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ARTICLES

De-Risking Underground

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Abstract

Carbon capture and storage ("CCS") technology—particularly the process of capturing carbon dioxide and injecting it underground—is being hailed as a breakthrough in the global fight against climate change. It has achieved uncommon bipartisan support for a climate initiative in the United States and remains one of the few currently receiving federal aid. Advocates claim that CCS is critical to limiting global warming to 2°C, a widely recognized threshold for avoiding catastrophic climate impacts, especially if fossil fuel reliance continues. CCS's potential scale is massive: deep saline formations in the United States alone could hold 22 million metric tons of injected carbon dioxide. But the sheer scale of CCS's potential is also what alarms critics. Industry and policymaker proposals to scale up the process amplify the risks associated with CCS: groundwater pollution, cross-boundary carbon migration, and induced seismicity. Some proponents argue that CCS's success must come at the sacrifice of fundamental subsurface property rights, that we must effectively force landowners to bear the legal and physical burdens of an industry-driven solution to carbon waste. A growing judicial pattern of reshaping long-established doctrines of ownership in ways that limit the right to exclude bolsters this claim. When oil and gas exploration has involved underground injection, courts have sometimes elevated public policy over private rights, revealing a broader trend of "de-risking underground": minimizing legal exposure for industry in subsurface trespass disputes by weakening property protections. Some argue this de-risking should extend to CCS. This article contends that courts are overstating limits on private property rights in the name of industrial convenience—sidestepping the constitutional requirement of just compensation and effectively reducing the ad coelum doctrine, which historically held that ownership extends "to the center of the earth," unnecessarily. The appropriate mechanism for advancing public goals that burden private property is not judicial exemption; instead, if private property rights must be taken to meet a public need, such taking must occur through eminent domain and with payment of just compensation. CCS,

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with its unprecedented scale and heightened risks, brings this trend of judicial de-risking into sharper focus. This article argues that courts and legislatures should follow normative property rights and thus protect a landowner's right to exclude subsurface carbon waste absent a lawful exercise of eminent domain.

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I. Introduction

Carbon capture and sequestration ("CCS") has rapidly ascended to the forefront of U.S. climate and energy policy.[1] Amid rollbacks of other green initiatives under the Inflation Reduction Act and shifting priorities at the Environmental Protection Agency, CCS is one of the few bipartisan-backed green technologies still standing.[2] Federal CCS support has been altered, but it remains intact—buoyed by billions in

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1 Carbon capture and sequestration (CCS) involves capturing CO_2 emissions from industrial sources and injecting them underground for long-term storage to reduce atmospheric greenhouse gases. Intergovernmental Panel on Climate Change, Climate Change 2022: Mitigation of Climate Change 31–32 (Hans-Otto Pörtner et al. eds., 6th Assessment Rep., Working Grp. III, 2022), https://www.ipcc.ch/report/ar6/wg3/downloads/report/IPCC_AR6_WGIII_SummaryForPolicymakers.pdf [https://perma.cc/9GXG-P525] [hereinafter IPCC 2022]; *NGFS Glossary*, Network for Greening the Fin. Sys., https://www.ngfs.net/ngfs-scenarios-portal/glossary/ [https://perma.cc/S2TD-2P5Q] (last visited Sept. 1, 2025) (defining CCS as "[a] process in which a relatively pure stream of carbon dioxide (CO_2) from industrial and energy-related sources is separated (captured), conditioned, compressed and transported to a storage location for long-term isolation from the atmosphere.").

2 Zahra Hirji, *Trump's Escalation of Clean Energy Fight Is Spreading More Pain Among Producers*, Bloomberg (Jul. 25, 2025, at 19:46 WST), https://www.bloomberg.com/news/newsletters/2025-07-25/trump-s-escalation-of-clean-energy-fight-is-spreading-more-pain-among-producers [https://perma.cc/W4MR-D3WU]; David Uberti, *The Moment the Clean-Energy Boom Ran Into "Drill, Baby, Drill"*, Wall St. J. (Jul. 5, 2025, at 05:30 ET), https://www.wsj.com/business/energy-oil/us-energy-industry-gop-megabill-d74b4e94 [https://perma.cc/8REN-ESGR]; *EPA Launches Biggest Deregulatory Action in U.S. History, Administrator Zeldin Announces 31 Historic Actions to Power the Great American Comeback*, U.S. Env't Prot. Agency. (Mar. 12, 2025) (last updated Mar. 14, 2025), https://www.epa.gov/newsreleases/epa-launches-biggest-deregulatory-action-us-history [https://perma.cc/56HM-ZMTH] (discussing the EPA's actions in response to Trump's executive orders).

subsidies and sustained by rare bipartisan support.[3] This unusual convergence of interests has drawn in stakeholders across the spectrum—from fossil fuel advocates to federal and state regulators—and, albeit with growing caution, some environmental policymakers.[4]

Enduring support for CCS through the second Trump administration speaks to how uniquely it is situated: it is both a climate mitigation tool and a fossil fuel extender.[5] CCS promises to decarbonize "hard-to-abate" sectors such as steel and cement, while also offering oil and gas companies a mechanism for reducing their greenhouse gas ("GHG") emissions.[6]

Few climate strategies have enjoyed such concentrated momentum.[7] The Intergovernmental Panel on Climate Change ("IPCC") includes CCS in nearly every scenario for limiting global warming to 2°C and emphasizes its necessity for net-zero pathways.[8] The 2°C threshold marks the point beyond which the risk of severe and irreversible climate impacts sharply increases; it is a core target of the 2015 Paris Agreement, an international treaty under the United Nations Framework Conventional on Climate Change.[9] In the United States, federal tax law heavily incentivizes deployment of CCS through section 45Q, which grants a tax credit for permanently storing carbon waste underground.[10]

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3 *See Statement: US Bipartisan Carbon Dioxide Removal Investment Act Levels the Playing Field for Carbon Removal Scale-Up*, World Res. Inst. (Nov. 21, 2024), https://www.wri.org/news/statement-us-bipartisan-carbon-dioxide-removal-investment-act-levels-playing-field-carbon [https://perma.cc/CDG3-T3UF].

4 *Capturing and Storing Carbon Emissions,* Chevron Corp., https://www.chevron.com/what-we-do/technology-and-innovation/capturing-and-storing-carbon-emissions [https://perma.cc/2XA2-9NWQ] (last visited July 28, 2025).

5 Emma Martin-Roberts et al., *Carbon Capture and Storage At the End of A Lost Decade,* 4 One Earth 1569, 1572–73, 1579 (2021); Gabriel Pacyniak, *State Sequestration: Federal Policy Accelerates Carbon Storage, But Leaves Full Climate, Equity Protections to States*, 14 San Diego J. Climate & Energy L. 95, 98–99 (2023) [hereinafter Pacyniak, *State Sequestration*].

6 Martin-Roberts et al., *supra* note 5, at 1572; IPCC Special Report 2022, *supra* note 1, at 36 ("The deployment of carbon dioxide removal (CDR) to counterbalance hard-to-abate residual emissions is unavoidable if net zero CO_2 or GHG emissions are to be achieved.").

7 Int'l Energy Agency, Energy Technology Perspectives 2020: Special Report on Carbon Capture Utilization and Storage: CCUS in Clean Energy Transitions 21 (2020), https://www.iea.org/reports/ccus-in-clean-energy-transitions [https://perma.cc/Q9RP-M2N3] ("[Power stations and industrial plants] could generate more than 600 GtCO2–almost two decades' worth of current annual emissions–if they were to operate as they currently do until the end of their technical lives.") [hereinafter IEA CCUS 2020].

8 IPCC Special Report 2022, *supra* note 1, at 28.

9 *Paris Agreement to the United Nations Framework Convention on Climate Change* art. 2(1)(a), Dec. 12, 2015, T.I.A.S. No. 16-1104.

10 26 U.S.C. § 45Q (2021); Nat'l Acads. of Scis., Negative Emissions Technologies and Reliable Sequestration: A Research Agenda 336 (2019), https://doi.org/10.17226/25259 [perma.cc/6YRQ-2KL7].

But this apparent consensus is beginning to fracture.[11] While proponents argue CCS has vast capacity for reducing GHGs in the atmosphere due to the sheer mass of underground pore space capable of housing carbon dioxide, scientists and policymakers increasingly caution that CCS may be neither feasible nor safe under current regulatory frameworks, particularly at the scale most believe necessary to limit global warming to 2°C.[12]

As recent scholarship notes, the permitting process for CCS remains slow and inconsistent, long-term liability is unresolved, and the technical challenges of guaranteeing permanent containment are formidable.[13] Moreover, the risks of leakage, induced seismicity, and aquifer contamination from CCS have triggered skepticism about its safety.[14] These concerns have prompted renewed scrutiny of CCS's role in climate mitigation, particularly when compared to alternative strategies such as afforestation and renewable energy expansion.[15]

One of the most significant concerns raised is whether regulatory oversight will ensure permanent sequestration of carbon dioxide, a condition generally perceived as necessary to ensure the technology's safety to human health and the environment.[16] Class VI wells are a specific category of wells regulated under the Safe Drinking Water Act's

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11 *See* David J. Mitchell, *Louisiana Approves First Carbon Capture Storage Well, Opening Way to Controversial Industry*, NOLA.ORG (Sept. 12, 2025), https://www.nola.com/news/business/louisiana-carbon-capture-emissions-climate-industry/article_d8e8abaa-2e24-5f3a-bf23-3c37740cd1a7.html [perma.cc/MG6E-L4KC] ("[C]ontroversy and grassroots opposition have also grown in some areas of conservative-leaning rural Louisiana where the major storage operations are proposed . . . Skepticism of climate change, the impact that the buoyant gas could have on overlying groundwater aquifers, CO2 pipeline leaks and taxpayer support for the projects have all blended into a stew of opposition for some rural residents. Environmentalists also oppose the technology because they say it is unproven and will help prevent the transition away from fossil fuels to clean energy.").

12 Pacyniak, *State Sequestration, supra* note 5 at 98–99; Zachary Rempel et al., *Unpacking Carbon Capture and Storage: The Technology Behind the Promise*, INT'L INST. FOR SUSTAINABLE DEV. (IISD) (Nov. 28, 2023), https://www.iisd.org/articles/insight/unpacking-carbon-capture-storage-technology#:~:text=Is%20CCS%20Technologically%20Feasible%20at,ought%20to%20limit%20our%20expectations [https://perma.cc/XFG7-4PA7] (stating that "CCS has developed at a snail's pace over the past few decades"); *but see* James E. Hansen et al., *Global Warming Has Accelerated: Are the United Nations and the Public Well-Informed?,* 67 ENV'T: SCI. & POL'Y FOR SUSTAINABLE DEV. 6 (2025), https://www.tandfonline.com/doi/epdf/10.1080/00139157.2025.2434494?needAccess=true [https://perma.cc/S87H-LBSR] ("Are the public and United Nations well-informed? Not if judged by assertions that global warming can be kept 'well below 2 °C,' the goal of the Paris Agreement, without purposeful global cooling (in addition to phase-down of greenhouse gas emissions). Intergovernmental Panel on Climate Change (IPCC) scenarios that achieve that target, such as RCP2.6 in Figure 15, are implausible.").

13 *Id.*

14 Pacyniak, *State Sequestration*, *supra* note 5, at 99.

15 Rempel et al., *supra* note 12; DECARBONISATION AND THE ENERGY INDUSTRY: LAW, POLICY AND REGULATION IN LOW-CARBON ENERGY MARKETS 103–05 (Tade Oyewunmi et al. eds., 2020).

16 *See* Wendy B. Jacobs, *Proposed Liability Framework for Geological Sequestration of Carbon Dioxide*, (Harvard Law Sch., Emmett Env't L. & Pol'y Clinic, Working Paper, Oct. 2010),

Underground Injection Control (UIC) program, a program designed specifically for the geologic sequestration of carbon dioxide.[17] While the EPA establishes national standards and oversees Class VI well permitting, the federal regulatory structure is both somewhat limited in scope and heavily reliant on state authorities.[18]

The technical capacity to ensure permanent storage for all carbon dioxide injected into underground reservoirs is not empirically proven. Injecting waste into wells is not a new technology, as it has been used for natural gas storage, wastewater injection, and oil and gas extraction technologies; yet there is no clear analog to carbon dioxide sequestration upon which we can accurately predict its success.[19] To date, only technical models have been used to "verify" that injected carbon dioxide will remain permanently underground.[20]

Amidst these environmental and safety issues lies a deeper question of property law: who owns the pore space beneath the surface where the carbon dioxide is injected, and what rights does the owner hold against intrusion from migrating carbon dioxide (either intentional or "due to leakage") without their consent?[21] In the context of other underground injection technologies, courts, scholars, and policymakers have approached with the view that underground injection technologies should be advanced for the greater good.[22]

As this Article will show, when courts have confronted similar questions in the context of oil and gas production, they have repeatedly granted injection technologies a degree of immunity from trespass liability, justified by the perceived necessity of extracting fossil fuels

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https://www.belfercenter.org/publication/proposed-liability-framework-geological-sequestration-carbon-dioxide [https://perma.cc/6AF8-FTPC].

17 These wells enable the long-term injection and secure storage of carbon dioxide deep underground in geologic formations, thereby preventing its release into the atmosphere and mitigating climate change – or so it is claimed. U.S. Env't. Prot. Agency, Geologic Sequestration of Carbon Dioxide–Underground Injection Control (UIC) Program Class VI Implementation Manual for UIC Program Directors, EPA 816-R-18-001 (Jan. 2018), https://www.epa.gov/sites/default/files/2018-01/documents/implementation_manual_508_010318.pdf [https://perma.cc/7SHX-JG2A].

18 A few states have assumed "primacy," meaning they have been granted primary enforcement responsibility for permitting and regulating these wells within their jurisdictions. In states without primacy, the EPA directly manages the program. This federal-state partnership reflects the complexity and localized nature of underground injection activities and highlights the significant role that state agencies play in ensuring compliance and environmental safety. *Id.*

19 *See infra* Part II.B.

20 *See generally* Lluís Saló-Salgado et. al., *Direct Comparison of Numerical Simulations and Experiments of CO2 Injection and Migration in Geologic Media: Value of Local Data and Predictability*, arXiv (Jan. 21, 2023), https://arxiv.org/pdf/2301.08875 [https://perma.cc/7K6C-CSYE].

21 Loretto v. Teleprompter Manhattan C.A.T.V. Corp., 458 U.S. 419, 435–46 (1982) ("The power to exclude has traditionally been considered one of the most treasured strands in an owner's bundle of property rights.").

22 *See infra* Part IV.B.

vital to industry.[23] This de-risking of underground technologies has traditionally been justified by public policy goals, with only limited attention paid to the costs imposed on property owners.[24] But the heightened risks associated with carbon capture and storage make those property rights harder to ignore, and the modest benefits that can be achieved given the risks of leakage cast further doubt on whether public interest still justifies this approach.

Historically, the law of the subsurface has been heavily shaped by oil and gas jurisprudence, including the "rule of capture," which holds that subsurface resources are not owned until brought to the surface.[25] This court-made rule reflected the fugitive nature of oil and gas, but it was quickly tempered by legislation and the doctrine of correlative rights—that is, the principle that each surface owner holds a common, though limited, right to the fugitive minerals beneath their land.[26]

Since CCS involves injection into pore space in lieu of extracting minerals from within it, the question is not who owns the right to extract minerals held in pore space but whether there is a right to inject into cavities under the surface. As CCS projects advance, some courts and commentators have looked to oil and gas principles to argue that injection of carbon dioxide into underground pore space does not amount to trespass.[27] Others contend that the public benefit of CCS justifies limiting landowners' rights absent a showing of actual harm.[28]

What has emerged is a growing body of scholarship and case law that seeks to "de-risk" carbon sequestration underground by softening traditional property protections of ownership and, included therein, the right to exclude or seek liability for trespass.[29] In many cases, courts or scholars have argued for narrowing the scope of the *ad coelum* doctrine—the foundational principle that landowners hold rights not only to the surface but also to the subsurface and airspace above.[30]

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23 *See infra* Part IV.B.

24 *See infra* Part IV.B.

25 Elliff v. Texon Drilling Co., 210 S.W.2d 558, 561 (Tex. 1948) ("The rule of capture is simply that the owner of a tract of land acquires title to the oil or gas which he produces from wells drilled thereon, though part of such oil or gas may have migrated from adjoining lands.").

26 *See infra* Part III.A.2.

27 *Id.*

28 *Id.*

29 As will be discussed herein, trespass law does not ordinarily require actual harm. RESTATEMENT (SECOND) OF TORTS § 158 (A.L.I 1965) ("One is subject to liability to another for trespass, irrespective of whether he thereby causes harm to any legally protected interest of the other, if he intentionally... enters land in the possession of the other, or causes a thing or a third person to do so.").

30 United States v. Causby, 328 U.S. 256, 260 (1946) ("It is ancient doctrine that at common law ownership of the land extended to the periphery of the universe—*Cujus est solum, ejus est usque ad coelum*."); 2 WILLIAM BLACKSTONE, COMMENTARIES *18 (1766) ("[L]and hath an indefinite extent, upwards as well as downwards.").

While some claim that this principle has been rejected in the context of modern oil and gas law, this Article will illustrate how American courts and legislatures have consistently affirmed subsurface ownership, even as they have developed doctrines to manage shared access and fluid migration.

As this Article will show, CCS does not require abandoning property law or twisting it to meet a public need for the reduction of GHGs; it requires a proper application of preexistent property law. Immunizing the hydrocarbon industry from trespass liability is not a substitute for the appropriate legal mechanism, eminent domain, which balances public benefit with private property rights through just compensation.[31] While carbon sequestration raises novel questions, it does not justify treating subsurface ownership as a dispensable interest. Instead, as with any constitutionally protected property right, the right to exclude and the right to enjoin via trespass should remain intact unless the state or its proxies act through lawful condemnation and, importantly, make payment.

Part II outlines the technical and regulatory structure of CCS, focusing on its climate role, legal framework, and risks to health, safety, and seismicity, and potential conflicts with other subsurface activities. Part III examines how property doctrines—particularly the *ad coelum* principle, the rule of capture, and correlative rights—have shaped judicial treatment of underground space, often through the lens of oil and gas law. Part IV surveys subsurface trespass doctrine, highlighting a judicial pattern, largely in dicta, of curtailing property rights to accommodate industrial underground injection. Finally, Part V critiques the legal and policy trend of minimizing ownership and trespass liability in the name of industry requirements and argues that "judicial narrowing of property rights is not a necessary predicate to climate policy. Legislatures may pursue CCS deployment while safeguarding landowner interests through clear recognition of pore space ownership, compensated takings where needed, and continued application of trespass law to unintended subsurface invasions.

This Article ultimately contends that carbon storage policy should be advanced through transparent and constitutionally sound mechanisms—namely, deliberate legislative action and, where necessary, the judicious use of eminent domain. It cautions against the gradual doctrinal and judicial erosion of private property rights through efforts

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31 Eminent domain authority has long been assigned to private industry for public need. U.S. Const. amend. V ("…nor shall private property be taken for public use, without just compensation."); Berman v. Parker, 348 U.S. 26, at 32–33 (1954) ("The concept of the public welfare is broad and inclusive. The values it represents are spiritual as well as physical, aesthetic as well as monetary. It is within the power of the legislature to determine that the community should be beautiful as well as healthy, spacious as well as clean, well-balanced as well as carefully patrolled.").

to de-risk carbon storage in the name of public benefit. Moreover, this Article upholds the traditional rules of trespass law and emphasizes that much of the oil and gas law relied upon to justify bending trespass principles consists of dicta, often from cases where underground trespass was not the central issue. Given that these earlier cases only suggested loosening trespass protections in passing, this Article argues that it is time to look forward and reconsider how CCS should be regulated with a renewed commitment to property rights and careful oversight.

II. CCS Overview

"Carbon capture and storage" or "carbon capture and sequestration," commonly referred to as "CCS," is a process whereby carbon dioxide is separated "from industrial and energy-related sources" and "transport[ed] to a storage location" for "long-term isolation from the atmosphere."[32] It is increasingly seen as a necessary tool in the fight against climate change because it allows for the continued use of fossil fuels—an outcome many now regard as inevitable given recent policy shifts favoring expanded oil and gas development alongside the rollback of renewable energy incentives.[33] Yet, the deployment of CCS is fraught with risks, including high costs and environmental and social harms such as "potential water and subsoil contamination, increased and perhaps unsustainable demand for land and water, and induced earthquakes."[34]

This Part briefly introduces key CCS technologies, reviews analogous underground injection practices, such as natural gas storage, wastewater injection, and EOR, and identifies the distinct risks posed by CCS. These risks include pore space conflicts, carbon dioxide migration, and induced seismicity.

A. The CCS Process

At base, CCS involves a three-step process: capture, transportation, and storage. It is distinguished from CCU or CCUS, where the added "U" stands for "utilization" of captured carbon.[35] In CCU, the carbon is

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32 *See* Sara Budinis et al., *Carbon Capture Utilisation and Storage*, Int'l Energy Agency, https://www.iea.org/energy-system/carbon-capture-utilisation-and-storage [https://perma.cc/Q9RP-M2N3] (last updated April 24, 2024), [hereinafter IEA CCS Report]; Howard Herzog, *Carbon Capture*, MIT Climate Portal (January 20, 2023), https://climate.mit.edu/explainers/carbon-capture [http://perma.cc/2C2L-MTPK]; Intergovernmental Panel on Climate Change, Carbon Dioxide Capture and Storage Special Report 3 (2005), https://www.ipcc.ch/site/assets/uploads/2018/03/srccs_wholereport-1.pdf [http://perma.cc/HGT4-KQD4] [hereinafter IPCC Special Report 2005].

33 IPCC Special Report 2022, *supra* note 1, at 20–23.

34 Pacyniak, *State Sequestration*, *supra* note 5, at 137.

35 Pacyniak, *State Sequestration*, *supra* note 5, at 103; IEA CCUS Report, *supra* note 32.

permanently embedded in a commercial product; in CCUS, utilization is a temporary step before the carbon is ultimately injected underground for long-term storage.[36] While both CCS and CCUS involve the sequestration of carbon dioxide underground, this Article focuses specifically on the legal implications of carbon storage, regardless of whether the captured carbon is also utilized beforehand. Therefore, all references to CCS herein may apply to CCUS processes as well.

1. Opposition and Critiques

Opponents of anthropogenic-sourced CCS argue that geological sequestration prolongs our reliance on hydrocarbons, thereby exacerbating the associated environmental and social harms linked to fossil fuel use.[37] In addition to this concern, the CCS capture process itself presents risks and *creates* additional carbon dioxide emissions.[38] CCS is increasingly viewed as a necessary tool in the fight against climate change, but critics point to a core contradiction: while it may reduce emissions in the short term, it both perpetuates long-term reliance on fossil fuels and produces its own emissions that may undercut its impact.[39] This tension raises critical questions about whether CCS is a transitional solution or a distraction from deeper systemic change.

2. Capture

Before turning to carbon storage and its limitations, it is worth briefly outlining the primary technologies involved in capturing carbon. There are several CCS mechanisms to remove carbon dioxide from the air. Direct air capture ("DAC") is a method that removes carbon dioxide already present in the atmosphere.[40] Although it holds substantial

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36 Pacyniak, *State Sequestration*, *supra* note 5, at 103.

37 Pacyniak, *State Sequestration*, *supra* note 5, at 136–37 (explaining that certain CCS methods rely heavily on fossil fuels).

38 CCS can likewise increase emissions of non-carbon dioxide air pollutants, such as nitrogen oxides, and the process generates emissions of carbon dioxide due to the additional energy required for capture, compression, and transportation. European Env't Agency, Air Pollution Impacts from Carbon Capture and Storage (CCS) 7 (2011) ("[A] conclusion of the review is that the life-cycle emissions from the CCS chain, particularly the additional indirect emissions from fuel production and transportation, may also be significant in some instances.").

39 *See infra* Part II.A.2 (discussing the façade of the just transition narrative).

40 Decarbonisation and the Energy Industry: Law, Policy and Regulation in Low-Carbon Energy Markets 105 (Tade Oyewaunmi et al. eds., 2020) ("Direct air capture can enable carbon removal in which CO2 captured from the atmosphere is permanently stored."). The only carbon dioxide released in direct air capture (DAC) comes from the energy used to capture, transport, and store it—that is, from carrying out the CCS process itself. Global CCS Inst., Global Status of CCS 2024: Collaborating For A Net-Zero Future 21 (2024), https://www.globalccsinstitute.com/wp-content/uploads/2024/11/Global-Status-Report-6-November.pdf [http://perma.cc/32EJ-R87L] ("Four commercial DAC facilities – Climeworks' ORCA and

potential for reducing atmospheric carbon levels, DAC remains less widely implemented due to its higher cost and comparatively early stage of commercial development.[41] Other processes with a higher return on carbon dioxide abatement include blue hydrogen sequestration and bioenergy with carbon capture and sequestration, or "BECCS."[42]

Although it removes less carbon overall and is insufficient to limit warming to 2°C, the CCS industry is primarily investing in capturing carbon directly from industry emitters prior to its release into the atmosphere.[43] Today, the most common method of capturing carbon dioxide involves chemical absorption from factory stacks.[44] Afterward, the carbon dioxide is stripped from the chemical solution for compression and storage, while the remaining gases are released safely into the atmosphere.[45]

Proponents claim this anthropogenic capture method promises several benefits to the environment, business, and society as a whole.[46] Beyond reducing GHG emissions, this CCS application is often presented as supporting a "just transition," a concept that seeks to ensure communities dependent on fossil fuel industries are not left behind but can move fairly and sustainably toward renewable energy sources like solar and wind.[47]

Mammoth plants in Iceland, Heirloom's DAC California plant and Heimdal's Bantam facility in Oklahoma–are presently operational, while 16 more facilities are in various stages of development, including two in the construction phase in Oman and the United States."). "The Oxy Low Carbon DAC plant in Texas will be the world's largest and the first of its kind to directly remove 1 Mt of CO2 per year from the atmosphere for use in EOR operations as soon as 2025." Martin-Roberts et al., *supra* note 5, at 1572.

41 Nancy W. Stauffer, *Reality Check on Technologies to Remove Carbon Dioxide From the Air*, MIT News (Nov. 20, 2024), https://sustainability.mit.edu/article/reality-check-technologies-remove-carbon-dioxide-air [http://perma.cc/3CW9-75XY] (concluding that DAC is not a reliable method for reducing CO2 to meet net-zero emissions).

42 Martin-Roberts et al., *supra* note 5, at 1570.

43 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 134.

44 Sonal Patel, *Capturing Carbon and Seizing Innovation: Petra Nova Is POWER's Plant of the Year*, POWER MAG. (Aug. 1, 2017), https://www.powermag.com/capturing-carbon-and-seizing-innovation-petra-nova-is-powers-plant-of-the-year/ [perma.cc/VU2P-YQJW]. In this process, the flue gas—the mixture of gases produced when fuel is burned in a factory or power plant—is passed through a special chemical solution. Keith B. Hall, *Carbon Capture and Storage: Models for Compensating Holdout Landowners*, 14 San Diego J. of Climate & Energy L. 39, 45–46 (2022-2023) [hereinafter Hall, *Carbon Capture*]. This solution selectively absorbs the carbon dioxide from the gas mixture, separating it from other gases like nitrogen and oxygen. *Id.* at 45; Federica Raganati et al., *Absorption of Carbon Dioxide for Post-Combustion Capture: A Review*, ENERGY FUELS, 35, 12846 (Aug. 5, 2021).

45 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 104-05.

46 *See e.g.,* Alex Townsend et al., The Value of Carbon Capture and Storage (CCS), Glob. CCS Inst. 3 (2020).

47 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 145–46; IPCC Special Report 2005, *supra* note 32, at 3.

However, these perceived benefits depend heavily on how and where CCS is implemented, especially when applied to existing industrial facilities.[48] Most current carbon dioxide emissions stem from industrial facilities powered by fossil fuels or biomass, such as natural gas, synthetic fuel, and hydrogen production plants.[49] Using CCS to "retrofit" these facilities, modifying existing infrastructure to add carbon capture, has been framed as a way to offset emissions.[50] Critics argue, though, that such retrofits only achieve marginal reductions and are prohibitively expensive.[51] While proponents maintain that even modest reductions are worthwhile, the IPCC has concluded that building new power plants equipped with CCS from the outset is a more efficient and effective strategy.[52] Yet this strategy challenges the promise of a smooth, equitable "just transition" for communities reliant on current GHG-producing factories.

The steps following capture are less controversial. The carbon dioxide must thereafter be compressed, transported, and securely stored to prevent its release back into the atmosphere. These steps are vital to the success of carbon sequestration efforts.[53] Captured carbon dioxide is compressed into a supercritical state, reducing the carbon dioxide to a liquid form.[54] It is then transported (usually by pipeline) to the geological sequestration site where it will first be stored, and then injected into the earth.[55] The transportation component of CCS is relatively well-developed, as oil and gas companies have used carbon dioxide pipelines for decades to transport carbon dioxide that would be utilized in the EOR industry.[56]

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48 Townsend et al., *supra* note 46, at 20 ("CCS enables existing industries to continue to make a sustained contribution to local economies while transitioning to a net-zero economy. Inefficient and uncompetitive industrial plants will still close, but supporting the longevity of the most innovative firms will help achieve a fair transition.").

49 IPCC Special Report 2005, *supra* note 32, at 3.

50 IEA CCUS 2020, *supra* note 7, at 52.

51 *Id.* at 22; IPCC Special Report 2005, *supra* note 32, at 10 ("Retrofitting existing plants with CO2 capture is expected to lead to higher costs and significantly reduced overall efficiencies than for newly built power plants with capture.").

52 IPCC Special Report 2005, *supra* note 32, at 10 ("In order to reduce future retrofit costs, new plant designs could take future CCS application into account.").

53 Pacyniak, *State Sequestration*, *supra* note 5, at 105–08. If the carbon dioxide does not remain stored, the net effect is release of more carbon—that which is required to capture it—than the factories would have ordinarily produced. *Id.* at 99.

54 Angela Jones et al., Cong. Rsch. Serv., R44902, Carbon Capture and Sequestration (CCS) in the United States (2022), https://www.congress.gov/crs-product/R44902 [https://perma.cc/8RFJ-6YAM].

55 *Id.* at 10. In CCUS, the carbon dioxide would be utilized by injecting the carbon underground to enhance recovery of minerals. Historically, this process, known as EOR, did not focus on sequestration. *Id.* at 8.

56 Pacyniak, *State Sequestration* , *supra* note 5, at 105.

B. Underground Storage – Analogs and Risks

The final step of CCS, and the focus of this Article, is the injection of carbon dioxide into underground geological formations. The underground spaces used for storage, called "pore spaces," are tiny gaps in rocks that can hold fluids like carbon dioxide. Injecting CCS underground has multiple legal implications, and it is helpful before proposing a legal structure for its implementation to look at similar practices such as injecting natural gas or wastewater underground, which have been carried out for many years and have established rules.

Yet, as will be discussed further below, there are unique risks related to injecting carbon dioxide. One major concern is that carbon dioxide might migrate underground, beyond the intended storage area. This could affect landowners both above and near the injection site, potentially causing health risks or interference with other use.[57] Because of these risks, it is important to consider whether traditional property laws—such as ownership of underground space, definitions of trespassing, and the government's power to take land for public use—need to be updated to address CCS effectively.

1. Understanding Pore Space

The third stage in the CCS process, at least the underground geological storage method of CCS at study here, involves injecting carbon dioxide into porous rock formations deep underground.[58] Geological storage can take many forms, but the industry is primarily invested in the most affordable option for the CCS industry[59]—the injection of anthropogenic carbon dioxide into deep saline formations and/or depleted oil and gas reservoirs.[60] These formations consist of porous and permeable rock—rock containing interconnected voids (pores) that can store and transmit fluids such as water, oil, gas, or supercritical carbon dioxide.[61]

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57 *See infra* Part II.C.

58 *See infra* Part II.C.

59 IEA CCUS 2020, *supra* note 7, at 14; Joseph A. Schremmer, *The Concurrent Use of Land for Carbon Sequestration and Mineral Development,* 75 Baylor L. Rev. 630, 634 (2023) [hereinafter Schremmer, *The Concurrent Use of Land*].

60 IPCC Special Report, *supra* note 32, at 3. "Potential technical storage methods are: geological storage (in geological formations, such as oil and gas fields, unminable coal beds and deep saline formations), ocean storage (direct release into the ocean water column or onto the deep seafloor) and industrial fixation of CO2 into inorganic carbonates." *Id.* Deep saline formations are "layers of porous and permeable rocks saturated with salty water (brine)" and exist both onshore and offshore. IEA CCUS 2020, *supra* note 7, at 112. Depleted former oil and gas reservoirs are "porous rock formations that have trapped crude oil or gas for millions of years before being extracted." IEA CCUS 2020, *supra* note 7, at 112. This is expected to be the most affordable option for CCS, beyond sequestration through CCUS, and can offset costs significantly.

61 Schremmer, *The Concurrent Use of Land, supra* note 59, at 634 ("Suitable rock formations must be porous, like a sponge, so that the carbon molecules can take up space within the rock's

These microscopic spaces between rock grains, referred to as "pore space," form the basis of underground storage.[62] The capacity and behavior of injected carbon dioxide depends heavily on the continuity and connectivity of this pore network.[63] While scientists can estimate certain characteristics such as porosity and formation pressure, they cannot fully predict the precise pathways that fluids might take; this is especially true in complex or fractured formations.[64] Some pore networks may be well-contained, but others' connections to neighboring formations increase the risk of unintended lateral or vertical migration.[65] It is for this reason that underground injection is regulated, particularly as unintended migration of injected carbon risks contaminating our drinking water.

2. *Regulation, Risks and Success of Underground Injection Analogs*

While CCS is a relatively undeveloped and thus understudied technology, injection into the subsurface is not new. The injection analogs that serve to frame CCS policy include natural gas injection, wastewater or toxic waste disposal, and enhanced oil recovery (EOR). Unlike CCS, these technologies have been scientifically studied over many decades.[66] Thus, the analogs can provide a helpful understanding of the safety, risks, and legal concerns that arise with underground injection generally.[67]

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microscopic pore spaces. The carbon also needs to flow through the rock so that a single injection well can fill up a large area of formation. In geology terms, the formation must be permeable, which it is if its pore spaces are sufficiently interconnected."); Joseph A. Schremmer, *A Unifying Doctrine of Subsurface Property Rights*, 46 Harv. Env't. L. Rev. 525, 532–33 (2022) [hereinafter Schremmer, *A Unifying Doctrine*].

62 Schremmer, *The Concurrent Use of Land*, *supra* note 59, at 634.

63 *See id.*

64 *See generally* Saló-Salgado et al., *supra* note 20.

65 *See* Schremmer, *The Concurrent Use of Land*, *supra* note 59, at 639 ("The process by which pore space becomes saturated with carbon could unfold either through direct injection from a well located on the surface of the same tract or through migration of carbon injected from wells in the same carbon storage complex located on the surface of neighboring tracts.").

66 *See e.g.*, Timothy Grant & Allison Guinan*, NETL Analog Studies to Geologic Storage of CO2* 2, U.S. Dep't of Energy, Nat'l Energy Tech. Lab'y (2018), https://www.osti.gov/servlets/purl/1615146 [http://perma.cc/M5HW-2MH9] (last visited Sep. 25, 2025) [*hereinafter* NETL Analog Studies].

67 *Id.* ("Examples of industrial (engineered) analogs to CO2 geologic storage include 1) underground natural gas storage, which has been commercially-operational for over 100 years in the United States (U.S.); 2) deep well waste disposal (injection and disposal of non-hazardous and hazardous wastes into deep confined rock formations), which has occurred in the United States since the 1930s; and 3) CO2 EOR, which has been commercially-operational since the early 1970s"). The first injection of carbon dioxide for EOR took place in 1964, and commercial EOR using carbon dioxide began in January 1972 in west Texas, with these operations continuing today. Bruce Hill et al., *Geologic Carbon Storage Through Enhanced Oil Recovery*, 37 Energy Procedia J., 6808, 6811 (2013).

While these older technologies and CCS all require the injection of fluids into the subsurface, each analog differs from the geological sequestration of carbon in important ways.[68] Scientists encourage "[u]nderstanding the unique perspectives of each analog industry" to provide a benefit to CCS stakeholders, and this Article will similarly rely on an understanding of the scientific and legal practices insofar as they affect the law of property.[69]

What is common among these analogs and CCS is their regulation by the EPA's Underground Injection Control ("UIC") Program, which classifies wells based on their purpose and assesses their risks.[70] The UIC program was promulgated by the EPA pursuant to the Safe Drinking Water Act (the "SDWA").[71]

Natural gas storage offers a particularly important analog for framing the legal issues surrounding CCS, especially in relation to subsurface property rights and the use of eminent domain. Since its inception in the early 1900s, operators have stored natural gas in underground formations for temporary storage, withdrawing it as needed to meet demand.[72] Importantly, the Natural Gas Act (the "NGA") authorizes holders of a certificate of public convenience and necessity to obtain the pore space necessary for gas storage by eminent domain if they "cannot acquire [it] by contract, or [are] unable to agree with the owner of property to the compensation to be paid[.]"[73]

Enhanced oil recovery ("EOR") is a technology that has been pitched as a helpful data source for the success of CCS, but its limitations exceed its benefits in that endeavor. Although EOR has been around since the 1970s and involves injection of carbon dioxide underground, that is where the commonalities with CCS stop. EOR involves "the injection of CO2 into depleted oil and gas reservoirs with the intent of maximizing oil and gas production."[74] In EOR, carbon dioxide is injected to alter the subsurface pressure system and thus

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68 NETL Analog Studies, *supra* note 66, at 3.

69 *Id.*

70 *See* 40 C.F.R §§ 144–189.

71 40 C.F.R § 144.1. There are currently six categories of injection wells created by the UIC, each of which have their own regulations intended to safeguard underground sources of drinking water ("USDWs"). 40 C.F.R § 144.6.

72 NETL Analog Studies, *supra* note 66, at 8 (Exhibit S-1). Storage of natural gas in depleted oil and gas reservoirs is a "critical component of the natural gas supply system in the United States and is necessary for meeting seasonal demand requirements as well as insuring against unforeseen supply disruptions." *Id.* at 3. The United States' first natural gas injection site began its operation in 1916 in New York. Ground Water Prot. Council and Interstate Oil and Gas Compact Comm'n, Underground Gas Storage Regulatory Considerations: A Guide for State and Federal Regulatory Agencies 1 (2017), https://www.gwpc.org/wp-content/uploads/2022/12/2017_GasStorageRegulatoryConsiderations_reduce.pdf [http://perma.cc/S2EL-ERVT].

73 15 U.S.C. § 717f(h).

74 NETL Analog Studies, *supra* note 66, at 5; IEA CCUS 2020, *supra* note 7, at 117.

improve hydrocarbon recovery.[75] The primary objective is not carbon sequestration, but some injected carbon dioxide remains underground naturally.[76] Because long-term retention has historically not been the end goal of EOR, operations lacked adequate monitoring data to confirm storage permanence.[77]

The process bears operational similarity to CCS in that both involve injection of carbon dioxide into underground pore space. However, there are critical differences in purpose, regulatory treatment, and technical design.[78] EOR did not historically require long-term containment; site selection, pressure management, and monitoring have been therefore less rigorous.[79] Because operators have not tracked the fate of injected carbon dioxide with the precision required for sequestration accounting, EOR offers only limited guidance as a predictive analog for CCS.

While evidence of carbon dioxide leakage from EOR operations is therefore limited, the few documented incidents underscore the severe consequences of failure in the UIC program and accompanying regulations. In 2012, at Anadarko Petroleum's Salt Creek Field in Wyoming, leakage was associated with the death of livestock and the detection of carbon dioxide in surface water.[80] And in a 2016 incident, a school located near an EOR project was evacuated and shuttered for several months after carbon dioxide levels rose to hazardous concentrations and oxygen levels fell below 19.5 percent.[81]

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75 *See* NETL Analog Studies, *supra* note 66, at 5.

76 *Id.* ("An additional benefit is that CO2 EOR inherently stores CO2 as part of its overall process.")

77 Hill et al., *supra* note 67, at 6812 ("Until recently enhancing the storing of CO2 has never been a consideration in flood design.").

78 IEA CCUS 2020, *supra* note 7, at 117 (injecting carbon dioxide into the reservoir "increases the overall reservoir pressure and improves the mobility of the oil, resulting in a higher flow of oil towards the production wells."); NETL Analog Studies, *supra* note 66, at 5 ("[T]he implementation of operations and overall objectives of each are drastically different. For example, the objective of CO2 storage is to maximize storage of CO2 from anthropogenic sources, while for EOR, the objective is to maximize oil production through efficient use of CO2.").

79 *See* Hill et al., *supra* note 67, at 6819 ("[A]lmost all of the transported CO2 ends up trapped by physical, solution and capillary trapping mechanisms and remains sequestered at depth.").

80 *CO2 in Stream, Dead Ducks Prompt DEQ Citation*, Wyo. Pub. Radio (Sept. 28, 2012 16:11 ET), https://www.wyomingpublicmedia.org/news/2012-09-28/co2-in-stream-dead-ducks-prompt-deq-citation? [http://perma.cc/PHU8-7BH4] ("Wyoming environmental regulators say carbon dioxide bubbling up from the ground may have killed six ducks and polluted a stream. The leak happened in an area where CO2 is injected underground to help revive an old oil field and boost oil production.").

81 Letter from Dep't of Health & Human Serv. Agency for Toxic Substances and Disease Registry to Dr. Kelly Weidenbach (Sept. 16, 2016), https://www.atsdr.cdc.gov/HAC/pha/Midwest-School/Midwest_School_letter_health_consultation_508.pdf?NETL [https://perma.cc/CJ4L-G9V5] ("At 9:30 am on May 26, FDL detected levels of CO2 as high as 26,000 ppm. Oxygen levels in some areas were below 19.5%, which is considered oxygen-deficient and an immediate health

These incidents demonstrate that not all injected carbon dioxide remains securely stored and suggest the possibility of underreported leakage events. The reality that carbon dioxide may leak when injected underground not only calls into question the presumed climate mitigation benefits of CCS (to the extent the leaked carbon migrates vertically back into the atmosphere) but also raises pressing legal and environmental issues regarding risks of CCS. Such questions are central to this Article's examination of subsurface property rights and the attendant threats to nonconsenting landowners.

C. Risks and Concerns of CCS

The technological conception of carbon capture through geological sequestration emerged in the mid-1990s, making it by far the youngest of the subsurface injection technologies discussed in this Article.[82] Its deployment has been slow due to several structural impediments, including difficulties in identifying appropriate injection sites, developing a workable regulatory framework, making the process financially viable, and implementing adequate monitoring to ensure the permanence of stored carbon.[83] These barriers are compounded by both real and perceived hazards CCS poses, such as induced seismicity and leakage, that challenge public acceptance of the technology.[84]

1. The CCS Industry Often Points To The Sleipner Project As A Success Story, But No Similar Examples Exist.

The heightened regulatory standards for CCS reflect the elevated risks it poses to human health and environmental safety. Carbon dioxide, once injected into the subsurface in supercritical form, is inherently unstable and will seek pathways of least resistance.[85]

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hazard. Elevated levels of CO2 can result in an oxygen-deficient atmosphere, and if high enough can affect mental acuity and cause asphyxia."); Stephanie Joyce, *What Happened in Midwest? The Mysterious Gas Leak That Shuttered A School*, Wyo. Pub. Radio (Nov. 7, 2016, 8:30 ET), https://www.wyomingpublicmedia.org/open-spaces/2016-11-07/what-happened-in-midwest-the-mysterious-gas-leak-that-shuttered-a-school? [http://perma.cc/ZK67-4PEJ] ("Carbon dioxide levels inside the school were 26 times the recommended limit, which made some areas of the school oxygen-deficient.").

82 NETL Analog Studies, *supra* note 66, at 8 (Exhibit S-1).

83 Nat'l Acads. of Sci., Negative Emissions Technologies and Reliable Sequestration 321 (2019), https://doi.org/10.17226/25259 [https://perma.cc/P88B-4BZ4].

84 Jorge Barrios et al., United States Energy Association: De-Risking CCS 17 (2022).

85 Pacyniak, *State Sequestration, supra* note 5, at 141; *see also* Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geological Sequestration (GS), 75 Fed. Reg. 77230, 77234 (Dec. 10, 2010) ("Supercritical or gaseous CO2 in the subsurface is buoyant, and thus would tend to flow upwards if it were to come into contact with a migration pathway, such as a fault, fracture, or improperly constructed or plugged well.") [hereinafter Class VI Final Rule].

This risk of leakage, the unintended escape of carbon dioxide from the storage formation and its release into the atmosphere, is well documented.[86] It arises from both known and unknown features of subsurface pore space.[87] By definition, permeable rock contains a network of voids through which fluids can move. However, the continuity of those voids and the presence of fractures or faults are not always ascertainable prior to injection.[88]

Once sequestered, carbon dioxide will migrate laterally and vertically within the formation in response to pressure gradients.[89] As the IPCC has warned, "[t]he actual implementation of CCS, as for other mitigation options, is likely to be lower than the economic potential due to factors such as environmental impacts, risks of leakage and the lack of a clear legal framework or public acceptance."[90]

Carbon dioxide's mobility is a concern for saline formations, which are now the preferred CCS target due to their prevalence and proximity to major emissions sources.[91] Scientists have described "significant uncertainty" and lack of confidence "that a saline site will accept the intended volumes of CO2 and that the confining system [will] operate as planned . . . during the entire injection period."[92]

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86 Pachauri et al., Intergovernmental Panel on Climate Change, Climate Change 2014 Synthesis Report 125 (2015) https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf, [https://perma.cc/62CZ-SMYG] [*hereinafter* IPCC 2014].

87 Saló-Salgado et. al., *supra* note 20, at 1–2 ("In GCS, reservoir simulation is the primary tool to assess subsurface CO2 migration, which is necessary to understand and manage geologic hazards such as fault leakage … and induced seismicity. In response to the inherent uncertainties associated with modeling and simulation of CO2 storage… building confidence in simulation models requires calibration (or, synonymously, history matching), a process that involves updating the reservoir model to match field observations as they become available…").

88 Charles F. Harvey, *Limitations of Science and Engineering Relevant to Protecting Drinking Water: The Mahomet Aquifer as a Case Study*, Eco-Justice Collaborative 2 (March 17, 2025) (explaining that the containment of CO2 "depend[s] on unknowable information about the subsurface (e.g., local variations in permeability).").

89 *Id.* at 3 ("These thin layers migrate laterally and upward depending on both pressure gradients and subtle features in the texture of the confining cap rock"); IPCC Special Report 2005, *supra* note 32, at 205 ("Once injected into the formation, the primary flow and transport mechanisms that control the spread of CO2 include: Fluid flow (migration) in response to pressure gradients created by the injection process; Fluid flow in response to natural hydraulic gradients; Buoyancy caused by the density differences between CO2 and the formation fluids; Diffusion; Dispersion and fingering caused by formation heterogeneities and mobility contrast between CO2 and formation fluid; Dissolution into the formation fluid; Mineralization; Pore space (relative permeability) trapping; [and] Absorbtion of CO2 onto organic material.").

90 IPCC Special Report 2005, *supra* note 32, at 12.

91 *See* IEA CCUS 2020, *supra* note 7, at 131.

92 "Hill et al., *supra* note 67, at 6820–21 ("This is because in a saline storage project the area of the plume, area of pressure increase, and thickness of the plume will continue to increase, potentially adding stress to the containment system— depending upon the volume and geometry of the confining zone. A corollary issue in saline sites is prediction of the ultimate fate of CO2. Some saline sites are identical to hydrocarbon traps, with a structural or stratigraphic closure that

The primary safeguard against vertical migration is caprock, which is dense, impermeable rock that forms a seal above the injection zone.[93] However, if that seal is compromised, carbon dioxide can reach groundwater or escape to the surface.[94] Ideal sequestration sites feature low leakage probability and are characterized by "highly impermeable caprocks, geological stability, absence of leakage paths and effective trapping mechanisms."[95] Yet even under optimal conditions, risks persist. The greatest perceived concerns as to leakage of carbon dioxide from underground storage sites include wellbore failures and faults and fractures in caprock integrity.[96] Operators must show that the area where they inject the carbon dioxide does not have any cracks or faults that could let it escape, that it is sealed off, and that it can keep the carbon dioxide trapped both during the project and for a period afterward while it is being monitored.[97] Even with these precautions, recent literature suggests that only a portion of injected carbon dioxide is likely to remain trapped over extended periods.[98]

Carbon dioxide leakage can create several health and safety risks, including directly threatening underground sources of drinking

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will limit lateral migration of the CO2. However, others are more open with long flow paths that can be taken by buoyant fluids under gravitational forces and assessing final fate of the plume may require significant effort and lead to uncertainty.").

93 *See* IPCC Special Report 2005, *supra* note 32, at 225–27 ("Caprocks or seals are the permeability barriers (mostly vertical but sometimes lateral) that prevent or impede migration of CO2 from the injection site. The integrity of a seal depends on spatial distribution and physical properties. Ideally, a sealing rock unit should be regional in nature and uniform in lithology, especially at its base. Where there are lateral changes in the basal units of a seal rock, the chance of migration out of the primary reservoir into higher intervals increases. However, if the seal rock is uniform, regionally extensive and thick, then the main issues will be the physical rock strength, any natural or anthropomorphic penetrations (faults, fractures and wells) and potential CO2-water-rock reactions that could weaken the seal rock or increase its porosity and permeability.").

94 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 141; *see also* IPCC Special Report 2005, *supra* note 32, at 217 (explaining that the caprock prevents migration out of the storage formation).

95 IPCC Special Report 2005, *supra* note 32, at 12–13.

96 *See* NETL Analog Studies, *supra* note 66, at 9 (Exhibit S-1).

97 U.S. Env't. Prot. Agency, *Class VI Wells Used for Geologic Sequestration of Carbon Dioxide*, https://www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-carbon-dioxide#ClassVIWell [https://perma.cc/K5PF-NBQX] (last visited July 28, 2025); 40 C.F.R. §§ 146.81–146.95 (2025).

98 Harvey, *supra* note 88, at 2 ("Neither our best science nor our best engineering can guarantee containment of CO2"). For example, reports suggest that injection operations at the In Salah project in Algeria may have damaged the caprock due to excessive injection pressure, leading to leakage. *See* Hill et al., *supra* note 67, at 6821. Similarly, Anadarko Petroleum was issued finding of violation and order in response to the CO2 leak from their facilities at the Salt Creek Field in Wyoming, where improper wellbore construction led to suspected surface leakage and contamination of surface water and livestock deaths. *See generally* Anadarko Petroleum, No. 5030-12 (Wyo. Dep't. Env't Quality 2012), http://eqc.state.wy.us/orders/Water%20Closed%20Cases/12-3208%20Anadarko/NOV%20and%20Order.pdf [https://perma.cc/TRQ7-PQNC].

water ("USDW").[99] Once in contact with water, carbon dioxide forms carbonic acid, which releases heavy metals, such as arsenic or lead, into the water from surrounding rock.[100] Leakage of carbon dioxide into shallow soils also poses ecological risks, like impairment of the health of plants and microbiomes.[101] Additionally, brine displacement from the injection zone can find its way into shallower freshwater aquifers, with implications for agricultural water supplies.[102] And finally, carbon dioxide, like carbon monoxide, can cause asphyxiation and death.[103]

In 1986, a natural carbon dioxide reservoir beneath Lake Nyos in Cameroon ruptured, releasing hundreds of thousands of tons of carbon dioxide in a matter of hours.[104] The resulting asphyxiation event killed over 1,700 people and thousands of livestock within a 16-mile radius.[105] Though this was a natural event, it illustrates the danger of sudden carbon dioxide release in populated areas. According to the IPCC, "[a] sudden and large release of CO_2 would pose immediate dangers to human life and health, if there were exposure to concentrations of CO_2 greater than 7–10% by volume in air."[106] The possibility of such events—particularly near petrochemical infrastructure where injection is most likely to occur—raises important questions about how underground storage rights affect neighboring landowners.

Importantly, CCS processes are not emission-free. A full lifecycle analysis of CCS must account for emissions from capture, compression, pipeline transport, and steel-intensive infrastructure.[107] Estimates of net carbon abatement vary, but in many cases, the "cradle-to-grave" return on investment is limited.[108] In addition to the above risks, residual contaminants from the carbon capture process, such as hydrogen

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99 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 141; Hisham Eldardiry & Emad Habib, *Carbon Capture and Sequestration in Power Generation: Review of Impacts and Opportunities for Water Sustainability*, 8 Energy, Sustainability & Soc'y 4 (2018).

100 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 141; Eldardiry & Habib, *supra* note 99, at 4; Class VI Final Rule, *supra* note 85, at 77235 (discussing that changes in acidity can cause leaching and mobilization of naturally-occurring metals or other contaminants from geologic formations into ground water).

101 *See* Federal Requirements for CO2 Geologic Sequestration Wells, 73 Fed. Reg. at 43497–98, (proposed July 25, 2008) (to be codified at 40 C.F.R. pt. 144 and 146).

102 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 142; Angela Jones, Cong. Rsch. Serv. R46192, Geologic Sequestration of Carbon Dioxide: Federal Role and Issues for Congress, (2020), https://crsreports.congress.gov/product/pdf/R/R46192 [https://perma.cc/5K43-KZYB].

103 Pacyniak, *State Sequestration*, *supra* note 5, at 142 (providing an example of a CO2 pipeline causing asphyxiation).

104 *See id.* at 142–143.

105 *See id.*

106 IPCC Special Report 2005, *supra* note 32, at 12.

107 *See* Gregory Cooney et al., *Evaluating the Climate Benefits of CO2-Enhanced Oil Recovery Using Life Cycle Analysis*, 49 Env't. Sci. Tech. 7491, 7493 (2015), https://doi.org/10.1021/acs.est.5b00700 [https://perma.cc/MAL9-BCTR].

108 *See id.* at 7498.

sulfide or mercury, may remain in the injected plume and exacerbate environmental harm.[109]

Risk management measures include site characterization, well remediation, and continuous monitoring.[110] However, if a leak is identified, mitigation options may be limited.[111] In some cases, the only available remedy may be extraction of the injected carbon dioxide,[112] and current regulatory frameworks do not require indefinite monitoring.[113] In short, it is not clear if CCS through underground sequestration will lead to less, or more, pollution and GHG emissions.

2. Space Wars

The anticipated migration of sequestered carbon dioxide presents not only health and safety concerns but also legal challenges, particularly with respect to property rights. Carbon dioxide that migrates beyond the boundaries of the injection formation may, through lateral or vertical migration, encroach on neighboring pore space, interfering with its use for other injection purposes or oil and gas extraction.[114] As Professor Joseph Schremmer has argued, such migration risks interfering with neighboring landowners' use and enjoyment of their legally recognized subsurface estates, particularly if those estates contain unutilized pore space or untapped mineral reserves.[115]

When pore space is recognized as part of the surface owner's estate—as many jurisdictions now affirm—unintended migration of injected carbon dioxide into adjoining lands may give rise to legal claims sounding in trespass or inverse condemnation.[116] Moreover, injected carbon dioxide may preclude future oil and gas production.[117] These claims become especially acute where the sequestered gas interferes with economically viable uses, such as wastewater injection

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109 *See* Pacyniak, *State Sequestration*, *supra* note 5, at 142; Class VI Final Rule, *supra* note 85, at 77235.

110 *See* Hill et al., *supra* note 67, at 6823–24

111 *See* IPCC Special Report 2005, *supra* note 32, at 13–14.

112 *See id.* at 14.

113 *See* Pacyniak, *State Sequestration, supra* note 5, at 108–10 (arguing for strict long-term monitoring); *see also* IPCC Special Report 2005, *supra* note 33, at 14 (indicating that CO2 monitoring may be required for very long periods).

114 *See* Schremmer, *The Concurrent Use of Land*, *supra* note 59, at 647–48.

115 *See* Schremmer, *A Unifying Doctrine*, *supra* note 61, at 532–33 (describing the connectivity of the subsurface pore space and the ability for neighbors' actions to affect other's use and enjoyment).

116 *See id.* at 561, 566–67; *see also* Schremmer, *The Concurrent Use of Land, supra* note 59, at 648 (describing the concern around recent litigation by landowners against oil and gas lessees injecting water into pore space without compensation).

117 Schremmer, *The Concurrent Use of Land*, *supra* note 59, at 669 ("[T]he permanent presence of carbon in pore space would preclude, or at least substantially impair, any ongoing and future uses of the pore space for other purposes and could contaminate hydrocarbon reserves.").

or other underground storage.[118] Moreover, once a geologic formation is saturated with carbon dioxide, it may no longer be feasible, or safe, to drill through to reach hydrocarbons located in deeper strata.[119] As Schremmer notes, this tension between competing underground uses exposes the limits of current property doctrines in managing multi-use conflicts within the subsurface.[120]

Although the siting process for Class VI wells includes modeling to avoid such conflicts, the possibility of migrating carbon dioxide intersecting with preexisting or future mineral development rights remains a serious legal and technical concern. As the federal government and private industry prepare to store an estimated 22 million metric tons of carbon underground in the United States alone, these unresolved questions of property allocation and liability loom large over the deployment of this climate mitigation strategy.[121]

3. Seismicity

In addition to leakage and spatial conflicts, CCS carries a non-trivial risk of inducing seismic events.[122] Although not a new phenomenon in subsurface injection practices, seismicity associated with fluid injection has become increasingly visible in the public and regulatory spheres following a dramatic spike in earthquake activity linked to wastewater disposal wells in oil- and gas-producing regions like Oklahoma.[123]

Induced seismicity arises when the injection of fluids increases pressure underground, altering the stress conditions on existing faults and potentially causing movement.[124] In the context of CCS, the large volumes of injected carbon dioxide raise these concerns at a larger scale due to the intended volume of underground storage of carbon dioxide.[125] Moreover, because the objective is long-term containment

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118 Schremmer, *A Unifying Doctrine, supra* note 61, at 570–71.

119 *See id.* at 576.

120 *Id.* at 577.

121 Cong. Budget Off., Carbon Capture and Storage in the United States (Dec. 2023), https://www.cbo.gov/system/files/2023-12/59345-carbon-capture-storage.pdf [https://perma.cc/WS8G-Y3RU].

122 IPCC Special Report 2005, *supra* note 32, at 249; Pacyniak, *State Sequestration*, *supra* note 5, at 144–45.

123 Katie M. Keranen et al., *Sharp Increase in Central Oklahoma Seismicity Since 2008 Induced by Massive Wastewater Injection*, 345 Sci. 448 (2014).

124 *How Does the Injection of Fluid at Depth Cause Earthquakes?*, U.S. Geological Survey (Feb. 28, 2022), https://www.usgs.gov/faqs/how-does-injection-fluid-depth-cause-earthquakes [https://perma.cc/PS8Z-GXWQ].

125 Pacyniak, *State Sequestration*, *supra* note 5, at 144 ("One study found reduced property values after EOR-induced earthquakes; another study found increases in stress and anxiety among residents.").

rather than fluid recovery, pressure relief mechanisms are limited once injection has begun.[126]

Induced seismicity and earthquakes can damage property values, cause property destruction, and increase "stress and anxiety among residents."[127] Not only does the induced seismicity create the aforementioned risks, but it also increases the risks of migration and leakage of the sequestered carbon dioxide.[128] Specifically, earthquakes can damage caprock or "enhance fracture permeability" to allow sequestered carbon dioxide to escape.[129] It is important to note that CCS will have widespread effects on seismicity as earthquakes may be triggered up to 20 km from the site of injection.[130]

The EPA's Class VI well requirements mandate that permit applicants demonstrate the injection zone lacks transmissive faults or fractures that could pose seismic hazards.[131] Nevertheless, seismic risk assessments rely on geologic models that may not capture all existing fault systems, particularly at depth.[132]

D. What These Risks Mean for Ownership

The risks associated with CCS have significant implications for subsurface property rights. At bottom, the effectiveness of CCS as a climate mitigation strategy depends on the ability to store carbon dioxide securely, indefinitely, and without impairing other resource uses or property interests. This places unprecedented stress on legal doctrines that were developed in the context of resource extraction, not injection.[133] Because carbon dioxide is mobile and will likely migrate

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126 Harvey, *supra* note 88, at 5 ("Oil and gas projects involve net removal of fluids and gases, thereby decreasing subsurface pressures, which tends to stabilize faults and fractures; however, carbon sequestration increases subsurface pressures, risks opening fractures, and potentially induces seismicity. Carbon sequestration is a brand new use case for reservoir characterization."); *see also* NETL Analog Studies, *supra* note 66, at 8–9 (Exhibit S-1) (comparing CCS and EOR); IEA CCUS 2020, *supra* note 8, at 104–105.

