The Property Problem: A Survey of Federal Options for Facilitating Acquisition of Carbon Sequestration Repositories

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I. Introduction

This paper surveys federal options for facilitating carbon capture and sequestration (CCS), in both the demonstration and commercial phases. A variety of legal impediments must be addressed before CCS will become commercially viable. This paper examines one of those impediments: the need of sequestration entities to acquire large amounts of suitable subsurface property (pore space) for use as a repository. Currently, uncertainty over the ownership of the pore space as well as high transaction costs for acquiring property rights from numerous landowners present substantial obstacles for sequestration entities. The presence of other conflicting uses of pore space further complicates the acquisition of the necessary property rights. As a result, if CCS is to become a viable activity, the government will likely be required to take some action to facilitate acquisition of pore space by sequestration entities. This paper provides a survey of the range of options available to the federal government.

This paper grew out of the author’s participation in the Harvard Law School’s Emmett Environmental Law and Policy Clinic, which has produced a variety of white papers and policy proposals relating to CCS. Unlike the work of the Clinic, as well as other similar projects, the

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1 This paper focuses on large-scale CCS, defined as CCS projects that inject more than 1 million tons per year of CO₂. There is some lack of clarity in the literature, with many authors referring to “commercial-scale” or “large-scale” deployment, without actually defining the size of such operations in terms of tons per year sequestered. *See, e.g., Gov’t Accountability Office, Climate Change: Federal Actions Will Greatly Affect the Viability of Carbon Capture and Storage As a Key Mitigation Option* (2008); *Int’l Energy Agency, CO₂ Capture & Storage: A Key Carbon Abatement Option* 16 (2008) [hereinafter IEA, Key Option]. Nevertheless, projects above one million tons per year are generally considered to be “large-scale” or “commercial-scale.” *See, e.g.,* International Energy Agency, Technology Roadmap: Carbon Capture & Storage 10 (2009) (referring to large scale projects as those greater than 1 million tons / year); *Intergovernmental Panel on Climate Change, Carbon Dioxide Capture & Storage* 7 n.12 (2005) (“‘Industrial-scale’ here means on the order of 1 MtCO₂ per year.”).

purpose of this paper is not to advocate for a specific proposal. Rather, the paper is designed to provide a comprehensive survey of the options available to the federal government, and a thorough assessment of the benefits and pitfalls of varying approaches.

The options surveyed include:

- Federal declaration of ownership over the entirety of the deep subsurface.
- Federal leases of offshore property to serve as carbon repositories.
- Federal establishment of regional repositories through the use of eminent domain.
- Granting the power of eminent domain to private entities to secure property for repositories.
- Granting the power of unitization to private entities to secure property for repositories.
- Establishing a default rate of compensation per unit of pore space acquired by eminent domain, to reduce acquisition costs, if an option utilizing eminent domain is chosen.
- Federal encouragement of state adoption of legislation clarifying ownership of the pore space.

II. Background

A. The Need For CCS

CCS is the process of capturing Carbon Dioxide (CO$_2$) from a major stationary source, transporting it to a suitable geologic formation (likely via pipelines) and then injecting it into the formations for indefinite storage.$^3$ Storage is “expected to take place at depths below 800 m, where the ambient pressures and temperatures will usually result in CO2 being in a liquid or


$^3$ INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 3; see also Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO$_2$) Geological Sequestration (GS) Wells, 73 Fed. Reg. 43,492, 43,495 (proposed July 25, 2008) [hereinafter Proposed UIC Regulations].
supercritical state.” When injected, the CO₂ “compresses and fills the pore space by partially displacing the fluids that are already present.” After injection occurs, “CO₂ is sequestered by a combination of physical and geochemical trapping processes. Physical trapping occurs because the relatively buoyant CO₂ reaches a layer of rock that inhibits further upward migration. Geochemical trapping occurs when the CO₂ reacts chemically with minerals in the geologic formation that result in the precipitation of solid minerals.” The upshot is that successfully sequestrated CO₂ will not enter to the atmosphere for thousands of years, and thus will not contribute to global warming.

There is broad consensus that CCS is likely to be a key tool in enabling substantial reductions in CO₂ emissions. One estimate is that with a carbon tax or cap and trade price of $50/ton of CO₂, CCS would account for 14% of the total emissions reduction needed for temperature stabilization. As the EPA has noted, “[t]hough CO₂ capture and geologic sequestration are occurring now on a relatively small scale, CCS is expected to play a major role

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4 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 31; see also Proposed UIC Regulations, supra note 3, at 43,495 (“[CO₂] would likely be injected at a depth (greater than approximately 800 meters, or 2,625 feet), such that a sufficiently high pressure and temperature would be maintained to keep the CO₂ in a supercritical state.”).
5 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 31.
6 GOV’T ACCOUNTABILITY OFFICE, supra note 1, at 10; see also INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 32.
7 JACOBS & STUMP, supra note 2, at 2 (“There is broad consensus in scientific, business, and political circles that CCS must be demonstrated quickly on a large scale because it is likely to be an important technology for reducing CO₂ emissions throughout the world.”); Klaas van Alphen et al., Accelerating the Deployment of Carbon Capture and Storage Technologies By Strengthening the Innovation System, 4 INT’L J. OF GREENHOUSE GAS CONTROL 396, 396 (2010) (“Energy experts now widely agree that carbon dioxide capture and storage (CCS) is indispensable in any credible CO₂ emission reduction portfolio, as CCS features prominently in all the main blueprints for reducing GHG emissions until 2050.”); Heleen de Coninck et. al., Global learning on carbon capture and storage, 37 ENERGY POL’Y 2161, 2162 (2009) (“Most global emission projections are currently suggesting that large-scale implementation of CCS is required to achieve deep reductions in emissions within the next few decades.”); GOV’T ACCOUNTABILITY OFFICE, supra note 1, at 9.
8 IEA, KEY OPTION supra note 1, at 16.
in mitigating [greenhouse gas] emissions from a wide variety of stationary sources.” The most recent recognition of the potential importance of CCS in combating climate change is President Obama’s creation of the Interagency Task Force on Carbon Capture and Storage, with a mandate to develop within 180 days a “plan to overcome the barriers to the widespread, cost effective deployment of CCS within 10 years, with a goal of bringing 5 to 10 commercial demonstration projects online by 2016.” In the same vein, the Clean Energy Jobs and American Power Act articulates a goal of achieving “widespread, commercial-scale deployment of carbon capture and storage in the United States . . . before January 1, 2030.”

CCS is anticipated to be a critical means of reducing emissions because the technique captures large quantities of CO₂ from major stationary sources before the CO₂ reaches the atmosphere. One of the major stationary sources anticipated to utilize CCS are power plants, which in the United States account for 42% of all greenhouse gas emissions. The GAO estimates that 53.3% of all emissions could be suitable for CCS. Similarly, the EPA notes that

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10 A Comprehensive Federal Strategy on Carbon Capture and Storage, 75 Fed. Reg. 6,087, 6087 (Feb. 5, 2010). This announcement was preceded by the Secretary of Energy’s belief that “we must make it our goal to advance carbon capture and storage technology to the point where widespread, affordable deployment can begin in 8 to 10 years.” Letter from Steven Chu, Secretary of Energy, Dep’t of Energy (Oct. 12, 2009), available at http://www.energy.gov/media/CCS_Letter_-_Final.pdf.
11 Clean Energy Jobs and American Power Act, S. 1733, 111th Cong. § 121(c) (as reported by S. Comm. on the Env’t & Pub. Works, Feb. 2, 2010).
12 PETER FOLGER, CONG. RESEARCH SERV., CARBON CAPTURE AND SEQUESTRATION (CCS) 1 (2009).
13 GOV’T ACCOUNTABILITY OFFICE, supra note 1, at 8.
95% of the 500 largest stationary sources of emissions are located within 50 miles of a candidate CCS reservoir.\textsuperscript{14}

![Figure 1: GAO Estimate of Emissions Suitable for CCS\textsuperscript{15}]

The potential amount of CO\(_2\) that could be sequestered in the United States is staggering: Estimates based on DOE and IEA studies indicate that areas of the U.S. with appropriate geology could theoretically provide storage potential for over 3,000 gigatons (or 3,000,000 megatons; Mt) of geologically sequestered CO\(_2\). Theoretically, this capacity could be large enough to store a thousand years of CO\(_2\) emissions from nearly 1,000 coal-fired power plants.\textsuperscript{16}

\textsuperscript{14} Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide, 75 Fed. Reg. 18,576, 18,578 (proposed Apr. 12, 2010).
\textsuperscript{15} GOV’T ACCOUNTABILITY OFFICE, supra note 1, at 8.
\textsuperscript{16} Proposed UIC Regulations, supra note 3, at 43,496. The Department of Energy estimates that between 3,592 and 12,933 billion metric tons of potential CO\(_2\) sequestration storage space exists in the United States. NAT’L ENERGY TECH. LAB., DEP’T OF ENERGY, CARBON SEQUESTRATION ATLAS OF THE UNITED STATES AND CANADA 139 (2d ed. 2008).
The feasibility of CCS is not theoretical. As Table 1 indicates, four large-scale sequestration operations have been underway for some period of time, “building confidence that geologic sequestration of large amounts of CO$_2$ can be achieved.”

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Injection Quantity</th>
<th>Injection Depth</th>
<th>Operating Since</th>
<th>Type of Geologic Formation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleipner</td>
<td>Norwegian North Sea</td>
<td>1 MT/year</td>
<td>800-1000m</td>
<td>1996</td>
<td>Offshore Saline Aquifer</td>
</tr>
<tr>
<td>Weyburn</td>
<td>Canada</td>
<td>1 MT/year</td>
<td>1500m (4900 feet)</td>
<td>2000</td>
<td>Oil Reservoir</td>
</tr>
<tr>
<td>In Salah</td>
<td>Algeria</td>
<td>1.2 MT/year</td>
<td>2400m (7900 feet)</td>
<td>2004</td>
<td>Deep Saline Aquifer Underlying a Natural Gas Reservoir</td>
</tr>
<tr>
<td>Snøhvit</td>
<td>Norwegian Barents Sea</td>
<td>.7 MT/year</td>
<td>2500m (8200 feet)</td>
<td>2008</td>
<td>Offshore Saline Aquifer</td>
</tr>
</tbody>
</table>

CCS is also attractive for other reasons. First, CCS is projected to dramatically lower the costs of achieving large-scale emissions reductions. The International Energy Agency estimates that achieving a 50% reduction in global emissions by 2050 will be 71% more expensive if CCS is not used. Second, the development of CCS capability could generate a substantial number of...

17 Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide, supra note 14, at 18,579.
18 Data compiled from: Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide, supra note 14, at 18,579; FOLGER, supra note 12, at 9, 11.
20 IEA, KEY OPTION, supra note 1, at 25; see also COMM’N OF THE EUR. CMTYS., supra note 10, at 85 (noting that without CCS “the costs of meeting a reduction in the region of 30% GHG in 2030 in the EU could be up to 40% higher”).
jobs and create expertise that could be exported to other countries. Third, the development of CCS is consistent with political goals of “energy independence.” The United States possesses the world’s largest coal reserves, and in 2008 coal-fired power plants accounted for 48.2% of electricity generation. If coal combustion can be made more environmentally friendly, the United States can maintain its reliance on domestically-produced coal for electricity generation.

B. The Need For Government Support of CCS

CCS is a classic case of a nascent industry. The technology is not fully tested, methodology and monitoring are underdeveloped, long-term consequences are uncertain, the legal and regulatory environment is murky, and costs are high. On top of these problems, there

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21 JACOBS & STUMP, supra note 2, at 2. The European Union has recognized that it may gain a substantial economic advantage by becoming a first-mover in commercial-scale CCS technology, noting that:

The competitive advantage on CCS resulting from large-scale deployment in Europe . . . would allow European industry to become leading players in a potentially burgeoning global market for CCS technology. Other developed nations, especially the USA and Australia, are vigorously pursuing clean coal and CCS technology development and deployment. Thus the enabling policy framework can contribute to the Lisbon Agenda objective of making Europe the most competitive and dynamic knowledge-driven economy in the world . . . .


23 ENERGY INFO. ADMIN., ELECTRIC POWER ANNUAL 2008 2 Fig. ES1 (2010), available at http://www.eia.doe.gov/cneaf/electricity/epa/epa_sum.html.

24 JACOBS & STUMP, supra note 2, at 2.

25 “A lack of funding for the large-scale demonstration of technologies is a well-recognized problem in technology innovation. After a successful R&D phase, public funding is often reduced, while private funding for application of the technology is still seen as uneconomical or too risky. The cash flow for the new technology dries up, and the ensuing ‘valley of death’ looms. This pattern of difficulty at the demonstration phase can be identified in many technologies, but is particularly pronounced in large-scale, capital intensive technologies such as CCS.” Coninck et. al., supra note 7, at 2162; see also COMM’N OF THE EUR. CMTYS., supra note 10, at 2 (identifying six barriers to the commercial deployment of CCS).

26 See, e.g., Council Directive 2009/31, On the Geological Storage of Carbon Dioxide, 2009 O.J. (L 144) ¶ 11 (“Each of the different components of CCS, namely capture, transport and storage of CO2, has been the object of pilot projects on a smaller scale than that required for their industrial application. These
is neither a price on carbon emissions in the United States nor any legal mandate that greenhouse
gas emitters reduce their emissions.\textsuperscript{27} Even in the European Union, which has a carbon pricing
system in place, “the benefits of reducing carbon emissions are not yet sufficient to outweigh the
costs of CCS.”\textsuperscript{28} In the absence of a sufficiently high price on CO\textsubscript{2} emissions, or a regulatory
mandate to reduce emissions, there is little incentive for private entities to develop CCS on their
own. Instead, the government must provide substantial support if the industry is to develop.\textsuperscript{29}
As one paper puts it, “public policy is essential to ensure CCS deployment because it is a
technology that is almost exclusively driven by political concerns over climate change and
diversification of energy supply (that is, it has no separate commercial rationale).”\textsuperscript{30}

The government can provide three forms of support for a nascent industry such as CCS:
direct fiscal incentives, in-kind benefits from the government, and removal of government-
created obstacles to CCS. The first form involves policies such as direct grants, tax incentives,
interest-free loans, etc. The second type involves dispersal of some type of non-monetary benefit
by the government that facilitates CCS – for instance, leasing federal land at below-market rates
to CCS entities. The third method involves altering the legal system in some manner to reduce
costs or liabilities for sequestration entities – for instance, by capping the amount of damages a
landowner who suffers migration of CCS onto his property could receive, or clarifying the

\begin{quote}
components still need to be integrated into a complete CCS process, technological costs need to be
reduced and more and better scientific knowledge has to be gathered.”
\end{quote}

\textsuperscript{27} JACOBS \& STUMP, supra note 2, at 1.
\textsuperscript{28} IEA, KEY OPTION, supra note 1, at 112.
\textsuperscript{29} INT’L ENERGY AGENCY, CO\textsubscript{2} CAPTURE \& STORAGE: PROGRESS \& NEXT STEPS 7 (2010) [hereinafter
IEA, NEXT STEPS] IEA, KEY OPTION, supra note 1, at 17 (“It is clear that market-based solutions alone
will be insufficient to finance critical early demonstration projects. Governments must lead by providing
sufficient direct financing or financial incentives for CCS demonstration.”).
\textsuperscript{30} COMM’N OF THE EUR. CMTYS., supra note 10, at 21; see also DOOLEY ET AL., supra note 19, at 6 (“The
fact that CCS technologies are commercially available today is also not sufficient to suggest that they
provide cost effective means for significantly reducing CO\textsubscript{2} emissions to the atmosphere absent a climate
policy that would create a significant disincentive on the free venting of CO\textsubscript{2} to the atmosphere thereby
creating a market for the services CCS technologies provide.”).
ownership of pore space, thus reducing the number of parties with whom a sequestration entity need negotiate.

There are substantial differences between the three forms of support. First, some methods will be more efficient than others. In instances where some type of market failure occurs (for instance, holdout landowners), it may be more efficient to change the legal rules governing the market than to simply provide the sequestration entity funds to engage in the market. Second, in some instances the type of support may not be fungible. For instance, no matter how much money the government provides a sequestration entity, a property owner may refuse to sell land necessary for construction of a repository. In such an instance, granting the power of eminent domain or unitization may be the only solution that enables that parcel of land to be utilized as a repository. Third, the type of support has distributional consequences. Direct government funding means that the taxpayer ultimately foots the bill. In-kind support may have the same result, or it may result in substantial benefits to the sequestration entity with little cost to the taxpayer (e.g., if the federal government leases deep saline aquifers offshore that would otherwise go unused).

The upshot is that while government support for CCS in its direct monetary form is important, it should not be conceived of as the only manner of incentivizing CCS.31 Other forms

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31 The federal government provides substantial direct monetary support for CCS. For instance, the American Recovery and Reinvestment Act of 2009 (commonly known as the stimulus package) appropriated $3.4 billion for “Fossil Energy Research and Development.” American Recovery and Reinvestment Act of 2009, Pub. L. 111-5, 123 Stat. 115, 139 (2009). Various other federal support is available, including loan guarantees and tax credits. See FOLGER, supra note 12, at 2; see also Letter from Steven Chu, supra note 10 (detailing the financial support the federal government has provided for CCS). The Clean Energy Jobs and American Power Act is designed to provide further financial support. The bill proposes the creation of a Carbon Storage Research Corporation empowered to assess power distribution fees totaling $1 billion each year to support CCS, if approved by two-thirds of the nation’s fossil fuel-based delivered electricity. Clean Energy Jobs and American Power Act, S. 1733, 111th Cong. § 125 (as reported by S. Comm. on the Env’t & Pub. Works, Feb. 2, 2010); S. REP. NO. 111-121, at 17 (2010).
of government action can have similar impacts. In some instances, these other types of action may be more efficient than simply providing direct financing, and may be critical to ensuring that CCS is able to occur at all.

