Carbon Capture and Sequestration in California: A Necessary Component to Achieve Greenhouse Gas Reductions

Randall Edgerly Reck[*]

I. INTRODUCTION 224
II. BACKGROUND 224
A. California's Greenhouse Gas Reduction Goals and Strategies 224
B. The Technology of Carbon Sequestration 225
C. The Need for Geologic Sequestration in California 226
D. Potential for Geologic Sequestration in California 228
E. Applicable Federal Law for Geologic Sequestration 229
F. Risks and Common Law Liabilities 230
III. PROPERTY LAW HURDLES TO IMPLEMENTATION 232
A. Property Ambiguity and Complications 232
B. Potential Strategies to Resolve Property Ambiguity 234
1. Complete Private Property Approach 234
2. Limited Private Property Approach 236
3. Public Resource Approach 237
IV. PROPOSED CALIFORNIA REVISIONS 238
A. Legal Theory Supporting Limitations on Private Property 239
1. Air Travel 239
2. Groundwater 241
3. Oil and Gas 242
4. Inverse Condemnation 243
B. California Should Adopt the Public Resource Approach 245
V. CONCLUSION 245

[*] J.D., University of California, Davis School of Law, Class of 2016. I would like to thank Albert C. Lin, Professor of Law at UC Davis, for his advice and guidance in writing this article; and my fiancé, Kimberly, for her unwavering love and support.

I. INTRODUCTION

Two major impediments prevent successful deployment of carbon capture and sequestration: cost and uncertainty. These barriers are inextricably linked and include the direct costs of capturing, transporting, and sequestering carbon dioxide, as well as the indirect costs of potentially unbounded future liability. Unresolved questions about who actually owns subsurface pore space lends the greatest uncertainty to the foreseeable direct costs.[1]

Property rights conferring the ownership of empty pore space are currently in a state of evolution. The familiar idea that a surface property owner holds the right to exclude "upwards to the heavens and downward to the center of the earth" must confront its own impracticality when faced with emerging technologies.[2] The development of air travel first directly challenged this concept early in the 20th century.[3] Today, new subsurface technologies similarly challenge the subsurface corollary of this concept of fee ownership. Instead of a purely private property approach to pore space ownership, a model should be adopted that balances private interests with society's need to reduce atmospheric greenhouse gas concentrations.

II. BACKGROUND

A. *California's Greenhouse Gas Reduction Goals and Strategies*

Former Governor of California, Arnold Schwarzenegger, first legitimized statewide greenhouse gas reduction efforts when he signed Executive Order S–3–05 on June 1, 2005.[4] This action established two important benchmarks: reduce greenhouse gas emissions to 1990 levels by 2020, and reduce emissions to eighty percent below 1990 levels by 2050.[5] The legislature codified the first benchmark in the Global Warming Solutions Act of 2006 (A.B. 32).[6] Subsequent executive and legislative actions now bridge the gap between the

[1] Addressing the market failure to adequately price the negative externalities of carbon emissions is beyond the scope of this article; therefore, a financial comparison to other commercially available alternatives, such as solar or wind generation combined with energy storage, is similarly beyond the scope of this paper.

[2] *See* John G. Sprankling, *Owning the Center of the Earth*, 55 UCLA L. Rev. 979, 992 (2008) (noting that though the origins are unclear, almost all modern cases acknowledge the maxim that a surface owner owns "from the heavens to the center of the earth").

[3] *See, e.g.*, Hinman v. Pac. Air Lines Transp. Corp., 84 F.2d 755, 757 (9th Cir. 1936) (following the invention of the airplane, the Ninth Circuit rejected the "heavens" approach to airspace ownership: "We think it is not the law, and that it never was the law.").

[4] *See* Cal. Exec. Order No. S–3–05 (June 1, 2005), https://www.gov.ca.gov/news.php?id=1861.

[5] *Id.*

[6] California Global Warming Solutions Act of 2006 (AB 32), ch. 488, 2006 Cal. Stat. 89 (codified at CAL. HEALTH & SAFETY CODE § 38500-38599 (West 2007)).

2020 and 2050 goals by setting a target of forty percent below 1990 levels by 2030.[7]

To facilitate these goals, the Legislature required the California Air Resources Board (CARB) to prepare and approve a scoping plan to achieve "maximum technologically feasible and cost-effective" greenhouse gas emissions reductions.[8] Both the initial Scoping Plan and the First Update to the Scoping Plan identified carbon capture and sequestration as a potential component of the State's overall strategy to reduce carbon emissions.[9] However, the initial Scoping Plan included only a brief statement in support of the technology.[10] It cautioned that an adequate regulatory framework must be in place and that more research needed to be done before CCS could be deployed.[11] The 2014 First Update to the Scoping Plan, published five years after the initial plan, similarly lacked details on how to implement geologic sequestration. [12] The First Update did commit CARB, in conjunction with other state regulatory bodies, to develop a "quantification methodology".[13] This process will evaluate the potential for CCS to reduce CO2 emissions and address other regulatory considerations.[14]

B. *The Technology of Carbon Sequestration*

The technology to inject carbon dioxide into geological formations is not new. Millions of tons of carbon dioxide are already injected each year to stimulate oil and gas wells through a process known as enhanced oil recovery (EOR).[15] The process begins with compressing the CO2 into a supercritical state (roughly 1,070 PSI) where it begins to exhibit characteristics of both a gas and a liquid.[16] This supercritical CO2 is then injected through injection wells into open pore

---

[7] Senate Bill No. 32, ch. 249, 2016 Cal. Stat. 88 (codified at CAL. HEALTH & SAFETY CODE § 38566 (West 2017)); Cal. Exec. Order No. B-30-15 (Apr. 29, 2015), https://www.gov.ca.gov/news.php?id=18938.

[8] CAL. HEALTH & SAFETY CODE § 38561 (West 2006).

[9] CAL. AIR RES. BD., CLIMATE CHANGE SCOPING PLAN 116-17 (2008) [hereinafter SCOPING PLAN]; CAL. AIR RES. BD., FIRST UPDATE TO THE CLIMATE CHANGE SCOPING PLAN 42 (2014) [hereinafter FIRST UPDATE].

[10] SCOPING PLAN, *supra* note 9, at 116-17.

[11] *Id.*

[12] *See generally* FIRST UPDATE, *supra* note 9 (addressing biological sequestration in detail, including forests and agriculture, but providing no details regarding geologic sequestration).

[13] FIRST UPDATE, *supra* note 9, at 42, 45.

[14] *Id.* CARB also gathered public input to develop the quantification methodology through a series of public workshops. *Carbon Capture and Sequestration Meetings*, CAL. AIR RES. BD., https://www.arb.ca.gov/cc/ccs/meetings/meetings.htm.

[15] Les Lo Baugh & William L. Troutman, *Assessing the Challenges of Geologic Carbon Capture and Sequestration: A California Guide to the Cost of Reducing CO2 Emissions*, 9 SUSTAINABLE DEV. L. & POL'Y, Winter 2009, at 17.

[16] Jeffrey W. Moore, *The Potential Law of On-Shore Geologic Sequestration of CO2 Captured from Coal-Fired Power Plants*, 28 ENERGY L.J. 443, 452 (2007).

space of sedimentary rock layers of varying degrees of permeability.[17] Potential sequestration sites are often very deep (from 3,000 to 15,000 feet) and the open pore space is often shared with saline aquifers.[18]

However, although EOR and CCS share similar injection technology, the goals of the two processes are fundamentally different. CCS intends to achieve permanent CO2 storage, whereas EOR's goal is solely focused on well stimulation.[19] Thus, potential migration of CO2 is a much bigger concern for CCS than EOR. It is essential for potential CCS sites that the open pore space be surrounded by an impermeable layer, such as a cap rock or clay, to prevent migration of the injected CO2.[20]

C. *The Need for Geologic Sequestration in California*

Carbon capture and sequestration projects currently operate in conjunction with large stationary sources of CO2, most often within the industrial and energy sectors.[21] Within the energy sector, CCS is most commonly associated with coal-fired electricity generation, as these facilities emit much more carbon dioxide than other types of generation facilities. Although coal-fired power plants are increasingly rare in California, natural gas-fired facilities are prevalent and also emit substantial amounts of CO2.[22] CCS can play a vital role in reducing CO2 emissions from both types of facilities and sectors from being released into the atmosphere.