127 Pacyniak, *State Sequestration*, *supra* note 5, at 144; IPCC Special Report 2005, *supra* note 33, at 249 (Other examples include induced seismicity "at the Rangely Oil Field in Colorado, USA" and in the "drillholes of the German continental deep drilling programme."); Keranen, *supra* note 123, at 448 (twenty percent of the earthquakes in the central United States could be attributed to just four of the wells).

128 Pacyniak, *State Sequestration*, *supra* note 5, at 144; IPCC Special Report 2005, *supra* note 33, at 249.

129 IPCC Special Report 2005, *supra* note 32, at 249.

130 Keranen, *supra* note 123, at 44–8.

131 *Class VI Wells Used for Geologic Sequestration of Carbon Dioxide*, U.S. Env't Prot. Agency (Aug. 20, 2025), https://www.epa.gov/uic/class-vi-wells-used-geologic-sequestration-carbon-dioxide [https://perma.cc/Y3KB-STC4] (last visited Sept. 4, 2025).

132 Harvey, *supra* note 88, at 46 ("Seismic data surveys are insufficient to identify all contamination pathways").

133 See *infra* Part III.A.

across property lines or into neighboring formations, its storage raises pressing questions about the nature and scope of pore space ownership.

If pore space is deemed a protected property interest—whether under the surface estate or severed by grant—then unauthorized migration of injected carbon may constitute trespass or takings, even in the absence of surface damage. Yet current oil and gas law and related scholarship might lead courts to hold otherwise.[134] Moreover, because sequestration may interfere with oil and gas operations or preclude future storage by occupying subsurface volume, it has the potential to generate conflict among resource owners, operators, and regulators.[135]

As CCS deployment accelerates, numerous proposals have emerged seeking to limit or eliminate trespass liability for underground injection to make these projects legally and economically viable.[136] Analog subsurface injection technologies, such as natural gas storage, wastewater disposal, and EOR, have often been cited to justify limiting trespass liability for CCS operations.[137] Scholars have argued that courts have correctly bent trespass doctrine with respect to these technologies and a similar approach should be embraced for CCS to enable development.[138] However, this asserted history of judicial flexibility is neither as broad nor as settled as sometimes portrayed.[139] Moreover, even if some trespass limitations have occurred, their acceptance does not automatically justify extending such doctrines wholesale to CCS.

The risks and policy stakes in underground carbon sequestration are distinct and significant—particularly the so-called permanence and vast demand it will create for underground pore space, which calls for a legal framework that respects subsurface property rights.[140] Rather than continuing to "de-risk" injection technologies by judicially narrowing property protections, climate policy goals can be served while protecting landowner rights through affirming pore space ownership, employing eminent domain where necessary, and holding onto normative trespass

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134 See *infra* Part IV.

135 *See infra* Part IV.D.

136 *See infra* Part IV.

137 Keith B. Hall, *Hydraulic Fracturing: If Fractures Cross Property Lines, Is There an Actionable Subsurface Trespass?*, 54 Nat. Resources J., 380–81 (2014) [hereinafter Hall, *Hydraulic Fracturing*] ("The trend in such suits is for courts to hold that a plaintiff cannot maintain a subsurface trespass action merely based on the migration of waste fluids into the subsurface of his property. Instead, a plaintiff must be able to show actual damages or an interference with some reasonably anticipated use of his property in order to sustain a trespass action.") (citing *e.g.,* W. Edmond Salt Water Disposal Ass'n v. Rosecrans, 226 P.2d 965, 969–70 (Okla. 1950)). *See also* Schremmer, *A Unifying Doctrine, supra* note 61, at 535–36 (discussing the fragmentation of subsurface trespass jurisprudence).

138 *See infra* Part IV.

139 *See infra* Part IV.

140 *See infra* Part V.

law for any unintended leakage of CCS.[141] This approach facilitates CCS while balancing public interest with private rights.

III. To the Skies and Underground: Property Theory and Its Subterranean Distortion

For centuries, the common law embraced the principle of *cujus est solum, ejus est usque ad coelum et ad inferos*—that the owner of the surface owns everything from the heavens to the depths of the earth (commonly known as the "*ad coelum*" doctrine).[142] But as technology evolved, this sweeping conception of indefinite dominion proved difficult to sustain. In the early twentieth century, the advent of aviation forced courts and lawmakers to limit the upward reach of property rights in favor of public necessity and navigable airspace.[143] A similar pressure has emerged below ground, driven not by airplanes—but by oil and gas extraction, injection technologies, and now carbon sequestration.[144] These technologies have pushed courts and scholars to reconsider the scope of subsurface ownership, especially with respect to the porous rock formations, or pore space, that serve as reservoirs for fluid injection.

While courts have described underground rights as contingent or fragmented, many legislatures have responded not by abolishing subsurface rights for landowners but by clarifying and affirming.[145] Rather than rejecting the *ad coelum* principle wholesale, legislatures have preserved the fundamental notion that surface owners retain interests below their land.[146] The law's development thus reflects refinement, not erosion, of subsurface ownership rights, and any modern reassessment of those rights in the context of carbon storage must be anchored in this affirmation of landowner ownership.

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141 *See infra* Part V.

142 Owen L. Anderson, *Geologic CO_2 Sequestration: Who Owns the Pore Space?*, 9 Wyo. L. Rev. 97, 99 (2009); David E. Pierce, *Employing a Reservoir Community Analysis to Define and Marshal Correlative Rights in the Oil and Gas Reservoir*, 76 La. L. Rev. 787, 789–90 (2016); Hall, *Carbon Capture*, *supra* note 44, at 51.

143 *See, e.g.*, United States v. Causby, 328 U.S. 256, 258 (1946) (when the Supreme Court considered "whether [plaintiff's]' property was taken within the meaning of the Fifth Amendment by frequent and regular flights of army and navy aircraft over [plaintiff's] land at low altitudes.").

144 *See infra* Part III (discussing courts' treatment of various forms of subsurface intrusions); *infra* Part IV (discussing the proper mechanism to address subsurface property intrusions from carbon sequestration).

145 *See, e.g.*, *infra* Part III.2. (discussing subsurface ownership and various mechanisms enacted by states—like pooling and unitization—that promote equitable resource extraction but burden the owner's rights).

146 *See infra* Part III.

A. The Classic Doctrine: Cujus Est Solum, Ejus Est Usque Ad Coelum Et Ad Inferos

A fundamental principle in American property law is that whoever owns the surface of land owns the airspace above and the earth below it. This doctrine is often referenced as "*ad coelum*," as it derives from the Latin maxim "*cujus est solum ejus est usque ad coelum et ad inferos*."[147] Translated literally, the doctrine stands for the proposition that the rights of the owner of land extend upwards to the heavens ("*ad coelum*") and downwards to hell ("*ad inferos*").[148] Commentators date the incorporation of *ad coelum* into common law as early as the 13th century, when King Edward I invited Roman lawyer Franciscus Accursius to lecture in England.[149] Sir Edward Coke, in his *First Institute of the Laws of England*, stamped his approval of the doctrine by noting "the earth hath in law a great extent upwards, not only of water as hath been said, but of aire, and all other things even up to heaven, for *cujus est solum ejus est usque ad coelum*, as it is holden."[150]

Blackstone, in his *Commentaries*, similarly endorsed this expansive vision of indefinite ownership above and below the surface of one's land, recognizing:

> Land hath also, in its legal signification, an indefinite extent, upwards as well as downwards. *Cuius est solum, eius est usque ad coelum*, is the maxim of the law, upwards; therefore no man may erect any building, or the like, to overhang another's land: and, downwards, whatever is

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147 Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change, Carbon Sequestration, and Property Rights*, 2010 U. Ill. L. Rev. 363, 386 (2010) ("With regard to airspace, until the early part of the twentieth century, courts and commentators continued to invoke the *ad coelum* doctrine, stating that common law ownership of land 'extended to the periphery of the universe.'"); David E. Pierce, *Employing a Reservoir Community Analysis to Define and Marshal Correlative Rights in the Oil and Gas Reservoir*, 76 La. L. Rev. 787 (2016) ("The ad coelum doctrine is a foundation of land law everywhere in the United States").

148 *See, e.g.*, Alyce Gaines Johnson Special Tr. v. El Paso E & P Co., L.P., 773 F. Supp. 2d 640, 645 (W.D. La.), aff'd, 438 F. App'x 340 (5th Cir. 2011). While the exact origin of the *ad coelum* doctrine is up for debate, "[i]t was not a principle of Roman law—despite the Latin phrasing of the maxim—nor was the theory recognized in early common law." Instead, it is believed to have been pronounced first by Cinus of Pistoia, an Italian scholar. John G. Sprankling, *Owning the Center of the Earth*, 55 UCLA L. Rev. 979, 983 (citing Jean Brissaud, History of French Private Law 283 (Rapelje Howell trans., Little, Brown & Co. 1912)).

149 Laura K. Donohue, *Who Owns the Skies? Ad Coelum, Property Rights, and State Sovereignty, in* Eyes to the Sky: Privacy and Commerce in the Age of the Drone 120 (Matthew Feeney ed., Cato Institute, 2021).

150 *See* Donohue, *supra* note 149, at 120–21 (quoting Edward Coke, Of Real Property, and First or Corporeal Hereditaments of Land, The First Part of the Institutes of the Lawes of England (London: Rawlins, Roycroft, and Sawbridge, 1684)). Donohue notes that "[a]t the time that Coke wrote, there was a sharp distinction in the law between the right in land (i.e. arising out of the ownership of the land), and the right of peaceful enjoyment of the property."). *Id.*

> in a direct line between the surface of any land, and the center of the earth, belongs to the owner of the surface[.][151]

To borrow Justice Blackmun's words, the use of the center of the earth theory in this context was akin to using "a missile to kill a mouse."[152]

Nevertheless, several states have legislatively adopted *ad coelum* doctrine in their statutes, and courts have used the doctrine "to find a trespass to airspace resulting from intrusions of 'eaves, cornices, roofs . . . [and] wires passing over a plaintiffs property'" rather "than from intangible intrusions such as dust, noise, or vibrations."[153]

1. The Shrinking Sky: Aviation and Air Space Limits

The doctrine of *ad coelum* faced two significant challenges in the 20th century amid modern advances in technology. As to the heavens, the advent of aviation challenged the maxim's far-reaching claims that ownership of the surface includes the airspace indefinitely. The United States Supreme Court took aim at this expansive proposition in *United States v. Causby*, a case in which landowners challenged the interference of their land use by airplane flights crossing above their property.[154] Specifically, and quite notably, the governments' military planes were regularly flying as low as 83 feet above the surface of the landowners' property.[155]

The impact of these flights on petitioners' ownership rights was startling. The Court observed that "the heavier [planes] . . . frequently passed over [petitioners'] land and buildings in considerable numbers and . . . [came] close enough at times to appear barely to miss the tops of the trees and at times so close to the tops of the trees as to blow the old leaves off."[156] This was more than a mere inconvenience for the petitioners and led to actual, commercial damages to petitioners' chicken farming business.[157]

Causby is often cited for its limitation of the *ad coelum* doctrine, as the Court proclaimed the doctrine "has no place in the modern world."[158]

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151 2 William Blackstone, Commentaries; *see also* Donohue, *supra* note 149, at 120.

152 Lucas v. S.C. Coastal Council, 505 U.S. 1003, 1036 (1992) (Blackmun, J., dissenting).

153 Tara K. Righetti, *Correlative Rights & Limited Common Property in the Pore Space: A Response to the Challenge of Subsurface Trespass in Carbon Capture & Sequestration*, 47 Env't. L. Rep. News & Analysis 10420, 10430 (2017) [hereinafter Righetti, *Correlative Rights*].

154 328 U.S. 256, 258.

155 *Id.*

156 *Id.* at 259.

157 *Id.* ("As many as six to ten of their chickens were killed in one day by flying into the walls from fright. The total chickens lost in that manner was about 150. Production also fell off. The result was the destruction of the use of the property as a commercial chicken farm.").

158 Sprankling, *Owning the Center of the Earth*, *supra* note 148 (stating that *Causby* was a "landmark decision signaling the demise of the *ad coelum* doctrine" in which "the Court confronted the fragmentation problem in the context of airspace—recognizing the surface owners' title to the columns of airspace above millions of parcels would give them virtual veto power over airplane

The Court agreed with the government that "air is a public highway, as Congress has declared,"[159] but the Court ultimately stated that the *ad coelum* doctrine was irrelevant to its analysis, and the court held in favor of landowners.[160] The Court attempted to delineate air rights as follows:

> [I]t is obvious that if the landowner is to have full enjoyment of the land, he must have exclusive control of the immediate reaches of the enveloping atmosphere. Otherwise buildings could not be erected, trees could not be planted, and even fences could not be run.[161]

Causby thus ultimately endorsed *ad coelum*, to some extent, but is cited for the proposition—albeit asserted in *dicta* of the Court—that the doctrine has been usurped by modern technology. Does an owner own the air? Yes. Do they own the heavens? Not so much.

Following the landmark decision in *Causby*, many courts developed what is commonly known as the "reasonable use" or "functional use" test to define the extent of a landowner's rights in the airspace above their property.[162] Under this test, a landowner's ownership of airspace is limited to the height necessary for the ordinary use and enjoyment of their land, rather than extending infinitely upward as the classical *ad coelum* maxim suggested.[163] This means that courts restrict the vertical extent of property rights to the portion of airspace that the owner can reasonably occupy or make beneficial use of in connection with the surface estate.[164]

Importantly, under this test, courts have not required that the landowner actually use the airspace to maintain a protected property interest. Instead, ownership and the right to exclude extend to

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travel, thus clogging the highways of the sky."); Joseph A. Schremmer, *Getting Past Possession: Subsurface Property Disputes as Nuisances*, 95 Wash. L. Rev. 315, 329 (2020) [hereinafter Schremmer, *Getting Past Possession*] (asserting that "[u]nder *Causby* and its progeny," landowners are not entitled to any remedy for an unauthorized entry of the property); Klass, *supra* note 147 at 386–87 (asserting that *Causby* "put to rest" the idea that the *ad coelum* doctrine "extended to the periphery of the universe.").

159 *Causby*, 328 U.S. 256 at 261.

160 *Id.* ("[T]hat general principle does not control the present case."). Notably, the Court was not asked to address the constitutionality of the relevant statutes and regulations, as the flights in question occurred within the designated public airspace as defined by Congress.

161 *Id.* at 264.

162 *See, e.g.*, Delta Air Corp. v. Kersey, 20 S.E.2d 245, 249 (1942) (holding that airspace rights extend only to the height necessary for reasonable use of the land); Aaron v. United States, 311 F.2d 798, 801 (Ct. Cl. 1963) (applying *Causby* and emphasizing landowner's rights in immediate airspace); Griggs v. Allegheny County, 369 U.S. 84, 87, 90 (1962) (confirming that repeated low-altitude overflights may constitute a taking by interfering with use and enjoyment).

163 Sprankling, *Owning the Center of the Earth*, *supra* note 148 (citing a court's explanation that the reasonable use rule "rejected the 'to the sky and to the depths' notion for another maxim, 'use your own property so as not to injure that of another.'").

164 *See, e.g.*, *Delta Air Corp.,* 20 S.E.2d at 248–49 (holding that airspace rights extend only to the height necessary for reasonable use of the land).

airspace the owner could reasonably use or reserve for future use.[165] Consequently, unauthorized intrusions that physically invade or substantially interfere with a landowner's use or enjoyment of their airspace, such as low-altitude overflights causing noise or physical occupation of the space by powerlines, may constitute a taking under the Fifth Amendment.[166]

However, not all low-altitude flights are actionable. Courts have declined to find a taking when overflights do not interfere with any "actual or foreseeable use of the land."[167] For example, in *Argentine v. United States*, the court emphasized that flights must result in a "direct and immediate interference" with use and enjoyment of the land to support a taking claim.[168] These cases illustrate that while the functional use test protects reasonable expectations of surface-related airspace, it does not provide an absolute shield against all intrusions.

Thus, although the functional use test narrows the scope of vertical ownership above the surface, it does not eliminate ownership altogether. As the test does not preclude a finding of ownership, it likewise does not preclude a finding that an unjustified invasion into useable airspace can constitute a taking.[169]

2. The Disappearing Depth: Subsurface Ownership

Technological advancement has not only redefined the limits of property in the skies but also compelled courts and scholars to reconsider the traditional *ad coelum* doctrine when applied in the opposite direction—*ad inferos*, or downward "to the center of the Earth." In contrast to the aviation-driven rethinking of aerial property rights, the key driver of subterranean legal development has been the expansion of oil and gas technologies throughout the 20th century.[170]

Understanding subsurface ownership begins with a crucial distinction among the three analytically distinct components below the surface: the earth's strata, the fluids or gases within the strata, and

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165 Loretto v. Teleprompter Manhattan C.A.T.V. Corp., 458 U.S. 419, 435–36 (1982) (holding that permanent physical occupation constitutes a taking even without interference with current use); *Causby*, 328 U.S. at 264–65 (recognizing takings liability for invasion of airspace regardless of development of that space).

166 *See* e.g., *Loretto*, 458 U.S. at 435–36; *Causby*, 328 U.S. at 264–65; *Griggs*, 369 U.S. at 86–87; *Aaron*, 311 F.2d at 805; *Delta Air*, 20 S.E.2d at 248–49. *See also* Keith B. Hall, *Reconciling Property Rights with Carbon Capture and Storage*, 10 Belmont L. Rev. 382 (2023) ("the ad coelum doctrine does not entitle landowners to relief for high altitude flyovers that do not cause harm or unreasonable inconvenience").

167 Baatz v. Columbia Gas Transmission, LLC, 295 F. Supp. 3d 776, 786–87 (N.D. Ohio 2018).

168 Argentine v. United States, 55 Fed. Cl. 427, 434 (2003); *cf.* Branning v. United States, 654 FF.2d 88, 1024 (Ct. Cl. 1981).

169 *See Causby*, 328 U.S. at 264–65.

170 *See supra* Part II.A.

the void pore space within the strata.[171] The strata itself is the "subsurface mass," like rock and soil, which we think of as the earth.[172] However, the Earth's crust, which remains the only portion humans can meaningfully access with current technology, is composed primarily of porous rock.[173] This porous medium contains either fugacious minerals, water, or empty voids; those voids are called "pore space."[174]

While the legal treatment of oil and gas ownership within these strata is relatively well-developed, the question of who owns the pore space itself remains unsettled in important respects. Although many states have enacted statutes declaring that pore space belongs to the surface owner, courts and commentators continue to debate the nature and scope of that interest.[175] The call for understanding pore space ownership is not new, but given the scale of proposed CCS operations, it is now more critical than ever before.[176]

Underground rights do not pose a merely theoretical problem—pore space is actively used in a wide range of underground injection technologies, including wastewater disposal, natural gas storage, EOR, and most recently, CCS. Yet CCS is distinct in both its scale and risk profile, demanding prolonged, large-scale occupation of pore space and presenting novel challenges related to containment and migration.[177] As a result, CCS raises the stakes for resolving longstanding ambiguities in subsurface property law.

While there is a growing body of scholarship on CCS, much of it emphasizes its critical public policy importance and the need for property law to adapt accordingly, often without engaging seriously with the potential risks and consequences posed by CCS operations. This section will review the evolution of oil and gas law and the treatment of pore space ownership through a corrective lens, aiming both to illuminate the contradictions that have been overshadowed by efforts to de-risk oil and gas extractions historically, which contradictions may be expanded to encourage CCS implementation, an undesirable result.

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171 Schremmer, *Getting Past Possession*, *supra* note 158, at 325–26; Righetti, *Correlative Rights supra* note 153, at 10423 (comparing the pore space to a split bone).

172 Schremmer, *Getting Past Possession*, *supra* note 158, at 325–26; Dunn-McCampbell Royalty Interest, Inc. v. Nat'l Park Serv., 630 F.3d 431, 442 (5th Cir. 2011).

173 Schremmer, *Getting Past Possession*, *supra* note 161, at 320 ("Humans have never penetrated below the crust, and it is within this layer that we have explored and developed commercial uses of the subsurface. The crust consists of layered beds of rock formations with differing properties. Like a sponge, the interior of these rock structures consists of small, interconnected pathways known as pore spaces."); Sprankling, *Owning the Center of the Earth*, *supra* note 148, at 994.

174 Schremmer, *Getting Past Possession*, *supra* note 158, at 320.

175 *See infra* Part III.B.

176 *See infra* Part III.D.

177 Owen L. Anderson, *Geologic CO_2 Sequestration: Who Owns the Pore Space?*, 9 Wyo. L. Rev. 97, 115–16 (2009) (noting the difference between carbon dioxide sequestration and natural gas storage and the risk of trespass).

i. History of Oil and Gas Law

Understanding the complex jurisprudence surrounding subsurface ownership begins with two foundational principles: the rule of capture and the correlative rights doctrine. Both doctrines were developed and applied in oil and gas law to address the unique physical characteristics of hydrocarbons, such as oil and gas, and how these fluid resources respond to human extraction technology.[178]

Oil and gas exist naturally in underground reservoirs, which are typically "pore space" within permeable rock formations large enough to hold commercially viable quantities.[179] Extraction involves drilling into these reservoirs and disrupting the pressure system, causing oil or gas to flow toward the wellbore and ultimately reach the surface.[180] Often, reservoirs contain a mixture of oil, gas, and water, resulting in the production of mixed fluids.[181]

A critical aspect of hydrocarbon production is the interconnected nature of the porous and permeable rock formations that house these resources.[182] Courts and commentators commonly liken the subsurface to a "sponge," an interconnected network of pores within the rock matrix.[183] Changes in pressure within these pore spaces cause fluids to move or be displaced, which is why oil and gas are often described as "fugacious" or "fugitive" minerals.[184]

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178 *See* Hall, *Hydraulic Fracturing*, *supra* note 137, at 363–64 (discussing the origins of oil and gas law doctrines related to fugitive minerals).

179 Nunez v. Wainoco Oil & Gas. Co., 488 So. 2d 955, 959–60 (La. 1986) describing reservoirs as "bodies of porous and permeable rock in which oil has accumulated in sufficient quantity to permit its commercial recovery."); JOHN S. LOWE ET AL., CASES & MATERIALS ON OIL & GAS LAW 8, 21 (7th ed. 2018) (defining reservoirs).

180 Hall, *Hydraulic Fracturing, supra* note 137, at 364–65 (explaining how drilling disrupts pressure systems causing oil or gas migration).

181 LA. REV. STAT. ANN. § 30:1104 (reservoirs may contain "commercially recoverable natural gas, condensate, or other commercial mineral[.]"); Hall, *Hydraulic Fracturing*, *supra* note 139, at 364–65 (describing the composition of reservoirs and the mechanics of extraction); Schremmer, *Getting Past Possession*, *supra* note 158, at 320 ("These pore spaces are voids in the rock that can contain any number of fluid substances including air, freshwater, saltwater, and hydrocarbons like oil and gas."); Righetti, *Correlative Rights*, *supra* note 153, at 10423.

182 *See* Hall, *Hydraulic Fracturing*, *supra* note 137, at 364.

183 Hall, *Hydraulic Fracturing*, *supra* note 137, at 364 (explaining fluid migration as a process wherein "oil or gas will flow of their own accord from a location at higher pressure to a location at lower pressure. . . . Thus, if a well is drilled to a formation that contains oil or gas, the natural pressure of the formation often will cause those fluids to flow to the well and up to the surface").

184 *See* LA. STAT. ANN. § 31:14 (using the term "fugitive minerals" interchangeably with "liquid or gaseous minerals from beneath [a landowner's] property[.]"); *Nunez*, 488 So. 2d at 963 (discussing "the problems of subsurface fugacious minerals" referring to oil and gas in the context of property rights.); Righetti, *Correlative Rights*, *supra* note 153, at 10420 (naming "fugacious substances" as part of "a perfect storm of problematic property law issues.").

The initial erosion of the *ad coelum* doctrine underground begins with both the physical realities of subsurface minerals and the legal system's effort to manage them. The porous nature of rock formations and the fugacious character of oil and gas render underground migration inevitable, and the rule of capture and doctrine of correlative rights embody courts' and legislatures' attempts to govern ownership and allocation in light of this reality.[185] These doctrines attempt to resolve the tensions created by migrating minerals while preserving incentives for resource development. Yet, while oil and gas law has been correlated to a reduction of *ad coelum* and the rights of the surface owner, the analysis in this section will show that ultimately the law of gas has not denied ownership underground—it has affirmed it.

a. The Rule of Capture and the Supposed Rejection of Ad Inferos

The rule of capture is grounded in the belief that fugacious minerals beneath the surface, such as oil and gas, are *res nullius*, or owned by no one, while in place.[186] Rather than adopting the principle that the surface owner holds title to the minerals beneath their land, early oil and gas decisions treated these substances as the property of the first person to lawfully reduce them to possession.[187] In this way, the rule of capture has often been understood as an early and influential departure from, or limitation on, the *ad coelum* doctrine, particularly in the subsurface context.[188]

Although its roots trace back to groundwater law, the rule of capture spread to oil and gas jurisprudence in early cases where

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185 For example, by 1939, when Professor Harriet Dagget of Louisiana State University published *Mineral Rights in Louisiana*, "[t]he task of developing a system of mineral law in Louisiana ha[d] fallen almost exclusively upon the courts which have laboriously shaped and woven together the fabric of a new and unique branch of the law without the aid of the Legislature or of the French and Spanish sources to whose authors the problem was unknown." J. Mort Walker Jr., *Mineral Rights in Louisiana, by Harriet Spiller Daggett*, 2 La. L. Rev. (1939) https://digitalcommons.law.lsu.edu/lalrev/vol2/iss1/29 [https://perma.cc/LKD4-G6CQ]; *see also Nunez*, 488 So. 2d at 961 (referencing New Mexico's 1936 statute authorizing "compulsory pooling" of minerals, and the Arkansas Legislature's then "recently enacted" law relating to oil and gas conservation).

186 Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 13 (Tex. 2008); Michael C. Blumm & Lucus Ritchie, *The Pioneer Spirit and the Public Trust: The American Rule of Capture and State Ownership of Wildlife,* 35 Env't L. 101, 105, 106 (2005) (describing *res nullius* property as literally "things owned by no one," meaning that things under this category are those that are "capable of individual appropriation, but which belonged to no one until a human took possession by occupation").

187 *E.g.*, Kelly v. Ohio Oil Co., 57 Ohio St. 317, 328 (Ohio 1897) (describing the rule of capture) ("In either event, it is the property of, and belongs to, the person who reaches it by means of a well, and severs it from the realty, and converts it into personalty.").

188 *E.g.*, T D X Energy, L.L.C. v. Chesapeake Operating, Inc., 857 F.3d 253, 256–57 (5th Cir. 2017) ("Courts later applied the doctrine to oil and natural gas, reasoning that they too cross property borders as they seep and spill through crevices underground.").

courts analogized the mobility of hydrocarbons to that of "animals *ferae naturae*."[189] Like wild animals, which roam freely across property lines and are only owned once captured, courts reasoned that oil and gas similarly moves underground and ceases to belong to the surface owner once they migrate off their property.[190] If a deer walks across your property and onto your neighbor's land, you can hardly sue your neighbor for theft; similarly, if hydrocarbons migrate from beneath your land into a neighbor's well, your exclusive claim to them is lost.

A seminal articulation of this analogy appeared in *Westmoreland & Cambria Nat. Gas Co. v. De Witt*, where the Supreme Court of Pennsylvania observed:

> Water and oil, and still more strongly gas, may be classed by themselves, if the analogy be not too fanciful, as minerals *feroe naturoe*. In common with animals, and unlike other minerals, *they have the power and the tendency to escape without the volition of the owner*.[191]

Despite its early embrace, the analogy of hydrocarbons to wild animals soon faced significant criticism.[192] William Colby, an oil and gas professor at Berkley, cautioned in the 1940s that the resemblance was "for the most part superficial" and warned against basing property rights in oil and gas on such a flawed comparison, noting the "fundamental characteristics" of these resources differed so greatly from animals that similar legal principles were inappropriate.[193]

The one consistent feature in commentary on the rule of capture is the persistence of criticism; the rule itself has rarely, if ever, been adopted in its purest form since the earliest cases. This enduring critique may stem in large part from the eventual unraveling of one of the courts' primary justifications for the rule of capture: that each surface owner did not suffer from the rule so long as they had a right to drill and capture the minerals themselves.[194] Creating an effect known as the "tragedy of the commons," the rule encouraged excessive

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189 Acton v. Blundell, 152 Eng. Rep. 1223 (Exch. 1843); Westmoreland & Cambria Nat. Gas Co. v. De Witt, 130 Pa. 235, 249, 18 A. 724, 725 (1889); Brown v. Spilman, 155 U.S. 665, 669 (1895); T D X Energy, L.L.C., 857 F.3d at 256 ("A cause was the "rule of capture," the common law doctrine initially used in hunting disputes to determine ownership of wild animals unconstrained by property borders."); *see also* Rance L. Craft, *Of Reservoir Hogs and Pelt Fiction: Defending the Ferae Naturae Analogy Between Petroleum and Wildlife*, 44 Emory L.J. 697, 708–09 (1995).

190 Kenneth R. Richards, et al., *Pouring Out Our Soils: Facing the Challenge of Poorly Defined Property Rights in Subsurface Pore Space for Carbon Capture and Storage*, J. Energy & Env't. L. 1, 39 (2012) (the rule of capture "does not give an individual a right to trespass onto another's property to pursue the wild animal, but does allow property-owners to take creatures that wander ('flow') onto their lands, even if a neighbor had planned on hunting it.").

191 Westmoreland & Cambria Nat. Gas Co. v. De Witt, 18 A. 724, 725 (emphasis added).

192 Craft, *supra* note 189, at 708; Pierson v. Post, 3 Cai. R. 175 (N.Y. Sup. Ct. 1805).

193 William E. Colby, *The Law of Oil and Gas*, 31 Cal. L. Rev. 357, 357 (1943).

194 Barnard v. Monongahela Nat. Gas Co., 65 A. 801, 802 (Pa. 1907).

drilling and inefficient resource depletion, as operators raced to extract resources before their neighbors could.[195] Oil was "milked too hard" and "not milked intelligently," *i.e.* extracted too quickly and inefficiently.[196] As early as the 1920s, the Federal Oil Conservation Board found that due to the rule's incentive to race to drop a wellbore everywhere, only about 20–25% of petroleum in reservoirs was recovered, even though 85–90% was technically extractable through coordinated efforts.[197]

Nonetheless, the rule of capture was widely codified in state legislation and endures as a cornerstone of oil and gas law.[198] The rule is not without limitation, though. As commentators and regulators increasingly recognized its destructive consequences, legislative reforms—such as pooling, unitization, and conservation laws—emerged to mitigate the rule's harsher effects. In practice, while the rule of capture remains legally operative, its force has been substantially constrained.[199]

b. Legislative and Doctrinal Limits: Pooling, Unitization, and Correlative Rights Doctrine

The aggressive drilling incentivized by the rule of capture led to significant inefficiencies, waste of valuable fossil fuels, and inequities among neighboring surface owners.[200] In response, states began enacting regulatory and legal mechanisms in the early 20th century to promote more rational, coordinated, and *equitable* resource extraction.[201] Among the earliest and most common of these efforts were well spacing and setback rules.[202] Through these regulations, states sought to curb over-drilling and promote fairness among neighboring landowners

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195 W. Land Servs., Inc. v. Dep't of Env't. Conservation, 26 A.D.3d 15, 16–17 (N.Y. App. Div. 2005); Frank Sylvester & Robert W. Malmsheimer, *Oil and Gas Spacing and Forced Pooling Requirements: How States Balance Energy Development and Landowner Rights*, 40 U. Dayton L. Rev. 47, 49 (2015) [hereinafter *Spacing and Forced Pooling*].

196 *T D X Energy, L.L.C.*, 857 F.3d at 256 (quoting Richard O'Connor, The Oil Barons: Men of Greed and Grandeur 85 (1971)).

197 Craft, *supra* note 189, at 712.

198 *E.g.*, La. Rev. Stat. 31:6, 1009.

199 Craft, *supra* note 189, at 711 (summarizing early 20th century commentators' criticisms of the rule of capture's results).

200 Hall, *Hydraulic Fracturing, supra* note 137, at 372–73.

201 Sylvester & Malmsheimer, *supra* note 195, at 54 (2015) ("The waste and inefficiency that resulted from the Rule of Capture caused states to adopt well spacing requirements."); Hall, *Hydraulic Fracturing*, *supra* note 137 at 373 ("Starting in the early 1900s, states began to address these problems with conservation statutes and regulations.").

202 Hall, *Hydraulic Fracturing*, *supra* note 137, at 373 ("Three of the most common methods are well spacing rules, setback rules, and forced pooling or unitization.").

by reducing the risk of drainage disputes and ensuring a more fair allocation of shared resources.[203]

ii. Pooling and Forced Pooling

As regulators imposed spacing and density requirements, landowners often had to combine their tracts with neighbors' land to form a legally recognized drilling unit—one large enough to be efficiently drained by a single well.[204] This process is known as pooling. In voluntarily pooled units, the operator drills a well and extracts oil or gas on behalf of all owners within the pool.[205] Each owner receives a proportional share of production and revenues based on their acreage.[206] The owner of the property from which the oil and gas is extracted, i.e., the person who captures the minerals, does so on behalf of the pooled landowners.[207] In other words, the capturer must share the benefits of the drilled well with the other members of the pool.[208]

To overcome the problem of holdouts, landowners who refuse to join a pool and thereby prevented drilling altogether, many states also adopted forced pooling (or "compelled integration") legislation.[209] These laws allow state regulators to compel nonconsenting owners to join a pool, typically contingent on a certain percentage of the mineral interest holders' agreement.[210] Forced pooling ensures fair access to development and balances landowner autonomy with broader conservation and economic goals.

With both voluntary and involuntary pooling, the distribution of revenue among owners is typically calibrated to whether individual landowners choose to participate in drilling costs.[211] While no state compels landowners to assume liability for these costs, a landowner's decision not to participate can significantly affect their share of

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203 T D X Energy, L.L.C., 857 F.3d 253, at 256–257; Sylvester & Malmsheimer, *supra* note 195, at 49–50; Rowland Harrison, *Regulation of Well Spacing in Oil and Gas Production*, 8 ALA. L. REV. 357, 361–62 (1970).

204 Sylvester & Malmsheimer, *supra* note 195, at 50; James R. Neal, *Compulsory Pooling Promotes Conservation of Michigan's Oil and Gas Natural Reserves*, 78 MICH. B.J. 158, 160–61 (1999) (a drilling "unit" is an area sized to correspond with what a single well can efficiently drain).

205 Sylvester & Malmsheimer, *supra* note 195, at 50; Neal, *Compulsory Pooling Promotes Conservation of Michigan's Oil and Gas Natural Resources*, at 160–61.

206 T D X Energy, L.L.C., 857 F.3d 253, at 256–57; Sylvester & Malmsheimer, *supra* note 195, at 50 ("Landowners whose lands collectively cover oil or gas deposits agree to build one well and share in the production profits based on the percentage of the pool that lies under their parcels."); Neal, *supra* note 204, at 161; LA. STAT. ANN. § 30:10 (2014).

207 Sylvester & Malmsheimer, *supra* note 195, at 50.

208 *Id.*

209 *E.g.*, ALA. CODE § 9-17-13(c)(5) (2001).

210 Sylvester & Malmsheimer, *supra* note 195, at 50; ALA. CODE § 9-17-13(c)(5) (2001).

211 Hall, *Carbon Capture*, *supra* note 44, at 69.

production revenue.[212] These mechanisms reflect an effort to equitably allocate both the financial risks and the economic benefits of mineral development across all owners within the pooled unit.[213]

iii. Unitization

Pooling's larger counterpart, unitization, serves similar goals at scale. Whereas pooling governs the acreage around a single well, unitization involves the joint operation of an entire reservoir—often across multiple leases, tracts, or even counties.[214] Unitization is especially important for complex operations like enhanced oil recovery (EOR) or production from deep formations requiring coordinated action or investment.[215]

Unitization can be voluntary, but many states allow compulsory unitization when voluntary agreement proves elusive.[216] Unlike forced pooling, which often requires a certain threshold of consent, unitization statutes often proceed without unanimous approval.[217] In fact, "[e]very major producing state, other than Texas and Pennsylvania, has a compulsory unitization statute."[218]

Like pooling, unitization seeks to distribute revenues and costs in a manner that equitably reflects the relative interests of surface owners to the shared resource.[219] Allocation formulas often account for factors such as surface acreage, the estimated depth of the reservoir beneath each tract, and the productivity of the underlying formation.[220] Thus, a smaller surface tract situated above a particularly rich or deep portion of the reservoir may justifiably receive a greater share of production than a larger tract overlying a less productive zone.[221] This approach helps balance the interests of neighboring landowners and promotes fairness in the collective production of minerals.[222]

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212 *Id.* at 70.

213 *Id.* The three approaches for failure to pay costs, (1) the free-ride, (2) risk-charge, and (3) the surrender-of-working-interest approaches are extensively explained in Professor Hall's discussion of proposed compensation models for CCS injection.

214 *Id.* at 78 (citing Patrick H. Martin & Bruce M. Kramer, Williams & Meyers Oil and Gas Law § 901).

215 *Id.* at 78–9.

216 *Id.* at 82.

217 Hall, *Carbon Capture*, *supra* note 44, at 82.

218 Bruce M. Kramer & Patrick H. Martin, The Law of Pooling and Unitization § 18.01, at 1 (3rd ed. 2022).

219 Hall, *Carbon Capture*, *supra* note 44, at 78.

220 *Id.* at 83–4.

221 *Id.*

222 *Id.*

iv. Correlative Rights and the Persistence of Subsurface Ownership

What emerges from the evolution of oil and gas jurisprudence is not a retreat from *ad coelum*, but its adaptation: the correlative rights doctrine transforms the ancient maxim into a modern framework that preserves subsurface ownership amid shared and migrating resources. Overlaying these statutory limits on the rule of capture is the judicially developed doctrine of correlative rights—a principle that affirms the existence of subsurface ownership, even in the face of migration and shared reservoirs.[223] The doctrine tempers the harshest consequences of the rule of capture by recognizing that each surface owner above a common reservoir possesses a shared but legally protected interest in the underlying minerals.[224] Each owner has the right to produce from their tract, but this right is qualified by duties not to waste the resource or unreasonably interfere with others' ability to do the same.[225]

As Professor Keith Hall explains, courts have utilized the correlative rights doctrine to set limits on the rule of capture for a number of reasons, imposing liability for "negligent or intentional waste of oil or gas in a reservoir," and "acts that are of no benefit to [the operator], and which are done with the intent of interfering with someone else's ability to exercise his rights to produce from the common pool."[226] And courts have held that the rule of capture does not apply when a party negligently or intentionally wastes oil or gas or interferes with another's ability to produce without benefit to themselves, or when conservation statutes and regulations supersede the rule.[227] These limitations are justified by the correlative rights doctrine.[228]

The correlative rights doctrine has been codified through conservation laws discussed above requiring pooling, unitization, and well

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223 *See* Bruce M. Kramer & Owen L. Anderson, *The Rule of Capture—An Oil and Gas Perspective*, 35 ENV'T. L. 899, 906–08 (2005) (describing how correlative rights developed to temper the harshness of the rule of capture).

224 *See* Victor B. Flatt, *Paving the Legal Path for Carbon Sequestration from Coal*, 19 DUKE ENV'T. L. & POL'Y F. 211, 235 (2009) (describing correlative rights of aquifers); *see also* David E. Pierce, *Employing a Reservoir Community Analysis to Define and Marshal Correlative Rights in the Oil and Gas Reservoir*, 76 LA. L. REV. 787, 800 (2014) (stating that the correlative rights doctrine was "the greatest threat to the rule of capture" during the early years of oil and gas law).

225 *See* PATRICK H. MARTIN & BRUCE M. KRAMER, THE LAW OF OIL AND GAS § 4.02[1] (2023 ed.) ("The rights of owners in a common source of supply are correlative. Each has the right to a fair opportunity to produce their share of the resource.").

226 Hall, *Hydraulic Fracturing*, *supra* note 137, at 371.

227 *Id.* at 368–69.

228 *Id.* at 369 ("This doctrine recognizes that when multiple tracts of land overlie a common reservoir of oil or gas, the owners of those separate tracts each have a right to produce oil or gas from the reservoir through operations on their own properties, but that each owner's exercise of his rights can affect the common reservoir and thereby affect the ability of the other owners' to produce oil or gas from the reservoir."); Eugene Kuntz, *Correlative Rights in Oil and Gas*, 30 MISS. L.J. 1, 1–2 (1958).

spacing— regimes that limit individual extraction in order to preserve the collective ownership interest.[229] Important to CCS and pore space ownership, the doctrine's significance extends beyond efficient oil production; it affirms that even in the context of migratory minerals, subsurface ownership exists and is legally protected. Critically, courts have upheld measures aimed at protecting correlative rights, framing them not as infringements on property rights, but as affirmations of ownership.[230]

In *Ohio Oil Co. v. Indiana*, the Supreme Court of the United States rejected a takings challenge to a law requiring the plugging of idle wells, holding that the state's interest in preventing waste and protecting all surface owners justified the regulation.[231] Far from divesting ownership, the law preserved it, the Court held, as it reasoned:

> Viewed, then, as a statute to protect or to prevent the waste of the common property of the surface owners, the law of the state of Indiana which is here attacked because it is asserted that it devested private property without due compensation, in substance, is a statute protecting private property and preventing it from being taken by one of the common owners without regard to the enjoyment of the others.[232]

The Court's logic reveals a crucial insight: regulation that limits one landowner's extraction rights does not negate ownership, it protects it.[233] The very fact that the Court could analyze the issue as one of a constitutional taking under the Fifth Amendment assumes a preexisting property interest.[234] In fact, it is the existence of ownership that justifies state action in service of conservation.[235]

Similarly, in *Patterson v. Stanolind Oil & Gas Co.*, the Oklahoma Supreme Court upheld the state's well-spacing act, which limited a landowner's share of production to a proportionate interest in the unitized area, rejecting claims that such regulation amounted to a taking without due process.[236] The court in *Patterson* emphasized that well-spacing is a practical means to ensure a fair distribution of production rights, upholding the state's authority to limit an individual

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229 *See* Kramer & Martin, The Law of Pooling and Unitization § 2.01 at 4–9 (describing conservation statutes as methods of protecting correlative rights and avoiding waste).

230 *See* Ohio Oil Co. v. Indiana, 177 U.S. 190, 210–11 (1900) (upholding conservation regulation as protection of private property rather than a taking).

231 *Id.* at 212.

232 *Id.* at 210.

233 *Id.* at 210–11.

234 *See* Ohio Oil Co., 177 U.S. at 210–11; *see also* Kramer & Martin, The Law of Pooling and Unitization § 5.01 at 2 (arguing that regulation recognizes and preserves fractional subsurface interests).

235 *Ohio Oil Co.*, 177 U.S. at 210.

236 Patterson v. Stanolind Oil & Gas Co., 77 P.2d 86, 95 (Okla. 1936).

owner's ability to extract the entire supply to their neighbors' detriment.[237]

Once again the court recognized the correlative rights doctrine's role as a fairness principle, protecting each surface owner's interest in the common reservoir by regulating production and preventing waste, stating "it is well established that the police power of the state extends to protecting the correlative rights of owners[.]"[238] *Patterson* underscores how the correlative rights doctrine, grounded in the *ad coelum* principle, recognizes that landowners retain ownership extending downward beneath their land, while legitimizing reasonable regulatory limits on extraction to preserve this collective subsurface ownership and prevent waste.

The principle that subsurface rights persist even when subject to coordination was echoed by the Louisiana Supreme Court in *Nunez v. Wainoco Oil & Gas Co*.[239] There, the court considered whether directional drilling across property lines within a unitized reservoir constituted trespass, where it crossed into the subsurface of the plaintiff landowner's property.[240] The court recognized that while unitization imposes significant restrictions, preventing some landowners from drilling at all or requiring them to share in production, it is nonetheless a "reasonable exercise of the police power" that protects the correlative rights of all surface owners.[241] As the court explained, unitization creates legally cognizable interests "beyond the traditional property lines[...] in the interest of conserving the natural resources of the state and, in effect, of protecting private property interests, or 'correlative rights,' of non-drilling landowners."[242]

Nunez reinforces the core argument of *Ohio Oil*: shared ownership is still ownership.[243] The fact that a resource migrates, or that property interests must be exercised in coordination, does not defeat the claim of possession or exclude the protections of trespass law.[244] Rather, the correlative rights doctrine ensures that each owner's entitlement is recognized and preserved, even where exclusive control is impractical.[245]

The same applies in the reverse, when fluids are, as with CCS, injected into pore space.

Together, *Ohio Oil*, *Patterson*, and *Nunez* demonstrate that subsurface ownership endures even in permeable, interconnected pore

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237 *Id.* at 88.

238 *Id.* at 89.

239 Nunez v. Wainoco Oil & Gas Co., 488 So. 2d 955, 965 (La. 1986).

240 *Id.* at 956.

241 *Id.* at 962–63.

242 *Id.* at 965.

243 *Id.*

244 *See id.* at 962–65.

245 Nunez v. Wainoco Oil & Gas Co., 488 So. 2d 955, 962–65 (La. 1986).

spaces, where fluids migrate freely across property lines. These cases affirm that the rule of capture does not negate ownership— it operates within it. Regulatory mechanisms like pooling and unitization do not eliminate property rights; they mediate and protect them. As Professor David Pierce explains, the correlative rights doctrine is "the greatest threat to the rule of capture" not because it destroys traditional notions of ownership, but because it affirms them in a communal form that extends protection to each owner's share of the common reservoir.[246] The correlative rights doctrine thus preserves the foundational *ad coelum* principle that landowners retain a protected interest in the physical subsurface, even when it is porous, migratory, and shared.

B. Pore Space Ownership and Its Doctrinal Uncertainty

Distinct from the fugitive minerals or water they may contain, pore space, the voids or cavities within subsurface formations, has emerged as a separate object of ownership. Statutes in several states define pore space as the "space not occupied by soil or rock" or as a "cavity or void."[247] While states vary in terminology, a growing number have adopted what is commonly referred to as the American Rule: the surface estate includes ownership of the underlying pore space, even if the mineral estate has been severed.[248] This position is reflected in both legislation and common law across most jurisdictions.[249]

Under the English Rule, by contrast, ownership of pore space follows the mineral estate, such that a party holding only surface rights would lack authority to use or exclude others from the pore cavity.[250] To date, only Alaska and Kentucky have arguably endorsed the English Rule— and even there, the decisions either turned on unique factual circumstances or were legislatively overruled, leaving the doctrine far from settled as state law.[251]

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246 David E. Pierce, *Carol Rose Comes to the Oil Patch: Modern Property Analysis Applied to Modern Reservoir Problems*, 19 Penn. St. [Dickinson] Env't. L. Rev. 241, 257 (2011).

247 Okla. Stat. Ann. tit. 60, § 60–6 (West, 2015).

248 *See, e.g.*, Mont. Code Ann. § 82-11-180 (West 2025); N.D. Cent. Code § 47-31-08 (2025); Wyo. Stat. Ann. § 34-1-152 (2025); Jean Feriancek, *Resolving Ownership of Pore Space*, 26 Nat. Res. & Env't 49, 50 (2012).

249 *See* Schremmer, *The Concurrent Use of Land, supra* note 159, at 326 (describing the presence of this position "among both states with a statutory declaration and common law states"); Hall, *Hydraulic Fracturing*, *supra* note 167, at 418 (citing Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39, 48 (Tex. 2017)) (stating that the surface owner owns the pore space rights).

250 Righetti, *Correlative Rights, supra* note 153, at 10425 (citing Cent. Ky. Nat. Gas Co. v. Smallwood, 252 S.W.2d 866 (Ky. 1952) (overruled on other grounds by Tex. Am. Energy Corp. v. Citizens Fid. Bank & Tr. Co., 736 S.W.2d 25 (Ky. 1987)).

251 *See* City of Kenai v. Cook Inlet Nat. Gas Storage Alaska, LLC, 373 P.3d 473, 477–78 (Alaska 2016) (adjudicating a case "in the unique context of Alaska's land laws."); Righetti, *Correlative Rights, supra* note 153, at 10425.

Under either rule, uncertainty persists regarding the depth and nature of pore space ownership. Scholars have long debated whether subsurface property rights extend *ad inferos* (to the center of the Earth), with arguments spanning from no ownership of pore space, ownership to a certain depth, or absolute ownership indefinitely.[252] Some raise the questions of whether pore space should be treated analogously to fugitive minerals, and whether principles like correlative rights apply.

This Article adopts the position that pore space is owned by the surface estate and that ownership should extend as far downward as is reasonably necessary to support surface use— an approach consistent with modern applications of the *ad coelum* doctrine, particularly as that doctrine is applied to the skies.[253] Because the dominant view recognizes surface ownership of pore space, this Article does not dwell on that foundational issue. Instead, it considers the central legal issue for CCS: whether pore space ownership confers the same core entitlements as surface ownership, including the right to exclude and the right to just compensation when taken for public necessity.[254]

The legal dynamics of CCS make this question particularly urgent. Injection into pore space operates in reverse of traditional oil and gas extraction, which relies on pressure depletion to draw fluids upward. As hydrocarbons are withdrawn, their migration through porous rock depends on the continuity and permeability of the pore structure.[255] Similarly, carbon dioxide injected into those same formations can migrate horizontally or vertically depending on geologic conditions— creating risks of escape, trespass, or interference with other stored fluids or extraction activity.[256]

Drawing on analogies to early oil and gas extraction, the reversal of flow in underground injection led at least one Texas court to adopt a "negative rule of capture" for pore space, permitting the first injector to use a formation without liability to neighboring surface owners.[257] While other courts have not clearly adopted a true negative rule of capture, they have bent traditional property doctrines to reach outcomes favorable to industry.

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252 *See, e.g.*, Sprankling, *Owning the Center of the Earth, supra* note 148, at 1008 (noting certain judicial "decisions do occasionally refer to the ad inferos maxim or to center of the earth ownership, but usually in the context of explaining that the absolute ownership theory is obsolete").

253 *See id.* at 1037.

254 *See id.* at 1024.

255 *See* Hall, *Hydraulic Fracturing, supra* note 137, at 364 (stating that oil and gas can travel through a rock formation "by moving from one pore space to the next, through interconnections between the pores.").

256 *See id.* ("if a well is drilled to a formation that contains oil or gas, the natural pressure of the formation often will cause those fluids to flow to the well and up to the surface.").

257 *See* R.R. Comm'n of Tex. v. Manziel, 361 S.W.2d 560, 568 (Tex. 1962).

IV. The Modern Erosion of Subsurface Trespass

Despite the development of doctrines like the rule of capture and correlative rights to manage resource extraction, modern subsurface technologies have intensified longstanding tensions over subsurface boundaries and trespass.[258] These practices increasingly involve, or result in, the migration of substances across property lines underground, raising difficult questions about whether such movement constitutes an actionable trespass on an owner's right to exclusive use of the pore space.

While courts have long recognized the potential for subsurface trespass, they have struggled to define its limits in the context of long-term or permanent underground storage.[259] They have resisted—or refused—to treat deep subsurface occupation as an actionable invasion.[260] Instead, many have drawn artificial distinctions between physical intrusion and legally cognizable interference, producing outcomes that are largely deferential to industry interests and effectively redefining traditional trespass principles.[261]

This trend is particularly troubling given the scale and permanence of proposed CCS operations, where the proposed result of CCS is that carbon will occupy pore space for thousands of years and make competing uses potentially impossible.[262] As CCS technologies turn pore space into a marketable commodity, courts have heretofore undermined the legal protections that give ownership meaning in favor of industry need.[263] What remains is a body of law that distorts foundational property principles and erodes the right to exclude in favor of industrial access.

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258 CSS has spurred considerable debate among legal scholars. *Compare* Hall, *Hydraulic Fracturing*, *supra* note 137, at 390 (arguing that compensation, but not injunction, is a proper legal remedy for landowners who suffer actual harm from subsurface trespasses) *with* Schremmer, *Getting Past Possession*, *supra* note 158, at 318 (proposing that legal remedies for nuisance, rather than trespass, should be applied to subsurface invasions) *and* Owen L. Anderson, *Subsurface "Trespass": A Man's Subsurface Is Not His Castle*, 49 Washburn L.J. 247, 248 (2010) [hereinafter Anderson, *Subsurface "Trespass"*] (asserting that subsurface intrusions may not be fairly adjudicated using nuisance laws).

259 *Compare* Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 4 (Tex. 2008) (reversing a lower court's jury verdict in favor of royalty interest owners to "hold that the rule of capture bars recovery of . . . damages" for subsurface invasion) *with* West Edmond Hunton Lime Unit v. Lillard, 265 P.2d 730 (Okla. 1954) (affirming a lower court's judgment in favor of lessee injured by subsurface invasion).

260 *See, e.g.*, Chance v. BP Chems., Inc., 670 N.E.2d 985, 991 (Ohio 1996) (finding no trespass where plaintiffs failed to demonstrate actual physical damage or interference with use).

261 *See id.* at 993.

262 *See generally* Schremmer, *Getting Past Possession*, *supra* note 158 at 323.

263 *See* Part V.B.

A. Ownership and the Bundle of Rights: Exclusion without Use

Ownership of land is not contingent upon active use, development, or economic exploitation; rather, it includes passive, reserved, and even speculative interests that may never be realized.[264] Among the owner's "bundle of sticks" are the rights to use and enjoy property; in the civil law tradition, these rights are named *usus* and *fructus*.[265] The Supreme Court of the United States has opined that the right to exclude is "one of the most essential sticks in the bundle of rights that are commonly characterized as property."[266] The law of trespass typically enforces and protects the right to exclude, regardless of whether the trespasser causes harm.[267] Concomitant with this right is the right to enjoy profit from charging others for use.

Trespass law imposes liability when a person "enters land in the possession of the other, or causes a thing or a third person to do so[.]"[268] "Every unauthorized entry upon the land of another is trespass."[269] This liability arises regardless of whether the person in possession of the thing suffered actual damage or if there was interference with present or intended use of the thing.[270] In such a case, nominal damages may be awarded.[271]

In cases of continuing trespass, courts may award damages based on the fair rental value of the occupied land, or alternatively, grant

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264 PruneYard Shopping Ctr. v. Robins, 447 U.S. 74, 81 (1980) (explaining that property rights are not lost merely because they are not exercised); *see also* Thomas W. Merrill, *Property and the Right to Exclude*, 77 Neb. L. Rev. 730, 730–31 (1998) (discussing how even unused rights can be fundamental to the concept of property ownership).

265 *See also* La. Civ. Code Ann. art. 477 (2025) (providing an exemplar of a civil tradition definition of ownership as ". . . the right that confers on a person direct, immediate, and exclusive authority over a thing. The owner of a thing may use, enjoy, and dispose of it within the limits and under the conditions established by law.").

266 Kaiser Aetna v. United States, 444 U.S. 164, 176 (1979).

267 *See* Restatement (Second) of Torts § 7 (A.L.I. 1965) ("[t]he most usual form of injury is the infliction of some harm; but there may be an injury although no harm is done. Thus, any intrusion upon land in the possession of another is an injury, and, if not privileged, gives rise to a cause of action even though the intrusion is beneficial, or so transitory that it constitutes no interference with or detriment to the land or its beneficial enjoyment.").

268 Restatement (Second) of Torts § 158 (A.L.I. 1965); *see also* Lightning Oil Co. v. Anadarko E&P Onshore, LLC, 520 S.W.3d 39, 47 (Tex. 2017) ("Trespass to real property is an unauthorized entry upon the land of another, and may occur when one enters—or causes something to enter—another's property."); Pub. Serv. Co. of Colo. v. Van Wyk, 27 P.3d 377, 388 (Colo. 2001) (stating trespass requires a physical invasion of property without the consent of the person lawfully entitled to possession).

269 Castano v. San Felipe Agric., Mfg., & Irrigation Co., 147 S.W.3d 444, 452 (Tex. App. 2004).

270 *See* Restatement (Second) of Torts § 158 (A.L.I. 1965).

271 *See* Coastal Oil & Gas Corp. v. Garza Energy Tr., 267 S.W.3d 1, 2 (Tex. 2008).

injunctive relief to halt the ongoing intrusion.[272] Thus, where unauthorized chemicals or waste have been injected into the pore space owned by a surface owner, traditional trespass law could either (1) enjoin the unlawful entry (at the court's discretion), or (2) require the one injecting the chemical to pay the landowner fair market rental value.[273]

Courts have openly reshaped trespass law to accommodate the operational needs of oil and gas extraction industries, prioritizing deployment over traditional property protections. If carried on by analogy to CCS, landowners would lose the right to exclude without compensation in favor of industry's ability to continue to rely on fossil fuels.

While this may appear solidified by analog injection technologies and the courts' review of trespass claims, this Part of the Article will illuminate how courts have, in many cases, purported to implement foundational trespass doctrine to shield injection activities from liability but have often done so in *dicta*.[274] Moreover, some courts have rejected this limitation on private rights in favor of public necessity without just compensation under the Takings Clause, reaffirming that subsurface property rights remain enforceable even in the face of advancing energy technologies.[275]

B. Deep Injections Cross Property Lines, Trespass Law Gets Rewritten

Subsurface intrusions in the context of injection (of wastewater, gas, or carbon) are well-documented.[276] And courts have long acknowledged that deep subsurface intrusions—such as through slant drilling or unauthorized wellbores—can constitute trespass. For instance, when a well is intentionally drilled at an angle into another's mineral estate, the rightful owner may recover the value of the extracted resources.[277] But as injection technologies evolved—from secondary oil recovery (EOR) to deep injection of waste and, more recently, carbon storage—the legal clarity has faded. Courts increasingly struggle to draw lines between actionable invasions and legally permissible industrial operations.

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272 *See* Minnwest Bank v. RTB, LLC, 873 N.W.2d 135, 145 (Minn. Ct. App. 2015); *see also* Restatement (Second) of Torts § 161 cmt. b (A.L.I. 1965) (noting that where a trespass is continuous, "an injunction may be granted to compel its removal").

273 *See* Hall, *Carbon Capture*, supra note 44, at 60, 72.

274 *See supra* Part III.

275 *See supra* Part III.

276 Righetti, *Correlative Rights*, *supra* note 153, at 10429 ("[s]ubsurface intrusions routinely occur in the context of oil and gas development and production and wastewater disposal.").

277 *See* Hall, *Hydraulic Fracturing*, *supra* note 137, at 370.

1. Early Justifications for Subsurface Intrusion

One of the earliest cases to address injection-related trespass was *West Edmond Salt Water Disposal Association v. Rosecrans*.[278] There, the Oklahoma Supreme Court held that the underground migration of injected saltwater did not constitute a trespass, emphasizing that the formation was already saturated with brine and that injection was the "most logical and sensible" method of disposal.[279] While apparently accepting that the injected saltwater into underground pore space caused saltwater in neighboring underground pore space to be displaced, the court emphasized that "the only effect of such migration[…] was to displace a similar amount of salt water in said formation and cause it to migrate further east."[280]

In concluding that no trespass occurred, the court emphasized that finding the activity to constitute a trespass would make the industry practice practically prohibited.[281] This "need-based" justification reappears across various opinions in the following decades, notably in cases where oilfield practices—especially waterflooding and other enhanced recovery techniques—relied on pressure changes that inevitably caused fluid to cross property lines.[282]

2. De-Risking Underground: Judicial Immunity for Trespass

In recent decades, courts confronting disputes over deep well injection and hydraulic fracturing have departed from the traditional protection of subsurface ownership, recasting trespass law to accommodate industrial and policy interests. Here, we will address how these cases have created this judicial immunity where the facts did not even evidence a trespass occurred—i.e., in dicta.