**C. Legal Hurdles Facing Implementation Of CCS**

There are a wide variety of legal uncertainties that pose a substantial obstacle to commercial-scale deployment of CCS. The President’s announcement establishing the Task Force on CCS recognized this, noting that “greater legal and regulatory clarity” than exists at the moment is necessary to facilitate private investment in large-scale carbon sequestration projects.\(^\text{32}\) Reduction in legal uncertainty is particularly critical to facilitate commercial deployment of CCS,\(^\text{33}\) given the already high estimated costs.\(^\text{34}\) For instance, McKinsey estimates the cost of capture, transport and storage of CO\(_2\) in the early commercial phase to be between $48-73 per metric ton of CO\(_2\).\(^\text{35}\)

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\(^\text{33}\) Legal uncertainty is widely recognized to be a major problem hindering commercial deployment of CCS. *See, e.g.*, IEA, *NEXT STEPS, supra* note 29, at 8 (“For jurisdictions that have started to develop their legal and regulatory frameworks, efforts to resolve outstanding issues must be a priority if near-term targets for demonstration are to be met.”); E. Chase Dressman, *COWho? Kentucky’s Need to Statutorily Define Property Interests in Geologically Sequestered Carbon Dioxide*, 98 K.Y. L.J. 375, 377 (2009) (“Due to the high costs currently associated with GCS, Kentucky must establish a framework that clearly resolves the legal issues involved in the sequestration process to provide consistency and predictability for the sequestration companies and third parties involved. Absent such a legal framework, few entities will be encouraged to pursue investment in sequestration projects within Kentucky.”); FOLGER, *supra* note 12, at 26 (“[L]iability, ownership, and long-term stewardship for CO\(_2\) sequestered underground are issues that would need to be resolved before CCS is deployed commercially.”); Proposed UIC Regulations, *supra* note 3, at 43,496 (“Establishing a supporting regulatory framework for the future development and deployment of CCS technology can provide the regulatory certainty needed to foster industry adoption of CCS, which is crucial to supporting the goals of any proposed climate change legislation.”).

\(^\text{34}\) Alexandra B. Klass & Elizabeth J. Wilson, *Climate Change, Carbon Sequestration, and Property Rights*, 2010 U. ILL. L. REV. 363, 423 (“Because of the government and private investment that will be necessary to create and implement such a regulatory system, how much money CO\(_2\) operators or the government will actually have to pay to obtain pore space and the complexity of the underlying transactions are important questions.”).

\(^\text{35}\) FOLGER, *supra* note 12, at 18. Storage costs are estimated to comprise $6-17 of the total. *Id.*
There are a wide variety of legal uncertainties relating to carbon sequestration. This paper addresses one important category of such uncertainties: those relating to acquisition of property rights to store CO\textsubscript{2} beneath the surface.\textsuperscript{36}

Entities pondering sequestration will want to have the property rights to the entire area into which CO\textsubscript{2} is likely to migrate. These entities may also wish to acquire the property rights to the area into which displaced water and the pressure front are likely to enter, an issue not yet thoroughly discussed by commentators.\textsuperscript{37} In the absence of owning the relevant portions of the subsurface, these entities may be liable for trespass,\textsuperscript{38} nuisance and other common-law claims.\textsuperscript{39}

Such claims could result in substantial legal fees paid in defending against the action, even if it is

\textsuperscript{36} Other uncertainties include the following. First, there are concerns about liability for leaks, migration, accidents and other hazards relating to injection. See JACOBS & STUMP, supra note 2, at 9-10. Similarly, there are concerns relating to the SDWA, CERCLA, RCRA and other federal environmental regulatory programs, and the extent to which they may create liability for sequestration owners and operators. See GOV’T ACCOUNTABILITY OFFICE, supra note 1, at 5 (“we are recommending that EPA more comprehensively examine barriers to CCS development beyond those relevant to the SDWA, by addressing issues under RCRA, CERCLA, and other statutes within the agency’s jurisdiction.”). Second, there are concerns relating to long-term stewardship and liability for the sequestration facility, after injection operations have ceased. See JACOBS & STUMP, supra note 2, at 11-12. Third, there are concerns relating to the construction of a pipeline network, principally relating to acquisition of the rights of way. JACOBS ET. AL., supra note 2, at 2 (“In the absence of certainty and in order to minimize risk, the owner/operator may decide to acquire the rights to the entire footprint of the CO\textsubscript{2} plume, the footprint of the area of displaced brine, and potentially the footprint area of elevated pressure. . . . [Q]uestions remain regarding details, such as whether the owner/operator must acquire access to the area of displaced brine and the area of elevated pressure.”).

\textsuperscript{37} See, e.g., Starrh & Starrh Cotton Growers v. Area Energy LLC, 63 Cal. Rptr. 3d 165, 170 (Cal. Ct. App. 2007) (“Causing subsurface migration of oilfield wastewater into a mineral estate (groundwater pore space) of another without that landowner's consent is a trespass under California law.”); Cassinos v. Union Oil Co., 18 Cal. Rptr. 2d 574, 579 (Cal. Ct. App. 1993) (“[C]ausing subsurface migration of fluids into a mineral estate without consent constitutes a trespass.”). See also Owen L. Anderson, Geologic CO\textsubscript{2} Sequestration: Who Owns the Pore Space?, 9 WYO. L. REV. 97, 110 (2009) (“Even if an injecting party holds the appropriate rights regarding the tracts actually used for the sequestration operation, that party may be liable for trespass or related torts if CO\textsubscript{2} . . . migrates to neighboring tracts.”); PAVLW. PARFOMAK, CONG. RESEARCH SERV., COMMUNITY ACCEPTANCE OF CARBON CAPTURE AND SEQUESTRATION INFRASTRUCTURE 18 (2008) (“Trespass may be important because CO\textsubscript{2} injected underground could spread in unanticipated ways through a geological formation with no way to prevent its entering the pore space of any particular landowner located within that formation.”).

unsuccessful. If these actions succeed, the result could be substantial damages owed to the property owner (particularly if the CO₂ interferes with a valuable mineral interest), or even an injunction prohibiting further injection of CO₂. Moreover, some states are requiring that sequestration entities own all of the pore space necessary to operate the sequestration facility before commencing sequestration operations. While a prudent measure, this makes it all the more important that sequestration entities have the ability to acquire the necessary property. These concerns are heightened given that commercial-scale CCS operations are anticipated to inject sufficient carbon dioxide to “cover tens to hundreds of square miles, affecting numerous property owners.” As a result, injecting CO₂ without owning the relevant property interests would entail a significant risk for the owners and operators of the sequestration facility.

The straightforward approach to this problem would be for a sequestration entity to acquire the property necessary for conducting sequestration activities. If the sequestration entity owned the property, none of the potential risks outlined above would be likely to materialize. However, five distinct problems render this straightforward solution impractical under the current legal framework.

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41 For instance, West Virginia law requires a sequestration entity’s permit application to contain “documentation sufficient to demonstrate that the applicant has, or will have prior to the commencement of the operation, all legal rights, including without limitation the right to surface or pore space use, necessary to sequester carbon dioxide.” W. Va. Code § 22-11A-5(a)(6) (2009).

42 Gov’t Accountability Office, supra note 1, at 26; see also Lee Gresham et. al., *Implications of Compensating Property Owners for Geologic Sequestration of CO₂*, 44 Envtl. Sci. & Tech. 2897, 2900 (2010) (estimating potential plume size between 4,500 and 11,000 square kilometers).

43 Gov’t Accountability Office, supra note 1, at 26 (“According to one power company official, this property rights issue is different from liability-related issues, since it could prevent CO₂ from being injected into the ground in the first place. If they cannot get access rights to the formation, they cannot do a project.”).
First, ownership of the pore space varies from state to state and, in some instances, is uncertain.\textsuperscript{44} This problem exists because the question of who owns the subsurface is a matter of state property law.\textsuperscript{45} In some states, the surface owner has the right to the pore space; in others, any subsurface interests will have that right; in yet others it is unclear.\textsuperscript{46} The upshot is that sequestration entities, to be safe, will likely need to acquire the consent of both surface and subsurface property owners, at least in states where the ownership of pore space is not clearly vested in one or the other.

A second issue is that, once the relevant property owners are determined, a sequestration entity will need to acquire the property rights from each individual owner. Given the likely scope of a commercial-scale repository, this will probably involve negotiations with numerous

\addcontentsline{toc}{section}{Notes}
\textsuperscript{44} CCSREG PROJECT, CARBON CAPTURE AND SEQUESTRATION: FRAMING THE ISSUES FOR REGULATION 55 (2009), available at http://www.ccsreg.org/pdf/CCSReg_3_9.pdf (noting that one of the issues that “looms largest for the viability of CCS in the U.S. is who—if anyone—owns the pore space that will be used for” CCS).

\textsuperscript{45} “Because the Constitution protects rather than creates property interests, the existence of a property interest is determined by reference to ‘existing rules or understandings that stem from an independent source such as state law.’” Phillips v. Wash. Legal Found., 524 U.S. 156, 164 (1998) (quoting Bd. of Regents of State Colleges v. Roth, 408 U.S. 564, 577 (1972)); Flatt, supra note 40, at 233 (“The property law of each state will control ownership of the depleted oil and gas reservoir pore space.”).

\textsuperscript{46} Anderson, supra note 38, at 99 (“As between the surface owner and mineral owner, most jurisdictions, including Texas, have not specifically determined the ownership of subterranean pore spaces.”); Flatt, supra note 40, at 233 (“There is no clear consensus on whether the ownership of the pore space lies with the surface estate or the mineral estate, and consideration of these rights varies significantly from state to state. . . . Legal commentators have also failed to come to any consensus as to the rightful ownership of pore space as between the mineral and surface estates.”); CCSREG PROJECT, supra note 44, at 57 (“In reality, today there is no uniformity, either from state-to-state or from fluid-type to fluid-type, in the way in which rights to inject fluid into deep pore space are currently being handled.”); FESMIRE ET. AL., N.M. ENERGY, MINERALS, NATURAL RES. DEP’T, OIL CONSERVATION DIV., A BLUEPRINT FOR THE REGULATION OF GEOLOGIC SEQUESTRATION OF CARBON DIOXIDE IN NEW MEXICO 14-15 (2007) (“In New Mexico, the common law on this issue is somewhat unsettled as no case directly tests theories of pore space ownership.”).
surface and mineral property owners. The time and expense that it might take to negotiate with each property owner could be extensive.

A third, related, problem is that there is a real danger of holdouts when so many owners are involved, a problem that has been extensively discussed in the context of eminent domain. The holdout problem arises when an entity attempts to assemble a large parcel of land by purchasing property from numerous smaller landowners. Once the landowner has acquired a substantial amount of property, and the remaining landowners are aware of this acquisition, they have a powerful incentive to holdout. The holdout can take two forms – demanding unreasonably high prices for the land, or refusing to sell at all. Both forms of the holdout problem have been recognized in the context of acquiring repositories for CCS.

Holdouts can demand exceedingly high prices – much higher prices than those who initially sold land to the assembler received. This is because the assembler has already made a substantial investment in the site, and paying high prices to a small number of landowners is more rational than relocating to another site. In this scenario, a CCS project may still go forward, but it will be substantially more expensive, given the high prices paid to the holdouts.

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47 See supra note 42 and accompanying text. See also Dressman, supra note 33, at 393 (“The large size of geological storage formations makes unanimous consent unwieldy, if not impossible.”).
48 “[E]stablishing a reservoir for use in CCS will almost certainly require the purchase of all property rights that could be impacted by the project . . . . The creation of such a geologic storage unit could potentially take months or years of negotiation, and some property interests will likely be adverse to use of their pore space for storage at all.” Flatt, supra note 40, at 233.
50 “Obtaining permission from all landowners before pumping CO\textsubscript{2} into the geological structure would drastically affect the viability of the whole [C]CS scheme. Concessions for property owners could drastically drive up costs under the best case scenario. The worst case scenario involves the outright refusal of property owners to allow [C]CS under their land.” Dressman, supra note 33, at 387-88.
Moreover, the very prospect of such a holdout can deter companies from investing in repositories altogether, because of the prospect of high-cost holdouts.

Holdouts could also be absolute – one or more owners could simply refuse to sell at any price. This problem may be particularly acute with respect to CCS, given that available data indicate substantial public fear of CCS activities. For instance, a 2007 French study found that 40% of respondents “would be afraid if CCS was to be used near their community.” Similarly, in Germany attempts to open a storage facility have engendered substantial community opposition, resulting in substantial delays; it is uncertain whether the project will ultimately move forward. In such a scenario, an entity faces the unpalatable choice of abandoning the project altogether or injecting and facing a potential lawsuit.

A fourth problem is that it will be necessary to secure some quantum of surface property rights. Most obviously, injection facilities and pipeline rights of way will need to be acquired. It may also be necessary to acquire additional sites for monitoring the CO$_2$ plume and potential leaks from the repository. EPA has recently proposed, in the context of its regulations requiring CO$_2$ emissions reporting, a rule requiring that injection entities “demonstrate to the Agency that the risk of leakage to the surface has been evaluated over the appropriate spatial area.” EPA “recognizes that surface rights access to the entire spatial area required for site characterization and monitoring may not conveniently rest with the owner or operator of the CO$_2$ injection wells,” and that the monitoring plan “will need to take into account the relevant ownership rights and property access.”

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51 PARFOMAK, supra note 38, at 15.
53 Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide, supra note 14, at 18,590.
54 Id. at 18,590.
The fifth legal issue is the presence of conflicting uses of the deep subsurface.\textsuperscript{55} These activities include: drilling for oil and gas; drilling for natural gas from shale utilizing hydraulic fracturing, which occurs at great depths (typically below 7,000 feet, although several projects are taking place at considerably shallower depths);\textsuperscript{56} mining operations for other minerals, and extraction of groundwater. The presence of conflicting uses could render sites otherwise suitable for CCS unsuitable, and could also drive up prices for utilization of the deep subsurface. The presence of these conflicting uses is likely to exacerbate the collective-action and holdout problem discussed above.

The upshot of all of these legal hurdles is that sequestration costs are likely to be substantially increased, and sequestration projects potentially derailed, under the current legal framework.

\textbf{D. Overview of Federal Options For Facilitating CCS}

The federal government has a variety of options it could utilize to ameliorate the problems outlined above. The options vary in terms of the monetary cost to the federal government as well as the breath and depth of federal involvement. This paper focuses on federal, rather than state, action for several reasons.

First, climate change is a national and international problem, not a local one. The solutions presented need to be commensurate with the scope of the challenge. CCS is simply one weapon, albeit an important one, in the government’s arsenal. In order to have a successful

\textsuperscript{55} See JACOBS ET AL., supra note 2, at 3 (discussing conflicting uses).
climate policy, other policies – most importantly, a price on carbon – must be implemented. The federal government thus ought to be the one to address the issues facing CCS, in order to ensure that the country is advancing a coherent, comprehensive climate change package that is designed to substantially curb greenhouse gas emissions.

Second, the property problem is only one out of several issues facing CCS. Other issues, such as long term liability and the impact of sequestration on federal environmental laws, will need to be addressed at the federal level. As a result, it makes sense to address all of these issues in an integrated manner, to ensure a coherent regulatory regime for sequestration activities.

Third, at least some sequestration sites are likely to cross state boundaries, given the immense size of sequestration repositories. Having a system of uniform regulation is the most sensible approach to resolving this issue. Similarly, the available pore space in the U.S. is not evenly distributed geographically. The largest volume of pore space is located west of the Mississippi, while major CO₂ emitters east of the Mississippi are not likely to be located in close proximity to potential onshore sequestration sites. As a result, federal involvement may be necessary to ensure that all states have access to sequestration facilities.

Fourth, only the federal government can enable sequestration on federal lands – most importantly, offshore. Given the substantial storage capacity offshore, the federal government will need to seriously consider how that option fits into the overall sequestration plan.

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57 See supra note 36.
58 See supra note 40 and accompanying text.
59 See NAT’L ENERGY TECH. LAB., supra note 16, at 139 (table indicating stationary source CO₂ emissions and sequestration capacity by state).
60 See infra Part III.B.
61 See infra Part II.E.4.
Finally, the federal government is already putting forward large amounts of money to support CCS, and more is likely to be forthcoming.\textsuperscript{62} The federal government should ensure that its return on this investment is maximized by ensuring that the legal framework is optimally structured to enable CCS.

**Spectrum Of Federal Options**

At the most basic level, the federal government could impose safety regulations, designed to ensure that repositories meet basic standards. While a detailed discussion of what safety regulations might look like is outside the scope of this paper, such regulations are necessary. Moreover, it is highly likely that some sort of safety regulations will be imposed – the EPA has already proposed regulations governing sequestration under the Safe Drinking Water Act.\textsuperscript{63}

Moving across the spectrum, the federal government could lease offshore property for sequestration entities to use for repositories. Because the federal government already owns

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\textsuperscript{62} *Supra* note 31.

