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A COOPERATIVE FEDERALISM FRAMEWORK FOR CCS REGULATION

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I. INTRODUCTION

Coal is the dominant energy resource used for power generation across the globe, and projections suggest this will remain the case for many years to come. According to the U.S. Energy Information Agency's (EIA) 2011 Annual Energy Outlook reference scenario, the amount of domestic electricity produced by burning coal continues to grow by 0.7 percent annually between 2009–2035.[1] Under this business-as-usual analysis, coal continues to dwarf other energy resources, including natural gas.[2] Even under the EIA's scenarios with more stringent environmental regulations and sustained low natural gas prices, "coal remains the largest single source of generation through 2035 in all but one of the cases" the EIA considered.[3]

While coal is an abundant, low cost domestic energy resource, it is also the most carbon-intensive of all of the fossil fuels. In the United States, coal-fired power plants are the single greatest source of anthropogenic carbon dioxide (CO_2), the most abundant greenhouse gas (GHG). Coal use accounts for approximately 34 percent of anthropogenic CO_2 emissions domestically and 20 percent globally.[4,5] Reducing GHG emissions from the energy sector through clean energy solutions is a necessary component of global emissions reduction, and leading climate change models and outlooks continue to recognize the

1. U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2011, Jan. 23, 2012, at 132 Table A8, *available at* http://www.eia.gov/forecasts/aeo/pdf/0383(2011).pdf.

2. *Id.*

3. *Id.* at 50.

4. Pew Center on Global Climate Change, *Coal and Climate Change Facts*, http://www.pewclimate.org/global-warming-basics/coalfacts.cfm (last visited August 8, 2011).

5. U.S. DEP'T OF ENERGY & NATIONAL ENERGY TECHNOLOGY LABORATORY, CARBON DIOXIDE CAPTURE AND STORAGE RD&D ROADMAP 5 (2010), *available at* http://www.netl.doe.gov/technologies/carbon_seq/refshelf/ CCSRoadmap.pdf [hereinafter CARBON DIOXIDE CAPTURE AND STORAGE RD&D ROADMAP].

important role of carbon, capture, and storage (CCS) in long-term mitigation of global CO_2 emissions.[6]

The amount of existing coal-fired infrastructure, the ongoing importance of coal to the nation's economy, the political support for the coal industry in the U.S. Congress, and the nation's need for stable, affordable baseload power generation all suggest that ability to capture carbon emissions and store them in underground geologic formations—a process commonly referred to as carbon, capture, and storage, or CCS—will likely be an important option for mitigating climate change.

CCS technology is important, not only for the United States, but also for developing countries as they address GHG emissions. China, for example, whose GHG emissions surpassed those of the United States in 2007, is expected to double its coal-fired generation in the next 20 years.[7,8] Without a viable option to capture and store emissions from its plants, China's other efforts to mitigate climate change will likely prove futile.

The Intergovernmental Panel on Climate Change estimates that 30 to 60 percent of all CO_2 emissions from electric power generation are suitable for capture.[9] Achieving anything close to this potential requires addressing numerous barriers currently preventing wide-scale deployment of CCS technologies. The barriers that tend to receive the most attention include the overall cost of the CCS process,[10] the need for more advanced

6. *See, e.g.,* INT'L ENERGY AGENCY, 2010 WORLD ENERGY OUTLOOK, EXECUTIVE SUMMARY 12 (2010), *available at* http://www.worldenergyoutlook.org/docs/weo2010/WEO2010_es_english.pdf; U.S. ENERGY INFO. ADMIN., ANNUAL ENERGY OUTLOOK 2010 81 (April 2010), *available at* http://www.eia.gov/oiaf/aeo/pdf/0383(2010).pdf; INT'L ENERGY AGENCY, TECHNOLOGY ROADMAP, CARBON CAPTURE AND STORAGE 1(2009), *available at* http://www.iea.org/papers/2009/CCS_Roadmap.pdf.

7. *See* Press Release, PBL Netherlands Environmental Assessment Agency, Global CO2 emissions: increase continued in 2007 (2008), *available at* http://www.pbl.nl/en/publications/2008/GlobalCO2emissionsthrough2007.

8. U.S. ENERGY INFO. ADMIN., INTERNATIONAL ENERGY OUTLOOK 2010 62 (2010), *available at* http://www.eia.doe.gov/oiaf/ieo/pdf/0484%282010%29.pdf.

9. BERT METZ ET AL. EDS., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SPECIAL REPORT: CARBON DIOXIDE CAPTURE AND STORAGE 22 (2005), *available at* http://www.ipcc-wg3.de/publications/special-reports/.files-images/SRCCS-WholeReport.pdf [hereinafter IPCC SPECIAL REPORT].

10. Cost estimates for capture, transport, and storage of CO2 vary widely from $15 to well over $100 per metric ton of CO2. *See, e.g.,* MCKINSEY AND COMPANY, CARBON CAPTURE AND STORAGE: ASSESSING THE ECONOMICS 32-33 (2008), http://origin.mckinsey.com/clientservice/sustainability/pdf/CCS_Assessing_the_Economics.pdf; MASS. INST. OF TECH., THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 91 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf; Howard Herzog, *The Economics of CO2 Capture and Storage*, Presented at the Second Int'l Symposium Capture and Geological Storage of CO2, Paris 2 (Oct. 5, 2007), *available at* http://www.colloqueco2.com/presentations2007/ColloqueCO2-2007_Session4_5-Herzog.pdf; Mohammed Al-Juaied & Adam Whitmore, Harvard Kennedy School Discussion Paper, *Realistic Costs of Carbon Capture*, at 32-33 (July 2009).

technologies to capture emissions,[11] and liability for long-term storage.[12]

In the United States, it will also be necessary to implement an appropriate legal structure to govern all three major phases of a CCS system—capturing emissions, transporting emissions, and sequestering emissions. The regulatory landscape as it stands now is a patchwork of state and federal regulations, with states taking the lead in many instances. Some existing federal environmental regulations will apply to CCS activities, including the Safe Drinking Water Act (SDWA), the National Environmental Policy Act (NEPA), and potentially the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)[13] and the Resource Conservation and Recovery Act (RCRA).[14] Legal uncertainties and differing legal standards could affect the manner, timing, and location of the build-out of carbon capture and storage networks.

Rather than allowing the legal framework for CCS to evolve in a piecemeal fashion, policymakers have the opportunity to think critically about the appropriate roles that each level of government should play. The significant cost projections for installing and operating CCS technologies indicate the desirability of a legal structure that encourages efficient system design. Given the existing regulatory approach to CCS and the legal challenges it still faces, it appears that a legal structure for CCS will likely best evolve within a cooperative federalism framework, with roles for the federal and state governments. This paper provides an overview of CCS and analyzes whether and how the issues are addressed under current law, reviews the history of cooperative federalism and how it may provide a framework to determine appropriate roles for federal and state governments, and applies that framework to the gaps in the CCS regulatory structure.

11. *See* MASS. INST. OF TECH., THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 84 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.

12. *See* Hart, Craig A., *Advancing Carbon Sequestration Research in an Uncertain Legal and Regulatory Environment: A Study of Phase II of the DOE Regional Carbon Sequestration Partnership Program*, DISCUSSION PAPER 2009-01, CAMBRIDGE, MASS.: BELFER CENTER FOR SCIENCE AND INTERNATIONAL AFFAIRS, 9 (Jan. 7, 2009).

13. Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. § 9601-9675 (2000).

14. Resource Conservation and Recovery Act, 42 U.S.C. § 6901 et. seq (2011).

II. CCS OVERVIEW

A. *The Science and Technology of CCS*

CCS generally refers to a three-step process by which CO_2 is captured at the source, transported, and sequestered in geologic formations underground, such as deep saline formations, oil and gas reservoirs, and unmineable coal seams.[15] The technology currently exists to perform all three of these functions.

At the capture phase of CCS, CO_2 is separated from the flue gas during energy production using a range of capture technologies. There are three major approaches to separating CO_2 from other gases: oxyfuel combustion, pre-combustion capture, and post-combustion capture. Capture of CO_2 from industrial gas streams has occurred since the 1930s in the natural gas industry and to produce food and chemical grade CO_2; however, the application of CO_2 capture to large power plants is relatively new, and the associated technologies are still developing.[16] Operating a capture system requires large amounts of energy; therefore, power plants with capture systems consume more fuel per unit of electricity generated than plants without capture.[17] This reduction in operating efficiency—referred to as an "energy penalty"—can reduce electricity output by as much as 30 percent, adding significant costs to power plants operating with CO_2 capture technologies.[18]

Transporting CO_2 in pipelines requires compressing the captured emissions under high pressure and converting them to a liquefied, supercritical state.[19] Currently, there are approximately 3,700 miles of CO_2 pipelines in the United States transporting 45 million metric tons of CO_2 annually—roughly the equivalent of CO_2 emissions from ten to fifteen midsized coal-fired power plants.[20]

The oil and gas industries have been injecting CO_2 into underground geologic formations to increase well production since the 1970s.[21] At the end of 2010, there were 114 of these

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15. *See* IPCC SPECIAL REPORT, *supra* note 9, at 60.
16. *Id* at 27.
17. CARNEGIE MELLON UNIVERSITY: CCSREG PROJECT, CARBON CAPTURE AND SEQUESTRATION: FRAMING THE ISSUES FOR REGULATION 18 (2008), *available at* http://www.aiche.org/uploadedFiles/FSCarbonMgmt/Resources/CCSReg_12_28.pdf.
18. REPORT OF THE INTERAGENCY TASK FORCE ON CARBON CAPTURE AND STORAGE 29 (Aug. 2010), *available at* http://www.fe.doe.gov/programs/sequestration/ccstf/CCSTaskForceReport2010.pdf [hereinafter TASK FORCE REPORT].
19. IPCC SPECIAL REPORT, *supra* note 9, at 122.
20. CARBON DIOXIDE CAPTURE AND STORAGE RD&D ROADMAP, *supra* note 5, at 46.
21. IPCC SPECIAL REPORT, *supra* note 9, at 60.

"enhanced oil recovery" (EOR) projects in operation in the United States, injecting millions of tons of CO_2 per year.[22] Thus far, EOR efforts have focused on injection rather than on monitoring the plume or verifying the retention of CO_2.[23] Although the injection of CO_2 for CCS differs from EOR in this and other aspects, this practice provides valuable technical guidance and legal precedence for CCS and suggests that it is possible to safely inject large volumes of CO_2 into geologic reservoirs.

Underground geologic reservoirs considered appropriate for long-term CO_2 storage are those composed of layers of porous rock that lie below one or more layers of impermeable rock that will prevent the escape of CO_2. Such storage reservoirs include saline formations, depleted oil and gas reservoirs, and unmineable coal seams. The stability of sequestered CO_2 slowly increases over time, and thus the potential for CO_2 to migrate or leak from the surface decreases over time.[24] When injected into deep saline formations, stabilization increases as CO_2 moves deeper into the pore space and slowly dissolves into brine, becoming part of the saline solution. Simulations show that over several decades, 30 percent of CO_2 dissolves into the surrounding saline solution, with complete dissolution occurring over centuries.[25] When injected into a coal seam, CO_2 undergoes mineralization with surrounding rock, which transforms the CO_2 into minerals and makes a gaseous release impossible.[26] This "geochemical trapping" is slow compared to dissolution in a saline solution, and can potentially take 1,000 years or longer.[27]

B. Viewing CCS as a System

CCS will likely see broad-scale deployment as a strategy for mitigating GHG emissions only if large quantities of CO_2 can be

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22. Guntis Moritis, *Special Report: EOR/Heavy Oil Survey: CO2 Miscible, Steam Dominate Enhanced Oil Recovery Processes*, 108 OIL & GAS J. 36,41 (2010). *See also*, J.J. DOOLEY ET AL., CO2-DRIVEN ENHANCED OIL RECOVERY AS A STEPPING STONE TO WHAT? 4 (2010), *available at* http://www.pnl.gov/main/publications/external/technical_reports/PNNL-19557.pdf.

23. *See* L. BRUCE HILL, CLEAN AIR TASK FORCE, A U.S. NGO'S PERSPECTIVES ON MONITORING OF SALINE AND EOR GEOLOGIC CARBON INJECTION AND SEQUESTRATION SITES 4-5 (2010).