In *Chance v. BP Chems., Inc.*, the Ohio Supreme Court rejected landowners' claims that deep well hazardous waste injection had trespassed beneath their properties.[283] Although the plaintiffs alleged lateral migration up to five miles, the court held that no actionable trespass had occurred because, the court claimed: (1) ownership rights do not

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278 *See* W. Edmond Salt Water Disposal Ass'n v. Rosecrans, 226 P.2d 965, 969 (Okla. 1950) ("[t]he question is one of first impression not only in this court, but in the courts of last resort of the United States. Counsel frankly state that their research has failed to disclose any case decided by any court of last resort determinative of this question, and we have failed to find any."); *see also* Hall, *Hydraulic Fracturing*, *supra* note 137, at 370.

279 *W. Edmond Salt Water Disposal Ass'n*, 226 P.2d at 973 (holding "that the contention of defendants that they are liable *only for actual damage suffered by plaintiffs* resulting from the injection of salt water into said well must be sustained") (emphasis added).

280 *Id.* at 969.

281 *See id.*

282 *See supra* Part III.A.2.

283 Chance v. BP Chems., Inc., 670 N.E.2d 985, 993–94 (Ohio 1996).

necessarily extend a half-mile underground, and (2) in any case, the plaintiffs could not demonstrate actual physical damage or interference with use.[284] Quoting *Hinman*, *supra*, the court stated "[w]e own so much of the space above the ground as we can occupy or make use of[. . .] [t]he owner of land owns as much of the space above him as he uses, but only so long as he uses it."[285] Ownership of the subsurface is limited, the court opined, as "ownership rights in today's world are not so clear-cut as they were before the advent of airplanes and injection wells."[286]

As to the principle issue of trespass, the court in *Chance* declined to apply the so-called "negative rule of capture" purportedly espoused by the Texas Supreme Court in *Railroad Commission of Texas v. Manziel*.[287] In *Manziel*, the court was reviewing claims that a permit for enhanced oil recovery through water injection constituted trespass, and the court reasoned that the "negative rule of capture" was inapposite where, as in *Chance*, the injection process did not relate to oil and gas extraction.[288]

The court went further to make several bold claims about subsurface ownership: first, that there was none.[289] The plaintiffs had no ownership interest in the pore space, according to *Chance*.[290] Even if a migration across property lines did occur, which the court found was not established, the plaintiff would have to prove that the injected waste would interfere with their "reasonable and foreseeable use of

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284 *See id.* at 993 ("[a]ppellee operates the wells pursuant to required permits; appellants' subsurface property rights are not absolute and in these circumstances are contingent upon interference with the reasonable and foreseeable use of the properties; the trespass alleged is an indirect one and, due to the type of invasion alleged, physical damage or actual interference with the reasonable and foreseeable use of the properties must be demonstrated.").

285 *Id.* at 991–92, *quoting* Hinman v. Pac. Air Transp., 84 F.2d 755, 758 (9th Cir. 1936).

286 *Id.* at 992.

287 *Id.* at 991. Courts attribute to *Manziel* the position that injection of water into pore space that migrates across property lines, where connected to extraction of oil and gas through enhanced oil recovery (EOR), does not constitute trespass if necessary to protect correlative rights in minerals. R.R. Comm'n of Tex. v. Manziel, 361 S.W.2d 560, 568 (Tex. 1962) ("it is relevant to consider and weigh the interests of society and the oil and gas industry as a whole against the interests of the individual operator who is damaged; and if the authorized activities in an adjoining secondary recovery unit are found to be based on some substantial, justifying occasion, then this court should sustain their validity").

288 *Manziel*, 361 S.W.2d at 568 (under a "negative rule of capture" a landowner may "inject into a formation substances which may migrate through the structure to the land of others, even if it thus results in the displacement under such land of more valuable with less valuable substances" for example, "the displacement of wet gas by dry gas."), *citing* Martin & Kramer, The Law of Oil and Gas, § 204.5, fn. 1; *but see Chance*, 670 N.E.2d at 991 ("[s]ince appellee's injection well operation has nothing to do with the extraction or storage of oil or gas, we find the negative rule of capture inapplicable to our consideration of this case.").

289 Chance v. BP Chems., Inc., 670 N.E.2d 985, 992 (Ohio 1996) (finding that "absolute ownership of [subsurface] rights is a doctrine which 'has no place in the modern world'"), quoting Vill. of Willoughby Hills v. Corrigan, 278 N.E.2d 658, 665 (Ohio 1972).

290 *Id.* at 992.

their property" for their trespass claim to survive.[291] This is notably, as the court recognized, a divergence from trespass law of the surface.[292]

For a case that found there was no evidence of lateral migration of the injected chemicals, *Chance* contains a profound amount of instruction about the rules of ownership and subsurface trespass. Indeed, the court held that because chemicals injected would mix with the brine, there were great difficulties (based on expert testimony) in establishing, as a matter of fact, that a property invasion had occurred.[293] Any conclusion would be "somewhat speculative," the court said.[294] This categorizes much of the *Chance* opinion on ownership as *dicta*.[295]

In a more recent case, *Baatz v. Columbia Gas Transmission, LLC*, the Sixth Circuit further narrowed subsurface trespass doctrine.[296] Landowners sued for storage of natural gas beneath their land, but the court held they had no actionable claim under Ohio law.[297] Relying on *Chance*, the court seconded that opinion and asserted that one with a possessory interest in pore space must demonstrate that the intrusion interfered with reasonable and foreseeable use.[298] Because the plaintiffs had neither used nor intended to use the deep pore space, the trespass claim failed.[299] Notably, Columbia Gas had eminent domain authority under the Natural Gas Act to utilize the underground pore space for gas storage if it could not acquire rights to that underground space by consent of the landowners whose surface estate was above.[300]

Another case that purportedly limited underground trespass in the context of injection is *Coastal Oil & Gas Corp. v. Garza Energy Trust*, a well-known Texas Supreme Court opinion addressing subsurface

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291 *Id.* at 993.

292 *See id.* at 992.

293 *See id.* at 992–93 (finding that the landowners "have a property interest in the rock into which the injectate is placed, albeit a potentially limited one, depending on whether [their] ownership rights are absolute. If [the] act of placing the injectate into the rock interferes with [landowners'] reasonable and foreseeable use of their properties, appellee could be liable regardless of the way the injectate mixes with the native brine.").

294 *Id*. at 993 ("[g]iven all these variables, there were great difficulties in appellants' establishing, as a factual matter, that a property invasion had occurred, so that appellants' claim must be regarded as somewhat speculative").

295 *See* Chance v. BP Chems., Inc., 670 N.E.2d 985, 993 (Ohio 1996).

296 *See* Baatz v. Columbia Gas Transmission, LLC, 929 F.3d 767 (6th Cir. 2019). Demonstrative of the natural gas storage injection process, the court explained: "Columbia Gas injects natural gas into the Medina Storage Field (and other storage fields) during the summer months when gas demand is low and withdraws the stored gas during the winter months when demand is high." *Id.* at 770.

297 *See id.* at 777 ("[l]andowners do not have a present possessory interest in their subsurface and by extension, lack the present ability to exclude Columbia Gas from its subsurface.").

298 *See id.* at 773 ("possessory interest is based on the reasonable and foreseeable use of the property owner's subsurface, regardless of how the trespass occurred.").

299 *See id.*

300 *See id.* at 770, citing 15 U.S.C. § 717f(c).

trespass in the context of hydraulic fracturing.[301] To understand the issues in the case, it is helpful to understand hydraulic fracturing (known as "fracking"), which the court described as follows:

> [A process] . . . done by pumping fluid down a well at high pressure so that it is forced out into the formation. The pressure creates cracks in the rock that propagate along the azimuth of natural fault lines in an elongated elliptical pattern in opposite directions from the well. Behind the fluid comes a slurry containing small granules called proppants—sand, ceramic beads, or bauxite are used—that lodge themselves in the cracks. . . . The fluid is then drained, leaving the cracks open for gas or oil to flow to the wellbore.[302]

Thus, like enhanced oil recovery ("EOR"), fracking is a mineral recovery method that uses injection, but this injection *intentionally* causes faults in the strata. The *Garza* case was complicated by unitization and the fact that Coastal, the operator, had to pay different percentages for royalties on neighboring property, incentivizing Coastal to develop a neighbor's property over the landowners who asserted trespass, among other claims (the Salinas).[303] The Salinas asserted, *inter alia*, that Coastal's fracking trespassed on their subsurface property by causing subsurface drainage of gas from their property to another, that Coastal breached its duty to act as a reasonable operator, and that Coastal engaged in bad faith pooling.[304] After trial and appeal, the Texas Supreme Court addressed whether any of these claims could survive in light of the rule of capture and prevailing oil and gas doctrine.[305]

As to trespass, in particular, the court found that Coastal had not committed trespass by draining minerals from the Salinas' land.[306] Importantly, that land was unitized with the neighboring property where Coastal performed its drilling (fracking) operations.[307] The court completely disregarded claims based on the injection of proppants into fault lines created by fracking under the Salinas' property because, the court reasoned, the Salinas only had a nonpossessory interest as mineral

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301 Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 4 (Tex. 2008).

302 *Id.* at 6–7.

303 *Id.* at 7.

304 *See id.* at 7–8.

305 *See id.* at 14 ("[t]he rule of capture is justified because a landowner can protect himself from drainage by drilling his own well, thereby avoiding the uncertainties of determining how gas is migrating through a reservoir," thus, the court refused to "change the rule of capture to allow one property owner to sue another for oil and gas drained by hydraulic fracturing that extends beyond lease lines.").

306 *See id.* at 14–15 ("allowing recovery for the value of gas drained by hydraulic fracturing . . . assumes that the gas belongs to the owner of the minerals in the drained property, contrary to the rule of capture.").

307 *See* Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d. 1, 7 (Tex. 2008).

lessors.[308] Like a landlord, or in this case a mineral lessor, who has a reversionary interest, the Salinas could only claim trespass if there was a loss in value from their property due to the fracking.[309] The only value claim the Salinas landowners made against Coastal was for drainage of minerals, not for the injection of proppants into fault lines.[310]

This holding is much more limited than what *Garza* is often cited for, though perhaps because the court went much further by expressly rejecting the *ad coelum* doctrine in a prominent passage of its opinion:

> Had Coastal caused something like proppants to be deposited on the surface of Share 13, it would be liable for trespass [. . .] Wheeling an airplane across the surface of one's property without permission is a trespass; flying the plane through the airspace two miles above the property is not. *Lord Coke, who pronounced the [ad coelum] maxim, did not consider the possibility of airplanes. But neither did he imagine oil wells.*[311]

After exhausting itself with this dicta, the court stated it "need not decide the broader issue here" of whether fracking constitutes trespass, much like the *Causby* decision that *Garza* echoed.[312] Actionable trespass for a landlord requires injury, the court reasoned, and where the only injury at hand was drainage of gas from one well to another, recovery was precluded by the rule of capture.[313] The Salinas had an interest in the oil and gas in place, but "this right does not extend to a specific oil and gas beneath the property."[314]

Interestingly, the *Garza* decision left open the idea that fracking may create issues with eminent domain. The court emphasized the Texas Railroad Commission's authority over ensuring the "correlative rights" of mineral rights owners and efficient production of oil and gas.[315] It noted that the Commission had not regulated fracking but, if it did, and if such regulations allowed fracking into neighboring mineral interest properties, such action might be considered a regulatory compensable

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308 *See id.* at 9.

309 *See id.* at 10.

310 *See id.* ("Salinas's reversion interest in the minerals leased to Coastal is similar to a landlord's reversion interest in the surface estate. By his claim of trespass, Salinas seeks redress for a permanent injury to that interest—a loss of value because of wrongful drainage. His claim is not speculative; he has alleged actual, concrete harm whether his leases continue or not, either in reduced royalty revenues or in loss of value to the reversion.").

311 *Id.* at 11 (emphasis added).

312 *Id.* at 12–13 ("[i]n this case, actionable trespass requires injury, and Salinas's only claim of injury . . . is precluded by the rule of capture.").

313 *See* Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 12–13 (Tex. 2008).

314 *Id.* at 15 ("[t]he minerals owner is entitled, not to the molecules actually residing below the surface, but to 'a fair chance to recover the oil and gas in or under his land, *or* their equivalents in kind.'"), quoting Gulf Land Co. v. Atl. Refin. Co., 131 S.W.2d 73, 80 (Tex. 1939).

315 *Id.*

taking.[316] Without the rule of capture, the court noted, *all* regulation of oil and gas would be a regulatory taking.[317]

The court also diverted into broad policy commentary, opining that "trial judges and juries cannot take into account social policies, industry operations, and the greater good which are all tremendously important in deciding whether fracking should or should not be against the law."[318] This policy-heavy justification, the court reasoned, supported limiting the right of trespass claims related to fracking.[319] The conclusion rested in part on expert testimony suggesting that fracking cannot both "maximize reasonable commercial effectiveness" and "avoid all drainage"—one of those goals must give way to the other.[320] At the time of the *Garza* decision, fracking had been commonplace for over sixty years, remained largely unregulated, and, as the court put it, "[i]nto a settled regime the common law need not thrust itself."[321]

The court did ultimately decide that Coastal was liable to landowners but did not rely on trespass. Instead, the court found Coastal liable because it failed to act as a reasonably prudent operator of the Salinas' share and engaged in bad faith pooling.[322] In other words, the court held Coastal liable for violations of the Salinas' correlative rights in the minerals under their property.[323]

A concurrence written by Judge Willett opined that the court should not obstruct means of producing oil and gas in the State of Texas, speaking more boldly about his opinion of the courts' role in oil and gas development, stating "[s]carcity [of oil and gas] exists, but *above*-ground supply obstacles also exist, and this Court shouldn't be one of them."[324]

Judge Willett would have expanded the *Manziel* "negative rule of trespass," reasoning that there is no subsurface trespass in such an instance not because of the absence of injury but because of the absence of actionable trespass.[325] He also would not have left open the possibility

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316 *See id.* at 15.

317 *See id.*

318 *Id.* at 16.

319 *See* Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 16 (Tex. 2008).

320 *Id.*

321 *Id.* at 17 ("[W]e hold that damages for drainage by hydraulic fracturing are precluded by the rule of capture. It should go without saying that the rule of capture cannot be used to shield misconduct that is illegal, malicious, reckless, or intended to harm another without commercial justification, should such a case ever arise. But that certainly did not occur in this case, and no instance of it has been cited to us.").

322 *See id.* ("Coastal had an implied obligation to act as a reasonably prudent operator to protect Share 13 from drainage").

323 *See id.*

324 *Id.* at 27 (Willett, J., concurring).

325 *See* Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 30 (Tex. 2008) (Willett, J., concurring).

for "non-drainage" fracking claims, averring such claims already have negligence as an available theory for recovery.[326]

The cases discussed above, which purport to limit subsurface ownership and the right to exclude, are at best ambiguous and, at worst, rely on dicta rather than binding precedent. The following section examines decisions that affirm property rights in the subsurface and illustrates why such cases provide a more appropriate foundation for addressing carbon storage going forward.

3. Truth Below Ground: Solid Rulings and the Muddying Role of Dicta

While some courts have weakened or bypassed trespass doctrine to accommodate underground energy practices, others have reaffirmed, or at least implied, that subsurface invasions—absent consent or legal authorization—remain actionable. These courts maintain that a physical encroachment below ground remains actionable despite public benefits or the absence of interference with present use. In *Nunez v. Wainoco Oil & Gas Co.*, the Louisiana Supreme Court addressed whether a defendant's wellbore entering the plaintiff's subsurface estate constituted a trespass.[327] The court defined subsurface trespass by citing Williams & Meyers' Manual of Oil and Gas Terms as "the bottoming of a well on the land of another without his consent," a wrong for which "the same liability attaches" as in surface trespass.[328] While recognizing that most subsurface trespass cases involved mineral extraction, the court noted that even criminal trespass statutes do not require a taking.[329] Still, the court held no trespass occurred because Louisiana's unitization laws redefined ownership as correlative within a common reservoir.[330] Once unitized, a surface owner's mineral interest is no longer exclusive; the right to exclude yields to shared reservoir management.[331] Thus, communal ownership under the correlative rights doctrine functioned as

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326 *See id*.

327 Nunez v. Wainoco Oil & Gas Co., 488 So. 2d 955, 956 (La. 1986) (the Court "granted writs to determine whether the intrusion of a well bore . . . at a point two miles beneath the surface, constitutes a trespass on the surface owner's property, where that property is included in a drilling unit created by the Commissioner of Conservation.").

328 *Id*. at 958–59 ("[S]ubsurface trespass, which by definition involves bottoming of a well on the land of another without his consent, and/or invading or intruding upon the subsurface of another's land, has in the jurisprudence generally been accompanied by removal of minerals, with the attendant damages consisting of the value of the extracted minerals.").

329 *See id.* at 959.

330 *See id.* at 962, 964 ("[T]he concept of unitization, embodying the principle of ownership in minerals produced from a common source of supply, co-extensive with the individual ownership of the overlying land, is a departure from the traditional notions of private property.").

331 *See id.* at 962 ("[I]t is clear that whatever the plaintiff may own under his tract, it does not include the liquid or gaseous minerals themselves. And, even the 'exclusive right to explore' is

a built-in limitation on trespass claims. Importantly, because the landowner would be compensated for oil extracted from their land, *Nunez* does not suggest that a subsurface intrusion outside of a unit or pool falls short of constituting trespass, but the court's implication that unitization matters is significant.[332]

In *Beck v. Northern Natural. Gas Co.*, the Tenth Circuit affirmed a jury award of fair rental value for subsurface explicitly, applying ordinary trespass law principles.[333] There, the defendant injected gas into a 23,000-acre reservoir, which migrated vertically into a lower formation beneath the plaintiffs' land.[334] Importantly, the court rejected the notion that each plaintiff needed to show specific proof of intrusion; generalized evidence of use sufficed.[335] The big limitation on *Beck's* broader implications, however, is that Kansas law relevant to the case expressly recognized compensation for use of substrata.[336] Therefore, it is to be expected that the court found that plaintiffs had a cognizable property right to the invaded formation.[337]

Even in *Railroad Commission of Texas v. Manziel*, often cited for the "negative rule of capture," the Texas Supreme Court acknowledged that unauthorized injection can constitute a trespass.[338] The court ultimately held that the authority granted to the Railroad Commission for the injection itself did not amount to an actionable trespass because it was conducted pursuant to a valid permit issued by the Railroad Commission.[339] However, the opinion notably acknowledged that unauthorized injection, or injecting substances that migrate onto the land of another without regulatory approval or the owner's consent, could constitute a trespass—even absent actual damage.[340]

And despite the fact that *Manziel* and *Garza* are cited in favor of limiting liability for the injection industry, the Texas Supreme Court would later clarify their limited reach in *FPL Farming Ltd. v. Environmental Processing Systems., L.C.*[341] The *FPL Farming* court emphasized that *Manziel* concerned only the Railroad Commission's

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qualified by the imposition of duties with regard to others who have rights in the common reservoir.") (quoting LA. REV. STAT. ANN. § 31:9-10).

332 *Id.* at 954, 964.

333 Beck v. N. Nat. Gas Co., 170 F.3d 1018, 1022, 1024 (10th Cir. 1999) (affirming the lower court because "a jury could make a reasonable inference from [the] evidence that there was an entry of storage gas in each of the landowners' properties.").

334 *See id.* at 1021. The jury awarded $100 per acre as fair rental value of the property for the period in question, amounting to nearly $140,000. *Id.*

335 *See id.* at 1021–22.

336 *Id.* at 1026, n.1 (quoting KAN. STAT. ANN. § 55–1210(c)(3)).

337 *See id.* at 1023.

338 *See* R.R. Comm'n of Tex. v. Manziel, 361 S.W.2d 560, 568 (Tex. 1962).

339 *See id.* at 574.

340 *See id.* at 566.

341 FPL Farming Ltd. v. Env't Processing Sys., L.C., 351 S.W.3d 306, 313 (Tex. 2011).

authority to issue permits, not whether those permits immunized operators from civil liability for trespass.[342] The Court noted that "[w]e made the point in *Manziel* that we were not deciding whether a permit holder is immunized from trespass liability by virtue of the permit."[343] In contrast, *FPL Farming* involved wastewater injection and expressly stated that regulatory approval does not shield the permittee from third party tort liability.[344]

Similarly, *FPL Farming* confined *Garza* to its facts: the plaintiffs were nonpossessory mineral lessors, and even in surface trespass law nonpossessory lessors must show actual damage.[345] In *Garza*, no actual damages were shown because the damage claimed from the hydraulic fracturing activity, drainage of minerals, was protected by the rule of capture.[346] Though the court declined to decide whether trespass occurred in *FPL Farming* due to limited evidence, it remanded for jury instructions on whether actual harm is a necessary element—implicitly recognizing that it might not be.[347]

The biggest distinction between *FPL Farming* and these prior decisions, the Texas Supreme Court held, is that *Garza* and *Manziel* involved *extraction* of minerals, and thus the rule of capture, and the policies in favor of greater oil and gas recovery, are not necessarily present "when a landowner is trying to protect his or her subsurface from migrating wastewater."[348] Because the lower courts had held so as a matter of law and not considered evidence of trespass, *FPL Farming* was remanded, and the higher court refrained from deciding an issue not presented, stating "[w]e do not decide today whether subsurface wastewater migration can constitute a trespass, or whether it did so in this case."[349]

FPL Farming thus marks a rare exercise of judicial restraint. Other cases, like *Chance v. BP Chemicals*, where the court found there was no evidence of migration of the injected matter, nevertheless opined on the rules of subsurface trespass.[350] Nevertheless, it must be noted that *FPL Farming* clearly suggests that public policy should play a role in trespass decisions.[351]

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342 *See id.* ("[T]he technical rules of trespass have no place in the consideration of the validity of the orders of the [Railroad] Commission.") (quoting *Manziel*, 361 S.W.2d at 569–70).

343 *Id.*

344 *Id.* at 314.

345 *Id.*

346 Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 4 (Tex. 2008).

347 FPL Farming Ltd. V. Env't Processing Sys., L.C., 351 S.W.3d 306, 314–15 (Tex. 2011).

348 *Id.* at 314.

349 *Id.* at 314–15.

350 Chance v. BP Chems., 670 N.E.2d 985, 993 (Ohio 1996).

351 *FPL Farming Ltd.*, 351 S.W.3d at 312.

Courts like those in *Nunez*, *Beck*, and *FPL Farming* have remained more grounded in traditional trespass principles, recognizing that subsurface invasions can give rise to liability regardless of whether there is a public policy favoring the injection or there is an interference with actual use.

These cases are especially relevant for technologies like CCS, where the physical occupation of subsurface formations is not incidental but carefully planned. Unlike traditional oilfield injections, CCS operators often model the anticipated migration of injected carbon dioxide across property lines and claim they can predict where the carbon dioxide will remain stored. In such circumstances, the occupation of another's pore space is not accidental, but foreseeable and deliberate, bringing into sharp focus whether existing doctrine will treat such encroachments as actionable trespass.

C. Contested Ground: Theorizing Property Rights Beneath the Surface

As courts have struggled to adapt traditional property doctrines to modern subsurface technologies, legal scholars have proposed divergent theories to reconcile evolving industrial practices with foundational principles of ownership. These proposals offer not only competing frameworks for how to conceptualize subsurface invasions but also differing views on the legal remedies that should apply.[352]

Some scholars, like Professor Joseph Schremmer, argue that subsurface invasions do not implicate possession and that the courts are correctly (although not directly) applying the law of nuisance to subsurface tort claims.[353] In Professor Schremmer's view, the complex and shared nature of geologic formations, especially under regulatory regimes, makes strict exclusion doctrines ill-suited to address the realities of underground energy infrastructure, and neither property nor tort law should interfere with the existence of a subsurface encroachment that is "societally valuable" unless or until it causes harm.[354]

Others, such as Professor Tara Righetti, emphasize that doctrines like correlative rights already limit subsurface ownership, particularly in common reservoirs.[355] Professor Righetti argues that pore

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352 *See, e.g.*, Hall, *Reconciling Property Rights*, *supra* note 166, at 407 (compensation for actual harm); Righetti, *Correlative Rights*, *supra* note 153, at 10421 (proportionate use doctrine); Anderson, *Subsurface "Trespass"*, *supra* note 258, at 247 (compensation for actual and substantial harm).

353 *See* Schremmer, *Getting Past Possession*, *supra* note 158, at 375 (arguing that "[c]ourts de facto apply nuisance principles in subsurface interference cases because nuisance standards are designed to mediate competing uses of property to achieve maximally efficient results.").

354 *See id.* at 334.

355 *See* Righetti, *Correlative Rights*, *supra* note 153 at 10438.

space ownership is not absolute but relational and contingent on shared use.[356] On this account, traditional trespass liability should be displaced where injection occurs within formations subject to common, regulated access— reflecting a coordinated resource framework rather than rigid exclusion rights.[357]

A third scholarly perspective supports applying a "negative rule of capture" to pore space: a doctrinal inversion of the classic rule of capture that would vest rights in the first injector rather than the first extractor.[358] Once a party lawfully initiates injection, under this view, the migration of substances within the formation would not give rise to actionable claims from neighboring property owners, who are seen as having lost the right to exclude by not using the pore space themselves.[359]

Professor Keith Hall argues that trespass law should still apply in certain cases of underground injection.[360] He emphasizes that intentional invasions—especially those involving harmful or hazardous materials—can and should give rise to trespass liability, regardless of whether the surface owner was actively using the subsurface.[361] Hall maintains that the basic structure of property law must still respect the right to exclude, and that regulatory convenience or industry preference should not eliminate longstanding legal protections.[362]

Professor Owen Anderson takes a position very similar to *Chance*: that a "trespass," in the context of lawful CCS operations "should not be actionable unless the neighboring landowner suffers actual and substantial damages," and "that injunctive relief or ejectment should not ordinarily be available."[363] Professor Anderson agrees with Professor Hall as to injunctions and "would not allow injunctive relief or ejectment for subsurface trespass unless the harm to a neighboring landowner clearly outweighs the utility of the subsurface invasion."[364]

These varied perspectives reflect an evolving debate among legal scholars about how best to adapt traditional property doctrines to modern subsurface practices. While some advocate for more flexible frameworks—such as nuisance law or a regulatory approach grounded

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356 *See* Tara K. Righetti, *A Rule of Capture for the Pore Space?*, 47 Env't L. Rep. 10613, 10617–18 (2017) (arguing that correlative rights limit exclusive control over pore space and suggesting that regulatory frameworks may displace strict trespass remedies).

357 *See* Righetti, *Correlative Rights*, *supra* note 153, at 10420.

358 *See* Anderson, *Subsurface "Trespass"*, *supra* note 258, at 116, 122–23 (endorsing a variation of the rule of capture for injection rights).

359 *Id.*

360 *See* Hall, *Hydraulic Fracking*, *supra* note 137, at 383–85 (arguing that underground invasions can constitute trespass when intentional, even without physical damage, and emphasizing the importance of honoring traditional exclusion rights).

361 *See id.*

362 *See id.*

363 Anderson, *Subsurface Trespass*, *supra* note 258, at 251.

364 *Id.* at 249.

in correlative rights—others emphasize the continued importance of protecting foundational ownership principles, including the right to exclude. The tension among legal theories reveals the broader challenge of balancing energy development with respect for long-standing property norms. As the next section argues, judicial adoption of these more permissive theories has enabled courts to reshape trespass law in ways that accommodate industrial injection—but at significant cost to traditional property protections.

D. Carbon Storage Pushes the Doctrine to its Breaking Point

As discussed in Part II, the permanence of underground carbon storage cannot be taken for granted, yet much of the scholarly commentary assumes that injected carbon will remain trapped. Unlike enhanced recovery operations, which use pore space to extract otherwise inaccessible oil or gas, CCS is designed for permanent storage. This storage may, indeed, come at the cost of other operations. While underground injection and migration within pore space do support a finding that rights to inject within certain reservoirs may be correlative, that does not foreclose requiring the exercise of eminent domain and payment of just compensation.

Moreover, the logic the courts have clung to with oil and gas injection appears far more soundly based in a justification favoring industry necessity, which can be accomplished through eminent domain, than a natural adaptation of property law. While *Chance* and other courts have sometimes cited *Hinman v. Pacific Air Transport* for the idea that property ownership does not extend into "unusable" zones such as high altitudes or deep formations, there are significant distinctions in underground storage technologies like CCS.[365] Aircrafts pass through airspace quickly and leave no trace; carbon storage, by contrast, permanently invades and alters the subsurface. If landowners are entitled to compensation when someone flies a drone at low altitude over their land, why not when a company fills their underground formation with industrial waste? [366]

Adding to the tension is the market reality that pore space is a valuable asset.[367] In states like Wyoming and North Dakota, companies have already begun acquiring subsurface rights for CCS projects—

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365 *See, e.g.*, Chance v. BP Chems., 670 N.E.2d 985, 991–92 (Ohio 1996); United States v. Causby, 328 U.S. 256, 264 (1946); Allegheny Airlines v. Vill. of Cedarhurst, 238 F.2d 812, 816 (2d Cir. 1956).

366 *See* Long Lake Twp. v. Maxon, 970 N.W.2d 893, 903–04 (Mich. Ct. App 2021); *see* also RESTATEMENT (SECOND) OF TORTS § 159(2) (A.L.I. 1965) (noting that aircraft intrusions may be trespass if they enter the "immediate reaches" of the airspace and interfere substantially with use and enjoyment).

367 *See, e.g.*, Browne v. Artex Oil Co., 144 N.E.3d 378, 385 (Ohio 2019).

sometimes through voluntary transactions, sometimes through eminent domain.[368] These purchases make clear that pore space is economically valuable and legally severable. If companies are willing to pay for it, courts should not dismiss it as "useless" to landowners. Nor should landowners be forced to demonstrate current or planned use in order to assert a right to exclude permanent occupation.

If the injected carbon dioxide leaks into neighboring pore space, liability should ensue. Industry experts frequently minimize this risk, but it is well established that carbon dioxide can move beyond its intended storage zone and interact with groundwater, mineral estates, or other uses.[369] Under traditional property law, this would be grounds for injunctive relief or damages, even absent actual harm.[370]

In sum, CCS—particularly what we know of it today—exposes the flaws of de-risking trespass doctrine underground. The practice is deliberate, permanent, and profitable— yet the dicta of certain oft-cited cases would have landowners denied both the right to exclude and the right to be compensated. Courts have bent trespass law to accommodate evolving energy practices, but the weight of that distortion is becoming harder to ignore when the risks of CCS—contaminated drinking water, increased earthquakes, and interference with other underground activities—are considered.[371] If the public interest demands long-term carbon dioxide storage, then just compensation, not judicial immunity, should be the mechanism by which private property is occupied.

V. Necessity Should Trigger Compensation, Not Judicial Immunity

CCS requires proper application of property law. Even more than other underground injection technologies, CCS heightens the importance of pore space ownership by attaching new economic and environmental value to the subsurface.[372] CCS is premised on the

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368 *See* Jacob Orledge, *North Dakota Negotiated Better Terms with Summit. Some Landowners Say They Didn't Get That Chance*, N.D. Monitor (Oct. 21, 2025, 05:00 ET), https://northdakotamonitor.com/2025/10/21/north-dakota-negotiated-better-terms-with-summit-for-carbon-dioxide-storage-some-landowners-say/ [https://perma.cc/7X85-GDZK]; *see also* Renee Jean, *Carbon Storage Planned Under Wyoming's Historic C.B. Irwin Ranch, and Others*, Cowboy State Daily (Nov. 14, 2024), https://cowboystatedaily.com/2024/11/13/carbon-storage-planned-under-wyomings-historic-c-b-irwin-ranch-and-others/ [https://perma.cc/B594-XKX6].

369 *See supra* Part II.

370 *See supra* Part IV.

371 *See supra* Part II.

372 *See* Hall, *Carbon Capture*, *supra* note 44, at 90 ("Relatively few CCS agreements are publicly available, but those that are available generally look somewhat like an oil and gas lease. The prospective CCS operator is required to make an upfront payment in return for the right to use subsurface pore spaces.").

permanent placement of carbon dioxide underground.[373] This kind of enduring use implicates not only possession but also *usus*, the Roman law concept of beneficial use, which remains a core element of the property rights bundle in both civil and common law traditions.[374]

Maintaining the framework of trespass—a protective mechanism for private property rights—is essential for the protection of subsurface ownership, and courts should not relax the doctrine for the greater good, effectively reducing the risk for those who venture under another's land without permission. In addition to the proper application of trespass law, anticipated use of subsurface pore space for CCS injection, absent consent, requires exercise of eminent domain, or the taking of private property for just compensation.[375] Both frameworks recognize the surface owner's property rights in the subsurface pore space; limitations on this ownership by the correlative rights doctrine do not diminish the right to compensation. Application of eminent domain would allow the legislature and the courts to properly balance public benefit with private burdens.

Additionally, potential technological advances allowing more precise subsurface mapping would improve compensation accuracy to owners and therefore a more equitable application of eminent domain. The "effectiveness" of CCS refers to its ability to securely contain injected carbon dioxide over the long term, a goal that depends on detailed scientific understanding of underground geological formations.[376] If scientists can reliably map and delineate the pore space suitable for injection, then they can also provide a clear basis for identifying who should be compensated for its use. This scientific certainty—if true, and despite the known or feared risks discussed in Part II of this Article—would create a strong foundation for applying eminent domain in a way that respects and compensates property owners.

A. Correlative Rights Do Not Diminish The Right to Compensation

Contrary to some assertions that ownership of subsurface pore space is uncertain or diminished, a clear property interest in pore space exists and is increasingly recognized both in judicial decisions

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373 Gege Wen & Sally M. Benson, *CO2 Plume Migration and Dissolution in Layered Reservoirs*, 87 Int'l J. Greenhouse Gas Control 66, 67 (2019).

374 *See* Merrill, *Property and the Right to Exclude*, *supra* note 264, at 733–34 (explaining the "bundle of sticks" approach to property rights, including use and possession); *see also* La. Civ. Code Ann. art. 477 ("…The owner of a thing may use, enjoy, and dispose of it within the limits and under the conditions established by law.").

375 U.S. Const. amend. V ("…nor shall private property be taken for public use, without just compensation.").

376 *See supra*, Part II.

and state statutes.[377] Many states have codified ownership rights in pore space, reflecting its integral connection to surface land ownership. For example, statutes in Utah, Louisiana, and Wyoming explicitly recognize the subsurface pore space as property that can be separately owned and conveyed.[378] This statutory recognition aligns with the *ad coelum* doctrine, despite some courts and scholars questioning such ownership.[379] The notion that pore space is owned by the surface owner makes intuitive and economic sense: it is an asset that the surface owner can utilize, lease, or otherwise monetize in connection with their land, and it possesses quantifiable value. This linkage between economic value and property rights is a fundamental principle in property theory.[380]

The correlative rights doctrine supports the notion that pore space owners have an interest in the subsurface and therefore have the right to compensation when injected fluids migrate beyond the original site of injection.[381] This doctrine recognizes that ownership interests in subsurface reservoirs are shared, requiring equitable and reasonable regulation to prevent waste and protect each owner's rights. The doctrine also acknowledges that each owner has a common interest in the enjoyment—such as profit—from the property.[382] Thus, collectively pore space owners have an interest in storage payment. The vast majority of common law courts have never endorsed a "negative rule of capture" that would allow unregulated invasion of pore space beneath another's

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377 See Righetti, *Correlative Rights*, *supra* note 153, at 10424–10425. Professor Righetti acknowledges that there is no "hard-and-fast rule of pore space ownership," but that "the majority of courts that have ruled on the issue have concluded that pore space is included in the surface estate. Consistent with the proposition that ownership of property extends from the sky to the center of the earth, it follows that the owner of a fee simple interest in property owns all that is above and below his or her property, including the airspace and all subsurface strata, pore space, and the minerals contained therein."

378 *See, e.g.*, La. Stat. Ann. § 31:6 (stating that ". . . the landowner has the exclusive right to explore and develop his property for the production of such minerals and to reduce them to possession and ownership."); Wyo. Stat. Ann. § 34-1-152(a) (stating that "the ownership of all pore space in all strata below the surface lands and waters of this state is declared to be vested in the several owners of the surface above the strata."); Utah Code Ann. § 40-6-20.5 (stating that "title to pore space underlying the surface estate is vested in the owner of the surface estate.").

379 *See supra*, Part IV.B.

380 *See* Denise R. Johnson, *Reflections on the Bundle of Rights*, 32 Vt. L. Rev. 247, 253 (2007) ("In the early 1960s, A. M. Honore wrote an essay on ownership in which he attempted to list the incidents of ownership that have come to be known as the bundle of rights. Honore claimed that his list of incidents of full ownership were 'common to all "mature" legal systems.'" The fourth item on the list is "4. The right to the income—the right 'to the benefits derived from foregoing personal use of a thing and allowing others to use it.'").

381 *See* Schremmer, *Getting Past Possession, supra* note 158, at 332 (discussing differing views on subsurface rights); Righetti, *Correlative Rights, supra* note 153 at 10420–21.

382 *See* Schremmer, *Getting Past Possession*, *supra* note 158, at 332.

land, nor should they.[383] To do so would be to invite a "tragedy of the commons" scenario, where the absence of enforceable rights leads to overexploitation and harm to individual owners.[384]

Such an understanding echoes the classical notion of property rights expressed in the *ad coelum* rule and rejects decades of *dicta* proclaiming the inapplicability of that doctrine "in the modern world" when the case presented does not truly challenge the doctrine.[385] Unitization and correlative rights doctrines do not contradict *ad coelum*; they embrace it.[386] As ownership extends underground, so too does the right to exclude others, including carbon waste.

B. The Correct Answer Is—and Always Has Been—Eminent Domain

From here, the solution is one that lawfully balances private property rights and public environmental goals: eminent domain. Eminent domain, a power sanctioned by the Fifth Amendment's Taking Clause, allows the government or its proxies to take private property as necessary for public use, provided just compensation is paid.[387] This power is broadly interpreted and, on a federal level, would clearly include public benefits such as infrastructure and environmental protection.[388]

The invocation of "public purpose" in cases dealing with underground injections is essentially an eminent domain argument in disguise.[389] Without applying eminent domain, the government or private actors are effectively taking property for a public need without compensation or due process. Although this judicial immunity is not always labeled as "eminent domain," the justification offered is

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383 *See supra* Part IV.B.2 for a broader discussion of the negative rule of capture; R.R. Comm'n. of Tex. v. Manziel, 361 S.W.2d 560, 568 (Tex. 1962); Chance v. BP Chems., Inc., 670 N.E.2d 985, 991 (Ohio 1996).

384 *See supra* Part III.

385 *See*, *e.g.*, United States v. Causby, 328 U.S. 256, 260 (1946).

386 *See supra*, Part III.

387 U.S. Const. amend. V ("...nor shall private property be taken for public use, without just compensation.").

388 Kelo v. City of New London, 545 U.S. 469, 480 (2005) ("The disposition of this case . . . turns on the question whether the City's development plan serves a public purpose. Without exception, our cases have defined that concept broadly […]").

389 *See, e.g.*, FPL Farming Ltd. v Env't Processing Sys, L.C., 351 S.W.3d 306, 314 (Tex. 2011) (stating that "[m]ineral owners can protect their interests from drainage through means such as pooling or drilling their own wells. That is not necessarily the case when a landowner is trying to protect his or her subsurface from migrating wastewater."); *see supra*, Part IV.B.3 for a broader discussion of the court's invocation of public policy in subsurface trespass cases ("Nevertheless, it must be noted that *FPL Farming* clearly suggests that public policy should play a role in trespass decisions").

functionally equivalent: a non-consensual use of private property for the public benefit. However, where no formal condemnation occurs, this raises constitutional concerns under the Fifth Amendment's Takings Clause.[390]

The solution, therefore, is not to erode trespass rights or subsurface ownership doctrine but to insist on eminent domain procedures to lawfully balance private property rights and public environmental goals. The Takings Clause already mediates public necessity with individual burdens, so a new jurisprudential solution is not necessary.[391]

1. Valuable Underground, Free for the Taking?

Centuries ago, prominent English lawyers recognized that a critical component of property ownership is the ability to reap profits from the property, stating that "*for what is the land but the profits thereof*; for thereby vesture, herbage, trees, mines. . ."[392] If value attaches to a resource, and if that resource is tied to ownership, then taking that resource, temporarily or permanently, triggers constitutional protections.[393] Pore space has value: it can be leased, sold, and utilized for commercial gain.[394] Indeed, the CCS industry has already begun to create a custom of paying landowners for their subsurface rights.[395]

The law already recognizes that, flowing from the right of ownership, a landowner has the right to use their property for economic benefit. For example, regulatory takings are one avenue that enforces the tie between ownership and value.[396] In a regulatory taking, the government deprives a real property owner of "all economically beneficial uses in the name of the common good."[397] Thus, even though there may be no

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390 *See* Cedar Point Nursery v. Hassid, 141 U.S. 2063, 2071 (2021).

391 *See* Murr v. Wisconsin, 582 U.S. 383, 384 (2017) ("A central dynamic of the Court's regulatory takings jurisprudence thus is its flexibility. This is a means to reconcile two competing objectives central to regulatory takings doctrine: the individual's right to retain the interests and exercise the freedoms at the core of private property ownership, and the government's power to 'adjus[t] rights for the public good.'").

392 Edward Coke, First Part of the Institutes of the Laws of England §1 (16th ed. 1809) (emphasis added).

393 U.S. Const. amend. V.

394 *See* Hall, *Carbon Capture*, *supra* note 44, at 83–86 (discussing the "allocation of costs and revenues under unitization").

395 *See id.*

396 *See generally* Lucas v. S.C. Coastal Council, 505 U.S. 1003 (1992). The Court recognized that regulatory takings require a more nuanced analysis than a physical invasion, stating that the "the Takings Clause does not require compensation when an owner is barred from putting land to a use that is proscribed by those 'existing rules or understandings' . . . When, however, a regulation that declares 'off-limits' all economically productive or beneficial uses of land goes beyond what the relevant background principles would dictate, compensation must be paid to sustain it." *Id.* at 1030.

397 *Id.* at 1019.

physical invasion, the landowner still has a right to compensation, simply from the deprivation of the right to earn profits.[398]

CCS creates a novel but increasingly valuable opportunity for landowners to put the subsurface of their property to productive economic use. As discussed above, the ability to derive such value is a central element of ownership. Yet if pore space beneath the land becomes filled—whether by migrated carbon dioxide or by another operator's lateral injections—before the landowner can develop it, the owner is deprived of two core incidents of property: the right to exclude and the right to exploit.[399] That deprivation strikes at the essence of ownership and demands compensation.[400]

The very fact that pore space can be monetized suggests we may soon witness a race to occupy it. History teaches us the dangers of such races: the rule of capture in oil and gas encouraged over-extraction and waste, until courts and legislatures intervened with doctrines of unitization and correlative rights. Simply awarding injection rights to the first user would replicate a "tragedy of the commons" belowground. The appropriate response, as with oil and gas, is to preserve ownership while regulating its use—not to erase property rights altogether.

2. *Keeping Trespass: Why Classification as a Property Right Matters*

The distinction between treating subsurface invasions as violations of a property right rather than as mere liability claims is fundamental.[401] When the law recognizes a property right, the landowner retains not only the right to compensation but also the right to exclude and to enjoin unwanted entry.[402] This preventive function is critical in the CCS

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398 *See id.*

399 *See* Merrill, *supra* note 264, at 730 (describing the right to exclude and rights relating to exploitation—"rights to consume it, to transfigure it, to transfer it, to bequeath or devise it, to pledge it as collateral, to subdivide it into smaller interests, and so forth.").

400 U.S. Const. amend. V.

401 *See, e.g.*, Carol M. Rose, *The Shadow of The Cathedral*, 106 Yale L.J. 2175, 2175 (1997) (discussing the distinction of entitlements into "property rules" and "liability rules," first established by Guido Calabresi and A. Douglas Melamed in the 1972 article, *Property Rules, Liability Rules, and Inalienability: One View of the Cathedral*, 85 Harv. L. Rev. 1089 (1972), summarizing that "[l]iability rules . . . are best applied in situations with high transaction costs, where the parties cannot easily find or bargain with one another. Property rules, on the other hand, are best applied in situations where rights and rights-holders are known and transactions costs are low, so that the parties can presumably organize a trade for themselves.").

402 *See* Calabresi & Melamed at 1092 ("An entitlement is protected by a property rule to the extent that someone who wishes to remove the entitlement from its holder must buy it from him in a voluntary transaction in which the value of the entitlement is agreed upon by the seller . . . Property rules involve a collective decision as to who is to be given an initial entitlement but not

context: recognizing subsurface trespass preserves the landowner's ability to either stop injections that impair or consume the economic potential of the pore space, or stop injections that are unwanted or undesired simply because they might create health risks for the landowner.[403] If courts instead downgrade the issue to a liability right, the owner is left only with the uncertain prospect of damages after the fact—if any damages can be proven at all—while losing the essential prerogative of control that defines property.

Equally troubling, courts that reject trespass and recast these disputes in terms of nuisance or liability often justify doing so by requiring a showing of actual harm, and referencing "the social value of the injector's activity and weigh[ing] it against the severity of the harm sustained by the plaintiff."[404] Part IV illustrates that several courts have suggested that, because landowners cannot demonstrate immediate plans to exploit pore space, they suffer no cognizable injury. But this reasoning strips property of its forward-looking and exclusionary character. The fact that a landowner has not yet put the subsurface to use does not erase its value—particularly in a market where pore space has emerging economic significance.[405] By foreclosing trespass claims, courts effectively deprive owners of compensation for the very value that would exist but for the intrusion, creating judicial immunity for a private taking.[406]

Maintaining the framework of trespass is thus essential. It ensures that property rights remain intact, prevents uncompensated private takings under the guise of regulatory necessity, and protects against judicially manufactured immunity for industries whose operations foreseeably cross boundary lines. The choice between property and liability rights is not merely semantic; it is the difference between a system that preserves ownership while channeling use through proper mechanisms like eminent domain, and one that dissolves ownership under the guise of doctrinal expediency.

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as to the value of the entitlement."). On the other hand, an entitlement is protected by a liability rule "[w]henever someone may destroy the initial entitlement if he is willing to pay an objectively determined value for it." *Id.*

403 *See* Beck v. N. Nat. Gas Co., 170 F.3d 1018, 1020–22 (10th Cir. 1999). In *Beck*, the court held that a trespass occurred when gas stored underground migrated into neighboring properties. *Id.* A finding of liability such as this acts as a deterrent to prevent other intrusions of a similar nature. *See also supra*, Part II (discussing health and safety risks of CCS).

404 Schremmer, *Getting Past Possession, supra* note 158, at 344.

405 *See supra*, Part I (discussing the growing of popularity of CCS); *see also* Hall, *Carbon Capture*, *supra* note 44, at 46–47, 89–93 (discussing how sequestered carbon is stored in pore space, and discussing various models of compensation for the landowners).

406 *See* Martha Thibaut, *The Greater Burden: Mapping the Lines on the Servient Estate*, 85 La. L. Rev. 1242, 1248, 1285 (2025).

C. Legislatures Can Authorize Eminent Domain and Expressly Acknowledge Subsurface Trespass

Eminent domain is the proper legal tool to reconcile public need with private rights. Accordingly, any intrusion of injected carbon waste into subsurface pore space without landowner consent or exercise of eminent domain is a trespass. When legislatures authorize CCS, they often do so by creating statutory frameworks for compensation and condemnation.[407] In doing so, states can establish eminent domain authority where consent to the injection is unobtainable. Such authority already exists in many states for carbon dioxide pipelines deemed necessary for enhanced oil recovery (EOR) operations.[408] This fix is relatively simple and reflects normative property rights without undue favor to industry over private property rights.

Yet a gap persists between legislative recognition and judicial treatment of subsurface property rights. This Article's closer look at the jurisprudence of subsurface trespass reveals that courts continue to rely on *dicta*, particularly in oil and gas contexts, to minimize rights in subsurface trespass claims.[409] In many of these cases, there is no evidence of actual subsurface intrusion, so the need to explore whether "actual damage" or "public necessity" should limit ordinary trespass rights in the subsurface context has been nonexistent.[410] This pattern shows us that courts are diverging from ordinary trespass rules – and doing so without necessity.

While private rights cannot resolve the concerns scientists have raised as to reliance on CCS as a climate solution, the reality is that injecting carbon waste into the subsurface is one of the only

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407 *See, e.g.*, LA. STAT. ANN. § 30:1104.2(C) (2025) ("An order for unit operation shall provide for just and equitable sharing of the benefits generated from use of such tracts for geologic storage and shall provide for just and equitable compensation to all owners in interest, including the storage operator, other owners in interest who consented in writing to geologic storage, and owners in interest who did not consent in writing to geologic storage, except that the order shall not vary, alter, or otherwise apply a standard of benefit sharing or compensation to the terms of any contracts between the storage operator and any owner in interest."); *see also* ALA. CODE § 9-17-162(5) (2025) ("All nonconsenting owners of a storage facility's pore space and storage rights for carbon dioxide shall be fairly and equitably compensated.").

408 *See, e.g.*, TEX. NAT. RES. CODE. ANN. § 111.019(a) (West 2025) (stating that "common carriers have the right and power of eminent domain."); TEX. NAT. RES. CODE. ANN. § 111.002(6) (West 2025) (stating that a "common carrier" includes a person who "owns, operates, or manages . . . pipelines for the transportation of carbon dioxide or hydrogen in whatever form . . ." if agreeing to be a common carrier).

409 *See supra* Part IV.B (discussing cases where courts limited the trespass rules when dealing with subsurface rights); Coastal Oil & Gas Corp. v. Garza Energy Tr., 268 S.W.3d 1, 29 (Tex. 2008) (focusing on how *ad coelum* has no place in the modern world).

410 *See supra* Part IV.B (reviewing cases such as *Chance v. BP Chems., Inc.*, where the court held that no trespass occurred, in part because the plaintiffs could not demonstrate actual damage or interference with use).

"green" initiatives currently supported by the federal government. Commentators have questioned whether regulation of the industry is sufficient to protect landowners, and certainly this remains a key question moving forward. This Article bolsters this call for regulation with a call to protect private landowner rights. If CCS implementation continues, landowners' normative rights include the right to exclude injection of carbon waste absent consent or proper invocation of eminent domain and, in either case, compensation.

If the CCS industry is so certain that leaks will not occur, that induced seismicity will not occur, and that interference with other uses of pore space will not occur, why are we preemptively saving them from a nonexistent risk? Let the industry pay landowners for the land required to resolve—if successful—the climate risks the fossil fuel industry creates.

VI. Conclusion

As carbon capture and storage (CCS) becomes a central strategy in climate mitigation efforts, it raises difficult and unsettled questions about subsurface property rights. This Article has shown that while courts often borrow concepts from oil and gas law to evaluate subsurface claims, oil and gas law itself recognizes and preserves the rights of surface owners in the underlying pore space. The right to exclude, even when modified by doctrines like correlative rights and unitization, is not extinguished—it is managed within a legal framework that continues to affirm subsurface ownership.

Courts have erred in their reliance on policy-driven reasoning to limit liability for migrating injections, and they effectively shield industry actors from trespass claims related to their underground waste disposal. In doing so, the courts erode property protections without the procedural safeguards of formal condemnation. This judicial "de-risking" benefits CCS operators at the expense of those who own or share legal title to the impacted subsurface. Whether pore space is held individually or collectively, it remains property. And if that property is occupied for public purposes pursuant to the lawful exercise of eminent domain or due to unlawful trespass—especially through permanent sequestration—the Constitution requires compensation.

If CCS is to follow the path of oil and gas law in legitimizing underground use of private lands, it should also inherit the obligations of outsiders to avoid interference with ownership and rights to exclude. Pore space owners whose formations are permanently filled with carbon dioxide should be compensated through eminent domain, not judicial immunity. And where injected carbon is not truly contained—where it migrates, leaks, or intrudes into neighboring pore space—those neighboring owners retain their rights in trespass. The risks of leakage

are not merely speculative; they carry the potential for real harm to groundwater, soil quality, and the atmosphere that both burdens landowners and frustrates climate goals. Courts have attempted to redefine trespass doctrine to insulate industrial underground operations from liability. CCS makes clear why that shift is so problematic, and this Article demonstrates why the jurisprudence has been not only unnecessary but also, ultimately, unpersuasive.

Protecting the Beauty and the Beach: Easing Regulatory Hurdles for Living Shorelines

*Karen "Kara" Consalo**

Rising sea levels and extreme weather events have caused extensive erosion to coastal shorelines around the world. As shorelines erode, coastal communities lose the beneficial value of beaches as buffers to hurricanes and floods, as homes to wildlife, and as beautiful vistas. Thus, many efforts have been made to halt shoreline erosion through the use of hard armoring or gray infrastructure structures, such as sea walls and bulk heads. These concrete, steel, and rock structures are expensive to install and maintain, ecologically destructive, and lack long-term efficacy at halting beach erosion. A superior technology for preventing beach erosion is the "living shoreline." A living shoreline is a nature-based method of combatting erosive forces through use of plants and other biotic materials. Plant roots hold sand and soil in place against the force of winds and waves, while plant stems and leaves slow water velocity and reduce turbulence, and taller bushes and trees block wind energy. Living shorelines are less expensive to install and maintain than comparative hard armoring. They also foster wildlife habitat, enhance water quality, and beautify the shoreline. Most significantly, living shorelines work as well, or better, than hard armoring at preventing shoreline erosion. Yet, despite their myriads of benefits, living shoreline installations lag far behind hard armoring installations. This article explores the reasons for the lack of popularity of living shorelines and concludes that much of the reluctance to use this technology is due to an uncertain regulatory environment. Based upon survey of existing federal and state legislation, as well as data-driven research, this article provides recommendations for policymakers seeking to stimulate greater use of living shorelines for coastal protection. This article provides detailed recommendations for drafting of legislative and administrative rules which can stimulate and incentivize living shorelines. Such recommendations include development of regulatory standards, including parameters for size, design, engineering, materials, and performance. Recommendations also include establishment of financial and non-financial incentives. Finally, recommendations include incorporation of a codified preference for nature-based solutions over

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hard armoring. It is the goal of this article to assist policymakers and legislative drafters in quickly and thoroughly developing the necessary regulatory and administrative tools to encourage greater use of living shorelines in their coastal jurisdictions

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I. Introduction

The American coast is home to forty percent of Americans, as well as a trillion dollars' worth of property and infrastructure.[1] Alongside human inhabitants, a myriad of marine and terrestrial species, including fishes, birds, and reptiles, rely on coastal habitats for their survival.[2] These essential sites are under increasing and devastating threats as climate change warms our oceans. Warming seas have spawned more frequent and more ferocious hurricanes over the last fifteen years.[3] The intense winds and punishing waves erode the sand, soil, homes, and habitats of coastal inhabitants.[4]

Hurricanes are not the shorelines' only pending threat. Rising sea levels have also made coastal communities more vulnerable to flooding, with flood waters rising higher and encroaching significantly farther inland over the last five years.[5] Like storm waters, flood waters cause erosion, property and habitat destruction while also posing threats to human health.[6]

Unfortunately, the effort to increase shoreline stability over the last century has focused on erecting steel and concrete structures to block

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1 *Economics and Demographics*, NOAA: Coast, https://coast.noaa.gov/states/fast-facts/economics-and-demographics.html [https://perma.cc/QRE5-6TRE] (last visited Aug. 8, 2025); *Climate Change Indicators: Coastal Flooding*, EPA (Jul. 1, 2016), https://www.epa.gov/climate-indicators/climate-change-indicators-coastal-flooding [https://perma.cc/T8VM-PA2S].

2 Both upland and submerged coastal areas are critical to the life cycle of fishes, turtles, birds, and aquatic mammals. *Wildlife 2060 - Coastal Challenges*, Fla. Fish & Wildlife Conservation Comm'n, https://myfwc.com/conservation/special-initiatives/wildlife-2060/coastal/ [https://perma.cc/VUM6-VMYU] (last visited Nov. 4, 2025); *Threats to Habitat*, NOAA: Fisheries, https://www.fisheries.noaa.gov/insight/threats-habitat [https://perma.cc/DFG6-LQ4L] (last visited Sep. 23, 2025).

3 Over the last 15 years, America has experienced six of the costliest disasters in its history, each caused by a tropical cyclone (a.k.a. hurricanes), including Hurricane Sandy (2012), Harvey (2017), Irma (2017), Ian (2022), and Ida (2021). *U.S. Billion-Dollar Weather and Climate Disasters*, NOAA (2023), https://www.ncdc.noaa.gov/billions/events/US/1980-2020 [https://perma.cc/J5G5-TL5X] (last visited Sep. 23, 2025). Data indicates that the "mean maximum" of North Atlantic tropical cyclones intensified nearly 30% between 2001 and 2020 as compared to the period between 1971 and 1990. Andra J. Garner, *Observed Increases in North Atlantic Tropical Cyclone Peak Intensification Rates*, Sci. Rep. 13, 16299 (2023), https://doi.org/10.1038/s41598-023-42669-y [https://perma.cc/W3RA-89XS].

4 Garner, *supra* note 3.

5 Due to rising sea levels, the annual high tide flooding frequency in America is more than twice what it was in 2000. *High Tide Flooding*, NOAA, https://coast.noaa.gov/states/fast-facts/recurrent-tidal-flooding.html [https://perma.cc/CV3D-6FH7] (last visited September 15, 2025). Between 2000 and 2025, there was a 400 to 1,100% increase in high tide flooding days across the Southeast Atlantic and Gulf Coast regions. NOAA predicts that by 2030, annual high tide flooding in the U.S. will occur between 7 to 15 days per year and by 2050 it will occur between 45 to 85 days per year. *Id.*

6 *Climate Change Indicators: Coastal Flooding*, *supra* note 1 (noting the risk of exposure to pathogens and harmful chemicals during flooding).

wave energy. This "hard armoring" has had mediocre effectiveness in protecting shorelines against rising sea levels and weather threats.[7] Hard armoring damages natural habitats, creates visual blight, requires costly maintenance, and worst of all, exacerbates erosion both downshore and off-shore.[8]

As climate change accelerates, the threats facing our coastal communities will continue to increase.[9] As we experience more frequent and stronger hurricanes and floods, these erosive forces will continue to break down our coastal communities and habitats. It is time for policy makers to aggressively pursue better technologies to stabilize our shorelines.

A promising shoreline stabilization technology is the "living shoreline." Living shorelines are a nature-based stabilization method which reintroduces natural materials, such as plants and shells, to coastal ecosystems in a manner designed to reduce wave and wind energies.[10] Living shorelines have been shown to effectively halt coastal erosion and even restore previously eroded areas.[11] Unlike hard armoring, living shorelines improve wildlife habitat, enhance coastal beauty and property values, and require little ongoing maintenance.[12] Despite its many benefits, this technology lags far behind hard armoring structures in shoreline stabilization efforts.

At every level of government, policymakers have failed to develop policies which encourage living shoreline technology. Rather, most

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7 Carter S. Smith, *Living Shorelines Equal or Outperform Natural Shorelines as Fish Habitat Over Time: Updated Results from a Long-Term BACI Study at Multiple Sites*, 47 Estuaries & Coasts 2664 (2024).

8 Shasha Liu et al., *Nature-Based Solutions for Coastal Restoration During Urbanization: Implications of a Case Study Along Chaoyang Port Coast, China*, 266 Ocean & Coastal Mgmt. 2 (2025); Daniel J. Coleman et al., *Quantifying the Impacts of Future Shoreline Modification on Biodiversity in a Case Study of Coastal Georgia, United States*, 39 Conservation Biology (2025); Sophie C.Y. Chan et al., *Mangrove Cover and Extent of Protection Influence Lateral Erosion Control at Hybrid Mangrove Living Shorelines*, 47 Estuaries & Coasts 1517, 1518 (2024); Explore Beaches, *Beach Health: Coastal Armoring*, Univ. of Cal. Santa Barbara: Explore Beaches, https://explorebeaches.msi.ucsb.edu/beach-health/coastal-armoring [https://perma.cc/EGM7-HFJK] (last visited May 20, 2025).