\textsuperscript{63} Proposed UIC Regulations, *supra* note 3. Similarly, the proposed Clean Energy Jobs and American Power Act requires the EPA administrator to establish regulations designed “to protect human health and the environment by minimizing the risk of escape to the atmosphere of carbon dioxide injected for purposes of geological storage.” Clean Energy Jobs and American Power Act, S. 1733, 111th Cong. § 813(b) (as reported by S. Comm. on the Env’t & Pub. Works, Feb. 2, 2010).
offshore land, pursuant to the Submerged Lands Act and the Outer Continental Shelf Lands Act, such a step would resolve many property related problems, although offshore sequestration poses technical and legal issues distinct from its onshore sibling, and the problem of conflicting uses remains.

The federal government can also limit liability. While outside the scope of this paper, it is important to note that limitations on liability for trespass, nuisance and similar claims could substantially ameliorate the holdout problem. That is, if a landowner is a holdout who refuses to sell, a sequestration entity may feel more comfortable moving forward with CO\textsubscript{2} injection, because it knows that it will face limited (or no) liability if the CO\textsubscript{2} migrates onto that landowner’s property.

The federal government could also grant private entities the power of eminent domain, or unitization, in order to resolve the holdout problem. There is precedent for such action in the Natural Gas Act, which grants the power of eminent domain to companies to build natural gas pipelines. Once this power is granted by statute, the federal government’s role with respect to acquisition of the property would merely be to certify particular sequestration entities as falling within the statute; in the Natural Gas Act this is done by granting the relevant entities a “certificate of public convenience.”

The federal government could also utilize the power of eminent domain itself, acquiring land for regional repositories. This would entail the federal government, rather than any sequestration entities, paying the required just compensation to affected landowners.

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64 43 U.S.C. § 1301.
66 See infra Part III.B.
67 For a proposal for federal liability limitations, see JACOBS & STUMP, supra note 2.
68 15 U.S.C. § 717f(h)
69 Id. § 717f(e).
Finally, the federal government could declare ownership of all property below a certain depth, with an exception for pre-existing uses. There is precedent for such an action – the declaration of federal dominion over the outer continental shelf, which occurred in the late 1940s.

**E. Description Of Potential Repository Types**

Before delving into the details of each of the federal options for facilitating acquisition of property for CCS, it is important to understand what sorts of repositories are suitable for CCS. CO₂ can be sequestered in a variety of geologic formations. Three formations are currently receiving the most study – depleted oil and gas reservoirs, deep saline aquifers, and unmineable coal seams.\(^70\) These geologic formations exist both on land and under the seabed.\(^71\) Each of these geologic formations presents advantages and disadvantages. The ultimate storage capacity and efficacy of utilizing each type of formation is unlikely to be accurately known until actual experience is gained in commercial-scale sequestration operations in each type of formation.\(^72\) Similarly, potential adverse consequences, the likelihood of leaks, and other risks bearing on the feasibility, costs and benefits of sequestration activities in repository types are only beginning to

\(^{70}\) FOLGER, *supra* note 12, at 8; IEA, *KEY OPTION*, *supra* note 1, at 17 (2008) ("In the medium term, depleted oil and gas reserves, unmineable coal seams, and deep saline formations are the best options for CO₂ storage.").

\(^{71}\) INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, *supra* note 1, at 200; *see also* FOLGER, *supra* note 12, at 10 ("As with oil and gas, deep saline reservoirs can be found onshore and offshore . . . .").

\(^{72}\) “EPA acknowledges that these capacity estimates do not directly address specific site suitability attributes that would be identified through the UIC permitting site-characterization process. Additionally, these formations (identified through capacity estimates) may be stratified, stacked, or layered and in combination, their cumulative capacity could be limited (*i.e.*, less than assessed). In the absence of such site-specific information, it is currently difficult to identify what percentage of assessed national capacity is actually suitable for GS. In addition, very small geologic storage sites, even when aggregated within a given area, may not be conducive to/appropriate for large-scale, commercial GS projects.” Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide(CO₂) Geological Sequestration (GS) Wells; Notice of Data Availability and Request for Comment, 74 Fed. Reg. 44,802, 44,810 (Aug. 31, 2009) [hereinafter Federal UIC Regulations, Notice of Data Availability].
be understood, as actual data is generated by large-scale CCS operations being conducted in the
United States and around the world.\footnote{FOLGER, supra note 12, at 26 (“[L]arge-scale injection experiments are only beginning in the United States to test how different types of reservoirs perform during CO$_2$ injection. Data from the upcoming experiments will undoubtedly be crucial to future permitting and site approval regulations . . . .”).}

1. Depleted Oil & Gas Reservoirs

Depleted oil and gas reservoirs are, as the name suggests, reservoirs that once held oil and gas but are now largely empty, as the hydrocarbons have been extracted. The Department of Energy estimates that 138 billion metric tons of CO$_2$ could be stored in such reservoirs, representing between 1 and 3.8 percent of the potential CO$_2$ storage capacity of the United States.\footnote{NAT'L ENERGY TECH. LAB., supra note 16, at 139 (percentages calculated by manually dividing relevant numbers)}

The primary advantage of utilizing depleted reservoirs is that the extensive experience with oil and gas reservoirs has generated a substantial amount of geologic data, which would be “directly transferable” to CCS site characterization.\footnote{Proposed UIC Regulations, supra note 3, at 43,502; see also FOLGER, supra note 12, at 10.}

However, there are two disadvantages associated with using such reservoirs. First, depleted oil and gas formations are perhaps the type of geologic formation most prone to leak CO$_2$ back into the atmosphere. Hundreds of wells have been drilled into these formations in order to initially extract the hydrocarbons. If, upon cessation of extraction activities, some of these wells were not plugged properly, the injected CO$_2$ could leak out,\footnote{Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide, supra note 14, at 18,590 (“Wells (and other artificial penetrations such as boreholes) are one of the most probable conduits for the escape of CO$_2$ from the injection zone.”); FOLGER, supra note 12, at 10 (“Wells that penetrate from the surface to the reservoir could be conduits for CO$_2$ release if they are not plugged properly.”); GRAHAM THOMPSON, UNIV. OF TORONTO, BURYING CARBON DIOXIDE IN UNDERGROUND SALINE AQUIFERS 26 (2009), available at http://www.powi.ca/pdfs/other/U_of_Toronto_Conference_Paper_CCS_and_Water_WW.pdf (“The most physically dependent . . . .”)}. substantiall
diminishing the efficacy of the sequestration operation and potentially resulting in liability for the site operator. Second, depleted oil and gas reservoirs are not evenly distributed throughout the country. In particular, as Figure 3 suggests, there is very limited capacity on the West Coast. As a result, either long pipelines will need to be constructed from emissions sources on the West Coast, resulting in increased costs, or alternative sequestration formations will need to be utilized for West Coast emissions sources.

Figure 3: Locations of Oil and Gas Reservoirs

2. Deep Saline Aquifers

direct route for any leaks would likely be through abandoned oil and gas wells, forgotten and crumbling.”).

77 Pipeline costs are highly variable and often depend on site-specific considerations, of which length is a key factor, and pipeline costs are anticipated to be a reasonable share of CCS costs (7-16 percent). PAUL W. PARFOMAK & PETER FOLGER, CONG. RESEARCH SERV., PIPELINES FOR CARBON DIOXIDE (CO₂) CONTROL 9-10 (2008).

78 NAT’L ENERGY TECH. LAB., supra note 16, at 18.
Deep saline formations are bodies of water located deep underground that contain water or brine with a high total dissolved solid (TDS) content (over 10,000 mg/l TDS) which renders the water unfit for human consumption. The Department of Energy estimates that between 3,297 and 12,618 billion metric tons of CO$_2$ could be stored within deep saline aquifers, representing between 91.8 and 97.6 percent of total potential storage capacity.

Utilizing deep saline aquifers presents two advantages. First, the storage capacity is extensive. Second, as indicated by Figure Four, such aquifers are found throughout the country, minimizing the amount of pipeline necessary to transport the CO$_2$ to a repository.

There are three disadvantages. First, most deep saline formations have not been investigated, which means that substantial site characterization will be necessary prior to commencing sequestration operations. Second, these aquifers could have substantial future value, either as sources of drinking/agricultural water, or as a supply of minerals. Indeed, the EPA notes that “water treatment of higher salinity waters . . . may be more cost effective than the

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The high TDS content exempts the aquifers from the provisions of the Safe Drinking Water Act (SDWA), 42 U.S.C. § 300h, which obliges EPA to “prevent underground injection which endangers drinking water sources.” U.S.C. § 300h(b)(1). The EPA regulations implementing the SDWA exclude from the definition of drinking water sources bodies of water containing more than 10,000 mg/l TDS. 40 C.F.R. § 146.3. The regulations also contain an exemption for aquifers where “[t]he total dissolved solids content of the ground water is more than 3,000 and less than 10,000 mg/l and it is not reasonably expected to supply a public water system.” Id. § 146.4. As a result, deep saline aquifers are not covered by the SDWA.

80 NAT’L ENERGY TECH. LAB., supra note 16, at 139 (percentages calculated by manually dividing relevant numbers)

81 Proposed UIC Regulations, supra note 3, at 43,502.

82 JACOBS & STUMP, supra note 2, at iii (“[N]ot enough attention has been paid to the possibility that deep saline aquifers may be called upon to serve multiple, potentially conflicting functions in the future: as storage reservoirs for captured CO2; as sources of metals and minerals such as lithium; and, after treatment and desalinization, as agricultural and/or drinking water supplies.”); id. at B-1, B-2; THOMPSON, supra note 76, at 44 (noting that deep saline aquifers contain silica, lithium, zinc, manganese and other valuable materials, and that at least one company plans on mining lithium from such aquifers in the near future).
cost of obtaining water rights or surface water elsewhere in the area.”

As technology improves, the likelihood that deep saline aquifers will be useful sources of drinking water will only increase. Injecting CO$_2$ into these aquifers could prevent utilization of the aquifers for these purposes. Finally, there are concerns that injected CO$_2$ can acidify the fluids in the reservoirs, potentially dissolving certain minerals, rendering the reservoir more permeable and thus increasing the possibility of leaks.

Figure 4: Locations of Deep Saline Aquifers

3. Unmineable Coal Seams

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83 Federal UIC Regulations, Notice of Data Availability, supra note 72, at 44,809.
84 Id.; see also THOMPSON, supra note 76, at 44.
85 JACOBS & STUMP, supra note 2, at iii (“There are various types of risks associated with CCS, including . . . contamination of water supplies (shallow and deep), [and] displacement of water supplies . . .”).
86 FOLGER, supra note 12, at 11-12.
87 NAT’L ENERGY TECH. LAB., supra note 16, at 20.
Unmineable coal seams are coal seams that are currently unable to be exploited for commercial purposes.\textsuperscript{88} The Department of Energy estimates that 157 and 178 billion metric tons of CO\textsubscript{2} could be stored in unmineable coal seams, representing between 1.4 and 4.3 percent of total storage capacity.\textsuperscript{89} This is the only one of the three main types of CCS formations under consideration which does not have large-scale CCS operations underway.\textsuperscript{90}

\textbf{Figure 5: Locations of Unmineable Coal Seams}\textsuperscript{91}

\section*{4. Offshore Geologic Formations}

Carbon dioxide can also be sequestered in offshore deep saline aquifers or depleted oil and gas formations.\textsuperscript{92} The Department of Energy estimates that between 1,287 and 5,146 billion

\begin{footnotesize}
\begin{enumerate}
\item The DOE estimates that 90\% of coal resources are not mineable with currently technology. \textit{Folger}, \textit{supra} note 12, at 12.
\item \textit{Nat’l Energy Tech. Lab.}, \textit{supra} note 16, at 139 (percentages calculated by manually dividing relevant numbers).
\item \textit{Folger}, \textit{supra} note 12, at 12.
\item \textit{Nat’l Energy Tech. Lab.}, \textit{supra} note 16, at 19.
\end{enumerate}
\end{footnotesize}
tons of CO$_2$ could be sequestered offshore, representing 35-37% of the total estimated storage space within the United States.\footnote{INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 200; see also FOLGER, supra note 12, at 10 (2009) (“As with oil and gas, deep saline reservoirs can be found onshore and offshore . . . .”).}

5. Other Geologic Formations

Other geologic formations could potentially be utilized for CO$_2$ sequestration. These include salt caverns, oil and gas shales, and basalts.\footnote{IEA, KEY OPTION, supra note 1, at 107-08.} Examination of these formations as potential sequestration sites is relatively underdeveloped compared to the formations discussed above.\footnote{INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 200 (“[S]ome consideration has been given to storage in caverns, basalt and organic-rich shales.”).} Preliminary evidence indicates that, at best, these formations may “provide niche options for geological storage of CO$_2$.”\footnote{Id. at 219. See also id. (“More research is needed, but in general, basalts appear unlikely to be suitable for CO2 storage. . . . The potential for storage of CO2 in oil or gas shale is currently unknown . . . but the very low permeability of these shales is likely to preclude injection of large volumes of CO.”).} As a result, these formations are not discussed.

III. Federal Options For Facilitating CCS

A. Declaration of Federal Dominion Over All Deep Pore Space

1. Overview

This option entails the federal government asserting ownership over all pore space below a certain depth. The relevant depth would likely be between 2,600 feet (the minimum thought

\footnote{NAT'L ENERGY TECH. LAB., supra note 16, at 136 (percentage calculated by manually dividing the relevant numbers).}
feasible for sequestration)\textsuperscript{97} and 8,000 feet or so (below this depth drilling becomes less practicable, and many of the potential repository structures are located above this depth).\textsuperscript{98}

While this may be politically challenging to do, there is precedent for such an action – the federal government’s declaration of dominion over the outer continental shelf, which was upheld by the Supreme Court in \textit{United States v. California}\textsuperscript{99} and \textit{United States v. Louisiana}.\textsuperscript{100}

In both of those cases, the Court relied on two lines of argumentation to find that the federal government could properly assert ownership over the continental shelf without needing to pay just compensation to states that formerly asserted ownership. First, the Court examined whether, around the time of the American Revolution and the founding of the United States, there was any document purporting to convey ownership over the continental shelf to the states.\textsuperscript{101} Second, the Court assessed whether ownership of the continental shelf more heavily impacted federal or state interests.\textsuperscript{102} The Court found that no document conveyed ownership of the continental shelf to the states, and that federal interests in national security, foreign affairs, and international commerce outweighed any interests the states had in owning the continental shelf, and as a result held that the federal government could properly assert dominion over the continental shelf.\textsuperscript{103} An analogous argument can be made for federal dominion over the deep subsurface – that no document conveyed land or water below a certain depth to the states, and that federal interests are substantially impacted by who owns the subsurface.

\textsuperscript{97} \textit{See supra} note 4 and accompanying text.
\textsuperscript{98} \textit{See} Table 1 (indicating that currently extant commercial-scale sequestration operations are occurring at or above 8,200 feet).
\textsuperscript{99} 332 U.S. 19 (1947).
\textsuperscript{100} 339 U.S. 699 (1950).
\textsuperscript{101} \textit{California}, 332 U.S. at 31-34; \textit{Louisiana}, 339 U.S. at 705.
\textsuperscript{102} \textit{California}, 332 U.S. at 34-40; \textit{Louisiana}, 339 U.S. at 704.
\textsuperscript{103} \textit{California}, 332 U.S. at 32-35, 41.
There is additional support for asserting federal dominion from the Court’s decision in United States v. Causby, where the Court held that it was neither a trespass nor a taking for airplanes to travel over private owners’ property. The Court there noted that the development of the airplane rendered outmoded conceptions of private ownership which held that a landowner owned all of the airspace above his property. An analogous argument can be made that the development of CCS renders the concept of private ownership of the land to all the depths unfit for modern times.

Several authors have argued that assertion of federal dominion over all the deep subsurface is a plausible solution to the ownership issue. Moreover, government ownership of the subsurface is not unheard of – other countries, such as Australia, and much of Europe, vest ownership of the subsurface in the government, which then has responsibility for granting access rights.

While there is a strong case for federal ownership, there are also persuasive counterarguments that can be made. First, the distinction between the deep and shallow subsurface, unlike the distinction between the continental shelf and the shore, is one of degree rather than kind. As a result, it may be difficult to convince a court that states at the time of the

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104 328 U.S. 256 (1946).
105 Id. at 260-61.
106 See, e.g., John G. Sprankling, Owning the Center of the Earth, 55 UCLA L. REV. 979, 1033-34, 1036-38 (2008) (advocating that land below 1,000 feet be treated as public land owned by the federal government, with exceptions for preexisting uses); CCSREG PROJECT, supra note 44, at 6 (“[I]t might be feasible to place deep pore space for use in GS under the sovereign control of state or federal government and to enact a statutory regime that standardizes procedures for access to and utilization of deep subsurface pore space for that purpose.”); see also Reisinger et. al., Reconciling King Coal and Climate Change: A Regulatory Framework for Carbon Capture and Storage, 11 VT. ENVTL. L. J. 1, 31-32 (2009) (“[P]roperty rights to the air and subsurface cannot extend infinitely in the face of modern necessity. Where the reasonable use of marketable underground assets ends, the public space designated for deep saline aquifer sequestration should begin. Therefore, legislation should define deep saline injection sites as public space for the purposes of prolonged carbon storage.”).
Revolution only claimed dominion over the land to a certain depth. Second, the relevant interest analysis in the subsurface context is indirect, rather than direct. Third, the *Causby* analogy may be unconvincing because the subsurface has historically been utilized for economic gain, unlike the airspace. As a result, it is unclear whether a court would accept the theory of federal dominion over the deep subsurface.