Coal-fired electricity generation provided less than six percent of California's total electricity in 2015, and it is expected to decline to zero by 2026.[23] This change is a result of legislation that established a greenhouse gas (GHG) emission performance standard for utility procurement of baseload generation—which requires GHG standards to be "no lower than levels achieved by a new combined-cycle natural gas turbine."[24] Subsequent regulations set this standard

---

[17] *Id.*

[18] *Id.* at 453. The water in these deep aquifers is considered commercially "useless" because of its extreme depth and high salt content, which is closer to seawater than other underground sources of potable drinking water. *Id.*

[19] Baugh & Troutman, *supra* note 15, at 16.

[20] Moore, *supra* note 16, at 454. Leaked CO2 may contaminate drinking water, or accumulate and migrate in soil vapor, causing harm to plants and animals. *Id.* at 467.

[21] CARBON SEQUESTRATION LEADERSHIP FORUM, 2013 CSLF TECHNOLOGY ROADMAP 7 (2013), https://www.cslforum.org/cslf/sites/default/files/CSLF_Technology_Roadmap_2013.pdf.

[22] CAL. ENERGY COMM'N, ACTUAL AND EXPECTED ENERGY FROM COAL FOR CALIFORNIA – OVERVIEW 1 (last updated Nov. 3, 2016), http://www.energy.ca.gov/renewables/tracking_progress/documents/current_expected_energy_from_coal.pdf [hereinafter ENERGY FROM COAL]; CAL. AIR RES. BD., CALIFORNIA GREENHOUSE GAS INVENTORY: 2000-2013 – BY SECTOR AND ACTIVITY 1 (2015) [hereinafter GREENHOUSE GAS INVENTORY BY SECTOR].

[23] ENERGY FROM COAL, *supra* note 22, at 1.

[24] Sen. Bill No. 1368, ch. 598, 2006 Cal. Stat. 91 (adding CAL. PUB. UTIL. CODE, §§ 8340-8341).

at 1,100 pounds of carbon dioxide (CO2) per megawatt hour (MWh) of electricity.[25] This standard effectively eliminated coal generation within California, as well as new long-term contracts for imported power from out-of-state coal fired plants.[26]

However, the emission performance standard—by its own terms—was specifically designed to allow combined-cycle natural gas plants to continue.[27] As a result, electricity generation still accounts for twenty percent of California's total GHG emissions, tied with industrial emissions (twenty percent) and behind only transportation (thirty-seven percent).[28] In 2013, electricity generated within the state constituted just over half of the sector's emissions, or 50.58 million tonnes of CO2 equivalent.[29] Imported electricity from out-of-state generation accounted for 40.05 million metric tonnes.[30] Accordingly, in-state generation accounts for roughly eleven percent of California's total GHG emissions.[31]

Looking forward, natural gas will continue to play an important role in meeting California's electricity generation requirements.[32] Not only will coal generation likely no longer be available after 2026, but demand for electricity is expected to grow .54–1.27 percent per year through 2025.[33] Renewable sources—recently mandated to provide fifty percent of retail sales of electricity by 2030—will fulfill some of this demand, but these intermittent sources also face challenges integrating into the grid without storage.[34] Thus, natural gas-fired generation combined with CCS will very likely be necessary if California seeks to meet its ambitious GHG reduction goals.[35]

---

[25] CAL. CODE REGS. tit. 20, § 2902(a) (2015).

[26] ENERGY FROM COAL, *supra* note 22, at 2.

[27] Sen. Bill No. 1368, s*upra* note 24.

[28] CAL. AIR RES. BD., CALIFORNIA GREENHOUSE GAS INVENTORY: 2000-2014 – TRENDS OF EMISSIONS AND OTHER INDICATORS 2 (2015), https://www.arb.ca.gov/cc/inventory/pubs/reports/2000_2014/ghg_inventory_trends_00-14_20160617.pdf.

[29] CAL. AIR RES. BD., CALIFORNIA GREENHOUSE GAS INVENTORY: 2000-2013 – BY SECTOR AND ACTIVITY 1 (Apr. 24, 2015), https://www.arb.ca.gov/cc/inventory/pubs/reports/ghg_inventory_00-12_report.pdf [hereinafter GREENHOUSE GAS INVENTORY BY SECTOR].

[30] *Id*.

[31] *Id*.

[32] CAL. ENERGY COMM'N, 2015 INTEGRATED ENERGY POLICY REPORT 150-51 (2016), http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-01/TN212017_20160629T154354_2015_Integrated_Energy_Policy_Report_Small_File_Size.pdf [hereinafter 2015 IEPR].

[33] ENERGY FROM COAL, *supra note* 22; 2015 IEPR, *supra* note 32 at 133.

[34] Clean Energy and Pollution Reduction Act of 2015, ch. 547, 2015 Cal. Stat. 93; *see* 2015 IEPR, *supra* note 32, at 64 (estimating that renewables at forty percent of sales will have to be curtailed mid-day because of overproduction).

[35] *See* CAL. COUNCIL ON SCI. & TECH., CALIFORNIA'S ENERGY FUTURE – THE VIEW TO 2050 44-48 (2011), http://ccst.us/publications/2011/2011energy.php (estimating that electricity generation will need to be completely decarbonized to meet 2050 goals, by relying on nuclear power, natural gas with CCS, and renewables).

Further, CCS is applicable to other sectors beyond electricity generation.[36] Industrial emissions—which in 2013 totaled 104.16 million tonnes of CO2 in California—are also well-suited for potential CCS deployment as emissions are often concentrated geographically and relatively pure CO2 streams are produced.[37] Beyond this, CO2 removal from the atmosphere may someday be deemed necessary and having CCS technology already deployed in other sectors could hasten this development.[38]

D. *Potential for Geologic Sequestration in California*

Carbon dioxide can be injected into three broad categories of geologic formations: depleted oil and gas fields, saline aquifers, and un-minable coal seams.[39] Saline aquifers offer the greatest potential for carbon sequestration.[40] In California, potential saline storage available is estimated to be between 30.33 and 417.07 billion metric tons.[41] In contrast, depleted oil and gas reservoirs offer between 3.56 and 6.63 billion metric tons of potential storage.[42] In 2013, California emitted 459.3 million tonnes of carbon dioxide equivalent.[43] Even if California continues to emit at this rate, available geologic storage could theoretically sequester all of California's annual emissions for the next 74 to 922 years—depending on the accuracy of the low and high estimates of total available storage capacity.[44] Focusing on sequestered emissions only from in-state electricity generation alone results in potential sequestration for the next 670 to 8,376 years.[45]

---

[36] ENGO NETWORK ON CCS, CLOSING THE GAP ON CLIMATE – WHY CCS IS A VITAL PART OF THE SOLUTION 8 (2015), http://hub.globalccsinstitute.com/sites/default/files/publications/197903/closing-gap-climate-ccs-vital-part-solution.pdf.

[37] GREENHOUSE GAS INVENTORY BY SECTOR, *supra* note 22, at 2; ENGO NETWORK ON CCS, *supra* note 36, at 8.

[38] ENGO NETWORK ON CCS, *supra* note 36, at 10, 11.

[39] Baugh & Troutman, *supra* note 15, at 16.

[40] *See* CAL. INST. FOR ENERGY & ENV'T, BACKGROUND REPORTS FOR THE CALIFORNIA CARBON CAPTURE AND STORAGE REVIEW PANEL 9-6 (2010), http://www.climatechange.ca.gov/carbon_capture_review_panel/documents/2010-12-31_Background_Reports_for_CCS.pdf.

[41] NAT'L ENERGY TECH. LAB., OFFICE OF FOSSIL ENERGY, U.S. DEP'T OF ENERGY, CARBON STORAGE ATLAS 110 (5th ed. 2015).