9 *How Climate Change Makes Hurricanes More Destructive*, Env't Def. Fund, https://www.edf.org/climate/how-climate-change-makes-hurricanes-more-destructive [https://perma.cc/9W-WU-UPEL] (last visited Oct. 12, 2025).

10 NOAA, Guidance for Considering the Use of Living Shorelines 4 (2015), https://www.habitatblueprint.noaa.gov/wp-content/uploads/2018/01/NOAA-Guidance-for-Considering-the-Use-of-Living-Shorelines_2015.pdf [https://perma.cc/7WBC-G6PC] [hereinafter NOAA Guidance].

11 *See id.*; Serkan Catma, *The Price of Coastal Erosion and Flood Risk: A Hedonic Pricing Approach,* 2 Oceans 149, 150 (2021), https://doi.org/10.3390/oceans2010009 [https://perma.cc/CJZ4-Z2D3]. *See also* Orrin H. Pilkey, Linda Pilkey-Jarvis & Keith C. Pilkey, Retreat from a Rising Sea: Hard Choices in an Age of Climate Change 1–5 (2016).

12 NOAA Guidance, *supra* note 10.

governments continue to rely on hard armoring to protect their coastlines, despite their high economic and environmental cost. It is time for our governments to adopt proactive measures, such as permitting regulations, policy preferences, and incentives, to encourage greater use of living shorelines to protect our coastal communities.

Part I of this Article describes the need to expand use of living shoreline technology in response to increasing threats to our shorelines. Part II explores the prevailing reliance on hard armoring and posits that this infrastructure is a poor investment strategy. Part II also explores current regulations affecting living shorelines at both the federal and state levels. These Parts explain the Army Corps' bias through policies which favor hard armoring over nature-based solutions, as well as the limited state policies which encourage living shorelines. Part III discusses the unnecessary and counterintuitive regulatory hurdles posed by federal and state governments which serve to impede greater use of living shorelines. Such hurdles range from a failure to regulate entirely, to unnecessary regulations which increase administrative burdens, to regulations which actively favor hard armoring infrastructure. Finally, Part IV provides specific recommendations for adoption of policies to stimulate greater use of living shoreline technology.

i. Sea Level Rise and Erosion

Warming oceans and associated rising sea levels have caused extensive erosion to coastal shorelines around the world.[13] The consequences of shoreline erosion are vast, including reductions in beach size, decreases in resiliency during extreme weather events, losses of habitats and wildlife, and reductions in coastal beauty.

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13 PILKEY, *supra* note 11, at 1–2. Sea level rise is defined as "the long-term increase in sea level relative to a local land-based reference." TOSIN A. GASKIN ET AL., U.S. ARMY ENG'R RSCH. & DEV. CTR., LIVING SHORELINE IN USACE PROJECTS: A REVIEW (2025), https://hdl.handle.net/11681/49678 [https://perma.cc/KY33-ADWP] [hereinafter USACE PROJECTS] (citing NOAA GUIDANCE). Sea level rise is due to high levels of carbon in the atmosphere from the burning of fossil fuels has led to such high levels of carbon in the atmosphere that the ozone layer has been significantly dissolved. PILKEY, *supra* note 11, at 1. Without the ozone barrier, greater amounts of sunlight are penetrating to the earth's surface and heating both land and water. PILKEY, *supra* note 11, at 1–3. Two weather phenomena are a result of this heating: 1) massive ice sheets and glaciers are melting and 2) warmed water is expanding. *Id.* at 1–3. These factors increase ocean volume and height, a phenomenon known as sea level rise. *Understanding Sea Level: Global Mean Sea Level*, NASA: EARTH DATA, https://sealevel.nasa.gov/understanding-sea-level/global-sea-level/overview [https://perma.cc/5ARD-H24K] [hereinafter NASA] (last visited July 28, 2025). *See also* Gary Griggs, *Can We Make Coastal Communities Resilient to Sea-Level Rise*?, 40 J. OF COASTAL RSCH. 572 (2024). Sea level rise impacts American coastlines as ocean waters rise higher, and further, inland and erode shorelines. PILKEY, *supra* note 11, at 1–5. *See also* Chan, *supra* note 8 (explaining that there is an anticipated increase of shoreline erosion at a rate of nearly 14% of current rates by 2090). *See* Liu, supra note 8; *see* NOAA GUIDANCE, *supra* note 10.

It is indisputable that sea levels are rising based on tidal data that has been collected for over a century, first by tide gauges and more recently by satellite images.[14] Thus, there is extensive data indicating the past rate of sea level rise to support forecasts for the future. Over the course of the twentieth century, worldwide sea levels rose between 4 and 6 inches.[15] Satellite image recordings beginning in 1993 indicate that the rate of sea level rise has significantly increased during the last thirty years to an additional rise of between 10 and 20 inches.[16] As the scientific community attempts to predict the rate of global sea level rise during the remainder of the twenty-first century, there is agreement that sea level heights will continue to increase, but estimates vary with regard to the speed and severity of such increase.[17] Recent modeling suggests nearly five feet (147.9 cm) of sea level rise by 2100.[18] Some studies acknowledge that if carbon emissions continue to increase, the amount may be closer to six to eight feet during the twenty-first century.[19] Models indicate that a five-foot increase in sea level correlates to a rate of shoreline erosion of 1,551 feet (517 meters).[20] Alternative modeling predicts future shoreline erosion will increase by 14% beyond the current rate by the year 2090.[21]

ii. American Shorelines

The United States has over 95,000 miles of coastline vulnerable to, and threatened by, destructive climate events including sea level rise, flooding, and storms, all of which lead to erosion of coastal shorelines.[22]

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14 Griggs, *supra* note 13, at 572; NASA, *supra* note 13; USACE Projects, *supra* note 13, at 17, 26.

15 Griggs, *supra* note 13, at 571–72.

16 *Id*.

17 *Id*.

18 Sèna Donalde Dolorès Marguerite Déguénon et al., *Sea-Level Rise and Flood Mapping: A Review of Models for Coastal Management*, 120 Nat. Hazards 2155, 2170 (2024), https://doi.org/10.1007/s11069-023-06225-1.

19 *Id*. at 2156; Griggs, *supra* note 13, at 572.

20 Déguénon, *supra* note 18; Pilkey, *supra* note 11, at 1–5; USACE Projects, *supra* note 13, at 5. Factors such as "the presence or absence of vegetation and burrowing organisms, soil strength, and shoreline morphology" can affect rates of erosion. USACE Projects, *supra* note 13.

21 Chan, *supra* note 8, at 1517. *See generally* Liu, *supra* note 8.

22 NOAA Guidance, *supra* note 10, at 4. *See also* Peter L. Pearsall, *Eyes in the Sky: How Satellite Imagery Transforms Shoreline Monitoring From "Data-Poor" to "Data-Rich"*, U.S. Geological Survey (Oct. 15, 2021), https://www.usgs.gov/centers/pcmsc/news/eyes-sky-how-satellite-imagery-transforms-shoreline-monitoring-data-poor-data [https://perma.cc/4Z5A-94LQ]; NASA, *supra* note 13. It should be noted that American coastlines have a variety of different physical dimensions, ecosystems and built environments, including beaches, estuaries, barrier islands, dunes, bluffs, and even mountains. Griggs, *supra* note 13. It may also be noted that the term "coastal" can include lake and river banks. However, the focus of this Article is on coastal areas adjacent to the ocean and sandy beaches and associated ecosystems located at or near sea level.

Frequent, high energy, high velocity waves move sand, soil, and other sediment on and off of the beach, as well as up or down the shoreline.[23] Absent aggressive mitigation and resilience infrastructure, coastal American communities will face even more destruction from floods and storms in the coming decades.[24] The National Oceanic and Atmospheric Administration ("NOAA") determined the cost of coastal storms striking the U.S. between 1980 and 2024 to be approximately $124 billion.[25] The economic damage from flooding in the U.S. is expected to average $6 billion per year by 2025,[26] and the economic impact of erosion upon coastal property values in America is estimated to reach $9 billion by 2100.[27]

The erosive effect of hurricanes is of particular concern to coastal states in the American Southeast and Mid-Atlantic, from Louisiana and Florida through New Jersey and New York. These intense storms bring powerful winds, intense wave action, and inland flooding.[28] The erosive effect is intensified by rising sea levels which cause water levels to be higher against the shore before, during, and after the storm. In turn, hurricanes have led to an increase of extensive beach erosion, coastal habitat loss, and destruction of the built environment.[29]

One of the traditional methods employed to address coastal erosion in the U.S. has been "beach nourishment," sometimes referred to as "beach renourishment."[30] This is a process of depositing massive

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23 *Why Shore Armoring Inevitably Fails*, Nature Change (Mar. 5, 2021), https://nature-change.org/2021/03/05/why-shore-armoring-inevitably-fails/ [https://perma.cc/L9U2-NF8R] (interviewing Guy Meadows, Professor, Great Lakes Research Center, Michigan Technological University). Long currents are those waves which flow down a beach and create offshore currents as the water returns the waves back to the ocean. *Id*.

24 Déguénon, *supra* note 18, at 2156 (citing Hallegatte et al., *Future Flood Losses in Major Coastal Cities*, 3 Nature Climate Change 802 (2013)).

25 NOAA, *Time Series*, https://www.ncei.noaa.gov/access/billions/time-series/US/cost [https://perma.cc/33XC-9NF7] (last visited May 26, 2025). NOAA's interactive data charting includes costs of various natural disasters, including tropical cyclones, winter storms, other severe storms, freezes, wildfires, droughts and floods. *Id.*

26 *Id*.

27 Catma, *supra* note 11, at 150.

28 Griggs, *supra* note 13, at 574. Unfortunately, it is anticipated that by 2030, dozens of American coastal cities, including New York, Boston, and Miami, will experience over a hundred floods causing inundation to at least 10% of the city every year. *Id*.

29 *See id*. at 572.

30 In *Stop the Beach Renourishment, Inc. v. Florida Department of Environmental Protection*, the U.S. Supreme Court confirmed the ability of governments to engage in beach renourishment projects, even when such additional sand or fill may modify the property boundaries of adjacent landowners. 130 U.S. 2592, 2594 (2010). The court explained that while littoral landowners have the right to ownership of graduate accretions of sediment, the littoral landowner does not have ownership of a sudden addition of sediment, known as avulsion, nor does the landowner have right to future accretions. *Id.*

amounts of sand on eroded beaches.[31] The term beach nourishment is often a misnomer; through the process, the existing ecosystem is often destroyed and the shoreline is not actually nourished.[32] This is to say nothing of the ecosystem and habitats which are destroyed through the process of dredging the sand from its original location to redeposit on the subject beach.[33] Beach nourishment does not fix the underlying causes of erosion, and therefore, the beach will eventually erode again.[34] Beach nourishment efforts have become an annual event in many states, despite the exorbitant cost, ecological damage, and legal changes.[35]

Between 1923 and 2024, there have been over 2,500 beach nourishment projects in the United States, representing over 1.6 billion cubic yards of fill dredged up from one location and filled into another, at a cost of over $11 billion.[36] Yet, the sand continues to erode after beach nourishment, perpetuating a destructive and expensive cycle.[37] Reliance on beach nourishment to protect and preserve American beaches is neither effective nor economically sound.[38] Governments must adopt proactive measures to prevent further erosion of our shorelines.

II. Background

A. Coastal Resiliency

Rather than accepting shoreline loss or continuing the fruitless cycle of beach renourishment, our coastal governments should focus on

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31 Eric Bird & Nick Lewis, Beach Renourishment 55 (2015).

32 "When fill sand is dumped onto shorelines during nourishment projects, it can smother and kill native infaunal (burrowing) communities in the swash zone, degrade shallow reefs and seagrass, reduce light availability, and disrupt sea turtle nesting and other beach-dependent wildlife." Charles H. Peterson & Melanie J. Bishop, *Assessing the Environmental Impacts of Beach Nourishment*, 55 BioSci. 887, 892, 895 (Oct. 2005), [https://perma.cc/S73G-U7JK].

33 Bird & Lewis, *supra* note 31, at 44. Renourishment fill may be dredged from other beaches, harbors, lagoons, river channels, inlets, the sea floor, etc. Franziska Staudt et al., *The Sustainability of Beach Nourishments: A Review of Nourishment and Environmental Monitoring Practice*, 25 J. of Coastal Conservation 1, 33 (2021).

34 Peterson, *supra* note 32; Griggs, *supra* note 13, at 573. The Program for the Study of Developed Shorelines at Western Carolina University maintains a comprehensive and interactive map of the beach renourishment projects categorized by state. W. Carolina Univ., *Beach Nourishment Viewer*, https://beachnourishment.wcu.edu/ [https://perma.cc/B2UM-8NRT] (last visited May 16, 2025). Examples of the futility of beach renourishment projects include the State of Florida, in which there have been 714 renourishment projects comprised of 370,107,142 cubic yards of fill at a cost of $2,675,673,487 (adjusted to 2024 cost: $4,603,096,107). *Id.* The State of New Jersey has engaged in 366 beach renourishment projects comprised of 251,580,553 cubic yards of fill at a cost of $2,245,336,494 (adjusted to 2024 cost: $3,409,592,715). *Id.*

35 *Id.*

36 W. Carolina Univ., *supra* note 34. *See also* Griggs, *supra* note 13, at 573.

37 In Florida, there are fifteen beaches which have been renourished over fifteen times, and Palm Beach has been renourished over 50 times! Griggs, *supra* note 13, at 573.

38 *Id*.

developing resiliency to destructive erosive forces. The term "resiliency" denotes efforts by a government, a community, or an individual to limit the adverse impacts of hazardous events.[39] In the environmental context, resiliency describes proactive measures which anticipate and prepare for destructive events, such as floods, hurricanes, tornadoes, fires, etc., to limit the harm caused by these events to manmade and natural environments.[40] As explained by the National Oceanic and Atmospheric Administration ("NOAA"), coastal resiliency is "the ability of a community to 'bounce back'' after hazardous events such as hurricanes, coastal storms, and flooding—rather than simply reacting to impacts . . . Resilience is our ability to prevent a short-term hazard event from turning into a long-term community-wide disaster."[41] It has also been defined as efforts "to enhance the protection and adaptation of coastal communities under an increasing magnitude and/or frequency of coastal hazards and their drivers, such as storms and sea level rise that cause erosion and flooding."[42]

The terms "shoreline stabilization" and "coastal armoring" commonly refer to resilience efforts that focus on rebuilding eroded shorelines and preventing further erosion.[43] There are a variety of ways to stabilize shorelines, each with differences in efficacy, costs, and sustainability. First, there are policy-based measures, such as zoning and building codes, which recognize coastal threats and anticipate ways to prevent, or at least mitigate, the harm which will be caused.[44] Examples of resilience-based policies include: prohibitions on development within a certain distance of the high water mark or on sand dunes; requirements regarding the types of engineering or building materials which may be used near the coast; and requirements for the types of plants which must

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39 *See generally Community Resilience, Disaster Relief & Disaster Resilience*, Bos. Coll. Ctr. for Corp. Citizenship (Aug. 2, 2024), https://ccc.bc.edu/content/bc-ccc/news/blogs/how-to-build-community-resilience.html [https://perma.cc/QCH8-Y3CY] (last visited Nov. 20, 2025). *See* Fed. Emergency Mgmt. Agency, *National Risk Index*, https://hazards.fema.gov/nri/community-resilience [https://perma.cc/8V57-68HV] (last visited Nov. 20, 2025).

40 *See generally* The Nat'l Acads., Disaster Resilience: A National Imperative 1 (2020). Coastal resilience includes activities that help communities prepare and adapt to climate changes, reduce risks posed by climate change, and facilitate recovery from hazardous events. Nature Conservancy, *Ten Years of Coastal Resilience*, Coastal Resilience, https://coastalresilience.org/project/ten-year/ [https://perma.cc/5TRM-YTNS] (last visited May 26, 2025).

41 Griggs, *supra* note 13, at 571 (citing NOAA Guidance).

42 Chan, *supra* note 8, at 1517.

43 U.S. Army Corps of Eng'rs & Nat'l Oceanic & Atmospheric Admin., Structural Measures for Shoreline Stabilization 2 (Feb. 2025) [hereinafter Structural Measures]; Griggs, *supra* note 13, at 573.

44 Structural Measures, *supra* note 43, at 2.

be used in landscaping—all of which place the burden on landowners to develop and maintain their property in resilient ways.[45]

Policy measures can also seek to steer development away from coastlines entirely. For example, state governments can discourage future coastal development by ending government subsidized insurance for buildings near shorelines.[46] Local governments can consider ceasing investment in infrastructure, such as roads and bridges, that facilitate development near coasts—ultimately ruining the ecosystems. Governments may also create trust funds to purchase lands in high-threat coastal zones so that existing structures can be removed and conservation projects undertaken to enhance the resiliency of that area.[47]

i. Hard Armoring/Gray Infrastructure

Another popular tool to increase coastal resiliency is the construction of infrastructure projects intended to stabilize sand and soil along shorelines. Traditionally, such shoreline infrastructure has been undertaken with "hard armoring," also referred to as "gray infrastructure."[48] Such terminology denotes the solid nature and dark appearance of materials commonly used in such stabilization efforts, such as metal, concrete, timber, and rocks.[49] These hard armoring installations limit erosion by serving as a barricade against the influx of tides, flood waters, and winds,[50] thereby blocking these erosive forces. A nonexclusive list of types of gray infrastructure includes:

- **Sea walls.** These are high vertical structures erected parallel to a shoreline that serve as a barrier blocking both water and

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45 Kara Consalo, *Vulnerable Populations: Climate Change and Weather Threats Facing Urban Communities*, 11 Chicago-Kent J. Env't & Energy L. 11, 34 (2022).

46 Omri Ben-Shahar & Kyle Logue, *The Unintended Effects of Government-Subsidized Weather Insurance*, Regul. Mag., Fall 2015, at 24.

47 Structural Measures, *supra* note 43, at 2. The government's power to acquire coastal land can include both purchase and exercise of the power of eminent domain. *See generally* Fla. Stat. § 253.12 (2025); Cal. State Lands Comm'n, *Public Engagement*, https://www.slc.ca.gov/public-engagement/ [https://perma.cc/GQ68-6D9Z] (last visited Jul. 30, 2025).

48 Griggs, *supra* note 13, at 573; USACE Projects, *supra* note 13, at 1. An estimate by Rachel Gittman and fellow researchers suggests that fourteen percent of the American coastline already has hard armoring structures in place. R.K. Gittman, et al., *Engineering Away Our Natural Defenses: An Analysis of Shoreline Hardening in the U.S.*, 13 Frontiers in Ecology & the Env't 303 (2015).

49 Griggs, *supra* note 13, at 573; Sarah Ball Gonyo, Ben Zito & Heidi Burkart, *The Cost of Shoreline Protection: A Comparison of Approaches in Coastal New England and the Mid-Atlantic*, 51 Coastal Mgmt. 145–157 (2023), https://doi.org/10.1080/08920753.2023.2186091 [https://perma.cc/E878-3HKK] (last visited Sep. 25, 2025).

50 Structural Measures, *supra* note 43, at 2; Griggs, *supra* note 13, at 573.

wind from impacting lands above the sea wall.[51] They are typically constructed of concrete or steel.[52]

- **Bulkheads.** These are vertical structures erected parallel to coastline, directly along the edge of land, for the purpose of creating a barrier between that land and the sea water so as to prevent erosion from the land and flooding.[53] They are typically smaller than sea walls and constructed of timber, steel, or concrete.[54]
- **Breakwaters.** These are vertical or sloped structures installed offshore at a height above that of anticipated waves.[55] They are generally erected parallel to the shoreline for the purpose of blocking waves from reaching the shore, or at least breaking waves into smaller parts so that the wave energy is reduced when it strikes the shore.[56] Breakwaters are typically constructed of rocks, concrete, or shells.[57]
- **Revetments.** These are sloping structures which are overlaid upon a shoreline or embankment in order to break the energy impact of waves.[58] These structures are typically constructed of concrete, stone, asphalt, wood, or large rocks.[59]
- **Groins.** Also referred to as "groynes," these structures are built perpendicular from the shoreline such that they extend

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51 Sean Cornell et al., *Coastal Processes, Hazards, & Society: Seawalls*, Pa. State Univ., https://www.e-education.psu.edu/earth107/node/1062 [https://perma.cc/9CNR-P7RD] (last visited May 16, 2025); *Seawalls & Bulkheads*, Marine Constr. Mag. (Aug. 2, 2019), https://marineconstructionmagazine.com/article/seawalls-bulkheads/ [https://perma.cc/5HNU-HC5K] (last visited Jul. 30, 2025); NOAA Guidance, *supra* note 10, at 4; Brit. Broad. Corp. (BBC), *Hard Engineering Strategies: Coastal Management*, (2024), https://www.bbc.co.uk/bitesize/guides/z2234j6/revision/1 [https://perma.cc/NC85-DK38] (last visited Jul. 30, 2025).

52 *Coastal Management*, *supra* note 51. *See also* Structural Measures, *supra* note 43, at 6.

53 *Seawalls & Bulkheads*, *supra* note 51; NOAA Guidance, *supra* note 10, at 4.

54 NOAA Guidance, supra note 10, at 4.

55 Nat'l Park Serv., *Breakwaters, Headlands, Sills, and Reefs*, https://www.nps.gov/articles/breakwaters-headlands-sills-and-reefs.htm [https://perma.cc/66JU-4RDH] (last visited May 16, 2025); *Coastal Flood Defences: Breakwaters*, Flood Hub (Oct. 2021), https://thefloodhub.co.uk/wp-content/uploads/2018/09/Breakwaters-1.pdf [https://perma.cc/74M2-AS65].

56 *See Breakwaters, Headlands, Sills, and Reefs*, *supra* note 55; *Coastal Flood Defences: Breakwaters*, *supra* note 55.

57 *Breakwaters, Headlands, Sills, and Reefs*, *supra* note 55; *Coastal Flood Defences: Breakwaters*, *supra* note 55.

58 Nat'l Park Serv., *Seawalls, Bulkheads, and Revetments*, https://www.nps.gov/articles/seawalls-bulkheads-and-revetments.htm [https://perma.cc/2EWU-NFT9](last visited May 16, 2025); *Coastal Flood Defences: Revetments*, Flood Hub (Sept. 2021), https://thefloodhub.co.uk/wp-content/uploads/2018/09/FT-Q-R83-Coastal-flood-defences-Revetments.pdf [https://perma.cc/G945-2FVG] (last visited Sep. 25, 2025).

59 *Seawalls, Bulkheads, and Revetments*, *supra* note 58; *Coastal Flood Defences: Revetments*, *supra* note 58.

> into the sea.[60] The purpose is to disrupt the natural flow of the water currents and longshore sediment deposits, thereby keeping sand on the "updrift" side of the groin.[61] However, erosion is allowed to continue on the "downdrift" side of the groin.[62] These structures are typically constructed of rocks, wood, or concrete.[63]

Unfortunately, all of these traditional installations employed to halt beach erosion have many drawbacks. First and foremost, they often fail. All of these structures are built to a specific size and scope, so they cannot grow or expand in the face of higher seas, taller waves, or stronger winds.[64] Thus, they are often insufficient to block these forces as sea levels continue to rise and weather events become stronger.[65]

Second, despite the extensive investment it has garnered, gray infrastructure is not a long-term solution to develop coastal resiliency.[66] These structures require repair and maintenance due to the rusting, cracking, and breakage that result from wave exposure.[67] Further, the materials used in hard armoring do not have the ability to grow or adapt to increases in wind energies or water levels, nor to other changes in weather patterns.[68] Thus, they may be obsolete if wave heights increase or wind or water patterns change. The physics of most hard armoring structures foster sediment removal on the seaward side of the structure, allowing water depth on the seaward side to deepen and eventually leading to the collapse of the structure.[69] Thus, within the course of a few decades, this very expensive infrastructure may worsen beach erosion, destroy habitats, and ruin coastal vistas.[70]

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60 Structural Measures, *supra* note 43, at 5; Griggs, *supra* note 13, at 573; Nat'l Park Serv., *Groins and Jetties*, https://www.nps.gov/articles/groins-and-jetties.htm [https://perma.cc/H4K7-Y5GD] (last visited May 16, 2025).

61 Structural Measures, *supra* note 43; *Groins and Jetties*, *supra* note 60; *Coastal Management*, *supra* note 51.

62 Structural Measures, *supra* note 43; *Groins and Jetties*, *supra* note 60.

63 Structural Measures, *supra* note 43; *Groins and Jetties*, *supra* note 60.

64 *See id.*

65 *See* Donatus Angnuureng et al., *Challenges and Lessons Learned from Global Coastal Erosion Protection Strategies*, iScience, Apr. 18, 2025, at 1, 10, 13.

66 Interview with Professor Meadows, *supra* note 23.

67 *See* Carter S. Smith, *Living Shorelines Equal or Outperform Natural Shorelines as Fish Habitat Over Time: Updated Results from a Long-Term BACI Study at Multiple Sites*, 47 Estuaries & Coasts 2655, 2664 (2024); Angnuureng, *supra* note 65, at 13. Additional problems with use of grey infrastructure include the inability to adjust to higher flooding than originally planned. *See* Griggs, *supra* note 13, at 574.

68 *See* USACE Projects, *supra* note 13, at 5, 18, 26–27.

69 Interview with Professor Meadows, *supra* note 23.

70 *See* Angnuureng, *supra* note 65, at 3, 7–8; Interview with Professor Meadows, *supra* note 23, at 04:09.

Third, gray infrastructure often decreases the natural beauty of a coastline.[71] Neither the materials nor the design of hard armoring enhances coastal aesthetics. Objectively, these materials do not comport with the coastal environments in which they are constructed, and so the structures create a jarring disconnect between the natural setting of a beach and these looming man-made structures.[72] These materials deteriorate over time, including metal rusting, concrete cracking, and timber rotting, which increases their adverse effect on the coastal aesthetic.

Fourth, hard armoring is destructive to the coastal ecosystems, including both marine and littoral habitats, to an extent that poses a threat to the sustainability of marine and littoral wildlife.[73] The installation of gray infrastructure typically involves dredging out the existing sandy dunes, salt marshes, mangrove forest, oyster reefs, and other habitat to replace it with the steel, concrete or similar materials.[74] These non-biological materials lack design complexity, leaving few spaces, material, or water retention in which wildlife habitat could regrow or thrive.[75] Thus, hard armoring destroys the existing natural habitat and connectivity without creating new habitat opportunities.[76] Further, the structures reflect wave energy back into the environment, affecting the sedimentation process and rendering it difficult for wildlife to thrive on the new structure.[77]

Fifth, hard armoring disrupts human access and enjoyment of coastal beaches.[78] The installations are often of such a size and location

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71 *See* Structural Measures, *supra* note 43, at 3–4; Griggs, *supra* note 13, at 573; *Disadvantages of Hard Structures*, Penn State, Dep't of Geosciences, https://www.e-education.psu.edu/earth107/node/1066 [https://perma.cc/2TX3-K4DB] (last visited May 20, 2025); USACE Projects, *supra* note 13, at 16, 37.

72 Structural Measures, *supra* note 43, at 5–6; *Disadvantages of Hard Structures*, *supra* note 71.

73 Liu et al., *supra* note 8, at 2, 6–7, 8; Coleman, *supra* note 8, at 1 & 2; Chan et al., *supra* note 8, at 1517–18; *Coastal Armouring*, Univ. of Cal. Santa Barbara, [https://perma.cc/EGM7-HFJK] (last visited May 20, 2025).

74 Thea E. Bradford et al., *Turning Riprap into Reefs: Integrating Oyster Shells into Shoreline Armouring*, 216 Marine Pollution Bull. 1, 1 (2025).

75 *Id.*; Travis O. Brandon, *Too Little Too Late: Why the Environmental Justice Problems Caused by the Army Corps's Nationwide Permit Program Run Much Deeper than Permit 12*, 48 Vermont L. Rev. 40, 69 (2023).

76 Coleman et al., *supra* note 8, at 2; Monterey Bay Nat'l Marine Sanctuary, Nat'l Oceanic & Atmospheric Admin., https://montereybay.noaa.gov/resourcepro/resmanissues/coastal.html [https://perma.cc/GD4H-HUX7] (last visited May 20, 2025); Travis O. Brandon, *A Wall Impervious to Facts: Seawalls, Livings Shorelines, and the U.S. Army Corps of Engineers' Continuing Authorization of Hard Coastal Armoring in the Face of Sea Level Rise*, 93 Tulane L. Rev. 557 (2019) [hereinafter Brandon, *Impervious to Facts*].

77 *Seawalls, Bulkheads, and Revetments*, *supra* note 58; Brandon, *Impervious to Facts*, *supra* note 76, at 573.

78 *Disadvantages of Hard Structures*, *supra* note 71.

that they reduce or eliminate access to public beaches.[79] Even private landowners may lose access to the beach on the seaward side of the structure.[80] Accepted engineering practices for gray infrastructure acknowledge that there will likely be a forfeiture of the sandy beach seaward of the installation.[81] In addition to sediment losses on the seaward side of the property upon which the hard armoring is located, there can also be disruption to the natural water currents or wind flows along wide stretches of coast which can exacerbate erosion at other locations along the shoreline.[82]

ii. Green Infrastructure through Living Shorelines

A better erosion-prevention strategy is expanding the use of living shorelines in coastal communities. This alternative to hard armoring or gray infrastructure is known as "soft armoring" or "green infrastructure."[83] Soft armoring or green infrastructure are types of "nature-based solutions" ("NbS") which utilize natural elements and sustainable methods to combat shoreline erosion and develop coastal resiliency,[84] and "living shorelines" are a type of green infrastructure used to stabilize coastlines by use of "plants and other natural materials, sometimes in combination with harder structures (e.g., rock sills), to provide habitat value and enhance resilience."[85] As the vegetation grows, plant roots help hold sand and soil in place despite wind and

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79 Structural Measures, *supra* note 43, at 4; Griggs, *supra* note 13, at 573; Brandon, *Impervious to Facts*, *supra* note 76, at 575.

80 Brandon, *Impervious to Facts*, *supra* note 76, at 572.

81 Structural Measures, *supra* note 43, at 4; Griggs, *supra* note 13, at 573; Savanna C. Barry, Elix M. Hernandez & Mark W. Clark, *Performance Assessment of Three Living Shorelines in Cedar Key, Florida, USA*, 48 Estuaries and Coasts 1, 2 (2025) (describing loss of sandy shoreline and habitat in Cedar Key, Florida after installation of shoreline armoring in the 1960s and '70s); Chan et al., *supra* note 8, at 1518; Smith et al., *supra* note 67, at 2664 (noting additional problems with use of grey infrastructure, including need for maintenance and repair and inability to adjust to higher flooding than originally planned); Bird & Lewis, *supra* note 31, at 29; *Coastal Armoring*, *supra* note 73; Brandon, *Impervious to Facts*, *supra* note 76, at 572.

82 *See* Brandon, *Impervious to Facts*, *supra* note 76, at 573.

83 *Gray Infrastructure & Nature-Based Solutions*, Nicholas Inst. for Energy, Env't & Sustainability, Duke Univ., https://nicholasinstitute.duke.edu/nature-based-solutions-roadmap/gray-infrastructure-nature-based-solutions [https://perma.cc/BZ7G-U73V] (last visited May 20, 2025); Brandon, *Impervious to Facts*, *supra* note 76, at 577–78.

84 Bradford et al., *supra* note 74, at 2; Liu et al., *supra* note 8, at 2.

85 Audrey Looby et al., *Intertidal Soundscapes of Hardened and Living Shorelines: A Case Study of Habitat Enhancement*, 34 Aquatic Conservation: Marsh Freshwater Ecosystem 1, 2 (2024); NOAA Guidance, *supra* note 10, at 4. Living shoreline projects may incorporate some hard armoring materials, such as stones and recycled metals, but the primary focus is natural and biological materials. Liu et al., *supra* note 8, at 2; Andrew Tweel et al., *Investigating the Effects of Site Characteristics and Installation Material Type on Intertidal Living Shoreline Performance in Coastal South Carolina, USA*, 48 Estuaries & Coasts 1, 2 (2025); Chan et al., *supra* note 8, at 1518; *Gray Infrastructure & Nature-Based Solutions*, *supra* note 83.

water energies.[86] Plant stems and leaves slow water velocity and reduce turbulence.[87] Taller bushes and trees can block wind energy and stabilize soil for the upland plant community.[88] An illustration of replacing gray infrastructure with green might be replacement of a traditional bulkhead, sea wall, groin, or revetment with reef or marsh restoration materials, oyster beds, seagrass, or mangrove trees.[89]

Like hard armoring installations, the primary purpose of a living shoreline is to stabilize the shoreline and adjacent seabed through prevention of erosion caused by water and wind.[90] There is ample evidence that living shorelines are at least as effective as gray infrastructure in halting erosion.[91] In areas of extremely heavy wind and wave energy impacts, a hybrid approach wherein some gray infrastructure is incorporated into a living shoreline project can also be a viable method to achieve the benefits produced by both technologies.[92]

Unlike hard armoring, this erosion prevention does not come at the cost of sacrificing other areas of the coast to greater erosion.[93] In fact, many living shorelines stimulate lateral accretion of sand along shorelines both in the immediate vicinity of where it was installed and further out along the shoreline.[94] Thus, there is dual benefit of slowing or halting erosion of the living shorelines, both seaward and landward, while new sand and sediment are deposited—with no sacrifice of beaches down shore from the living shoreline.

In addition to preventing beach erosion and helping to stimulate beach nourishment, living shorelines also foster sustainable habitats, nurseries, refuge, and food sources for aquatic and littoral wildlife.[95] Living shoreline projects have a significantly higher number and diversity of fish and crustaceans than hard armoring installations.[96]

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86 USACE Projects, *supra* note 13, at 7.

87 *Id*.

88 *Id*. at 39.

89 *See* Nicholas Inst., *supra* note 83.

90 *See* Bradford, *supra* note 74, at 2; Coleman, *supra* note 8, at 1; Structural Measures, *supra* note 43, at 4; Chan, *supra* note 8, at 1518; USACE Projects, *supra* note 13, at 9.

91 Living shorelines have been shown to significantly limit wave energy, even during hurricanes. *See* Barry, *supra* note 81, at 17. Living shorelines in both coastal and marshy ecosystems have been shown to enhance sediment volume. *See* Coleman, *supra* note 8, at 10-11; Robert J. Weaver, *Mangroves as Coastal Protection for Restoring Low-Energy Waterfront Property*, 12 J. Marine Sci. & Eng'g 3 (2024).

92 *See* USACE Projects, *supra* note 13, at 1.

93 *See* Looby, *supra* note 85, at 3; Structural Measures, *supra* note 43, at 4–6.

94 *See* Looby, *supra* note 85, at 3–4; Structural Measures, *supra* note 43, at 4; Coleman, *supra* note 8, at 8; Barry, *supra* note 81, at 16; USACE Projects, *supra* note 13, at 10, 17–18.

95 *See* Smith, *supra* note 67, at 2664, 2666. The U.S. Army Corps of Engineers refers to the many benefits provided by living shorelines as "cobenefits" or "ecosystem services." USACE Projects, *supra* note 13, at 12.

96 USACE Projects, *supra* note 13, at 16.

Living shorelines also enhance water quality through a variety of mechanisms.[97] The vegetation captures floating sediments in the water which both improves the quality of the water and also reduces turbidity.[98] The plants then serve as "carbon sinks" that store carbon dioxide.[99] Certain organisms actively consume contaminants in the water.[100] Because of this, living shorelines which incorporate suspension feeding species, such as barnacles, mussels or tube worms, serve to remove micro algae and suspended organic matter through the process of biofiltration.[101]

Finally, living shorelines foster aesthetically pleasing beaches.[102] Such aesthetic benefits have a subjective nonmonetary value to the community of beach enthusiasts who enjoy their natural beauty. There are also quantifiable economic benefits through increased coastal property values and beach tourism.[103]

iii. Engineering a Living Shoreline

Living shorelines can be employed in a variety of coastal settings, including ocean beaches, estuarine coasts, bays, and tributaries.[104] In selecting the appropriate location, design, and materials for an installation, consideration should be given to the geographic location, typography, sediment foundation, variations in wind and wave energy, and storm conditions.[105]

Certain detailed characteristics of the shoreline should be taken into consideration.[106] First, what are the sources and impacts of weather phenomena at the project location? This includes evaluation of wind

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97 *See* Bradford, *supra* note 74, at 1-2; Coleman, *supra* note 8, at 1; USACE Projects, *supra* note 13, at 13, 16.

98 USACE Projects, *supra* note 13, at 16.

99 *Id.*

100 *See* Bradford, *supra* note 74, at 1–2.

101 *See id.*; USACE Projects, *supra* note 13, at 13.

102 *See Understanding Living Shorelines*, NOAA Fisheries, https://www.fisheries.noaa.gov/insight/understanding-living-shorelines#what-are-the-main-benefits-of-living-shorelines? [https://perma.cc/WQQ6-RSAQ] (last visited June 26, 2025).

103 *See* USACE Projects, *supra* note 13, at 16.

104 NOAA Guidance, *supra* note 10, at 4.

105 *See id.* at 15; Tweel, *supra* note 85, at 13 (noting that oyster reefs are beneficial to prevention of erosion due to both wind and water influxes); Ruth Reef & Sabrina Sayers, *Wave Attenuation by Australian Temperate Mangroves*, 13 J. Marine Sci. & Eng'g 2, 12 (2025) (noting that mangroves are excellent protection against erosion due to wind forces); Weaver, *supra* note 91, at 3. Living shorelines may not be feasible at all locations, due to lack of unbuilt-lands, topography, or weather patterns. Griggs, *supra* note 13, at 575.

106 The U.S. Army Corps of Engineers recommends five broad areas of consideration in designing a living shoreline: 1) System Parameters such as erosion history and tidal range, 2) Ecological Parameters such as water quality, soil type, and sunlight exposure; 3) Hydro Parameters such as wind, waves, and currents; 4) Terrestrial Parameters such as slope, foundation strength, and

speeds, directions, and distance; daily and seasonal tidal range, as well as tidal incursions caused by storm surges or king tides; length, height, and force of waves, known as "wave energy"; and evaluation of the extent of previous erosion.[107]

Second, spatial and biological constraints of the project areas should be considered, including: the geographic size, including the horizontal length of the project along the shoreline and the inland and seaward width of the project; offshore water depths; the upland and shoreline slopes in and around the project area; the type and firmness of the substrate or foundational material; which species are best suited for success at a particular location and for a specified purpose; optimal location and density of plant installations; the existing (or previously existing) native habitat and wildlife, including seasonal wildlife such as nesting and spawning species; and size and location of existing human development and infrastructure, particularly with regard to their proximity to the project site.[108]

Based on evaluation of the foregoing, living shorelines can be engineered in several different ways. The design may be as simple as planting vegetation, such as mangrove trees; these will develop a root structure to hold sand and soil in place and develop vertical growth to slow waves and wind.[109] Correct vegetation can also provide flood water storage and filtration, as well as habitat and food for aquatic and littoral species.[110] Vegetation also adds aesthetic benefits to the area.[111] However, there are drawbacks to the use of only vegetation in a living shoreline. Most significantly, young plants may succumb to animal predation and erosive forces before they develop strong root systems.[112] Therefore, many living shorelines incorporate edging (long tubes filled with biological material) or sills (uneven natural barriers, such a large rocks and oyster/mussel reefs) along the tidal line to hold the vegetation

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offshore depth; and 5) additional considerations such as permitting and construction constraints. USACE Projects, *supra* note 13, at 25.

107 *See* Structural Measures, *supra* note 43, at 2; USACE Projects, *supra* note 13, at 25–27.

108 Structural Measures, *supra* note 43, at 2; Roma Bodycomb, *Kelp Aquaculture as a Nature-Based Solution for Coastal Protection: Wave Attenuation by Suspended Canopies*, 11 J. Marine Sci. & Eng'r 2 (2023); USACE Projects, *supra* note 13, at 28.

109 Structural Measures, *supra* note 43, at 3; USACE Projects, *supra* note 13, at 2.

110 Structural Measures, *supra* note 43, at 3.

111 Alexis Mooser et al., *An Innovative Approach to Determine Coastal Scenic Beauty and Sensitivity in a Scenario of Increasing Human Pressure and Natural Impacts Due to Climate Change,* Water, (2021), https://www.mdpi.com/2073-4441/13/1/49 [https://perma.cc/BE47-EV5D] (last visited Jul 31, 2025); NOAA Fisheries, *Understanding Living Shorelines*, https://www.fisheries.noaa.gov/insight/understanding-living-shorelines#what-are-the-main-benefits-of-living-shorelines? [https://perma.cc/WQQ6-RSAQ] (last visited June 26, 2025).

112 Madeleine Jepsen, *Seeding Shorelines*, https://storymaps.arcgis.com/stories/533455809e2347a8a0bced563d607a2d [https://perma.cc/QRG4-QQ7Y].

and sand/soil in place.[113] Some incorporate elements of hard armoring, particularly in areas of high wave energy, which is often referred to as a hybrid design.[114]

Commonly used biotic materials include oyster and mussel shells, oyster and mussel reefs, mangrove trees, sea weed, sea grass, kelp, rocks, natural fibers (often used as bags, pads, baskets or logs), wood and timber, and rocks.[115] Both the selection and the location of materials within the project site are important considerations for the success and longevity of a living shoreline.[116] Recognizing that most materials are living entities, optimal seasonal timing of installation and assurance of adequate sunlight for growth are also important considerations.[117]

The level of expertise needed to prepare and implement a living shoreline project varies according to the nature and scope of the project. Often, landscape architects with experience with coastal vegetation are needed.[118] Trained marine contractors may be needed for more intricate parts of the living shoreline project.[119] Ecologists should be consulted to ensure that proper plants and other materials are incorporated correctly to achieve project goals.[120] Actual installation of the plants and biotic material may not require specific expertise, however, and volunteers can be used to plant living shoreline vegetation.[121]

iv. Costs of a Living Shoreline

Generally, the costs of installation and ongoing maintenance for a living shoreline is less expensive than it is for a gray installation.[122] The initial installation cost of a gray infrastructure project is five to ten times more expensive than that of a comparable green infrastructure

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113 Structural Measures, *supra* note 43, at 3; USACE Projects, *supra* note 13, at 19–21.

114 USACE Projects, *supra* note 13, at 1.

115 Tweel, *supra* note 85, at 2; Chan, *supra* note 8, at 1518, 1525. Living shorelines may be "soft," meaning purely biotic materials, or "hybrid" in which some engineered structures are incorporated as well. Bodycomb, *supra* note 108, at 2; Nat'l Wildlife Fed'n, Softening Our Shorelines: Policy and Practice for Living Shorelines Along the Gulf and Atlantic Coasts 4 (2020); USACE Projects, *supra* note 13, at 19.

116 Tweel, *supra* note 85, at 15.

117 USACE Projects, *supra* note 13, at 22.

118 *Id.* at 33; *Living Shoreline Case Study - Shore Avenue Park*, The Nature Conservancy N. J., https://coastalresilience.org/wp-content/uploads/2019/11/Case_Study-Ship_Bottom.pdf [https://perma.cc/3WUQ-AMGC] (last visited August 1, 2025).

119 *Living Shoreline Training*, Sea Grant Fla., https://www.flseagrant.org/workforce-training/living-shorelines-training/ [https://perma.cc/TL85-DVMC] (last visited August 1, 2025).

120 *Can Living Shorelines Survive the Rising Seas?*, The Applied Ecologist (May 1, 2019) https://appliedecologistsblog.com/2019/05/01/can-living-shorelines-survive-the-rising-seas/ [https://perma.cc/KVU6-LYE3].

121 USACE Projects, *supra* note 13, at 15, 58.

122 *Id.* at 15.

project.[123] These cost savings are partially due to cheaper material costs, as plants are typically less expensive than concrete or steel.[124] There are also comparative cost savings during the project installation because living shorelines rarely require specialized equipment or labor.[125] As noted above, even volunteers can be used as the labor pool to plant vegetation.[126]

After installation, maintenance costs are also demonstrably less expensive for living shorelines. While maintenance costs are variable in both gray and green infrastructure projects, the anticipated cost to maintain a bulkhead or seawall installation over 50 years is approximately $500 per foot per year, while the cost over the same period to maintain a comparable living shoreline project is less than $100 per foot per year.[127]

v. The Need to Encourage Greater Use of Living Shorelines

Policymakers need to actively encourage the use of living shorelines to protect our coasts. Despite the many advantages of green infrastructure, living shorelines do not have the popularity and widespread use that gray infrastructure enjoys. There are a variety of reasons for this disparity. First, soft armoring is relatively new in American coastal management, becoming a common practice only during the last decade.[128] Thus, landowners, marine contractors and permitting authorities lack familiarity with the options and techniques for living shorelines.

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123 *Id.* at 15. There are many examples of the cost differential in materials used for living shorelines versus hard armoring installations. One study found that riprap revetments costs $120-$180 per foot versus natural fiber mats which costs less than one dollar per foot. *Id*. Grey wave attenuation material such as rock and wood can range in cost from $60 to $250 per foot which comparable oyster shells cost from $45 to $55 per cubic yard.

124 A study by the Mississippi-Alabama Sea Grant Consortium along the Gulf of Mexico coastline found the installation cost for vegetative living shorelines to range from $1.30 to $3.50 per foot. *Id.*

125 *Id.*

126 *Id.* at 15 & 58.

127 *Id.* at 15. The Florida Fish and Wildlife Conservation Commission (FFWCC) presented a data summary indicating dramatic differences in the cost and longevity of soft armoring (including plantings and oyster bags) installation and maintenance costs versus the same costs for hard armoring (including revetments, breakwaters, bulkheads and retaining walls) in Atlantic and Gulf Coast States. Fla. Fish & Wildlife Conservation Comm'n, *A Landowner's Guide to Living Shorelines in Florida* 24 (2021), https://www.nccoast.org/wp-content/uploads/2021/06/FL-LS-Manual_Final_.pdf [https://perma.cc/YN8K-TMDT]. Such installation costs for soft armoring ranged from $45-$700 while hard armoring for comparable uses ranged from $500-$3,370. *Id.* Maintenance for hard armoring was also significantly more expensive, estimated to be between 50-100% of the installation costs while soft armoring was estimated to be 10-20% of the installation costs. *Id.* Ironically, despite the much less expensive maintenance costs, living shorelines had an indefinite lifespan, while hard armoring was measured in decades. *Id.*

128 *Id.* at 1, 17.

The relative newness of living shoreline solutions means that there is less data to demonstrate their long-term sustainability and efficacy as erosion prevention techniques.[129] Due to their reliance on materials that require growth over a term of years to reach maturity, few living shoreline projects have reached their full potential.[130] Consequently, data from projects installed within the last few years may not demonstrate the full benefit of the project since the vegetation, particularly trees, may not have reached their maturity.[131]

This lack of fully mature projects also leaves a dearth of data regarding best practices and materials. Since living shoreline projects serve a variety of purposes (i.e., erosion prevention and rehabilitation, flood mitigation, wind buffering, habitat restoration, etc.), there are many different installation designs and materials which have been explored for each purpose. Long-term data is necessary to evaluate which materials and structural designs are better, with consideration of the wide variety of coastal settings (i.e., sandy beaches, marshes, rocky cliffs, etc.) where a living shoreline may be used.

The relative newness of living shoreline technology is also the cause of its second significant hurdle: the lack of implementing legislation. As with most coastal development projects, living shoreline installations require permitting from governments, often including federal and state agencies, as well as potentially cities and counties.[132]

Despite the many advantages of green infrastructure, living shorelines do not have the popularity and widespread use that gray infrastructure enjoys. The purpose of the following section is to review existing regulatory frameworks for living shorelines and discuss the regulatory hurdles that continue to limit greater use of this technology. Then, this Article will conclude with recommendations for policymakers seeking to expand the use of coastal living shorelines.

B. Federal Regulation of Living Shorelines

There are a variety of federal regulations that may impose permitting requirements on living shorelines, including the Clean Water Act,

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129 Some experts posit that sufficient data is available but not readily accessible, and this lack of access to data about living shorelines is another hurdle to their successful development. *Id.* at 39.

130 Smith, *supra* note 67, at 2656. Living shorelines become more efficient and more resilient as they age, while hard infrastructure tends to be its strongest at the time it is installed and weaken over time. *Id*.

131 This lack of long-term data is not just detrimental to the expanded use of living shorelines but also leaves a dearth of information on best materials and techniques. There are highly specific engineering questions still under analysis, such as whether oyster reefs are better than bagged oyster to encourage sand accumulation or are rocks better than timber for long-term sustainability of a living shoreline in areas with strong tidal forces. Chan, *supra* note 8, at 1525.

132 USACE Projects, *supra* note 13; Nat'l Wildlife Fed'n, *supra* note 115.

the Rivers and Harbors Act, the Coastal Zone Management Act, the Endangered Species Act, and the Magnuson-Stevens Fisheries Conservation and Management Act.[133] These laws designate a group of federal agencies with permitting responsibility over coastal development projects, including the Environmental Protection Agency ("EPA"), the U.S. Fish and Wildlife Service ("FWS"), the National Marine Fisheries Services ("NMFS"), the National Oceanic and Atmospheric Administration ("NOAA"), and the U.S. Army Corps of Engineers ("Corps"), respectively.[134]

The federal law which has an obvious role in development of living shoreline policies is the Clean Water Act ("CWA"). This law is designed to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[135] This goal is accomplished, in part, by a prohibition upon the "discharge of any pollutant" in the nation's waters, unless the polluter seeks and receives a National Pollutant Discharge Elimination System (NPDES) permit from the Environmental Protection Agency (EPA).[136] The CWA definition of "pollutant" is broad and includes both rock and sand, both of which are common fill material used in living shorelines.[137]

Section 404 of the CWA delegates permitting authority to the Corps, rather than the EPA, if the project involves "the discharge of dredged or fill material into the navigable waters" of the United States.[138] Thus, the Corps is the permitting entity involved where any sediment is excavated or dredged from a navigable water body and also where any material is deposited or filled into a navigable water body.[139]

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133 Endangered Species Act of 1973, 16 U.S.C. §§ 1531–44 (2024); Federal Water Pollution Control Act ("Clean Water Act"), 33 U.S.C. § 1251, *et seq.* (as amended through Pub. L. 118-198 (2024)); Act of March 3, 1899 ("Rivers and Harbors Appropriation Act"), 33 U.S.C. § 403, *et seq.* (as amended through Pub. L. No. 118-272 (2025)); Coastal Zone Management Act, Pub. L. No. 92-583, 16 U.S.C. §§ 1451-1466 (1972) as amended; Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1801 *et seq.* (as amended through Pub. L. No. 118-229 (2025)).

134 *See supra* note 133.

135 33 U.S.C. § 1251 (2024).

136 33 U.S.C. § 1342 (Section 402) (2024).

137 33 U.S.C. § 1362 (Section 502) (2024).

138 *Id.* The EPA retains some oversight of Corps permits under Section 404(b)(1), including the ability to place on probation the issuance of a permit which will have "unacceptable adverse impact" on ecosystems "of concern" and/or "municipal water supplies, shellfish beds and fishery areas… wildlife, or recreational areas." 33 U.S.C. § 1344. The CWA does anticipate a scenario in which a state might seek to administer its own permitting framework for dredged and fill material into certain navigable waters and creates a process by which the state may establish such a program through state legislation or an interstate compact. *Id.*, at (g)(1). However, such a permitting framework must be approved by the EPA subject to federal parameters. *Id.*, at (g).

139 Under Section 502, the CWA defines various waters in the following manner: "Navigable Waters" means the waters of the United States, including the territorial seas; "Territorial Seas" means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland

Such authority complements the Corps' permitting obligations under Section 10 of the Rivers and Harbors Act to regulate "any obstruction" to the "navigable capacity of any waters of the United States."[140] This Act allocates specific permitting authority to the Corps regarding any activity which will "excavate or fill, or in any manner to alter or modify the course, location, condition, or capacity of, any port, roadstead, haven, harbor, canal, lake, harbor of refuge, or enclosure within the limits of any breakwater, or of the channel of any navigable water . . ."[141]

Because dredging and filling of soil, sand, rocks, and other matter are common actions in living shorelines, the Corps has significant permitting authority over these projects.[142] Most installations affecting waters on the seaward side of the mean high tide line will require a permit from the Corps.[143] This authority, in turn, has given the Corps significant experience with coastal permitting and development of streamlined permit procedures.

As a designated permitting entity of several federal laws, including the CWA and the Rivers and Harbors Act, the Corps has extensive experience in drafting permitting rules.[144] Its permitting authority

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waters, and extending seaward a distance of three miles; "Contiguous zone" means the entire zone established or to be established by the United States under Article 24 of the Convention of the Territorial Sea and the Continuous Zone; and "Ocean" means any portion of high seas beyond the contiguous zone. 33 U.S.C. § 1362 (Section 502) (2024). For the purposes of living shoreline regulation, definitions applicable to Navigable Waters and Territorial Seas are most relevant as they are the areas within which a living shoreline project would be located.

140 Rivers and Harbors Act, 33 U.S.C. § 403 (Section 10) (2025).

141 33 U.S.C. § 403 (2025).

142 Endangered Species Act of 1973, 16 U.S.C. §§ 15351–44 (2024) (The Endangered Species Act requires permitting from the National Marine Fisheries Services if a project will affect an endangered or threatened marine species and/or permitting from the U.S. Fish and Wildlife Service (FWS) if a living shoreline project will affect an endangered or threatened land or freshwater species). The Magnuson-Stevens Fishery Conservation and Management Act 38 U.S.C. § 1891(d) (2024) (The Magnuson-Stevens Fishery Conservation and Management Act may require NOAA approval if the living shoreline project incorporates commercial fishing activities or affects fish habitats); National Historic Preservation Act of 1966, 54 U.S.C. §§ 3003061–7108 (2024) (The National Historic Preservation Act may limit project parameters if the area of the project threatens historic or prehistoric buildings, structures, or artifacts).

143 Nat'l Wildlife Fed'n, *supra* note 115, at 6; Geographic and Jurisdictional Limits of Oceanic and Tidal Waters, 33 C.F.R. § 329.12(a)(2) (2024).

144 Brandon, *Impervious to Facts*, *supra* note 76, at 563–4. A sampling of some Corps permitted projects include: U.S. Army Corps of Eng'rs, Jacksonville Dist., *Flagler County Coastal Storm Risk Management Project 2024*, https://www.saj.usace.army.mil/Missions/Civil-Works/Shore-Protection/Flagler-County/ [https://perma.cc/P3W2-WGJG] (last visited Aug 1, 2025); U.S. Army Corps of Eng'rs, Jacksonville Dist., *Flagler County, Florida Hurricane and Storm Damage Reduction Project* (2014), https://www.saj.usace.army.mil/Portals/44/docs/Shore Protection/Flagler_County_HSDR/FLAGLER_CWRB_PLACEMAT_FINAL_082114_a.pdf [https://perma.cc/GR49-6HYW] (last visited Aug 1, 2025); U.S. Army Corps of Eng'rs, N.Y. Dist., *Fire Island to Montauk Point (FIMP)*

includes individual or "standard" permits as well as general permits. The individual permit process is required "when projects have more than minimal individual or cumulative impacts, are evaluated using additional environmental criteria, and involve a more comprehensive public interest review."[145] Such individual permits require a case-by-case analysis of all aspects of the project.[146] General permits may be issued in lieu of an individual permit when the "structures, work, or discharges that will result in only minimal adverse effects."[147] General permits are intended to streamline and expedite review of development projects, and in some cases, even waive permitting requirements.[148] They create an easier, quicker, and less expensive process for the application and the application review, benefiting both the applicant and the Corps.[149] General permits fall into three categories: Nationwide Permits ("NWP"), Regional General Permits ("RGP"), and Programmatic General Permits ("PGP").[150] As the names imply, Nationwide Permits are used throughout the country, Regional General Permits are used within specific geographic areas, and Programmatic General Permits are used in circumstances where there is already a federal, state, or local regulatory program that should not be duplicated by the Corps' permitting activities.[151]

Due in part to their ability to adapt to rising sea levels, the Corps has recognized and expressed interest in greater use of living shorelines to develop "social, economic, and environmental resilience."[152] The Corps

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Coastal Storm Risk Management Project, https://www.nan.usace.army.mil/Missions/Civil-Works/Projects-in-New-York/Fire-Island-to-Montauk-Point/ [https://perma.cc/XRH3-BUQW] (last visited Aug 1, 2025); *and* U.S. Army Corps of Eng'rs, N.Y. Dist., *Fact Sheet- Fire Island to Montauk Point, NY* (2024), https://www.nan.usace.army.mil/Media/Fact-Sheets/Fact-Sheet-Article-View/Article/2407147/fact-sheet-fire-island-to-montauk-point-ny/ [https://perma.cc/TJW4-KC9B] (last visited Aug 1, 2025).

145 *Regulatory Program and Permits: Obtain a Permit*, U.S. Army Corps of Eng'rs, https://www.usace.army.mil/Missions/Civil-Works/Regulatory-Program-and-Permits/Obtain-a-Permit/ [https://perma.cc/JK5G-TD9H] (last visited June 4, 2025) [hereinafter *Regulatory Program and Permits*].

146 U.S. Army Corps of Eng'rs, Mobile Dist., https://www.sam.usace.army.mil/Missions/Regulatory/Permit-Types/ [https://perma.cc/GP29-D657] (lasted visited Jun. 18, 2025) (individual permits may be in the form of a Standards Permit or a Letter of Permission).

147 *Regulatory Program and Permits*, *supra* note 145.

148 Brandon, *Impervious to Facts*, *supra* note 76, at 566, 570 (the Corps is authorized to review individual permit applications on a case-by-case basis or, if there is a minimal risk of harm to the environment, under general permit standards).

149 *Id*. at 570.

150 Nationwide Permit Program, 33 C.F.R. § 330.1 (2025) (authorizing the Army to "issue, modify, suspend, or revoke nationwide permits; to identify conditions, limitations, and restrictions on the nationwide permits; and, to identify any procedures, whether required or optional, for authorization by nationwide permits"). *See also Regulatory Program and Permits*, *supra* note 145.

151 *Id*.

152 USACE Projects, *supra* note 13, at 3.

is subject to a mandate in the federal Water Resources Development Act to reduce flood and storm damage and restore aquatic ecosystems in such a manner which "to the maximum extent practicable, seek[s] to incorporate natural features and nature-based features."[153] Interestingly, the Water Resources Development Act also mandates that the Comptroller General analyze the use of nature-based features by the Corps in its various projects and any hurdles, regulatory or otherwise, which limit the ability of the Corps to incorporate such nature-based features.[154]

The Corps has taken steps in recent years to encourage the installation of living shorelines , albeit typically in conjunction with gray infrastructure.[155] The Corps has generated many studies and reports to provide guidance on best practices, important considerations, and examples of various completed living shoreline projects.[156] Through a partnership with NOAA, the Nature Conservancy, the Conservation Fund, and other entities, the Corps has also developed a resiliency practice repository called the Systems Approach to Geomorphic Engineering ("SAGE").[157] The SAGE program seeks to encourage planning, policy, research, and outreach regarding the use of nature-based solutions for coastal resiliency.[158] In partnership with another Corps program, USACE Engineering With Nature, SAGE also provides directives and case studies for financing nature-based resiliency projects.[159] In 2025, the Corps' Ecosystem Management and Restoration Research Program published an extensive technical report focused on expanding the use of living shorelines in Corps projects.[160] This study provided great detail on a variety of topics, including design and construction standards, training and educational resources, results of existing projects, regulatory standards, and recommendations for expanding use of living shorelines.[161] A top recommendation from this report was for the Corps to provide

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153 Water Resources Development Act of 2024, Pub. L. 118-272, 138 Stat. 3007 § 1108(b)(2) (2025); USACE Projects, *supra* note 13, at 24.

154 Water Resources Development Act of 2024 § 1242(n).

155 Structural Measures, *supra* note 43, at 2; USACE Projects, *supra* note 13, at 1 (many design experts recommend that living shorelines should incorporate hard armoring, a hybrid design, in high-energy settings).