The primary advantage of asserting federal dominion is that it would entirely resolve the property issue. The federal government would own title to all the land beneath a certain depth (although there would likely need to be an exception for pre-existing uses). As a result, it could easily lease land to private entities to conduct sequestration activities, thus obviating the holdout problem discussed above.

There are, however, several disadvantages to this option. Politically, it is unclear whether Congress would be willing to declare dominion. Such dominion will likely spark intense litigation over whether the federal government can properly assert dominion. Resolving this litigation will likely take several years, and there is a possibility that the courts would disagree with the government’s assertion of dominion. Thus, while the advantage of this opinion is clear, it also carries large downside risks.

### 2. The Legal Basis for Asserting Dominion

#### a. The Historical Argument

The relevant assessment is whether “the English charters granted to this nation’s settlers, []or the treaty of peace with England, []or any other document . . . showed a purpose to set apart” the deep subsurface “for colonial or state ownership.”\(^{108}\) Whether such ownership was intended to be conveyed to the Colonies by any of the relevant charters from England is based on both the

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language used in the relevant charters, as well as the intent of the parties to such charters, which is informed at least in part by the practices of the time. The same analysis holds for states that joined the Union after its initial formation, under the “equal footing” doctrine, which holds that “new States are admitted to the Union on an ‘equal footing’ with the original 13 Colonies.”

With respect to the text of the documents conveying territory to the original colonies, there is no clear answer as to whether the deep subsurface was included. For instance, the letters patent to the Duke of York for the territory that became the State of New Jersey conveyed:

> [A]ll the lands, islands, soils, rivers, harbours, mines, minerals, quarries, woods, marshes, waters, lakes, fishings, hawkings, hunttings, and fowlings, and all other royalties, profits, commodities, and hereditaments to the said several islands, lands, and premises belonging and appertaining with their and every of their appurtenances, and all the estate, right, title, interest, benefit, and advantage, claim, and demand of the king, in the said land and premises . . . .

While this language is extremely broad, it does not specifically convey the territory to the infinite depths, although it does convey all of the “lands,” “mines,” “minerals,” “quarries” and “waters.” As a result, this language does not answer the question of whether, for example, a saline aquifer several thousand feet below the ground, which no one at the time had any knowledge existed, nor any ability to access, falls within the language of the grant.

Given that the language of the grants is unlikely to be dispositive, the relevant question is likely to be whether the parties intended to convey the land to all the depths. Two facts support

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109 Martin v. Waddell, 41 U.S. 367, 408 (1842) (“The point in dispute between the parties . . . depends upon the construction and legal effect of the letters patent to the Duke of York . . . .”).
110 See California, 332 U.S. at 32-33 (noting that at the time of the Revolution, “there was no settled international custom or understanding among nations that each nation owned a three-mile water belt along its borders,” and that there is no historical evidence that those who settled this country “wanted or claimed a right to block off the ocean’s bottom for private ownership and use in the extraction of its wealth”).
112 Martin, 41 U.S. at 408.
an argument that they did not intend such a conveyance: that subsurface activity was conducted at relatively shallows depths at the time, and that the legal doctrine of the time did not recognize ownership of all land beneath a piece of property.

As a factual matter, exploitation of the subsurface around the time of the Revolution did not come close to reaching the depths below which CCS is likely to operate. Around the time of the Revolution, mining activities “rarely reached a depth of 1000 feet.”\textsuperscript{113} Much the same is true of exploitation of groundwater – for instance, in 1829, a 120 meter well in France was judged to be of a “considerable depth.”\textsuperscript{114} In the Colonies, exploitation of the subsurface was even more limited in depth than in Europe. This is logical given that the country had not been mined for millennia, as was the case in England at the time.\textsuperscript{115} This meant that it was unnecessary to explore ever deeper for minerals; shallow, easy to access deposits could be exploited. For example, the first copper mine in America was operated from 1709 to 1773, and only operated at a depth of eighty feet.\textsuperscript{116} The costs of operating mines at greater depths were excessive – one copper mine in New Jersey was abandoned after the ore had been worked out to a depth of fifty feet, because the cost of labor proved excessive.\textsuperscript{117}

As a legal matter, the doctrine that property owners own the surface to all the depths, embodied in the maxim “cujus et solum, ejus est usque ad coelum et ad infernos,”\textsuperscript{118} was not accepted at the time of the Revolution. This doctrine was “invented” by Blackstone in 1766.

\textsuperscript{113} Sprankling, \textit{supra} note 106, at 988.

\textsuperscript{114} NORMAN SMITH, \textit{A HISTORY OF HYDRO-TECHNOLOGY} 108 (1975).

\textsuperscript{115} See CEDRIC E. GREGORY, \textit{A CONCISE HISTORY OF MINING} 83-85 (1980) (noting that the Romans mined for gold, silver, iron, and lead in Britain from the first to the third century, A.D.).

\textsuperscript{116} THOMAS A. RICKARD, \textit{A HISTORY OF AMERICAN MINING} 6 (1932). \textit{See also id.} at 1 (“The American mining industry is vigorous today because it is young. At a time when the ore deposits of central Europe, for example, were being exploited actively, those of the United States were lying practically untouched.”).

\textsuperscript{117} \textit{Id.} at 7.

\textsuperscript{118} Meaning “the rights of the surface owner extend upward to the heavens (ad coelum) and downward to the center of the earth (ad inferos).” Sprankling, \textit{supra} note 106, at 980-81.
“without any prior foundation in English [or Roman] law.” Indeed, “[i]n the ensuing decades, Blackstone’s center of the earth theory appeared in only a handful of English cases and treatises.” In America, this “theory first appeared . . . in the 1797 decision of State v. David.” The same holds true of the analogous “absolute ownership” rule of groundwater, which was not enunciated until the 1843 case of Acton v. Blundell.

The argument for federal ownership, then, is that the land below a certain depth was never intended to be transferred to the Colonies. The analogy is to the continental shelf, where the Supreme Court found that “[t]here is no substantial support in history for the idea that [those who settled this country] wanted or claimed a right to block off” the continental shelf “for private ownership and use in the extraction of its wealth.”

b. The Federal Interests Argument

In addition to the historical analysis, the Court invoked three federal interests to support its conclusion that the federal government has dominion over the continental shelf: national security, implications for foreign affairs, and international commerce. These interests are arguably implicated with respect to ownership of the deep subsurface. The interest is not direct; rather, the argument is that climate change poses substantial threats to all of these interests, and that ownership of the deep subsurface is important to combating climate change, resulting in the deep subsurface having importance to all of these interests.

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119 Id. at 982-83.
120 Id. at 988.
121 Id. at 989.
124 Id. at 35; see also United States v. Louisiana, 339 U.S. 699, 704 (1950) (“The marginal sea is a national, not a state concern. National interests, national responsibilities, national concerns are involved. The problems of commerce, national defense, relations with other powers, war and peace focus there.”).
Major declarations issued by both political branches – the American Clean Energy and Security Act of 2009 ("Waxman-Markey"), H.R. 2454, passed by the House in 2009, and the EPA Administrator’s finding under the Clean Air Act that greenhouse gas emissions pose a danger to public health and welfare – contain clear statements that climate change poses a threat to these interests.

Waxman Markey makes clear that: “The consequences of global climate change, including increases in poverty and destabilization of economies and societies, are likely to pose long-term challenges to the national security, foreign policy, and economic interests of the United States.” The bill also notes that “[i]t is in the national security, foreign policy, and economic interests of the United States to recognize, plan for, and mitigate the international . . . effects of climate change . . . .”

The EPA Administrator’s findings are in accord with this assessment. “[E]missions in other countries can affect the United States. Furthermore, impacts in other regions of the world may have consequences that in turn raise humanitarian, trade, and national security concerns for the United States.” “Because human induced climate change has the potential to aggravate natural resource, trade, and humanitarian issues in other world regions, which in turn may

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126 Waxman-Markey § 491(a)(6) (emphasis added). Waxman-Markey also contains numerous other statements relevant to this discussion. “The Congress finds as follows: (1) Global warming poses a significant threat to the national security, economy, public health and welfare, and environment of the United States, as well as of other nations.” Id. § 701(a). “Congress finds the following: (1) Global climate change is a potentially significant national and global security threat multiplier and is likely to exacerbate competition and conflict over agricultural, vegetative, marine, and water resources and to result in increased displacement of people, poverty, and hunger within developing countries.” Id. § 491(a). “Nations of the world look to the United States for leadership in addressing the threat of and harm from global warming. Full implementation of the Safe Climate Act is critical to engage other nations in an international effort to mitigate the threat of and harm from global warming.” Id. § 703(a)(6).
127 Id. § 491(a)(7).
contribute to the endangerment of public welfare in the United States, this provides additional support for the Administrator’s finding that the greenhouse gas air pollution is reasonably anticipated to endanger the public welfare of current and future generations of the United States population.”

Note that the EPA reviewed these claims in light of comments it received and “disagrees that the potential national security impacts of climate change that we identify . . . are ‘speculative and attenuated.’ Examination of the literature . . . confirms that this discussion is based upon best available projections of future climate change impacts and expert assessment of the sociopolitical outcomes that could potentially result.”

As a result, since climate change is anticipated to pose substantial risks with respect to national security, foreign relations, and international commerce, and CCS has potential to be an important asset in combating climate change, ownership of the subsurface for CCS purposes has a distinct relationship to these interests.

There is also an important, under-recognized federal interest unique to deep saline aquifers: their use as a potential source of drinking water. While not one of the interests discussed in the continental shelf cases, the presence of this importance federal interest could be an additional ground for asserting federal dominion over the deep subsurface, given that deep saline aquifers cover much of the country.

The Supreme Court has held that the federal government has a substantial interest in regulating water supplies:

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129 Id. at 66,535-36.
131 See supra Part II.A.
132 See supra notes 82-84 and accompanying text.
133 See supra Figure 4.
[S]tudies indicate that over 80% of our water supplies is used for agricultural purposes. The agricultural markets supplied by irrigated farms are worldwide. They provide the archtypical example of commerce among the several States for which the Framers of our Constitution intended to authorize federal regulation. The multistate character of the Ogallala aquifer . . . confirms the view that there is a significant federal interest in conservation as well as in fair allocation of this diminishing resource.  

The Court also noted that “[g]round water overdraft is a national problem and Congress has the power to deal with it on that scale.”

This federal interest in protecting water supplies is only projected to grow as a result of climate change. As the EPA has remarked:

> The Administrator finds that the total scientific literature provides compelling support for finding that greenhouse gas air pollution endangers the water resources important for public welfare in the United States, both for current and future generations. The adequacy of water supplies across large areas of the country is at serious risk from climate change.

In addition to their use as sources of drinking water, deep saline aquifers may also be used a source of minerals. As a result, a strong case can be made that the federal government is best suited to manage these conflicting demands on this valuable resource.

c. The Airspace Analogy

In *United States v. Causby*, the Court held that it was neither a trespass nor a taking for airplanes to travel over private owners’ property. In reaching this conclusion, the Court remarked that:

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135 *Id.* at 954.
137 *See supra* note 82 and accompanying text.
138 328 U.S. 256 (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*. But that doctrine has no place in the modern world. The air is a public highway, as Congress has declared. Were that not true, every transcontinental flight would subject the operator to countless trespass suits. Common sense revolts at the idea. To recognize such private claims to the airspace would clog these highways, seriously interfere with their control and development in the public interest, and transfer into private ownership that to which only the public has a just claim.\(^{139}\)

Thus, the Court recognized that changed circumstances – namely the growth of air travel – warranted a reconfiguration of property rights. This case is particularly relevant in that it invalidated one half of the “ad coelum et ad infernos” maxim. One can argue that the pressing issue of climate change, along with the increasing variety of uses that the subsurface is subject or potentially subject to, justifies invalidating the remaining portion of the maxim and transferring ownership of the deep subsurface to the federal government.

**d. Counterarguments**

The legal case for federal dominion is hardly airtight; there are various counterarguments that a court could find compelling in assessing whether federal dominion is justified.

First, the distinction between the deep subsurface and the shallow subsurface, unlike the distinction between the land and the continental shelf, is one of degree, rather than a bright-line binary. As a result, it is extremely difficult, given that mining was a common practice and the relevant documents explicitly transferred mines, quarries and the like, to draw a specific line and argue that below that line there was no thought given to transfer of the territory below that depth. Even though the deep subsurface could not be exploited at the time of the Revolution, it is

\(^{139}\text{Id. at 260-61.}\)
possible that the documents intended to convey the land to all the depths, so that it could be exploited as technology and mining techniques advanced.

Second, with respect to the interest analysis, the link to foreign affairs, national security, and international commerce concerns is more attenuated in the subsurface context than in the continental shelf – there is only a link if one assumes that the subsurface will be used for CCS, and, in turn, that CCS will have an appreciable effect on climate change. As a result, unlike in the continental shelf cases, where activity and control over the continental shelf had a very clear and direct link to the policy considerations at issue, here the link between CCS and these considerations involves several intervening steps. This argument is bolstered by the fact in United States v. California the Court noted that “[t]he belief that local interests are so predominant as constitutionally to require state dominion over lands under its land-locked navigable waters finds some argument for its support.”

Third, with respect to the Causby analogy, the airspace can be readily distinguished from the subsurface. The main distinction is that the subsurface, unlike the airspace, has been utilized for a long period of time, and involves far more competing uses. As a result, property owners arguably have a much greater expectation interest with respect to their subsurface rights than property owners had with respect to airspace rights.

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140 See United States v. California, 332 U.S. 19, 35 (1947) (“The three-mile rule is but a recognition of the necessity that a government next to the sea must be able to protect itself from dangers incident to its location. It must have powers of dominion and regulation in the interest of . . . the security of its people from wars waged on or too near its coasts. . . . The very oil about which the state and nation here contend might well become the subject of international dispute and settlement.”); see also United States v. Texas, 339 U.S. 707, 719 (1950) (“[O]nce low-water mark is passed the international domain is reached. Property rights must then be so subordinated to political rights as in substance to coalesce and unite in the national sovereign. Today the controversy is over oil. Tomorrow it may be over some other substance or mineral or perhaps the bed of the ocean itself.”).

141 332 U.S. at 34.

142 Klass & Wilson, supra note 34, at 388-89. Others have raised further distinctions – that Congress has not enacted legislation designating the subsurface a public good, that the sequestration site will be privately controlled, and that the airspace is infinite while the subsurface is finite. Reisinger et. al., supra note 106, at 16.
3. Advantages of Asserting Federal Dominion

Asserting federal dominion over all deep pore space has several advantages.

First, it would provide a comprehensive solution to the ownership question. Adopting this approach would clearly establish that title to the deep subsurface is vested in the federal government. The federal government would then have virtually unlimited power to regulate the disposition of the deep subsurface. Article 4 of the Constitution provides that “[t]he Congress shall have Power to dispose of and make all needful Rules and Regulations respecting the Territory or other Property belonging to the United States.”\textsuperscript{143} The Supreme Court has held that “[t]he power of Congress to dispose of any kind of property belonging to the United States ‘is vested in Congress without limitation.’”\textsuperscript{144} As a result, the government would have the ability to lease land to private entities for CO$_2$ sequestration operations.

Second, it would provide for acquisition of all of the deep pore space without having to compensate landowners. In the continental shelf cases, the Court did not require the federal government to compensate the states or any private entities.\textsuperscript{145} However, it is likely that the federal government would need to allow current uses of the subsurface to continue if it wishes to avoid paying just compensation. In the continental shelf context, the Outer Continental Shelf Lands Act established a procedure for validation of prior leases.\textsuperscript{146}

Third, it removes some potential sources of litigation. In addition to resolving the question of ownership rights, if the federal government possessed title to the land below a certain depth, subsurface trespass below that depth would cease to be an issue.

\textsuperscript{143} U.S. Const., Art. 4, § 3, cl. 2.  
\textsuperscript{144} Alabama v. Texas, 347 U.S. 272 (1954)  
\textsuperscript{145} California, 332 U.S. at 32-33.  
\textsuperscript{146} 43 U.S.C. § 1335; Texaco, Inc. v. Hickel, 437 F.2d 636, 639 (D.C. Cir. 1970) (“Section 6(b) of the Outer Continental Shelf Lands Act, 43 U.S.C. § 1335(b) provides that any person holding such a lease ‘may continue to maintain such lease, and may conduct operations thereunder’ provided that the lease meets the requirements specified in § 6(a).”).
4. Disadvantages of Asserting Federal Dominion

First, federal assertion of dominion will result in substantial amounts of litigation over the legality of such action, both by private parties whose subsurface interests are impacted as well as by the states. This litigation could be quite protracted, as the case of the continental shelf illustrates. President Truman initially proclaimed federal ownership of the shelf in 1945.\textsuperscript{147} Several cases followed, including \textit{United States v. California}\textsuperscript{148} in 1947 as well as \textit{United States v. Louisiana}\textsuperscript{149} and \textit{United States v. Texas}\textsuperscript{150} in 1950. As a result, adopting this option would ensure several years of litigation, which would need to be resolved before large-scale sequestration operations could move forward.\textsuperscript{151}

Second, as discussed above, it is by no means ensured that the legal argument in favor of federal dominion will succeed. Thus, the years of litigation could ultimately result in a decision that the federal government cannot simply assert dominion over the deep subsurface, resulting in no improvement to the status quo.

Third, declaration of federal ownership over all of the deep subsurface seems overbroad. Only certain geologic formations are feasible for CO\textsubscript{2} storage, so a declaration of federal ownership over all of the deep subsurface seems to be a more massive step than is required if the purpose of such a declaration is to facilitate CCS.