[42] *Id.* Saline formations are primarily found in California's central valley. *Id.* at 28.

[43] GREENHOUSE GAS INVENTORY BY SECTOR, *supra* note 22, at 2. Compare CARB's estimate of California's 2013 CO2 emissions of 459.3 to the federal estimate of 106—this paper assumes CARB's estimate more accurately reflects California's true GHG emissions. *Id.*; NAT'L ENERGY TECH. LAB., *supra* note 41, at 110.

[44] Capacity estimated by dividing the estimated total geologic storage (including saline and depleted oil and gas reservoirs) by total 2013 emissions. For example, 33.6 billion metric tonnes divided by 456.3 million tonnes per year is 74 years.

[45] Same methodology as above, but utilizing only in-state electricity generation emissions.

E. *Applicable Federal Law for Geologic Sequestration*

Federal regulation has largely taken a hands-off approach to CCS, presumably to facilitate state experimentation and allow for CCS technology development.[46] However, four existing federal laws apply to CCS: the Safe Drinking Water Act, the Clean Air Act, the Resource Conservation and Recovery Act, and the Comprehensive Environmental Response, Compensation, and Liability Act.

The most comprehensive and most stringent CCS regulations have been issued through the Underground Injection Control (UIC) program of the Safe Drinking Water Act (SDWA). Through this authority, the United States Environmental Protection Agency (USEPA) established a new well class, Class VI, specifically for geologic sequestration.[47] This program requires site characterization, monitoring, well construction specifications, and a showing of financial responsibility before a permit may be issued.[48] The program does not, however, specifically determine property rights or possible transfers of liability.[49] Further, the UIC program excludes consideration of EOR and natural gas operations and has been legislatively constrained to not "unnecessarily disrupt" existing state underground injection control programs.[50] Thus, although a federal UIC Class VI permit is necessary for CCS projects, USEPA lacks authority to comprehensively regulate CCS projects through the UIC program.[51]

The Clean Air Act (CAA) has also been invoked by USEPA to pass a rule requiring GHG monitoring and reporting for all CO2 injection and geologic sequestration projects.[52] Notably, this authority includes EOR, as well as broader reporting requirements not proscribed under UIC.[53] However, this rule is also limited in scope in that it only requires monitoring and reporting and does not impose any substantive regulations on sequestration facilities.[54]

The Resource Conservation and Recovery Act (RCRA) regulates solid and

---

[46] Christopher Bidlack, *Regulating the Inevitable: Understanding the Legal Consequences of and Providing for the Regulation of the Geologic Sequestration of Carbon Dioxide*, 30 J. LAND RESOURCES & ENVTL. L. 199, 213 (2010).

[47] Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells, 75 Fed. Reg. 77230, 77233 (Dec. 10, 2010).

[48] *Id.*

[49] Jonas J. Monast, Brooks R. Pearson & Lincoln F. Pratson, *A Cooperative Federalism Framework for CCS Regulation*, 7 ENVTL. & ENERGY L. & POL'Y J. 1, 14 (2012).

[50] 42 U.S.C. § 300h (2006) (a regulation disrupts a state UIC program only if it cannot comply with both the regulation and the UIC program); Bidlack, *supra* note 46, at 213.

[51] EPA, REPORT OF THE INTERAGENCY TASK FORCE ON CARBON CAPTURE AND STORAGE 57-58 (2010), https://www3.epa.gov/climatechange/Downloads/ccs/CCS-Task-Force-Report-2010.pdf (asserting that the UIC process is also exempt from NEPA because it is considered a functional equivalent).

[52] Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide, 75 Fed. Reg. 75060, 75062-64 (Dec. 1 2010) (relying on CAA Section 114).

[53] *Id.* at 75,060.

[54] *Id.*

hazardous waste.[55] USEPA, however, has conditionally excluded all CCS CO2 injections from RCRA's reach as long as they meet Class VI permit requirements.[56] Further, CCS operators may be able to avoid regulation even if they fail to meet Class VI permit requirements by asserting to store CO2 for later use.[57] USEPA rejected this rationale, instead reasoning that CO2 injected specifically for geologic sequestration (and not EOR) is injected with the intent of isolating it from the atmosphere indefinitely and not for later reuse.[58] It is an open question as to which interpretation is more persuasive.

Finally, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) may impose liability if a release occurs, but only if CO2 is classified as a hazardous waste or exhibits a hazardous characteristic.[59] Because pure CO2 is not itself a hazardous waste, CERCLA is only likely to apply if it can be shown that the sequestered CO2 contained an additional hazardous waste when injected or that it caused a hazardous waste to migrate after injection.[60] Further, potentially responsible parties under CERCLA may avoid liability under the statute's "federally permitted release" provision as long as the operators satisfy the requirements of its UIC Class VI permit, and the injected CO2 behaves in accordance with the permit requirements.[61] Thus, an unexpected release event may fall outside Class VI permit conditions and may not insolate a potentially responsible party from liability.

F. *Risks and Common Law Liabilities*

While CCS presents an attractive option to mitigate anthropogenic carbon released into the atmosphere, it also carries significant uncertainty and risk. Potential risks include:

1) Groundwater contamination from CO2 leakage;
2) Induced seismic activity due to large volumes of high pressure CO2;
3) Acute risk to human health or the environment from large CO2 releases to the surface;
4) Generalized climate change exacerbation from slow, chronic or sudden, large releases; and
5) Property damage, including contamination of other underground

---

[55] Resource Conservation and Recovery Act, 42 U.S.C. § 6901 et seq. (1994).

[56] Hazardous Waste Management System: Conditional Exclusion for Carbon Dioxide (CO2) Streams in Geologic Sequestration Activities, 79 Fed. Reg. 350, 351-53. (Jan. 3, 2014).

[57] *Id.* at 354-55.

[58] *Id.*

[59] 42 U.S.C. § 9601(14) (2002); *See* Monast, Pearson & Pratson, *supra* note 49, at 15-17.

[60] *See* Monast, Pearson & Pratson, *supra* note 49, at 15-17.

[61] Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells, 75 Fed. Reg. 77230, 77260 (Dec. 10, 2010).

assets [62]

The common law acts as a backstop remedy for risks that fall outside statutory liability. Foreseeable claims could arise under tort common law, including trespass, nuisance, negligence, or strict liability.[63] No California court has yet addressed these claims as they relate to CCS.[64]

Even if a tort claim is otherwise successful, the question of damages may limit recovery; or, stated inversely, the difficulty in determining proper damages may limit the liability of CCS project operators.[65] Damages for subsurface migration of CO2 will likely be difficult to prove, unless there is clear interference with an existing use.[66] Even then, courts are given wide latitude to award damages as appropriate.[67] The uncertain nature of this area of law represents a significant risk of unbounded liability for CCS operators.

The above-identified risks are particularly troubling because of the indefinite timescale that CO2 must be sequestered.[68] The responsible entity could, therefore, incur indefinite potential liability. Given this, governments (whether state or federal) are likely the only entity equipped to assume ultimate responsibility.[69] In fact, this approach has been endorsed by five states who have passed legislation to take title to sequestered CO2 in CCS projects.[70] The precise terms vary in scope. For example, Illinois and Texas limited their liability to specific demonstration projects, whereas North Dakota, Louisiana, and Montana will only take title after a term of years and where the CCS operator can demonstrate the integrity of the storage reservoir.[71] Without such agreements, however, operators are potentially indefinitely liable, which could be a severe impediment to CCS deployment.[72]

---

[62] Bidlack, *supra* note 46, at 208.

[63] Baugh & Troutman, *supra* note 15, at 18-19.

[64] *See generally id.*; Moore, *supra* note 16, at 477-78 (citing the only cases that relate to these claims, none of which are under California jurisdiction; Elizabeth J. Wilson & Mark A. de Figueiredo, *Geologic Carbon Dioxide Sequestration: An Analysis of Subsurface Property Law*, 36 ENVTL. LAW REP. 10114, 10118-23 (2006).