24. *See* IPCC SPECIAL REPORT, *supra* note 9, at 209.

25. BERT METZ ET AL. EDS., INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CARBON DIOXIDE CAPTURE AND STORAGE: SUMMARY FOR POLICYMAKERS 206 (2005), *available at* http://www.ipcc.ch/pdf/special-reports/srccs/srccs_summaryforpolicymakers.pdf [hereinafter SUMMARY FOR POLICYMAKERS].

26. Christopher Bidlack, *Regulating the Inevitable: Understanding the Legal Consequences of and Providing for the Regulation of the Geologic Sequestration of Carbon Dioxide*, 30 J. LAND RESOURCES & ENVTL. L. 199, 209 (2010).

27. SUMMARY FOR POLICYMAKERS, *supra* note 25, at 209.

captured, transported and stored relatively inexpensively. While a number of CCS demonstration projects are underway or planned,[28] only one (the Weyburn-Midale Project[29]) currently integrates all three components of CCS, so costs remain tentative. Recent estimates place the cost to capture and store CO_2 at about sixty dollars per ton.[30] This includes an average estimated cost of one to eight dollars per ton of CO_2 for transport and less than one to eight dollars per ton of CO_2 for storage and monitoring.[31] The remainder is the estimated cost for capture. Assuming these estimates are accurate, CCS would increase the cost to generate electricity using coal-fired power plants by 50 to 100 percent.[32] This applies to both newly built conventional pulverized plants, as well as to future integrated gasification combined cycle (IGCC) plants.[33]

The true cost of CCS, however, has the potential to be significantly more expensive. While capture technologies are on average the most costly component of CCS, transport and storage costs could run in excess of $100 per ton of CO_2 without careful, integrated planning of the entire CCS system. In the case of storage, the United States appears to have the underground capacity for sequestering decades if not centuries worth of current national CO_2 emissions.[34] However, the rate at which CO_2 can be injected underground, and thus the cost to store it, is highly variable due to the geologic heterogeneity of the candidate reservoirs.[35] This heterogeneity exists not only between the reservoirs, but also within them.[36] For example, estimated storage costs within fifteen of the largest potential CO_2 reservoirs in the United States range from less than one dollar per ton of CO_2 to greater than $1,000 per ton of CO_2.[37] And of the reservoir areas where cost could be estimated, the vast majority of the lowest cost storage sites (i.e., less than or equal to five dollars per

28. R. Stuart Haszeldine, *Carbon Capture and Storage: How Green Can Black Be?*, 325 SCI. 1647, 1647-52 (2009).

29. Allan Casey, *Carbon Cemetery*, CANADIAN GEOGRAPHIC MAGAZINE, Jan./Feb. 2008, at 56-66.

30. Dan Charles, *Stimulus Gives DOE Billions for Carbon-Capture Projects*, 323 Sci. 1158, 1158 (2009).

31. IPCC SPECIAL REPORT, *supra* note 9, at 11.

32. *Id.* at 27.

33. *Id.*

34. U.S. DEP'T OF ENERGY & NATIONAL ENERGY TECHNOLOGY LABORATORY, CARBON SEQUESTRATION ATLAS OF THE UNITED STATES AND CANADA 9 (3rd ed.) (2010), *available at* http://www.netl.doe.gov/technologies/carbon_seq/refshelf/atlasIII/index.html.

35. Jordan K. Eccles et al., *Physical and Economic Potential of Geological CO2 Storage in Saline Aquifers*, 43 ENVTL. SCI. & TECH. 1962, 1962-1969 (2009).

36. *Id.*

37. Jordan K. Eccles et al., *The Impact of Geologic Variability on Capacity and Cost Estimates for Storing CO2 in Deep-Saline Aquifers*, ENERGY ECON. 6-7 (forthcoming 2012).

ton of CO_2) lie within only two of the reservoirs.[38] This means that it could be more economical to ship CO_2 to a storage site located hundreds of kilometers away from the power plant where emissions are captured than to inject the CO_2 underground onsite or transport it to another possible but more expensive storage site located closer by.

This, of course, depends on the cost of transport, which is the other potentially highly variable determinant in the overall expense of CCS. However, CO_2 pipelines, the only feasible mode for moving large volumes of CO_2,[39,40] can be configured to minimize not only transport costs but also the total cost of CCS. In general, the former is achieved by finding the shortest path between CO_2 emitting plants and potential storage sites, while the latter is achieved by linking the plants to the least cost storage site. Early studies of CO_2 transport attempted to achieve both goals by minimizing the length of a single pipeline that directly connected a single plant to the nearest, lowest cost single injection site.[41,42] Subsequent studies have shown that if distant but large-capacity, low-cost reservoirs are a storage option for captured CO_2, transport costs can be significantly reduced through economies of scale achieved by networking feeder pipelines from individual plants into larger trunk pipelines that aggregate the CO_2 and carry it to the distant storage site.[43,44] This in turn has prompted the development of even more sophisticated optimization programs for designing pipeline networks that honor multiple competing constraints while linking CO_2 sources to the lowest cost storage sites, further reducing not only transport costs but the overall cost of a CCS system.[45,46]

38. *Id.* at 7.

39. Rickard Svennson et. al., *Transportation Systems for CO2—Application to Carbon Capture and Storage*, 45 ENERGY CONVERSION AND MGMT. J. 2343, 2346 (2004).

40. IPCC SPECIAL REPORT, *supra* note 9, at 181.

41. Mass. Inst. of Tech., Carbon Capture and Sequestration Technologies Group*, MIT CO2 Pipeline Transport and Cost Model* 6 (2006), *available at* http://e40-hjh-server1.mit.edu/energylab/wikka.php?wakka=MIT.

42. J.J. DOOLEY ET. AL., BATTELLE, JOINT GLOBAL CHANGE RESEARCH INSTITUTE, CARBON DIOXIDE CAPTURE AND GEOLOGIC STORAGE: TECHNOLOGY REPORT FROM THE SECOND PHASE OF THE GLOBAL ENERGY TECHNOLOGY STRATEGY PROGRAM 39 (2006), *available at* http://www.battelle.org/news/06/CCS_Climate_Change06.pdf.

43. Jeffrey M. Bielicki, *Spatial Clustering and Carbon Capture and Storage Deployment*, 1 ENERGY PROCEDIA 1691, 1697 (2009).

44. Munish Kumar Chandel et. al, *Potential Economies of Scale in CO2 Transport Through Use of a Trunk Pipeline*, 51 ENERGY CONVERSION AND MGMT. J. 2825, 2833 (2010).

45. Richard S. Middleton & Jeffrey M. Bielicki, *A Scalable Infrastructure Model for Carbon Capture and Storage: SimCCS*, 37 ENERGY POLICY 1052, 1055 (2009).

The picture that is emerging from this line of work is that the most cost effective CCS systems would be large.[47] They would involve an extensive pipeline system that collects captured CO_2 from a number of plants distributed throughout multiple states, and then carries that CO_2 to a smaller number of large, low cost underground storage reservoirs that can extend beneath state boundaries. Not factored into these results, however, is the current and pending legal framework for CCS development, and whether such extensive systems can in fact be economically developed under the current evolution of state and federal regulatory systems.

C. Drivers for CCS Technologies

Although the federal climate debate stalled in the Senate in 2010 and there is no indication that the 112th Congress will take up comprehensive climate and energy legislation, developing and deploying CCS technologies remains a key element of federal energy policy.

The current administration has made the largest government investment in CCS research and development than any other nation in history. The American Recovery and Reinvestment Act of 2009 alone allocated $3.4 billion in funding to CCS-related programs.[48] Members of Congress from both sides of the aisle are also pushing to advance early demonstration projects. For example, Senators Jeff Bingaman (D-NM), John Barrasso (R-WY), Lisa Murkowski (R-AK) and Jay Rockefeller (D-WV) introduced the Department of Energy Carbon Capture and Sequestration Program Amendments Act in March 2011, which would establish a program to facilitate commercial-scale demonstration projects nationwide.[49] In his 2011 State of the Union Address, President Obama announced the goal of generating 80 percent of the nation's electricity supply from clean, low- or zero-carbon energy sources by 2035, including

46. Presentation by Darmawn Prasodjo & Lincoln Pratson, Optima CCS Carbon Capture and Storage Infrastructure (CCS) Optimization: Texas Case Study, Tenth Annual Conference on Carbon Capture & Sequestration, Pittsburgh, PA, (May 2-5, 2011) at 9.

47. Lincoln Pratson, Nicholas School of the Environment at Duke University, *Building an Underground 'Highway' for Carbon Dioxide* 2, http://www.nicholas.duke.edu/thegreengrok/co2pipeline/ (last visited August 10, 2011).

48. CONG. RESEARCH SERV., CARBON CAPTURE AND SEQUESTRATION 2 (June 19, 2009).

49. S. 699, 112th Cong. (2011) at 1.

power plants with CCS technologies.[50] To date, this proposal has not appeared in a formal legislative proposal.

Another potential future regulatory driver for CCS development may come from the EPA as a performance standard. On January 2, 2011, the EPA began regulating GHG emissions from large stationary sources under the Clean Air Act's Prevention of Significant Deterioration (PSD) permitting program.[51] PSD permits require the use of the Best Available Control Technology (BACT) for emissions control. In determining BACT, all available control options, including CCS, should be considered in the first step of the four-step BACT analysis.[52] The second step of a BACT analysis eliminates technologically infeasible options, the third step ranks technologically feasible options in order of overall effectiveness, and the fourth step requires permitting authorities to consider the economic, energy, and environmental impacts of control options.[53] The current state of CCS technology development as well as the economic realities of applying CCS to a source will almost certainly eliminate CCS as BACT under present conditions. However, as CCS becomes commercially and economically viable it could become a legitimate BACT option. The EPA will also be incorporating GHG emissions into the new source performance standards (NSPS) for power plants and refineries in the coming years.[54] It is unlikely that the EPA will require emissions reduction levels achievable with CCS as the NSPS, but it is possible that the Agency could move in that direction in the future as CCS becomes a feasible option for coal-fired power generating facilities.

III. CURRENT STATE OF THE LAW

This section covers specific legal issues. One overriding issue is the range of different standards that apply at the state level and questions about the direct application of existing environmental laws, which are generally at the federal level.

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50. U.S President Barack Obama, State of the Union Address 7 (January 25, 2011), *available at* http://www.whitehouse.gov/the-press-office/2011/01/25/remarks-president-state-union-address.

51. U.S. ENVTL. PROT. AGENCY, *Clean Air Act Permitting For Greenhouse Gases*, http://www.epa.gov/nsr/ghgpermitting.html (last visited August 11, 2011).

52. U.S. ENVTL. PROT. AGENCY, *PSD and Title V Permitting Guidance for Greenhouse Gases* 32, http://www.epa.gov/nsr/ghgdocs/ghgpermittingguidance.pdf (last visited August 11, 2011).

53. *Id.* at 18.

54. U.S. ENVTL. PROT. AGENCY, *Addressing Greenhouse Gas Emissions*, http://www.epa.gov/airquality/ghgsettlement.html (last visited August 11, 2011).