Fourth, from a political perspective, this would be a profound governmental action, as it would involve the government taking exclusive title over all land below a certain depth (or all

\begin{footnotesize}
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\item California, 332 U.S. at 34 n.18.
\item 332 U.S. 19 (1947).
\item 339 U.S. 699 (1950).
\item 339 U.S. 707 (1950).
\item Klass and Wilson appear to agree with this analysis, noting that “[w]hile such an approach would certainly facilitate the development of CCS by reducing acquisition costs associated with subsurface pore space, it would almost just as certainly invite takings challenges, creating uncertainty surrounding total costs of CCS implementation and leaving the issue for the courts.” Klass & Wilson, \textit{supra} note 34, at 406.
\end{enumerate}
\end{footnotesize}
land amenable for CCS purposes below a certain depth). The backlash to such a sweeping action could be great – both by entities whose specific interests may be impacted (mining companies, oil and gas companies, etc.) as well as the broader public. The backlash could well be greater than that following the controversial decision of *Kelo v. City of New London*, which “set off fiery protests across the country.” That backlash was so great that at least 34 states passed laws in the wake of *Kelo* restricting the use of eminent domain. This threat of backlash could well deter Congress from passing such a law asserting dominion. Even if Congress were to pass such a law despite the risk of backlash, the protests triggered could be sufficient to place serious pressure on the political support for CCS operations.

### B. Offshore Sequestration

#### 1. Overview

Offshore geological sequestration entails injecting CO₂ beneath the seabed into an oil or gas formation or a deep saline aquifer: “Subsurface geological storage is possible both onshore and offshore, with offshore sites accessed through pipelines from the shore or from offshore platforms.” Such sequestration is fundamentally the same as sequestration onshore; the primary difference being that the relevant geological repository is located under the seabed, rather than underground. Substantial storage capacity exists offshore – the Department of

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153  *Hands off our homes*, ECONOMIST, Aug. 18, 2005.
154  *An American’s home is still her castle*, ECONOMIST, Nov. 23, 2006.
155  INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 200; see also FOLGER, supra note 12, at 10 (“As with oil and gas, deep saline reservoirs can be found onshore and offshore . . . .”).
156  It is important to distinguish offshore sequestration below the seabed from offshore sequestration above the seabed, in the water column itself. The latter has been suggested as a possible sequestration method. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 37. However, this is an ill-advised course of action. First, there is virtually no experience with this form of sequestration – “[o]cean storage has not yet been deployed or demonstrated at a pilot scale, and is still in the research phase.” *Id.* Second, such sequestration is likely to violate the London Convention. Karen N. Scott, *The
Energy estimates that between 1,286,726 and 5,146,493 million tons of CO\textsubscript{2} could be sequestered offshore.\textsuperscript{157} This is between 35\% and 37\% of the total estimated storage space within the United States.\textsuperscript{158}

Offshore sequestration has been experimented with – since 1996, the Sleipner Project has operated in the North Sea, injecting approximately 1 million tons of CO\textsubscript{2} a year into a saline aquifer located 800 meters beneath the seabed.\textsuperscript{159} Thus far, there appear to be no leaks from the Sleipner Project and it has demonstrated the technical feasibility of offshore sequestration in deep saline aquifers.\textsuperscript{160}

The primary advantage of offshore sequestration is that, pursuant to OCSLA and the Submerged Lands Act, the federal government already owns all of the relevant property. As a result, transaction costs and the threat of litigation relating to the migration of CO\textsubscript{2} would be minimal. Moreover, leaks are both less likely to occur and, if they do occur, are less likely to cause serious problems.

The primary disadvantage of offshore sequestration is that it may conflict with international agreements and domestic laws currently in force. While the application of these laws to sequestration under the seabed is unclear, it is at least possible that sequestration will violate these laws. A second disadvantage is that offshore CCS is projected to be more expensive than onshore storage.

\textsuperscript{157} NAT’L ENERGY TECH. LAB., supra note 16, at 136.
\textsuperscript{158} Id.
\textsuperscript{159} FOLGER, supra note 12, at 11.
\textsuperscript{160} Id., see also IEA, KEY OPTION, supra note 1, at 105 (“The results to date from extensive time-lapse seismic and other monitoring technologies combined with modelling suggest that there is no leakage and that CO\textsubscript{2} storage is technically feasible.”).
expensive than onshore CCS (not taking into account the costs of property acquisition) – pipelines and injection facilities are more expensive to maintain at sea than on land.

2. Advantages

The first advantage of offshore sequestration is that the federal government already owns the seabed, beginning 3 miles off the coast.

OCSLA provides that “the subsoil and seabed of the outer Continental Shelf appertain to the United States and are subject to its jurisdiction, control, and power of disposition as provided in this Act”\textsuperscript{161} OCSLA defines “outer Continental Shelf” to include “all submerged lands lying seaward and outside of the area of lands beneath navigable waters as defined in section 2 of the Submerged Lands Act.”\textsuperscript{162} The Submerged Lands Act, in turn, defines “lands beneath navigable waters” to include lands covered by tidal waters extending “seaward to a line three geographical miles distant from the coast line of each such State.”\textsuperscript{163} As a result, OCSLA establishes federal ownership of all submerged lands three miles beyond the coastline.\textsuperscript{164} This reading of OCSLA is further supported by another portion of the Submerged Lands Act, which reaffirms that:

> Nothing in this Act shall be deemed to affect in any wise the rights of the United States to the natural resources of that portion of the subsoil and seabed of the Continental Shelf lying seaward and

\textsuperscript{161} 43 U.S.C. § 1332(1).

\textsuperscript{162}  Id. § 1331(a).

\textsuperscript{163}  Id. § 1301(a)(2).  In some instances, this boundary extends beyond three miles. The provision continues: “and to the boundary line of each such State where in any case such boundary as it existed at the time such State became a member of the Union, or as heretofore approved by Congress, extends seaward (or into the Gulf of Mexico) beyond three geographical miles . . . .”  \textit{Id.} § 1301(a)(2).  In United States v. Louisiana, 363 U.S. 1 (1960), the Court held that, pursuant to an 1845 Congressional resolution, Texas’s maritime boundary extends to three leagues (approximately 10.35 miles). \textit{Id.} at 64.

\textsuperscript{164}  OCSLA does not define the distance from the shoreline at which federal jurisdiction ends. However, the general rule, articulated in the United Nations Law of the Sea (UNCLOS) is that a nation’s exclusive economic zone extends 200 miles out to sea. \textit{See} UNCLOS art. 57 (“The exclusive economic zone shall not extend beyond 200 nautical miles from the baselines from which the breadth of the territorial sea is measured.”); \textit{id.} art. 76(1) (“The continental shelf of a coastal State comprises the seabed and subsoil of the submarine areas that extend beyond its territorial sea . . . to a distance of 200 nautical miles from the baselines from which the breadth of the territorial sea is measured . . . .”).
outside of the area of lands beneath navigable waters, . . . all of which natural resources appertain to the United States, and the jurisdiction and control of which by the United States is hereby confirmed.165

As discussed above in connection with asserting federal dominion over deep pore space, the Supreme Court has confirmed that the United States possesses ownership over the seabed lying three miles or further from the coast.166 Moreover, in subsequent cases, the Court has expressly confirmed the constitutionality of both OSCLA and the Submerged Lands Act. In Alabama v. Texas,167 Alabama and Rhode Island challenged the constitutionality of the Submerged Lands Act. The Court rejected this challenge, holding the Property Clause of the Constitution168 governs the disposition of the lands covered by that act, and “[t]he power over the public land thus entrusted to Congress is without limitations. . . . [I]t is not for the courts to say how that trust shall be administered. That is for Congress to determine. . . .”169 In United States v. Maine,170 the Court reaffirmed that by enacting the Submerged Lands Act and OCSLA, “Congress emphatically implemented its view that the United States has paramount rights to the seabed beyond the three-mile limit.”171 The Court also noted that it “should not undertake to re-examine the constitutional underpinnings of the California case and of those cases which followed and explicated the rule that paramount rights to the offshore seabed inhere in the Federal Government as an incident of national sovereignty.”172

Thus, because the federal government already owns the relevant property, it could lease it to entities willing to conduct sequestration activities. Indeed, OCSLA provided a framework

166 See supra notes 99-100.
168 U.S. CONST. art. IV, § 3, cl. 2.
169 Alabama, 347 U.S. at 273-74.
171 Id. at 526.
172 Id. at 524.
establishing a competitive bidding system for oil and gas leases,\textsuperscript{173} to be administered by the Secretary of the Interior.\textsuperscript{174} In 2005, Congress enacted the Energy Policy Act of 2005, which amended OCSLA to provide the Secretary the authority to “grant a lease, easement, or right-of-way on the outer Continental Shelf for activities not otherwise authorized,” so long as the activity “produce[s] or support[s] production . . . of energy.”\textsuperscript{175} This language appears broad enough to give the Secretary authority to authorize sequestration activities.

However, the implementing regulations promulgated by the Minerals Management Service (MMS) do not appear to encompass sequestration activities. In 2009, MMS finalized a set of regulations establishing leasing procedures for renewable energy and alternative uses of the outer continental shelf, exercising its authority under the 2005 Act.\textsuperscript{176} The regulations provide that “MMS may issue leases on the [outer continental shelf] for the assessment and production of renewable energy.”\textsuperscript{177} Renewable energy, in turn, is defined as “energy resources other than oil and gas and minerals . . . . Such resources include, but are not limited to, wind, solar, and ocean waves, tides, and current.”\textsuperscript{178} This language does not seem broad enough to allow MMS to grant leases for sequestration. The preamble accompanying the regulations makes no mention of sequestration. The regulations also provide that the MMS may “[p]ermit alternate use activities to occur that is currently in use under an approved [outer continental shelf] lease.”\textsuperscript{179} “Alternate use” is defined as “energy- or marine-related use of an existing OCS facility for activities not

\textsuperscript{173} 43 U.S.C. § 1337.
\textsuperscript{174} Id. § 1334.
\textsuperscript{178} Id. § 285.112.
\textsuperscript{179} Id. § 285.1000.
otherwise authorized by this subchapter or other applicable law.”

This clearly encompasses sequestration, but only with respect to facilities already in use for some other purposes.

In any event, the MMS regulations do not contain any technical standards or other requirements relating to carbon sequestration. If this option is selected, MMS should conduct notice-and-comment rulemaking to determine regulations specifically applicable to sequestration activities offshore, rather than simply write into each lease case-by-case standards, in order to provide a coherent framework for sequestration operators.

It is worth emphasizing that federal ownership only applies beyond the three mile limit. Within three miles of the shore, the several states have ownership of the seabed. At least one state is moving forward to establish an offshore repository within its territory. Texas law provides that the state commissioner of the General Land Office shall “conduct a study of state-owned offshore submerged land to identify potential locations for a carbon dioxide repository,” with the School Land Board making a final selection of the repository site. Once a repository is selected, the Board has the authority to accept carbon dioxide for storage.

The second advantage of offshore sequestration is that leaks are less likely to occur. Oil and gas wells and other penetrations of the Earth’s surface are projected to be the most likely conduits through which leaks will occur. Some of these old projects may have created channels that will leak if certain geologic formations are utilized for sequestration. This is much

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180 Id. § 285.112
182 Id. § 382.505(a) (“Once the carbon dioxide repository is established, the board may accept carbon dioxide for storage.”).
183 Mandatory Reporting of Greenhouse Gases: Injection and Geologic Sequestration of Carbon Dioxide, supra note 14, at 18,590 (“Wells (and other artificial penetrations such as boreholes) are one of the most probable conduits for the escape of CO₂ from the injection zone.”); THOMPSON, supra note 76, at 26 (“The most direct route for any leaks would likely be through abandoned oil and gas wells, forgotten and crumbling.”).
less likely to be an issue with respect to offshore sequestration – offshore wells are fewer in number (having primarily operated only during the past 50 years).

The third advantage of offshore sequestration is that leaks which do occur are less likely to prove harmful, at least to humans and their property. An offshore leak poses minimal risk of any impact on human or property, although there is a risk to the aquatic environment. Moreover, if a leak occurs, the overlying seawater can form a barrier and slow or halt the release of CO\textsubscript{2} into the atmosphere (depending on the depth at which the CO\textsubscript{2} is released).

3. Disadvantages

a. Potential Conflict With International Law

Offshore CCS may conflict with currently extant international law. There are three relevant international treaties – the United Nations Convention on the Law of the Sea (UNCLOS), the London Convention, and the London Protocol. However, given that the most recent treaty (the London Protocol) expressly allows for CCS, such a conflict is unlikely to occur.

UNCLOS is an international agreement which establishes a comprehensive legal framework for governing activities on, in and under the world’s oceans. UNCLOS was opened for signature in 1982 and entered into force in 1994. Currently, there are 160 parties to the treaty. The United States is not a signatory to UNCLOS, although the treaty is on the

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184 JACOBS & STUMP, supra note 2, at B-2 (discussing harms of offshore sequestration);
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 249.
185 INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, supra note 1, at 249.
187 Id.
Obama Administration’s Treaty Priority List.\textsuperscript{190} Moreover, portions of the treaty may represent customary international law, binding on the United States.\textsuperscript{191} As a result, a brief discussion of the treaty’s provisions is warranted.

UNCLOS requires states to adopt laws designed “to prevent, reduce and control pollution of the marine environment from land-based sources . . . .”\textsuperscript{192} It also requires that states adopt laws “to prevent, reduce and control pollution of the marine environment arising from or in connection with seabed activities subject to their jurisdiction . . . .”\textsuperscript{193} Lastly, it requires that states adopt laws “to prevent, reduce and control pollution of the marine environment by dumping.”\textsuperscript{194}

UNCLOS appears to have limited relevance to offshore CCS. First, as mentioned above, the United States is not a party to the convention. As a result, it does not presently bind the United States, except to the extent to which it constitutes customary international law. Second, the London Convention provides more specific rules with respect to “dumping” in the marine environment. “Currently, the global standards referred to in Article 210 of UNCLOS are embodied in the 1972 London Convention.”\textsuperscript{195} As a result, the London Convention, to which the United States is a party, appears to be the governing international agreement. Finally, language

\begin{footnotesize}
\begin{itemize}
  \item Scott, \textit{supra} note 156, at 64 n.46 (“While UNCLOS cannot be regarded as customary international law in its entirety, the International Court of Justice has taken the approach that individual provisions of UNCLOS may be assessed independently in order to decide whether they themselves may nevertheless be regarded as customary law.”).
  \item Id. Art. 208(1).
  \item Id. Art. 210(1).
  \item Scott, \textit{supra} note 156, at 74.
\end{itemize}
\end{footnotesize}
of the relevant UNCLOS provision is fairly vague and to some extent precatory; it does not come close to adopting a clear ban on sequestration of CO\textsubscript{2} beneath the seabed.

The London Convention was opened for signature in 1972 and entered into force in 1975.\textsuperscript{196} As of 2008, 85 countries, including the United States, were parties to the Convention.\textsuperscript{197} The overarching goal of the Convention is to “promote the effective control of all sources of pollution of the marine environment,” which the parties promise to do by taking “all practicable steps to prevent the pollution of the sea by the dumping of waste and other matter.”\textsuperscript{198} The Convention bans dumping of certain material altogether, requires a special permit for other material, and finally requires only a general permit for a residual third category of material.\textsuperscript{199} Before delving into these categories, however, a threshold determination of whether CO\textsubscript{2} sequestration even constitutes “dumping” is warranted.

The definition of dumping is “any deliberate disposal at sea of wastes or other matter from vessels, aircraft, platforms or other man-made structures at sea.”\textsuperscript{200} “Sea” is defined as “all marine waters other than the internal waters of States.”\textsuperscript{201} There is a strong argument that the treaty does not apply to subseabed sequestration because the definition of “sea” into which dumping is prohibited refers only to “marine waters.” As a result, if the CO\textsubscript{2} is directly injected into the geologic formation beneath the seabed, there is no disposal into the “marine waters” and hence no issue raised under the treaty. The International Energy Agency agrees with this interpretation of the Convention: “The relevance of the London Convention to CO\textsubscript{2} storage is limited but important – it only applies to storage conducted from aircraft and vessels and

\textsuperscript{198} London Convention, Art. 1.
\textsuperscript{199} Id. Art. 4.
\textsuperscript{200} Id. Art. III, ¶ 1(a).
\textsuperscript{201} Id. Art. III, ¶ 3.
platforms in the water column. Consequently, it does not apply to storage in the ocean seabed or its subsoil or from a land-based pipeline.”

Similarly, Rene Coenen, Head of the Office for the London Convention, has taken the position (in his personal capacity) that “[s]torage of CO₂ in geological structures under the seabed is not covered under the London Convention.”

Moreover the London Protocol, a more recent treaty that supercedes the London Convention for states that are a party to the Protocol (the U.S. is not) has explicitly permitted oceanic geologic sequestration under certain circumstances (as is discussed below). If the United States complied with the Protocol’s requirements for sequestration, it would seem strange to argue that it was violating the Convention or other applicable international law.

As a result, it is unlikely that the London Convention prohibits subseabed geologic sequestration.