[65] Baugh & Troutman, *supra* note 15, at 19.

[66] *Id.*; Statutory tort damages are "the amount which will compensate for all detriment proximately caused." Cal. Civ. Code § 3333 (West 2017).

[67] Cassinos v. Union Oil Co., 14 Cal. App. 4th 1770, 1784-89 (1993) (holding a company liable for unintended subsurface migration of injected wastewater, but only for the amount it should have paid for disposal, not actual harm caused).

[68] Baugh & Troutman, *supra* note 15, at 17.

[69] Moore, *supra* note 16, at 476-77.

[70] Holly Javedan, *Regulation for Underground Storage of CO_2 Passed by U.S. States*, MASS. INST. OF TECH. 4 (2013), https://sequestration.mit.edu/pdf/US_State_Regulations _Underground _CO2_Storage.pdf.

[71] *Id.* at 5-6.

[72] *Id.* at 3.

III. PROPERTY LAW HURDLES TO IMPLEMENTATION

The California Civil Code adopted the idea of *cuius est solum, eius est usque ad coelum et ad inferos* (or the *ad coelom/ad inferos* doctrine) in prescribing: "The owner of land in fee has the right to the surface and to everything permanently situated beneath or above it."[73] This right expressly includes "free or occupied space for an indefinite distance upwards as well as downwards."[74] However, a literal interpretation of these provisions, and the *ad coelum* doctrine in general, has been rejected.[75] Thus, even fee ownership of the surface property may not necessarily include a property right to the open subsurface pore space. Ownership of pore space becomes even more ambiguous when mineral rights have been severed from the surface estate.[76]

Existing case law provides no easy answers to the question of who owns the pore space necessary for sequestration. Analogies can be drawn from cases involving oil and gas resource ownership, groundwater rights, and air travel cases.[77] Ultimately, however, pore space ownership must be clarified. Other states have circumvented potential common law complexities by legislatively establishing a property rights schema for pore space, often as the sole property of the surface owner, subject to certain restrictions.

A. *Property Ambiguity and Complications*

Fee landowners are granted wide latitude to dispose of their property as they wish. This includes the ability to completely separate the underlying stratum (often termed a mineral estate) from the surface or overlying land.[78] In this instance, the two estates are analogous to adjacent surface landowners, in that each is distinct and separate from the other.[79] The fee owner may also grant a lesser property interest, such as a lease for extraction of minerals, oil, or gas for

---

[73] CAL. CIV. CODE § 829 (West 2017).

[74] *Id.* § 659.

[75] Hinman v. Pac. Air Lines Transp. Corp., 84 F.2d 755, 757 (9th Cir. 1936) (holding that ownership of airspace only extends to what can reasonably be used by the landowner, applying California law).

[76] *See* TASK FORCE ON CARBON CAPTURE AND GEOLOGIC STORAGE, INTERSTATE OIL & GAS COMPACT COMM'N, STORAGE OF CARBON DIOXIDE IN GEOLOGIC STRUCTURES: A LEGAL AND REGULATORY GUIDE FOR STATES AND PROVINCES 15 (2007), http://iogcc.publishpath.com/Websites/iogcc/PDFS/2008-CO2-Storage-Legal-and-Regulatory-Guide-for-States-Full-Report.pdf [hereinafter TASK FORCE].

[77] *See generally* Wilson & Figueiredo, *supra* note 64 (citing various state and federal cases that illustrate how courts have addressed ownership of pore space and its impact on property ownership rights).

[78] Graciosa Oil Co. v. Santa Barbara Cty., 155 Cal. 140, 144 (1909) ("[T]he estate of the owner of the overlying land and of the owner of the subterranean stratum will be as distinct and separate as is the ownership of respective owners of two adjoining tracts of land.").

[79] *Id.*

a term of years.[80] In California such a lease, termed a "*profit à prendre*," entitles the leaseholder to reasonable access to enter the land as necessary to develop and remove the corpus of the granted resources.[81] This right of access can be inferred, even when the grant does not expressly contain it.[82] Courts have often struggled to define the exact nature of any particular grant—either because the terms of the grant are ambiguous, or because the grantor did not have absolute fee title when a purported grant was made.[83]

Thus, the very nature of property ownership raises several potential problems for geologic sequestration, namely identification of the proper landowner(s), high transaction costs, potential for holdouts when multiple landowners are involved, high operating costs to lease pore space, and potential common law liabilities to anyone with a property interest in the proposed storage basin. In this way, pore space ownership represents a potential tragedy of the anticommons where multiple barriers prevent the most efficient use of a resource.[84]

At the outset, it may be difficult to ascertain who needs to be contracted with to obtain rights to inject CO2 into open pore space—either the surface landowner, mineral estate owner, or both. This is true even in a fee title grant that creates a separate mineral estate because open pore space by definition is not itself a mineral, and therefore may not have been transferred in a mineral grant absent express language.[85] Resolution of this question would likely require a searching inquiry into the exact terms of the specific grant to determine if some type of "horizontal" division of property was granted, or the grant merely transferred ownership of a specified mineral.[86] Even if a clear division in fee title was created, a grant of mineral rights might not necessarily also convey the right to inject CO2 into the open pore space. The usual understanding was for

[80] *Id.* ("The right vested in plaintiff is an estate for years, so far as necessary for the purpose of taking oil therefrom, and it carries with it the right to extract the oil and remove it from the premises.").

[81] Richfield Oil Co. of Cal. v. Hercules Gasoline Co., 112 Cal. App. 431, 434 (1931).

[82] Francis v. W. Va. Oil Co., 174 Cal. 168, 170-71 (1917) (holding that a contract between plaintiff and defendant allowed for entry and possession of oil resources on the land, even if terms of the contract

were not explicit).

[83] *See e.g.*, Brown v. Terra Bella Irr. Dist., 51 Cal. 2d 33 (1958) (showing how a court interprets a deed's differing terms as they relate to property rights between a lessee and landowner); Callahan v. Martin, 3 Cal. 2d 110 (1935) (holding that both a lessee and an assignee of a royalty interest in oil rights have interest or estate in relate property); Standard Oil Co. of Cal. v. John P. Mills Org., 3 Cal. 2d 128 (1935); Lever v. Smith, 30 Cal. App. 2d 667 (1939) (showing how a cause of action can arise from ambiguous terms found in two separately executed instruments).

[84] *See* Michael A. Heller, *The Tragedy of the Anticommons: Property in the Transition from Marx to Markets*, 111 HARV. L. REV. 621, 624 (1998). California's expansive definition of fee ownership compounds this problem.

[85] R. Lee Gresham & Owen L. Anderson, *Legal and Commercial Models for Pore-Space Access and Use for Geologic CO_2 Sequestration*, 72 U. PITT. L. REV. 701, 709-10 (2011).

[86] *See Richfield Oil*, 122 Cal. App. at 434.

extractive rights and does not necessarily convey a right to inject.[87]

On the other hand, even if the surface owner unmistakably retained the pore space, he still might be prevented from injecting carbon dioxide if it would somehow interfere with the mineral estate. This is a result of the corollary to the *profit à prendre* doctrine: just as the leaseholder is entitled to reasonable use of the surface property in furtherance of mineral extraction, the surface property owner is prevented from unreasonably interfering with the extractor's operation.[88] Thus, a surface landowner would likely be prevented from sequestering CO2 in the pore space if it would interfere with a leaseholder's ability to extract oil and gas or any other mineral.

These problems are compounded when a potential CO2 storage basin spreads across multiple parcels. In the oil and gas context, field "unitization" (or combining multiple lease areas to form a single unit) is used to facilitate development and mitigate the problem of holdouts.[89] This process can be voluntary or compulsory.[90] A similar process could be used to facilitate geologic sequestration, but the basic problems of identifying all stakeholders, high transaction costs, potential for holdouts, high operating costs to lease pore space, and common law liabilities remain.