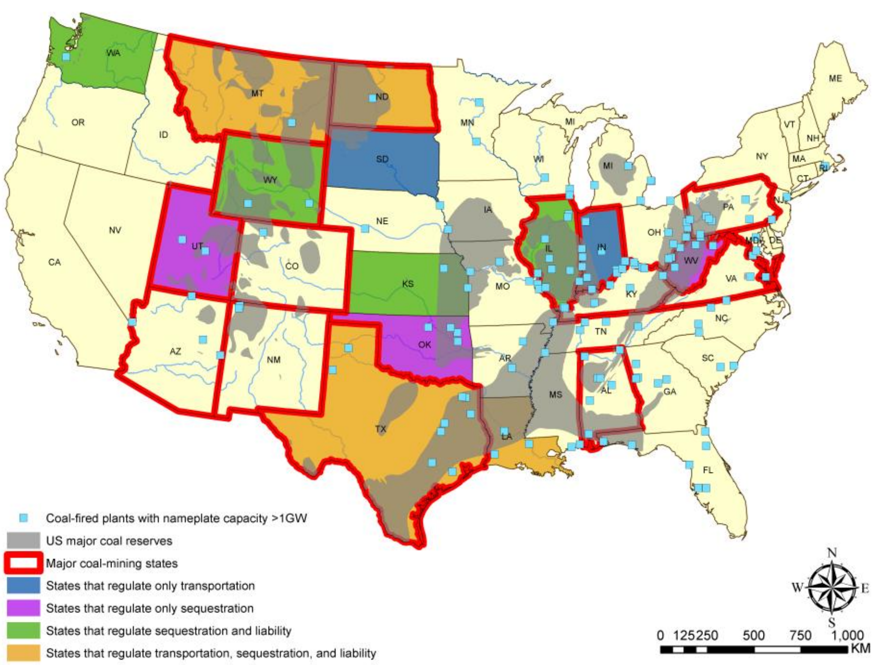
A. State

Between 2005 and 2010, twenty-one states enacted legislation pertaining to CCS. The stated purpose of these pieces of legislation is economic development and greenhouse gas emissions reduction, but a closer examination of the states that are passing CCS policy suggests that additional factors are likely influencing the states' actions. States that are moving forward with CCS legislation include:

States that are dependent on coal for power generation or have significant mining interests and significant coal reserves, such as Wyoming, Kentucky, Montana, North Dakota, Texas and West Virginia;

States that have established EOR operations and want to protect that industry while exploring the potential for incorporating geologic sequestration into the business model, such as Oklahoma, Louisiana, and Texas; and

States with large amounts of storage capacity for CO_2, such as Montana, Wyoming, Texas and Louisiana.



As is the case with the impetus behind regulation, the resulting state action varies widely. The first state CCS policies mostly focused on incentives such as providing tax credits, permitting perks, or financial assistance for power plants working toward capturing and sequestering CO_2.[55] More recently, policy activities have focused on tactical issues such as permitting rules, property rights such as access to pore space, and long-term liability and stewardship of sequestration sites. In addition, several states are supporting research and development activities, often through State universities, and some have created task forces to assess the potential for CCS or to address barriers to deployment.[56]

Incentives include portfolio standards that allow for the inclusion of electricity generated from power plants with CCS, alternative fuel standards, streamlining of the permitting process for power plants with CCS, tax exemption, tax credits, reduced sales tax, and full or partial cost recovery.[57] In addition to incentives, states have legislated permitting requirements for storage sites and pipelines, ownership of injected CO_2, the status of EOR, the primacy of mineral rights, and have developed strategies related to liability and pore space acquisition.[58]

The inconsistency of state regulations could prove to be costly and inefficient for industry. An example can be seen in the differentiation in treatment of property rights issues by the states. Montana, Wyoming, and North Dakota all address ownership of the open spaces in the subsurface that are unoccupied by solid structures – called "pore space" – through

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55. *See* S.B. 1368, 2006 Leg. (Cal. 2006); H.B. 06-1281, 111th Gen. Assemb. (Colo. 2006); S.B. 1592, 97th Gen. Assemb. (Ill. 2007); H.B. 1, 2007 Leg. (Ky. 2007); H.B. 1459, 2009 Leg. (Miss. 2009); H.B. 3, 60th Leg. (Mont. 2007); S.B. 25, 60th Leg. (Mont. 2007); S.B. 994, 45th Leg. (N.M. 2007); H.B. 1365, 60th Leg. (N.D. 2007); H.B. 1202, 2007 Leg. (Pa. 2007); H.B. 3732, 80th Leg. (Tex. 2007); W. Va. Code § 24-2-1(g) (2006); and H.B. 61, 58th Leg. (Wyo. 2006).

56. *See, e.g.,* A.B. 1925, 2006 Leg. (Cal. 2006); H.B. 06-1322, 111th Gen. Assemb. (Colo. 2006); H.B. 3854, 96th Gen. Assemb. (Ill. 2009); H.B. 5018, 183rd Gen. Court (Mass. 2008); S.F. 2096, 85th Leg. (Minn. 2007); S.B. 1765, 51st Leg. (Okla. 2008); S.B. 679, 52nd Leg. (Okla. 2009); S.B. 1387, 81st Leg. (Tex. 2009); H.B. 1796, 81st Leg. (Tex. 2009); H.B. 2200, 2009 Gen. Assemb. (Pa. 2009); and H.B. 2860, 59th Leg. (W. Va. 2009).

57. *See, e.g.,* H.B. 2812, 86th Gen. Assemb. (Ark. 2007); S.B. 1368, 2006 Leg. (Cal. 2006); H.B. 06-1281, 111th Gen. Assemb. (Colo. 2006); H.B. 549, 2007 Leg. (Fla. 2007); S.B. 1592, 95th Gen. Assemb. (Ill. 2007); S.B. 1987, 96th Gen. Assemb. (Ill. 2009); H.B. 2419, 2007 Leg. (Kan. 2007); H.B. 1, 2007 Gen. Assemb. (Ky. 2007); L.D. 2126, 121st Leg. (Me. 2008); H.B. 4016, 95th Leg. (Mich. 2009); H.B. 1459, 2009 Leg. (Miss. 2009); S.B. 25, 60th Leg. (Mont. 2007); H.B. 3, 60th Leg. (Mont. 2007); S.B. 994, 45th Leg. (N.M. 2007); H.B. 1365, 60th Leg. (N.D. 2007); S.B. 2221, 61st Leg. (N.D. 2009); S.B. 21, 127th Gen. Assemb. (Ohio 2008); S.B. 101, 75th Leg. Assemb. (Or. 2009); H.B. 1202, 2007 Gen. Assemb. (Pa. 2007); H.B. 80, 2009 Gen. Assemb. (Pa. 2009); R.I. Code § 42-98-2 (2001); R.I. Code § 42-98-3 (2001); H.B. 3732, 80th Leg. (Tex. 2007); H.B. 469, 81st Leg. (Tex. 2009); S.B. 1416, 2007 Gen. Assemb. (Va. 2007); W. Va. Code § 24-2-1(g) (2006); H.B. 61, 58th Leg. (Wyo. 2006).

58. *See, e.g.,* H.B. 1704, 95th Gen. Assemb. (Ill. 2007); Ind. Code § 8-1-22.5 (2009); N.M. Exec. Order No. 2006-69; S.B. 2095, 61st Leg. (N.D. 2009); S.B. 610, 52nd Leg. (Okla. 2009); H.B. 80, 2009 Gen. Assemb. (Pa. 2009); H.B. 1129, 84th Leg. (S.D. 2009); H.B. 1796, 81st Leg. (Tex. 2009); S.B. 202, 57th Leg. (Utah 2008); Wa. Admin. Code § 173-218-115 (2008); H.B. 2860, 79th Leg. (W. Va. 2009) and H.B. 90, 59th Leg. (Wyo. 2008).

legislation, but all three take a different approach. Although all three provide for the dominance of the mineral estate over the surface estate and vest subsurface pore space ownership to the surface owner, each handles the severance of pore space from the surface estate differently.[59] In the absence of federal regulation, this type of difference in geographically clustered states has the potential to greatly increase the transaction costs of sequestration for project operators.

Another example of inconsistency can be seen with the issue of long-term stewardship and liability. Of the seven states that have passed legislation on this topic, four states have accepted responsibility for site management only and have declined to accept responsibility for compensatory damages arising from harm or injury during long-term stewardship. In those states, liability for compensatory damages remains with the operator. Two states, Montana and North Dakota will accept responsibility for both site management and compensatory damages, but in Montana this occurs thirty years after injection ceases and in North Dakota it occurs ten years after injection ceases. Both states require certain criteria be met before transfer.

The status of state policy on CCS is important because in the absence of federal legislation, states are setting precedents and creating a regulatory structure in which CCS will operate. Left unaddressed, the inconsistency of state regulations could drive up the transaction cost of CCS for industry and create an inefficient regulatory environment. At the same time, however, these existing state laws may provide a model for federal legislation. State actions regularly inform federal action, as the United States has a unique history of allowing states to act as laboratories for innovation. A recent example of this type of collaboration exists with California's tailpipe emissions standards, which limit GHG emissions from vehicles. The federal government used California's emissions standards as an example in setting the federal standards. It is likely that the federal government will exemplify the most effective CCS regulatory measures from state legislation when crafting a federal regulatory structure.

59. In North Dakota, pore space belongs to the surface owner and may not be severed. N.D. Code § 47-31-05 (2009). In Wyoming, pore space belongs to the surface owner and may be severed. Wyoming also made it clear in their legislation that the statute did not invalidate subsurface pore rights conveyed prior to the passage of legislation. H.B. 89, 59th Leg. (Wyo. 2008). In Montana, where pore space also belongs to the surface owner and may be severed, the presumption that the surface owner owns the pore space applies only if ownership cannot otherwise be determined from deeds or severance documents. S.B. 498, 61st Leg. (Mont. 2009).

B. Federal

The federal government has already begun to take steps to speed the commercial deployment of CCS. In addition to investment in research and development through the Recovery Act mentioned earlier, along with various other incentives such as loan guarantees and tax credits for CCS demonstration projects, the federal government has also begun to develop regulations to address the sequestration component of CCS. On November 22, 2010, the EPA finalized two new rules relating to CCS. The first requires facilities that inject or sequester CO_2 underground to report GHG data to the EPA annually under the authority of the Clean Air Act.[60] This will allow the EPA to track the amount and location of sequestered CO_2.

The second rule added a new well class for the underground injection of CO_2 for geologic sequestration to the Safe Drinking Water Act's (SDWA) Underground Injection Control (UIC) Program.[61] A new well class was needed for CCS to account for the large volumes that will be injected, the buoyancy and viscosity (mobility) of CO_2, and it's corrosivity in the presence of water. The final Class VI well rule sets requirements for site characterization, well construction, monitoring, and financial responsibility for liability incurred during injection.[62]

The SDWA's UIC program regulates the injection of fluids underground for the purpose of preventing the contamination of underground drinking supplies. Because of this limited purpose, the UIC program does not resolve several major questions associated with the sequestration of CO_2. In the Class VI well rule, the EPA acknowledges these shortcomings. "The SDWA does not provide authority to develop regulations for all areas related to GS. These areas include, but are not limited to, capture and transport of CO_2; determining property rights (i.e., to permit its use for GS and for possible storage credits); transfer of liability from one entity to another; and accounting or certification for greenhouse gas (GHG) reductions."[63]

In addition to the SDWA, other existing environmental regulations that may apply to CCS include the National

60. U.S. ENVTL. PROT. AGENCY, *Geologic Sequestration of Carbon Dioxide,* http://water.epa.gov/type/groundwater/uic/wells_sequestration.cfm (last visited August 12, 2011).

61. *Id.*

62. Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells, 75 Fed. Reg. 77,230, 77,230 (Dec. 10, 2010).

63. Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells, Proposed Rule, 73 Fed. Reg. 43,491, 43,495 (July 25, 2008).

Environmental Policy Act (NEPA), and possibly the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)[64] and the Resource Conservation and Recovery Act (RCRA).[65]

NEPA requires federal agencies to conduct environmental reviews prior to undertaking major federal actions that could have detrimental environmental effects. CCS activities that may trigger NEPA obligations include the use of federal or Tribal lands for sequestration or pipeline siting, and the receipt of federal financial assistance for CCS projects. If the project is expected to have a significant environmental impact, NEPA requires a rigorous environmental impact statement (EIS), but the process can be streamlined using a programmatic environmental impact statement (PEIS), which takes a region-wide approach to impact analysis. A PEIS may be appropriate for some aspects of a CCS network, such as an entire pipeline corridor or sequestration project. The issuance of SDWA UIC permits by the EPA would not trigger NEPA review, as the UIC permitting process is deemed a "functional equivalent" of the NEPA process.[66]

Both CERCLA[67] and RCRA[68] contain liability regimes that may apply to CCS. RCRA regulates the generation, transmission, storage, and disposal of solid wastes, which are further classified as "hazardous" or "non-hazardous." If the EPA determines that the CO_2 solution injected underground ("injectate") is a hazardous solid waste under RCRA, a right of action would exist for injunctive relief to remediate any harm resulting from the release or migration of sequestered CO_2. CO_2 is not currently classified as a hazardous waste under RCRA, and it is unlikely that CO_2 alone would be considered hazardous. However, the EPA will consider a solid waste that exhibits characteristics of toxicity as hazardous under RCRA. Depending on the concentration of impurities in the injectate, such as mercury and hydrogen sulfide, supercritical CO_2 may exhibit characteristics of toxicity. The EPA addressed this in their rule for regulating CO_2 geologic sequestration wells under the UIC. Because the types of impurities and their concentrations in the CO_2 stream are likely to vary by facility, coal composition, plant operating conditions, and pollution removal technologies, the

64. Comprehensive Environmental Response, Compensation, and Liability Act, 42 U.S.C. §§ 9601-9675 (2000).

65. Resource Conservation and Recovery Act, 42 U.S.C. § 6901 et. seq (2011).

66. TASK FORCE REPORT, *supra* note 18, at 58.

67. 42 U.S.C. §§ 9601-9675 (2000).