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202 IEA, LEGAL ASPECTS, supra note 107, at 62. See also DE FIGUERIĘDO, supra note 39, at 112 (“It is likely that sub-seabed CO₂ storage is not governed by the London Convention because dumping is defined as deliberate disposal at sea.”); Ray Purdy, The Legal Implications of Carbon Capture And Storage Under The Sea, 7 SUSTAINABLE DEV. L & POL’Y 22, 24 (2006) (“The London Convention seeks only to control dumping at ‘sea’ and would probably not cover CO₂ storage.”); Carbon Sequestration Leadership Forum Regulatory Workshop, Draft Record of Meeting 9 (Nov. 7, 2003) (“Another aspect of the London Convention is that it only applies to water columns and does not refer to the sea bed.”), available at http://www.cslforum.org/publications/documents/Transcript.pdf. At least one author, however, argues that there is some basis for treating the London Convention as governing offshore geologic sequestration, and that it should govern such sequestration. See Scott, supra note 156, at 75-76. However, even Scott hedges, noting that application of the London Convention to subseabed sequestration is “arguably” supported by a purposive approach to treaty interpretation, and that though this issue has been debated by treaty parties, “no consensus” was arrived at. Id.


204 There are also other ways in which the Convention might be found not to apply. First, the Convention defines dumping to exclude “placement of matter for a purpose other than the mere disposal thereof.” London Convention, Art. III, ¶ 1(b)(ii). To the extent that subseabed sequestration can be characterized as placement of CO₂ for a purpose other than mere disposal (for instance, scientific research), sequestration may not constitute “dumping.” Second, as noted in the main text, the Convention only bans certain substances – those listed in Annex I – from being dumped; other substances can be dumped if a permit is issued. Id. Art. 4. While CO₂ is not listed in Annex I, Annex I does include “industrial waste,” which “means waste materials generated by manufacturing or processing operations.” Id. Annex I ¶ 11. CO₂ may (or may not) fall into this definition. Even if CO₂ is an “industrial waste”, that definition includes an exception for “uncontaminated inert geological materials the chemical constituents of which
The final relevant international agreement is the London Protocol. The Protocol was opened for signature in 1996 and entered into force in March 2006.\textsuperscript{205} As of January 2009, there were 37 parties to the London Protocol.\textsuperscript{206} The United States is not a party, but did sign the Protocol in 1998,\textsuperscript{207} and the Protocol is on the Obama Administration’s Treaty Priority list.\textsuperscript{208} The London Protocol supersedes the London Convention for countries that are party to both.\textsuperscript{209}

The Protocol is similar to the Convention in many respects. Parties to the Protocol agree to “protect and preserve the marine environment from all sources of pollution.”\textsuperscript{210} The Protocol is stricter than the Convention in that it prohibits dumping of any “wastes or other matter” except for those listed in Annex I.\textsuperscript{211} The definition of “dumping” is also broader than that of the Convention – it includes “any storage of wastes or other matter in the seabed and the subsoil thereof from vessels, aircraft, platforms or other man-made structures at sea.”\textsuperscript{212} As a result, as initially enacted, the Protocol appeared to prohibit subseabed sequestration of CO\textsubscript{2}.

However, in November 2006, the parties to the Protocol adopted an amendment to Annex I to the Protocol, which has the effect of permitting subseabed sequestration.\textsuperscript{213} This amendment entered into force in February 2007.\textsuperscript{214} The amendment adds to the list of wastes in Annex I that are unlikely to be released into the marine environment.\textsuperscript{215} 

\begin{itemize}
\item \textit{Id.} Annex I ¶ 11(e). CO\textsubscript{2} may fall into this exemption.
\item \textit{Id.}
\item \textit{Id.} U.S. Dep’t of State, \textit{Treaty Priority List for the 111\textsuperscript{th} Congress} (May 11, 2009), available at http://www.globalsolutions.org/files/general/White_House_Priorities_List.pdf
\item \textit{Id.} London Protocol, Art. 23 (“This Protocol will supersede the Convention as between Contracting Parties to this Protocol which are also Parties to the Convention.”).
\item \textit{Id.} Art. 2.
\item \textit{Id.} Art. 4 ¶ 1.1.
\item \textit{Id.} Art. 1 ¶ 4.1.1.
\item \textit{Id.}
\end{itemize}
may be “considered for dumping” “[c]arbon dioxide streams from carbon dioxide capture processes for sequestration.” \(^{215}\) CO\(_2\) streams “may only be considered for dumping, if: [1] disposal is into a sub-seabed geologic formation; and [2] they consist overwhelmingly of carbon dioxide . . . and [3] no wastes or other matters are added for the purpose of disposing those wastes or other matter.”\(^ {216}\) As a result, the Protocol as amended clearly allows for CCS.\(^ {217}\)

Ultimately, then, it is unlikely that the United States is prevented by international agreement from engaging in offshore sequestration beneath the seabed. Neither UNCLOS nor the London Convention clearly prevents such sequestration, and the only relevant treaty to be negotiated after global warming and CCS became international issues, the London Protocol, explicitly allows CCS activities to be conducted. The simplest way to ensure that no international obligations are violated would be for the Senate to ratify the London Protocol. This would permit sequestration, supercede the London Convention and would be a more specific implementation of UNCLOS’s environmental provisions. Thus, it would present the only international obligation governing subseabed sequestration.\(^ {218}\)

b. Potential Conflict With Domestic Law

Offshore sequestration may run afoul of two domestic laws: the Marine Protection, Research and Sanctuaries Act (MRPSA) and the Clean Water Act (CWA). If this option is utilized, Congress, or the implementing agencies, should clarify the laws to ensure that entities

\(^{215}\) Id.; London Protocol Annex I ¶ 1.8
\(^{218}\) See Council Directive 2009/31, On the Geological Storage of Carbon Dioxide, 2009 O.J. (L 144) ¶ 12 (“At the international level, legal barriers to the geological storage of CO\(_2\) in geological formations under the seabed have been removed through the adoption of related risk management frameworks under the 1996 London Protocol . . . .”).
are not dissuaded from offshore sequestration due to uncertainty about the application of these two laws.

The MPRSA governs ocean dumping. The Act flatly prohibits any person from “dumping into ocean waters” any “sewage sludge or industrial waste” after 1991.\(^{219}\) Like the London Convention, it the MPRSA only governs dumping into the \textit{waters} of the ocean, and thus does not appear to cover subseabed activities.\(^{220}\) If the MPRSA does cover the seabed, the question of whether CO\(_2\) is an industrial waste arises. Industrial waste is defined as “any solid, semisolid, or liquid waste generated by a manufacturing or processing plant.”\(^{221}\) Again, as with the London Convention, there is some uncertainty over whether CO\(_2\) constitutes an “industrial waste.”\(^{222}\) Unfortunately, there is no case law with respect to whether the MPRSA covers the seabed or whether CO\(_2\) constitutes industrial waste within the meaning of the act.

The Clean Water Act provides that “[e]xcept as in compliance with [the Act], the discharge of any pollutant by any person shall be unlawful.”\(^{223}\) The definition of “discharge of any pollutant” encompasses (1) “any addition of any pollutant to navigable waters from any point source” and (2) “any addition of any pollutant to the waters of the contiguous zone or the

\(^{219}\) 33 U.S.C. § 1414b.

\(^{220}\) See Ann Brewster Weeks, \textit{Subseabed Carbon Dioxide Sequestration As A Climate Mitigation Option For The Eastern United States}, 12 OCEAN & COASTAL L.J. 245, 262 (2007) (“Unsurprisingly, the plain text of the MPRSA includes many of the same ambiguities as the London Convention with respect to its application to subseabed carbon dioxide sequestration.”). \textit{But see} Sumit Som, \textit{Creating Safe and Effective Carbon Sequestration}, 17 N.Y.U. ENVTL. L.J. 961, 976-77 (2008) (arguing that because sequestered carbon could leak into the ocean, it could harm the marine environment, and thus the MPRSA “should be interpreted as including subseabed sequestration as a form of dumping”).

\(^{221}\) 33 U.S.C. 1412a(b). Some argue that CO\(_2\) would not fall under this definition, because it is a gas. Som, \textit{supra} note 220, at 976-77. It is unclear whether this would be the case. If injected below 800 meters, CO\(_2\) would be a “supercritical fluid,” which is a “fluid above its critical temperature,” thus exhibiting “physical properties intermediate to those of gases and liquids.” Proposed UIC Regulations, \textit{supra} note 3, at, 43,494-95. Whether such a fluid would be considered a “liquid” or a “gas” for the purposes of the MPRSA is unclear. If CO\(_2\) considered a gas, rather than a liquid, it would not constitute an industrial waste, and thus the EPA could grant a permit to allow sequestration. Som, \textit{supra} note 220, at 977-78.

\(^{222}\) \textit{See supra} note 204.

\(^{223}\) 33 U.S.C. § 1311(a).
ocean from any point source other than a vessel or other floating craft.” 224 “Navigable waters” means the waters of the United States, including the territorial seas.” 225 “Territorial seas” is defined as the portion of water between the coast, “extending seaward a distance of three miles.” 226 The “contiguous zone” is defined in accordance with the Convention on the Territorial Sea and the Contiguous Zone, 227 and consists of the area three and twelve miles from the coast. 228 Finally, “ocean” is defined as “any portion of the high seas beyond the contiguous zone.” 229 The upshot, then, is that the act covers any discharge of a pollutant from a point source up to three miles offshore, and covers any discharge of a pollutant beyond three miles except those discharged from a vessel or floating craft.

The CWA exhibits the same jurisdictional limitation as the London Convention and MPRSA – it covers discharges into “waters” and the “high seas,” and nowhere makes mention of covering discharges underneath the seabed. As a result, it seems unlikely to cover offshore CCS conducted beneath the seabed.

Nevertheless, Congress or the relevant agencies can and should clarify the CWA and MPRSA should it decide that offshore sequestration presents an attractive option. Congress should make clear that a permit granted by MMS shall satisfy the requirements of the MPRSA and CWA. Failure to do so will mean that companies considering embarking on offshore sequestration may refrain to do so from fear of penalties under the CWA and MPRSA – there is enough doubt over the application of the MPRSA and CWA to subseabed sequestration that

224 Id. § 1362(12).
225 Id. § 1362(7).
226 Id. § 1362(8).
227 Id. § 1362(9).
228 Convention on the Territorial Sea and the Contiguous Zone Art. 24 ¶ 2 (“The contiguous zone may not extend beyond twelve miles from the baseline from which the breadth of the territorial sea is measured.”)
Congress should clarify that such sequestration does not give rise to liability under those statutes.230

**C. Federal Taking Of Regional Repositories**

1. **Overview**

Here, the federal government would use its power of eminent domain to take sufficient land for large-scale, regional repositories.231 Ideally, these would be strategically placed around the country (for instance, in the Northwest, Southwest, Texas, Great Plains, Northeast and South). It would be optimal to take a variety of geological formations, so as to generate useful data concerning the feasibility, benefits and obstacles of sequestration in the various formations (e.g., sequestration should be attempted in deep saline aquifers, unmineable coal seams and depleted oil and gas wells). Moreover the federal government could use land it already owns as the nucleus of the repository, at least west of the Mississippi, where it owns a substantial amount

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230 Other disadvantages also exist.

First, offshore sequestration is projected to be more expensive than onshore sequestration. In the oil and gas context, shallow offshore wells can cost four times as much as equivalent onshore wells; deep-water wells are even more expensive. IEA, KEY OPTION, supra note 1, at 89. McKinsey estimates that onshore storage costs will be 4-5 Euros per ton of carbon, while offshore storage costs will be 11-12 Euros per ton. MCKINSEY & CO., CARBON CAPTURE & STORAGE: ASSESSING THE ECONOMICS 20 (2008). While this may seem to counsel against engaging in offshore sequestration at all, these increased costs may be counterbalanced, if the federal government provides the repository space at low cost, and by the reduced risk of liability incurred offshore.

Second, at least in the Gulf of Mexico and the Southern Atlantic coast, CCS facilities will be at a risk of destruction from hurricanes. With respect to oil platforms and pipelines, “Hurricane Ivan in 2004 destroyed seven platforms in the Gulf of Mexico, significantly damaged 24 platforms, and damaged 102 pipelines. Hurricanes Katrina and Rita in 2005 destroyed more than 100 platforms and damaged 558 pipelines.” U.S. GLOBAL CHANGE RESEARCH PROGRAM, GLOBAL CLIMATE CHANGE IMPACTS IN THE UNITED STATES 57 (2009). This may counsel in favor of locating offshore CCS facilities off of the Northeast or West Coasts rather than in more hurricane-prone regions.

231 The Harvard Law School Emmett Environmental Law and Policy Clinic advocates this approach. JACOBS ET. AL., supra note 2, at ii.
of land. Even if some private land had to be taken to round out the repository, this would be a cheaper and perhaps more politically palatable option than taking an entire repository.

The mechanics of the federal taking could operate in at least two different ways.

First, Congress could fund and authorize an agency to utilize the power of eminent domain to acquire the relevant land.

Second, Congress could directly take the land. As the Supreme Court has remarked:

Congress occasionally exercises the power of eminent domain directly. For example, when Congress thinks that a tract of land that it wishes to preserve inviolate is threatened with imminent alteration, it sometimes enacts a statute appropriating the property immediately by ‘legislative taking’ and setting up a special procedure for ascertaining, after the appropriation, the compensation due to the owners.

An example of this procedure is found in 16 U.S.C. § 79c(b), which “vested in the United States all right, title, and interest in, and the right to immediate possession of, all real property within the area indicated as ‘Proposed Additions’ on the map entitled ‘Additional Lands, Redwood National Park, California.’” This act requires the Secretary of the Treasury to pay just compensation to owners whose property rights are taken. Property owners can file suit in the district court where the property was located to recover just compensation, or the United States can initiate proceedings for determining just compensation pursuant to 28 U.S.C. §§ 1358, 1403.

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232 NAT’L ENERGY TECH. LAB., DEP’T OF ENERGY, STORAGE OF CAPTURED CARBON DIOXIDE BENEATH FEDERAL LANDS ES-1 (2009) (“[T]he vast majority of Federal lands are west of the Mississippi. . . .”); see also id. at ES-2 (map showing federally owned land).
233 “An officer of the Federal Government authorized to acquire real estate for the erection of a public building or for other public uses may acquire the real estate for the Government by condemnation, under judicial process, when the officer believes that it is necessary or advantageous to the Government to do so. The Attorney General, on application of the officer, shall have condemnation proceedings begun within 30 days from receipt of the application at the Department of Justice.” 40 U.S.C. § 3113.
236 Id. § 79c(b)(2).
After the federal government has acquired this land, it would make arrangements with private entities to conduct sequestration in these regional repositories. Because the federal government owns this land, such arrangements should be able to be made in a fairly straightforward fashion, although certain requirements must be followed when leasing federal land. 237

2. Advantages

First, this option would allow for centralized planning of the types and locations of repositories. This would enable the federal government to ensure that various types of geological formations can be utilized, in order to develop information about the efficacy of each repository type. This would also allow for strategic location of repositories, enabling them to serve each region of the country. Moreover, such planning would allow for regional “hub and spoke” networks to be developed that would minimize the amount of pipeline necessary to transport large volumes of carbon dioxide to the sequestration site, thus minimizing costs. 238

If private interests were to select the sites, they would likely pick those that (a) are easiest to develop into sequestration sites (likely depleted oil and gas wells, given that large amounts of geological data are already known about those sites) (b) easiest to acquire (especially if they are not granted the power of eminent domain and need to acquire the land via negotiation) and (c) located nearest areas producing large quantities of CO2. This may lead to sub-optimal repository locations and a lack of experimentation with a variety of repository types.

237 For instance, Bureau of Land Management has a specific leasing process, and the National Environmental Policy Act would apply to projects on leased land. NAT’L ENERGY TECH. LAB., supra note 232, at 20-24.

238 See IEA, KEY OPTION, supra note 1, at 16 (noting that “[r]egional ‘hub and spoke’ network structures would be the most efficient way of connecting many emitting nodes to large storage sites.”).
Second, this option could move forward with relative speed. It is likely to arouse much less opposition and litigation than a declaration of ownership over the entire subsurface. All Congress would need to do is provide funding and authorization for an agency to carry out the taking, or enact legislation that affects a legislative taking. Moreover, utilization of eminent domain for CO\textsubscript{2} storage falls squarely within the province of the traditional purpose of eminent domain. As one scholar notes:

A public interest finding for carbon dioxide storage provides the same underlying basis for ranking community interests above individual property rights as in other infrastructure projects benefiting the broader community and could justify some form of condemnation of a reservoir’s pore space interests (and surface interests) in order to obtain a geologic storage site satisfactory for the storage of anthropogenic CO\textsubscript{2}.\textsuperscript{239}

3. Disadvantages

First, this option will require the federal government to pay just compensation for acquiring the land.\textsuperscript{240} It is unclear what value, if any, the various potential subsurface repository sites will have.\textsuperscript{241} However, it would be possible for Congress to provide that an agency, via regulation, could establish the default rate of compensation.\textsuperscript{242}

\textsuperscript{239} Philip M. Marston & Patricia A. Moore, From EOR to CCS: The Evolving Legal and Regulatory Framework For Carbon Capture and Storage, 29 ENERGY L. J. 421, 485 (2008).

\textsuperscript{240} The federal government could attempt to recoup such costs in leasing arrangements with private entities. However, this would likely be an unwise decision – such an action could deter sequestration entities from engaging in sequestration. From the perspective of encouraging nascent industries, having the federal government pay the cost of the taking could easily be perceived as a benefit, rather than a disadvantage.