B. *Potential Strategies to Resolve Property Ambiguity*

There are three potential strategies resolve pore space ownership ambiguities: (i) a complete private property approach; (ii) limited private property approach; and (iii) a public resource approach.[91]

1. Complete Private Property Approach

The complete private property approach would classify the pore space as the private property of either the surface landowner or mineral rights owner, subject to reasonable access limitations arising from any granted leases.[92] This approach is arguably the most intuitive. It comports with existing perceptions about

---

[87] *See* Makar Prod. Co. v. Anderson, No. 07-99-0050-CV, 1999 WL 1260015, at *2 (Tex. App. Dec. 15, 1999) (an unreported Texas case holding that a mineral grant did not include an implied right to inject oilfield waste, salt water, or other by-product or material not produced from the leasehold).

[88] Owen L. Anderson, *Geologic CO_2 Sequestration: Who Owns the Pore Space?*, 9 WYO. L. REV. 97, 101 (2009); *see* Callahan v. Martin, 3 Cal. 2d 110, 125-27 (1935) (expanding the doctrine to grant an assignee a right of entry); Wall v. Shell Oil Co., 209 Cal. App. 2d 504, 516-17, (1962).

[89] Wilson & Figueiredo, *supra* note 64, at 10118-19.

[90] *Id.*

[91] JERRY R. FISH & ERIC L. MARTIN, CAL. CARBON CAPTURE STORAGE REVIEW PANEL, TECHNICAL ADVISORY COMMITTEE REPORT: APPROACHES TO PORE SPACE RIGHTS 2 (2010), http://www.climatechange.ca.gov/carbon_capture_review_panel/meetings/2010-08-18/white_papers/Pore_Space_Rights.pdf.

[92] *Id.* at 1.

property rights—namely that a fee property owner has total dominion over their property. This approach is also endorsed by the Interstate Oil and Gas Compact Commission (a consortium of 30 state governors) and was an express assumption in crafting their Model General Rules and Regulations.[93]

Under this approach it would be necessary to obtain permission from the surface owner, mineral rights owner, and any lessees prior to injecting sequestered CO2.[94] These property owners would also have to be compensated accordingly.[95] Although this has the benefit of mitigating potential future litigation, it carries very high initial transaction costs, operating costs, as well as the potential for holdouts.[96]

Three states—Wyoming, Montana, and North Dakota—have enacted this approach.[97] In doing so, each expressly vested pore space as part of the surface estate.[98] Wyoming and Montana, however, recognize severability of the pore space, such as through express grants of a mineral estate.[99] Therefore, although some clarity is provided by these statutes, a thorough examination of all previous deeds and grants would likely still be required to determine precise pore space ownership—which does little to mitigate potential complexity, costs, or delay for CCS projects. In contrast, North Dakota proscribes severing pore space from the surface estate.[100] This approach should provide greater predictability for CCS operators.[101]

All three states also expressly provide for unitization of underground storage basins.[102] Montana and North Dakota have similar provisions that allow unitization if sixty percent of the subsurface owners agree; Wyoming is the outlier in requiring eighty percent of landowners to be in agreement.[103] The

---

93 TASK FORCE, *supra* note 76, at 11 (stating "[t]he right to use reservoirs and associated pore space is considered a private property right in the United States, and must be acquired from the owner").

94 *Id.* at 15.

95 FISH & MARTIN, *supra* note 91, at 2 (noting that compensating landowners is standard practice).

96 *Id.* at 4.

97 MONT. CODE ANN. §§ 82-11-180, 82-11-182 (West 2017); N.D. CENT. CODE §§ 47-31-02, 47-31-03, 47-31-04, 47-31-05 (West 2017); WYO. STAT. ANN. § 34-1-152 (West 2017).

98 MONT. CODE ANN. §§ 82-11-180, 82-11-182 (WEST 2017); N.D. CENT. CODE §§ 47-31-02, 47-31-03, 47-31-04, 47-31-05 (WEST 2017); WYO. STAT. ANN. § 34-1-152 (WEST 2017).

99 MONT. CODE ANN. §§ 82-11-180, 82-11-182 (West 2017); WYO. STAT. ANN. § 34-1-152 (West 2017).

100 N.D. CENT. CODE § 47-31-05 (West 2017).

101 *Id.* Potential liability between the mineral estate and surface estate's pore space as a result of this legislation is already being litigated. Fisher v. Cont'l Res., Inc., 49 F. Supp. 3d 637 (D.N.D. 2014).

102 MONT. CODE ANN. § 82-11-204 (West 2009); N.D. CENT. CODE § 38-22-10 (West 2017); WYO. STAT. ANN. §§ 35-11-314 to -317 (West 2009).

103 MONT. CODE ANN. § 82-11-204 (West 2009); N.D. CENT. CODE § 38-22-08; WYO. STAT. ANN. § 35-11-316 (West 2009). Under current California law, seventy-five percent of working and

possibility of unitization thus provides some relief from the problem of holdouts, as well as common law claims.

Condemnation of pore space through eminent domain proceedings could similarly be used to mitigate against holdouts. From a CCS operator's perspective, condemnation would likely be cheaper than unitization because unitization would require continued payments for as long as the property is being used.[104] For example, typical oil and gas leases require a royalty of one-eighth the value of production.[105] Although this calculus is not directly applicable in the CCS context (as CO2 is added to pore space, rather than oil and gas being extracted), landowners would likely be entitled to some level of compensation for as long as CO2 is sequestered on their property—perhaps through a set dollar amount per ton of injected CO2.[106] In contrast, condemnation would be a one-time payment, and proper compensation would likely be minimal because empty pore space is currently viewed as having little economic value.[107] From a landowner's perspective, ongoing payments in perpetuity through unitization may be preferred to a one-time payment for subsurface storage rights that could be of little value in a condemnation proceeding.[108]

2. Limited Private Property Approach

A limited private property approach would confer similar private property rights to property owners as the complete private property approach, but only if the owner could demonstrate that CO2 sequestration would interfere with a reasonable, foreseeable use of the property.[109] This would mitigate the number of pore space owners that must be compensated, especially for saline aquifers where there is currently little economic value.[110] This approach has been endorsed by CCSReg Project, a collaborative group of academics and lawyers, but not yet adopted by any jurisdiction.[111]

---

royalty interests must consent. CAL. PUB. RES. CODE §§ 3642, 3643 (West 2017).

104 FISH & MARTIN, *supra* note 91, at 3.

107 Patrick H. Martin and Bruce M. Kramer, Williams & Meyers, Oil and Gas Law, § 642.1 (LexisNexis Matthew Bender 2016).

106 FISH & MARTIN, *supra* note 91, at 2-4 (suggesting that compensation to property owners will lessen opposition or even encourage development).

107 FISH & MARTIN, *supra* note 91, at 2-4; James Robert Zadick, *The Public Pore Space: Enabling Carbon Capture and Sequestration by Reconceptualizing Subsurface Property Rights*, 36 WM. & MARY ENVTL. L. & POL'Y REV. 257, 275 (2011) (stating that modern property owners do not require exclusive control of the pore space to extract all reasonable economic benefit).

108 FISH & MARTIN, *supra* note 91, at 2-4.

109 *Id.* at 5.

110 *Id.* at 6.

111 CCSREG PROJECT, POLICY BRIEF: GOVERNING ACCESS TO AND USE OF PORE SPACE FOR DEEP GEOLOGIC SEQUESTRATION (2009), http://www.ccsreg.org/pdf/PoreSpace_07132009.pdf.