68. 42 U.S.C. § 6901 et. seq (2011).

EPA cannot make a categorical determination as to whether injected CO_2 is hazardous under RCRA.[69] The EPA is currently considering a conditional exemption for CO_2 streams under RCRA to facilitate CCS.[70] A proposed rule was published on August 8, 2011, and a final rule is expected in February 2013.[71]

CERCLA provides for the cleanup of potentially harmful releases of hazardous substances and allows federal, state, and local governments as well as private landowners to bring tort-like liability claims for the recovery of costs associated with the cleanup of contaminated private lands or resources.[72] Liability under CERCLA is joint and several, and extends to current and past facility owners and operators as well as anyone who generated or transported the hazardous substances. If CO_2 injectate is classified as a "hazardous substance" it will be subject to CERCLA liability. Further, CO_2 injectate will be subject to CERCLA liability if it *contains* hazardous substances such as arsenic and selenium.[73] The EPA addressed this in its proposed rule for regulating CO_2 geologic sequestration wells under the UIC. Whether or not there is a "hazardous substance" that may result in CERCLA liability from a sequestration facility depends entirely on the make-up of the specific CO_2 stream and of the environmental media (e.g., soil, groundwater) in which it is stored.[74] The EPA does not have the authority to exempt CO_2 injectate from CERCLA liability through a regulatory action, and a statutory change would therefore be required if an exemption were deemed appropriate.

The majority of academic and government writing on the subject posits that applying CERCLA and RCRA liability to CCS will render projects untenable by driving up operational costs and risk premiums.[75] It has also been noted, however, that existing liability regimes serve to encourage responsible behavior

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69. Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells, 75 Fed. Reg. 77,230, 77,260 (Dec. 10, 2010).

70. U.S. ENVTL. PROT. AGENCY, *Hazardous Waste Management Systems: Identification and Listing of Hazardous Waste: Carbon Dioxide (CO2) Injectate in Geological Sequestration Activities*, http://yosemite.epa.gov/opei/RuleGate.nsf/byRIN/2050-AG60?opendocument (last visited Aug. 30, 2011).

71. *Id.*

72. A.B. Klass and E.J. Wilson, *Climate Change and Carbon Sequestration: Assessing a Liability Regime for Long-term Storage of Carbon Dioxide*, 58 EMORY L.J. 103, 124 (2008).

73. TASK FORCE REPORT, *supra* note 18, at 59.

74. 75 Fed. Reg. 77,230, 77,260 (Dec. 10, 2010).

75. *See, e.g.* J.W. Moore, *The Potential Law of On-shore Geologic Sequestration of CO2 Captured FromCcoal-fired Power Plants*, 28 ENERGY L.J. 443, 444 (2008); U.S. GOV. ACCOUNTABILITY OFFICE, FEDERAL ACTIONS WILL GREATLY AFFECT THE VIABILITY OF CARBON CAPTURE AND STORAGE AS A KEY MITIGATION OPTION 26 (Sept. 2008).

and serve as a backstop to compensate injured parties.[76] Both arguments should be considered when crafting legislation that strikes the appropriate balance between encouraging investment and protecting human and environmental health. If it is determined that CERCLA and RCRA liability should not apply to CCS, the federal government will need to take appropriate measures to exempt geologic carbon sequestration from these statutes.

IV. FRAMEWORK FOR CREATING OPTIMAL REGULATORY STRUCTURE

Policymakers face a number of choices as we move toward a more comprehensive regulation of CCS. This section provides a framework for evaluating the value choices and analyzing at which level of government responsibility should lie.

A. Appropriate Role of State and Federal Actors

In some ways, state regulation of CCS makes sense. The states already have experience regulating oil and natural gas production and natural gas storage. The state regulators who would oversee permitting and injection and who would monitor sequestered CO_2 may be more familiar with local geology than federal regulators. Finally, states typically regulate some aspects of CCS, such as property and mineral rights issues, the siting of certain types of pipelines, and utilities' ability to recover costs of infrastructure development. Forward-thinking state CCS policy could speed technological and regulatory developments, enhance public acceptance, and inform future national policy.

In other ways, federal regulation of CCS could be more effective than state regulation. Comprehensive federal regulation could provide consistency in how sequestration sites are selected and managed. Also, compliance with one federal regulation could result in a lower transaction cost for industry than compliance with several state regulations. Situations may arise in which carbon is captured at a power plant in one state, transported via pipelines across several other states to reach a sequestration facility located in a fourth or fifth state. If the regulation of CCS differs in each state, this could add to the overall cost of a CCS system that would likely result in higher prices for electricity and consumer goods. Finally, there are some issues that states have thus far, for the most part, been unwilling

76. Klass, *supra* note 72, at 123.

or unable to tackle, such as long-term financial liability. Federal regulation would allow the federal government to address these complicated environmental and legal issues.

B. Cooperative Federalism

The law of American federalism is based in the Tenth Amendment, which recognizes that states are sovereign entities with their own powers and responsibilities.[77] The American federalist system has historically operated under the doctrine of dual federalism, whereby the federal and state governments operate as separate entities, each with its own discreet scope of authority.[78] Despite this, the Supremacy Clause of the United States Constitution allows Congress to preempt state law, supplanting it with a federal regime, even when the state is acting within the realm of the powers delegated to it under the Tenth Amendment.[79] This is known as the doctrine of preemptive federalism.

Cooperative federalism strikes a balance between dual federalism and preemptive federalism. Cooperative federalism allows state and federal governments to share responsibility for the regulation of an activity with the goal of generating more effective results than either level of government acting alone would be capable of achieving. In the late 1960s and early 1970s Congress increasingly began to rely on this approach to regulation, beginning with dozens of federal environmental regulations, including the Clean Air Act and the Clean Water Act. Since then, a variety of endeavors have utilized this approach, from telecommunications to health insurance to financial aid for needy families.[80]

Cooperative federalism operates according to two basic structures. Under the first model, state agencies follow federally set standards in order to receive funds to implement a federal statutory scheme.[81] This model is utilized in the Medicaid Act, which provides federal funding to the states to reimburse the cost

77. U.S. CONST. amend. X. ("The powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people.")

78. *See, e.g.* Texas v. White, 74 U.S. 700, 725-27 (1869) (in which the U.S. Supreme Court first expressed the doctrine of dual federalism).

79. U.S. CONST. art. VI, cl. 2. *See also* McCulloch v. Maryland, 17 U.S. (4 Wheat.) 316, 316-17 (1819); Maryland v. Louisiana, 451 U.S. 725, 746 (1981).

80. Robert L. Glicksman, *From Cooperative to Inoperative Federalism: The Perverse Mutation of Environmental Law and Policy*, 41 WAKE FOREST L. REV. 719, 725-26 (2006).

81. Philip J. Weiser, *Towards A Constitutional Architecture for Cooperative Federalism*, 79 N.C. L. Rev. 663, 668 (2001).

of providing medical treatment to the poor.[82] A cooperative federalist approach was chosen for Medicaid to provide the states flexibility in implementing the program while still maintaining federal control.[83] The provision of funds gives states an incentive to implement the federal policy.

Under the second model, the federal government grants the states the authority to regulate subject matter areas that would otherwise be reserved for the federal government.[84] An example of this model can be seen with the Clean Air Act (CAA). The CAA, originally passed in 1970, was the first major piece of federal environmental legislation to utilize a cooperative federalism framework.[85] A national standard was needed to combat the "race to the bottom," whereby the states looked to attract industry by creating a favorable regulatory environment, which often resulted in lenient environmental regulations. Under this approach, the federal government sets a minimum level of environmental protection — a regulatory "floor"— that states cannot drop below in administering the Act. This allows the federal government to utilize their knowledge of the situation at the national level, and their access to the best scientific data, to determine the parameters of the regulatory structure, but allows the states, with their unique knowledge of the situation in their area, to implement the program as they see fit. Often, a combination of the two models is used, where the federal government provides grants to non-federal entities to implement a program, and conditions the grant money on the state or local entity complying with minimum federal standards.[86]

Proponents of cooperative federalism say that it balances the competing interests in having federal oversight of issues that are of national importance and recognizing each states' right to regulate issues that are traditionally in their purview.[87] Proponents of this approach further argue that state and local governments are better equipped to create programs tailored to their unique needs, and that allowing regulation to operate at this level will result in greater citizen participation in local

82. 42 U.S.C. § 1396 (2010).

83. L.B. Deutsch, *Medicaid Payment for Organ Transplants: The Extent of Mandated Coverage*, 30 COLUM. J.L. & SOC. PROBS. 185, 207-08 (1997).

84. Cassandra Jones Havard, *"Goin' Round in Circles" . . . and Letting the Bad Loans Win : When Subprime Lending Fails Borrowers: The Need for Uniform Broker Regulation*, 86 Neb. L. Rev. 737, 772-74 (2008).

85. Clean Air Act, 42 U.S.C. §§ 7401-7671q (2000).

86. Roderick M. Hills, Jr., *Federalism in Constitutional Context*, 22 HARV. J.L. & PUB. POL'Y 181,185-86 (1998).

87. Havard, *supra* note 84, at 772-74.

government.[88] This approach could also help to spread the burden of enforcement between the federal government and the states, and could streamline federal administrative requirements by allowing states to issue permits, investigate violations, and issue sanctions. Another benefit is that cooperative federalism allows for policy experimentation by the states, from which other states and the federal government can learn without taking on the risk of the experimentation themselves.

Cooperative federalism also has potential drawbacks. When states have primary responsibility for administering a program, that program becomes subject to budgetary issues, changing political landscapes, and interstate competition.[89] Critics argue that federal oversight will be inadequate or inconsistent under a cooperative federalist regime, and that administrators of the programs and affected citizens could become confused as to which level of government is accountable in any given situation.[90] Analysts claim that this occurred in the aftermath of Hurricane Katrina, where the shared responsibility for disaster preparedness and relief by the local, state, and federal governments resulted in blame shifting and ineffective action by any one level of government.[91]

C. Cooperative Federalist Approach to CCS Regulation

CCS regulation is already evolving in a cooperative federalist direction, as evidenced by the SDWA's Class VI well program, where the federal government grants states the authority to regulate the underground injection of CO_2 for the purpose of long-term sequestration.[92] As is often the case with cooperative federalism in environmental regulation, the SDWA UIC program includes baseline standards set by the federal government that act as a floor for state regulatory programs. The federal government grants states the authority to run the program, provided they meet or exceed the set minimum requirements.

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88. Kevin Ramakrishna, *Subduing the Ceaseless Storm: Breaking the Build-Destroy-Rebuild Cycle Following Major Catastrophes Through Taxation and Responsibility*, 2 ALB. GOV'T L. REV. 328, 330-31 (2009).

89. Will Reisinger et. al., *Environmental Enforcement and the Limits of Cooperative Federalism: Will Courts Allow Citizen Suits to Pick Up the Slack?*, 20 DUKE ENVTL. L. & POL'Y F. 1, 3 (2010).

90. Ramakrishna, *supra* note 88, at 330-31.

91. *See* Christina E. Wells, *Katrina and the Rhetoric of Federalism*, 26 MISS. C. L. REV. 127, 127-29 (2006-2007); Ramakrishna, *supra* note 88, at 332.

92. Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO2) Geologic Sequestration (GS) Wells, 75 Fed. Reg. 77,230, 77,242 (Dec. 10, 2010).

A cooperative federalist approach would minimize the extent to which the pursuit of the federal goal of greenhouse gas emissions reduction would infringe on state sovereignty. It would also allow states discretion as to how to achieve the best results, recognizing that states have diverse political, economic and geologic circumstances.