\textsuperscript{241} At least one author has suggested that such compensation may be minimal:

In common law, pore spaces may not have any value to a property owner unless the owner has an investment-backed, reasonably foreseeable expectation of using the deep pore spaces at the time of the invasion. The government’s use, or authorization of use, of pore spaces will infringe upon the owner’s right to exclude others, but if the pore spaces have no value and provided the owner cannot demonstrate investment-backed
expectations of using the pore spaces, then the taking of pore-spaces may require only nominal compensation.


Klass & Wilson agree that this may sometimes be the case:

Ultimately, to the extent CO₂ sequestration is sought in private subsurface areas in which there are already private commercial uses for natural gas storage, oil and gas development, or other uses, the costs of obtaining rights to the subsurface by eminent domain may be significant. In other cases though, where the geologic formation is appropriate for CO₂ sequestration but is not appropriate for other, existing commercial uses, the costs associated with acquiring that property may be no more than the one dollar ultimately awarded to the apartment owners in Loretto, or even zero. Thus, even if one assumes that all surface owners have protectable property interests to the center of the earth, the amount of compensation owed may be next to nothing or nothing in some of those cases. As a result, there may well be a sliding scale of compensation for subsurface pore space based not on the existence of a property right, but on the value of that right based on the existing or reasonably foreseeable uses of the pore space.

Klass & Wilson, supra note 34, at 422.

Even in the case of natural gas storage facilities, a much more developed industry than CCS, courts have struggled with determining the appropriate amount of just compensation to award condemnees:

It may fairly be said that there are no true ‘comparables’ in dealing with underground storage reservoirs. There are relatively few such properties in the state, and those noted by the experts involved different geographical locations, temporal transactions, and physical characteristics. In normal circumstances this would preclude the use of a comparable sales approach. But it is clear that underground storage properties are sui generis and that normal approaches to valuation are problematical. For this reason latitude must be accorded an expert in valuing such properties, and any approach that is ‘just and equitable’ may be considered.


See JACOBS ET. AL., supra note 2, at iii, 11; Klass & Wilson, supra note 34, at 422 (“One option is for Congress to create a presumption regarding just compensation similar to that suggested above for defining a property right in the first place. Thus, Congress could create a presumption that subsurface pore space has no value, and consequently no compensation is due, but give property owners the opportunity to rebut that presumption . . . .”); Flatt, supra note 40, at 239 (“The EPA, as the proposed CCS regulatory agency, could promulgate regulations establishing the method for determination of fair market value.”); CCSREG PROJECT, supra note 44, at 64 (arguing that the amount of just compensation could be specified by
Second, if CCS proves to be a successful activity, the cost of subsurface land for CCS activities will rise dramatically. In the status quo, the cost is minimal because there is thought to be little use for subsurface repositories of the kind that would be used for CCS. Once it is known that this is a viable activity, the price will rise. As a result, the future costs of CCS will increase. By contrast, if the federal government were to simply assert dominion over all the subsurface, it would be able to acquire this land before any cost increases could occur. This would enable the government to subsidize CCS activities to a greater extent, because it could decide to lease land at rates much cheaper than a private entity would.

Third, if CCS proves to be a successful activity, this course of action does not resolve any of the fundamental issues with respect to property ownership and liability. As a result, when more repositories are required, the states or the federal government will still have to grapple with all of the problems raised above. (Note, however, that this may be beneficial to the extent that it allows for state experimentation with alternative arrangements).

D. Granting Private Sequestration Entities the Power of Eminent Domain

1. Overview

Instead of utilizing eminent domain itself, the federal government could grant CCS entities the power of eminent domain, limited to the purpose of securing subsurface space for sequestration. Such a grant of authority has precedent at the federal level in the Natural Gas Act (NGA), and at the state level, with respect to CCS specifically, in the Louisiana Geologic legislation or regulation and could be de minimis. For a discussion of the legality of such a scheme, see infra Part III.F. }24315 U.S.C. §§ 717-717w.

- 61 -
Sequestration of Carbon Dioxide Act. These statutes provide that private entities, once authorized by a governmental entity, may condemn land necessary for constructing pipelines and storage facilities.

At the federal level, the NGA grants natural gas companies the power of eminent domain to secure “the necessary land or other property . . . for the location of . . . stations or equipment necessary to the proper operation” of natural gas pipelines. Courts have determined that the plain language of this provision covers underground natural gas storage facilities as necessary incidents to “the overall function of supplying natural gas to the consuming public.”

However, the NGA’s condemnation authority is only available if two conditions exist. First, eminent domain authority is only available if the company “cannot acquire by contract, or is unable to agree with the owner of the property to the compensation to be paid.” Second, the company must already hold a “certificate of public convenience and necessity,” which the NGA requires for any construction or expansion of natural gas facilities. Certificates are issued by the Federal Energy Regulatory Commission (FERC) and can only be granted if the applicant demonstrates that three conditions are met: (1) it can and will “perform the service proposed,” (2) it will conform to the requirements of the NGA and FERC regulations, and (3) the proposed

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244 LA. REV. STAT. ANN. tit 30, ch. 11.
248 Id. § 717f(c)(1)(A).
activity “is or will be required by the present or future public convenience and necessity.”

FERC may condition the grant of the certificate – and thus presumably the associated eminent
domain power – on “such reasonable terms and conditions as the public convenience and
necessity may require.” This conditioning authority gives FERC substantial authority to
restrict the location of approve facilities. Various scholars have advocated for the power of
eminent domain, based on the Natural Gas Act, to be granted to CCS entities.

At the state level, one state – Louisiana – has already granted CCS entities the power of
eminent domain, subject to oversight by the Commissioner of Conservation. Similar to the
NGA, storage operators must acquire a certificate of public convenience from the Commissioner
before they may use the power of eminent domain. Before such a certificate may issue, the
Commissioner must find that the reservoir proposed to be used to store CO₂ is “suitable and
feasible for such use.”

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249 Id. § 717f(e).
250 Id.
251 See, e.g., Columbia Gas Transmission Corp., 776 F.2d at 127 (holding certificate for an underground
gas storage pool delineated by a map did not authorize condemnation of subsurface outside the map area,
even if alleged to be connected to the authorized pool); Kern River Gas Transmission Co. v. Clark
County, 757 F. Supp. 110, 1113 (D. Nev, 1990) (noting FERC certificate for a natural gas pipeline was
limited to a one-mile corridor, and any departure from the approved corridor would require additional
FERC approval).
252 Klass & Wilson, supra note 34, at 426-27; Reisinger et. al., supra note 106, at 35 (“[L]egislation
should also establish eminent domain as a viable option for the gathering of subsurface sequestration and
storage rights under a public use theory.”); THE INTERSTATE OIL & GAS COMPACT COMM’N, STORAGE
propose the required acquisition of these storage rights and contemplates use of state natural gas storage
eminent domain powers or oil and gas unitization processes to gain control of the entire storage
reservoir.”).
254 Id. (“Any storage operator is hereby authorized, after obtaining any permit and any certificate of public
convenience and necessity from the commissioner required by this Chapter, to exercise the power of
eminent domain and expropriate needed property to acquire surface and subsurface rights and property
interests necessary or useful for the purpose of constructing, operating, or modifying a storage facility and
the necessary infrastructure . . . .”)
255 Id. § 30:1104(C)(1).
2. Advantages

First, this option prevents holdout landowners from blocking a CCS site by enabling the sequestration entity to simply take the land if negotiations are unsuccessful.\textsuperscript{256} Note, however, that there would still be uncertainty over who is entitled to compensation – the surface owner, entities with subsurface interests, or both.\textsuperscript{257} This uncertainty may counsel in favor of adopting procedures that require the condemnee, rather than the condemnor, to initiate proceedings in federal court to receive just compensation, with the condemnee bearing the burden of proof to show that state law grants the condemnee a property interest in the pore space.\textsuperscript{258}

Second, such an option makes private entities, rather than the federal government, the primary decisionmakers with respect to where to conduct CCS activities. To the extent that one believes that private entities, operating in market conditions, are better than the government at making decisions about the most cost-effective locations to conduct sequestration operations, this will provide for cheaper sequestration.

Third, this would entail minimal costs to the government. The private entity, rather than the state, would pay the required just compensation.\textsuperscript{259} The government would bear the

\textsuperscript{256} Anderson, supra note 38, at 108 (“If a party seeking to sequester CO\textsubscript{2} had the power of eminent domain, then no ‘owner,’ whether surface or mineral, would be able to prevent a sequestration project.”).


\textsuperscript{258} The CCS Reg Project, in its recently released model legislation, has proposed a similar approach. Under its approach, a sequestration entity could apply for a federal “pore space permit.” CCS REG PROJECT, MODEL LEGISLATION: THE CARBON CAPTURE & SEQUESTRATION REGULATORY ACT OF 2010, at § 323(c) (2010). The regulatory entity in charge of granting such permits would publish in the Federal Register a notice of the application, and afford a period of 60 days for holders of preexisting interests to intervene. \textit{Id.} If an interested party did not intervene, it “shall be deemed to have waived any and all rights and property interests that become impaired by the project.” \textit{Id.} § 323(c)(2)(A).

\textsuperscript{259} As discussed, supra Part II.B, this may be perceived as a disadvantage. Moreover, it would still be possible for Congress or an agency to set a default rate of compensation. \textit{See supra} note 242 and accompanying text.
relatively minimal costs of issuing a certificate public convenience to sequestration entities, along with any related oversight and monitoring costs.

Fourth, as discussed above, there is substantial precedent for this type of legislation at both the state and federal level. As a result, from a political and legal standpoint this would be potentially the easiest form of legislation to pass.

3. Disadvantages

First, this does not subsidize sequestration entities to the same extent as is if the federal government engaged in site selection and acquisition of the relevant property rights. Even if the federal government grants private entities the power of eminent domain, property acquisition costs, combined with the other technical and regulatory uncertainties and the lack of a price on carbon emissions may still prevent any sequestration from occurring.

Second, this option reduces the government’s ability to determine where CCS and in what type of repository sequestration activities should take place. The government would still retain some influence since it may impose conditions on the certificate of public convenience, but it would not have complete control over site selection. As a result, as discussed above, companies may engage in sequestration in depleted oil and gas reservoirs. To the extent that this takes place to the exclusion of sequestration in deep saline aquifers and unmineable coal seams, it would represent a lost opportunity to develop knowledge and experience with respect to sequestration in those alternate repository types. As a result, it may be preferable for the government to select and acquire the initial demonstration sites, with private entities becoming responsible for site selection only when CCS becomes commercially viable.

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260 See supra notes 243-245.
Third, granting private entities the power of eminent domain can raise fairness considerations, and the specter of CCS entities engaging in illegitimate takings out of self-interest. As a result, should it choose this option the federal government may want to maintain oversight of the exercise of eminent domain power by granting narrow certificates of public convenience.

E. Granting Private Sequestration Entities The Power Of Unitization

Another option is to grant private sequestration entities the power of unitization, a feature common in various state oil and natural gas regulatory schemes. Under this approach, a sequestration entity would first secure some minimum threshold of the relevant repository through negotiations with property owners (usually between 51 and 80 percent). After securing this threshold amount, the operator can then compel any non-consenting property owners to join the unit, which is then operated as one large pool. However, in states with high threshold percentages, unitization is a difficult and often drawn-out process. As a result, to the extent that unitization is considered appropriate, the percentage rate should be as low as possible (51%).

Some states have passed legislation providing for unitization in the CCS context. For instance, North Dakota allows for unitization if the sequestration entity has acquired at least “sixty percent of the storage reservoir’s pore space,” and the industrial commission approves

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261 PARFOMAK, supra note 38, at 17.
262 Marston & Moore, supra note 239, at 476-77; PARFOMAK, supra note 38, at 17.
263 PARFOMAK, supra note 38, at 17-18.
unitization. Wyoming law also allows for unitization, but requires the sequestration entity to acquire the consent of the property owners of 80% of the storage capacity – likely a tall order. Other states, however, have declined to include unitization or eminent domain provisions in their CCS legislation. Oklahoma, for example, passed a law providing granting state agencies broad authority to establish permit conditions for CCS facilities. However, the act explicitly declines to grant the right of condemnation to sequestration entities, and contains no provision for unitization. Similarly, West Virginia law does not appear to grant sequestration entities the power of eminent domain or compulsory unitization.

The legal authority for such statutes is the state’s general police power. This power is unavailable to the federal government. At first glance, then, it would seem that the federal government would be unable to enact a unitization scheme. However, it should be possible to create a modified variant, based on the federal government’s power of eminent domain. Rather than compelling non-consenting unit members to participate in the unit once a certain consent

265 Id. § 38-22-10.
266 WYO. STAT. ANN. § 35-11-316(c) (2010). The percentage of property required can be reduced to 75 under if the sequestration entity has negotiated in good faith with the relevant property owners for at least nine months. Id.
267 OKLA. STAT. tit. 27A § 3-5-104(C) (2009).
268 Id. § 3-5-106(D) (2009) (“Nothing in this act shall grant a private operator the right of condemnation or eminent domain for any purpose.”).
269 Id. § 3-5-101(C)(2) (2009) (“In the event the State of Oklahoma establishes a unitization process to support the establishment of CO2 sequestration facilities in this state, the Corporation Commission shall regulate all aspects of such process . . . .”).
272 United States v. Morrison, 529 U.S. 598, 617 (2000) (“[W]e can think of no better example of the police power, which the Founders denied the National Government and reposed in the States, than the suppression of violent crime and vindication of its victims.”) (emphasis added); United States v. Lopez, 514 U.S. 549, 566 (1995) (“The Constitution mandates this uncertainty by withholding from Congress a plenary police power that would authorize enactment of every type of legislation.”).
threshold has been reached, a federal unitization statute would simply grant a condemning authority the power of eminent domain for the limited purpose of acquiring any non-consenting owners’ pore space within the unit. Given that this is essentially a conditional grant of eminent domain authority, there should be no legal barrier precluding such an option.  

Under this modified approach, the benefits and disadvantages of unitization are similar to that of granting private entities the power of eminent domain. The primary difference is that a unitization scheme is more protective of private property interests – given that a certain number of landowners must consent to the project before it may move forward, sequestration entities will have to bargain with property owners to secure the necessary threshold, rather than simply being able to condemn the property they need. While this is advantageous for landowners, and may deter ill-advised site selection, it could also entail substantial delays and negotiation costs, especially if a high consent threshold is established.

**F. Establishing a Default Rate of Compensation & Its Associated Procedure For Eminent Domain**

As was noted above, it should be possible for Congress to establish a default rate of compensation (or delegate such a power to an agency) in instances where eminent domain is utilized to acquire pore space. While several commentators have asserted this proposition, none appears to have extensively investigated the legality of such an approach. This is problematic, as there is language from the Supreme Court that could be interpreted as invalidating this option: “The ascertainment of compensation is a judicial function, and no power exists in any other

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273 See Marston & Moore, supra note 239, at 478 (“This aspect of compulsory unitization is somewhat analogous to the condemnation of property for underground storage, except that the interests that are included do not lose their property interest, but rather participate in the unit operations as if all owners had agreed to the project.”).

274 See supra note 242.
department of the Government to declare what the compensation shall be or to prescribe any
binding rule in that regard.”\textsuperscript{275} This section discusses the legality of establishing a default, \textit{de
minimis} rate of just compensation and placing the burden of proof on a landowner challenging
that rate to show that a higher rate of compensation is due. The section also suggests a
procedural framework for such a process. There are several lines of precedent indicating that
such a scheme would be upheld by the courts.

First, the Supreme Court has strongly implied that such a method of determining just
compensation would be constitutional. In \textit{Loretto v. Teleprompter Manhattan CATV Corp.}\textsuperscript{276} at
issue was a New York law providing that a landlord must permit a cable television company to
install cable facilities on the landlord’s premises.\textsuperscript{277} The case ultimately held, as a \textit{per se} rule,
that whenever a physical intrusion takes the form of “permanent physical occupation, a taking
has occurred.”\textsuperscript{278} The Court mentioned that the statute at issue delegated authority to the state
commission to determine the default rate of just compensation for any taking that might occur
from installation of cable facilities, which the commission determined to be a nominal, one-time
payment of $1 “in the absence of a special showing of greater damages attributable to the
taking.”\textsuperscript{279} The dissenters noted that “[h]appily, the Court leaves open the question whether [the

\textsuperscript{275} United States v. New River Collieries Co., 262 U.S. 341, 343-44 (1923); \textit{see also} United States v.
Sioux Nations of Indians, 448 U.S. 371 (1980) (“The Court of Claims’ present formulation of the test,
which takes into account the adequacy of the consideration given, does little more than reaffirm the
ancient principle that the determination of the measure of just compensation for a taking of private
property ‘‘is a judicial and not a legislative question.’”’) (quoting Monongahela Navigation Co. v. United
States, 148 U.S. 312, 327 (1893)); United States v. Commodities Trading Corp., 339 U.S. 121, 125 n3
(1950) (“Had Congress prescribed a rule that prices fixed under the Act should constitute the measure of
constitutional ‘just compensation,’ courts upon proper challenges would have been faced with
responsibility of determining whether that rule satisfied the requirements of the Fifth Amendment.”).
\textsuperscript{276} 458 U.S. 419 (1982).
\textsuperscript{277} \textit{Id.} at 421.
\textsuperscript{278} \textit{Id.} at 426.
\textsuperscript{279} \textit{Id.} at 423-24.
law] provides landlords like appellant sufficient compensation for their actual losses. After *Loretto*, several state courts upheld statutes establishing nominal default rates of compensation for cable installation takings.  