Under this approach, a CCS project applicant would apply to a state or federal agency for a sequestration permit and the agency would hold a hearing where property owners could seek compensation by asserting a "non-speculative economic interest" in the proposed pore space.[112] The definition of a non-speculative economic interest would be of critical importance. The suggested definition is "the ability to recover actual mineral resources or engage in other current or imminent subsurface activities that have substantial economic value."[113] If the landowners fail to assert this interest at the hearing, they effectively waive any later claim to compensation.[114]

This approach would be beneficial in that it would definitively decide at the outset who has a compensable interest in the pore space.[115] However, an adjudication is required.[116] Such a proceeding would likely be time consuming, expensive, and test the limits of an agency's institutional competency to decide complex property rights cases. Further, there may be opposition to adopting this approach from landowners (and especially mineral estate owners) who feel the burden is shifted on to them to demonstrate a viable economic interest.[117] This may be particularly challenging because pore space is often viewed as having little economic value.[118] This approach also challenges private property assumptions that a fee owner is secure in their property, even for undiscovered resources beneath or within their property.[119] This would be nearly impossible to prove in an adjudication before the resource is discovered.[120]

3. Public Resource Approach

The public resource approach relies on the state's police power to authorize the use of storage basins for carbon sequestration.[121] A legislative enactment would be necessary, but a CCS project proponent could then proceed without otherwise acquiring subsurface property rights.[122] This approach is an outgrowth of unitization and public airspace cases, and is also grounded in public trust

[112] FISH & MARTIN, *supra* note 91, at 5; CCSREG PROJECT, MODEL LEGISLATION (2010), http://www.ccsreg.org/pdf/CCS%20Legislation%20October%202011.pdf [hereinafter MODEL LEGISLATION].

[113] MODEL LEGISLATION, *supra* note 112, at § 322(b).

[114] *Id.* at § 323(c)(2)(A).

[115] FISH & MARTIN, *supra* note 91, at 5-8.

[116] *Id.*

[117] *Id.*

[118] Zadick, *supra* note 107, at 275. However, current economic value is highly dependent on market conditions, which may change rapidly in the future if CCS becomes more prevalent.

[119] FISH & MARTIN, *supra* note 91, at 5-8.

[120] *Id.*

[121] *Id.* at 8-10.

[122] *Id.*

legal theory.[123] Takings issues may arise with this approach, as well as public opposition because of the direct affront to existing notions of private property.[124]

IV. PROPOSED CALIFORNIA REVISIONS

CCS has the potential to significantly reduce California's greenhouse gas emissions and facilitate reducing GHG emissions eighty percent below 1990 levels by 2050. Geologic sequestration is technologically feasible today, but cost, legal uncertainty, and public acceptance stand as primary barriers to deployment.

Despite CCS's laudable potential benefits, efforts to regulate or clarify pertinent law have, to date, only been taken by states that are either dependent on coal power generation or that have significant EOR operations and coal reserves.[125] This perhaps suggests the impetus for action was something other than climate change mitigation. However, even California will rely on fossil fuels for energy generation and other industrial uses for the immediately foreseeable future.[126] This suggests CCS will be an important component of a comprehensive strategy to reach current CO2 emissions targets.[127]

California began to publicly consider CCS in 2006 by enacting legislation directing the Energy Commission to research and report on cost-effective geologic sequestration strategies.[128] The process has slowly progressed since then with multitudes of state-funded studies, reports, councils, and collaborations that supplemented other federal efforts, many of which identified pore space ownership ambiguities as a bar to successful CCS implementation in California.[129] Soon, the California Air Research Board will define a quantification methodology to accurately account for CCS under A.B. 32.[130]

---

[123] *See generally* Zadick, *supra* note 107 (tracing unitization, air travel developments, and the public trust doctrine to conclude that a public resource approach should be uniformly adopted).

[124] FISH & MARTIN, *supra* note 91, at 8-10; Zadick, *supra* note 107, at 277-80.

[125] Monast, Pearson & Pratson, *supra* note 49, at 11.

[126] *See generally* CAL. ENERGY COMM'N, DRAFT STAFF REPORT: 2015 NATURAL GAS OUTLOOK (2015), http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-03/TN206501_20151103T100153_Draft_Staff_Report_2015_Natural_Gas_Outlook.pdf.

[127] *See supra* Part II.B; *see generally* CAL. COUNCIL ON SCI. & TECH, *supra* note 35.

[128] Cal. Assem. Bill No. 1925, ch. 471, 2006 Cal. Stat. 93 (imposing various duties on the State Energy Resources Conservation and Development Commission).

[129] *See e.g.*, CAL. ENERGY COMM'N, GEOLOGIC CARBON SEQUESTRATION STRATEGIES FOR CALIFORNIA: REPORT TO THE LEGISLATURE 130 (2008), http://www.energy.ca.gov/2007publications/CEC-500-2007-100/CEC-500-2007-100-CMF.PDF; CAL. COUNCIL ON SCI. & TECH., ELECTRICITY FROM NATURAL GAS WITH CO2 CAPTURE FOR ENHANCED OIL RECOVERY: EMISSIONS ACCOUNTING UNDER CAP-&-TRADE AND LCFS (Jan. 2015); CAL. CARBON CAPTURE & STORAGE REVIEW PANEL, FINDINGS AND RECOMMENDATIONS 1-2 (Dec. 2010) (voluntarily creating the Panel in February 2010 by the California Public Utilities Commission, California Energy Commission, and Air Resources Board).

[130] *See Carbon Capture and Sequestration*, CAL. AIR RES. BD., http://www.arb.ca.gov/cc/ccs/ccs.htm (last visited March 14, 2017).

Given the resources invested in CCS to date, and the looming targets in 2020, 2030, and beyond, it seems unlikely that the state government would choose not to address pore space ambiguities through the proverbial "no action" alternative. Instead, the status quo's legal quagmire should be addressed prospectively through legislative action.

All three strategies to clarify pore space ownership are supported by existing legal precedent.[131] However, the complete private property approach will likely lead to fragmented ownership of any large potential storage basin.[132] If the obstacles created by private ownership outweigh the potential benefits to CCS operators, there is a high probability of this leading to a loss of utility, or underuse of the resource—a tragedy of the anticommons. [133] Consequently, open pore space would be wasted through underuse and the potential societal benefits of sequestration would be lost.

On the other hand, both the limited private property and public resource approach facilitate the objective of sequestering carbon dioxide by limiting potential interested parties. The difference between these two options is at what stage the right to inject CO2 is clarified. Under the limited private property approach, the property owner (whether surface, mineral, or lessee) could assert their interest at an adjudicative hearing before CCS operations commence. Under the public resource approach these assertions would be made post-hoc in a court of law. Therefore, this significant policy choice may depend in part on the perceived urgency with which GHG emissions must be addressed.

A. *Legal Theory Supporting Limitations on Private Property*

Existing precedent from air travel, groundwater, oil and gas, and inverse condemnation cases provide examples of pressing public needs trumping private property rights and support both the limited private property and public resource approaches.

1. Air Travel

Air travel cases, from both federal and California courts, provide legal precedent in favor of limiting the *ad coelum* ("to heaven") doctrine. Although these cases do not address the *ad inferos* ("to hell") portion of *cuius est solum, eius est usque ad coelum et ad inferos,* their rationale is instructive.[134] Some scholars even speculate that just as the invention of the airplane exposed the failings of *ad coelum*, so will new subsurface drilling technologies expose the

131 *See supra* Part III.A.

132 See Zadick, *supra* note 107, at 279 n.169.

133 *See supra* Part II.A.