Even if policy makers determine that a cooperative federalist approach to CCS regulation is the most effective path forward, questions will arise as to the best way to go about dividing regulation between the federal government and the states. Cooperative federalist regimes approach this division in a variety of ways. One option is to confine the federal role to providing information and financial support. Conditioning the receipt of funds on adherence to federal standards, but leaving implementation authority with the states could strengthen this model. A second option is for the federal government to displace state and local power over some aspects of CCS, while allowing states to regulate other issues.

Regardless of what model is chosen, we are likely to see a combination of federal and state authority in the regulation of CCS moving forward. Further questions will arise due to the patchwork of policy that already exists and in which CCS research and development projects are already operating. For example, how should federal regulation incorporate regulatory actions already taken by the states? How can federal regulation build on the best state regulatory programs, and how should it address the inconsistencies between state regulations without requiring a uniform approach? Should there be horizontal cooperation between the states, such as regional initiatives, in addition to vertical cooperation between the federal, state, and local governments? How should these be governed?

Government regulation of each aspect of CCS will fall along a continuum, with regulation completely at the state level on one extreme, and regulation completely at the federal level on the other extreme. For example, cost recovery for the construction and operation of capture-ready power plants will fall completely under the purview of state utility regulation, whereas carbon sequestration under federal lands will be regulated solely by the federal government. Most issues will fall between these two dual federalist extremes, and would likely be most effectively regulated through cooperation between the state and federal governments.

In the following section we take each major regulatory issue inhibiting the widespread, cost effective deployment of CCS in turn, analyzing the most appropriate role for each level of government. In determining the appropriate role for the federal and state governments, we considered the following:

Whether there are applicable laws already on the books;

Whether the issue falls under an area traditionally regulated by the states;

Whether there is a need for consistent standards;

Whether the issue is one that will continue to be present over a long time frame;

Whether there is a need for more resources than one state can provide;

Whether there are cross border issues; and

Whether there is a need for consistent standards.

V. LEGAL AND REGULATORY ISSUES

A. Capture

It is possible that the existing legal structure is sufficient to regulate the capture of CO_2, at least in the early stages. If so, then there would be no need to alter existing state and federal roles as applied to the CO_2 capture stage. There are some issues that policymakers need to resolve moving forward, however, each of which can be more effectively resolved by amending existing regulatory vehicles for capture than by creating a standalone regulatory structure. This is because the issues associated with capture are few in comparison to those associated with transportation and sequestration. Furthermore, these issues do not tend to present questions about which level of government is most appropriate for regulation. Rather, the issues involve the application of existing law, and whether clarifications or potential exemptions are necessary to promote the most effective regulatory structure for capture.

For instance, the construction and operation of a capture-ready power plant could raise questions about cost recovery for electric utilities under state utility regulation in states with a traditional regulatory structure. Cost recovery may prove necessary for CCS projects to obtain financing and move forward, but existing state utility commission regulation might not allow cost recovery for this type of investment. This issue should be addressed at the state level, as the regulation of electric utilities is the purview of the states. Some states have already enacted regulation addressing this issue. For example, Indiana has created financial incentives for clean coal technology that include an enhanced rate of return on investment in CCS and cost recovery through rate adjustment.[93] Because utility regulation and financial incentives vary from state to state, this could affect the location of build out of CCS.

Carbon capture technologies may produce large quantities of hazardous chemicals. Some processes would use chilled ammonia to strip CO_2 from combustion gases, and the current amine based capture technologies generate wastes such as vanadium, antimony, and cyanide compounds that are classified as hazardous by the EPA.[94] These chemicals raise more concern for public acceptance than they do for occupational health and safety, because they are chemicals that are present at power plants in the absence of CCS as process waste generated by SO_2 and NO_x emissions control systems, and plants already meet the standards set by federal environmental regulations.[95]

Another issue that needs clarification is the possibility that building CCS infrastructure into an existing power plant could change the emission profile of the plant and thereby trigger permitting requirements under the Clean Air Act (CAA). The CAA requires stationary sources of pollution, such as power plants, factories, and refineries, to obtain an air pollution permit before commencing construction of a new facility or making major modifications to an existing facility—a process known as new source review (NSR). Energy is needed to capture and compress CO_2. If the equipment built in to capture CO_2 at the facility results in a significant increase in emissions of a regulated pollutant, NSR preconstruction review programs may apply to some capture facilities, which could require the facility to install state-of-the-art emissions control equipment. Retrofitting power plants to capture carbon will also result in an increase in water usage,[96] which could require changes to state level water withdrawal permits.

B. Transportation

Different regulatory models exist for different types of pipelines. At the federal level, pipeline regulation falls primarily to three agencies, with the Federal Energy Regulatory Commission (FERC) overseeing separate regulatory regimes for natural gas and oil pipelines, the Surface Transportation Board (STB) regulating pipeline rates for "commodities other than

93. S.B. 251, 117th Gen. Assemb., Reg. Sess. (Ind. 2011).

94. CONG. RESEARCH SERV., COMMUNITY ACCEPTANCE OF CARBON CAPTURE AND SEQUESTRATION INFRASTRUCTURE: SITING CHALLENGES 8-9 (July 29, 2008).

95. *Id.*

96. CARBON DIOXIDE CAPTURE AND STORAGE RD&D ROADMAP, *supra* note 5, at 25.

water, gas, or oil,"[97] and the Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA) overseeing pipeline safety. Pipeline regulation generally focuses on the following categories: siting, access, rates, and safety. Of these issues, only the application of PHMSA's pipeline safety rules to CO_2 appears settled at the federal level.[98] Other CO_2 pipeline issues either fall to the states or remain unregulated for the small number of existing CO_2 pipelines.

Federal regulators considered CO_2 pipeline regulation in the late 1970s and early 1980s. The FERC rejected jurisdiction over CO_2 pipelines in 1979, finding that CO_2 is not a "natural gas" under the Natural Gas Act.[99] Shortly thereafter, the Interstate Commerce Commission (ICC), the predecessor to the STB, ruled in 1980 that Congress intended to exclude any "gas" from its jurisdiction, and therefore it did not have authority over CO_2.[100] The ICC acknowledged the regulatory gap for CO_2, but subsequently affirmed that CO_2 was not within its jurisdiction.[101] There appears to be an assumption that the STB has jurisdiction over CO_2 pipelines, but the authority has not been tested, as no party has brought a rate case to the Board.

The existing models for federal pipeline regulation demonstrate the range of options available to policymakers considering the optimal legal structure to oversee a CCS pipeline network. For example, FERC's jurisdiction over oil and natural gas pipelines differs significantly. Oil pipeline regulation is based on a common carrier model, requiring pipeline operators to charge "just and reasonable" rates and provide "reasonable access" to customers.[102] The FERC does not control the construction or abandonment of oil pipelines, nor does it approve tariff rates in advance. Regulation of natural gas pipelines, on the other hand, is based on the public utility model. The FERC approves construction and abandonment of pipelines and authorizes rates[103] and has the authority to initiate cases as well

97. 49 U.S.C §15301 (2012).

98. Hazardous Liquid Pipeline Act of 1979, as amended, 49 U.S.C. § 60101 et seq. (2012); Hazardous Materials Transportation Act, 40 U.S.C. § 5101 et seq. (2012), 40 C.F.R. §§ 190–199 (2012); 40 C.F.R. §§ 171–180.

99. CONG. RESEARCH SERV., Adam Vann and Paul W. Parfomak, REGULATION OF CARBON DIOXIDE (CO2) SEQUESTRATION PIPELINES: JURISDICTIONAL ISSUES 4 (Apr. 15, 2008)(*citing Cortez Pipeline Company*, 7 FERC ¶ 61,024 [1979]).

100. Cortez Pipeline Company – Petition for Declaratory Order – Commission Jurisdiction over Transportation of Carbon Dioxide by Pipeline, 45 Fed. Reg. 85,177 (Dec. 24, 1980).

101. *Id.*

102. Pub.L. 102- 486, Title XVIII, § 1803(a); *Phillips Pipe Line Co. v. Diamond Shamrock Refining and Marketing Co.*, 50 F.3d 864, 867 (10th Cir. 1995).

103. 15 U.S.C. § 717 (c) & (d) (2011).

as hear cases filed by injured parties.[104] They may direct pipeline operators to construct pipelines in some circumstances and may issue "public certificates of public convenience and necessity" allowing a pipeline owner to build a pipeline and granting eminent domain authority after approval by a federal circuit court.[105] The FERC's regulations over natural gas pipelines preempt state laws.[106]

The STB also follows the common carrier model, with limited jurisdiction to resolve rate discrimination disputes for some interstate pipelines.[107] The STB has no authority to initiate a rate-case on its own, and pipeline operators are under no obligation to inform the STB of planned rate changes, new pipeline construction, or pipeline acquisitions.[108] The Board also has no eminent domain or siting authority and has no authority over intrastate pipelines.[109]

Resolving siting and access issues is necessary to facilitate the development of a large-scale interstate CCS pipeline network. The Interagency Task Force on Carbon Capture and Storage (Task Force), initiated by President Obama in 2010, identified three viable options for siting CO_2 pipelines on private lands: (1) maintaining the current legal structure, with states or local governments overseeing siting issues; (2) following the electricity transmission approach, with states retaining primary siting authority but the federal government gaining the authority to site an interstate CO_2 pipeline only where a State does not or cannot site the pipeline; and (3) exclusive federal siting authority, either with eminent domain (the natural gas pipeline approach) or without eminent domain (the liquefied natural gas import terminal approach).[110] Similarly, the Task Force identified a range of options to govern rate regulation for CO_2 pipelines, with various levels of state and federal authority.[111]

Siting pipelines through populated areas is difficult, especially on a multistate scale. Legal challenges will arise regardless of whether siting of CO_2 pipelines falls under federal or state jurisdiction. Residents may object to pipeline siting, and

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104. 15 U.S.C. § 717(l) & (m) (2011).

105. 15 U.S.C. § 717f(c) (2011).

106. *See, e.g.,* PAUL FRISMAN, STATE PERMITS REQUIRED FOR GAS PIPELINE (Conn. OLR Research Report July 19, 2002), *available at* http://www.cga.ct.gov/2002/olrdata/env/rpt/2002- R- 0657.htm.

107. 49 U.S.C. §§ 1530, 15501- 15506, 15901 (2011).

108. 49 U.S.C. § 15901(a) (2011).

109. CONG. RESEARCH SERV., Parfomak & Folger, *CARBON DIOXIDE (CO2) PIPELINES FOR CARBON SEQUESTRATION: EMERGING POLICY ISSUES* (Jan. 17, 2008); 49 U.S.C. § 15301(b) (2011).

110. TASK FORCE REPORT, *supra* note 18, at appendix M1-M3.

111. *Id.*

there is the risk that some landowners may refuse to grant a right-of-way to pipeline companies if eminent domain is not available.[112] Considering the relative strengths and experience at the federal and state levels suggests that CO_2 pipeline regulation is a prime example of an emerging area of law where a cooperative federalist approach could balance the benefits of federal and state oversight authority.

First, the federal government and many state governments already have experience with pipeline regulation. Second, except in specific instances where Congress has granted federal agencies a role in siting decisions, property issues are an area of traditional state authority. The states may therefore be in the best position to assess and address local siting concerns. At the same time, the public policy goals of rapid and efficient deployment of a CCS network suggest a role for the federal government in siting decisions. Consistent federal rules regarding siting and rate regulation could speed the planning and construction process for interstate pipelines, allowing companies to avoid inconsistent and potentially conflicting standards. As the Task Force demonstrates with its list of regulatory models, there are options available to design a system that balances the states' interests and expertise with the benefits of federal standards. For example, the option for the states to retain primary siting authority with the federal government stepping in when a state cannot or will not take the necessary actions to allow construction of an interstate pipeline could be a starting point.