156 USACE Projects, *supra* note 13 at 74.

157 Structural Measures, *supra* note 43, at 2.

158 *Systems Approach to Geomorphic Engineering (SAGE)*, U.S. Army Corps of Eng'rs, Inst. for Water Res., https://www.iwr.usace.army.mil/SAGE/ [https://perma.cc/D3JT-DWWV] (last visited June 6, 2025).

159 *Funding and Financing Natural Infrastructure: Best Practices and Lessons Learned*, U.S. Army Corps of Eng'rs, Inst. for Water Res., https://www.iwr.usace.army.mil/SAGE/Funding-Finance/ [https://perma.cc/9V7Z-FP6N] (last visited June 6, 2025).

160 USACE Projects, *supra* note 13, at 2–3.

161 *Id.* at iii-iv, 72, 83.

specific design standards and best practices to its offices in coastal states.[162]

In 2017, the Corps also created NWP 54, a new nationwide permit to authorize certain soft armoring projects which can be used to develop living shoreline projects.[163] The parameters of this NWP are set forth in a robust 26 page document providing directions and parameters for applicants seeking a general permit for a living shoreline project.[164] Following this NWP enables an applicant for a living shoreline installation to combine the permitting review under both the Rivers and Harbors Act and the CWA.[165]

NWP 54 defines a living shoreline as a project which "has a footprint that is made up mostly of native material. It incorporates vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline structure (e.g., oyster or mussel reefs or rock sills) for added protection and stability."[166] Use of NWP 54 is limited to projects which extend no further than "30 feet from the mean low water line in tidal waters" and "no more than 500 feet in length along the bank."[167] Several other specifications are identified as parameters for permitting approval, including required use of native plants and

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162 *Id*. at 80.

163 Nationwide Permit 54: Living Shorelines, 86 Fed. Reg. 73,522, (Dec. 27, 2021) [hereinafter NWP 54]; Reissuance & Modification of Nationwide Permits, 86 Fed. Reg. 73,522, 73,581-82 (Dec. 27, 2021) (Nationwide Permit 54, Living Shorelines, effective Feb. 25, 2022 – Mar. 14, 2026). There are other NWPs which may be applicable to a living shoreline project, including Bank Stabilization (NWP 13), Minor Discharges (NWP 18), Minor Dredging (NWP 19), Aquatic Habitat Restoration, Establishment, and Enhancement Activities (NWP 27), Commercial Shellfish Mariculture Activities (NWP 48), Seaweed Mariculture Activities (NWP 55), Finfish Mariculture Activities (NWP 56). *Id.* at 73,522; Reissuance and Modification of Nationwide Permits, 86 Fed. Reg. 2,744 (Jan. 13, 2021); U.S. Army Corps of Eng'rs, 2021 Nationwide Permit General Conditions 1-2, https://www.poh.usace.army.mil/Portals/10/docs/Regulatory/2021_Nationwide_Permit_General_Conditions.pdf [https://perma.cc/ES6R-WACB] (last visited Aug. 1, 2025) [hereinafter 2021 Nationwide Permit General Conditions]; USACE Projects, *supra* note 13, at 78–79. Thus, depending upon the specific scope of a living shoreline project, it may require more than one NWP and might also require an RGP, PGP, or individual permitting. 2021 Nationwide Permit General Conditions at 1, 11, 14; USACE Projects, *supra* note 13, at 78.

164 NWP 54, *supra* note 163. The Corps also provided "Tips for Success (Permitting and Project Goals)" in a coastal resilience presentation. *Living Shorelines and Nationwide Permit #54*, U.S. Army Corps of Eng'rs, https://coastalresilience.org/wp-content/uploads/2020/01/USACE-Living-Shorelines-and-Nationwide-Permit-54.pdf [https://perma.cc/3C2D-QE5K] (last visited Aug. 5, 2025). These tips included advice to "clearly articulate the purpose and the need" for the living shoreline based on engineering or scientific data and ensure compliance with NWP 54. *Id*. at 19; Brandon, *Impervious to Facts*, *supra* note 76, at 560.

165 *USACE Nationwide Permit 54 - Living Shorelines*, Sustainable Conservation, https://acceleratingrestoration.org/permits/nationwide-permit-54-living-shorelines/ [https://perma.cc/B2TD-9SSH] (last visited May 25, 2025).

166 NWP 54, *supra* note 163, at 1.

167 *Id*. at 1. A project may extend further only if the district engineer makes a written determination that such extension(s) will not have more than minimal adverse environmental effects. *Id.*

design standards which minimize adverse effects on the water body and the shoreline.[168] Perhaps in an acknowledgment that beach nourishment projects do little to protect wildlife habitats, stop erosion, or limit flooding, the Corps specifically excludes beach nourishment and land reclamation activities from NWP 54.[169] Also of note, an NWP 54 permit requires maintenance and repair of the living shoreline, including both soft and hard elements.[170] This allowance for future repairs saves project administrators the time and expense of seeking permit modifications or renewals when such repairs or adjustments become necessary. In general, NWP 54 is intended to encourage greater use of living shorelines, albeit those of a limited size and scope. For projects which exceed the scope of an NWP 54 permit, the applicant will need to either seek waivers to the problematic aspects of NWP 54 or pursue an individual permit for those elements or the entire project.

Another nationwide permit first developed by the Corps in 2017 is NWP 27, which regulates "Aquatic Habitat Restoration, Enhancement, and Establishment Activities" and therefore may also be part of the regulatory review for a living shoreline.[171] NWP 27 is generally intended for projects which will restore and enhance non-tidal waters, such as rivers, streams, and wetlands.[172] An NWP 27 permit might be used where a coastal living shoreline project involves or directly affects non-tidal waters or wetlands, but it is not common for coastal permitting.[173]

Despite the Corps' various studies and reports, in a study published in 2025 in conjunction with NOAA and the University of Virginia, the Corps acknowledged that despite these efforts, there is "limited guidance on proven techniques to aid in design and construction of [living shoreline] projects, geographic differences, and applicability of

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168 *Id*.

169 *Id*. at 2.

170 *Id*.

171 Issuance & Reissuance of Nationwide Permits, 82 Fed. Reg. 1,860, 1,989 (Jan. 6, 2017) (Nationwide Permit 27, Aquatic Habitat Restoration, Enhancement & Establishment Activities) (effective Mar. 19, 2017 – Mar. 18, 2022).

172 *Id*.

173 *Id.* Several types of marine construction are listed as appropriate for the NWP 27, including activities directly relevant to living shorelines: "the construction of small nesting islands; the construction of open water areas; the construction of oyster habitat over unvegetated bottom in tidal waters; shellfish seeding; activities needed to reestablish vegetation, including plowing or discing for seed bed preparation and the planting of appropriate wetland species; re-establishment of submerged aquatic vegetation in areas where those plant communities previously existed; re-establishment of tidal wetlands in tidal waters where those wetlands previously existed…" *Id.* There are differences in measures used in a NWP 27 permit as compared to a NWP 54 permit of which practitioners should be aware. These projects must mimic an "ecological reference" which is an "intact aquatic habitat or riparian area of the same type that exists in the region," or for regions lacking an intact ecological area, "may be based on a conceptual model developed from regional ecological knowledge of the target aquatic habitat type or riparian area." *Id.*

available resources, as well as paradigm constraints over the lack of trust in the ability of the [living shoreline] approach to protect shorelines and coastal systems against adverse natural conditions such as flooding and storm surge."[174] This demonstrates that the Corps, as the primary federal authority on coastal armoring, is not doing enough to stimulate the use of living shorelines.

There has been ongoing criticism of the Corps' continued reliance on hard armoring for erosion and flood control, both within living shoreline projects and as stand-alone gray infrastructure projects.[175] Such reliance is evidenced by NWP 13, "Bank Stabilization," which creates a simpler review and permitting process for gray infrastructure than what is provided by NWP 54.[176] In 2017, the Corps adopted NWP 13 standards which allow property owners to build seawalls and bulkheads up to 500 feet in length without a permit—in fact, without even a requirement to notify the Corps of this construction activity.[177]

Even where a permit is required, NWP 13 is less restrictive than an NWP 54 permit in several ways. NWP 54 is limited to living shoreline projects that are 30 feet or less from the mean low water line; limit any effect on water movement or movement of aquatic organisms between the waterbody and the shore to the minimal extent possible; and limit sills and breakwaters to the minimum size necessary to protect fringe wetlands.[178] None of these requirements are part of the NWP 13 permitting process. Further, hard armoring under NWP 13 allows beach nourishment and temporary structures, neither of which are options under the NWP 54.[179] Thus, while NWP 54 may ease federal permitting of some living shoreline projects, the Corps continues to provide an easier route for property owners to use hard armoring in their shoreline stabilization efforts.[180] Lastly, the more relaxed permitting requirements, and associated cost and time savings allowed by NWP 13, may steer

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174 USACE Projects, *supra* note 13, at 24.

175 Structural Measures, *supra* note 43, at 2; USACE Projects, *supra* note 13, at 1–2 (noting that living shorelines should incorporate hard armoring in high-energy settings); Brandon, *Impervious to Facts*, *supra* note 76.

176 Brandon, *Impervious to Facts*, *supra* note 76, at 557.

177 U.S. Army Corps of Eng'rs, Nationwide Permit 13: Bank Stabilization (2022); Brandon, *Impervious to Facts*, *supra* note 76, at 560, 581. (noting that the waiver process has been used repeatedly by the Corps to allow bulkhead much larger than 500 feet).

178 NWP 54, *supra* note 163.

179 *Id.*

180 Nat'l Wildlife Fed'n, *supra* note 115, at 12. Many scholars and environmentalists view NWP 13 to be violative of the Clean Water Act, since most gray armoring structures result in significant adverse environmental impacts, including habitat destruction and greater erosion on the seaward side of the structure. Brandon, *Impervious to Facts*, *supra* note 76, at 560–561, 572 (noting that in addition to ecological concerns posed by the hard armoring supported by NWP 13, there is also concern that greater use of hard armoring negatively affects neighboring properties which is an environmental justice concern).

coastal property owners away from pursuing a living shoreline project in order to use the easier permitting process for hard armoring structures.

While over the last decade the Corps has taken incremental steps to encourage living shorelines, its slow pace toward normalizing this technology as a method of shoreline stabilization has been a distinct hurdle to greater use of living shorelines. Recent proposed changes to NWP 13 indicate that the Corps will require incorporation of nature-based solutions which provide wildlife habitats to be incorporated into a hard armoring bank stabilization project, as well as consideration of whether a soft armoring approach may work better,[181] but to truly incentivize living shorelines in lieu of hard armoring, the Corps will need to take more aggressive steps to shift permitting incentives toward living shorelines. These include creating exemptions for certain, small-scale living shoreline projects, which is at least as inclusive as the NWP 13 exemption for small-scale hard armoring projects. The Corps should also ease the general permitting requirements for NWP 54, such as the size and scope of the projects which can be allowed under NWP 54.

C. State Regulations

The United States has twenty-two coastal states with shorelines along the Atlantic or Pacific Ocean.[182] These states have sovereign jurisdiction over development of their coastal areas which may overlap with common law and regulatory jurisdiction of the federal government.[183] It would stand to reason that coastal states would adopt policies to encourage greater use of living shorelines to enhance their coastal resiliency. Unfortunately, policies specific to living shoreline projects are rare and incentives are practically nonexistent. Among coastal states, approximately a dozen states have instituted regulations or codes to encourage greater use of living shorelines, including Louisiana, Alabama, Delaware, California, New Jersey, New York, South Carolina, North Carolina, Maryland, Washington, and Florida.[184] However, there is a wide disparity amongst coastal states in their approaches to living

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181 U.S. Army Corps of Eng'rs, Summary of the Proposed 2026 Nationwide Permits 3 (2025), https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll9/id/3134 [https://perma.cc/K64B-QDKH]; U.S. Army Corps of Eng'rs, Draft Decision Document Nationwide Permit 13, 3, 7, 57 (2025) https://usace.contentdm.oclc.org/utils/getfile/collection/p16021coll9/id/3088 [https://perma.cc/6HED-M2YB].

182 World Population Review, https://worldpopulationreview.com/state-rankings/coastal-states [https://perma.cc/P852-CX78] (last visited Nov. 20, 2025).

183 John A. Duff, *The Coastal Zone Management Act: Reverse Pre-Emption or Contractual Federalism*, 6 Ocean & Coastal L.J. 109, 110 (2001).

184 USACE Projects, *supra* note 13, at 77; Nat'l Wildlife Fed'n, *supra* note 115.

shoreline regulation.[185] While a few states have developed regulatory frameworks specific to the development of living shorelines, other states rely on general coastal development codes to review these projects and default to regulator discretion in developing living shoreline permits.

i. State Assumption of Permitting Responsibilities

Amongst those states which directly regulate coastal armoring activities, their legislative frameworks may overlap, complement, or exceed federal regulations. However, state regulations may not weaken or invalidate the federal regulations. Congress has developed several legal processes by which state regulations may coexist with federal regulations; one example is a provision in the CWA which allows a state to assume both federal and state permitting authority, a process commonly referred to as "assumption."[186] Through the assumption process, a state can collaborate with the Corps and the EPA to develop a streamlined, potentially "single-stop" permitting process within that state for dredging and filling activities.[187] Once such a plan is adopted, the state assumes federal permitting responsibilities.[188] A core tenant of assumption is that the state process must be at least as protective of environmental resources as the federal permitting process would be.[189] Assumption is not common, however, with only two states having active assumption status to date: New Jersey and Michigan.[190] Thus, the process of protecting shorelines through assumption is not a method currently available to the majority of coastal states.

Fortunately, assumption is not the only method by which a state's coastal regulations may operate alongside federal regulations. Per the CWA, any state may adopt more stringent regulations and broader

185 Coastal states use different benchmarks which trigger a permitting mechanism; however, a common feature is activities which impact coastal waters, submerged lands, or shorelines. *See* Nat'l Wildlife Fed'n, *supra* note 115, at 28–63.

186 404 State Program Regulations, 33 U.S.C. Title 40, Chapter 1, Subchapter H, Part 233.1; *see also* Susan Roeder & Rachael Santana, *State Assumption of the Clean Water Act Section 404 Permitting Program: Part I, An Overview*, 95 Fla. Bar J. 38 (2021).

187 Under the CWA, the EPA is vested with the authority to establish procedures and parameters under which a state may assume CWA permitting authority and to approve or deny assumption applications. 404 State Program Regulations, *supra* note 186; *see generally* Roeder, *supra* note 186.

188 404 State Program Regulations, *supra* note 186.

189 404 State Program Regulations, *supra* note 186; Roeder & Santana, *supra* note 186.

190 Roeder & Santana, *supra* note 186. The EPA had approved an assumption program for the State of Florida in 2020. However, in 2024, the federal circuit court for the District of Columbia invalidated that approval and divested Florida of such authority. Center for Biological Diversity, et al. v. Regan, et al., 597 F. Supp. 3d 173 (D.D.C. 2022). Florida challenged this order to the U.S. Court Appeals for the D.C. Circuit on April 15, 2024. Notice of Appeal, Center for Biological Diversity, et al. v. Michael S. Regan, et al., 1:21-cv-00119-RDM (D.C. Cir. Apr. 14, 2024). As of the date of this writing, such appeal is pending.

programs than those set forth in the Act.[191] Several coastal states have regulations regarding coastal development, even some directly addressing living shorelines, which work in conjunction with Corps permitting. However, through the assumption process, a state can greatly simplify the coastal permitting processes within its borders.

ii. Joint State and Federal Permitting Responsibilities

The Coastal Zone Management Act ("CZMA") creates an avenue for states to shape their coastal laws and policies to encourage living shorelines despite reluctance to adopt this technology on the part of the federal government.[192] Congress enacted the CZMA in 1972 with the purpose of promoting coordination among federal agencies and the various agencies of states and territories tasked with coastal resource protection.[193]

The CZMA contains several provisions to clarify the shared authority between government agencies and to help with resource conservation.[194] First, the Act encourages states to develop Special Area Management Plans (often referred to as Coastal Management Programs or CMPs) to protect natural resources and preserve economic growth in coastal zones, even if such coastal zones are already subject to federal regulatory authority.[195] States which have an adopted and approved

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191 404 State Program Regulations, *supra* note 186.

192 Coastal Zone Management Act, Pub. L. 92-583, 16 U.S.C. §§ 1451–1466 (1972) as amended. The Declaration of Policy states, in part: "(1) to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations; (2) to encourage and assist the states to exercise effectively their responsibilities in the coastal zone through the development and implementation of management programs to achieve wise use of the land and water resources of the coastal zone …" *Id.* at § 1452.

193 *Id.*

194 The CZMA, along with the Submerged Land Act, also delineates areas of primary regulatory authority within coastal waters as between the federal and state governments such that states have general authority over the submerged lands, waters, and natural resources within three nautical miles of the coastline. 43 U.S.C. § 1312 (2018); 16 U.S.C. § 1456 (2018).

195 The definition of a Special Area Management Plan is "a comprehensive plan providing for natural resource protection and reasonable coastal-dependent economic growth containing a detailed and comprehensive statement of policies; standards and criteria to guide public and private uses of lands and waters; and mechanisms for timely implementation in specific geographic areas within the coastal zone." 16 U.S.C. § 1453. As long as states include certain required standards, they may draft their CMPs to address a variety of matters, including their coastal zone boundaries, coastal issues of importance to the state, and policies to advance the state's goals in regard to coastal resource protection and management. 16 U.S.C. §§ 1454, 1455(b). *See also* Eva Lipiec, Cong. Rsch. Serv., R45460, Coastal Zone Management Act (CZMA): Overview and Issues for Congress, at fig. 1 (2025), https://www.congress.gov/crs-product/R45460 [https://perma.cc/R6W4-4SEU].

CMP are authorized to enact a wide variety of coastal regulations, so long as such laws do not weaken federal coastal protections.[196]

In support of state CMPs, the CZMA requires federal agencies undertaking any action which will affect a state's coastal zone to ensure that such activity is "carried out in a manner which is consistent to the maximum extent practical with the enforceable polices of [a CMP]" and provide a written "consistency determination" to that state.[197] Federal actions which require consistency determinations include permits issued by the Corps, EPA, and NOAA.[198] In general, the CZMA consistency determination process does not guarantee the state plan will supersede the federal activity, but it does provide certain rights and due process to the state that encourage greater cooperation and even deference to state policy.[199] The CZMA consistency determination with regard to a federal permitting action gives a state regulation even more precedence: if a state objects to the issuance of a federal permit based upon consistency with the state CZMA, the federal agency is prevented from issuing that permit unless the Secretary of Commerce overrides the state's objection.[200]

This grant of power to states that have an approved CMP is demonstrated by Alabama's coastal management program. Alabama has codified its preference for living shorelines in both its legislative regulations and its administrative code, expressly stating a legislative purpose "to encourage the use of living shoreline techniques in coastal areas in lieu of vertical seawalls, revetments, or bulkheads…"[201] Alabama has

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196 The CZMA grants authority over approval of CMPs to the Secretary of Commerce, which has in-turn been delegated to NOAA's Office for Coastal Management. Lipiec, *supra* note 195. As relevant to coastal living shoreline projects, the areas which are included in the definition of "coastal zone" include coastal waters, submerged lands, adjacent shorelines (to the extent necessary to control shorelines) and adjacent waters, and beaches "seaward to the outer limit of State title and ownership under the Submerged Lands Act (43 U.S.C. § 1301 et seq.)." 16 U.S.C. § 1453.

197 16 U.S.C. § 1456. Federal consistency requirements apply to any federal actions which have a reasonably foreseeable effect on state or interstate coastal uses or resources. This includes activities within the state's coastal zone as well as nearby federal waters and even out-of-state waters which have an interstate effect. Lipiec, *supra* note 195. The CZMA does retain federal supremacy where a state determination would violate or contradict a federal law. States gain this right to oversight by participation in the National Coastal Zone Management Program (NCZMP) (which is further discussed above). *Id.*

198 *Id*. The state review of a federal permit is known as a "consistency determination review." *Id.*

199 Lipiec, *supra* note 195.

200 16 U.S.C. § 1456; *see also* Lipiec, *supra* note 195. Of note, between 1978 and January of 2025, there were 50 appeals of consistency decisions, in which the Secretary overruled the state's objection in 17 cases and agreed with the state's objection in 33 cases. *Id*. at 12.

201 Ala. Code § 9-7-13.1 (2024); Ala. Admin. Code r. 335-8-1 (2024); Ala. Admin. Code r. 335-8-2 (2024). Within the Alabama administrative code, most hard armoring structures are only permitted under certain demonstrated conditions, including a finding that "there are no feasible non-structural alternatives . . . [such as] . . . preservation and restoration of dunes, beaches, wetlands,

incorporated this preference for living shorelines within its CMP by expressly stating its policy to "encourage the use of living shorelines."[202] Thus, any federal permitting must take the State preference for living shorelines into account, and the federal government cannot easily permit hard armoring along Alabama's coast.

The Alabama Department of Environmental Management also collaborated with the Corps to develop a Regional General Permit ("RGP") in order to simplify permitting for living shoreline projects within the State.[203] This RGP incorporates Alabama's policy to encourage living shorelines.[204] The regulatory framework and permitting standards used in Alabama demonstrate the strength of state preferences under an approved CMP and the opportunities that can be created to encourage living shorelines.

Another state which has used the CZMA to ensure its own coastal management preferences are respected by federal permitting authorities is Louisiana. Upon making a determination that neither NWP 13 nor NWP 54 sufficiently protect its coastal resources, Louisiana has "disavow[ed]" both types of nationwide permitting, effectively preventing coastal landowners from using either NWP to streamline federal permitting.[205] Louisiana has also codified a strong preference for soft armoring by requiring property owners to use "nonstructural methods of shoreline protection."[206] By removing the incentives toward gray infrastructure fostered by NWP 13, it has created a more level "playing field" between gray and green infrastructure choices.[207]

Like Alabama, Louisiana collaborated with the Corps to develop a PGP, known as the New Orleans District Programmatic General Permit, for use in lieu of a NWP.[208] The Louisiana Department of

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submersed grass beds, and shoreline restoration and nourishment and retreat or abandonment." Ala. Admin. Code r. 335-8-2-.06.

202 Ala. Coastal Area Mgmt. Program IV, Coastal Hazard Mgmt. Policy 3, 26 (2017).

203 U.S. Army Corp of Eng'rs, Mobile Dist., Reg'l Gen. Permit ALGP-10 (2021); Ala. Admin. Code R. 335-8-2-.06 (2024); Nat'l Wildlife Fed'n, *supra* note 115, at 28. *See*; Ala. Code § 9-7-15 (2024).

204 USACE Regional Gen. Permit, *supra* note 203.

205 State of La., Nationwide Permit (NWP) Regional Conditions, 4, 11 (2017), https://www.mvn.usace.army.mil/Portals/56/State%20of%20Louisiana%202017%20Nationwide%20Permit%20%28NWP%29%20Regional%20Conditions.pdf, [https://perma.cc/4N2P-V8FL] [hereinafter *Louisiana*]. *See also* Alyssa Craton, *Calling All Oysters: An Analysis of Living Shorelines, Legal Impediments, and Louisiana's Land Loss Crisis*, 10 LSU J. Energy L. & Resources 207 (2022). *See* La. Stat. Ann. § 49:214.21 et seq. (2024).

206 La. Admin. Code Tit. 43, pt. I, § 709(D)–(E) (2025).

207 *Id*.

208 Louisiana, *supra* note 205 at 2. A Coastal Use Permit (GP-17) may be required for dredging and filling for the purpose of shoreline stabilization. La. Dep't of Nat. Res., Off. of Coastal Mgmt., General Permit GP-17 (2022), https://www.dnr.louisiana.gov/assets/OCM/permits/gp/Current_Documents/GP17_2022.pdf [https://perma.cc/5KCS-NC8K].

Energy and Natural Resources and the Corps developed this PGP for certain development projects within Louisiana's coastal zone.[209] Unfortunately, this PGP does not restate the State's legislative preference for non-structural shoreline stabilization, and it may be viewed as a lost opportunity to create an incentive toward greater use of living shorelines.[210] However, the State's rejection of general nationwide permitting standards remains a strong stance against a one-size-fits-all coastal permitting framework that demonstrates states' ability to shape their own coastal policies.

In addition to creating avenues for cooperation between the federal government and the states in furtherance of coastal protection policies, Congress embedded financial incentives within the CZMA to provide assistance to states advancing coastal protection initiatives.[211] Financing is offered through two programs: the National Coastal Zone Management Program ("NCZMP") and the National Estuarine Research and Reserve System ("NERRS").[212] The NCZMP provides financial assistance to states with approved CMPs as they develop and enforce policies for "resource protection [and] management of costal development."[213] Such aid includes funding and technical assistance to develop living shoreline policies and regulations.[214] As of 2025, thirty-four states are participants in the CZM and nearly $1.7 billion has been disbursed.[215]

It should be noted that the CZMA does permit states to delegate authority to implement and enforce the provisions of its CMP to local governments, including cities, counties, school boards, and special districts, through local government codes, permits, programs, and policies.[216] Additionally, local governments are allowed to access funding provided by the CZMA to develop and operate coastal protection

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209 U.S. Army Corps of Eng'rs, New Orleans Dist., Programmatic General Permit, (2022), https://www.mvn.usace.army.mil/Portals/56/docs/regulatory/permits/generalpermits/PGP_exp_06-2027.pdf [https://perma.cc/7GFB-Q4SL]; Nat'l Wildlife Fed'n, *supra* note 115, at 39; Craton, *supra* note 205, at 207.

210 In the event that a coastal activity does not input federal permitting authority, Louisiana has developed a state-only general permit, Coastal Use Permit (GP-17), for dredging and filling for the purpose of shoreline stabilization. La. Dep't of Nat. Res., General Permit 17 (2022). Such permit would be evaluated under the auspices of the stated legislative preference for soft armoring.

211 16 U.S.C. §§ 1455, 1456(a)–(b), 1456-1 (2018).

212 *See* 16 U.S.C. §§ 1456(a), 1456-1 (2018); *see also* NOAA Guidance, *supra* note 10, at 31.

213 15 C.F.R. § 923.3(c) (2024); NOAA Guidance, *supra* note 10, at 31.

214 NOAA Guidance, *supra* note 10, at 31.

215 Lipiec, *supra* note 195, at 3, 8, fig. 1.

216 16 U.S.C. § 1453 (2024); Lipiec, *supra* note 195, at 2. *See generally* S.C. Code Ann. §§ 48-39-100, -350 (2024); La. Admin. Code tit. 43, pt. I, § 725 et seq. (2025).

programs, including living shorelines, under the terms of the state CMP.[217] Where there is no state regulation to the contrary, local governments may enact ordinances or commence programs to encourage and fund living shorelines. It is often the case that local governments are "laboratories" of innovative policies, and thus such governments should take note of this opportunity to use federal funding to experiment with nature-based shoreline stabilization opportunities.

iii. Separate State and Federal Permitting Requirements

A state may either opt to require state permits in addition to the required federal permits, or engage in joint permitting with the federal government on certain aspects of a project while still requiring state-only permits for others.[218] When an applicant must pursue separate permitting, one for the state and one for the federal government, it adds to the regulatory hurdles, costs, and time required to achieve approval of the project.[219] Further, states which lack a clear regulatory framework may disincentivize living shorelines because neither the applicants, the regulators, nor the contractors have a clear understanding of what will be required or prohibited within the project. This uncertainty can steer applicants toward the more readily understood permitting requirements for gray armoring structures.

All American coastal states maintain rules and regulations regarding coastal development. However, many of these states lack specific regulations for living shoreline projects and default to general coastal regulations to review and approve or deny a living shoreline project.[220] This can necessitate subjective determinations or requirements by the permitting authorities due to the lack of clear guidance from legislative or administrative rules. This fosters an environment of uncertainty amongst landowners, contractors, and regulatory authorities.[221] Without

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217 Amy F. Blizzard & William R. Mangun, *Intergovernmental Influences on the Implementation of Coastal Zone Management in the United States: Public Shoreline Access in the Southeast*, 51 Ocean & Coastal Mgmt. 443 (2008), https://www.sciencedirect.com/science/article/pii/S0964569108000446 [https://perma.cc/RU3F-7MNN].

218 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 28.

219 *See* Duff, *supra* note 183.

220 A non-exhaustive list of states which rely on general coastal regulations to regulate living shorelines include Florida (Fla. Stat. § 161.011 et seq. (2025)), Georgia (Ga. Code Ann. § 12-5-230 et seq. (2025)), Connecticut (Conn. Gen. Stat. § 22a-361 (2025)), Delaware (Del. Admin. Code § 7504-4.10.1.2 (2025)), and New York (6 N.Y. Comp. Code R. & Regs. tit. 6, §§ 505, 608 & 661 (2025)).

221 *See generally* Mandy Baily & Armando Ubeda, *How Complicated Is Permitting a Living Shoreline? It Depends!*, Univ. Fla. Inst. Food & Agric. Sci. Extension Sarasota County (July 6, 2023), https://blogs.ifas.ufl.edu/sarasotaco/2023/07/06/how-complicated-is-permitting-a-living-shoreline-it-depends/ [https://perma.cc/3BBY-DWNB].

clear and transparent permitting standards, subjective and changing standards are inevitable.

Therefore, states with transparent and detailed living shoreline standards can aid and encourage potential applicants. Both South Carolina and New Jersey have developed robust regulatory frameworks for living shorelines,[222] and in both states, an abundance of living shoreline projects have been used to successfully stabilize their respective shorelines.[223]

After a century of decline in the size and quality of its coastal marshes, South Carolina determined that living shoreline technology was a necessary component to shoreline stabilization.[224] In 2021, the State Legislature enacted a regulatory framework for coastal protection which included an unequivocal preference for the use of nature-based resources over hard armoring to address shoreline erosion and habitat loss, noting that:

"In reality, these hard structures, in many instances, have increased the vulnerability of beachfront property to damage from wind and waves while contributing to the deterioration and loss of the dry sand beach which is so important to the tourism industry."[225]

Thus, the State's legislative policy is to:

"severely restrict the use of hard erosion control devices to armor the beach/dune system and to encourage the replacement of hard erosion control devices with soft technologies as approved by the department which will provide for the protection of the shoreline without long-term adverse effects. . ."[226]

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222 Both South Carolina and New Jersey participate in the CZMA CMP and the laws cited herein may also be relevant to a consistency review. S.C. Code Ann. 48-39-10 et seq. (2025); N.J. Admin. Code § 7:7-6.24. (2025).

223 Nicholas J. Angarone, N.J. Dep't of Env't Prot., *Case Studies/Projects: Living Shoreline Projects*, https://www.nj.gov/dep/bcrp/case-studies-projects/living-shorelines-projects.html [https://perma.cc/76ZY-H8ME] (last visited Aug. 8, 2025); Nature Conservancy & S.C. Dep't of Health & Env't Control, *Living Shoreline Explorer Application*, https://maps.coastalresilience.org/south-carolina/living-shorelines/ [https://perma.cc/FPY8-8BA8] (last visited July 1, 2025) [hereinafter *Living Shorelines Interactive Mapping*].

224 In 2016, the Marine Resources Division of the South Carolina Department of Natural Resources (MRD) undertook a five-year study of living shorelines which led to the adoption of both legislative and administrative living shoreline regulations. Blair Williams, S.C. Dep't of Env't Servs., South Carolina Living Shoreline Regulations and Permitting, https://des.sc.gov/sites/des/files/Documents/BCM/LivingShorelinesRegsPermittingProcess.pdf [https://perma.cc/4G4A-X52F]; *Living Shorelines*, S.C. Dep't of Env't Servs., https://des.sc.gov/programs/bureau-coastal-management/critical-area-permitting/living-shorelines [https://perma.cc/H5A5-6RDT] (last visited June 23, 2025); Tweel, *supra* note 85, at 2.

225 S.C. Code Ann. § 48-39-250(5) (2025).

226 S.C. Code Ann. § 48-39-260(3) (2025); S.C. Code Ann. Regs. 30-1 (2025). South Carolina defines "living shoreline" as a "shoreline stabilization approach utilized in intertidal wetland environments that maintains, restores, and/or enhances natural estuarine processes through the

This preference is implemented by the South Carolina Department of Environmental Services through the enactment of administrative codes stating that living shorelines are "encouraged as an alternative to traditional hardened erosion control structures."[227] The code also establishes the requirements and parameters for living shoreline installations, including geographical constraints; requirements for native vegetation; permissibility of effects on navigation and public use of lands and waters; prohibitions on dredge and fill activities; and maintenance, repair, and monitoring requirements.[228] The State also provides education and training opportunities to potential living shoreline applicants, including collaborations with Clemson University and the Nature Conservancy, respectively.[229] These efforts have resulted in the development of multiple living shoreline projects along the State's coastline and coastal marshes.[230]

New Jersey has also adopted a detailed framework for living shoreline permitting through its administrative codes, as implemented by the New Jersey Department of Environmental Protection.[231] These permitting rules start with a legal presumption that a living shoreline project is acceptable so long as it satisfies certain elements as described in the rule.[232] Such elements include a demonstration that the project will be consistent with other applicable laws, will maintain or improve affected ecosystems, and that the use of fill and the disruption of identified "special areas" are minimized.[233] This presumption of approval for a project that meets the clearly specified parameters both fosters confidence in project applicants and provides clear direction as to how to design and present the project application.

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strategic placement of native vegetation and/or use of green infrastructure …". *Id*. at 30-1D(32). Such installations "are encouraged as an alternative to traditional hardened erosion control structures…" *Id*. at 30-12Q.

227 *Id.*

228 S.C. Code Ann. Regs. 30-12(Q) (2025); *see also* Williams, *supra* note 224.

229 Williams, *supra* note 224; Clemson Coop. Extension, https://cpe.clemson.edu/browse/extension/water-resources/courses/living-shorelines---on-demand [https://perma.cc/KWA3-36FN] (last visited July 1, 2025); *Living Shorelines Interactive Mapping*, *supra* note 223.

230 *Living Shorelines Interactive Mapping*, *supra* note 223.

231 N.J. Admin. Code § 7:7-1.1 (2024). The N.J. Administrative Code defines a living shoreline as a "shoreline management practice that addresses the loss of vegetated shorelines, beaches, and habitat in the littoral zone by providing for the protection, restoration, or enhancement of these habitats . . . [t]hrough the strategic placement of plants, stone, sand, or other structural and organic materials. There are three types of living shorelines: natural, hybrid, and structural. Natural living shorelines include natural vegetation, submerged aquatic vegetation, fill, and biodegradable organic materials . . ." N.J. Admin. Code § 7:7-1.5 (2024). *See generally* Nicholas Angarone et al., N.J. Dep't of Env't Prot., Climate Change Resilience Strategy 92, 98 (2021), https://dep.nj.gov/wp-content/uploads/climatechange/docs/nj-climate-resilience-strategy-2021.pdf [https://perma.cc/28QN-F348].

232 N.J. Admin. Code § 7:7-12.23 (2024). *See also* N.J. Admin. Code § 7:7-16.2 (2024).

233 N.J. Admin. Code § 7:7-12.23 (2024).

In addition to establishing a presumption of acceptability for a living shoreline project, New Jersey has created a general permit to regulate "habitat creation, restoration, enhancement, and living shoreline activities."[234] This general permit process also commences with a regulatory presumption that a living shoreline project is acceptable, provided certain conditions are met.[235] This permitting code provides dual assurances and transparency for living shoreline permit applicants. As a result, New Jersey has dozens of already permitted and concept-stage living shoreline projects along its coastline.[236]

iv. State Incentive Programs

In addition to a clear regulatory framework, another important tool for state governments to use in stimulating interest in living shorelines is the provision of financial incentives. Such incentives can be structured as low interest loans and grants. Some of this funding is made available through the CZMA, as discussed above, but states and local governments can also directly fund living shoreline projects through tax revenues, special assessments, bonds, and other strategies.[237]

The Florida Department of Environmental Protection ("FDEP") is an example of a state agency which dedicates a revenue stream to living shoreline projects.[238] Much of the project review, funding, and supervision is conducted through the Florida Resilience Coastline Program, a program established to aid coastal communities in preparing for current and future effects of sea level rise, including flood and erosion prevention and ecosystem protection.[239] Program priorities include flood prevention and mitigation, community and infrastructure vulnerability assessment, resiliency measures, and use of nature-based options

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234 N.J. Admin. Code § 7:7-6.24 (2024); N.J. Dep't of Env't Prot., *Coastal Zone Management Application Checklist—General Permit 24* (rev. Oct. 5, 2021), https://nj.gov/dep/landuse/download/cp_gp24.pdf [https://perma.cc/NP4B-W66R].

235 N.J. Admin. Code § 7:7-6.24 (2024).

236 *See* N.J. Dep't of Env't Prot., Off. of Coastal & Land Use Planning, *Case Studies/Projects: New Jersey Ecological Solutions Projects,* https://www.nj.gov/dep/oclup/case-studies-projects/nj-ecol-solution-projects.html#permitted [https://perma.cc/HY3U-6UXB] (last visited Jul. 2, 2025).

237 Kara Consalo, *India's Use of Public--Private Partnerships to Promote Rapid Expansion of Solar Electricity Facilities*, 33 Fla. J. Int'l L. 175, 191 (2023).

238 Though the FDEP Office of Resilience and Coastal Protection, Florida maintains the Florida Resilient Counties Program which distributes federal and state funds under the auspices of Coastal Partnership Initiative Grants, State Agency and Water Management Districts Grant Program, Clean Vessel Grants, Beaches Funding Program, Florida Resilient Coastlines Program, and the Resilient Florida Program. Fla. Dep't of Env't. Prot., *Resilience and Coastal Protection Project Funding Sources*, https://floridadep.gov/rcp/florida-resilient-coastlines-program/content/resilience-and-coastal-protection-project-funding [https://perma.cc/9D4E-JG37] (last visited June 23, 2025) [hereinafter *Resilience and Coastal Protection Project Funding Sources*].

239 *Id.*

to fight coastal flooding and erosion.[240] The state has provided funding for over a dozen living shoreline projects with a high level of success and longevity.[241] The design and data collection for these projects is provided in a web repository available to the public.[242]

Yet, Florida lacks a statutory or administrative framework specific to living shoreline projects.[243] Rather, permitting review of living shoreline applications is based upon a mixture of related statutes and codes, such as the Environmental Resources Permit for development activities on private land and the Government Restoration Activities for installations on lands held in the public trust.[244] The Florida approach to living shorelines does demonstrate a strong interest in stimulating living shorelines, but one which is stymied by a lack of clear regulations for potential applicants. While beneficiaries of a living shoreline project which is government-funded have an incentive to struggle through permitting hurdles, privately funded projects do not have the same impetus to navigate an uncertain permitting process.

III. Analysis

A. Hurdles to Greater Use of Living Shorelines

The popularity of living shorelines has increased over the last twenty years, but this method of shoreline stabilization still lags far behind the use of hard armoring structures.[245] On its face, the relative lack of interest in living shorelines makes little sense because living shorelines are cheaper, more attractive, more effective, and longer

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240 *Id.*

241 *Resilient Florida Grants (interactive mapping)*, Fla. Dep't of Env't. Prot., https://experience.arcgis.com/experience/d4f2e042f59e4b2eaee108c0777a0937 [https://perma.cc/K96E-FQXQ] (last visited June 23, 2025).

242 *Id*.

243 Interestingly, Florida does incentivize living shoreline projects through an exemption for certain soft armoring projects from otherwise applicable coastal permitting. Fla. Admin. Code Ann. r. 62-330.051(12)(e) (2024). However, this permitting exemption is quite limited as it only applies to projects 500 linear feet or less and no farther than 10 feet waterward of the mean high-water line or ordinary high-water line, strictly limits fill, and does not exempt the property owner from permitting if the property is in, on, or over state-owned submerged lands. *Id.* This exemption is also preceded by more expansive exemptions for hard armoring activities which may counteract the presumed purpose of the living shoreline exemption to encourage such projects in lieu of hard armoring. *Id.* at 12(a)-(d).

244 Fla. Admin. Code Ann. R. 62-330 et seq. (2024). The Environmental Resource Permitting rules do contain an exception from permitting requirements for both certain types of gray armoring and soft armoring. *Id*. at 62-330.051(12). This permitting exception for soft armoring is limited to projects 500 linear feet or less and 10 feet or less water ward of the mean high-water line or ordinary high-water line. *Id.* at (12)(e). However, armoring on state-owned lands requires other permitting approvals. *Id.* 18-21.002 et seq. (regulating activities in state-owned submerged lands).

245 Nat'l Wildlife Fed'n, *supra* note 115, at 1.

lasting than hard armoring structures.[246] Many researchers, including those working on federally-funded studies, posit that the reason for this lag can be attributed to regulatory hurdles, including both the lack of clear permitting rules in some jurisdictions and the requirement for duplicate or triplicate permitting in others.[247]

i. Onerous Federal Permitting Requirements

By virtue of its nature as an installation that will alter aquatic and riparian areas, a living shoreline project will almost always be subject to federal regulations. At a minimum, such projects will require permitting under the CWA and/or the Rivers and Harbors Act.[248] There is also a likelihood of additional permitting required by the Endangered Species Act, the CZMA, and the Magnuson-Stevens Fisheries Conservation and Management Act.[249] This creates extensive regulatory requirements at the federal level, in addition to potential state and local government permitting.[250] Understandably, many property owners and marine contractors will opt for gray infrastructure options if it reduces regulatory hurdles.

Unfortunately, in many cases, hard armoring is easier to permit at the federal level.[251] Hard armoring technology has been established longer, is more consistent in its implementation, and therefore is better understood by regulators, which leads to quicker and easier permitting.[252] NWP 13 allows many applicants for bulkheads and seawalls to avoid the hurdles of an individual permit and even, in some cases, proceed with construction without further notification or oversight by the Corps.[253] No such comparable exemption is offered for living shoreline projects. Further, NWP 13 allows projects to be larger and more disruptive to water flow and aquatic wildlife than what is afforded

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246 NOAA Guidance, *supra* note 10, at 4; Barry, *supra* note 81, at 18; Structural Measures, *supra* note 43, at 4; Coleman, *supra* note 8, at 8.

247 Nat'l Wildlife Fed'n, *supra* note 115, at 1.

248 *See* Federal Water Pollution Control Act ("Clean Water Act"), 33 U.S.C. § 1251, *et seq.* (as amended through Pub. L. No. 118-198, 138 Stat. 2678 (2024)); Act of Mar. 3, 1899 (Rivers and Harbors Appropriation Act), 33 U.S.C. § 4066, *et seq.* (as amended through Pub. L. No. 118-272, 138 Stat. 2992 (2025)).

249 Endangered Species Act of 1973, 16 U.S.C. §§ 1531–44 (2024); Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1801 *et seq.* (as amended through Pub. L. No. 118-229, 138 Stat. 2824 (2025)); Coastal Zone Management Act, 16 U.S.C. §§ 1451-1466 (1972) (as amended Pub. L. No. 92-583, 123 Stat. 991 (2009)).))

250 Jennifer E. D. O'Donnell, *Regulatory Issues for Implementing Living Shorelines*, 38 Nat'l Wetlands News 20 (2016).

251 Nat'l Wildlife Fed'n, *supra* note 115, at 12.

252 *Id.*

253 *See* Issuance and Reissuance of Nationwide Permits, 82 Fed. Reg. 1,860, 1,986 (Jan. 6, 2017) [hereinafter NWP 13].

under NWP 54.[254] NWP 13 also permits both temporary structures and beach nourishment, neither of which is within the parameters of NWP 54.[255] As discussed above, a living shoreline project that cannot operate within the parameters of NWP 54, such as projects which extend more than 500 feet in length along the shoreline or which extend further than 30 feet from the mean low water line, will require application for an individual federal permit.[256] Since individual permits are evaluated on a case-by-case basis, this adds time and expense to the project.[257] Thus, by simplifying the permitting standards for gray infrastructure more than the standards for green infrastructure, the Corps continues to discourage use of living shorelines.[258] It is time for the Corps to reverse this status quo and adopt an NWP to actively encourage the use of nature-based prevention techniques.

ii. Additional State Regulations, or Lack Thereof

In addition to federal permitting requirements, coastal states and their local governments often have additional coastal development requirements.[259] In a study published by the National Wildlife Federation, researchers' survey of eighteen coastal states found a vast diversity in the availability and scope of permitting frameworks.[260] As discussed above, state permitting can operate to ease the federal process by creating a one-stop-permit under the CZMA. However, state permitting can also present additional hurdles by creating a duplicate or even triplicate system, in which an applicant must seek federal, state, and, potentially, local permitting approvals separately. Such states require the applicant to invest time in applicant meetings, application and document assemblies, and monitoring and reporting to multiple separate government entities, not to mention the additional fees and additional opportunities for objections to the project. Clearly, such overlapping bureaucracy presents a daunting prospect to potential applicants.

Exacerbating the difficulty of multi-jurisdictional permitting requirements, many states lack a clear regulatory framework to guide applicants and regulators in the evaluation of a living shoreline application. In such states, a living shoreline applicant is faced with the uncertainty of what data and documents will be required, what

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254 NWP 54, *supra* note 163.

255 NWP 13, *supra* note 253; NWP 54, *supra* note 163.

256 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 7.

257 *See id.* Individual permit review for living shoreline projects will likely require including shoreline surveys and geotechnical reports.

258 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 12.

259 *See id*. at 6.

260 *See id*. This review included "desktop research" as well as interviews with regulators, scientists and practitioners, and workshops.

standards will be applied, and what subjective aspects of design might make or break permitting approval.[261]

Adding to the complexity, many coastal states have a constitutional or legislative-established public trust over certain coastal waters and submerged lands.[262] These public trust or sovereignty lands are generally water bodies and submerged lands which are property of the state to be used for the benefit of that state's citizens.[263] Within such jurisdictions, the state is tasked with the ongoing care and maintenance of coastal lands and waters, including shoreline stability efforts.[264] Often, there are enhanced regulatory requirements for coastal activities on these jurisdictions' state-owned lands to ensure ongoing protection of the public resource and preservation of public access.[265]

One would think that the nature-based characteristics of living shorelines, as well as their beauty, efficacy and longevity, would cause this type of armoring to be preferred on public-trust lands. However, the opposite is often true for two reasons. First, public trust laws are drafted to strictly regulate development to ensure protection of public resources, and, for this reason, they often have little room for discretion. Thus, in a state without express legislative approval for installing living shorelines on public trust lands, such projects cannot be approved legally.[266] Further, many states have rules which allow shoreline stabilization on public lands above a jurisdiction line, such as the mean high-water line, but not below that line. Such a requirement allows for various types of hard armoring which are primarily land based, yet it will prohibit most living shorelines that are graded into the water and require certain water depths for successful plant growth.[267]

Each coastal state should evaluate its current regulations to identify and remove hurdles to greater use of living shorelines. States should also undertake consideration of where incentives to living shoreline development can be incorporated.

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261 Florida, a state which does not have a regulatory framework specifically for living shoreline, acknowledged that "permitting information on living shorelines is ever-evolving." FFWCC, *supra* note 127, at 67; *see also* Sara Martin et al., *Reducing Barriers to Living Shorelines Through Sea Grant Extension Programs*, 37 Oceanography 129, 132 (2024), https://tos.org/oceanography/article/reducing-barriers-to-living-shorelines-through-sea-grant-extension-programs [perma.cc/88UT-MTF7].

262 *See* Karen Consalo, *Changing Historic Concepts of Water Rights and Water Ownership*, *in* Property Rights in Contemporary Governance 126-27 (Staci Zavattaro, Gregory Peterson & Anne Davis, eds., 2019).

263 *See id.*

264 *See id.*

265 *See id.*

266 Nat'l Wildlife Fed'n, *supra* note 115, at 13.

267 *See id.*

iii. Lack of Professional Training & Community Outreach

In addition to the regulatory hurdles associated with living shorelines, there is a dearth of training and public outreach to coastal landowners and marine construction professionals.[268] Despite their many benefits, living shorelines will not increase in popularity if the public and the relevant professionals are not aware of this technology.

Approximately seventy percent of shoreline property in America is privately owned, and there are limited public awareness campaigns regarding living shorelines as a shoreline stabilization technique.[269] These campaigns are necessary, both to raise public awareness of the option of living shorelines as a stabilization technique, and to inform the public of the benefits of living shorelines for limiting erosion, flooding, and similar coastal hazards. Public relation campaigns should also advertise the economic benefits associated with soft armoring, such as lower installation and maintenance costs. When considering the many benefits of living shorelines, it is reasonable to assume that many property owners would be interested in utilizing these techniques over hard armoring if they were aware of the option and its benefits.[270] To increase such awareness, governments and public interest groups should engage in greater outreach to coastal property owners through conferences, webinars, social media, newspapers, and demonstration pilot projects.[271]

There is also a dearth of outreach and training for professions in the marine construction industry, including engineers, landscapers, marine contractors, and environmental consultants.[272] Such industry professions can exert great influence on their clients who rely on professional expertise in determining how best to stabilize their property.[273] Thus, these professions can play a critical role in raising public awareness of the living shorelines approach.[274] Some states do provide such training: Florida has an excellent example of training which both addresses the technical aspects of living shorelines and provide guidance regarding how to encourage clients to explore this option.[275] Equally important is the need for federal, agency, and local governments to train their own

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268 *See id.* at 1.

269 *See id.* at 13.

270 *See* Tamara Dietrich, *Living Shorelines: Virginia Landowners Learning the Value of Manmade Marshes and Beaches*, The Virginian-Pilot (Sept. 11, 2012, 5:51 ET), https://www.pilotonline.com/2012/09/11/living-shorelines-virginia-landowners-learning-the-value-of-man-made-marshes-and-beaches/ [https://perma.cc/9X73-R5F2]; FFWCC, *supra* note 127, at 10.

271 *See* Univ. of Minn., Coll. of Continuing & Pro. Studies, *The Power of Social Media for Climate Justice Advocacy*, (Oct. 25, 2023), https://ccaps.umn.edu/story/power-social-media-climate-justice-advocacy [https://perma.cc/7XLQ-P9Z2].

272 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 13.

273 *See id.*

274 *See id.*

275 *See* FFWCC, *supra* note 127.

regulators in the various facets of living shoreline regulations, including permit review, monitoring, and data analysis, so that living shoreline applications will not be subject to modification or rejection simply due to a lack of familiarity by regulatory officials.

B. Recommendations for Regulatory Change to Stimulate Living Shorelines

There is a myriad of benefits to be gained from greater use of living shorelines as erosion and flood resiliency measures. Yet, soft armoring continues to be less utilized than hard armoring infrastructure. There are many regulatory and policy measures which federal, state, and local governments can and should adopt to close this gap and encourage greater use of living shorelines.

i. Regulatory Standards

Regulation is often considered a negative factor by industry and landowners. Yet in the realm of living shorelines, regulations are a necessity to alleviate uncertainty and confusion.[276] Without clear and detailed regulations, property owners and contractors face unpredictable permitting environments that may lead to project changes, time delays, and additional costs. This discourages the pursuit of living shoreline permits. Thus, to encourage living shorelines, governments should adopt regulatory and/or administrative frameworks to clarify permitting standards, both for their applicant and their regulators.

In drafting legislation, policymakers must first define what a "living shoreline" will incorporate. Components of this definition should include the spatial and geographical constraints for a living shoreline. For example, to what extent will fully submerge coastal areas and reefs be included? Similarly, to what extent will inland and upland areas, such as sand dunes or rocky cliffs, be incorporated? To encourage greater use of living shorelines, it would behoove drafters to cast a wide net of what installations will be termed a living shoreline toto encourage both innovation and larger projects. Where there is concern that such a wide net may inadvertently cause harm to certain vulnerable coastlines, exemptions for certain types of projects or areas can be added.

The next consideration in drafting regulations is to establish design and performance standards. Creation of a successful living shoreline is not simply the result of planting vegetation and hoping for the best,[277] nor is it as simple as attempting to mimic the shoreline which existed

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276 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 1.

277 *See id.* at 18.

prior to human development.[278] Rather, successful living shoreline projects require a complex "mesh of engineering principles with ecological restoration to create sustainable ecosystems that benefit humans and nature."[279] These principles must be based upon sound data, as good law depends on good science.[280]

South Carolina engaged in a five-year study of living shorelines prior to adopting its statewide standards.[281] While a five-year study may not be necessary, detailed data collection and analysis regarding coastal needs should be undertaken prior to the adoption of living shoreline standards. At a minimum, studies of shoreline conditions should include hurricane and flood risks; erosion risks; existing soils, sands, and other foundational materials; existing and previous aquatic and riparian habitats; invasive and native species; water and wind patterns; pre-human natural conditions; and human-development proximity, including homes, businesses, and infrastructure.[282]

Data analysis and policy input should be solicited from various areas of expertise, including ecologists, biologists, hydrologists, engineers, marine contractors, lawyers, and coastal landowners.[283] There is sufficient data from long-term existing shoreline projects that would behoove policy makers to examine; projects and techniques that have been used in other jurisdictions with similar coastal conditions can serve as a supportive model for a project proposal.[284]

Once the data collection and analysis is complete, the goal should be to develop comprehensive, yet reasonably understandable, living shoreline design standards.[285] These details should include scope and size parameters, design standards, material lists, and permitting requirements.[286] Design standards are an integral element of living

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278 *See* Smith, *supra* note 67, at 2656.

279 *Id*. The Corps recommends consultation with experts prior to implementation of a living shoreline. *See* USACE Projects, *supra* note 13, at 4.

280 *See* Daubert v. Merrell Dow Pharm., Inc., 509 U.S. 579, 593, 597 (1993).

281 Williams, *supra* note 224, at 1.

282 *See generally* Cesia J. Cruz-Ramírez et al., *Coastal Management: A Review of Key Elements for Vulnerability Assessment*, 12 J. Marine Sci. & Eng'g 386 (2024), https://www.mdpi.com/2077-1312/12/3/386 [https://perma.cc/NR5L-XCYW] (discussing different indices of shoreline conditions).

283 *See, e.g.*, Barry et al., *supra* note 81, at 4; *and see* NOAA Guidance, *supra* note 10, at 19–20, 21.

284 *See, e.g.*, USACE Projects, *supra* note 13, at 31 (providing a chart of coastal conditions and the various living shoreline approaches that are appropriate to each context based on its conditions). *See also* Nat'l Wildlife Fed'n, *supra* note 115, at 21 (arguing that public data on factors that impact living shoreline projects is a valuable resource).

285 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 14 (noting that states and marine contractors and engineers find the lack of clear, geographically-specific design" standards to be prohibitive regulatory and performance barriers).

286 *See id.* at 16.

shoreline regulation.[287] In developing design standards, it is important to consider the physiographic differences of distinct coastal areas including the various native wildlife, habitats, and vegetation; weather-based threats; and existing development.

Design standards should, at a minimum, include recommendations for: vegetative heights and widths; best timing and locations for successful plantings; location of edging or sills; any requirements or allowance for public access; allowance for the incorporation of hard armoring; and whether beach nourishment will be allowed.

Design determinations should be based upon policy goals, such as erosion prevention, wind attenuation, beach beautification, habitat restoration, or a combination of concerns. Where feasible, it is beneficial to include photos or renderings of applicable living shoreline designs.[288] Policy makers may also opt to incorporate, or reference as an appendix, technical guidance and advice.[289]

In addition to design standards, a list of recommended materials, as well as any prohibited materials, should be specified. A common feature of living shoreline requirements is reliance on native vegetation and removal of exotic or invasive species. Notably, vegetation that is native at one geographic area location may not be native at another, even within the same state or region. As such, lists of acceptable vegetation should be linked to geographic parameters. Beyond the lists of vegetation, other acceptable materials such as types of shells, rocks, and fill should be specified. If some amount of gray armoring will be allowed, the size and type of such installations should be addressed.[290] A list of materials may also incorporate recommendations as to which types of materials have been demonstrated to work best in areas of that government's jurisdiction.

Performance standards should also be adopted in order to allow the government to evaluate whether installations are thriving and achieving their intended goals, such as erosion prevention, habitat protection, water quality improvement, and biodiversity growth.[291]

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287 *See id.*

288 *See, e.g.*, USACE Projects, *supra* note 13, at 36-46. *See also* Presentation of James Cherry, U.S. Army Corps of Eng'rs, Corps of Engineers: Regulatory 101 (Dec. 5, 2019).

289 *See, e.g.*, Nat'l Wildlife Fed'n, *supra* note 115, at 28–63 (providing "Relevant Resources and Guidance" sources for living shoreline design and implementation in each East Coast and Gulf Coast state.).

290 *See id*. at 4 (noting that "the goal of living shorelines is often to provide shoreline stabilization services similar to those achieved through a gray-only approach like sea walls, while maximizing the benefits inherent to natural shorelines by mimicking the function of natural shorelines in the local system." Therefore, the amount of gray armoring that can be utilized in a living shoreline project should be articulated in the design standards.).

291 *See, e.g.*, Coleman, *supra* note 8 (measuring the success of living shoreline projects – natural infrastructure – based on their impact on ecological functions, namely, biodiversity).

This portion of a regulation will require data collection, analysis, and reporting, which in addition to providing guidance on the specific project, can also be used for making broader determinations of local best practices.[292] Performance standards can also serve as a parameter to adjudge whether a project needs to be modified to enhance its effectiveness. To that end, it is also important that regulations allow for some level of modification without further permitting so that if data indicates a project is struggling, the problematic aspects of the project can be modified, removed, or reinstalled.[293] Such a modification allowance can be based upon a percentage-of-project area (i.e., up to 20% of the original plantings) or linked to a specific time frame basis (i.e., after two years), or even linked to a catastrophic event, such as damage from a hurricane. Whatever modification standards are used should balance the need for timely project adjustments with a recognition that many types of living shoreline vegetation require years to reach full maturity and efficacy.[294]

Another practical standard for consideration is whether commercial enterprises can be considered living shorelines, or if any portion of a living shoreline can also serve as a commercial enterprise. Commercial marine agriculture, or "mariculture," can thrive within the growing conditions found in a living shoreline.[295] This is an important consideration if living shorelines are to have financial or permitting incentives that commercial enterprises may seek to leverage.[296] If commercial installations may be considered as living shorelines, it is advisable to require certain performance standards be met; one standard to monitor could

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292 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 16.

293 *See e.g.*, Jenny P. Shinn et al., *Seven Years of Monitoring the Development of an Oyster Reef Living Shoreline*, 48 Estuaries & Coasts at 1, 5 (2025) (noting that practitioners in Delaware face limitations in attempting to modify projects due to regulatory constraints).

294 *See* Chan, *supra* note 8, at 1518 (describing the ability of living shorelines to adapt to climate change and sea level rise. Policymakers should recognize that hydrological processes and timeline may not be simply seasonal or annual and that in some cases, a living shoreline may display short term failures but reassert success in the long term, even as much as 25 years after installation). *See also* Tweel et al., *supra* note 85, at 9, 14 (noting the variability of environmental response times to living shoreline installations. For example, the South Carolina Department of Environmental Sciences characterized a living shoreline at Data Island as a failure in 2018 after finding it covered in sediment. However, by 2023, the shoreline was partially uncovered and displayed an increase in the oyster reef as wall the marsh protected by the reef.). USACE Projects, *supra* note 13, at 14.

295 *See* Bodycomb, *supra* note 108, at 2 (noting examples of mariculture including kelp farms and farms breeding various species of fish). *See also*, Andrew M. Scheld, et al., *Valuing Shoreline Habitats for Recreational Fishing*, Ocean & Coastal Mgmt., July 2024, at 1, 2 (noting that in the Middle Peninsula Region of Virginia, which has a strong living shoreline policy mandate, aquaculture is a key industry).