134 J. Thomas Lane et al., *Carbon Sequestration: Critical Property Rights and Legal Liabilities—Real Impediments or Red Herrings?*, 32 ENERGY & MIN. L. INST. 23 (2011).

impracticalities of *ad inferos.*[135]

In *Hinman v. Pacific Air Lines Transportation Corporation* (1936), the Ninth Circuit (applying California law) considered if a landowner could recover damages and enjoin the owners of a nearby airport from flying over his property.[136] The Court denied all recovery and rejected a literal interpretation of the *ad coelum* doctrine, stating, "it is not the law, and [it] never was the law."[137] Instead, the Court held that a landowner only holds a property right in the air above his property to the extent that the area is put to a beneficial use, such as being occupied by a building.[138] The Court reasoned that to hold otherwise would be, "utterly impracticable and would lead to endless confusion" in light of nascent air travel technology.[139] The Court also specified that no other person could acquire any title or exclusive right to use the space above another person's property.[140]

The U.S. Supreme Court bolstered this holding in *United States v. Causby* (1946) in holding *ad coelum* "has no place in the modern world," and that "the air is a public highway" where private claims should not interfere with the public interest.[141] In reaching this conclusion, the Court relied on the Air Commerce Act of 1926 that granted the federal government complete and exclusive national sovereignty in the air space over the United States.[142] However, unlike *Hinman*, here the Court awarded damages because the landowners proved that frequent, low-level flights interfered with their existing use and enjoyment of the property (a chicken farm).[143]

These cases illustrate the court's willingness to limit the *ad coelum* doctrine in furtherance of the public interest. However, the applicability of these cases in dealing with *ad inferos* subsurface pore space rights is untested in California.[144] If read narrowly they could be entirely inapplicable given that there is no possibility of public travel through pore space, there has been no declaration of a public interest from any legislative body, or simply because air and pore space are fundamentally different and therefore inapposite. However, such a superficial dismissal seems unlikely.[145] In fact, the Supreme Court of Texas in

135 John G. Sprankling, *Owning the Center of the Earth*, 55 UCLA L. REV. 979, 981 (2008).

136 Hinman v. Pac. Air Lines Transp. Corp., 84 F.2d 755, 756-57 (9th Cir. 1936).

137 *Id.* at 757 (specifically citing California Civil Code sections 659 and 829).

138 *Id.* at 758.

139 *Id.*

140 *Id.*

141 United States v. Causby, 328 U.S. 256, 261 (1946) (holding that a landowner could recover because he proved a significant interference with existing use and enjoyment of property).

142 *Id.* at 260.

143 *Id.* at 264-66.

144 *See* Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change, Carbon Sequestration, and Property Rights*, 2010 U. ILL. L. REV. 363, 388-90.

145 *Id.* at 396.

2008 invoked *Causby* in suggesting that *ad inferos* is similarly misplaced in the modern world.[146]

Thus, it seems entirely likely that other courts will similarly take a close examination of the rationale behind these air travel cases to decide their persuasive value when deciding *ad inferos* challenges. In future pore space cases, courts should look to the strength of the public purpose of carbon sequestration and the asserted private use of the pore space to decide if any existing use would be infringed.

2. Groundwater

Early California law recognized title as absolute, which granted a landowner virtually unlimited use of groundwater—even to the detriment of other overlying landowners.[147] In *Katz v. Walkinshaw* (1903), the California Supreme Court flatly rejected this strict interpretation of the *ad inferos* doctrine as applied to groundwater.[148] Instead, the Court imposed a "reasonable use" limitation that restricted landowner extractions to only as much water as was reasonably necessary for some useful purpose connected to the overlying land.[149] The Court reasoned that to hold otherwise would threaten "utter destruction" to other overlying landowners, subvert justice, and be against sound public policy and the general welfare.[150] The Court also clarified that an overlying landowner does not actually hold title to groundwater, but merely has a usufructuary right—again a clear repudiation of the strict *ad inferos* doctrine.[151] Interestingly, the State of California itself does not hold title to its groundwater either—instead title is held by "the people of the State."[152] The distinction is insubstantial, however, as the State retains the power to regulate and control groundwater as necessary to avoid harm to other landowners.[153]

Again, the application of this precedent to subsurface pore space is not direct; however, the courts' rational in limiting *ad inferos* generally is instructive. The courts exercised their discretion in limiting the idea that a landowner owns

---

[146] Coastal Oil & Gas Corp. v. Garza Energy Trust, 268 S.W.3d 1, 12, n.30 (Tex. 2008) (holding that "fracing" fluid that crossed property lines did not constitute a trespass because there was no injury). But, the issue is far from settled. *See generally*, Environmental Processing Systems, L.C. v. FPL Farming, Ltd., 58 Tex. Sup. J. 293 (Tex. 2015) (expressly refusing to rule on whether Texas law recognizes a trespass cause of action for deep subsurface wastewater migration).

[147] City of San Bernardino v. City of Riverside, 186 Cal. 7, 14-15 (1921) (tracing the origins of California's percolating water law). Until 1903, a landowner only had to pump groundwater from his own land without malicious intent to ensure an unlimited supply. *Id.*

[148] Katz v. Walkinshaw, 141 Cal. 116, 133-37 (1903).

[149] *Id*.

[150] *Id*.

[151] *Id*.

[152] State v. Superior Court of Riverside Cnty., 78 Cal. App. 4th 1019, 1026 (2000).

[153] *Id*.

everything within the subsurface, in part, because that imported common law theory could not be realistically applied in California in the twentieth-century.

3. Oil and Gas

Three areas of oil and gas law are instructive for the limitation of *ad inferos* property rights: ownership theory, field unitization, and trespass as it relates to well stimulation.

There are two basic theories of oil and gas ownership: ownership-in-place and non-ownership theory.[154] Ownership-in-place holds that title to subsurface oil and gas is vested in the fee owner and subject to absolute ownership in place (conforming to traditional *ad inferos* doctrine).[155] California rejected this theory in favor of non-ownership theory, which states a landowner does not hold title to subsurface oil and gas, but instead merely holds an exclusive right to drill for that resource and title is only transferred upon capture.[156] Non-ownership theory is further evidence of the rejection of the *ad inferos* doctrine in California.

Similarly, the legislature again declared that the "people of the state" have a "primary and supreme interest" in all deposit of oil and gas within the state, and thereby prohibited the waste of those resources. [157] In doing so, the state acted through its police power, which applied a prohibition on waste even after the oil and gas had been captured.[158]

California's oil and gas law also recognizes field unitization, a process of combining interests in land to promote recovery of oil and gas in order to prevent waste of those natural resources.[159] If all landowners cannot agree, California provides for a process to force unitization, as long as seventy-five percent of the working and royalty interests agree.[160] This process is another example of a California's existing limitations on *ad inferos* ownership.

Further, courts have found the public interest in oil production to trump common law claims of trespass from secondary recovery operations.[161] Secondary recovery involves injecting wastewaters to increase production, whereas enhanced oil recovery (EOR) usually refers to injecting CO2.[162] In California, landowners may be able to recover where they can prove

[154] KEVIN L. SYKES & MARGEAUX KIMBROUGH, WHAT IS THIS THING CALLED LEASE?, OHIO ENERGY + ENV'T 4-5 (2014), http://www.keglerbrown.com/content/uploads/2015/01/What-is-This-Thing-Called-Lease.pdf.

[155] *Id.* (as oil and gas are fugitive resources, they are also subject to the rule of capture).

[156] See Callahan v. Martin, 3 Cal. 2d 110, 116-18 (1935); SYKES, *supra* note 154, at 4-5

[157] People v. Associated Oil Co., 211 Cal. 93, 105 (1930) (upholding California's waste statute as a valid exercise of the police power).

[158] *Id.* at 95.

[159] CAL. PUB. RES. CODE § 3630 (West 2017).

[160] CAL. PUB. RES. CODE § 3642 (West 2017).

[161] Klass & Wilson, *supra* note 144, at 394.

[162] *Id.* at n.193.

compensable damages.[163] However, no court has affirmed an actual property right that would allow a landowner to preemptively exclude others from injecting secondary recovery fluids or other substances.[164]

Taken together, these oil and gas examples demonstrate, again, how policy goals driven by the public interest in natural resource preservation have directly challenged the *ad inferos* doctrine. Although there is a clear distinction between resource extraction conservation and CCS storage requirements, these examples demonstrate an existing reluctance to uncritically affirm the *ad inferos* doctrine. If nothing else, these examples suggest the possibility that a legislative finding of overriding public interest could further weaken conceptions of private pore space ownership.