Second, at least two circuits have held initial determinations of just compensation by federal agencies to be constitutional, so long as judicial review is available. In *Wisconsin Central Limited v. Public Service Commission of Wisconsin*, the Seventh Circuit noted that:

> The railroads are quite correct that a decision concerning the just compensation owed one whose property is taken is the province of judicial not legislative – determination. However, . . . this requirement is satisfied by the availability of judicial review. The *Fifth Amendment* does not require a judicial determination of just compensation in the first instance on each occasion of a taking of private property.

Similarly, the Eleventh Circuit in *Gulf Power Co v. United States* noted that:

> [T]he fact that our constitutional scheme dictates that the judicial branch is entrusted with the ultimate responsibility for ensuring that just compensation is awarded does not mean the other branches of government must be excluded from the process of determining the proper level of just compensation. . . . While a process in which the judicial branch does not make the final determination of what constitutes just compensation may be constitutionally inadequate, we see no constitutional problem with a process that employs an administrative body, such as the FCC, to determine just compensation in the first instance.

No federal appellate courts have reached the opposite conclusion.

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280 *Id.* at 456 n.12 (Blackmun, J., dissenting).
282 95 F.3d 1359, 1369 (7th Cir. 1996) (internal citations omitted).
283 187 F.3d 1324, 1333 (11th Cir. 1999).
Third, a federal appellate court has held that if Congress sets a default rate of interest, which constitutes an essential component of just compensation,\(^{284}\) that default rate is applicable unless the condemnee makes a showing that a higher interest rate is justified in the particular case.\(^{285}\)

Fourth, at the state level, Florida’s Supreme Court has upheld a form of default compensation in the context of destruction of infected plants.\(^{286}\) In 1984, a form of citrus canker was discovered in Florida.\(^{287}\) Fearing that the disease would devastate the citrus industry, the Department of Agriculture and Consumer Services began a program to eradicate citrus cankers.\(^{288}\) The law promulgated to implement this program provided that owners would be given a default amount of compensation for the destruction of plants; if they were unsatisfied with this amount, they could request an administrative hearing to determine the amount of just compensation.\(^{289}\) The hearings were subject to appellate review.\(^{290}\)

The Supreme Court of Florida rejected challenges to the default schedule of compensation that the act established. The court first noted that “[i]t is true that the legislature may not set conclusive values for property taken for a public purpose because the determination of just compensation is a judicial function.”\(^{291}\) Nevertheless, the court held that the legislature did not infringe on this judicial function because “the presumptive values set forth in chapter 89-

\(^{284}\) See Library of Congress v. Shaw, 478 U.S. 310, 317 n.5 (1986) (“The ‘constitutional requirement’ arises in a taking under the Fifth Amendment. To satisfy the constitutional mandate, ‘just compensation’ includes a payment for interest.”)

\(^{285}\) United States v. 50.50 Acres of Land, 931 F.2d 1349, 1355 (9th Cir. 1991) (“[T]he court must first determine if the statutory formula is constitutionally inadequate given the factual circumstances of the case. The court should receive evidence from each side and consider a variety of investment measures. If the court finds the statutory formula to be inadequate, it must then determine the appropriate rate to be used.”) (internal citations omitted).

\(^{286}\) Dep’t of Agric. & Consumer Servs. v. Bonanno, 568 So. 2d 24 (Fla. 1990).

\(^{287}\) Id. at 26.

\(^{288}\) Id.

\(^{289}\) Id. at 27.

\(^{290}\) Id.

\(^{291}\) Id. at 31.
91 are not conclusive, but are rebuttable presumptions. The owner may come forth with evidence showing that in that particular case, those presumptive values would not provide just compensation. Thus, the Bonanno court’s holding supports the constitutionality of a default rate of condemnation with respect to subsurface space.

Finally, all of these decisions are in accordance with the general principle that the condemnee bears the burden of proof in determining the value of just compensation. As a result, it should be constitutional for Congress to establish a default rate, or delegate power to establish a default rate to the legislature, so long as judicial review is available.

Procedurally, the best way to implement this process is as follows. The condemning entity should be required to initiate an informal proceeding in front of an administrative body, in which it would outline the property it is proposing to acquire, demonstrate that it has sufficient statutory authority to engage in such a taking, and provide sufficient notice to the relevant landowners (in the form of both individualized notice through the mail and generalized publication). If the affected landowners do not request a hearing, within a certain period of time (perhaps 60 or 90 days), from the publication of notice, they should be conclusively deemed to have waived their right to challenge the default rate of condemnation established by the agency (or by Congress). If the landowner does challenge the proceeding, the agency, operating under the formal adjudication provisions of the Administrative Procedure Act, should determine the

292 Id.
293 See United States ex rel. TVA v. Powelson, 319 U.S. 266, 273 (1943) (“The burden of establishing the value of the lands sought to be condemned was on respondent [landowner/condemnee].”); Bd. of County Supervisors of Prince William County v. United States, 276 F.3d 1359, 1364 (Fed. Cir. 2002) (condemnee has “the burden of establishing the value” of the taken property.”); United States v. 4.0 Acres of Land, 175 F.3d 1133, 1140 (9th Cir. 1999) (“The property owner bears the burden of proving the value of the condemned land.”); United States v. 69.1 Acres of Land, 942 F.2d 290, 292 (4th Cir. 1991) (“The burden of proving the value of the land taken is on the landowner.”).
294 “Informal” here is utilized in contrast to the “formal” adjudication provisions of the APA.
proper value of compensation available in the first instance, with an appeal to a federal appellate
court available. This procedure is the optimal method of ensuring compliance with the due
process clause while minimizing costs to the condemning entity.

This approach is similar to that proposed by the CCSReg Project. Under its approach, a
sequestration entity could apply for a federal “pore space permit.”\textsuperscript{296} The regulatory entity in
charge of granting such permits would publish in the Federal Register a notice of the application,
and afford a period of 60 days for holders of preexisting interests to intervene.\textsuperscript{297} If an interested
party did not intervene, it “shall be deemed to have waived any and all rights and property
interests that become impaired by the project.”\textsuperscript{298} If an interested party does intervene, the
regulatory entity must determine whether it is demonstrated that a preexisting interest would be
materially impaired by the granting of a CO\textsubscript{2} injection permit.”\textsuperscript{299} A “pre-existing interest” is
defined as an interest in subsurface activities that is a “non-speculative economic interest,”
defined as an activity that has “current or imminent . . . substantial economic value.”\textsuperscript{300} If such a
material impairment is shown, the pore space permit may only be issued if the entity seeking a
permit acquires the property, via contract or eminent domain.\textsuperscript{301} If the entity opts for eminent
domain, the proceedings are to occur in federal court.\textsuperscript{302}

There are three primary distinctions between the approach advocated here, and that of the
CCSReg Project. First, the notice required by the Project’s proposed statute is likely
constitutionally deficient. Second, the Project does not discuss the procedures required to
determine whether a pre-existing interest will be materially impaired, thus triggering the

\textsuperscript{296} CCS REG PROJECT, supra note 258, at § 323(c).
\textsuperscript{297} Id. § 323(c).
\textsuperscript{298} Id. § 323(c)(2)(A).
\textsuperscript{299} Id. § 323(d)(1).
\textsuperscript{300} Id. §§ 322(b), (d).
\textsuperscript{301} Id. § 323(d).
\textsuperscript{302} Id. § 323(e)(1).
requirement for eminent domain proceedings or other means of securing the property. Such a procedure will likely need to approximate that provided by the formal adjudication procedures of the APA to satisfy constitutional requirements. Finally, the Project provides that a federal district court, rather than the agency overseeing CCS activities, make the determination of just compensation in the first instance. For reasons of efficiency, the agency, rather than the courts, should make the first determination of just compensation.

Simply publishing notice to impacted landowners in the Federal Register is likely to be constitutionally insufficient. In *Walker v. City of Hutchinson*, the Court made clear that “due process requires that an owner whose property is taken for public use must be given a hearing in determining just compensation. The right to a hearing is meaningless without notice.” The Court went on to find that posting notice of a condemnation proceeding solely in a newspaper was constitutionally insufficient, noting that “[i]t is common knowledge that mere newspaper publication rarely informs a landowner of proceedings against his property.” This holding was reaffirmed in *Schroeder v. City of New York*, which articulated that mailing a letter to the condemnee would have discharged the notice obligation. It seems unlikely that the Federal Register will be more likely to inform a property owner of a condemnation proceeding than a local newspaper publication. As a result, such a procedure, standing on its own, will likely fail to meet the notice requirement of due process. Instead, a the statute establishing the condemnation proceeding should require that, whenever possible, individual notice should be

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304 *Id.* at 116.
306 The *Walker* court did note that the “notice required will vary with circumstances and conditions. We recognize[] that in some cases it might not be reasonably possible to give personal notice, for example where people are missing or unknown.” *Walker*, 352 U.S. at 115-16.
sent to the condemnee via the mail, in addition to requiring publication in the Federal Register and perhaps, a local newspaper.

Second, the adjudicatory agency ought to follow the formal adjudication procedures of the APA once a condemnee has asserted his right to compensation. It is clear that an individual has a due process right to a hearing, should they choose to challenge the amount of compensation offered by the condemning entity. Such a due process right should also pertain to this threshold decision of whether a “taking” has in fact occurred. In order for this decision to preclude additional litigation against the taking party, it must meet minimum due process standards. This position is roundly supported by the Supreme Court’s analysis of the preclusive effect of agency decisions. The Court has made clear that “[w]hen an administrative agency is acting in a judicial capacity and resolves disputed issues of fact properly before it which the parties have had an adequate opportunity to litigate, the courts have not hesitated to apply res judicata to enforce repose.”  What is key is that the parties must have had an “adequate opportunity to litigate.” If there is no such opportunity, the decision of the agency may be reexamined in subsequent judicial proceedings. As a result, the initial administrative determination will be of little value – individuals will be able to challenge the condemnation in subsequent proceedings.

Unfortunately, “[i]t is difficult to state a general formula to capture the essential elements of adjudicatory procedure that may entitle administrative decisions to preclusion effects in subsequent judicial proceedings.” What is clear, however, is that proceedings under the formal adjudication provisions of the APA satisfy such a requirement. The APA’s formal adjudication provisions prescribe a hearing, on the record, with the opportunity for both

308 18B C. Wright, A. & E. Cooper, Federal Practice & Procedure, § 4475 (2009)
309 5 U.S.C. §§ 554(b), (c), 556.
sides to present argument and evidence,\textsuperscript{311} and cross examine adverse witnesses,\textsuperscript{312} with the assistance of counsel,\textsuperscript{313} in front of an impartial decisionmaker,\textsuperscript{314} who must explain the reasons for his decision.\textsuperscript{315}

Finally, the agency should make the initial determination in instances where condemnation is challenged by the landowner. The agency is likely to have greater expertise, and may be able to resolve the issues in a more efficient fashion than the federal courts.\textsuperscript{316}

\section*{G. Clarifying Ownership Of Pore Space}

As discussed above, who owns the pore space varies from state to state, and in many instances is unclear.\textsuperscript{317} This is problematic, as it creates a difficulty in determining with whom a party needs to negotiate to acquire the rights to sequester CO\textsubscript{2}. Even if eminent domain were to be utilized, a lack of clarity with respect to pore space ownership will make it difficult to determine against whom condemnation procedures need to be initiated.\textsuperscript{318} Similarly, unitization requires identification of and negotiation with the relevant property interests before that process may move forward.\textsuperscript{319} As a result, regardless of which of the above solutions is adopted by Congress, clarification of the ownership of pore space is desirable.\textsuperscript{320}

\textsuperscript{310} \textit{Id.} § 556(e).
\textsuperscript{311} \textit{Id.} § 556(d).
\textsuperscript{312} \textit{Id.}
\textsuperscript{313} \textit{Id.} § 555(b).
\textsuperscript{314} \textit{See id.} §§ 554(d), 557(d).
\textsuperscript{315} \textit{Id.} § 557(c).
\textsuperscript{316} \textit{See} Gulf Power Co. v. United States, 187 F.3d 1324, 1333 (11th Cir. 1999) (“Indeed, use of an administrative body with some technical expertise over the subject matter of the property to be valued likely will aid the judiciary in arriving at a more reliable determination of the proper level of just compensation.”).
\textsuperscript{317} \textit{Supra} notes 44, 46 and accompanying text.
\textsuperscript{318} \textit{Supra} notes 257-258 and accompanying text.
\textsuperscript{319} \textit{See supra} notes 261-262 and accompanying text.
\textsuperscript{320} The exception is if Congress were to declare dominion over the deep subsurface. In such an instance, clarification of ownership may actually be harmful, as it gives property owners a stronger case that their property is being taken.
Some states have passed legislation clarifying pore space ownership. For instance, North Dakota law provides that “[a] conveyance of title to the surface of real property conveys the pore space in all strata underlying the surface of the real property,”\(^{321}\) and that title to pore space may not be severed from the surface estate.\(^{322}\) Wyoming law also vests ownership of the pore space in the surface owner,\(^{323}\) but allows for severance.\(^{324}\) Montana law provides that if deeds or severance documents do not clearly indicate who owns the pore space, such ownership is vested in the surface owner.\(^{325}\)

These efforts on the part of state legislatures to clarify title to pore space should be encouraged, as they are likely to substantially reduce the number of relevant parties with which a sequestration entity much negotiate.\(^{326}\) Vesting ownership in the surface owner accords with those states that have drafted acts thus far\(^{327}\) as well as with the majority of commentators.\(^{328}\) Severance of the pore space from the surface estate should be permitted, so that sequestration

\(^{321}\) N.D. CENT. CODE § 47-31-04 (2010).
\(^{322}\) Id. § 47-31-05. This provision does not apply retroactively to transactions occurring before April 9, 2009, however. Id. § 47-31-07.
\(^{323}\) WYO STAT. ANN. § 34-1-152(a) (2010) (“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.”).
\(^{324}\) Id. § 34-1-152(b) (“A conveyance of the surface ownership of real property shall be a conveyance of the pore space in all strata below the surface of such real property unless the ownership interest in such pore space previously has been severed from the surface ownership or is explicitly excluded in the conveyance.”).
\(^{325}\) MONT. CODE ANN. § 82-11-180(3) (2009).
\(^{326}\) See Grave, supra note 257, at 97-98 (advocating that South Dakota adopt a pore space ownership law similar to that of Montana, North Dakota and Wyoming); Reisinger et. al., supra note 106, at 34 (“Legislation should further establish that the surface owner will retain ownership of all pore space not appropriated to the public. . . . As a direct property question, this is clearly legislation that individual state legislatures can develop and promulgate.”).
\(^{327}\) See supra notes 321-325 and accompanying text.
\(^{328}\) See supra note 326; see also THE INTERSTATE OIL & GAS COMPACT COMM’N, supra note 252, at 22 (advocating that “GS statutes and rules would best serve the public by . . . clearly identifying the surface owner as the person with the right to lease pore space for storage”). But see id. at 19-20 (discussing commentators who believe that ownership rights to the pore space should be vested in the mineral owners).
entities can acquire just the subsurface, but should be required to be unambiguous in its terms, to
prevent unnecessary confusion over who possesses title to the subsurface.

Given that determining who owns the pore space is a matter of state law, the role of the
federal government in this area is somewhat limited. The federal government cannot simply
decree that state legislatures adopt clarifying laws. In New York v. United States, 505 U.S. 144
(1992), the Court held unconstitutional a federal law requiring states to either dispose of its own
waste or take title to and possession of the waste. The Court held that “Congress may not simply
commandeer the legislative processes of the States by directly compelling them to enact and
enforce a federal regulatory program.” This makes it clear that any attempt to order the state
governments to alter their property laws would be unconstitutional.

However, the federal government could use its Spending Clause authority to condition
the receipt of certain federal funds on state’s adopting legislation clarifying the ownership of the
pore space. The foundational case of South Dakota v. Dole, 483 U.S. 203 (1987), upheld a
federal law withholding a portion of federal highway funding to states that did not increase their
legal drinking age to 21. At the same time, that case also articulated restrictions on Congress’s
use of the spending power:

The first of these limitations is derived from the language of the Constitution itself: the exercise of the spending power must be in pursuit of ‘the general welfare’ . . . Second, we have required that if Congress desires to condition the States’ receipt of federal funds, it must do so unambiguously . . . Third, our cases have suggested (without significant elaboration) that conditions on federal grants might be illegitimate if they are unrelated ‘to the federal interest in particular national projects or programs.’

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329 Supra note 45.
331 South Dakota v. Dole, 483 U.S. 203, 207. (1987); see also New York, 505 U.S. at 167 (“Such
conditions [on spending] must (among other requirements) bear some relationship to the purpose of the
federal spending . . . .”)
The most substantial of these restrictions is the third – that the condition bear some relationship to the federal interest in a particular program. However, given the widespread impact of climate change, and the relevance of CCS to mitigating those impacts, it should be fairly simple establish such a relationship with respect to vast areas of federal funding.

IV. Conclusion

Carbon capture and sequestration is anticipated to play an important role in reducing CO$_2$ emissions. However, before CCS may be implemented on any meaningful scale, certain legal barriers must be removed. One of those legal barriers involves the ability of sequestration entities to acquire sufficient property to conduct sequestration activities. There are a wide variety of approaches that the federal government, and the states, could take to resolve this issue. These approaches contain different risks, benefits, and require varying degrees of federal activity to implement. As a result, policymakers must engage in careful deliberation before selecting a particular solution to the property problem. Both academic and policymaking circles have yet to come to a consensus regarding the best options for resolving the property issues facing sequestration. Hopefully, this paper has provided a useful survey that can be used to help determine what option ought to be implemented by policymakers.