Nordhaus and Pitlick in their model legislation released by CCSReg—a joint project of Carnegie Mellon University, the University of Minnesota, Vermont Law School, and the law firm VanNess Feldman—propose an option that further refines this state/federal option.[113] This approach would retain states as the primary siting authority. If a state cannot or chooses not to site a particular pipeline, the applicant can apply to the FERC for a federal siting permit for the new pipeline. Upon receipt of the application, the FERC would have exclusive authority, similar to that under the Natural Gas Act (NGA), to grant or deny the applications. Once the FERC grants a permit, the project sponsor would have federal eminent domain authority, and the

112. Jonas Monast, From Carbon Capture to Storage: Designing an Effective Regulatory Structure for CO2 Pipelines, 20-22 (Working Paper, Dec. 2008), available at http://www.nicholas.duke.edu/ccpp/ccpp_pdfs/ co2_pipeline.pdf. (Current CO2 pipelines exist primarily in rural, unpopulated areas. Their operators have thus avoided many of the problems associated with siting large energy infrastructure projects.)

113. Robert R. Nordhaus and Emily Pitlick, *Carbon Dioxide Pipeline Regulation*, 30 ENERGY L.J. 1 (2009).

permit would have the same preemptive effect over state and local land use regulation as a certificate of public convenience and necessity now does under the NGA. Once operational, the pipeline would be subject to non-discriminatory access and rate regulation similar to the FERC's current authority over oil pipelines and the STB's authority over commodity pipelines.

C. Storage

The majority of unresolved legal and regulatory issues associated with CCS arise in the context of geologic sequestration of CO_2. Project operators will need to acquire large amounts of subsurface storage space to serve as a repository for CO_2. Uncertainty over the ownership of subsurface pore space, conflicting use of pore space, and the cost and means of acquisition present hurdles for the deployment of CCS. Sequestration sites that span state borders or that underlie federal or tribal lands further complicate these issues. Finally, sequestration could generate liability in the form of an obligation to finance post-closure site management or an obligation to pay compensatory damages arising from harm or injury resulting from migrated or leaked CO_2.

There are other legal issues that will arise in the context of storage, such as storage under federal lands and offshore storage. These issues fall squarely on the federal extreme of the government regulatory continuum. As was the case with capture, the level of government is not in dispute, and an analysis of these issues is therefore not included in this paper.

1. Property Rights

The property rights implicated by a sequestration project will depend on the type of geologic structure into which the CO_2 is injected and stored. Where sequestration occurs in saline formations, groundwater rights will be implicated. There is virtually no case law regarding the property rights issues associated with sequestration in saline formations.[114] To date, water rights doctrine has focused on ownership of groundwater in the aquifer and not on the space in which the water resides. Some parallel exists with the injection of produced waters from

114. Victor B. Flatt, *Paving the Legal Path for Carbon Sequestration from Coal,* 19 DUKE ENVTL. L. & POL'Y F. 211-246 (Spring 2009), *available at* http://scholarship.law.duke.edu/delpf/vol19/iss2/2.

oil and gas operations into saline formations,[115] but the comparison is limited because the injection often occurs in fully unitized fields where property rights have been contracted as part of the unitization agreement. Complicating the matter is the fact that the general public owns the water in aquifers in many states, such as Colorado and Montana.[116] CO_2 storage in saline aquifers therefore may involve agreements with groundwater owners if water in saline aquifers will be displaced as well as acquisition of the rights to the space into which the CO_2 will be injected.[117]

Sequestering emissions in depleted oil and gas reservoirs will implicate subsurface pore space rights if the activity could interfere with mineral rights. There is a developed body of law relating to the subsurface injection of wastes generated by oil producers and chemical companies, CO_2 for enhanced oil recovery, and natural gas for storage from which to draw comparisons. Although saline formations will likely be the predominant storage structure in the long term due to their large storage capacity, initially most geological sequestration will likely occur in depleted oil and gas reservoirs, because there is existing subsurface data about these structures due to EOR activities, and selling CO_2 for EOR operations can help offset some of the CCS costs.[118]

State law traditionally governs property rights and it is highly likely that the states will continue to play a role with CCS-related property rights issues.[119] Federal law could potentially clarify some aspects of property ownership associated with CO_2 sequestration without completely preempting state action, such as the approach to eminent domain that will be discussed below.

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115. PRODUCED WATER SOCIETY, *Produced Water Facts*, http://producedwatersociety.com/index.php/produced_water_facts/ (last visited Mar. 22, 2012)("65% of the produced water generated in the US is injected back into the producing formation, 30% into deep saline formations and 5% is discharged to surface waters.")

116. Vanessa Finch et al., *CCS Briefing Paper #2: Subsurface Ownership Rights* (Dec. 12, 2008), *available at* http://dnr.state.co.us/SiteCollectionDocuments/CCS%20DOCS/SubsurfaceOwnershipRights.pdf

117. *Id.*

118. MASS. INST. OF TECH., THE FUTURE OF COAL: OPTIONS FOR A CARBON-CONSTRAINED WORLD 91 (2007), *available at* http://web.mit.edu/coal/The_Future_of_Coal.pdf.

119. *See, e.g.* Wendy Jacobs et. al, *Proposed Roadmap For Overcoming Legal and Financial Obstacles to Carbon Capture and Sequestration* (Mar. 2009) (Discussion Paper, Print); Flatt, *supra* note 114.

a. Ownership of Pore Space

To the extent that there is a reasonably foreseeable use of the pore space that houses the resources, there is likely to be a protectable property interest there as well. Acquiring property rights to the entire area in which a CO_2 plume might migrate would provide the greatest protection against common law claims of nuisance and trespass for entities sequestering CO_2. Although courts have been reluctant to uphold trespass claims in the absence of actual economic damage to the subsurface,[120] trespass is a plausible claim for the geophysical subsurface migration of CO_2, as it is a viable cause of action for even very minor violations. It is also possible that migrating or leaking CO_2 could constitute a public or private nuisance if it harms nearby soil, surface water, groundwater, or mineral resources, or if it negatively impacts human health.

Several factors complicate the acquisition of pore space. Property rights in the United States are divided into surface estates and mineral estates, and in areas where subsurface minerals are present, the surface owner may have conveyed the mineral rights to a third party. The mineral estate owner has a right to use the pore space for mineral extraction, including the injection of CO_2 for enhanced oil recovery. The majority of courts hold that once all minerals have been exhausted, the surface owner retains the right to the depleted pore space. Wyoming, North Dakota, and Montana have adopted legislation vesting ownership of the subsurface pore space with the surface owner.[121] Both Montana and Wyoming allow pore space to be severed and transferred as a distinct property interest. North Dakota does not allow severance, though the surface owner may lease pore space.

In states that have not clarified pore space ownership, the surface owner will likely retain ownership in the absence of a deed expressly conveying pore space to the mineral owner.[122] Wyoming, North Dakota, Texas, West Virginia, Oklahoma and Montana have legislated for the primacy of pore space for the

120. *See, e.g.,* Chance v. BP Chemicals, Inc., 670 N.E.2d 985 (Ohio 1996). ("Physical damage or actual interference with the reasonable and foreseeable use of the properties must be demonstrated."), FPL Farming, Ltd. v. Texas Natural Res. Conservation Comm'n, 03-02-00477-CV, 2003 WL 247183 (Tex. App.—Austin Feb. 6, 2003, no pet.) ("Some measure of harm must accompany the migration for there to be impairment."), Coastal Oil & Gas Corp. v. Garza Energy Trust, 268 S.W.3d 1 (Tex. 2008)(holding that there was no cause of action for subsurface trespass, because trespass requires actual injury, which should not be inferred when physical invasion occurs far below the surface.)

121. S.B. 498, 61st Leg. (Mont. 2009); S.B. 2139, 61st Assemb. (N.D. 2009); H.B. 89, 61st Leg. (Wyo. 2012).

122. Duhig v. Peavy-Moore Lumber Co., 144 S.W.2d 878, 880 (Tex. 1940) (A right not expressly conveyed is retained. Surface owners typically retain property right unless they have expressly conveyed those rights to another entity.)

extraction of minerals over pore space for storage, meaning that mineral estate owners may prevent the injection of CO_2 that interferes with their mineral rights, at least until the formation is depleted of minerals.[123] Complicating the matter is the fact that it is difficult to predict what minerals will be profitable for extraction in the future due to technological advances and commodity pricing, and furthermore, it is not always clear when all minerals have been exhausted. As a result of these complications, it would be prudent for a sequestration project to obtain the consent of both the surface and mineral estate owners.

While ownership of pore space for CO_2 storage raises some challenging legal issues, the longstanding body of law regarding ownership of and access to subsurface oil, gas, and minerals, typically governed at the state level, suggests that the states generally have the capacity to develop the appropriate regulatory structure for subsurface property rights. States are able to assess and enforce ownership, access, and extraction. Like CO_2 storage, oil, gas, and mineral resources may cross state boundaries, potentially subjecting entities seeking to purchase rights to the resources to different legal regimes—a situation that those seeking to extract the resources may prefer to avoid, but one that has proved workable over the years. The appropriateness of a federal role regarding pore space ownership could turn on whether rapid acquisition of pore space is desirable or property owners prove unwilling to grant access to the storage space therefore delaying or blocking storage in sites with the best geologic features for safe, stable, cost-effective sequestration.

Some scholars have suggested the federal government could pave the way for widespread deployment of CCS by declaring deep saline aquifers to be a national resource under the control of the federal government,[124] as was done with airspace rights when a significant public interest developed in airspace.[125] In addition to clarifying ownership for sequestration of CO_2, this would prevent potential battles over ownership of water supply if it ever becomes necessary to tap deep saline aquifers for drinking water or agricultural purposes. Others argue that this would be politically unfeasible, as there is a history of conveying, buying,

123. S.B. 498, 61st Leg. (Mont. 2009); S.B. 2095, 61st Assemb. (N.D. 2009); S.B. 1387, 81st Leg. (Tex. 2009); H.B. 2860, 78th Leg. (W. Va. 2009); H.B. 57, 61st Leg. (Wyo. 2012); S.B. 610, 51st Leg. (Okla. 2009).

124. *See, e.g.* CARBON DIOXIDE CAPTURE AND STORAGE RD&D ROADMAP, *supra* note 5.

125. 72 Stat. 739, 49 U.S.C. 1301 (24) (1982) (Congress redefined "navigable airspace" to mean "airspace above the minimum altitudes of flight prescribed by regulations issued under this chapter, and shall include airspace needed to insure safety in take-off and landing of aircraft.")

selling and developing subsurface rights that was not present with rights to airspace, and that this action would be detrimental to public acceptance of CCS.[126] As was discussed prior, there is no precedent for determining ownership of pore space in subsurface saline formations. This is an unresolved issue that will need clarification going forward. This is not an action that necessarily needs to be taken at the federal level, however, and could be determined on a state-by-state basis, as other subsurface property ownership issues have been.

To mitigate potential common law claims, federal regulation could require ownership of all potentially affected property rights in order to secure an injection permit, leaving the states to determine the method and parameters of acquisition.[127] It is in the interest of states to pass legislation clarifying pore space ownership in order to create the certainty needed to attract projects to that state, as Montana, North Dakota, and Wyoming have done.[128] Another approach to mitigating the impact of common law liability claims is through federal legislation that limits trespass liability to cases of material impairment exceeding a certain dollar amount where operators are acting pursuant to a validly issued permit.[129]

b. Acquisition of Pore Space

A related complication is the sheer number of landowners from whom a sequestration project would need to acquire pore space in areas of the country where lot sizes are small. A plume of CO_2 could potentially spread to cover as much as 4,500 to 11,000 square kilometers.[130] In addition to the cost of negotiating with and acquiring property rights from such a large number of landowners, it is possible that one or two holdouts could prevent a project from moving forward by refusing to sell or by demanding unreasonably high prices for the use of their pore space. States have successfully addressed similar issues in the context of natural gas storage and oil and gas production.

126. *See e.g.* Klass, *supra* note 72; Gresham, R. Lee, GEOLOGIC CO2 SEQUESTRATION AND SUBSURFACE PROPERTY RIGHTS: A LEGAL AND ECONOMIC ANALYSIS (2010)(dissertation, *available at* http://repository.cmu.edu/cgi/viewcontent.cgi?article=1007&context=dissertations).

127. *See, e.g.* Flatt, *supra* note 114.