296 *See generally* Bodycomb, *supra* note 108, at 2 (discussing the economic viability of aquacultural products).

be that the project must result in a demonstrated amount of wave attenuation within a certain period of time.[297]

ii. Consideration of Private and Public Lands

Ownership of coastal and submerged lands may be held by private entities or by the state government in a public trust. Ownership might also involve privately-owned lands that are directly adjacent to and landward of state-owned submerged lands and waters.[298] If a government seeks to regulate living shorelines on publicly-owned lands differently than it does on privately-owned lands, such differences should be articulated in the overall legislative framework.[299] This may not necessitate dual living shorelines codes; it may be as simple as a reference to additional regulations which will be applied if state-owned lands are affected by the living shoreline project. For example, if a state has public trust regulations which require public access across state-owned lands, such access requirement can be incorporated by reference into the living shoreline regulations and then become a permitting requirement.[300]

iii. Financial Incentives

There are a variety of incentives that governments may use to stimulate greater interest in living shorelines.[301] Such financial incentives can take many forms, including: grants, low-interest loans, reduction to ad valorem/property taxes on the land where the project is located, rebates to sales taxes on materials, income tax breaks for persons or entities installing a living shoreline, reduced permitting fees for the

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297 *See id.* at 1–2 (noting studies of commercial kelp facilities, which use suspended infrastructure in longlines along the shore, have demonstrated that these facilities' wave attenuation abilities increase coastal resiliency).

298 *See* FWCC, *supra* note 127, at 139.

299 S*ee, e.g.*, Ala. Admin. Code r. 220-4-.09 (2024) (articulating that the specific purpose of the statute is "to aid in fulfilling the duties and responsibilities of the Commissioner of the Alabama Department of Conservation and Natural Resources" vis-à-vis Alabama's *publicly owned* lands).

300 *See NOAA Guidance*, *supra* note 10, at 20–21. In many states, lands within a designated distance to the mean high or low water line are reserved in public trust. *See id.* However, living shoreline projects may immediately, or over many years, alter those lands by adding more sediments and raising the level of the water line. *See id.* It may also be necessary to address private rights, or lack thereof, to accretions of sediment from a successful living shoreline installation. *See* Stop the Beach Renourishment, Inc. v. Florida Dep't of Env't Prot., 130 U.S. 2592, 2615–16 (2010).

301 *See* Nat'l Wildlife Fed'n, *supra* note 115 at 28–63; Consalo, *supra* note 237, at 178.

project, expedited permitting for the project, and technical assistance during project development and installation, to name a few options.[302]

Grants and low-interest loans can be provided to fund a portion, or all, of the installation costs of a living shoreline project.[303] Grants and loans may be issued, unencumbered, at the start of a project or may be issued in phases according to timing and performance requirements.[304] States and local governments should explore the use of disaster mitigation funds as funding sources for such grants.[305] For example, Alabama has utilized settlement funds from the Deepwater Horizon Gulf oil spill to expand living shoreline projects along its coast.[306]

Tax breaks are an option which do not require governments to expend dollars up front. Tax breaks can be offered by each level of government.[307] For example, both the federal government and some state governments assess income taxes.[308] Either level of government could therefore create an income tax deduction, similar to that of the federal clean energy tax credit, for persons who install living shorelines.[309] Similarly, state and local governments each have some level of authority over *ad valorem* or property taxes. While local governments generally have the exclusive right to assess property taxes, states can create exemptions to certain tax assessments. As such, both state and local governments can create a reduction to taxes on real property where a living shoreline has been installed. This reduction in property taxes need not be permanent; it could be limited to the number of years deemed appropriate. Finally, state governments control sales taxes, and therefore they

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302 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 244; Consalo, *supra* note 237, at 190–91.

303 *See Resilience and Coastal Protection Project Funding Sources*, *supra* note 238.

304 *See* Kara Consalo, *Let the Sun Shine: Methods for Expansion of Small-Scale Solar to Reduce Fossil Fuel Dependence, Ease Financial Burdens and Enhance Community Resiliency*, 24 Nev. L.J. 793, 817, 823, 839–40 (2024) (describing Hawaii's state-run bank, the Hawaii Green Infrastructure Authority, which is authorized to issue low interest ones for solar energy installments on private property).

305 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 26.

306 *See id.* at 29. *See also* David Rainer, *Deepwater Horizon Settlement Projects Surpass $1 Billion*, Outdoor Ala. (May 25, 2023), https://www.outdooralabama.com/articles/deepwater-horizon-settlement-projects-surpass-1-billion [https://perma.cc/CF9U-4J8A].

307 *See* U.S. Joint Committee on Internal Revenue Tax'n, 74th Cong., Rep. on The Taxing Power of the Federal and State Governments 65, 107–08 (Comm. Print 1936).

308 *See, e.g.*, *id.* at 35, 107–08.

309 The 2005 Energy Policy Act created a tax credit for those who invested in clean energy, which was both amended and renewed in 2022 by the Inflation Reduction Act of 2022, H.R. 5376, 117th Cong. § 13102 (2022). *See, e.g.*, Energy Policy Act of 2005, Pub. L. No. 109-58, 119 Stat. 594 (2005);) Inflation Reduction Act of 2022, Pub. L. No. 117-169, 136 Stat. 1818 (2022).One example of the type of tax credits available is a credit of 30% of the cost of installation of a new residential solar system. *See Home Energy Tax Credits*, Internal Revenue Serv. (Jul. 2, 2025), https://www.irs.gov/credits-deductions/home-energy-tax-credits [https://perma.cc/8U5C-RNJ4]. A similar style federal tax credit could be made available for landowners who install a living shoreline.

may opt to offer a rebate on the sales taxes on the materials used in a living shoreline project. Each type of tax break could be linked to certain performance standards, ensuring that the government is receiving public benefits from the living shoreline at issue.

There are other creative methods by which governments can incentivize living shorelines. Governments can offer permitting incentives, such as application fee waivers and/or expedited permitting. Governments can also offer free training and technical assistance to parties interested in adopting nature-based technologies for shoreline stabilization. Local governments may offer communities the opportunity to fund their own living shorelines through the option of a voluntary special assessment. A "special assessment" creates a long-term funding source, under which the government may initially bear the cost to install a living shoreline before it is then repaid over several years by special assessments on the nearby properties that benefit from the living shoreline project.[310]

iv. Preference Over, or at Least Parity with, Hard Armoring

Lastly, a state or local government seeking to encourage living shorelines should include a rebuttable presumption favoring living shorelines over hard armoring.[311] Such a presumption should be strongly worded to stimulate the greatest incentivization of living shorelines over other types of shoreline stabilization. For example, Massachusetts adopted a nearly outright ban on the use of hard armoring structures, stating, "no new bulkhead, revetment, seawall, groin or other coastal engineering structure shall be permitted on such coastal bank except [certain buildings constructed prior to 1978]."[312] If a jurisdiction does not wish to impose a total ban on hard armoring, language similar to that used by Alabama will still serve to limit use of hard armoring in circumstances where soft armoring would serve as well.[313] The Alabama Administrative Code states that hard armoring structures should only be allowed upon a finding that "there are no feasible non-structural alternatives…"[314] This language will be more enforceable in a permit review than a mere statement of legislative preference.[315] Another alternative approach to creating a rebuttable presumption in favor of living shorelines is used by Virginia, which articulates a science-based

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310 *See* Colin McCubbins, *Special Assessments*, Columbia L. Sch. Blue Sky Blog (Sept. 23, 2015), https://clsbluesky.law.columbia.edu/2015/09/23/special-assessments/ [https://perma.cc/JS79-DRMG].

311 *See* Nat'l Wildlife Fed'n, *supra* note 115, at 19.

312 310 Mass. Code Regs. § 10.30(3) (2014).

313 *See* Ala. Admin. Code r. 335-8-2-.06 (2024).

314 *Id.*

315 *See, e.g.*, *id.*

preference: "[t]he Commission shall permit only living shoreline approaches to shoreline management unless the best available science shows that such approaches are not suitable. If the best available science shows that a living shoreline approach is not suitable, the Commission shall require the applicant to incorporate, to the maximum extent possible, elements of living shoreline approaches into permitted projects."[316]

If a legislative preference is not adopted, it is important to ensure that living shoreline regulations and permitting requirements are at least on par with hard armoring alternatives.[317] If an exemption from permitting is carved out for certain hard armoring installations, a similar exemption should be provided for soft armoring installations. The types and details of supporting documentation for living shoreline permit applications should be no more onerous or expensive than that for gray infrastructure installations.[318] Similarly, permitting fees and review timelines should be comparable.[319]

If the jurisdiction is amenable to hybrid projects——those projects which combine some element of hard armoring within a living shoreline——such allowance should be specified.[320] This section of the regulatory framework can establish limits on the extent of hard armoring that will be allowed. Such limits may include an allowance for only certain types of gray infrastructure (i.e., only revetments), or allowance only for certain purposes or under certain circumstances (i.e., in areas of a project subject to particularly high wind or wave energies), or even allowance limited to a certain area or cost percentage of the overall project.

IV. Conclusion

There is extensive evidence that living shorelines are the solution to a myriad of coastal problems: erosion, flooding, wind damage, habitat loss, and aesthetic preservation. They are also a less expensive to install and more easily maintained method of shoreline stabilization than comparable gray infrastructure. Over time, rather than decaying, a well-established living shoreline will continue to grow and enhance community benefits.

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316 Va. Code Ann. § 28.2-104.1 (West 2022).

317 Nat'l Wildlife Fed'n, *supra* note 115, at 19.

318 *See id.* at 20.

319 *See id*.

320 Nat'l Wildlife Fed'n, *supra* note 115, at 19. *See generally Natural and Structural Measures for Shoreline Stabilization*, NOAA 1, 2 (2015), https://coast.noaa.gov/data/digitalcoast/pdf/living-shoreline.pdf [https://perma.cc/GB87-YS8L] (stating that USACE and NOAA promote hybrid shoreline designs depending on site-specific considerations emphasizing the need for jurisdictions to expressly specify any allowance for such hybrid projects).

Despite these advantages, living shorelines are underutilized when compared to gray installations. There are several reasons for this disparity, including a general lack of living shoreline awareness amongst contractors and the general public. However, this Article supports the belief of many researchers that the primary reason living shorelines have not enjoyed widespread popularity is the lack of regulatory guidance. This lack of regulations creates a permitting atmosphere of uncertainty, delay, and expense. When comparing the regulatory risks of a living shoreline application against the simplicity of traditional hard armoring, many property owners and their agents will default to the easier option.

It is urgent that American governments at all levels actively pursue regulations, policies and incentives to stimulate interest in living shoreline development. This Article provides guidance on how regulations should be amended to cure the regulatory deficiencies. Simple changes in legislation or code, such as creating a definition, basis standards, and parity with hard armoring, can make a great difference in the way contractors, landowners, and regulators view a living shoreline application. Considering the extensive coastal benefits living shorelines foster, regulatory changes are long past due to ensure the survival of our coastal communities.

Cut the Creep: Curbing National Security Creep in American Foreign Investment Screening to Finance Domestic Green-Energy Development

*Alexander Dumm**

Energy is a core aspect of modern life, yet reliance on fossil fuels is unsustainable. Foreign direct investment ("FDI") is key to transitioning to a green-energy economy, because the green-energy sector relies heavily on foreign capital. Complicating the issue, in a sensitive sector like energy, there is a looming threat that FDI could allow hostile foreign actors to leverage their investments to harm national security or manipulate policymaking. Countries screen foreign investment transactions for these potential threats. In the United States, this process is conducted by the Committee on Foreign Investment in the United States ("CFIUS"). Since CFIUS's inception, permissively articulated legislation has allowed the Committee to grow such that its power, and the associated discretionary power of the President, now risk undermining the rule of law under the auspices of national security. Ultimately, this inhibits the development of the U.S. green energy sector because it harms the U.S.'s ability to attract FDI. Pursuing CFIUS reform that restrains the Committee, and the president, such that potential investors are not completely exposed to onerous and confidential administrative proceedings, or the shifting sands of presidential whim will promote the U.S. transition to a sustainable-energy economy.

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I. Introduction

Energy is a modern human necessity.[1] Fossil fuels constitute around 80 percent of global energy production.[2] The well-documented negative externalities of fossil fuels have propelled increased attention to growth in Greentech,[3] Cleantech,[4] and the renewable energy sector.[5]

Foreign direct investment ("FDI") is one aspect of this attention. FDI is a substantial capital investment by a company or government in a business or project located in another country.[6] FDI is integral to financing the transition to a sustainable-energy economy: nearly half of all renewable-energy generation investment around the globe involves some form of FDI.[7] FDI targeted at these projects is extremely attractive

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1 *See* U.N. Food and Agric. Org., *The Energy and Agriculture Nexus* 15 (Env't and Nat. Res. Serv., Sustainable Dev. Dep't, Working Paper No. 4, 2000), https://www.fao.org/uploads/media/EAN%20-%20final%20web-version.pdf [https://perma.cc/N7WW-7JX9].

2 *See*, *Renewable Energy–Powering a Safer and Prosperous Future*, U.N.: Climate Action, https://www.un.org/en/climatechange/raising-ambition/renewable-energy [https://perma.cc/6X8R-S8Z7] (citing Int'l. Energy Agency, World Energy Outlook 2022 30 (2022), https://iea.blob.core.windows.net/assets/830fe099-5530-48f2-a7c1-11f35d510983/WorldEnergyOutlook2022.pdf [https://perma.cc/3AE7-FD8C].

3 *Green Technology*, Oxford Eng. Dictionary, https://www.oed.com/dictionary/green-technology_n?tab=meaning_and_use#201989384 [https://perma.cc/EMH3-8NXU] (last visited Oct. 4, 2025) (defining green technology or Greentech as "[e]nvironmentally beneficial technology, esp. as applied to mitigating or remediating the effects of human activity on the environment.").

4 Jason Fernando, *Cleantech: Term for Environmentally-Friendly Practices and Tech*, Investopedia (May 4, 2025), https://www.investopedia.com/terms/c/cleantech.asp [https://perma.cc/5WNV-FQLR] (noting that "[i]n finance, the term cleantech—short for clean technology—is used to refer to various companies and technologies that aim to improve environmental sustainability.").

5 Stephen S. Golub, Céline Kauffman & Phillip Yeres, *Defining and Measuring Green FDI: An Exploratory Review of Existing Work & Evidence* 9 (OECD, Working Papers on Int'l. Inv., Paper No. 2011/02, 2011), https://dx.doi.org/10.1787/5kg58j1cvcvk-en [https://perma.cc/USQ2-5UQH] (noting "[r]ecognition of the serious threats posed by global warming and environmental degradation has elevated the issue of how to promote 'green growth' to the top of the policy agenda at OECD and elsewhere.").

6 *See* Adam Hayes, *Foreign Direct Investment (FDI): What It Is, Types, and Examples*, Investopedia (Oct. 3, 2025), https://www.investopedia.com/terms/f/fdi.asp#:~:text=A%20disadva…20of%20FDI%2C%20however,higher%20level%20of%20political%20risk [https://perma.cc/9NY3-AKCZ].

7 U.N. Conf. on Trade and Dev., *World Investment Report 2023: Investing in Sustainable Energy for All*, 147, UNCTAD/WIR/2023, https://unctad.org/system/files/official-document/wir2023_en.pdf [https://perma.cc/282E-EBGQ].

because it simultaneously promises sustainable economic growth and energy production.[8]

States seeking to reap the benefits of FDI, particularly FDI targeting a sensitive economic sector like energy, must be cautious: FDI could act as a "Trojan horse" for national security risks.[9] For example, a hostile foreign actor could utilize its investment in the United States as a platform to undermine U.S. national security.[10] A foreign actor could also leverage its investment in a key economic sector to manipulate U.S. policymaking on certain issues.[11] The energy sector is particularly vulnerable to these threats since its fundamental role in the economy and society provides attractive leverage for hostile foreign actors.[12] Governments combat this potentiality by screening FDI transactions.[13]

In the United States, FDI transactions are screened by the Committee on Foreign Investment in the United States ("CFIUS" or the "Committee"). The Committee is the manifestation of the proverbial bureaucracy: its jurisdiction and powers are broad, and its procedures are largely confidential.[14] Accordingly, businesses have little guidance on preparing transactions, or on the Committee's disposition during

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8 *Green FDI & Sustainable Infrastructure in a Changing World*, P'SHIPS FOR INFRASTRUCTURE (Mar. 14, 2025), https://www.partnershipsforinfrastructure.org/newsroom/green-fdi-and-sustainable-infrastructure-changing-world [https://perma.cc/9K9W-H58L] (noting, "[g]reen FDI prioritises sustainability by integrating Environmental, Social, and Governance (ESG) principles, ensuring long-term economic and environmental resilience.").

9 Heath P. Tarbert, *Modernizing CFIUS*, 88 GEO. WASH. L. REV. 1477, 1482 (2020) (noting that "despite its many benefits, foreign investment has not always been without its downfalls.").

10 *See* David E. Sanger, *Under Pressure, Dubai Company Drops Port Deal*, N.Y. TIMES (Mar. 10, 2006), https://www.nytimes.com/2006/03/10/politics/under-pressure-dubai-company-drops-port-deal.html [https://perma.cc/7W4C-3UUR] (noting that the scuttling of the Dubai Ports deal, whereby the U.A.E.-owned company would acquire 5 ports in the US – New York-New Jersey, Philadelphia, Baltimore, New Orleans, and Miami–was scuttled after Congress whipped public opinion against the deal over "concern[s] about possible terrorist attacks.").

11 *See* Tarbert, *supra* note 9, at 1482 (citing EDWARD M. GRAHAM & DAVID M. MARCHICK, US NAT'L. SEC. & FOREIGN DIRECT INV. 20 (2006) (noting with regard to creation of CFIUS that "there was some consternation about FDI in the United States during the late 1970s, in particular from the Organization of Petroleum Exporting Countries (OPEC). Major oil price increases in 1974 and 1977, instigated by OPEC countries, caused concerns that the large amount of petrodollars being accumulated by these nations might be used to buy key US assets.").

12 *See* Maria Rosaria Mauro, *Energy Security, Energy Transition, and Foreign Investments: An Evolving Complex Relationship*, 13 LAWS, no. 4, 2024, at 1, 4 (noting that "[e]nergy represents a key element for economic development of each State, being a fundamental component of national security and deeply influencing international relations of governments.").

13 *See* Jonathan Bonnitcha, *The Return of Investment Screening as a Policy Tool*, INT'L. INST. FOR SUSTAINABLE DEV.: INV. TREATY NEWS (Dec. 19, 2020), https://www.iisd.org/itn/en/2020/12/19/the-return-of-investment-screening-as-a-policy-tool-jonathan-bonnitcha/ [https://perma.cc/2M-LU-C2GE] (noting that "the return of investment screening shows that governments are taking a more active role in assessing the costs and benefits of foreign investments on a case-by-case basis rather than simply assuming that all foreign investment is beneficial.").

14 *See* 50 U.S.C. § 4565(c).

transactional reviews.[15] This presents an element of legal uncertainty, which deters many risk-averse potential investors.[16] The Committee has increasingly scrutinized FDI targeting the U.S. renewable-energy sector in recent years.[17]

Further increasing the degree of legal uncertainty associated with FDI transactions in the United States, the Committee's power is also vulnerable to abuse for ulterior political ends. Under the auspices of protecting national security, recent presidential administrations have weaponized executive economic authorities, including those surrounding CFIUS, to achieve their own political objectives.[18] For example, the Biden administration used the Committee to investigate the potential takeover of US Steel by Japan's Nippon Steel Corporation.[19] During his final weeks in office, President Biden blocked that transaction, and some accused the President of exercising CFIUS's power to fulfill the campaign pledge of protecting domestic union jobs.[20]

CFIUS needs reform. First, lawmakers should dramatically tailor the scope of CFIUS's jurisdiction. Second, lawmakers should reform the Committee's investigative process by 1) relieving pooled investment funds from onerous reporting requirements which create legal dilemmas;

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15 *See* Amy S. Josselyn, Comment, *National Security At All Costs: Why The CFIUS Review Process May Have Overreached Its Purpose*, 21 Geo. Mason L. Rev. 1347, 1374–76 (2014) (noting how CFIUS reforms that "provid[ed] better feedback to foreign investors on the specific considerations used in each CFIUS review" would "increase investor confidence.").

16 Freshfields, *Court Challenges to FDI Decisions*, Foreign Inv. Monitor, no. 8, May 2024, at 1, 9, https://www.freshfields.com/globalassets/our-thinking/campaigns/fi-monitor/past-editions/foreign-investment-monitor-issue-8.pdf [https://perma.cc/7CNV-DSWF] (noting that legal uncertainty is a major deterrent in the success of a foreign investment in a market and that "investors, without a clear understanding of their prospects in court…may opt to abandon deals altogether.").

17 Berkeley Rsch. Group, *Renewable Energy and Foreign Investment: Q&A with CFIUS Expert Steven Klemencic,* Thinkset Mag. (Fall 2024), https://www.thinkbrg.com/thinkset/renewable-energy-and-foreign-investment-qa-with-cfius-expert-steven-klemencic/ [https://perma.cc/GN6F-MMBG].

18 *See, e.g.*, Michael Froman, *Liberation and its Discontents*, Council on Foreign Rels. (Apr. 4, 2025, at 14:31 ET), https://www.cfr.org/article/liberation-and-its-discontents [https://perma.cc/PQ9D-6WJ5] (noting that President Trump's volley of "Liberation Day" tariffs were "designed to achieve three objectives: spur the reindustrialization of the U.S. economy, raise revenues for the federal government, and create strategic leverage with countries around the world.").

19 *See* Kayla Tausche, *Fate of U.S. Steel's Deal With Japan's Nippon Is Now Up To Biden, Sources Say*, CNN (Dec. 24, 2024, at 6:45 ET), https://www.cnn.com/2024/12/23/business/us-steel-nippon-cfius-biden/index.html [https://perma.cc/2LRS-6PXZ] (noting CFIUS's role as an investigative body charged with determining, with regard to the very recent controversy surrounding the proposed takeover of US Steel by Japan's Nippon, whether the deal would constitute a threat to US national security).

20 *See* Matt Egan, *Biden Killed US Steel Deal Even Though Some US Officials Rejected National Security Concerns*, CNN (Jan. 6, 2025, at 16:38 ET), https://www.cnn.com/2025/01/06/business/us-steel-biden-japan-nippon/index.html [https://perma.cc/8FMC-XSSR] (noting that President Biden made the discretionary call to block the deal when the Committee was unable to make a final determination about whether to do so, and that the decision could have been made to protect union jobs).

2) reducing and clarifying the criteria the Committee may consider when evaluating a transaction; and 3) curtailing the executive's discretionary authority to decide whether a transaction poses a risk. Lastly, lawmakers should restrain the executive's largely unfettered power to neutralize national security risks during the mitigatory stage.

Part I of this Note introduces Green FDI, demonstrates its fundamental role in the transition to green energy, and dissects FDI's "Trojan horse" problem. Part II surveys the legal regime that governs CFIUS. Part III articulates several of the predicaments resulting from the current regime and proposes reforms. Part IV concludes this Note with a brief conspectus of the arguments presented.

II. Background

A. *Green FDI – Putting the Green into Green Energy*

Energy consumption is the foundation of modern life.[21] However, fossil fuels are not sustainable long-term sources of energy.[22] The global community must undertake a transition to a sustainable energy system. Investment is key to promoting the development of clean, sustainable energy,[23] and it is necessary to find fertile destinations for these investments.[24] Foreign direct investment is the process by which a person or entity contributes a substantial capital investment in a company or project located in another country.[25] FDI is among the most vital sources of project financing for economic growth, technology diffusion, research and development, and sustainability.[26]

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21 U.N. Food and Agric. Org., *supra* note 1, at 1.

22 Trevor M. Letcher, *Introduction with a Focus on Atmospheric Carbon Dioxide & Climate Change*, *in* Future Energy: Improved, Sustainable & Clean Options For Our Planet 2 (Trevor M. Letcher, ed., 2014) (ebook).

23 *See* U.S. Dep't. of Com., Off. of the Under Sec'y for Econ. Affs., Foreign Direct Investment in the US 1 (2024), https://www.commerce.gov/sites/default/files/2024-10/FDI-Report-Final.pdf [https://perma.cc/79DV-E6R8] (noting the partnership between FDI and public investment in the Biden-Harris Administration's agenda to promote improvements in U.S. infrastructure and innovation in U.S. clean energy). *See also* U.N. Conf. on Trade and Dev., *supra* note 7, at 56 (noting with respect to green energy specifically, that "investment policies at both national and international levels play a crucial role in driving the shift towards clean energy, which is at the center of the policy response to climate change."); Christopher Fitzpatrick, Note, *Where Ralls Went Wrong: CFIUS, the Courts, and the Balance of Liberty & Security*, 101 Cornell L. Rev. 1087, 1088 (2016) (noting that FDI "is the lifeblood" of the modern, globalized world).

24 *See* Md Qamruzzaman & Salma Karim, *Clarifying the Relationship Between Green Investment, Technological Innovation, Financial Openness, and Renewable Energy Consumption in MINT*, Heliyon, no. 9, 2023, at 4 (noting that "financial openness can facilitate the passage of capital into renewable energy initiatives, thereby facilitating their development and deployment.").

25 *See* Hayes, *supra* note 6.

26 *Foreign Direct Investment: An Important Source of External Development Financing for the Poorest Economies*, U.N. Conf. on Trade & Dev. (Jun. 5, 2015), https://unctad.org/news/foreign-direct-investment-important-source-external-development-financing-poorest-economies

The United States has been the leading destination for FDI for nearly 20 years thanks to deliberate policies ensuring open and stable markets.[27] The trend continues: in 2023, for example, the United States gained over $5 trillion in FDI.[28] The U.S. renewable energy sector is one of the leading destinations for this FDI.[29] This Green FDI is a means of "transfer[ring] environmentally-friendly industries, technology and practices that directly contribute to environmental progress."[30] However, all that glitters is not gold; FDI can be a "trojan horse", allowing a hostile foreign actor to leverage its investment in the United States to harm U.S. national security.[31] This is particularly worrisome in the energy sector because it is fundamental to almost every aspect of modern life.[32] Illustrating the threat, if an entity controlled by a hostile foreign actor were to gain control over the primary energy supply of a major U.S. city or the national electrical grid, it could leverage that control through threats, such as cutting off power entirely, to advance its own objectives.

This is not an unfounded concern. Russia has exploited its ownership of Ukraine's energy pipelines since 2006 to exert political influence over its neighbor.[33] In 2005, pro-Western reformer Viktor Yushchenko was elected President of Ukraine.[34] A year later, in response to Yushchenko's decampment from the Kremlin's looming political shadow, Gazprom, a Russian state-owned enterprise that owns most of Ukraine's

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[https://perma.cc/LU75-VNTT] (noting that FDI "contribute[s] to employment generation, technology diffusion, economic growth and sustainable development.").

27 U.S. Dep't. of Com., *supra* note 23, at 2. *See also* Jannick Damgaard & Carlos Sánchez-Muñoz, *US is World's Top Destination for Foreign Direct Investment*, IMF Blog (Dec. 7, 2022), https://www.imf.org/en/Blogs/Articles/2022/12/07/united-states-is-worlds-top-destination-for-foreign-direct-investment [https://perma.cc/G27C-MDL8] (noting global trends in FDI among the world's top FDI-destination economies and examining the potential causes of these trends); Press Release, The White House, Investing in Places Historically Left Behind: Foreign Direct Investment in U.S. Clean Energy Manufacturing (June 6, 2024) (noting that the United States is "the largest recipient of foreign direct investment in the world.").

28 *Compare* U.S. Dep't. of Com, *supra* note 23, at 2 (putting the figure of inward FDI in the United States in 2023 at $5.5 trillion), *with Direct Investment by Country and Industry*, *2023*, Bureau of Econ. Analysis (Jul. 23, 2024), https://www.bea.gov/news/2024/direct-investment-country-and-industry-2023 [https://perma.cc/U4SU-DNK2] (putting the figure of inward FDI in the United States as of July 2024 at $5.39 trillion).

29 *See Select USA, Energy Industry*, U.S. Dep't. of Com., Int. Trade Admin., https://www.trade.gov/selectusa-energy-industry#:~:text=Foreign%20direct%20investment%20totaled%20%2446.4,oil%20and%20gas%20extraction%20industry [https://perma.cc/9F8K-YXKK] (last visited Aug. 29, 2025) (documenting that the US was ranked the "second most attractive country for renewable energy investment" in 2019).

30 Golub, *supra* note 5.

31 *See generally* Tarbert, *supra* note 9.

32 *See* U.N. Food and Agric. Org., *supra* note 1, at 1.

33 Andrew Kramer, *Russia Cuts Off Gas to Ukraine in Cost Dispute*, N.Y. Times (Jan. 2, 2006), https://www.nytimes.com/2006/01/02/world/europe/russia-cuts-off-gas-to-ukraine-in-cost-dispute.html [https://perma.cc/YT4X-B5PC].

34 *See id.*

natural gas pipelines, suspended energy flows throughout the country to signal that Ukraine's political independence was limited.[35] Afterward, Russia regularly used its leverage to squeeze Ukraine's energy supply whenever Ukraine acted against Russian interests.[36] To balance the threat of similar coercion with the need for FDI, states have developed legal regimes to screen foreign investments.[37] In the United States, CFIUS conducts FDI screening for national security threats.[38]

B. National-Security Mission Creep and the Story of CFIUS's Unchecked Expansion

CFIUS's role is to strike a balance between promoting FDI and safeguarding United States' national security.[39] Unlike today, when FDI is frequently met with skepticism, FDI was once largely assumed to be beneficial.[40] In this environment, CFIUS's role was limited.[41] Today, national security concerns are paramount, and investment screening mechanisms are more robust.[42]

The story of CFIUS's development is one of episodic, explosive expansion. CFIUS was established in May of 1975 when President Ford signed Executive Order 11,858.[43] The Committee was born out of fear that members of the Organization of Petroleum Exporting Countries ("OPEC") would use their considerable fortunes to make investments in the United States and use the influence they gained for their own purposes.[44] This fear was not entirely unfounded as OPEC was, and remains, a cartel of oil-producing states that was formed to control the

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35 *See id.*

36 Paul Kirby, *Russia's Gas Fight with Ukraine*, BBC News (Oct. 31, 2014), https://www.bbc.com/news/world-europe-29521564 [https://perma.cc/J87N-EQGB].

37 *See* Bonnitcha, *supra* note 13.

38 Cathleen Cimino-Isaacs & Karen Sutter, Cong. Rsch. Serv., IF10177, Comm. on Foreign Inv. in the United States (CFIUS) 1 (2024), https://crsreports.congress.gov/product/pdf/IF/IF10177 [https://perma.cc/CQP2-FB9X].

39 *See* Tarbert, *supra* note 9, at 1479 ("Encouraging an open market for foreign investment while upholding national security have been the main goals of CFIUS.").

40 *See* Douglas Irwin & Oliver Ward, *What is the "Washington Consensus?"*, Peterson Inst. for Int'l Econ. (Sep. 8, 2021, at 8:30 ET), https://www.piie.com/blogs/realtime-economic-issues-watch/what-washington-consensus [https://perma.cc/6LA3-WBUW].

41 *See* Tarbert, *supra* note 9, at 1484 ("the initial iteration of CFIUS could do little more than monitor foreign acquisitions of American businesses").

42 *See* Bonnitcha, *supra* note 13.

43 Exec. Order No. 11,858, 3 C.F.R. 990 (1971–1975). *See also* Tarbert, *supra* note 9, at 1483.

44 Tarbert, *supra* note 9, at 1483 (citing Graham & Marchick, US Nat'l. Sec. & Foreign Direct Inv. 20 ("there was some consternation about FDI in the United States during the late 1970s, in particular from the Organization of Petroleum Exporting Countries (OPEC). Major oil price increases in 1974 and 1977, instigated by OPEC countries, caused concerns that the large amount of petrodollars being accumulated by these nations might be used to buy key US assets.").

price of crude oil.[45] Together, these states control over 80% of proven global oil reserves.[46] In the 1970s, OPEC established a reputation for leveraging its control to manipulate energy-dependent states into acquiescing to its geopolitical demands.[47] CFIUS was formed to monitor any potentially nettlesome foreign investments that could expose the United States to such manipulation.[48]

At its inception, CFIUS was comprised of four Cabinet Secretaries from the Departments of State, Treasury, Defense, and Commerce, and two Assistants to the President for economic and international affairs.[49] This group was charged with monitoring the effects of incoming FDI.[50] However, CFIUS could not take any direct action to counter an FDI transaction's potential threat.[51]

The Committee's early impotence dramatically changed with the passage of the 1988 Exon-Florio Amendment to the National Defense Production Act of 1950.[52] A surge of FDI under the Reagan administration, particularly in the defense sector, prompted calls for reform of the U.S.'s foreign investment screening process.[53] To satisfy these demands, the Exon-Florio amendment allowed the President, or his designee, to block any given foreign investment transaction subject to a credible finding that 1) the foreign investor "could threaten U.S. national security," and 2) there was no extant legislation that could mitigate the threat.[54] In 1989, President Reagan delegated his new power under Exon-Florio to CFIUS through Executive Order 12,661.[55]

Exon-Florio and Executive Order 12,661 had three further effects. First, CFIUS's membership and jurisdictional mandate were greatly

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45 Michael Bromberg, *OPEC's Influence on Global Oil Prices*, Investopedia (Oct. 10, 2024), https://www.investopedia.com/ask/answers/060415/how-much-influence-does-opec-have-global-price-oil.asp#:~:text=Many%20of%20the%20largest%20oil,to%20control%20supply%20and%20price [https://perma.cc/D6DA-XJW5].

46 *Id.*

47 Michael Corbett, *Oil Shock of 1973–74*, Fed. Rsrv. Hist. (Nov. 22, 2013), https://www.federalreservehistory.org/essays/oil-shock-of-1973-74 [https://perma.cc/5PRM-PUCW] (noting that OPEC's predecessor, the Organization of Arab Petroleum Exporting Countries instituted the original 1973 oil embargo "immediately following President Nixon's request for Congress to make available $2.2 billion in emergency aid to Israel for the conflict known as the Yom Kippur War.").

48 Tarbert, *supra* note 9, at 1484 (observing that "the initial iteration of CFIUS could do little more than monitor foreign acquisitions of American businesses.").

49 Exec. Order No. 11,858, *supra* note 43; *see also* Tarbert, *supra* note 9, at 1484.

50 Exec. Order No. 11,858, *supra* note 43.

51 *See* Tarbert, *supra* note 9, at 1484.

52 Cimino-Isaacs & Sutter, *supra* note 38.

53 *See* Tarbert, *supra* note 9, at 1485–86 (discussing the Fairchild controversy in which a Japanese firm, Fujitsu Ltd., was set to acquire Fairchild Semiconductor Corporation, the fear of which prompted passage of the Exon-Florio Amendment).

54 *See* Tarbert, *supra* note 9, at 1486–87.

55 Exec. Order No. 12,661, 54 Fed. Reg. 799, 780–81 (Jan. 9, 1989), https://archives.federalregister.gov/issue_slice/1989/1/9/768-786.pdf [https://perma.cc/D8KQ-R4TZ].

expanded.[56] Second, CFIUS received strict timelines for its actions.[57] Third, the Committee received, for the first time, an expansive set of criteria with which to adjudge a covered transaction.[58]

In 2007, the Foreign Investment and National Security Act ("FINSA") further expanded CFIUS's role. The list of criteria available to the Committee when judging a covered transaction grew, as did its membership.[59] FINSA also granted the Committee new power to reopen and unwind transactions it previously cleared in instances involving fraud.[60] This includes situations where it later found that clearance had been based entirely on fraud, or where stated compliance with the terms of a risk-mitigation agreement, on which clearance was predicated, was fraudulent.[61]

The most recent update to the CFIUS regime was the Foreign Investment Risk Review Modernization Act of 2018 ("FIRRMA").[62] The changes to CFIUS codified by FIRRMA manifested a growing sense within the U.S. government that FDI, particularly that originating in China, was more of a national security liability than an economic asset.[63] FIRRMA had three primary effects. First, the act expanded the Committee's jurisdictional scope.[64] Second, the criteria the Committee can reference when determining if a covered transaction constitutes a national security threat was further expanded.[65] Lastly, the act modestly lengthened the timeline for a transactional investigation.[66]

III. Analysis

A. *Reforming CFIUS–What Needs Changing, and How?*

Today, CFIUS is very different from the body established in 1975. In stark contrast to the Committee's early, passive role as a mere monitor, the nine agency heads that comprise CFIUS take an active part

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56 *See id.*

57 *See id*.

58 *See* 50 U.S.C. § 4565(f).

59 *See* Tarbert, *supra* note 9, at 1490–91.

60 *See id.* at 1491–92.

61 *See id*.

62 *See* Cathleen Cimino-Isaacs, Cong. Rsch. Serv., IF10952, Cfius Reform Under FIRRMA (2020), https://crsreports.congress.gov/product/pdf/IF/IF10952 [https://perma.cc/5VWR-GZWH] (noting FIRRMA's passage in 2018).

63 *See* Cimino-Isaacs & Sutter, *supra* note 38 (noting that "[c]ongressional focus on CFIUS has intensified since 2016 amid growing attention to the potential national security ramifications of investments by firms directed, controlled, or funded by a foreign government, notably the People's Republic of China (PRC), and in strategic sectors.").

64 *See* Cimino-Isaacs, *supra* note 62.

65 *See id.*

66 *See id.*

in screening global investment entering the United States.[67] CFIUS's jurisdiction, its investigative powers and criteria used to judge, and the associated discretionary Executive power have mushroomed to such an extent that the shadow now threatens to chill FDI flows into the United States.[68] This is particularly problematic for FDI directed toward the U.S. renewable energy sector, which has come under enhanced scrutiny by the Committee.[69] To combat this danger, CFIUS needs reform that tailors the Committee's jurisdiction, investigative authority, and the president's discretionary power such that legitimate national security threats are culled, innocuous transactions are not unduly burdened, and the rule of law supplants executive discretion.

Savvy investors are nearly always wary of unpredictability and legal uncertainty.[70] There are some intrinsic uncertainties in investment transactions,[71] but the scrutiny of an almost omnipotent bureaucratic Committee whose deliberations, procedures, and actions are largely confidential does not inspire commercial confidence.[72] In this environment, investors could avoid investing in the U.S. market or could "abandon [their extant] deals altogether."[73]

So far, the United States remains the foremost national destination of FDI thanks to policies promoting open and stable markets.[74] Nevertheless, without CFIUS reform, the legal uncertainties engendered by the current regime could hamper investment in the green energy sector where a substantial percentage of investment comes from foreign sources.[75] There are three primary areas in which reform would alleviate the chilling effect of the Committee's confidentiality, discretion, and lack of accountability over foreign investment in the United States.

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67 *See, e.g.*, Tausche, *supra* note 19 (noting CFIUS's role as an investigative body charged with determining, with regard to the very recent controversy surrounding the proposed takeover of US Steel by Japan's Nippon, whether the deal would constitute a threat to US national security).

68 *Compare* Exec. Order No. 11,858, *supra* note 43, *with* 50 U.S.C. § 4565.

69 Klemencic, *supra* note 17.

70 *See generally* Freshfields, *supra* note 16.

71 Jiwon Lee et al., *The Economics of Legal Uncertainty* 7 (Eur. Corp. Governance Inst. – L., Working Paper No. 669/2022) (noting inherent uncertainties in traditional business transactions, such as where "a firm requires capital from an investor and there is legal uncertainty in the event of bankruptcy or a firm requires human capital from a worker and there is legal uncertainty in the event of a breach of contract.").

72 31 C.F.R. § 800.802 (2025); *see* Josselyn, *supra* note 15 at 1348, 1374–75.

73 Freshfields, *supra* note 16, at 9.

74 U.S. Dep't. of Com, *supra* note 23, at 2. *See also* Damgaard & Sánchez-Muñoz, *supra* note 27, at 1; Press Release, The White House, *supra* note 27, at 1.

75 Press Release, The White House, *supra* note 27, at 2 (noting that "45 percent… of the value of new clean energy manufacturing investment announcements in 2022 and 2023" were from "investors with headquarters in foreign countries" and "excluding domestic-foreign joint ventures").

First, the Committee's jurisdiction should be curtailed. Currently, the Committee can initiate a lengthy and costly review of any transaction in which a foreign person could gain control of a U.S. business, or acquire rights in a U.S. business handling sensitive technology, infrastructure, or data.[76] This broad jurisdiction has created legal problems such as the Inadvertent Foreign Person Problem, where a U.S. business is considered a foreign person under the law because of its relationship to a foreign investor.[77] These issues stymie green-energy development, since pooled investment vehicles play a major role in financing green-energy projects, and are at particular risk of legal traps since they typically have a diverse investor pool whose identity they might not know, or be able to disclose, but on whom the Committee could require them to report.[78] The potential to be caught in this legal "catch-22" could disincentivize such pooled investment funds from investing in the United States, which would harm the development of the renewable energy sector.[79]

Second, in the investigative stage, there are two reforms that should be implemented. First, lawmakers should codify terminological clarifications that limit the criteria the Committee uses to evaluate a

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76 50 U.S.C. § 4565(a)(4)(B); *see also* Jason Chipman, *CFIUS Under Trump 2.0: Continued Scrutiny of Cross-Border Deals*, Wilmer Hale (Feb. 21, 2025), https://www.wilmerhale.com/en/insights/publications/20250210-cfius-under-trump [https://perma.cc/DWJ8-XXDD] (noting that "today, the CFIUS regime has the potential to impact any foreign person's acquisition of or investment in a U.S. business involved in a wide range of technologies and economic sectors.").

77 *See* Nancy A. Fischer, Matthew R. Rabinowitz & Thomas M. Shoesmith, *The Inadvertent 'Foreign Person' Trap for American Companies*, Pillsbury Winthrop Shaw Pittman LLP 1, 2 (June 27, 2018), https://www.pillsburylaw.com/print/v2/content/24383/the-inadvertent-foreign-person-trap-for-american-cos.pdf [https://perma.cc/W3PM-Q2X2] (noting that "'the inadvertent foreign person' trap is this: An American company that has taken enough investment from non-U.S. sources such that more than 10 percent of its voting equity is now held by foreign persons technically may become a foreign person itself.").

78 Ian Tiseo, *Global Climate Technology Venture Capital Investments 2010–2023*, Statista (Jul. 10, 2024), https://www.statista.com/statistics/1197389/global-climate-tech-venture-capital-investment/ [https://perma.cc/JTC3-VZQX] (noting that the total value of venture capital funding in climate technology in 2022 alone – at the height of the COVID-19 pandemic – comprised $USD 70.1 billion). *See also* David Houck, *CFIUS Publishes New FAQs Regarding Mandatory Filings and Disclosure Requirements for Investment Funds*, Winston & Strawn, LLP: Global Trade & Foreign Pol'y. Insights (June 7, 2023), https://www.winston.com/en/blogs-and-podcasts/global-trade-and-foreign-policy-insights/cfius-publishes-new-faqs-regarding-mandatory-filings-and-disclosure-requirements-for-investment-funds [https://perma.cc/GEX5-3JTR] (noting that investment funds are put in a legal dilemma if the Committee asks them to report on their foreign investors whom they either do not have information on, or are not legally allowed to disclose such information).

79 *See* Houck, *supra* note 78. *See also* World Bank Group, Pub. No. 91713, Financing Business Innovation: A Review of External Sources of Funding for Innovative Businesses and Public Policies to Support Them vi (2012) https://openknowledge.worldbank.org/server/api/core/bitstreams/8f18a8cd-c358-57a7-a817-1ebddff64e23/content [https://perma.cc/S4C7-JEXM] (noting that "if risks and rewards are very high, venture capital is typically the only source of [financing] available [to scale up and commercialize a start-up]."); Tiseo, *supra* note 78.

transaction. Further, lawmakers should restrain, or eliminate, the President's statutory authority to evaluate a covered transaction against any criteria.[80]

Lastly, the Committee's authority to mitigate or block a transaction should be reduced. In particular, such reforms must address the Executive's statutory prerogative to mitigate a national security risk by any means.[81] Pursuing such reforms would foster economic rule-of-law and a secure and healthy foreign investment market.

i. Reigning in CFIUS Sprawling Jurisdiction

Limiting the Committee's vast jurisdiction would help mitigate the chilling effect that the Committee's unfettered power—such as the ability to halt and subject transactions to a lengthy, costly, and unpredictable process—on U.S.-bound FDI. Congress should redefine what classifies a business or entity as foreign, and what the term 'control' means under 50 U.S.C. § 4565. These distinctions would help curtail the Committee's jurisdiction and preempt the resultant legal dilemmas–like the Inadvertent Foreign Person Problem–under the current regime. Lawmakers should also ease investor-reporting requirements so that certain pooled investment funds are not forced into legal conundrums where the Committee requires them to provide information on their investors, which they may not have or are not at liberty to provide.

Admittedly, the Committee's evaluation of risk during the investigative stage—where risk is calculated as the product of the transaction's threat, U.S. vulnerabilities, and potential consequences–largely filters out innocuous transactions.[82] However, the fact that such innocuous transactions can reach the investigative stage, and the Committee can force the parties to report their transaction, is an inefficient use of public resources and imposes unnecessary burdens on transacting parties. Limiting the scope of the Committee's jurisdiction from the outset, so innocuous transactions do not fall within its remit, would encourage increased FDI and would better allocate the Committee's resources to screening out legitimate national security threats.

CFIUS's jurisdiction extends to any "mergers, acquisitions, and takeovers that could result in foreign control of a U.S. business; [and] certain noncontrolling investments in businesses involved in critical technologies, critical infrastructure, or sensitive personal data."[83] In practice, all foreign entities are foreign persons, but not all foreign persons are foreign entities.[84]

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80 50 U.S.C. § 4565(f).

81 *Id*. at § 4565(d).

82 Cimino-Isaacs & Sutter, *supra* note 38.

83 Cimino-Isaacs & Sutter, *supra* note 38; *see also* 50 U.S.C. § 4565(a)(4)(B).

84 31 C.F.R. § 800.224 (2025).

For CFIUS purposes, a foreign person is "any foreign national, foreign government, or foreign entity; or…any entity over which control is exercised or exercisable" by one of those three groups.[85] Within that subset of foreign persons, a foreign entity is "any branch, partnership, group or sub-group, association, estate, trust, corporation or division of a corporation, or organization" that is incorporated abroad and has either, or both, its "principle place of business" abroad or its "equity securities are primarily traded on one or more foreign exchanges."[86] Importantly, an entity's principle place of business is its nerve center (i.e., "the primary location where an entity's management [or someone on the entity's behalf] directs, controls, or coordinates the entity's activities").[87]

These definitional provisions contrive a legal trap termed the Inadvertent Foreign Person Problem. This dilemma articulates a common scenario in which an American person[88] is considered a foreign person under the law because a foreign person may exercise a nominal measure of control over it, or more than 10 percent of its non-passive equity is owned by foreign persons directly or through a pooled investment fund.[89] Without the low threshold to be considered a foreign person, CFIUS would not have jurisdiction to investigate, and potentially block, these companies' transactions. This imposes an unnecessary burden on commercial activity that is especially troublesome for Greentech, Cleantech, and the renewable energy sector, which are high-risk.[90] These sectors therefore derive a substantial amount of financing from pooled

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85 *Id.*

86 31 C.F.R. § 800.220(a) (2025).

87 31 C.F.R. § 800.239(a) (2025). Under 31 C.F.R. § 800.220(b) there is one limited exception to the foreign entity = foreign person rule, and that is if the foreign entity can prove that U.S. nationals own the majority of its equity, it is not considered foreign. Importantly, these U.S. nationals do not have to have control over the entity, they merely need to own a 51 percent stake in its equity, controlling or not.

88 The term 'person' is used here in the legal sense, to include both natural and artificial persons. *See Person*, Black's Law Dictionary (12th ed. 2024).

89 *See* Fischer, *supra* note 77. *See also* Tricia Reville, Note, *Rice Paddies on the White House Lawn: CFIUS & The Foreign Control Requirement*, 10 Colum. J. Race & L. 114, 151–55 (2020) (noting how accepting investment from a private equity fund could fall into the inadvertent foreign person trap and providing a detailed illustration of how the inadvertent foreign person problem works and the CFIUS problems that lie therein); Cimino-Isaacs & Sutter, *supra* note 38 (noting that CFIUS jurisdiction also extends to "certain noncontrolling investments in [TID] businesses."). As such, it is important to note that the threshold for CFIUS jurisdiction is much lower for businesses involved in critical technology, critical infrastructure, or sensitive personal data since the legislation largely dispenses with the "control" analysis and focuses on the nationality of even limited passive investors.

90 Elizabeth Tan, *High-Risk Bets in Early-Stage Climate Tech Startups Can't Be the Only Focus of Impact Investing*, Nasdaq (Aug. 23, 2023, at 13:43 ET), https://www.nasdaq.com/articles/high-risk-bets-in-early-stage-climate-tech-startups-cant-be-the-only-focus-of-impact#:~:text=Digging%20a%20little%20deeper%2C%20it,need%20a%20different%20funding%20mechanism [https://perma.cc/64JD-U7CG], (noting that most climate tech investments are "high-risk bets.").

investment funds, particularly venture capital, that could easily fall into this trap based on the background of their investors.[91]

For CFIUS purposes, a U.S. business is "any entity, irrespective of the nationality of the persons that control it, engaged in interstate commerce in the United States."[92] This broad definition grants CFIUS jurisdiction to review the commercial dealings of any foreign person with any commercial entity in the United States *without exception*.[93] For example, under the current regime, a neighborhood hardware store in Kansas City, Missouri – which presumably does business on the Kansas side of the city – that is seeking to scale their business and is courting a business angel investment from their neighbor who happens to be a green-card holder, would fall within the purview of the Committee. It is unlikely that such a transaction would not be given safe harbor by the Committee since the risk of such a transaction would be low, if not zero. However, that such hypothetical transaction theoretically falls within the Committee's jurisdiction demonstrates its overly broad nature, and the concomitant need for reform. Accordingly, reigning in this definition would foster a pro-business economic environment such that foreign persons will be less wary of investing in green-energy production start-ups or established businesses because the potential risk of undergoing a long, costly, and unpredictable investigative procedure is held in check by the Committee's jurisdictional limitations.

Another term that could be more narrowly defined in 50 U.S.C. § 4565 is 'control.' The Committee's purview extends to actions that would grant "foreign control [over] a U.S. business,"[94] and foreign persons include "entit[ies] over which control is exercised or exercisable by a foreign national, foreign government, or foreign entity."[95] Control is defined as "the power, direct or indirect, whether or not exercised…to determine, direct, or decide important matters affecting an entity."[96] The vagueness and immense scope of this definition grants the Committee power to exercise jurisdiction over transactions in which a foreign person or foreign entity might only be tangentially related.[97]

The need for these jurisdictional reforms is particularly evident from the perspective of pooled investment vehicles such as hedge funds, private equity funds, and venture capital funds. Unlike other types of FDI, such as mergers and acquisitions or business angel investments, there are extra degrees of separation between investors in pooled

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91 *See* World Bank Group, *supra* note 79; *see also* Tiseo, *supra* note 78.

92 31 C.F.R. § 800.252(a) (2025).

93 *See* Chipman, *supra* note 76.

94 Cimino-Isaacs & Sutter, *supra* note 38; *see also* 50 U.S.C. § 4565(a)(4)(B).

95 31 C.F.R. § 800.224 (2025).

96 31 C.F.R. § 800.208(a) (2025). "Decide" includes the authority to "direct, take, reach, or cause decisions" on important matters. *Id*.

97 *See* 31 C.F.R. § 800.208 (2025).

investment vehicles and the transaction.[98] As written, the Committee's stakeholder reporting requirements, used to determine the degree of a pooled investment fund's foreignness, could impose a legal catch-22 on such funds where they become trapped between acquiescing to the Committee's demands and fulfilling their legal obligations to their investors.[99]

For example, any foreign investor "involved in a transaction, directly *or indirectly*," is subject to CFIUS's mandatory filing requirements.[100] This puts pooled investment funds in a legal dilemma with respect to any foreign partners about whom they might not have, or might not be at legal liberty to disclose, the information required by the Committee.[101] Hampering such funds inhibits the development of marketable green-energy production alternatives to fossil fuels since venture capital comprises such a large proportion of funding for innovation projects and climate technology.[102] Cleantech and Greentech startups are considered high risk, which attracts venture capital funds because of the "promise of scale and returns."[103] A startup must survive the "valley of death" in the middle rounds of fundraising where initial funding is secured, but financing is still not sustainable in the long-term.[104] Cleantech and Greentech startups are particularly susceptible to the dangers of the "valley of death" because they take longer to scale and, accordingly, to generate revenue.[105] Encumbering venture capital funds will inevitably hinder the development of green energy projects because venture capital funds will not be able to help these startups launch or survive long-term.

ii Preventing Potential Fishing Expeditions – Limiting CFIUS's Investigative Power

Lawmakers should limit the criteria used to determine if a transaction poses a national security threat and should restrain the Executive's discretionary power in making such determinations. The criteria used by the Committee fall into two main categories: domestic factors and

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98 James Chen & Gordon Scott, *Understanding Pooled Funds: Definition, Examples, Benefits & Drawbacks*, Investopedia (Oct. 4, 2025), https://www.investopedia.com/terms/p/pooledfunds.asp [https://perma.cc/U2KP-9U2R].

99 *See* Houck, *supra* note 78, at 1–2.

100 *Id.*, at 1 (emphasis added).

101 *See id.*, at 2.

102 *See* World Bank Group, *supra* note 79, at vi; *see also* Tiseo, *supra* note 78.

103 Tan, *supra* note 90.

104 Tim De Chant, *Many Startups Fail in the 'Valley of Death,' so Collaborative Fund and Wyss Institute Partnered to Bridge It*, TechCrunch (May 23, 2023, at 3:00 PT), https://techcrunch.com/2023/05/23/collaborative-fund-wyss-institute-partnership/ [https://perma.cc/5KMN-BGQR].

105 *Id.*

international factors.[106] Together, the criteria are so broad that the Committee could find cause to flag even a harmless transaction. The threat of such action erodes confidence in the rule of law by potentially opening the transaction to costly and unnecessarily burdensome investigative procedures. This, in turn, discourages foreign persons from wanting to invest in the United States, particularly in a highly sensitive economic sector such as energy production.

Domestically, the Committee considers the national defense, energy, critical resource, and material needs of the United States and the capability of domestic producers to meet those needs.[107] The Committee also considers the potential effect of foreign citizens controlling or having business activity in those sectors.[108] Lastly, the Committee can consider the transaction's ramifications on the technological leadership, critical infrastructure, and critical technologies of the United States.[109]

Among the international factors, the Committee may account for the likelihood of the covered transaction resulting in the sale of "military goods, equipment, or technology" to rogue states.[110] The Committee may also consider whether the covered transaction "could result in the control of any United States business by a foreign government" or its agent.[111] Additionally, the Committee may look to the likelihood that a covered transaction could result in the "transshipment or diversion of technologies with military applications."[112] Lastly, CFIUS may take into consideration whether the investment's country of origin adheres to "nonproliferation control regimes" and has a record of cooperating with the United States on "counter-terrorism efforts."[113] Both the domestic and international sets of criteria are broad and vague in a way that the Committee could find justification to flag any transaction it was investigating.

The Executive's discretionary power to consider any other factor not listed that it may deem "appropriate, generally or in connection with a specific review or investigation" is the most detrimental to the legal predictability requisite of a flourishing commercial environment.[114] President Biden, in his final weeks in office, cancelled the Nippon Steel

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106 *See* 50 U.S.C. § 4565(f).

107 *See id.*

108 *See id.*

109 *See id.*

110 *Id.* Here, the term "rogue states" is used to describe, per the statute, "any country… that supports terrorism;… [is] a country of concern regarding missile proliferation… or chemical and biological weapons;… [or poses] a potential regional military threat to the interests of the United States."

111 50 U.S.C. § 4565(a)(7).

112 *Id.* at § 4565(f).

113 *Id.*

114 *Id.*

Corporation acquisition of U.S. Steel.[115] The President's likely reason for using his incredible discretionary authority under § 4565 to cancel the deal was the protection of union jobs in the United States.[116] Giving the Executive such unrestrained power contradicts the very premise of legal predictability and the rule of law. Such circumstances are not conducive to fostering a flourishing business climate, particularly in already high-risk sectors such as Greentech, Cleantech and renewable energy.[117]

iii. Panacea or Prodigious Burden? Reforming the Executive's Mitigatory Power

In the mitigative stage, the President once again enjoys incredible discretionary power. Provided the President or the Committee find a credible national security threat and the International Emergency Economic Powers Act ("IEEPA") is insufficient to mitigate that threat, the President may block, suspend, or mitigate the transaction.[118] This decision is not subject to judicial review.[119]

The degree of the threat necessary to allow the exercise of this power is unspecified.[120] Furthermore, the transaction is evaluated against the vague investigative stage criteria and the President's own subjective judgement critiqued above.[121] This, combined with the lack of judicial accountability for executive decisions, increases legal unpredictability and transactional uncertainty which inhibits the flourishing of U.S. FDI markets.[122]

The Biden Administration used this mitigative executive power to terminate the MineOne cryptocurrency mining operation. MineOne was a British Virgin Islands company ultimately owned by Chinese nationals, though the degree of separation between MineOne's ownership and its operations was left unspecified.[123] In June 2022, MineOne

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115 Egan, *supra* note 20.

116 *Id.* (compiling a variety of opinions by top government officials and business leaders on the repercussions of the transaction having proceeded and on it having been cancelled. Of particular note is the inclusion of a quote by former Obama administration economic official Jason Furman on X saying, "President Biden claiming Japan's investment in an American steel company is a threat to national security is a pathetic and craven cave to special interests that will make America less prosperous and safe…I'm sorry to see him betraying our allies while abusing the law.").

117 Freshfields, *supra* note 16, at 9; *see also* Tan, *supra* note 90.

118 50 U.S.C. § 4565(d).

119 *Id*. at § 4565(e)(1).

120 *See id.* at § 4565(f).

121 *Id.*

122 Freshfields, *supra* note 16, at 9.

123 Mario Mancuso, Luci Hague & Justin Schenck, *4 Takeaways From Biden's Crypto Mining Divestment Order*, Kirkland & Ellis (May 17, 2024), https://www.kirkland.com/publications/article/2024/05/4-takeaways-from-bidens-crypto-mining-divestment-order [https://perma.cc/B6WJ-652B].

bought land in Cheyenne, Wyoming near Warren Air Force Base, a U.S. strategic missile base.[124] Roughly two years later, the President found that MineOne's proximity to Warren Air Force Base and the fact that the company was using foreign-sourced technology for its mining activity—though the exact nature of the foreign-sourced technology was left unspecified—were grave threats to national security.[125] The President further found that alternative mitigatory action was not possible, and that IEEPA did not go far enough in granting him power to address the situation.[126] Accordingly, pursuant to 50 U.S.C. § 4565, President Biden ordered MineOne to cease its cryptocurrency mining activities, evicted the company without compensation from its twelve-acre property, and ordered MineOne to clear all the improvements the business had made to its land over the preceding two years.[127]

The potential for such power to be abused is grave. The Biden Administration's actions toward MineOne may have been motivated by concerns unrelated to national security: President Biden had a chilly relationship with the cryptocurrency industry.[128] One possible reason for this relationship dynamic is crypto's massive carbon footprint.[129] Wyoming is the second most crypto-friendly state in the nation.[130] This is largely thanks to Wyoming's low electricity costs resulting from the state's booming coal industry.[131] MineOne's mining site in Cheyenne

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124 Order of May 13, 2024, Regarding the Acquisition of Certain Real Property of Cheyenne Leads by MineOne Cloud Computing Investment I L.P., 89 Fed. Reg. 43301 (May 16, 2024), https://www.govinfo.gov/content/pkg/FR-2024-05-16/pdf/2024-10966.pdf [https://perma.cc/PHR9-MJW3].

125 *See id.*

126 *See id.*

127 *See id.* at 43301–02.

128 Julia Shapero, *Biden Admin Opens Line with Crypto Industry Amid Icy Relations*, The Hill (July 12, 2024, at 5:30 ET), https://thehill.com/business/4766890-biden-admin-opens-line-with-crypto-industry-amid-icy-relations/ [https://perma.cc/CD27-NLNT] (noting that in a meeting between White House officials, congressional leaders, and cryptocurrency industry representatives in July of 2024, the Biden Administration's position on cryptocurrencies was described by the Coinbase's top lawyer as "almost uniformly hostile.").