4. Inverse Condemnation

The California Constitution provides expansive protection of private property against uncompensated takings, above and beyond the protections provided by the Fifth and Fourteenth Amendments of the U.S. Constitution.[165] Article I, Section 19 of the California Constitution provides, "[p]rivate property may be taken or *damaged* for public use only when just compensation . . . has first been paid . . . to the owner" (emphasis added).[166] This provision prohibits not only direct physical invasions, but also damages from the construction of public improvements.[167] As a practical matter, the state may be liable for just compensation either through customary prospective eminent domain proceedings, or through "inverse condemnation," where the property owner brings an action to recover damages after the property has already been taken or damaged.[168]

Inverse condemnation liability attaches upon a showing of "any actual physical injury to real property proximately caused by [a public] improvement . . . whether foreseeable or not."[169] The definition of a public improvement is expansive, and the government's role need only touch upon the "planning, approval, construction or operation of the project."[170] Further, the causation element has morphed, through judicial construction, into a strict liability scheme.[171]

---

163 CAL. CIV. CODE. § 731c (West 2017).

164 Klass & Wilson, *supra* note 144, at 397.

165 David Ligtenberg, *Inverse Condemnation: California's Widening Loophole*, 10 CAL. LEG. HIST. 209, 215 (2015).

166 CAL. CONST. art. I, § 19 (emphasis added).

167 Customer Co. v. City of Sacramento 10 Cal.4th 368, 379-380 (1995).

168 *Id.* at 376.

169 Albers v. Cty. of Los Angeles 62 Cal.2d 250, 263-64 (1965).

170 DiMartino v. City of Orinda, 80 Cal.App.4th 329, 336 (2000).

171 Ligtenberg, *supra* note 165, at 220-22. One exception to strict liability exists for flood

An important exception exists for any public entity exercising its police power to protect public health, safety, or welfare.[172] This exercise of authority is distinct from the power of eminent domain, and it does not trigger the Constitution's compensation requirements.[173] Generally, a public entity validly exercises its police power when it acts reasonably to protect the order, safety, health, and general welfare of society.[174]

Inverse condemnation has been found inapplicable in at least one case of subsurface migration. In *Niles Sand & Gravel Company v. Alameda County Water District*, the court dealt with a dispute between a gravel pit excavation operation and a water district engaged in aquifer storage and recovery.[175] There, the water district flooded the neighboring gravel pits in the course of recharging its underground water basin, rendering the gravel business inoperable.[176] The court rejected the operator's taking claim premised on interference with its subterranean rights arising under Civil Code section 829's *ad inferos* property rights theory.[177] In holding inverse condemnation inapplicable, the Court relied, in part, on the legitimate exercise of the police power.[178] In doing so, the Court reaffirmed the state's legitimate exercise of its police power "reasonable use" water restrictions (per a Constitutional amendment in 1928), as well as the water district's legitimate exercise of that power in implementing its recharge activities.[179]

The specter of inverse condemnation is an ever-present threat over any public entity in California. At first impression, it appears any state-authorized CCS project opens the door to a clear challenge: a permitting agency would be sufficiently involved, there would be a physical invasion, and the entity would be strictly liable. However, three points weigh against finding liability. First, the bounds of pore space ownership are not clear, so proving an actual physical injury or occupation may prove difficult. Second, a declaration by the legislature of the public benefits of CCS, and the associated exercise of its policy power in authorizing CCS permitting, would weigh strongly against inverse condemnation liability. Third, even if there was an unintended release of stored

control project failures, which are instead held to a rule of reasonableness. Belair v. Riverside Cty. Flood Control Dist., 47 Cal. 3d 550, 555-56 (1988); Paterno v. State of California, 113 Cal.App.4th 998, 1016 (2003).

[172] Freeman v. Contra Costa Cnty. Water Dist., 18 Cal.App.3d 404, 408 (1971).

[173] *Id.* (holding a water district's requirement to install a protective devise on a water well was a valid exercise of the police power and therefore not compensable).

[174] *Id.*; Holtz v. Superior Court 3 Cal.3d 296, 305 (1970) (stating the "police power" doctrine generally operates in the field of regulation, "rendering 'damages' occasioned by the adoption of administrative or legislative provisions non-compensable").

[175] Niles Sand & Gravel Co. v. Alameda Cty. Water Dist., 37 Cal. App. 3d 924 (1974).

[176] *Id.* at 928-29.

[177] *Id.* at 935-37.

[178] *Id.*

[179] *Id.* at 936.

CO2, it may prove difficult to show any actual damage to real property as a result.

B. *California Should Adopt the Public Resource Approach*

As shown, strong legal precedent exists in support of limiting *ad inferos* property rights. The air travel cases highlight the need to balance the asserted public purpose against the severity of infringement on private property. The groundwater cases highlight the need to adapt the *ad inferos* doctrine to contemporary existing conditions. Oil and gas law reinforces the ownership interest of the People of the State that extends to the subsurface. Finally, inverse condemnation cases show the broad discretion afforded to the state in exercising its police power to protect public health, safety, and the general welfare of society.

The potential public health and welfare impacts of GHG emissions were expressly recognized by both the Legislature and Governor in adopting their respective emission targets.[180] These include reduced water supply through loss of Sierra snowpack, increased air quality problems, rising sea levels that result in displacement, as well as broader negative economic impacts to agriculture, tourism, recreation, and forestry.[181] A finding that CCS mitigates these potential negative effects should not be difficult. These effects, combined with the impending deadlines of 2020 and 2030, should motivate the Legislature to expressly find CCS to be in the public interest and exercise its police power by authorizing regulatory permits for CCS projects.

Beyond this, the Legislature should expressly recognize that subsurface pore space belongs to the People of the State. The emerging need for CCS and pore space CO2 injection to protect the public health and welfare is a sufficiently changed condition to justify a reinterpretation of the *ad inferos* doctrine. Further, the potentially substantial public benefits appear to outweigh the burden on individual private property interests, which currently encompass only economically useless deep pore space.

Legislative findings further elucidating the necessity for CCS and expressly recognizing the link between CCS and the protection of human health will further bolster the case for subsequent legal challenges.

V. CONCLUSION

Each of the three potential approaches to resolving pore space ownership

---

[180] *See* California Global Warming Solutions Act of 2006 (AB 32), ch. 488, 2006 Cal. Stat. 89 (codified at CAL. HEALTH & SAFETY CODE § 38500-38599 (West 2007)); *See* Cal. Exec. Order No. S–3–05 (June 1, 2005), https://www.gov.ca.gov/news.php?id=1861.

[181] CAL. HEALTH & SAFETY CODE § 38501(a)-(b) (West 2007); Cal. Exec. Order No. S–3–05 (June 1, 2005), https://www.gov.ca.gov/news.php?id=1861.

ambiguity has potential benefits and disadvantages. Ultimately, however, the public resource approach provides the best path forward as the approach that most appropriately balances private property interests with society's need to reduce atmospheric greenhouse gas emissions.

The private property approach intuitively comports with existing perceptions that a property owner's right to exclude extends indefinitely downwards as well as upwards. However, this approach will delay CCS implementation because of existing ownership ambiguities, high transaction costs, and the potential for holdouts. This may result in a tragedy of the anticommons if these barriers lead to underuse of otherwise open pore space. Further, the time delay from identifying and contracting with multitudes of potential parties may jeopardize the pressing need to sequester CO2 as a way for California to achieve its aggressive GHG reduction targets.

The limited private property would require landowners to affirmatively assert a non-speculative economic interest in the pore space at an adjudicative hearing before a sequestration permit could be issued. This would definitively decide property interests at the outset, but comes with complexity, cost, and an additional time-delay.

The public resource approach, on the other hand, would streamline CCS deployment by declaring sequestration a public purpose. This approach also provides a definitive answer to the pore space ownership question, but would challenge existing notions of private property.

Open pore space should be viewed as a public resource, owned by the People of the State, just like air, water, oil and gas, and other natural resources. Declaring open pore space a public resource is a first step towards meeting California's ambitious 2020 and 2030 GHG emissions targets. This approach is a natural progression in a line of precedent limiting private property rights to other public resources. These private property interests are outweighed by our collective need to both reduce GHG emissions, as well as our continued need to rely on natural gas for electricity generation and other industrial needs in the immediate future. The public resource approach facilitates the highest use of the expansive deep saline formations in California. Additionally, common law claims will provide a backstop for concrete interests that may be actually harmed by CCS operations. Thus, it is in the best interest of all Californians to clarify pore space ownership through the public resource approach in order to facilitate adoption of carbon capture and sequestration.