128. S.B. 498, 61st Leg. (Mont. 2009); S.B. 2139 61st Assemb. (N.D. 2009); H.B. 57, 60th Leg. (Wyo. 2009).

129. *See e.g.* CCSREG PROJECT, POLICY BRIEF: GOVERNING ACCESS TO AND USE OF PORE SPACE FOR DEEP GEOLOGIC SEQUESTRATION, *available at* http://www.ccsreg.org/pdf/PoreSpace_07132009.pdf (March 11, 2011) [hereinafter POLICY BRIEF]; Jacobs, *supra* note 119.

130. Lee Gresham et. al., *Implications of Compensating Property Owners for Geologic Sequestration of CO2*, 44 ENVTL. SCI. & TECH. 2897, 2900 (2010).

Natural gas storage rights have historically been obtained through eminent domain, as the property right belongs to the surface owner. [131] In the context of oil and gas extraction, mineral rights are implicated and are obtained through unitization, which allows project operators to force holdouts to participate (with compensation) once the entity seeking to purchase the resource has obtained the minimum percentage of approvals as defined by state law.[132]

Both unitization, for sequestration of CO_2 in oil and gas reservoirs, and eminent domain, for sequestration of CO_2 in saline reservoirs, hold promise for CCS. Like acquisition of pore space, current state laws suggest that the states can, and in many cases already are, addressing the issue. There is not, however, uniformity among the state laws. For example, Montana, North Dakota, and Wyoming all allow for unitization upon the acquisition of a certain percentage of storage capacity.[133] Wyoming's House Bill 80 allows for unitization if the owners of 80 percent of the pore space storage capacity consent to the injection. North Dakota and Montana both set the threshold at 60 percent. Because pore space extends both vertically and horizontally, it may prove difficult to calculate with certainty the storage potential of any given plot of land above a geologic sequestration site, and it will thus be difficult to determine when the threshold of consent has been reached.[134] This will be particularly difficult in areas where smaller plots of land are involved, as will likely be the case in northeastern states.

Louisiana, North Dakota, West Virginia, and Oklahoma have declared geologic sequestration to be in the public interest, paving the way for the operator to exercise the power of eminent domain.[135] Louisiana has taken this a step further, providing a process by which project operators can use the power of eminent domain. It is also possible that federal regulation could declare the geologic sequestration of CO_2 to be in the public interest, which would facilitate the use of eminent domain in all states.[136]

131. Interstate Oil and Gas Compact Commission, *Storage of Carbon Dioxide in Geologic Structures: A Legal and Regulatory Guide for States and Provinces* (Sept. 2007).

132. *Id.*

133. S.B. 498, 61st Leg. (Mont. 2009); S.B. 2095, 61st Assemb. (N.D. 2009); H.B. 89, 61st Leg. (Wyo. 2012).

134. THE ENERGY POLICY INSTITUTE, ANALYSIS OF EXISTING AND POSSIBLE REGIMES FOR CARBON CAPTURE AND SEQUESTRATION: A REVIEW FOR POLICYMAKER (Apr. 2011).

135. H.B. 661, Reg. Session (La. 2009); S.B. 2095, 61st Assemb. (N.D. 2009); H.B. 2860, 78th Leg. (W. Va. 2009); S.B. 610, 53rd Leg. (Okla. 2012). Only Louisiana, via H.B. 661, has established a process that would allow developers to obtain a certificate: "The commissioner can grant a certificate of public convenience and necessity to a storage operator, subject to certain findings, which authorizes the operator to exercise the power of eminent domain."

136. *See e.g.* POLICY BRIEF, *supra* note 129; Flatt, *supra* note 114.

This would allow the states to determine whether they would like to allow for the use of eminent domain, with federal action providing a means for implementing the state's decision. In addition, federal legislation could clarify that mineral rights, as a property interest, are subject to eminent domain. In some projects, the federal power of eminent domain may be necessary in the absence of a state policy to ensure that CCS projects are able to move forward despite holdouts. To encourage public support of CCS, it would be prudent to require a good faith effort to negotiate with property owners as well as appropriate compensation before federal eminent domain becomes an available option.

c. Ownership of Sequestered CO_2

A final property rights issue involves the ownership of sequestered CO_2, which could arise in the context of determining who bears liability for harm incurred due to the leakage or migration of CO_2. Title to injected natural gas has historically been determined by either the "non-ownership theory" or the "ownership-in-place theory," though all states now follow the latter.[137] Early jurisprudence (1930's) followed the "non-ownership theory," whereby ownership of natural gas is lost upon injection. Later courts rejected this theory outright,[138] and the "ownership-in-place theory" gained steam in the 1960s. According to this theory, title to injected gas is not lost when the gas is injected into a natural underground reservoir for storage purposes. Common law thus indicates that ownership of injected natural gas is with the injector. Analysts have suggested that courts would apply the same reasoning to ownership of sequestered CO_2.[139] Although existing case law is specific to natural gas storage and therefore does not have direct application to CO_2 storage, it is valuable as precedent. Courts have not been consistent in their terminology, using the term "injected gas" in lieu of "injected natural gas" in several cases. If this language were taken literally, these cases could apply to injected CO_2.[140] Some state laws addressing CCS include provisions regarding the ownership of sequestered CO_2. In

137. M.A. De Figueiredo, D.M. Reiner, P.L. Joscow, K.A. Oye & H.J. Herzog, Regulating Carbon Dioxide Capture and Storage 6, Mass. Inst. of Tech. Ctr. for Energy and Envtl. Policy Research (2007).

138. New Meadows Holding Co. v. Washington Water Power Co., 102 P.2d 495 (1984).

139. *See, e.g.* M.A. De Figueiredo, D.M. Reiner, & H.J. Herzog, *Framing the Long-Term In Situ Liability Issue for Geologic Carbon Storage in the United States,* 10 MITIGATION AND ADAPTION STRATEGIES FOR GLOBAL CHANGE 647-657, 648 (2005).

140. *Id.*

Montana, Wyoming, and North Dakota, ownership of sequestered CO_2 remains with the operator.[141] In Oklahoma and Texas, ownership remains with the operator unless otherwise provided by contract.[142]

Viewing CO_2 ownership as an isolated issue, a single standard for CO_2 ownership does not seem critical to the development of a CCS network unless a sequestration site involves multiple jurisdictions (multiple states, or some combination of a state, tribal, or federal lands). As stated above, however, ownership of sequestered CO_2 may be tied to liability issues, in which case a governmental entity that accepts liability for the CO_2 may need to directly address the ownership issue. See section (V)(C)(3) supra for a discussion of operational and long-term liability.

2. Interstate Sequestration Facilities

Many geologic basins that contain formations suitable for geologic sequestration underlie more than one state, and it is very likely that some large-scale CCS projects will cross state borders.[143] For example, the Vermillion Basin that spans the borders of Wyoming and Colorado could serve as a CO_2 storage space once the oil and gas wells have been depleted. The Mount Simon Sandstone, a deep geologic saline formation that spans much of the Midwestern United States, is another example of a storage site that would cross state borders.[144] Although some states have taken action to clarify property-rights issues including access to and ownership of pore space, and interaction between mineral and surface rights, property rights issues currently vary widely from state to state.[145] Project developers of sequestration projects that cross state borders may face various state-level rules and requirements. Without comprehensive and predictable permitting rules, project developers may not be willing to invest the time and capital required to build large-scale CCS projects.[146] Disputes would likely arise between states if

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141. Act Regulating Carbon Sequestration, S.B. 498, Ch. 474 (Mont. 2009), Act Relating to Carbon Sequestration, H.B. 58, 60th Leg. (Wyo. 2008); Geologic Storage of Carbon Dioxide, S.B. 2095, 61st Assemb. (N.D. 2009).

142. Carbon Capture and Geologic Sequestration Act, S.B. 610, 51st Leg. (Okla. 2009), Act Relating to the Implementation of Projects Involving the Capture, Injection, Sequestration, or Geologic Storage of Carbon Dioxide, S.B. 1387, 81st Leg. (Tex. 2009).

143. See e.g. Policy Brief, supra note 129.

144. Press Release, Battle, Success Marks C02 Injection Into Mt. Simon Sandston (Oct. 22, 2009), *available at* http://216.109.210.162/userdata/Press/No_51_East_Bend_Injection_press_release.pdf.

145. Task Force Report, supra note 18, at L-4.

146. CSSReg Project, Carbon Capture and Sequestration: Framing the Issues for REGULATION 71 (Jan. 2009), *available at* http://www.ccsreg.org/pdf/CCSReg_3_9.pdf.

one was receiving all of the economic benefits of a sequestration project while another was housing migrated CO_2 from that project. Finally, it is not clear who would accept liability for injected CO_2 that crosses into a state that does not have a liability structure in place for CCS.

The nature of the issue implies some role for the federal government, as more than one state is necessarily implicated, though the extent of federal involvement is open to discussion. The federal role could be as involved as allowing for eminent domain in cases where cross-border landowners cannot agree to terms, or as removed as providing dispute resolution when states or landowners disagree. Other options for the federal government include: (1) providing a model rule tailored to interstate sequestration for the states to follow, or (2) providing federal funds to compensate states with interstate sequestration facilities that are not on the injection side and are therefore not reaping the economic benefits of the sequestration project.

Policy makers may need to create a regional coordination mechanism, such as an interstate or interagency compact or a memorandum of understanding (MOU) for CCS projects that cross state borders.[147] This could be done at the federal level, by amending the SDWA UIC Class VI well rule, or at the state level, by amending existing state level permitting programs, or writing a regional coordination mechanism into new state legislation. These amended or new rules could expressly authorize the negotiation and development of regional coordination mechanisms among all state- and federal-level UIC regulators who have permitting and regulatory authority over geologic sequestration projects.[148] A regional coordination mechanism would serve to establish obligations with respect to permitting, monitoring, and enforcement responsibilities. This approach could apply to sequestration projects involving Tribal lands, where a contract between the Tribal UIC permitting authorities and the federal government could be established, expressly stating responsibilities for all permitting, monitoring, and enforcement activities.

Development of an interstate compact or MOU would ensure consistency among the agencies with authority to permit CCS operations and would provide developers with a single set of regulations with which to adhere, thus reducing uncertainty surrounding permitting and operational requirements. It should be noted that the U.S. Department of Energy recommends the

147. *Id.* at 67.
148. *Id.* at 85.

establishment of memorandums of agreement (MOA) as a Best Management Practice (BMP) for oil and gas extraction activities where jurisdictional authority is split between state agencies.[149] Though not directly related to geologic sequestration activities, this practice could serve as a model for geologic sequestration projects that cross state borders.

3. Liability

The compression, transport, injection, and storage of CO_2 carries with it inherent risks, and the widespread implementation of CCS therefore requires a stable regulatory framework that addresses liability, as that issue has the potential to de-rail otherwise feasible projects. A stable liability framework would encourage investment in CCS projects by resolving uncertainties and decreasing risk for stakeholders. In the absence of a federal regulatory framework, judicial precedent ("common law") and existing state law will determine who bears liability for damages incurred from CCS, and what form that liability takes. Liability associated with capturing, transporting and storing CO_2 can be divided into three categories: operational liability; climate liability; and post-injection liability.[150]

a. Operational Liability

Operational liability includes environmental, health, and safety risks associated with the capture, transport, and injection of CO_2. It will most likely arise as a result of well or pipeline failure. In the context of a regulatory structure that limits greenhouse gas emissions, leaks of CO_2 to the surface could result in climate liability (e.g., requiring an operator to account for the leaked CO_2 by, for example, purchasing emission allowances or carbon offsets equal to the amount released).[151] If the mechanism used to regulate greenhouse gas emissions were a cap-and-trade emission-trading scheme, climate liability would likely take the shape of contractual liability for the loss of captured carbon during the operational and post-injection phases, including capture and transportation.[152] Under a cap-and-trade based system it would also be necessary to account for

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149. U.S. DEP'T OF ENERGY & NATIONAL ENERGY TECHNOLOGY LABORATORY, STATE OIL AND NATURAL GAS REGULATIONS DESIGNED TO PROTECT WATER RESOURCES 7 (May 2009), *available at* http://www.energyindepth.org/wp-content/uploads/2009/03/oil-and-gas-regulation-report-final-with-cover-5-27-20091.pdf.

150. Framing the Long-Term In Situ Liability Issue, supra note 139, at 648-49.

151. *See, e.g.,* Monast, *supra* note 112, at 20-22.