129 Jeremy Hinsdale, *Cryptocurrency's Dirty Secret: Energy Consumption*, Columbia Climate Sch. (May 4, 2022), https://news.climate.columbia.edu/2022/05/04/cryptocurrency-energy/ [https://perma.cc/R7WG-JZH8] (noting that crypto "uses a lot of energy… Bitcoin, the world's largest cryptocurrency, currently consumes an estimated 150 terawatt-hours of electricity annually—more than the entire country of Argentina, population 45 million. Producing that energy emits some 65 megatons of carbon dioxide into the atmosphere annually—comparable to the emissions of Greece—making crypto a significant contributor to global air pollution and climate change.").

130 *See* Scott Cohn, *These 10 States are Leading America in Creating a Crypto Economy*, CNBC (July 18, 2022, at 13:01 ET), https://www.cnbc.com/2022/07/18/these-are-the-10-states-leading-americas-crypto-industry.html [https://perma.cc/48L3-MCUD].

131 *See Frequently Asked Questions: Which States Produce the Most Coal?*, U.S. Energy Info. Admin. (Oct. 20, 2023), https://www.eia.gov/tools/faqs/faq.php?id=69&t=2 [https://perma.cc/368T-BLBK] (noting that Wyoming produces 41.2 percent of total U.S. coal production).

had a power capacity of 75 megawatts.[132] This is equivalent to the energy generated to serve between 30,000 and 67,500 U.S. homes in a year.[133] Considering this massive energy footprint, and the non-renewable sources from which it was likely derived, it is not hard to believe the Biden administration might have terminated MineOne's operation as part of the administration's broad policy of setting the foundation for a net-zero greenhouse gas economy.[134] After all, the President's order lacks any specificity regarding the relationship between MineOne's Chinese ownership and the company's cryptocurrency mining activities, or the actual potential for hostile acts.[135]

Where the Biden administration may have wielded executive authority in the MineOne case to effectuate his administration's environmentally friendly political ends, President Trump is likely to use this same authority for his own purposes. On his first day back in office, President Trump issued the Unleashing American Energy memorandum.[136] In relevant part, the memorandum states, "It is the policy of the United States…to protect the United States's economic and national security and military preparedness by ensuring that an abundant supply of reliable energy is readily accessible in every State and territory of the Nation."[137] One month later, President Trump issued the America First Investment Policy.[138] The policy memorandum bluntly signals that the

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132 *CleanSpark Acquires 75MW Cheyenne Bitcoin Mining Sites*, The Miner Mag (Aug. 1, 2024), https://www.theminermag.com/news/2024-08-01/cleanspark-cheyenne-bitcoin-mining [https://perma.cc/7H5K-UAZE].

133 *See What is a Megawatt?*, Nuclear Regul. Comm'n at 3 (Feb. 24, 2012), https://www.nrc.gov/docs/ML1209/ML120960701.pdf [https://perma.cc/J2BT-TY2W] (noting that "[f]or conventional generators, such as a coal plant, a megawatt of capacity will produce [the equivalent amount of electricity as that] consumed by 400 to 900 homes in a year."). Thus, the energy consumed by the MineOne site would require multiplying the generation capacity of a conventional generator – generating one megawatt hour of power that is able serves 400-900 homes in a year – by 75, which would mean the MineOne site was using power equivalent to that consumed by 30,000-67,500 US homes in a year.

134 *See* Press Release, The White House, Fact Sheet: President Biden Sets 2035 Climate Target Aimed at Creating Good-Paying Union Jobs, Reducing Costs for All Americans, and Securing U.S. Leadership in the Clean Energy Economy of the Future (Dec. 19, 2024), https://bidenwhitehouse.archives.gov/briefing-room/statements-releases/2024/12/19/fact-sheet-president-biden-sets-2035-climate-target-aimed-at-creating-good-paying-union-jobs-reducing-costs-for-all-americans-and-securing-u-s-leadership-in-the-clean-energy-economy-of-the-future/#:~:text=This%202035%20NDC%20aligns%20with,economy%20of%20the%20future%2C%20reducing [https://perma.cc/2BMT-HABV].

135 *See generally*, Regarding the Acquisition of Certain Real Property of Cheyenne Leads, *supra* note 124.

136 Exec. Order. No. 14,154, 90 Fed. Reg. 8353 (Jan. 29, 2025).

137 *Id.*

138 *America First Investment Policy*, The White House (Feb. 21, 2025), https://www.whitehouse.gov/presidential-actions/2025/02/america-first-investment-policy/ [https://perma.cc/6C63-95JZ].

powers of the President as they relate to FDI transactions, and CFIUS itself, will be used "to restrict [People's Republic of China]-affiliated persons from investing in United States… energy."[139] Combined, these policies have the potential to gravely impact the domestic renewable energy sector since globally, China is the leading source of green foreign investment by a wide margin.[140] Thus, far from an apolitical, bureaucratic investment screening apparatus, the Committee, and the President's accompanying powers, have been transformed into a weapon that could be used, under the auspices of national security, to effect any number of executive objectives free from the scrutiny of judicial review, and subject to the whims of political change every four years.

The potential for harsh penalties such as forced divestment and eviction, as seen in the MineOne termination, to be meted out based on the subjective analysis of the President, and without the safeguard of judicial review, is not conducive to building the legal certainty necessary to encourage foreign direct investment. This is particularly true for a capital-intensive and highly sensitive sector such as energy.[141] It also provides the President with a powerful, and potentially punitive, tool to be wielded for purposes wholly unrelated to national security. The potential for this power to be abused, and used for conflicting purposes by successive administrations every four years, would likely engender some trepidation in even the savviest of foreign investors. These concerns are particularly salient in the energy industry.[142]

The jurisdictional, investigative, and mitigatory provisions set forth in the relevant CFIUS legislation and regulation ensure that the Committee can exercise jurisdiction over almost any commercial venture involving foreigners, can likely find a national security threat over any covered transaction, and can mitigate or block that transaction. Proponents might argue that this incredibly expansive jurisdiction is

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139 *Id.*; *see also* Stephen Heifetz, *Trump's Investment Policy: Clarifying & Confounding*, Council on Foreign Rel. (Mar. 5, 2025), https://www.cfr.org/article/trumps-investment-policy-clarifying-and-confounding [https://perma.cc/HNS7-RPGA] (arguing that "the memorandum is clear that U.S. investment policy is now a tool for countering China.").

140 Lucía Fernández, *Global Energy Transition Investment 2024, By Leading Country*, Statistica (Feb. 13, 2024), https://www.statista.com/statistics/1290974/investment-in-energy-transition-by-country/#statisticContainer [https://perma.cc/A953-TRD8].

141 *See* Mikko Rajavuori & Kaisa Huhta, *Investment Screening: Implications for the Energy Sector and Energy Security*, 144 Energy Pol'y at 7 (May 2020) (noting that "[h]istorically, energy has featured prominently in government interventions to cross-border transactions in order to ensure the security of critical infrastructures."); *see also* Freshfields, *supra* note 16.

142 *See* Alec Tyson & Brian Kennedy, *How Americans View National, Local and Personal Energy Choices*, Pew Rsch. Ctr. (June 27, 2024), https://www.pewresearch.org/science/2024/06/27/how-americans-view-national-local-and-personal-energy-choices/#:~:text=What's%20behind%20declines%20in%20support,be%20the%20more%20important%20priority [https://perma.cc/D285-BW3G] (noting, "gaps between Republicans and Democrats over energy policy now approach the very wide partisan divides seen over the importance of climate change.").

not inherently malignant. After all, transactions that pose no threat to national security will be allowed to proceed after review while those that pose a threat will be blocked. Moreover, most CFIUS reporting is voluntary–unless CFIUS determines through its monitoring that it should review a given unreported transaction–so this issue is overblown.[143]

That argument merely amounts to the time-honored logical fallacy that "if you have nothing to hide you have nothing to fear."[144] Such broad jurisdiction and criteria for evaluation give the Committee expansive power over transacting parties, which introduces detrimental legal uncertainty caused by the threat of long and costly investigative procedures and potential subjection to discretionary decisions. This unpredictability could deter foreign persons from investing or doing business in the United States.[145] The Executive's incredible prerogative in evaluating a transaction and mitigating any potential threats, free from judicial review, compounds this problem. Checking this trend would immensely benefit the U.S. investment market, and with it, the ability of actors in the green-energy sector to secure capital.

IV. Conclusion

Energy is the foundation of modern human society.[146] While the globally ubiquitous practice of sourcing that energy from fossil fuels is efficient and economical, it is neither sustainable nor healthy for mankind or the planet.[147] To maintain modern standards of living in the long term, it is imperative that sustainable, clean (i.e., green) energy sources become the new foundation of the global energy sector. However, a technological shift will need to occur, and such sustainable, clean energy technologies will need to become marketable against presently cheap and efficient fossil fuels.[148] Green investment is integral to "driving the shift" to a green, clean-energy global energy-production regime.[149] The sources of this FDI, particularly when it originates in the market of a

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143 *CFIUS Overview*, U.S. Dep't of Treasury, https://home.treasury.gov/policy-issues/international/the-Committee-on-foreign-investment-in-the-united-states-cfius/cfius-overview#:~:text=The%20process%20remains%20largely%20voluntary,except%20in%20certain%20limited%20circumstances [https://perma.cc/R63L-MJXQ] (last visited Jan. 24, 2025).

144 Upton Sinclair, The Profits of Religion: An Essay in Economic Interpretation (Project Gutenberg ed., 1998) (1917) (ebook) https://www.gutenberg.org/cache/epub/1558/pg1558-images.html [https://perma.cc/WWE5-62DY].

145 *See* Freshfields, *supra* note 16.

146 *See* U.N. Food and Agric. Org., *supra* note 1, at 1.

147 Letcher, *supra* note 22, at 2.

148 Samantha Gross, *Why are Fossil Fuels So Hard to Quit?*, Brookings (June 2020), https://www.brookings.edu/articles/why-are-fossil-fuels-so-hard-to-quit/ [https://perma.cc/LVL8-GPUS] (noting that "[p]lentiful and inexpensive fossil fuels make transitioning away from them more difficult.").

149 U.N. Conf. on Trade and Dev., *supra* note 7, at 56.

global competitor, can sometimes cause unease in investment-destination countries.[150]

CFIUS was created to address such concerns. However, since its inception in 1975, this secretive Committee's authority and purview have grown so markedly through permissively articulated legislation and regulation that it now stifles the very market it was meant to protect, by chilling FDI flows with the shadow of legal uncertainty cast by its relatively unchecked power.[151] The United States is still the premier destination for FDI.[152] Nevertheless, if CFIUS does not undergo much-needed reform, alternative destination markets could become the new winners in the race to innovate and develop scalable and marketable green energy production systems.[153]

In 2018, FIRRMA sailed through the U.S. House of Representatives and the U.S. Senate with large bipartisan majorities, was signed by President Donald Trump, and dramatically expanded CFIUS's power and presence in the U.S. market.[154] Now, lawmakers of both parties

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150 Dimitri Slobodenjuk et al., *The Evolving Concept of Nat'l. Sec. Around the World*, *in* Global Competition Rev., Foreign Direct Investment Regulation Guide 29, 33 (Veronica Roberts, 3d ed., 2023), https://www.cliffordchance.com/content/dam/cliffordchance/briefings/2023/12/the_evolving_concept_of_national_security_around_the_world.pdf [https://perma.cc/MGZ5-CNDN] (noting that PRC investments are coming under heightened scrutiny).

151 Freshfields, *supra* note 16.

152 U.S. Dep't. of Com, *supra* note 23, at 2; *see also* Damgaard & Sánchez-Muñoz, *supra* note 27; *and see* Press Release, The White House, *supra* note 27.

153 *See, e.g.*, Julien Chaisse, *FDI Screening: CFIUS is the Benchmark, the EU's is Toothless (For Now)*, FDI Intel. (June 26, 2023), https://www.fdiintelligence.com/content/opinion/fdi-screening-cfius-is-the-benchmark-the-eus-is-toothless-for-now-81790 [https://perma.cc/T6MV-5ZD9] (noting that "the EU regulation lacks teeth" because following the implementation of the "EU-wide framework for the screening of foreign investment, where member countries report to the European Commission their national screening activities" the statistics on transaction activity suggest a lack of arduous scrutiny on the part of the European Commission. For example, in "[i]ts second annual report…the Commission received 1563 requests for authorization. Around 71% of all the applications were deemed to not require a formal screening because of an evident lack of impact on public order and security, while the remaining 29% (453 cases) were formally screened. Of those, only 1%, or five projects, were prohibited; 3% were withdrawn by the parties and 23% were approved with mitigating conditions.").

154 *See* Press Release, U.S. H.R. Fin. Serv. Comm., House Passes Foreign Investment Reform Bill (June 26, 2018), https://financialservices.house.gov/news/documentsingle.aspx?DocumentID=403695 [https://perma.cc/2AMH-RTQP] (noting that "[t]he Financial Services Committee favorably reported this bill to the House in May 2018 by a unanimous vote of 53-0," and once brought to the floor "[t]he House of Representatives…passed the Foreign Investment Risk Review Modernization Act of 2018 (FIRRMA) by a strong bipartisan vote of 400-2."); *see also* Press Release, U.S. S. Comm. on Banking, Hous., and Urb. Aff., Banking Committee Advances CFIUS Legislation (May 22, 2018), https://www.banking.senate.gov/newsroom/press/banking-Committee-advances-cfius-legislation [https://perma.cc/ZHS3-MJXQ] (noting that Senators Cornyn (R-TX) and Feinstein (D-CA) introduced the bill that would become FIRRMA to the Senate, and the bill "was voted out unanimously 25-0 by the Banking Committee."); *and see* Kathleen Scott, *President Trump Signs into Law CFIUS Reform Bill*, Norton Rose Fulbright:

should seize the opportunity to pass market-oriented, and ultimately ecologically beneficial, CFIUS reform that 1) tailors the scope of CFIUS jurisdiction; 2) reduces the criteria the Committee may consider when evaluating a transaction; and 3) limits the application of executive prerogative over the evaluation and mitigation of certain transactions. In pursuing such reforms, not only will CFIUS's mission be better served, but Greentech, Cleantech, and renewable-energy businesses will have access to a world of financing to develop, scale, and market their innovations.

Glob. Regul. Tomorrow (August 16, 2018), https://www.regulationtomorrow.com/us/president-trump-signs-into-law-cfius-reform-bill/ [https://perma.cc/5ZMD-PQX5] (noting President Trump's signing of FIRRMA into law).

Should I Stay or Should I Go?: The Constitutional Right to Travel and Climate-Related Displacement in the United States

*Peter Fasoli**

While seemingly strong at first glance, the constitutional right to travel, specifically intrastate travel, is wrought with major gaps. These gaps have been exacerbated over time due to a lack of clear guidance from the Supreme Court and the various interpretations by courts across the country that have ensued in this vacuum. As the climate crisis continues to worsen, climate-related disasters will continue to rise in frequency and severity. As a result, more individuals throughout the United States will be displaced and seeking new places to call home, either in a new state or in their current one. However, these communities receiving waves of internal climate refugees may choose to limit the ability of those displaced individuals from settling in their borders in the interest of protecting their current residents, for a multitude of potential reasons. When faced with such challenges, the fractured understanding and application of intrastate travel by the courts, highlighted by the Covid-19 pandemic, will be insufficient to adequately protect the rights of individuals across the country that are displaced by climate change. This note advocates for the Supreme Court to declare that the right to intrastate travel is encompassed by the broader right to travel, for courts to reject the Jacobson *framework in climate displacement cases, and for courts to exercise heightened diligence to the many factors that are in play with climate displacement cases, all to ensure the proper protection of the individual liberties of populations that will be forced from their homes due to the consequences of climate change.*

Table of Contents

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I. Introduction

Every day, Americans exercise various fundamental rights granted by the Constitution, often with little awareness of the nuances of those protections, including their origins, the scope of the rights, or the circumstances under which they may be limited. Although less tangible than other rights, the right to travel has sparked conversation through multiple instances in history. Most recently, the COVID-19 pandemic sparked discussion about the right to travel, as municipalities imposed restrictions that aimed to stem the spread of the virus. Various approaches were explored; some state governments went so far as to restrict those who could enter their borders.[1]

The severe and disheartening effects of climate change displacement were well-discussed, captivating news headlines throughout the pandemic and well after. However, COVID-19 is not the only recent recollection of mass displacement and restrictions on travel; climate change has had increased ripple effects touching almost every area of the country. As climate change consequences exponentially increase in severity and frequency, more Americans will consider the prospect of moving before danger occurs or will be forced to relocate with little notice.[2] According to the U.S. Census Bureau's Pulse Survey, roughly 1 out of every 70 Americans were displaced from their homes due to a natural disaster in 2023.[3] Furthermore, about one third of those Americans have been displaced for a substantial period of time, around 1 million Americans in 2023 alone.[4] In 2024, two hurricanes, Hurricanes

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1 Lawrence Gostin & Meryl Chertoff, *Lockdowns, Quarantines, And Travel Restrictions During COVID and Beyond: What's the Law, And How Should We Decide?*, Health Aff.: Forefront (Mar. 24, 2021), https://www.healthaffairs.org/content/forefront/lockdowns-quarantines-and-travel-restrictions-during-covid-and-beyond-s-law-and-should [https://perma.cc/H6WU-4GXX].

2 *See* Damian Carrington, *Climate 'Whiplash' Events Increasing Exponentially Around the World*, The Guardian (Jan. 15, 2025, at 10:00 ET), https://www.theguardian.com/environment/2025/jan/15/climate-whiplash-events-increasing-exponentially-around-world [https://perma.cc/8TTP-LPFT].

3 Andrew Rumbach & Sara McTarnaghan, *More Than 3 Million Americans Were Displaced By a 'Natural' Disaster in the Past Year. How Can We Prepare for Our Climate Future?*, Urban Inst.: Urban Wire (Nov. 15, 2023), https://www.urban.org/urban-wire/more-3-million-americans-were-displaced-natural-disaster-past-year-how-can-we-prepare [https://perma.cc/35GF-TPYD].

4 *Id.*

Helene and Milton, battered the Southeastern United States.[5] Those storms were unprecedented in their reality of rapidly evolving into category five storms over the ocean, and hitting the same regions just two weeks apart.[6] So far, the number of individuals displaced by Hurricane Helene has reached nearly 12,000 in North Carolina alone, with many of these individuals remaining displaced at the start of 2025.[7] This reality, combined with estimates that 95% of the property damaged by Hurricane Helene was uninsured, suggests that those displaced will likely need to find homes in new, permanent locations.[8] Additionally, the silent yet ever-present threat of sea-level rise will significantly contribute to displacement in a slower, but still consistent, manner.[9] Some estimates predict that more than 13 million people will be displaced on the east coast due to sea level rise by the end of the century.[10]

The climate crisis has already begun to spark discussion among lawmakers throughout the United States about possible solutions, one of which is "managed retreat."[11] This strategy involves a government proactively considering and planning for the mass relocation of its community.[12] However, implementation of such a strategy has been nearly nonexistent on the federal level.[13] Former President Joe Biden implemented measures to begin incorporating managed retreat and climate

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5 Andrew B. Hagan, *The 2024 Atlantic Hurricane Season: Helene and Milton Highlight 5 U.S. Hurricane Landfalls*, 78 Weatherwise, at 19, 23–25 (2025).

6 Lina Stern, *Assessing the Environmental Consequences of Hurricanes Helene and Milton in Florida*, Fla. Specifier, (Nov. 9, 2024, at 14:36 ET), https://floridaspecifier.com/issues/v46n6/assessing-the-environmental-consequences-of-hurricanes-helene-and-milton-in-florida/ [https://perma.cc/55TR-KAMF].

7 Will Hofmann & Ryley Ober, *As 12,000 Remain Displaced from Helene, Campers Become Homes. The Problem is Keeping Them Warm*, Citizen Times (Jan. 13, 2025, at 05:07 ET), https://www.citizen-times.com/story/news/local/2025/01/13/wnc-residents-displaced-by-helene-turn-to-campers-as-housing/77574924007/ [https://perma.cc/38NT-9TZ3].

8 Seth Bornstein, *Helene and Milton Are Both Likely to Be $50 Billion Disasters, Joining Ranks of Most Costly Storms*, AP News (Oct. 16, 2024, at 04:46 ET), https://apnews.com/article/helene-milton-hurricanes-climate-development-damage-costly-82c1d5df81c76fa08e035bf7c6db3a37 [https://perma.cc/QXX2-ST3R].

9 *See generally* Nat'l Oceanic & Atmospheric Admin., Off. for Coastal Mgmt., *Examining Sea Level Rise Exposure for Future Populations*, Digital Coast, https://coast.noaa.gov/digitalcoast/stories/population-risk.html [https://perma.cc/XB6Y-6BK2].

10 *See* Caleb Robinson et al., *Modeling Migration Patterns in the USA Under Sea Level Rise*, 15 PLOS One, at 11 (2020) [https://doi.org/10.1371/journal.pone.0227436].

11 *See generally* S. 3261, 118th Cong. § 2(d)(1)(e)(ii)(IV) (2023).

12 *See* Ira Feldman, *Creating Resilient Receiving Communities: How Will We Relocate the Climate Displaced In North America?*, Adaptation Leader (Nov. 15, 2023), https://www.adaptationleader.org/creating-resilient-receiving-communities-how-will-we-relocate-the-climate-displaced-within-north-america/ [https://perma.cc/5G4A-WP4Q].

13 *See* Ira Feldman & James R. May, *Climate Displacement, Managed Retreat, and Constitutional Revolution*, Nat. Res. and Env't., Summer 2024, at 1, 2.

resiliency within the Executive Branch.[14] However, these efforts, largely focused on the areas people would be leaving, failed to address the equally important question of where people would go. The issue of protecting the rights of those who must relocate is exacerbated as extreme weather events continue to grow in severity and frequency. Therefore, ensuring that the rights of individuals who are forcibly displaced by the consequences of climate change are robust, enforceable, and well-understood is a vital component of adapting to climate change.[15]

This Note analyzes the right to travel within the United States, reviewing how the COVID-19 pandemic prompted the most significant recent developments to the doctrine. The Note seeks to highlight the shortcoming of the judiciary's current approach to the right to intrastate travel, particularly in protecting the rights of displaced individuals considering the consequences of climate displacement throughout the country. Part I will describe the current consequences of climate change on extreme weather events and sea level rise, including how they are predicted to alter internal migration of those in the United States. Part II will give the constitutional foundation of the Supreme Court's interpretation of the right to interstate travel and examine the discrepancies in its approach to intrastate travel issues. Part III will analyze how the COVID-19 pandemic brought the longstanding, but seldom-used, *Jacobson* analysis to the forefront of the right to travel. Part IV will hypothesize a situation where climate displacement and the right to intrastate travel converge, presenting considerations that courts would consider in such a situation. Part V will propose recommendations on how to settle the right to travel issues to ensure climate displaced individuals are properly protected and give concluding thoughts.

II. Background

A. *The Climate Crisis and Migration Implications*

The consequences of climate change are here and are likely to worsen as their presence is ignored.[16] Some have said that we are too far gone and it is no longer a matter of stopping climate change, but one of mitigating further damage while adapting to the guaranteed changes in

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14 *See* Jeff Peterson et al., *Federal Leadership for Relocation of Coastal Communities*, 53 Env't. L. Rep. 10791, 10793 (2023).

15 *See* Karla Mari McKanders, *Climate Migration*, A.B.A. (Oct. 30, 2024), https://www.americanbar.org/groups/crsj/resources/human-rights/2024-october/climate-migration/ (discussing the need for a protective framework for climate refugees in the United States).

16 *See* Daniel Vernick, *Is Climate Change Increasing the Risk of Disasters?*, World Wildlife Fund (Jan. 14, 2025), https://www.worldwildlife.org/stories/is-climate-change-increasing-the-risk-of-disasters [https://perma.cc/WFG3-D76N].

our environment.[17] Although attention to the climate crisis and the role of greenhouse gas emissions in global temperatures has increased, the world has been slow to take effective measures to stop emissions. Over the last half-century, greenhouse gas emissions have increased 100%, and average global temperatures have gone from 13.7 degrees Celsius to 15 degrees Celsius, with no outlook on either of those rates slowing down.[18] Increased atmospheric temperatures are one of the most prominent causes of rising ocean temperatures.[19] Warmer waters are the largest cause of sea level rise and extreme weather events, especially hurricanes.[20] Researchers predict that these effects play a significant role in the expected changes in migration patterns and mass displacement.[21]

Extreme weather events play a significant role in the climate displacement seen in the United States. Hurricanes are prominent examples of catastrophic weather events; notably, Hurricane Katrina is considered as one of the most disastrous and costly hurricanes in the country's history.[22] Katrina displaced roughly 1.5 million residents throughout New Orleans and the surrounding region in 2005.[23] In 2018, Hurricane Michael displaced an estimated 464,000 people throughout the Southeast United States.[24] Hurricanes are not the only natural disaster causing migration, as about 150,000 Americans are estimated to be displaced annually due to wildfires.[25] Additionally, sea level rise,[26]

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17 *See generally* Feldman, *supra* note 12.

18 *See* Feldman, *supra* note 13, at 1.

19 *See* Rebecca Lindsey & Luann Dahlman, *Climate Change: Ocean Heat Content*, Nat'l Oceanic & Atmospheric Admin. (June 26, 2025), https://www.climate.gov/news-features/understanding-climate/climate-change-ocean-heat-content.

20 *See* Caroline Craig & Brian Palmer, *Sea Level Rise 101: The Causes and Effects of This Undeniable Consequence of Climate Change-and How Communities Can Respond*, Nat. Res. Def. Council (Mar. 25, 2024), https://www.nrdc.org/stories/sea-level-rise-101 [https://perma.cc/22X5-D5JG]; *see also How Does the Ocean Affect Hurricanes?*, Nat'l Oceanic & Atmospheric Admin (Dec. 16, 2020), https://oceanexplorer.noaa.gov/facts/hurricanes.html [https://perma.cc/HE9N-RBYA].

21 *See* Robinson, *supra* note 10, at 2.

22 Eric Blake, Christopher W. Landsea & Ethan J. Gibney, Nat'l Oceanic and Atmospheric Admin., The Deadliest, Costliest, and Most Intense United States Tropical Cyclones From 1851 to 2010 (And Other Frequently Requested Facts) 5 (2011).

23 *See* Danielle Baussan, *When You Can't Go Home: The Gulf Coast 10 Years After Katrina*, Ctr. for Am. Progress (Aug. 18, 2015), https://www.americanprogress.org/article/when-you-cant-go-home/ [https://perma.cc/5C4W-2JZ4].

24 *See* Carlos Martin, *Who Are America's "Climate Migrants," and Where Will They Go?*, Urban Inst.: Urban Wire (Oct. 22, 2019), https://www.urban.org/urban-wire/who-are-americas-climate-migrants-and-where-will-they-go [https://perma.cc/R2GR-ALKR].

25 *See* Erol Yaboke et al., *A New Framework for U.S. Leadership on Climate Migration*, Ctr. for Strategic and Int'l Stud. Briefs, Oct. 2020, at 4.

26 *See generally* Robinson, *supra* note 10, at 2 (modeling migration patterns due to sea level rise); *see also* Matthew E. Hauer, Sunshine A. Jacobs & Scott A. Kulp, *Climate Migration Amplifies Demographic Change and Population Aging*, Proc. Nat'l Acad. Scis., 2024, at 1 (researching how climate migration affects climate migration patterns and aging within "origin areas" of the displacement event).

tornadoes, and numerous other weather events also play a significant role in climate related displacement in the United States.[27]

Mass displacement due to extreme weather events in the United States is not a new phenomenon. It is estimated that nearly 2.5 million Americans migrated during the Dust Bowl of the 1930s, with nearly 200,000 of them moving to California alone.[28] However, as climate change worsens, and the frequency and destruction of weather events increase exponentially, these significant migration events also increase.[29] In light of these realities, it is imperative to understand the evolution of the right to travel in the United States, and to look for ways to adapt the law for future use in the climate crisis.

B. The Right to Travel in the United States

Americans travel in many ways throughout and across the United States, and each mode of travel raises questions about how the travel is protected by the Constitution. One's ability to travel between states is interstate travel, while one's ability to move within the borders of a state is intrastate travel.[30] Case law has evolved into a consensus that the right to interstate travel is protected by the Constitution through various interpretations.[31] However, the lack of a single, clearly-defined, enumerated text for courts to point to has raised significant questions and concerns about the right to travel, particularly the constitutional status of intrastate travel. Varying protections for intrastate travel have emerged across the country. With climate change displacing communities, safeguarding their constitutional right to choose where to relocate is paramount.

i. The Interstate Travel Right

The right to interstate travel is considered a fundamental right of all citizens of the United States, despite not appearing explicitly in the

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27 *See* Tim Robustelli, Helen Bonnyman & Yuliya Panfil, New America, Climate Migration's Impact on Housing Security in the United States 1 (2024), https://www.newamerica.org/future-land-housing/reports/climate-migrations-impact-on-housing-security/ [https://perma.cc/2RVE-UDSG].

28 *See Mass Exodus from the Plains*, Am. Experience (last visited Oct. 6, 2025), https://www.pbs.org/wgbh/americanexperience/features/surviving-the-dust-bowl-mass-exodus-plains [https://perma.cc/J2ED-EJYM].

29 *See generally* Carrington, *supra* note 2.

30 *See What is the Difference Between Moving Interstate Versus Intrastate?*, Conn. Dep't of Transp., https://portal.ct.gov/dot/knowledge-base/articles/what-is-the-difference-between-moving-interstate-versus-intrastate?language=en_US [https://perma.cc/L76A-GVSW] (last visited Oct. 10, 2025).

31 *See* Noah Smith-Drelich, *The Constitutional Right to Travel Under Quarantine,* 94 S. Cal. L. Rev. 1367, 1395–96 (quoting Saenz v. Roe, 526 U.S. 489, 501 (1999)).

text of the Constitution.[32] However, the Supreme Court's understanding of where the right to interstate travel originates from within the Constitution has changed over time. Analyzing these various approaches and perspectives of the right to interstate travel is crucial in determining the law's ability to address challenges arising from climate migration.

One of the earliest proclamations of the right to interstate travel was in 1823 in *Corfield v. Coryell*, where the plaintiff argued that a New Jersey law prohibiting citizens of different States from harvesting oysters from a specific cove in New Jersey violated the Privileges and Immunities Clause in Article IV, Section 2 of the Constitution.[33] The Circuit Court for the Eastern District of Pennsylvania stated, "[t]he right of a citizen to pass through, or to reside in any other state … may be mentioned as some of the particular privileges and immunities of citizens, which are clearly embraced by the general description of privileges deemed to be fundamental."[34]

Challenges to interstate travel have been brought many times over the years, leading to a natural evolution of the jurisprudence.[35] Given the lack of clear textual basis within the Constitution, many Supreme Court justices have contended that the right to travel originates from different parts of the Constitution.[36]

Modern case law regarding the right to travel begins with *Edwards v. California*.[37] The case involved a California law that criminalized aiding an indigent person to enter the State.[38] The Supreme Court ruled that the transportation of indigent persons across state lines constituted interstate travel and commerce, couching both the right to travel and Congress' ability to regulate it, in the Commerce Clause of the Constitution.[39] The Court reasoned that the regulation of such matters should be left solely to Congress because the Commerce Clause stands for the proposition that interstate commerce is immune from state control.[40] In applying this principle to the California law, the Court found that transportation of indigent persons fell under federal jurisdiction.[41] Therefore, California's law limiting interstate travel was "an unconstitutional barrier to interstate commerce."[42] California had attempted to

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32 *See* Saenz v. Roe, 526 U.S. 489, 501 (1999).

33 *See* Corfield v. Coryell, 6 F. Cas. 546, 549 (C.C.E.D. Pa.1823).

34 *Id.* at 552.

35 *See infra* text accompanying notes 38–61.

36 *See generally* Edwards v. California, 314 U.S. 160 (1941); *Saenz*, 526 U.S. 489; Crandall v. Nevada, 73 U.S. 35 (1867).

37 *See generally Edwards*, 314 U.S. 160.

38 *See id.* at 171.

39 *See id.* at 176.

40 *See id*. (citing Milk Control Brd. v. Eisenberg Farm Prods., 306 U.S. 346, 351 (1939)).

41 *See id*.

42 *Edwards*, 314 U.S. at 173.

justify the law by alleging problems from the high influx of migrants, such as health, morals, and a specific emphasis on finance.[43] However, the Court did not agree that such issues opened the door for California to enact such a law, stating that the Commerce Clause does not allow a state to isolate itself from "difficulties common to all" by "restraining the transportation of persons and property across borders."[44]

While the majority opinion found the right to interstate travel in the Commerce Clause, Justice Douglas' concurrence asserted that the right was worthy of more protection than the movement of mere "cattle, fruit, steel and coal across state lines."[45] Instead, he believed that the origin of the right was in the Privileges or Immunities Clause of the Fourteenth Amendment, saying "[t]he right to move from state to state is an incident of national citizenship … protected against state interference."[46] Justice Douglas cited a prior decision, issued before the Fourteenth Amendment, *Crandall v. Nevada*, where the Court found that the right to travel is fundamental to one's national citizenship.[47] While both the Justices believed the right to interstate travel existed, the lack of consistency from the Court left holes that may be exploited in future challenges.

The Supreme Court attempted to bring clarity to interstate travel protections near the turn of the twenty-first century in *Saenz v. Roe*.[48] In 1992, California enacted a law which sought to limit the maximum welfare benefits available to people who had recently arrived in the state. Those who had been in the state for less than twelve months were only able to collect welfare benefits payable to the state of their prior residence.[49] Three residents challenged the constitutionality of the durational residency requirement, pointing to its discriminatory treatment against those who had recently moved into the State.[50] Here, the Court explained that, while the right to travel is not explicitly identified in the text of the Constitution, it "is firmly embedded in our jurisprudence."[51] The Court proceeded to establish the guiding principles that scholars and legal practitioners rely on for the right to travel, dividing it up into three main components:[52]

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43 *See id.*

44 *Id*.

45 *Id.* at 177 (Douglas, J., concurring).

46 *Id.* at 178.

47 *Id*. (citing *Crandall*, 73 U.S. at 47).

48 *See* Timothy Carey, *Comity, Coronavirus, and Interstate Travel Restrictions*, Univ. of Chi. Legal F. 325, 331 (2021); *Saenz*, 526 U.S. at 515.

49 *See Saenz*, 526 U.S. at 492.

50 *See id.* at 493–94.

51 *Id.* at 498 (citing United States v. Guest, 383 U.S. 745, 757 (1966)).

52 *See id.* at 500; *see also* Carey, *supra* note 48, at 332.

> "The 'right to travel' discussed in our cases embraces at least three different components. It protects the right of a citizen of one state to enter and to leave another State, the right to be treated as a welcome visitor rather than an unfriendly alien when temporarily present in the second State, and, for those travelers who elect to become permanent residents, the right to be treated like other citizens of that State."[53]

Justice Stevens, writing for the majority, attempted to use these three components and the prior explanations of the right to travel in the Constitution to clarify the doctrine.[54] For the first component, Justice Stevens stated that the right to interstate travel was written in the Articles of Confederation and "may simply have been 'conceived from the beginning to be a necessary concomitant of the stronger Union the Constitution created.'"[55] Justice Stevens continued, explaining that the second component, being treated as a welcome visitor, was located within the Privileges *and* Immunities Clause of Article IV Section Two.[56] Justice Stevens also identified the third component in the Privileges *or* Immunities Clause of the Fourteenth Amendment.[57] Justice Stevens wrote that the right to be treated equally as a citizen of one's new State is "not only protected by the new arrival's status as a state citizen, but also by her status as a citizen of the United States."[58] In an effort to reconcile past inconsistencies, Justice Stevens emphasized that even though there have been disagreements in the past about the breadth of circumstances the clause covers, it has always been commonly understood that the Privileges or Immunities Clause protects the third component.[59] While each of these components are easier to digest due to Justice Stevens' approach, it does not solve the fundamental problem that the right to travel is not explicitly stated in the text of the Constitution.

ii. The Intrastate Travel Right

It may seem that a right to intrastate travel would flow logically from the right to interstate travel; however, the Supreme Court has not determined that to be the case. The Court suggested support for the idea of a right to freedom of movement, but many of those discussions have been in concurrences, dissents, or dicta.[60] Justice Douglas made the

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53 *Saenz*, 526 U.S. at 500.

54 *See id.* at 500–04.

55 *Id.* at 501 (quoting *Guest*, 383 U.S. at 758).

56 *See id.* at 501–502.

57 *See id.* at 502–03.

58 *See Saenz*, 526 U.S. at 502.

59 *See id.* at 503.

60 *Id. See also* Kent v. Dulles, 357 U.S. 116, 126 (1958) ("[F]reedom of movement is basic in our scheme of values."); Bykofsky v. Borough of Middletown, 429 U.S. 964, 964 (1976) (Marshall, J., dissenting) (arguing that the freedom of movement is "of the very essence of a scheme of ordered liberty").

strongest case for the existence of the right in his majority opinion in *Papachristou v. City of Jacksonville*, writing that the "amenities" of the Constitution regarding movement "have been in part responsible for giving our people the feeling of independence and self-confidence. …"[61] Though seemingly an inclination in favor of the freedom of movement, this notion was treated as mere dicta and lacked binding authority.

Additionally, the Supreme Court has previously suggested that the right of interstate and intrastate travel may be facially distinct. In *Bray v. Alexandria Women's Health Clinic*, the Court stated that "a purely intrastate restriction does not implicate the right of interstate travel, even if it is applied intentionally against travelers from other states, unless it is applied *discriminatorily*."[62] This proclamation suggests the Court views the concepts of inter and intrastate travel as distinct principles, except for when claims of discrimination arise.

The Court's inconsistent approach to this issue, in the absence of a strong textual basis in the Constitution, has led to discrepancies among judges, legal practitioners, and scholars as to whether the right to intrastate travel is distinct and therefore whether it is granted Constitutional protections.[63] These discrepancies have created a divide among federal courts over which level of constitutional protection and judicial scrutiny is granted to intrastate travel.[64] Such division within the judicial system grants varying levels of protection to the right to intrastate travel for similarly situated groups depending on the forum their case is brought in. Therefore, understanding how lower federal courts interpret the right to intrastate travel under the uncertain conditions of the doctrine is critical for securing consistent constitutional protections for climate-displaced communities. The following section will highlight how federal courts across the country determine intrastate travel's place in the broader right to travel jurisprudence.

Multiple federal circuit courts have found a constitutional right to intrastate travel. In *Jeffery v. City of New York*, the City of New York implemented a nighttime curfew following the protests in response to the death of George Floyd in 2020.[65] Plaintiffs challenged the curfew under the First, Fourth, and Fourteenth amendments of the Constitution.[66] The Second Circuit declined to predict whether the Supreme Court would recognize the right to intrastate travel, as they had done

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61 Papachristou v. City of Jacksonville, 405 U.S. 156, 164 (1972).

62 Bray v. Alexandria Women's Health Clinic, 506 U.S. 263, 277 (1993).

63 *See* Kathryn E. Wilhelm, *Freedom of Movement at a Standstill? Toward the Establishment of a Fundamental Right to Intrastate Travel*, 90 B.U. L. R. 2461, 2469–71 (2010) (discussing theories of the relationship between interstate and intrastate travel approaches).

64 *See infra* text accompanying notes 67–83.

65 *See* Jeffrey v. City of New York, 113 F.4th 176, 178 (2d Cir. 2024).

66 *See id.* at 186.

so in previous cases.[67] Instead, the court further explained that it historically has not located the right in any particular constitutional text. Rather, it has identified a constitutional right to travel "as [a] fundamental [right] to 'personal liberty.'"[68] Additionally, the Eighth Circuit has not affirmatively recognized the right to intrastate travel, but has assumed that the right exists for the purpose of analyzing certain constitutional questions and stated it "would likely be 'correlative' to the right to interstate travel discussed in *Saenz*."[69] Other circuits have taken a similar approach.[70] While these courts' approaches suggest a recognition of a right to intrastate travel, they stop short of explicitly endorsing it. The Supreme Court's lack of guidance clearly contributes to this continued uncertainty.

Some courts have decided to avoid giving a definitive answer on whether a right to intrastate travel exists. The Sixth Circuit gently broached the issue of the right to intrastate travel in *Wardwell v. Board of Education*, finding that Cincinnati Board of Education's rule requiring teachers hired by the Board to establish residency in the school district within ninety days of employment to be constitutional.[71] The Sixth Circuit assumed that the right to intrastate travel existed under the Fourteenth Amendment for the purposes of analysis to reach a conclusion on the question of which level of scrutiny to apply, and did not issue any binding holding on the existence of a right.[72] The Sixth Circuit clearly distinguished the case from others involving interstate travel and durational residency requirements, explaining that the right to intrastate travel had not been granted federal constitutional protection and was subject to lesser scrutiny.[73]

The same court revisited the intrastate travel issue in *Johnson v. City of Cincinnati*, this time ruling on an ordinance that excluded individuals who had been convicted of certain drug offenses from "drug exclusion zones."[74] Plaintiffs challenged the ordinance, arguing that it violated their right to travel under the Fourteenth Amendment's Due

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67 *See Jeffrey*, 113 F.4th at 191; *see also* Selevan v. N.Y. Thruway Auth., 584 F.3d 82, 100 (2d Cir. 2009).

68 *Jeffrey*, 113 F.4th at 191 (quoting King v. New Rochelle Mun. Hous. Auth., 442 F.2d 646, 648 (2d Cir. 1971)).

69 Doe v. Miller, 405 F.3d 700, 713 (8th Cir. 2005) (quoting Johnson v. City of Cincinnati, 310 F.3d 484, 497 n. 4 (6th Cir. 2002)).

70 *See Johnson*, 310 F.3d at 495 ("We conclude that the existence of a right to intrastate travel remains an open question in this circuit."). *See also* Potter v. City of Lacey, No. 101188-1, 2022 WL 18146232 (Wash. Aug. 18, 2022) (Bennet, J., dissenting) ("We can simply assume without deciding that there is a federal constitutional right to intrastate travel …").

71 Wardwell v. Bd. of Educ., 529 F.2d 626, 629 (6th Cir. 1976).

72 *See id.* at 628.

73 *See id.* at 627–628.

74 *Johnson*, 310 F.3d at 493–98.

Process and Equal Protection clauses.[75] The Sixth Circuit, in addressing the existence of the right to intrastate travel, analyzed the court's prior holdings on the issue, including *Wardwell*.[76] Ultimately, the court fell back on its prior position and found that "the existence of a right to intrastate travel remain[ed] an open question in [the Sixth] [C]ircuit."[77] It is evident that the lack of clear guidance by the Supreme Court has led to hesitation, even from courts seemingly poised to grant the right if such guidance existed.

While some courts have avoided declaring an intrastate travel right, others have outright rejected the notion. The Tenth Circuit in *McCraw v. City of Oklahoma City* was faced with a challenge to a city ordinance that prohibited standing, sitting, or remaining on certain road medians.[78] The court, in analyzing potential right to travel infringements, determined that "the fundamental right to freedom of movement 'applies only to interstate travel.'"[79]

The District Court of Colorado followed the Tenth Circuit's precedent. In *Lawrence v. Polis*, the District Court was faced with an order from the Governor implementing travel restrictions in response to the COVID-19 pandemic.[80] Plaintiffs challenged the orders, arguing that they violated their right to interstate and intrastate travel. In addressing the claims of infringement on the right to intrastate travel, the District Court found that "[t]he right to intrastate travel is not a federally recognized fundamental right, and restrictions on intrastate travel and local freedom of movement are subject only to rational basis review."[81] Such discrepancies in the jurisprudence around the right to intrastate travel leads courts across the United States to apply varying levels of scrutiny to similar government actions, resulting in inconsistent protections for displaced people seeking refuge or permanent relocation depending on which jurisdiction they fall in, rather than on the merits of their case.

iii. The Strict Scrutiny and Rational Basis Test

The levels of scrutiny deployed by the judicial system when governments are suspected of infringing on individual liberties are paramount, as they seek to balance both the individual liberties at risk and the ability of governments to regulate certain activities for its own interests.[82]

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75 *Id.* at 489.

76 *See generally Johnson*, 310 F.3d at 493.

77 *Id.* at 495.

78 McCraw v. Okla. City, 973 F.3d 1057, 1061 (10th Cir. 2020).

79 *Id.* at 1081 (emphasis omitted) (citing D.L. v. Unified Sch. Dist. No. 497, 596 F.3d 768, 776 (10th Cir. 2010)).

80 Lawrence v. Polis, 505 F. Supp. 3d 1136, 1140 (D. Colo. 2020).

81 *Id.* at 1147 (citing *McCraw*, 973 F.3d at 1081).

82 *See* Stephen A. Siegel, *The Origin of the Compelling State Interest Test and Strict Scrutiny*, 48 Am. J. Legal Hist. 355, 394 (2006).

While courts apply multiple levels of scrutiny,[83] the focus will be on strict scrutiny and rational basis, where the usage depends on the whether the liberty at issue is protected by the Constitution and the severity of the infringement on protected rights.[84]

The Court introduced this tiered judicial review structure in a footnote of its *United States v. Carolene Products* opinion to establish stronger protections against regulation of certain groups of people,[85] in response to the very deferential precedent established in *Lochner v. New York*.[86] Stemming from that footnote, the strict scrutiny test imposes a high burden on the government action at issue.[87] First, a court must answer three threshold questions: (1) whether the government is found to have a suspect classification for targeting individuals under the action in question, such as through race or national origin,[88] (2) whether there is a fundamental right at issue, and (3) whether the action being taken by the government is an actual infringement on the fundamental right.[89] If the court finds that there is a tangible infringement on a fundamental right, strict scrutiny is applied.[90] In the instances where a suspect classification is found, strict scrutiny is applied regardless of a fundamental right being at issue.[91]

The requirements a government must satisfy under the strict scrutiny test are, as one might guess, the most difficult to overcome.[92] To survive strict scrutiny, a government's action must "further 'interests of the highest order' by means 'narrowly tailored in pursuit of those interests.'"[93] In other words, a government must have a compelling interest

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83 *See id.* at 358 (describing multiple levels of heightened scrutiny, including strict scrutiny, intermediate scrutiny, and minimal scrutiny with bite, alongside the lowest level of rationality review).

84 *See id*. at 365 (quoting Sweezy v. New Hampshire, 354 U.S. 234, 251 (1957) (writing about state interest in relation to strict scrutiny)). *See also* Joseph F. Dierdrich, *Separation, Supremacy, and the Unconstitutional Rational Basis Test*, 66 Vill. L. Rev. 249, 251 (2021) (writing about state interest in relation to rational basis test).

85 *See* Dierdrich, *supra* note 84, at 255 (citing United States v. Carolene Products Co., 304 U.S. 144, 155, n.4 (1938)).

86 Lochner v. New York, 198 U.S. 45 (1905).

87 *See* Roy Spece & David Yokum, *Scrutinizing Strict Scrutiny* 10–11, n. 32 (James E. Coll. of L., Ariz. Legal Stud. Discussion Paper No. 15-12, 2015).

88 *See* Siegel, *supra* note 82, at 355.

89 *See* Saenz v. Roe, 526 U.S. 489, 498 (1999) (first establishing that the right to travel is a constitutional right at the outset of the discussion). *See also* Page v. Cuomo, 478 F. Supp. 3d 355, 362 (N.D.N.Y. 2020) (highlighting that the right to travel is a constitutional right before discussing preliminary injunction).

90 *See* Richard Fallon Jr., *Strict Judicial Scrutiny*, 54 UCLA L. Rev. 1267, 1269 (2007).

91 *See* Siegel, *supra* note 82, at 355.

92 *See* Richard Fallon Jr. & Michael W. McConnell, *The Supreme Court, 1996 Term*, 111 Harv. L. Rev. 54, 79 (1997) ("'strict in theory' will routinely prove 'fatal in fact'").

93 *See* Tandon v. Newsom, 593 U.S. 61, 64–65 (2021) (quoting Church of Lukumi Babalu Aye, Inc. v. Hialeah, 508 U.S. 520, 546 (1993)).

to infringe on the protected right, and then must take action that furthers the interest while restricting the right as little as possible.[94]

Courts administer the rational basis test if they determine there is not a constitutionally protected right at stake, granting much greater deference to governments.[95] The proceeding question then is whether the government action being challenged is rationally related to *any legitimate* government interest.[96] If the government meets this burden, courts will deem the action valid.

In the years after *United States v. Carolene Products*, the Court developed the rational basis test into its modern form. In *Williamson v. Lee Optical of Oklahoma*, Oklahoma passed a law making it illegal for anyone other than a licensed optometrist or ophthalmologist to fit, replace, or duplicate eyeglass lenses.[97] The Court explained many possible reasons for the Oklahoma legislature to enact such a law, such as necessity of prescriptions to be given by medical experts.[98] While the law may not have been the most congruous way to remedy potential problems, the Court found that "the law need not be in every respect logically consistent with its aims[,]" and that a legislature finding an evil, and rationally believing the law in question remedied it, is enough to pass muster.[99] The Court further entrenched the low bar for the rational basis test in *Federal Communications Commission v. Beach*, where Justice Thomas, writing for the majority, stated that a government showing "any reasonably conceivable state of facts … could provide a rational basis."[100]

Rational basis review has recently been applied to issues such as lockdown restrictions during the COVID-19 pandemic, presidential orders limiting immigration of foreign nationals, and agency regulations.[101] While the rational basis test is appropriate when the rights at issue are clearly unprotected by the Constitution, the right to intrastate travel is far from well-understood.[102] Courts that have not recognized intrastate travel as a constitutional right will apply a lower standard of review, such as the rational basis test. As a result, communities affected

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94 *See* Bayley's Campground, Inc. v. Mills, 985 F.3d 153, 159–60 (1st Cir. 2021).

95 *See* Wilhelm, *supra* note 63, at 2488.

96 *See* Dierdrich, *supra* note 84, at 255–56; *see also Carolene Prods. Co.,* 304 U.S. at 152 n.4 (explaining that a narrower scope of judicial review is needed when legislation facially infringes on Constitutional liberties).

97 Williamson v. Lee Optical of Okla., Inc., 348 U.S. 483, 485 (1955).

98 *See id.* at 487.

99 *See id.* at 487–88.

100 FCC v. Beach Commc'ns, Inc., 508 U.S. 307, 313 (1993).

101 *See* Lawrence v. Polis, 505 F. Supp. 3d 1136, 1140 (D. Colo. 2020) (covid lockdown restrictions). *See also* Trump v. Hawaii, 585 U.S. 667, 667 (2018) (presidential order); Abigail Alliance v. Eschenbach, 495 F.3d 695, 695 (D.C. Cir. 2007) (agency regulation).

102 *See supra* text accompanying notes 66–87.

by the consequences of climate change remain vulnerable to government actions that infringe on their ability to travel intrastate and limit their autonomy in choosing where to relocate.

C. Right to Travel Developments During the COVID-19 Pandemic

Governments whose actions face judicial review may look to public health interests to justify their actions. The public health justification manifested during the smallpox epidemic of the early 20th century in *Jacobson v. Massachusetts*–a case which, notably, did *not* implicate the right to travel.[103] *Jacobson* does not strictly fall within strict scrutiny or rational basis; it provides a separate framework for courts, specifically in public health situations.[104] COVID-19 lockdowns and travel restrictions–which implicated both public health concerns *and* often the right to travel–brought with them opportunities for the federal judiciary system to engage with the *Jacobson* framework and the right to travel more than it had previously. However, "public health" is broad, and it is scope remains uncertain, as courts have not explicitly set a clear definition.[105] As extreme weather events, escalated by climate change, force swaths of communities to relocate, many issues such as increased potential for infectious diseases and viruses to spread, will encourage governments to introduce travel restrictions in response.[106]

In *Jacobson*, Massachusetts implemented a law that required residents to obtain a vaccine against smallpox after the State determined it to be "necessary for the public health or the public safety."[107] The Court stated that it must invalidate an action justified by protecting public health if that action has no substantial relation to protecting the public health and if it is "a plain, palpable invasion of rights secured by fundamental law. …"[108] The Court suggested deference towards governments actively facing public health issues, saying that the liberties in the Constitution do "not import an absolute right in each person to be, at all times and in all circumstances, wholly freed from restraint[,]"[109] and that governments have and need the ability to protect themselves and their constituencies when faced with epidemics.[110]

Courts tasked with analyzing government actions in response to COVID-19 were split. Some applied the analysis from *Jacobson*,

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103 *See generally* Jacobson v. Massachusetts, 197 U.S. 11 (1905).

104 *See* Smith-Drelich, *supra* note 31, at 1372.

105 *See* Carey, *supra* note 48, at 345.

106 *See* Celia McMichael, *Climate Change-Related Migration and Infectious Disease*, 6 VIRULENCE 548, 549–550 (2015).

107 *Jacobson*, 197 U.S. at 27.

108 *Id*. at 31

109 *Id*. at 26.

110 *Id.* at 27.

granting greater deference to the state's decision to infringe on individuals' rights due to the public health nature of facts surrounding the action.[111] Others applied the strict scrutiny standard, analyzing suspicious state actions while providing the utmost protection of individual liberties and limiting a government's ability to diligently respond to the pandemic.[112]

Cases from lower federal courts around the country illustrate differing approaches to evaluating inter-and intrastate travel issues in the public health context. In *Carmichael v. Ige*, the District Court of Hawaii addressed a motion for a preliminary injunction against the governor's orders imposing measures to fight COVID-19.[113] As a part of these orders, the governor implemented a fourteen-day quarantine requirement for all persons entering the state, and violations of the quarantine were classified as misdemeanors.[114] The court inquired into the nature of the orders and whether they discriminated against non-residents under the Equal Protection Clause.[115] If the court found the orders to be discriminatory, they would immediately be reviewed under strict scrutiny, regardless of whether a fundamental right is being infringed upon.[116] The court determined that the Emergency Proclamation clearly outlined that quarantining was required for both residents and non-residents, and it did not have the underlying purpose of deterring out-of-state plaintiffs from entering the state.[117] Therefore, the proclamations were not immediately reviewed under strict scrutiny.[118]

Following that analysis, the district court contemplated whether to apply the more deferential *Jacobson* framework or strict scrutiny.[119] Due to the emergency situation presented by the pandemic, the court concluded that the *Jacobson* analysis applied to the State's orders.[120] After considering the evidence presented by the State, including the ongoing pandemic, infection and death rates, and statements from the state

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111 *See* Smith-Drelich, *supra* note 31, at 1372.

112 *See* Siegel, *supra* note 82, at 358 (strict scrutiny offers a form of heightened protection for constitutional rights greater than rationality review).

113 *See* Carmichael v. Ige, 470 F. Supp. 3d 1133, 1139 (D. Haw. 2020) (the governor issued orders such as a stay-at-home mandate, extended quarantine to inter-island travelers, social distancing requirements, and extended quarantine requirement and eviction moratorium).

114 *See id.*

115 *See id.* at 1146.

116 *Cf. id* at 1145–46, 1149 (commenting that if public health order was discriminatory then strict scrutiny would be triggered since either a suspect classification or implication of a fundamental right requires a higher test than rational basis); *see generally* Smith-Drelich, *supra* note 31, at 1375–77 (describing the early history of strict scrutiny involving a case in which the court struck down race-based enforcement of a public health measure under the Equal Protection Clause).

117 *See Carmichael*, 470 F. Supp. 3d at 1146.

118 *See id*.

119 *See id*. at 1142.

120 *See id.* at 1142–43.

epidemiologist, the court found that the orders were in close relation to a public health emergency.[121] The Court then evaluated whether the regulation palpably conflicted with constitutional rights.[122] The Court concluded that the orders did not violate any constitutional rights and would potentially survive strict scrutiny if needed.[123] It highlighted that it was the plaintiffs' own decision not to travel to the state due to the quarantine requirements and nothing within the orders themselves restricted actual entry.[124]

Other courts were not as quick to engage the *Jacobson* framework and instead rejected its applicability in the modern context. The District Court of Colorado rejected the notion that *Jacobson* required an alternative analysis of government action related to public health when analyzing orders in response to COVID -19 in *Lawrence v. Polis*.[125] There, the court found that *Jacobson* is not just an exception that allows a government to avoid strict scrutiny when they attempt to justify an action under public health needs.[126] Ultimately, the court determined that if a public health emergency did in fact create an exemption from regular constitutional review, "then courts would have to be much more demanding in reviewing the government's assessment of what constitutes such an emergency."[127] Instead of spiraling into seemingly endless arguments over the aspects of *Jacobson*, the court found it better to reject the *Jacobson* test altogether and "apply consistent constitutional principle and doctrines," or more simply, use rational basis and strict scrutiny.[128]

Public health and how it applies to the right to travel is still ill-defined.[129] The Supreme Court previously outlined considerations in the quarantine context that "pestilence cannot be quarantined when it can be demonstrated that unlimited travel to the area would directly and materially interfere with the safety and welfare of the area or the Nation as a whole."[130] This viewpoint from the Court appears to implicate a *Jacobson* style of deference to states in times of crisis directly affecting public health. While what constituted "public health" may have been clear during the COVID-19 pandemic, as governments' orders in response to the pandemic become less common, it becomes

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121 *See id.* at 1143–44.

122 *Id.* at 1145.

123 *See Carmichael*, 470 F. Supp. 3d at 1147.

124 *See id.* at 1141.

125 *See* Lawrence v. Polis, 505 F. Supp. 3d 1136, 1143 (D. Colo. 2020).

126 *See id.* at 1144.

127 *Id*.

128 *Id*.

129 *See* Zemel v. Rusk, 381 U.S. 1, 15–16 (1965); *see also* Bayley's Campground, Inc., 985 F.3d at 159.

130 *Zemel*, 381 U.S. at 15–16.

less clear what could be encapsulated by "public health." The terms, such as "safety," "welfare," and "Nation as a whole," are too broad and allow the opportunity for creative government officials to take an inch and turn it into a mile.

III. Analysis

A. *Considerations for Climate Displacement Cases*

Extreme weather events have displaced thousands of Americans just in the past year. Hurricanes Helene and Milton made landfall in the southeast United States within one week of each other. Statistics show that around 375,000 households were displaced in some capacity due to Helene alone.[131] Current data estimates that the Los Angeles wildfires displaced over 13,000 households, with many of them seeking housing on a longer-term basis.[132] Given the increased likelihood of droughts affecting areas around the country due to rising global temperatures, the chance of extreme wildfires will also grow.[133] When considering issues related to intrastate travel, it is useful to analyze how a court might handle a scenario implicating these concerns and how the applicable levels of scrutiny would affect such evaluation.

Consider the hypothetical state of Solaria, located on the Colorado River, dependent upon the waters of Lake Mead. Lake Mead's water levels have dropped to unprecedented low levels, straining local municipal water systems that are attempting to keep up with demand.[134] Within Solaria, the densely populated city of Tree Bend and the surrounding suburbs experience a devastating wildfire, displacing tens of thousands of residents. Estimates forecast that it will take years at minimum to recover Tree Bend, leaving many to consider long term or permanent relocation within Solaria. Highland is a much smaller town located near Tree Bend. In response to the emergency in Tree Bend, Highland issues an Emergency Order. This Order is titled the Water Access Order

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131 Natasha Fernandez, *The Aftermath of Hurricane Helene*, Univ. of Ala. Birmingham Inst. For Hum. Rts. Blog (Nov. 2, 2024), https://sites.uab.edu/humanrights/2024/11/02/the-aftermath-of-hurricane-helene/ [https://perma.cc/JC8F-3VRW].

132 *The Los Angeles Wildfires Have Caused Billions in Real Estate Losses, Displaced Thousands*, The Pride LA (Feb. 23, 2025), https://thepridela.com/2025/02/the-los-angeles-wildfires-have-caused-billions-in-real-estate-losses-displaced-thousands/ [https://perma.cc/EHP6-BTJT].

133 *See Does Climate Change Cause Wildfires?*, Int'l. Fund for Animal Welfare (Oct. 24, 2024), https://www.ifaw.org/journal/climate-change-wildfires [https://perma.cc/VBM5-MNPS].

