalgamation, eminent domain, state agency approvals, and priority among estate holders is also a necessary initial step in the process.

Pore space acquisition is more straightforward on property that either is unified (i.e., not severed) or is in a jurisdiction that clearly defines who owns the pore space. In those jurisdictions, the developer can likely readily identify the owner(s) with whom to negotiate fee title, leases, or easements for pore space. Although publicly held land issues are beyond the scope of this article, the same can be true for property owned by a state or federal governmental entity.

However, in jurisdictions where ownership of pore space and priority among estates are not settled law, additional steps should be considered to ensure that rights holders who may be impacted by a CCS project are accounted for as part of the negotiation for pore space. Mutual agreements as to priority and access rights can address uncertainty with mineral interest holders, for example, who may have uncertain rights relative to a pore space severance, or fee simple title acquisition. Those agreements also can include terms to address what the parties will do in the event of a subsequent change in state law. In addition, pore-space agreements should address drill-through rights, indemnification, conflicts with neighboring owners, and surface use limitations to accommodate the construction, operation, and maintenance of a CCS project.

In summary, voluntary commercial goals, as well as state and federal laws, provide significant baseline incentives to grow the CCS industry. But underlying property laws may hamper implementation of those incentives. As commercial goals and laws evolve, developers must continue to adapt their efforts to ensure successful acquisition of pore space for CCS projects. 

Vanessa A. Silke is a partner and Hannes D. Zetzsche is an attorney at Baird Holm LLP in Omaha, Nebraska. They may be reached at vsilke@bairdholm.com and hzetzsche@bairdholm.com, respectively.