134 *See The Colorado River Crisis: Water Shortages, Climate Change, and Sustainable Management*, Penn State Inst. of Energy and the Env't., (last updated Sept. 18, 2025) https://iee.psu.edu/news/blog/colorado-river-crisis-water-shortages-climate-change-and-sustainable-management#:~:text=The%20primary%20challenge%20is%20how,higher%20temperatures%20and%20drier%20conditions [https://perma.cc/28QR-9UR3] (Lake Mead's levels have dropped consistently over the last 25 years, with only systemic changes in water usage solving the problem).

(Order). The Order states "for 12 months, no individual or household not domiciled in Highland as of the date of this Order shall be permitted to obtain a new residential water connection. Exceptions apply for family members of existing residents or essential service employees." Residents of Tree Bend file a lawsuit in federal court, claiming that the Order violates their right to travel within the State.

The threshold question would be determining whether the Order utilizes a suspect classification. Recall *Saenz*, where the Court struck down a durational residency requirement as discriminatory, determining that (1) a resident's former State or duration of being a citizen of the new State plays no role in their need for benefits, and (2) allowing such a classification would open the door for the State to limit new resident's access to schools, the fire department, and other public services.[135] An order that is facially discriminatory, such as one that says "only long-term residents of Tree Bend who can prove birth in Solaria may obtain a new residential water connection," would face immediate strict scrutiny.[136] In our hypothetical, Highland's Order is crafted more neutrally, not mentioning race, ethnicity, or other suspect classifications. The adjudicating court may consider what the demographic make-up of the displaced people are, whether there was a disparate impact on the displaced individuals leading to a discriminatory outcome, or whether the government of Highland knew about the outcome.[137] People who face climate displacement may consist disproportionately of certain disadvantaged socioeconomic groups.[138] Therefore, courts analyzing the classification employed by a government order must be diligent of these considerations to properly protect groups that are already vulnerable.

If the Order is found to not include a suspect classification, the court adjudicating the Order would need to address the subsequent question of whether there is a fundamental right at issue. Here, the displaced individuals are claiming that the order violates their right to intrastate travel. Without Supreme Court precedent providing a definitive answer, the district court in this hypothetical would face the disparate understandings of the right to intrastate travel seen throughout the federal judiciary.[139] The extent of constitutional protection that the court decides that the right to intrastate travel deserves will heavily influence the level of scrutiny the Order will be subject to.[140] As the

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135 *See* Saenz v. Roe, 526 U.S. 489, 505–07 (1999).

136 *See Bray*, 506 U.S. at 277 (explaining that the inter/intrastate travel distinction does not matter if the law is applied "*discriminatorily*").

137 *See generally* Thomas B. Henderson, *Proving Discriminatory Intent From A Facially Neutral Decision With a Disproportionate Impact*, 36 Wash. & Lee. L. Rev. 109 n.8 (1979).

138 *See* Alique Berberian et al., *Racial Disparities in Climate Change-Related Health Effects in the United States*, Current Env't. Health Rep. 451 (2022).

139 *See supra* text accompanying notes 67–83.

140 *Id.*

court considers arguments from either side, the weight each of those arguments receive will vary greatly depending on whether strict scrutiny, rational basis, or *Jacobson* is being used.

Many of the arguments surrounding this Order will center around the water shortage emergency in Highland. While the Order in this hypothetical may not clearly implicate a public health issue as *Jacobson,* what if it was altered so that simultaneous to the wildfire, e. coli was found in parts of Highland's water supply? The reviewing court would need to consider whether the e. coli falls under *Jacobson's* public health framework and whether to engage in a *Jacobson* analysis. With both potential scenarios, scientific analysis would play a prominent role in determining water access, and the court would likely need to begin making critical decisions about issues like individual rights surrounding access to water.[141]

The duration of the order may also be a relevant factor for the court to assess.[142] Orders that are executed as temporary measures but end up extending far past the initial outlook may garner increased suspicion from the court, as displaced individuals would be continually barred from traveling intrastate even after the original emergency subsided. The District Court of Colorado directly addressed this concern in *Polis*.[143] The court shared the plaintiff's concern regarding the lack of a continuing emergency justifying the orders, stating that "[t]here is a real danger to civil liberties if courts simply defer to government decisions about what constitutes a public-health emergency. …"[144] If intrastate travel is found to not be a fundamental right, *Jacobson* and rational basis would give Highland greater ability to argue that an ongoing water shortage is sufficient justification for the Order. Alternatively, finding constitutional protections for intrastate travel paves the way for strict scrutiny and allows the court to take a much deeper look at whether there truly is an emergency.[145] Stricter scrutiny would thus place the burden on the government to find the least restrictive means possible, and offer increased protections to the populations faced with the difficult reality of leaving their homes.[146]

The court, in response to Highland's Order, may have to consider whether the order is a response to a sudden and acute migration event, like a wildfire, or a slow onset event, such as encroaching sea level rise. Without a recognized fundamental right, and therefore strict scrutiny,

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141 *See generally* Karrigan Bork, *Water Right Exactions*, 47 Harv. Env't L. R. 65, 108–15 (2023).

142 *See* Lawrence v. Polis, 505 F. Supp. 3d 1136, 1144 (D. Colo. 2020).

143 *Id*.

144 *Id*.

145 *See* Adam Winkler, *Fatal in Theory and Strict in Fact: An Empirical Analysis of Strict Scrutiny in the Federal Courts,* 59 Vand. L. Rev. 793, 800 (2019).

146 *See id*.

an acute event like the wildfire in the hypothetical may push the court towards the more deferential levels of review due to its emergency characteristics.[147] Slow onset events would be more akin to the California law in *Edwards* responding to the problem of indigents entering the State.[148] None of the justifications given by the government were considered enough of an emergency for the Supreme Court to uphold the law in *Edwards*.[149] Regardless of which category of event were to occur, a court finding intrastate travel to be protected by the Constitution would offer the most protections for displaced individuals, ensuring they could resettle on their own terms.

IV. Conclusion

The judicial discrepancies surrounding the right to inter- and intrastate travel, which levels of review are implicated for each, and how *Jacobson*'s public-health justification is to be treated leave considerable gaps in protection for individuals displaced by climate change. Courts that recognize a right to intrastate travel will grant more protections for individuals suffering from climate displacement than courts that do not.[150] Additionally, courts that do not recognize Constitutional protections for intrastate travel may to apply the rational basis test, or rely on *Jacobson,* depending on how the government justifies the action. Individuals forced from their homes, many with limited relocation options, deserve universal constitutional protections to choose where they decide to call home.

Courts presented with cases involving climate displacement and intrastate travel should decline to employ *Jacobson*. The *Jacobson* framework, with its "public health" justification, is too broad and does not allow the courts proper flexibility in considering the liberty interests of affected individuals. The District Court of Colorado in *Polis* emphasized the concern that clever governments could claim a public-health crisis to evade effective constitutional scrutiny.[151] The far-reaching nature of climate displacement and the many effects it has such as economic changes, housing issues, and job markets,[152] exacerbate the problem with the public health rationale outlined within the *Jacobson* framework.

To remedy the broader issue of intrastate travel, the Supreme Court should, given the opportunity, hold that intrastate travel is a

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147 See *supra* text accompanying notes 134–135.

148 *See Edwards*, 314 U.S. at 167.

149 *See id*. at 173.

150 *See* Winkler, *supra* note 145 (explaining that strict scrutiny applies to infringements on core constitutional rights, allowing only the most "pressing circumstances" can justify a government's action).

151 Lawrence v. Polis, 505 F. Supp. 3d 1136, 1144 (D. Colo. 2020).

152 *See* Hauer et. al., *supra* note 26 at 5.

constitutionally protected right. Doing so would remedy the different understandings and levels of constitutional protection from lower courts and provide one standard to follow. Furthermore, while strict scrutiny provides an ample foundation for courts to consider the right to travel in the climate migration context, courts will need to exercise heightened diligence and scrutiny of orders limiting travel, given the multifaceted and complex factors that will be favorable to the interests of both sides.

The climate crisis presents an omnipresent challenge to the United States and the rest of the world. Its unrelenting and indiscriminate nature will force many to reconsider the ways in which certain aspects of life that have normally been taken for granted may be taken away. Individuals will be forced from their homes due to no fault of their own, and many will be faced with limited options. The judicial system must ensure that the rights of those individuals, including intrastate travel, are protected by the strongest mechanisms available. Doing so will help to ensure that in the most difficult of times, everyone, regardless of where they are, will have the freedom to choose where they call home.

Use By, and Freeze By, and Best By, Oh My! How the Federal Government Should Use Food Date Labels to Tackle the Food Waste Epidemic

*Tori Kendle**

Most food products in the United States have some kind of date label, but the defining terms associated with these dates can vary dramatically because they are unregulated. Without uniform date labeling terms, consumers are confused by what all the dates mean, resulting in high rates of food waste. Food waste takes up more space in landfills than anything else, generates methane as it sits, and ultimately worsens climate change concerns. While Congress has attempted to create a uniform labeling system with no luck, California is on track to become the first state to successfully ban the use of certain date labels in 2026. However, leaving regulations up to the states can get messy, and the terms selected by California can be difficult for consumers to distinguish. To keep consumers informed and to combat food waste, this Note argues that the United States Department of Agriculture and the Food and Drug Administration should prohibit all but two labeling terms– "Best if Used By" to indicate food quality, and "Discard After" for food safety.

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I. Introduction

Imagine getting home from the grocery store and opening your refrigerator to put away the food you just bought. But there is no room for anything you purchased, because the refrigerator is full of half-consumed food items. You decide to commence a full refrigerator clean-out by checking the expiration dates on all the food products. However, you quickly realize that there is no consistency among the terms that accompany the dates: a pack of bacon has a date that suggests when to "Use By"; a bag of mini bell peppers has a date that says when to "Sell By"; a bottle of mustard indicates when it is "Best if Used By"; a pack of lunchmeat lists a date to "Discard After." You become more overwhelmed than you were before. You have no idea if any of the food is safe to eat, so you decide to just throw everything away out of an abundance of caution.

This is the reality of food product labeling in the United States. Many people believe that all food date labels are indicative of food safety, meaning when the product is or is not safe to consume.[1] In reality, most date labels are meant to indicate when the food product has reached its peak quality; this is when the food should taste the best, and has little to do with whether the food is safe.[2] There are currently no federal regulations controlling how companies should date food products, which has led to food companies using a myriad of different date labeling terms on their products.[3] The United States Department of Agriculture ("USDA") and the Food and Drug Administration ("FDA") are the primary federal agencies responsible for regulating labels on food products.[4]

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1 *See Food Product Dating*, USDA Food Safety and Inspection Serv., https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/food-product-dating [https://perma.cc/US5W-TKTN] (last updated Nov. 30, 2023).

2 *See id*.

3 This is with the exception of infant formula and a few other products, which *are* regulated for safety purposes. *Id*.

4 Comm. on the Nutrition Components of Food Labeling, Nat'l Acad. of Scis., Nutrition Labeling: Issues and Directions for the 1990s 52 (D.V. Porter & R.O. Earl eds., 1990), https://www.ncbi.nlm.nih.gov/books/NBK235563/ [https://perma.cc/YA8N-NUPE].

Despite having comprehensive schemes for regulating other attributes of food labels, food product dating has remained untouched.[5]

Without federal guidance on how to date food products, producers use whichever labels they see fit, often without any explaining what those labels mean. As a result, consumers cannot tell which labels–if any–indicate food safety and which merely suggest when the food should be consumed for freshness or quality. This confusion and uncertainty leads to higher food discard, resulting in food waste piling up in U.S. landfills.[6] Food waste is an especially detrimental issue because it takes up more space in landfills than any other type of waste.[7] While it sits in piles, the food waste produces a greenhouse gas known as methane, which contributes to global warming.[8] Food waste alone produces such high greenhouse gas emissions that it outpaces the total emissions of most countries.[9] As the Earth heads toward a global warming crisis, it is crucial that something is done about the food waste problem.

The absence of federal standards is not for lack of trying. Both the House and Senate have introduced bills seeking to establish a uniform national labeling scheme, including the Food Date Labeling Act of 2016,[10] and the Food Date Labeling Act of 2021[11] –both of which were stifled in Congress. Most recently, the House proposed the Food Date Labeling Act of 2023.[12] However, with no legislative action since May of 2023, it appears that Congress' progress on the bill has stalled out as well.[13] The state of food labeling regulation is not entirely grim, as

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5 The FDA produces a labeling guide for the food industry, which is updated periodically to reflect the current federal regulations around food labeling. This guide includes information on regulations such as where food labels must appear on packaging, which statements must be included on the food label, and what size the text on the food labels must be. FDA, Guidance for Industry: A Food Labeling Guide 5–6 (2013), https://www.fda.gov/media/81606/download?attachment [https://perma.cc/SQ35-8784. *See also*, 21 C.F.R. § 101 (2025); *Food Product Dating*, *supra* note 1.

6 *Survey: Misunderstanding Food Date Labels Linked with Higher Food Discards*, Johns Hopkins Bloomberg Sch. of Pub. Health (Feb. 19, 2019), https://publichealth.jhu.edu/2019/survey-misunderstanding-food-date-labels-linked-with-higher-food-discards [https://perma.cc/49VA-DTJB].

7 *See* Elaine S. Povich, *How Confusing Labels Contribute to our Food Waste Problem*, PBS News (Apr. 2, 2019, at 15:19 ET), https://www.pbs.org/newshour/health/how-confusing-labels-contribute-to-our-food-waste-problem [https://perma.cc/2PXV-XW2R].

8 *Id*.

9 "If food wastage were a country, it would be the third largest emitting country in the world." Food and Agric. Org. of the U.N., Food Wastage Footprint and Climate Change 1, https://openknowledge.fao.org/server/api/core/bitstreams/7fffcaf9-91b2-4b7b-bceb-3712c8cb34e6/content [https://perma.cc/SA5B-P8U8].

10 Food Date Labeling Act of 2016, H.R. 5298, 114th Cong. (2016).

11 Food Date Labeling Act of 2021, S. 3324, 117th Cong. (2021).

12 Food Date Labeling Act of 2023, H.R. 3159, 118th Cong. (2023).

13 *All Actions: H.R. 3159 – 118th Congress (2023-2024)*, Congress.gov, https://www.congress.gov/bill/118th-congress/house-bill/3159/all-actions [https://perma.cc/7TQ2-5UJQ] (last visited Feb. 3, 2025).

California recognized this problem and became the first state to prohibit the use of misleading date-labeling terms.[14] California's law bears some similarities to the federal proposals, aiming to create a more coherent labeling framework by mandating the use of two specific terms, separated out by food quality and food safety, and implementing format requirements for the labels.[15] It is hard to know why date label reform seems to be lacking in momentum; it could be due to the prioritization of other important issues, or a bipartisan bill may seem unpopular during such a tumultuous time.

Date labels on food products in the United States thus remain unregulated, leading to consumer confusion and high rates of food waste across the country. With no change coming from Congress, federal agencies must step in to resolve the food waste problem. To combat this decades-old issue, the UDSA and the FDA should enact a federal regulation with provisions similar to those of California's law–which permits only two date labels on their products: one indicating food quality and another indicating food safety. Instead of adopting the terms selected by California, the federal government should mandate the use of either "Best if Used By" or "Discard After" dates on food products to clarify the distinction between food quality and food safety and help combat food waste in the most effective way possible.

Part II of this Note walks through the background of date labeling practices, beginning with the environmental concerns around inconsistent labeling and then moving into the current regulatory landscape of the food system. The background will then transition to a detailed explanation of the California law and the legal authorities involved when both federal and local governments regulate food products. Part III analyzes why a federal date labeling regulation is necessary, first looking into a real-life example of the confusion caused by inconsistent labeling practices. This Note then proposes that the federal government follows California's lead by banning more than two date labeling terms, while selecting clearer terminology than that of California. Finally, the analysis addresses the necessity of proper date labels and argues against leaving the regulation to the states.

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14 Jaimie Ding, *Is the Food in the Fridge Still Good? California Wants to End the Guessing Game*, U.S. News & World Rep. (Oct. 1, 2024, at 15:50 PT), https://www.usnews.com/news/best-states/california/articles/2024-10-01/is-the-food-in-the-fridge-still-good-california-wants-to-end-the-guessing-game [https://perma.cc/3UCY-FYMT]; Assemb. B. 660, 2023-2024 Leg., Reg. Sess. (Cal. 2024).

15 *See* Food Date Labeling Act of 2016, *supra* note 10; Food Date Labeling Act of 2021, *supra* note 11; Food Date Labeling Act of 2023, *supra* note 12.

II. Background

A. Date Labels and Food Waste: An Environmental Issue

As it currently stands, there are few federal regulations addressing the date labels on food products.[16] The only food product with regulated expiration dates in the US is infant formula.[17] There is a "pack date" requirement for poultry and "thermally processed, commercially sterile products," which helps increase food traceability in the event of a disease outbreak, but does little for consumers who are wondering if they can consume the food.[18] For all other food products, the USDA recommends using a "Best If Used By" date on all products to indicate flavor and quality–a friendly suggestion with no legal teeth nor collective understanding.[19] The result is an inconsistent food labeling system across the US.

Varied food label dating practices lead to consumer confusion, as many people mistakenly believe that food items past their expiration dates are unsafe to eat.[20] However, many unopened foods are safe to eat for years after their purchase, far outlasting the quality date on their packaging.[21] When consumers are uncertain about the meaning of date labels and whether their food is still safe to consume, it results in high quantities of food waste across the country.[22]

More food is sitting in landfills than any other type of waste, and this is not a concern that should be taken lightly.[23] Every year, "roughly a third" of all food in the United States is wasted.[24] Food waste is a monumental issue because it occurs at every step in food supply chain: production, processing, retail, and consumption.[25] Food waste coming directly from consumers, such as that caused by confusing date labels, has cumulative impacts because it occurs further along the supply chain.[26] This means that rather than only the food itself going to waste,

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16 *Food Product Dating*, *supra* note 1.

17 21 C.F.R. § 107.20(c) (1985); *Food Product Dating*, *supra* note 1.

18 9 C.F.R. § 381.126 (1974); *Food Product Dating, supra* note 1.

19 *See Food Product Dating*, *supra* note 1.

20 Povich, *supra* note 7.

21 *See* Marianne Gravely, *Before You Toss Food, Wait. Check It Out!*, USDA (June 27, 2013, 17:00 ET), https://www.usda.gov/about-usda/news/blog/you-toss-food-wait-check-it-out [https://perma.cc/5MBM-HSFJ].

22 Povich, *supra* note 7.

23 *See id*.

24 Kristen Jaglo, Shannon Kenny & Jenny Stephenson, From Farm to Kitchen: The Environmental Impacts of U.S. Food Waste 52 (2021), https://www.epa.gov/system/files/documents/2021-11/from-farm-to-kitchen-the-environmental-impacts-of-u.s.-food-waste_508-tagged.pdf [https://perma.cc/4TRZ-2VJ6].

25 *See id*. at 5.

26 *See id.* at iii.

"food wasted during the consumption stage embodies the resources used to grow, process, package, store, and distribute the food up to the point the food reaches the consumer."[27] Food waste is detrimental not only because of the sheer volume sitting in landfills, but also due to the additional resources that are wasted, and its contributions to greenhouse gas emissions and climate change.

As it decomposes, food waste "breaks down relatively quickly," and generates methane in the process.[28] Methane is a "powerful greenhouse gas" that has a warming effect on the climate, thus contributing to global warming.[29] It is "second only to [carbon dioxide] in driving climate change," but with a shorter atmospheric lifetime – making it a higher climate priority in many cases.[30] This means that methane's effects on the climate will be felt more quickly than those of carbon dioxide.[31] The amount of methane currently present in the atmosphere further exacerbates the issue, as it continues to increase "at record rates and is projected to increase by up to 13% by 2030."[32] If the quantity of methane in the atmosphere continues to rapidly increase, its effects will worsen, and climate change will accelerate.

Methane concerns are worsened by a vicious cycle: food waste produces methane, methane contributes to climate change, and climate change leads to crop loss, which subsequently creates more food waste.[33] In fact, it is estimated that 58% of the atmospheric methane emissions released from municipal solid waste landfills come from food waste.[34] As the population continues to grow exponentially, reducing food waste can help sustainably feed a rapidly growing population.[35] The global population is expected to continue booming, and it is predicted that the population could reach 9.3 billion by 2050.[36] Keeping up with that many mouths to feed is no small feat, and it is estimated that it will require over 50% more food than the levels produced in 2010.[37]

If food waste decreases, it will make farming more sustainable, and fewer new food sources will need to be created.[38] Standardized date

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27 *Id.*

28 *Quantifying Methane Emissions from Landfilled Food Waste*, EPA (last updated Dec. 30, 2024), https://www.epa.gov/land-research/quantifying-methane-emissions-landfilled-food-waste [https://perma.cc/X56V-P2YC].

29 *Id.*; Povich, *supra* note 7.

30 *See Methane*, Climate & Clean Air Coal. (last visited Feb. 3, 2025), https://www.ccacoalition.org/short-lived-climate-pollutants/methane [https://perma.cc/4ND5-Z798].

31 *See id.*

32 *Id.*

33 *See id.*; Povich, *supra* note 7.

34 *Quantifying Methane Emissions from Landfilled Food Waste*, *supra* note 28.

35 Jaglo, Kenny & Stephenson, *supra* note 24, at ii.

36 *Id.*

37 *Id.*

38 *Id.*

labels can help with reducing food waste; by discarding less perfectly edible food that is thrown away, Americans will not have to purchase as much food from week to week. Simply put, wasted food is also wasted resources. Over a quarter of the total land in the United States is used for food production, and land is a valuable fixed resource.[39] As the population continues to grow, more land will be needed to sustain communities.[40]

There is only so much land available, so it is vitally important that farmland is used as sustainably as possible.[41] Otherwise, land wasted on discarded food could have served a better purpose, such as sustainable housing or community resources. Like land, usable freshwater is also limited.[42] Freshwater is used in multiple stages of the food cycle, such as irrigation, processing, preparation, and cooking.[43] When consumers throw out food, both the food product and the water used to create the food will be wasted. Water is vital to life, and with less than one percent of all water on Earth being suitable for human purposes, wasted water takes from other necessary uses.[44] Decreasing food waste will help combat this tension and reduce the threat of water scarcity.[45] Overall, the negative environmental impacts of food waste are overwhelming.

B. The Current Regulatory Landscape of the Food System

Federal regulation of the food system is complex. There are four main agencies that regulate food production, each with distinct, though occasionally overlapping, roles.[46]

The Food and Drug Administration ("FDA"), housed within the Department of Health and Human Services, regulates all foods "marketed in interstate commerce" except for meat and poultry.[47] The Federal Food, Drug, and Cosmetic Act grants this broad regulatory authority to the FDA.[48] The National Marine Fisheries Service, an agency within the

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39 *See id.* at 7.

40 *See generally* Laura Short, *Insights on Population Growth and Agricultural Land Use*, Population Educ. (Nov. 30, 2022), https://populationeducation.org/insights-on-population-growth-and-agricultural-land-use/ [https://perma.cc/2FNH-BP54].

41 *See id.*

42 Jaglo, Kenny & Stephenson, *supra* note 24, at 7.

43 *See id*. at 37.

44 *See How We Use Water*, EPA (last updated Sept. 12, 2024), https://www.epa.gov/watersense/how-we-use-water [https://perma.cc/3TCQ-V8YH].

45 Jaglo, Kenny & Stephenson, *supra* note 24, at ii.

46 Council Comm. to Ensure Safe Food from Prod. to Consumption, Nat'l Acad. of Scis., Ensuring Safe Food: From Production to Consumption 26 (1998), https://www.ncbi.nlm.nih.gov/books/NBK209121/ [https://perma.cc/F8Y8-RN9U].

47 *Id.*

48 Federal Food, Drug, and Cosmetic Act, 21 U.S.C. § 371 (hereinafter "FDCA").

Department of Commerce, works alongside the FDA to regulate seafood products.[49]

The Food Safety and Inspection Service, an agency under the United States Department of Agriculture ("USDA"), regulates all meat, poultry, and egg products that travel in interstate commerce.[50] Unlike the FDA, whose authority is granted by one broad statute, the USDA derives its authority from several statutes, depending on the type of food product under its regulation[51] The various statutes include the Federal Meat Inspection Act, Poultry Products Inspection Act, and Egg Products Inspection Act.[52]

Though the Environmental Protection Agency ("EPA") is not responsible for regulating food itself, the agency is responsible for regulating the use of pesticides and sanitizers on food products.[53] Like the FDA, the EPA's authority also comes from the Federal Food, Drug, and Cosmetic Act.[54] Additionally, the EPA is required, under the Clean Water Act, to monitor water quality, which has a direct impact on food sources such as fish, shellfish, and wildlife.[55] The EPA's involvement in the growing and processing of food products underscores the interrelation within the food system and the government's heightened involvement in issues relating to food products.

Of these federal agencies, the USDA and the FDA are the two biggest contributors to food product regulation, as they regulate food products most directly.[56] While the jurisdictional split between the two agencies may seem clear, there are many products that end up falling within the regulatory jurisdiction of both agencies.[57] A notable example of this is a frozen pepperoni pizza. Typically, frozen pizza would fall under the FDA's jurisdiction, since it is made primarily of non-meat

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49 Comm. to Ensure Safe Food from Prod. to Consumption, *supra* note 46, at 27-28; Magnuson-Stevens Fishery Conservation and Management Act, 16 U.S.C. § 1802 (2007).

50 Comm. to Ensure Safe Food from Prod. to Consumption, *supra* note 46, at 27.

51 When discussing food product regulation, it is common practice to refer to the jurisdictional split as being between the FDA and the USDA. For consistency, this note will reference those agencies as well, even though the Food Safety and Inspection Service is technically the responsible agency which functions under the USDA. *Compare* FDCA *supra* note 48, at § 371; Federal Meat Inspection Act, 21 U.S.C. § 601; Poultry Products Inspection Act, 21 U.S.C. § 453; Egg Products Inspection Act, 21 U.S.C. § 1031.

52 *Id.*

53 Comm. to Ensure Safe Food from Prod. to Consumption, *supra* note 46, at 26.

54 *See* 21 U.S.C. 346(a); Statement of Organization and General Information, 40 C.F.R. § 1.43 (2025) (noting the role of EPA in regulating pesticide usage under the Federal Food, Drug, and Cosmetic Act).

55 Clean Water Act, 33 U.S.C. § 1251 *et seq*.; Comm. to Ensure Safe Food from Prod. to Consumption, *supra* note 46, at 37.

56 *See* Nat'l Acad. of Scis., *supra* note 4, at 52.

57 *Id.*

ingredients like cheese and flour.[58] However, if the pizza is made of at least 2% pepperoni, it is also classified as a meat product and must be regulated by the USDA.[59] This means that the frozen pizza will have to comply with *both* FDA and USDA regulations – the two are not mutually exclusive.[60] It is reasonable for the pizza producer to comply with both sets of regulations as FDA and USDA regulations do not conflict, so this requirement is not too inhibitive; it simply means that there are additional steps that the producer must take when it brings the product to market.[61] The regulatory scheme of frozen pizza exemplifies the interconnectedness of different products within the food system and shows how important it is that the FDA and USDA cooperate in their regulations.

The FDA and the USDA are also the two agencies primarily responsible for regulating food labeling, which includes date labels.[62] As stated, the FDA's authority comes from the Federal Food Drug and Cosmetic Act, while the USDA's authority is more piecemeal, stemming from specific statutes for each food category which grant regulatory authority to the USDA.[63] The regulatory process for each agency is also different. The USDA requires prior approval for labels, while the FDA does not, but the FDA has many more formal requirements for the products it regulates.[64] This distinction in processes is likely due to the sheer amount of food products the FDA must regulate. As is the case with frozen pepperoni pizzas, some products must comply with both labeling regimes. Since there are no federal standards for date labels, current agency regulations primarily focus on other aspects of food product labeling. Food date labels are typically not mandated by the federal government and are instead included on packaging at the discretion of the manufacturer.[65] Even without being required to, many food companies choose to include date labels on their products because it gives them the opportunity to communicate when the product will be at its freshest.[66] Date labels are well-intentioned, but currently lack in execution, preventing them from reaching their full potential.

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58 Comm. to Ensure Safe Food from Prod. to Consumption, *supra* note 46, at 26.

59 *Id.* at 27.

60 *See id.*

61 Nat'l Acad. of Scis., *supra* note 4, at 54.

62 *Id.* at 52.

63 *See* FDCA, *supra* note 48, at §§ 301-99. Rather than having one cohesive statute granting regulatory authority to the USDA, there are several statutes granting authority to the agency to regulate the related food product. *See* Federal Meat Inspection Act, *supra* note 51; Poultry Products Inspection Act, *supra* note 51; Egg Products Inspection Act, *supra* note 51.

64 Nat'l Acad. of Scis., *supra* note 4, at 53.

65 Infant formula is the only food product that is federally required to display a date label; any other dating is merely encouraged. *See* 21 C.F.R. § 107.20(c) (1985); *Food Product Dating*, *supra* note 1.

66 *See Food Product Dating*, *supra* note 1.

C. The California Law

Having had enough of the date labeling chaos, California is banning the use of certain date labels on food products processed in the state, making it the first state to do so.[67] In 2024, California Governor Gavin Newsom signed a bill that will ban the use of all but two date labels on food products, starting in July of 2026: "Best if Used by" to indicate peak food quality, and "Use by" to indicate a date after which food is no longer considered safe to eat.[68] These terms are not perfect as they may not be easily distinguishable, potentially leading to more consumer confusion. Limiting packaging to only two terms is a step in the right direction. California is embracing the positive environmental effects associated with improving date labeling, with Assemblymember Jacqui Irwin calling its signing a "monumental step to keep money in the pockets of consumers while helping the environment and the planet."[69]

The law has a few exceptions, including infant formula, eggs, beer, and "other malt beverages."[70] Additionally, the law does not require date labels to be printed on any additional products that do not already utilize them.[71] Rather than requiring *more* date labels, the California law aims to ensure that *if* a date label is printed, it is consistent with the terms chosen by the legislature.[72]

Currently, the lack of federal regulation allows manufacturers to incorporate date labels at their own discretion. Instead of creating an additional requirement for food companies to put on their products, the law will focus on creating a cohesive labeling scheme to help reduce consumer confusion and resulting food waste. However, if federal law already requires the inclusion of a date label on a specific product, California will start to require that the term used on the date label fits within the parameters of the new state law.[73] Since the focus of the law

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67 Ding, *supra* note 14; Assemb. B. 660, *supra* note 14.

68 For foods that can be frozen, the law also allows for "BEST if Used or Frozen by" to indicate peak food quality date and "USE by or Freeze by" to indicate the food safety date. Assemb. B. 660, *supra* note 14, at § 2(a)(1-2). For clarity and cohesion, this note only refers to the terms "best if used by" and "use by."

69 Press Release, Gavin Newsom, Governor, State of California, *Governor Newsom Signs Legislation to Address Concerns With Processed Food Industry, Increase Youth Access to Healthy, Local Foods* (Sep. 28, 2024), https://www.gov.ca.gov/2024/09/28/governor-newsom-signs-legislation-to-crack-down-on-processed-food-industry-increase-access-to-healthy-local-foods.

70 Assemb. B. 660, *supra* note 14, at § 2(e).

71 *Id.* at § 2(d)(2) ("Unless otherwise required by law, this section shall not be construed to require the use or display of a date label on a food item for human consumption unless the food item displays a date label.").

72 *See id.*

73 Existing regulations require an expiration date on infant formula, and a pack date on poultry or egg products. Emily Stone, *Date Labels and the New California Law*, Nat'l Agric. L. Ctr. (Oct. 17, 2024), https://nationalaglawcenter.org/date-labels-and-the-new-california-law/.

is to reduce the amount of food thrown away by consumers, the law will not ban the use of coded "sell by" dates.[74] These dates are intended to help grocery stores and retailers stock their shelves, and do not contribute to the food waste issue because their codes typically cannot be deciphered by consumers.[75]

Non-compliance with the law will be criminally punishable, indicating the severity with which California views the issue.[76] California's seriousness in the matter illustrates the importance of addressing date labeling, because of its impacts on food waste and its subsequent ties to the climate crisis.[77] California took the opportunity to reduce food waste in the state by cleaning up labeling practices, and it is hoping to reduce "climate-warming emissions" in the process.[78] This legislation was signed in late September of 2024,[79] and given its recency, it has not yet been challenged in any state or federal courts.[80]

D. Federal Authority: The Commerce Clause

The FDA and USDA's ability to regulate food date labels comes from the basic constitutional principles underlined in the Commerce Clause. It is well-established that Congress has the power to regulate goods traveling in channels of interstate commerce, as granted by the Commerce Clause of the Constitution.[81] The Supreme Court first articulated this notion in *Gibbons v. Ogden*, where it noted that "Congress is authorized 'to make all laws which shall be necessary and proper' for the purpose" of carrying out its powers which are enumerated in the Constitution.[82] The Court then built on this premise in *Wickard v. Filburn*, extending the federal government's powers under the Commerce Clause to goods that are inherently local, because of their effect on interstate commerce in the aggregate.[83]

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74 These coded dates are known as "closed dating," while the typical dates that are seen by consumers are known as "open dating." *Id.* ("Closed dating is not formatted in a way that is easy for consumers to understand."). *Id.*

75 *See Food Product Dating*, *supra* note 1.

76 *See* Assemb. B. 660, *supra* note 14, at § 2.

77 Ding, *supra* note 10.

78 *Id.*

79 Stone, *supra* note 73.

80 Given the lack of federal regulations around food date labeling, it is possible that California will be the target of lawsuits from out of state producers, claiming that the state law is unconstitutional. This argument is unlikely to succeed and is discussed further in the Dormant Commerce Clause section of this Note. *Infra* Section II.E.

81 U.S. Const. art. I, § 8, cl. 3.

82 Gibbons v. Ogden, 22 U.S. 1, 187–92 (1824). In its syllabus, *Gibbons* defines "commerce" as "the transportation and sale of commodities." *Id.* at 76.

83 *See generally* Wickard v. Filburn, 317 U.S. 111 (1942).

In *Wickard*, a small farmer argued that his wheat farm was not subject to federal regulations because his business was inherently local and did not travel outside of Ohio.[84] The farmer was trying to avoid compliance with the Agricultural Adjustment Act of 1938, which aimed to influence wheat prices by controlling the volume of wheat moving in interstate commerce.[85] He argued that since his wheat did not leave the local area, he could not be subject to the regulation.[86] But the Court disagreed, finding that locally consumed wheat still impacts interstate commerce because its consumption "constitutes the most variable factor in the disappearance of the wheat crop."[87] In other words, the aggregate effects of local wheat impacts interstate commerce because any locally grown wheat that is consumed, even if by the farmer himself, takes potential sales from the interstate market.

If the farmer in *Wickard* were instead spared from the regulations and produced more than what he was allotted, he could "market his wheat at a price 'far above any world price based on the natural reaction of supply and demand.'"[88] Thus, the federal government has the authority to regulate even businesses that seem inherently local because of aggregate effects on interstate commerce. This would give the USDA and FDA the authority to regulate expiration date labels on *all* food products, even products that are sold and consumed in the same state in which they are produced. The Commerce Clause is vitally important because uniformity among *all* products is the only way for consistency to be achieved within the food system. If Commerce Clause powers could reach some products but not others, federal regulations would be futile. Without a cohesive regulatory structure that extends to all date labels, inconsistencies and food waste will continue.

E. Federalism and State Authority: The Dormant Commerce Clause

To use the California law as a model for federal regulation, the California law would need to be constitutionally strong and rooted in valid legal principles to survive a constitutional challenge. While impending lawsuits may be inevitable, given the Dormant Commerce Clause, any lawsuit challenging the regulation would be unlikely to succeed. States, like California, have the authority to regulate date labels within their borders because federal and state governments have concurrent jurisdiction over food labels generally.[89] This principle also comes from

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84 *Id*. at 119.

85 *Id*. at 115.

86 *Id*. at 114.

87 *Id*. at 127.

88 *Id*. at 131.

89 *Gibbons*, 22 U.S. at 36–37 ("[A]ll *enumerated* powers are to be considered *concurrent*, unless they clearly fall under the head of *exclusive:* either as being granted, in terms, exclusively to

Gibbons v. Ogden, where the court emphasized the importance of concurrent powers for maintaining the balance of federalism, so long as the "plain letter of the constitution" is not violated.[90] The Supreme Court held that since "Congress has no power to regulate the internal commerce of any State, none of its regulations can affect so much of the exclusive grant[,]" meaning that state governments have the authority to regulate commerce within their borders.[91]

Dormant Commerce Clause principles strongly support the constitutionality of the California law. The Dormant Commerce Clause is an implicit principle in the United States Constitution that the Supreme Court has interpreted to "prohibit state laws that unduly restrict interstate commerce even in the absence of congressional legislation."[92] Despite not being explicit in the text of the Constitution, the Dormant Commerce Clause has become a check on state power, "bar[ring] state or local regulations" if they may impact the flow of commerce to or from any other state.[93] Given the broad scope of what classifies as interstate commerce, the Dormant Commerce Clause is a principal that cannot be overlooked when evaluating the constitutionality of a state law.

In *National Pork Producers Council v. Ross*, a group of pork producers ("the council") challenged a California law prohibiting "the in-state sale of whole pork meat that comes from breeding pigs (or their immediate offspring) that are 'confined in a cruel manner.'"[94] The council claimed that the law inhibited their business practices and violated the Dormant Commerce Clause, thus making it unconstitutional.[95] The lower courts dismissed the case, and the Supreme Court affirmed their decisions, finding that some indirect impact on other states is not sufficient to find a Dormant Commerce Clause violation.[96]

The Court ultimately found that a Dormant Commerce Clause violation requires clearer discrimination than what was presented by the petitioners, especially given the interconnected nature of interstate commerce.[97] Since the California law only targeted the *in-state* sale of pork, the Court could not find enough evidence that out of state

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the United States, or as expressly prohibited to the States, or as being exclusive in their nature, as before explained.").

90 *Id*.

91 *Id.* at 88.

92 *Art.I.S8.C3.7.1 Overview of Dormant Commerce Clause*, Const. Ann., https://constitution.congress.gov/browse/essay/artI-S8-C3-7-1/ALDE_00013307/ [https://perma.cc/KD88-M5SC]; U.S. Const. art. I, § 8, cl. 3.

93 *Id.*

94 Nat'l Pork Producers Council v. Ross, 598 U.S. 356, 365–66 (2023) (quoting Cal. Health & Safety Code Ann. § 25990(b)(2) (West Cum. Supp. 2023)).

95 *Id.* at 364.

96 *Id*. at 390-91.

97 *Id*. at 390 (" . . . this Court has recognized since *Gibbons* that virtually all state laws create ripple effects beyond their borders.").

producers would be impacted by the law.[98] The Court additionally noted that "[p]reventing state officials from enforcing a democratically adopted state law in the name of the [D]ormant Commerce Clause is a matter of 'extreme delicacy,' something courts should do only 'where the infraction is clear.'"[99]

Since the California date labeling law only applies to in-state food products, the parallels with *National Pork Producers Council* are obvious.[100] Given the hesitancy of the Court to apply Dormant Commerce Clause principles to laws that target only in-state producers, if the new law is to be challenged on a constitutional basis, it is likely to be upheld. The California law is legally sound and proves it can serve as a blueprint for a future federal regulation.

Basic federalism principles highlight that federal law and state law can coexist so long as they are not in conflict.[101] But when a state law does conflict with a federal law, the federal law is always viewed as supreme.[102] This means that until the federal government decides to regulate date labels, states are free to do so on their own, however they please. It is only once the federal government decides to exercise its jurisdiction in the area that states will have to tailor their regulations accordingly.[103] To promote consistency and uniformity of date labels across the country, federal regulations would be a better approach than leaving date label regulations up to the states.

III. Analysis

A. A Real-World Example of Date Label Confusion: United States v. Farinella

Beyond consumer confusion within the home, the lack of federal date regulation has already made its way to the courts. In *United States v. Farinella*, the defendant purchased salad dressing that was nearing the date printed on its label, covered the date with a new one, and resold the dressing to discount stores.[104] A jury in the United States District Court for the Northern District of Illinois found the defendant guilty of misleading labeling practices when he altered the "best when purchased by" date to push it back several months.[105] But the Seventh Circuit overruled the decision and acquitted the defendant, finding that

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98 *Id*.

99 *Id*.

100 *See generally* Assemb. B. 660, *supra* note 14; *Ross*, 598 U.S. 356, n.1.

101 U.S. Const. art. VI, cl. 2.

102 *Id*.

103 *Id.*

104 United States v. Farinella, 558 F.3d 695, 697 (7th Cir. 2009).

105 *Id*.

there was nothing in the record—or elsewhere—to sustain a conviction for mislabeling related to food product dates.[106]

There is nothing about date labels in the definition of "misbranded food," nor is there FDA guidance on what "best if purchased by" means.[107] The court did not find sufficient evidence to prove that customers know what the "best when purchased by" language really meant, and there was also no evidence that the phrase is universally understood within the food industry.[108] The court makes clear that while "expiration date" is a universally understood term, many other labeling terms used may be confusing to consumers:

> The term "expiration date" (or "sell by" date, another date that the government's brief confuses with "best when purchased by" date) on a food product, unlike a "best when purchased by" date, has a generally understood meaning: it is the date after which you shouldn't eat the product.[109]

This case illustrates the confusion surrounding current labeling practices, worsened by a lack of federal guidance for date labeling. It emphasizes the need for transparency in food date labeling and furthers the claim that labels will continue to confuse consumers unless they become consistent. The Seventh Circuit ultimately reversed the defendant's conviction, despite his efforts to deceive consumers, because the government had no way of proving that his conduct was illegal.[110] In fact, it is possible that the conviction purely stemmed from the prosecutor's misconduct:

> Because the government presented insufficient evidence that the defendant engaged in misbranding, he is entitled to be acquitted. But since there was insufficient evidence, why did the jury convict? Perhaps because of a series of improper statements by prosecutor Juliet Sorensen in her rebuttal closing argument, for which the government in its brief (which she signed) belatedly apologizes . . .[111]

Some of Sorensen's statements included referring to the bottles as "truckfulls of nasty, expired salad dressing," and falsely claiming that the salad dressing was no longer "fresh" after the "expiration date" had passed.[112] These statements led the jury to believe that the salad dressing was truly unsafe for consumption, but there was no evidence that

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106 *Id*. at 700.

107 *Id*. at 698.

108 *Id*.

109 *Farinella*, 558 F.3d at 697.

110 *Id*. at 700.

111 *Id*.

112 This statement is false not only because there was no evidence that the dressing had gone bad, but also because the printed date was not an "expiration date" at all. *See id*. at 701.

any tests had been run on the dressing to determine its quality.[113] The prosecutor's misconduct is illustrative of a bigger point: even *government attorneys* are confused by the current US date labeling regime. A federal regulation creating a cohesive regulatory scheme for date labels could have prevented or, at the very least, provided clarity in these circumstances.

The *Farinella* matter could have also benefitted from a shift in consumer perception regarding quality dates on food products.[114] Had consumers held a clear consensus on food-date labeling and understood that most products are safe beyond their printed dates, the jury might not have accepted the prosecutor's assertions, and the case likely would not have proceeded to the circuit court. Even more importantly, less food would be thrown out, and environmental impacts would be minimized. However, as it is now, consumers are left to shuffle through and interpret the differences among the food labeling terms, so safe, quality food goes to waste.

B. Proposal for a Change in the Law: USDA and FDA Regulation Based on the California Law

To take charge in combating food waste and to promote labeling consistency, the federal government should regulate the date labels printed on food products. To do so, the USDA and FDA should prohibit the use of more than two different expiration date labels. Of the two labels allowed, one should indicate peak food quality, and the other should indicate food safety, similar to that of the California legislature.[115] Once the federal government regulates food date labels, any state laws on the matter would be preempted, because federal law reigns supreme.[116] This is true not only of federal laws, but also of federal regulations.[117]

As the two main agencies that regulate food products in the United States, the USDA and FDA have a history of cooperation; the FDA began as a part of the USDA before it moved to the Department of Health and Human Services (formerly the "Federal Security Agency") in 1940.[118] In 2018, the two agencies took a step toward formal

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113 *Id.* at 701.

114 *See generally*, *Farinella*, 558 F.3d 695.

115 Assemb. B. 660, *supra* note 14.

116 U.S. Const. art. VI, cl. 2.

117 "[P]reemption is compelled not only when the conflict involves a federal statute, but also when it involves valid federal regulations." Grocery Mfrs. of Am., Inc. v. Gerace, 755 F.2d 993, 999 (2d Cir. 1985) (holding that a New York law mandating the use of the word "imitation" on cheese alternative packaging was preempted because it conflicted with federal regulations).

118 The FDA was initially known as the "Food, Drug, and Insecticide Administration" when it was established under the USDA in 1927. *Our History*, USDA Food Safety and Inspection

cooperation by signing an agreement to enhance "collaboration and coordination on areas of mutual interest."[119] Areas of cooperation are not limited to those enumerated in the agreement, but the agreement explicitly mentions "food products in interstate commerce," over which "USDA and FDA share jurisdiction."[120] The agreement is valid through 2028, and although it is not legally binding, it indicates a willingness of the agencies to work together on formal matters.[121] Given this, the idea that the agencies would regulate food date labels together is not too far-fetched. Additionally, Congress can use its oversight authority to help implement the policy and promote uniformity and cooperation between the agencies.[122]

The FDA and USDA also signed a formal agreement with the EPA and U.S. Agency for International Development ("USAID") in May of 2024, with the explicit goal of reducing food waste.[123] In signing the agreement, the FDA emphasized the government's commitment to food waste reduction and its connection back to consumers:

> 'The FDA is committed to achieving the goal of a 50% reduction of food loss and waste by 2030 through a whole-of-government approach in collaboration with the USDA, EPA and USAID,' said FDA Commissioner Robert M. Califf, M.D. 'We also recognize the role that empowered U.S. consumers can play in helping to reach the national food waste reduction goal. We encourage consumers and retailers to use the FDA's food loss and waste reduction resources . . . to bolster their efforts.'[124]

This agreement is indicative of continued collaboration efforts among federal agencies, as well as how seriously the federal government views the food waste issue.[125] However, the agreement lacks the legal power of a law or regulation, so more action must be taken. Creating a

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Serv. (last updated Feb. 21, 2018), https://www.fsis.usda.gov/about-fsis/history [https://perma.cc/YZN4-2789].

119 *Formal Agreement Between USDA and FDA Relative to Cooperation and Coordination*, FDA (as of Jan. 29, 2018), https://www.fda.gov/food/international-interagency-coordination/formal-agreement-between-usda-and-fda-relative-cooperation-and-coordination [https://perma.cc/3UZ9-BW9W].

120 *Id.*

121 *See id.*

122 Todd Garvey, Mark J. Oleszek & Ben Wilhelm, Cong. Rsch. Serv., IF10015, Congressional Oversight and Investigations 1 (2024).

123 *FDA, USDA, EPA Enhance Efforts to Reduce Food Loss and Waste, Welcome USAID to Interagency Collaborative*, FDA (May 31, 2024), https://www.fda.gov/news-events/press-announcements/fda-usda-epa-enhance-efforts-reduce-food-loss-and-waste-welcome-usaid-interagency-collaborative [https://perma.cc/4668-84QE].

124 *Id.*

125 *See id*.

cohesive food date labeling regime can help reduce food waste, and the California law can help set a blueprint for how to do so.[126]

In May of 2023, the House introduced the Food Date Labeling Act of 2023, which sought to implement the same two date labels as the California law: "best if used by" for quality, and "use by" for food safety (known in the bill as a "discard date").[127] Though the bill's progress has stalled, that does not mean that the federal government has abandoned ship. In December 2024, the USDA and FDA announced a joint Request for Information ("RFI"), later published to the Federal Register, seeking public comment on consumer perceptions, food waste, and industry practices as they relate to food date labels.[128] RFIs are a tool the government uses to solicit the general public's views on certain topics, and they can indicate where future policy decisions may be made.[129] While this RFI does not necessarily mean that a new regulation is guaranteed to follow, it shows that the federal government is still seriously considering the effects food date labels have on food waste.[130]

One flaw with the California law and the Food Date Labeling Act of 2023, which the USDA and FDA should avoid in issuing its regulation, is the similarity between the language of the two food labels. California and the House both selected "BEST if Used By" to indicate a food product's peak quality date, and "USE By" to indicate when food should be discarded for food safety concerns.[131] However, the terms themselves are not all that different. At first glance, "USE By" can appear to just be a shortened version of "BEST if Used By", and the similarity could still lead to confusion between the two. To make the distinction between peak food quality and food safety even clearer for consumers, the USDA and FDA should require that food products use the term "Discard After" for dates that indicate food safety concerns. The agencies should still use "Best if Used By" to indicate quality, as the language is sufficiently different from "Discard After." Additionally, the USDA currently recommends that food companies

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126 *See generally* Assemb. B. 660, *supra* note 14.

127 *See* Food Date Labeling Act of 2023, *supra* note 12, at § 3.

128 *USDA-FDA Seek Information About Food Date Labeling, Aim is to Provide Further Clarity, Transparency, and Cost Savings for U.S. Consumers*, USDA (Dec. 3, 2024), https://www.usda.gov/about-usda/news/press-releases/2024/12/03/usda-fda-seek-information-about-food-date-labeling-aim-provide-further-clarity-transparency-and-cost [https://perma.cc/XEV5-VFB3]; Request for Information, 89 Fed. Reg. 96205 (Dec. 4, 2024).

129 *Id.* ("The information collected from the RFI may be used to inform future policy decisions, guidance, or consumer education campaigns on food date labels intended to help reduce the premature discard of wholesome and safe food.")

130 *Id*.

131 *See* Assemb. B. 660, *supra* note 14; Food Date Labeling Act of 2023, *supra* note 12, at § 3.

use "Best if Used By," so the agency will be mandating something that it already recommends.[132]

The California law and the Food Date Labeling Act of 2023 take the surface area of the packaging into account, suggesting that "Best if Used By" be shortened to "BB" and "Use By" be shortened to "UB" in instances where the whole term cannot fit onto the packaging.[133] Ideally, the whole term should be used whenever possible, as it will inevitably be clearer than the shortened version. However, these shortened terms appear more distinct from each other than their longer counterparts, so there is no need to disrupt the idea of label shortening. Except, of course, the shortened terms should reflect the longer phrases that they represent. For instance, the USDA and FDA could keep "BB" to shorten "Best if Used By," and they could use "DA" to shorten "Discard After." A uniform shortened term to accompany each labeling term is something the California law did well, and it will be important to keep because it should help further reduce consumer confusion.

California's decision to still allow coded "Sell By" dates is also a good choice that the federal government should include in its regulation.[134] Coded dates identify when the product was produced, which helps store employees stock their shelves.[135] These codes are not easily read by consumers, so they can serve a unique purpose without contributing to food date confusion.[136] This element of the regulation does not impact consumers and thus should have no impact on food waste, so it should also be included in any future regulations.

This proposal should not be overly burdensome for the food producers or agencies involved. Like the California law, this Note does not suggest mandating date labels on all food products, requiring that producers who do not currently use date labels must start to do so.[137] Instead, this Note proposes that *if* the food product has a date label, it should cohere with the federal date guidelines. This would not place an additional burden on producers who do not currently use date labels but would rather shift the terms used for producers who do choose to date their food products. One potential burden would be if companies have to re-print any of their labels to comply, but a compliance deadline of at least a year into the future should help mitigate this issue.

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132 *Food Product Dating*, *supra* note 1.

133 Assemb. B. 660, *supra* note 14, at § 2(a)(3-4); Food Date Labeling Act of 2023, *supra* note 12, at § 3.

134 *See* Assemb. B. 660, *supra* note 14, at § 2(b)(2).

135 *See* Stone, *supra* note 73.

136 *See* Assemb. B. 660, *supra* note 14, at § 2(b)(2).

137 *Id*. at § 2(d)(2) ("Unless otherwise required by law, *this section shall not be construed to require the use or display of a date label on a food item* for human consumption unless the food item displays a date label.") (emphasis added).

Regardless, the seriousness of food waste and its impacts on the environment outweigh any minimal burden to be placed on food producers.

If producers are unsure of which future date to print on their products, there are plenty of existing governmental regulations which they can turn to. The Food Safety and Inspection Service ("FSIS"), which falls under the USDA, already issues guidance on how long shelf-stable foods can last,[138] as well as guidelines for refrigerated and frozen foods for food companies to follow.[139] These guidelines are just recommendations, but they give producers something to follow to know the best way to date their foods.

Additionally, there is no reason for the USDA and FDA to alter their typical regulatory regimes for food labels; the USDA should continue to seek prior approval for labels, and the FDA should keep its typical "formal regulations detailing its requirements."[140] If the USDA and FDA can cooperate to pass a uniform regulation that prohibits the use of any date labels except for "Best if Used By" for food quality, and "Discard After" for food safety, the federal government will be well on its way to reducing food waste.

C. Addressing Counterarguments

i. Do We Really Need Date Labels?

Although food date labels are not statutorily required for many products, and consumers tend to over-rely on them, date labels are still necessary.[141] Since shelf-stable food items never truly expire as long as they are unopened, others have suggested that producers should omit date labels on these products.[142] In theory, this would stop consumers from getting confused over the dates, and thus lead to less food being

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138 Food Safety and Inspection Serv., Shelf-Stable Food Safety (2024), https://www.fsis.usda.gov/food-safety/safe-food-handling-and-preparation/food-safety-basics/shelf-stable-food [https://perma.cc/BGH6-LAPF].

139 *See* U.S. Dep't of Health & Hum. Servs., *Cold Food Storage Chart*, FoodSafety.gov (last reviewed Sept. 19, 2023), https://www.foodsafety.gov/food-safety-charts/cold-food-storage-charts [https://perma.cc/6QFK-VHG4].

140 *See* Nat'l Acad. of Scis., *supra* note 4, at 53.

141 *See generally* FDCA *supra* note 48, at §§ 301-99; Federal Meat Inspection Act, *supra* note 51; Poultry Products Inspection Act, *supra* note 51; Egg Products Inspection Act, *supra* note 51. *See, e.g.*, Povich, *supra* note 7; *Survey: Misunderstanding Food Date Labels Linked with Higher Food Discards*, *supra* note 6.

142 *See e.g.* Allyson Wade, *More Haste to Reduce Food Waste: Adopting Food Date Labeling Standards Under Priority Area Four of the Winning on Reducing Food Waste Initiative*, 78 Food & Drug L. J. 87, 104-05 (2023); Mary K. Bedard, *Hunger Games in the Capital: An Examination of the Need for America's Elected Officials to Emerge from the Legislative Landfill and Combat our Country's Food Waste and Hunger Epidemics*, 42 U. Dayton L. Rev. 283, 304-05 (2017); Carmen Shaeffer Kalashian, *Out of Sight, Out of Mind: Finding a Solution to Food Waste in America*, 23 San Joaquin Agric. L. Rev. 103, 121 (2014).

thrown away. However, removing dates completely could also lead to increased hesitancy by consumers, as it is plausible that many Americans may have a hard time believing that the food is good *forever*. Rather than omitting labels entirely, a more logical solution may be to encourage producers to print dates farther into the future that better represent the shelf life of the product.[143]

From a legal perspective, the USDA and FDA may also run into issues trying to stop shelf-stable producers from including dates on their products, as "Congress has not specifically given the agencies authority or direction to address date labels on food packages."[144] This would make it difficult for the federal agencies to dictate which food products get a date label.[145] The proposal in this Note falls within the USDA and FDA's statutory authority because it still allows food producers to choose whether or not to include a label, merely dictating the terms to be used.[146] Taking that choice away from food producers could result in more legal challenges. Since many food labels are indicators of food quality, producers have an incentive to use these labels to make sure that their products are eaten when they taste the best.[147] Without allowing producers to choose whether they include a date label, producers have no say in when their food is consumed. For this reason, federal regulations that prohibit date labels would likely receive more opposition than simply mandating which terms are used. Date labels can be confusing, but they are ultimately necessary.

ii. Why Not Leave It to the States?

If the federal government does not regulate expiration date labels, leaving that responsibility to the states, nothing will truly change. As noted in earlier in this Note, since the California law seems to be constitutionally valid, one could make the argument that there is no need for a federal regulation.[148] This argument lacks merit because a federal regulation would promote uniformity across the food system in a way that state laws and regulations cannot.

Other states may follow California's lead and come up with their own labeling standards, but there is nothing that prohibits each state

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143 *See* Gravely, *supra* note 21.

144 U.S. Gov't Accountability Off., USDA and FDA Could Take Additional Steps to Reduce Consumer Confusion 2 (2019), https://www.gao.gov/assets/gao-19-407.pdf.

145 *See id*.

146 *See* FDCA *supra* note 48, at §§ 301–99; Federal Meat Inspection Act, *supra* note 51; Poultry Products Inspection Act, *supra* note 51; Egg Products Inspection Act, *supra* note 51.

147 *See Food Product Dating*, *supra* note 1.

148 *Supra* Section II.E.

from settling on different terms in their own legislation.[149] Just because California settled on "Best if Used by" and "Use by" does not mean that other states will follow suit—nor should they, considering the confusion that these terms may create.[150] It is similarly risky that other states may fall short in their implementation, given that they will undoubtedly lack the subject matter expertise of the FDA and USDA. Additionally, the California law applies only to in-state *processors*.[151] Any food that California imports, either domestically or internationally, will not be subject to the same restraints.

With so much food that travels in interstate commerce, date labels would vary based on where the food was produced, and would result in a system of date labels that are still as inconsistent and confusing as they are now.[152] The varying labels would make the state laws virtually useless, leaving the country in the same predicament that it is in now, leading to an array of labels in consumers' pantries and refrigerators, and ineffective in combatting food waste. The waste will continue to fill landfills at an alarming rate, and the environment will continue to suffer.[153] In the end, this scenario would not look any different and would only create stricter guidelines and harsher penalties for food production companies.[154]

The current regulatory regime for food product dating is simply not working. When left up to the states, as it has been for decades, "every state has [chosen] a different approach to regulating date labels."[155] Given how interconnected the food system has become, this has led to consumer confusion and contributed to the country's food waste epidemic.[156] As the population increases and food waste's environmental impact grows exponentially larger, the federal government must step in to reduce food waste by creating a federal date labeling system that is clear to consumers.

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149 State differences in date labeling standards already lead to consumer confusion–sometimes even with multiple dates and labels on the same product. *See, e.g.*, microwav3d, r/mildlyinteresting, Reddit (2024), https://www.reddit.com/r/mildlyinteresting/comments/18jepws/my_milk_has_different_sell_by_and_best_by_labels/ [https://perma.cc/KQ9T-ASET].

150 Assemb. B. 660, *supra* note 14, at § 2(a).

151 *Id*. at § 1(a).

152 Holly Hill, Food Miles: Background and Marketing 1 (2008), https://attradev.ncat.org/wp-content/uploads/2022/06/foodmiles.pdf ("Recent studies have shown that th[e] distance [food travels from producer to consumer] has been steadily increasing over the last 50 years. Studies estimate that processed food in the United States travels over 1,300 miles, and fresh produce travels over 1,500 miles, before being consumed.").

153 *See* Povich, *supra* note 7.

154 Any producer who violates the California law will be held criminally liable, so this is assuming that other states would implement criminal penalties as well. Assemb. B. 660, *supra* note 10, at (2).

155 Stone, *supra* note 73.

156 *See* Povich, *supra* note 7.

IV. Conclusion

There are dozens of different date labels printed on food products in the U.S., and this has created chaos and confusion. As evidenced by *Farinella*, even government prosecutors do not understand the role that current date labels play. By creating a uniform federal regulation for food date labels, the FDA and USDA have the power to set the standard and ameliorate this issue. A federal regulation that allows only two terms to be printed on date labels, one for food quality and one for food safety, will eliminate the confusion for consumers.

If consumers better understand what the date labels on their food mean, food waste will decrease. In turn, this will reduce the rate at which methane enters the atmosphere and slows its effect on climate change. As the Earth plummets toward a global warming crisis, it is necessary that everyone does their part to minimize the impact. Limiting food waste may seem trivial but, given the compounding effects of food being wasted from production to consumption, and the potential for better use of the country's resources, the impact can be enormous. California has already taken the steps to combat these issues on the state level, but for there to be real change, date labels need to be consistent across the country.