152. Hart, supra note 12, at 9.

leaked CO_2 to ensure that the cap on emissions is maintained at the target level.

Contaminated groundwater is another potential liability concern. There are two possible ways for groundwater quality to be affected by the geologic sequestration of CO_2. When injected into a saline aquifer, CO_2 could displace the native brine in the formation, which could then be pushed into sources of drinking water. In addition to rendering the water undrinkable, this infiltration of saline water into groundwater could negatively impact or even eliminate some land for agricultural use.[153] The second risk to groundwater is that the CO_2 itself could detrimentally affect the overlying fresh groundwater[154] or could mobilize naturally occurring toxic metals in the formation, such as sulphates or chloride, which could in turn enter the drinking water supply. This could change the odor, color, or taste of the water, and at high levels could exclude the water from use for irrigation or drinking.[155]

A final concern is that the injection of large volumes of fluid underground has been known to induce seismicity, which creates the potential not only for earthquakes, but also for the loss of the sequestered CO_2.[156] Recent earthquakes in England and in Arkansas are attributed to the underground disposal of wastewater from natural gas extraction operations.[157] In the 1960s, the injection of wastewater under the Rocky Mountain Arsenal near Denver, Colorado, resulted in a series of earthquakes, including one at a magnitude of 4.3.[158] The subsurface is not porous at the Rocky Mountain Arsenal, and the injection resulted in widespread pressure buildup in the rock's fractures. In contrast, the geologic sequestration of CO_2 for CCS

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153. J. STEPHENS AND D. KEITH, HEALTH, SAFETY AND ENVIRONMENTAL RISKS OF CO2 STORAGE 8-7, http://science.uwaterloo.ca/~mauriced/earth691-duss/CO2_Materials_From_ARC_APEC_Beijing_2006 /CarSeq_Module8.pdf (last visited Mar. 19, 2012).

154. Mark G. Little and Robert B. Jackson, *Potential Impacts of Leakage from Deep CO2 Geosequestration on Overlying Freshwater Aquifers*, 44 Environ. Sci. Technol. 9225, 9225 (2010).

155. Metz, *supra* note 25, at 63.

156. WORLD RESOURCES INSTITUTE, CCS GUIDELINES: GUIDELINES FOR CARBON DIOXIDE CAPTURE, TRANSPORT, AND STORAGE 74 (2008), *available at* http://pdf.wri.org/ccs_guidelines.pdf [hereinafter WRI GUIDELINES].

157. *Shale Gas Fracking: MPs Call for Safety Inquiry After Tremors*, BBC NEWS LANCASHIRE, Jun. 8, 2011, *available at* http://www.bbc.co.uk/news/uk-england-lancashire-13700575;Sarah Eddington, *Arkansas 'Fracking' Site Closures Extended as Earthquake Link Studied*, HUFFPOST GREEN, Mar. 17, 2011, *available at* http://www.huffingtonpost.com/2011/03/18/arkansas-fracking-earthquakes_n_837485.html.

158. D.M. Evans, *The Denver Area Earthquakes and the Rocky Mountain Arsenal Disposal Well*, 3 THE MOUNTAIN GEOLOGIST 23, 28 (1966), *reprinted in* Engineering Case Histories No. 8, 25, GEOLOGICAL SOCIETY OF AMERICA (1970).

would be conducted in areas with a porous rock structure, which is better able to absorb the injectate without the pressure buildup associated with induced seismicity. Still, sedimentary rocks can be and often are highly fractured, and increased seismicity cannot be excluded as a risk even in areas with a porous rock structure. Careful site selection with consideration of pressure thresholds would further reduce the risk, as would microseismic monitoring during and after injection.[159]

The risks associated with the operational phase of CCS, including the capture, transport, and injection of CO_2, are not expected to be radically different than those encountered in any large-scale industrial activity and can be addressed using conventional strategies.[160] Ideally, state or federal policy makers will design a CCS regulatory structure to diminish identified risks or to avoid them altogether through risk management. This could be done at the federal level with state implementation, through the SDWA UIC Class VI well rule. The permitting requirements of the Class VI injection well rules compel project owners and operators to take steps to limit liability through design and operational requirements. States have the option of setting stricter Class VI well permitting requirements as they see fit, which allows each state to respond to the needs and demands of its citizens.

An additional means of managing operational liability is to require adequate capitalization or insurance to cover contingencies. States that have enacted CCS legislation have taken this approach to operational liability.[161] For example, Montana law holds the operator liable for "the operation and management of the carbon dioxide injection well, the geologic storage reservoir, and the injected or stored carbon dioxide."[162] The law further requires a bond or other surety adequate to cover incurred liability.[163]

A mechanism for funding liability will be necessary to address any problems that arise at each stage of CCS. Requiring owners and operators to demonstrate financial responsibility for covering liability in the form of insurance, surety bonds, guarantees, letters of credit, or other evidence of financial responsibility is an appropriate risk management tool for most stages of CCS. This approach is used in several pieces of existing

159. WRI GUIDELINES, *supra* note 156, at 74.
160. TASK FORCE REPORT, supra note 18, at 72; *Framing the Long-Term In Situ Liability Issue*, *supra* note 139, at 648.
161. *See, e.g.*, S.B. 498, 2009 Leg., (Mont. 2009); H.B. 661, 2009 Sess., (La. 2009).
162. S.B. 498, 2009 Leg., (Mont. 2009).
163. *Id.*

environmental legislation, including the SDWA, CERCLA, and RCRA. The posting of a bond or the acquisition of insurance signals the operators' willingness to comply with federal regulations.

Bonding and insurance are effective for well-understood risks over well-defined time frames.[164] As such, the usefulness of this approach will be limited to the time of sequestration, closure, and a limited post-closure period. Despite this limitation, insurance and bonding could be an effective means of ensuring the availability of adequate financial resources for liability arising during the operational period. It would also compel operators to internalize the costs of injection and monitoring into their sequestration plan. Insurers have indicated a willingness to issue coverage through site closure for conventional operational risks but will likely be unable to underwrite the long-term risks of sequestration.[165] The sequestration of CO_2 is a novel challenge for the insurance industry that is made more difficult by the long time frame during which liability can be incurred and the uncertainty of how the tort process will play out in the context of CCS.[166] Analysts have suggested that environmental impairment liability (EIL) coverage may be more feasible than comprehensive general liability coverage.[167] EIL policies are relatively new and are used for claims made on past environmental damages, such as those made through CERCLA's liability structure. EIL should be considered as a potentially viable mechanism for insuring both the operational and post-closure phases of CCS; though it is as yet unclear if this approach will be practicable.

If insurance coverage proves to be a viable means of protecting against operational liability, this can be accomplished through the private sector, and it will not be necessary for the federal government to step in to assist the states. However, if conventional commercial insurance coverage proves to be difficult for operators to secure, it may be necessary for the federal government to provide other financial security mechanisms, such as a liability cap, as the state governments may not have the means to cover large liability claims.

A liability cap could be used in conjunction with insurance, whereby the operator would be responsible for damages up to a certain point and a government fund would cover anything beyond that point. This approach is used in the Price-Anderson

164. Flatt, *supra* note 114, at 224.
165. TASK FORCE REPORT, *supra* note 18, at 70-71.
166. Klass, *supra* note 72, at 164.
167. *Id.* at 163-64.

Act, which was originally passed in 1957 and has been renewed four times since, most recently in 2005.[168] The Act establishes a framework for payments to the public in the case of a nuclear accident. It mandates private insurance coverage for the industry but caps liability, which provides incentives for insurance companies to offer the mandated insurance. Liability responsibility lies with the industry through the acquisition of insurance, and also with the federal government, which assumes liability beyond the cap (currently set at $10 billion). The Terrorism Risk Insurance Act also uses a liability cap, limiting insurance claims for terrorist-related losses to $100 billion. This measure, which is set to expire in 2014, was created to help the insurance industry recover from 9/11 and to provide a transition period during which they could develop policies for responding to terrorist acts.[169]

The advantage of a liability cap is that it would remove the threat of extreme liability and would thus increase market penetration. A downside of a liability cap is that it could potentially create a moral hazard by absolving operators of liability and would externalize the cost of liability beyond the cap to taxpayers. The Deepwater Horizon oil spill in 2010 provides an example of the potential shortcomings of a liability cap. Following the Exxon Valdez oil spill in 1990, Congress passed the Oil Pollution Act, which made the company that owns the spilled oil responsible for cleanup, but also capped liability for damages at $75 million if the company did not violate any regulations leading up to the spill.[170] Following the Deepwater Horizon disaster, which spilled 4.9 million barrels of oil into the Gulf of Mexico and cost an estimated $40 billion in cleanup and damages,[171] the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling report to the president recommended lifting the cap, though Congress has not yet taken action to do so.[172] Another concern with a liability cap is with public perception. It may be detrimental to the public's opinion

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168. Price-Anderson Nuclear Industries Indemnity Act, 42 U.S.C. §2210 et. seq (2006).

169. *Framing the Long-Term In Situ Liability Issue*, *supra* note 139, at 652.

170. Oil Pollution Act, 33 U.S.C. §2701 et. seq (1990).

171. Joel Achenbach and David A. Fahrenthold, *Oil Spill Dumped 4.9 Million Barrels into Gulf of Mexico, Latest Measure Shows,* THE WASHINGTON POST, Aug. 3, 2010, *available at* http://www.washingtonpost.com/wp-dyn/content/article/2010/08/02/AR2010080204695.html.

172. NATIONAL COMMISSION ON THE BP DEEPWATER HORIZON OIL SPILL AND OFFSHORE DRILLING, DEEP WATER: THE GULF OIL DISASTER AND THE FUTURE OF OFFSHORE DRILLING: THE REPORT TO THE PRESIDENT 245-246 (Jan. 2011), *available at* http://www.oilspillcommission.gov/sites/default/files/documents/DEEPWATER_ReporttothePresident_ FINAL.pdf.

of CCS to be associated with catastrophic events such as nuclear meltdown and terrorist acts, when the likelihood of large-scale disaster is much lower for sequestered CO_2 than with scenarios currently subject to a liability cap.

b. Long-term Liability and Stewardship

Post-injection liability arises from risks associated with the long-term sequestration of CO_2. The Interagency Task Force on Carbon Capture and Storage identified two major types of post-injection liability in their August 2010 report: obligations to comply with regulatory standards, and obligations to compensate parties for legally compensable losses or damages.[173] Post-injection liability garners much debate as there is little precedent for managing the risks associated with injecting large quantities of CO_2 into the earth and leaving it there for thousands of years. Much of the debate centers on where responsibility should lie as between private developers, state governments and federal governments for tort liability, contract liability, and liability under existing and future state and federal legislation.

Managing post-injection liability will require implementing less conventional strategies than those required for operational liability and climate liability. The majority of academic writing advocates a transfer of liability to a government entity at some point during the post-injection period coupled with an industry financed trust fund. Transferring liability reflects a policy decision to appropriate the long-term responsibility of sequestering carbon to the public at large, which will reap the long-term benefits of this technology. Under this approach, liability is divided into two time periods, whereby responsibility lies with the operator of a sequestration facility for the first time period and the state or federal government assumes liability for the second time period.[174] Under this arrangement, the operator is liable when the risk is the greatest, during injection and immediately afterward, which promotes appropriate safety precautions and protects the state from excessive liability. To avoid a moral hazard, liability could remain with the operator for willful violations of regulatory requirements.

The transfer of liability from the operator to the state or federal government can occur as a time-period based transfer of liability or as a performance based transfer of liability. Both approaches, which ultimately transfer liability to a governmental entity, have the drawback of potentially costing taxpayers.

173. TASK FORCE REPORT, *supra* note 18, at 68.
174. Bidlack, *supra* note 26, at 221.

Despite this, states will likely be willing to assume liability in order to facilitate investment in CCS projects in the state. While competing for the FutureGen Project, for example, both Texas and Illinois passed legislation that would transfer liability to the state for that project.[175] A hybrid of the two approaches has been used by states that have legislated a post-injection transfer of liability. For example, in Montana, a "certificate of completion can be issued upon determination that the injected CO2 is stable and will be retained in the geologic storage reservoir, not less than 15 years after carbon dioxide injections end."[176]

The Carbon Capture and Storage (CCS) Deployment Act of 2010 draft legislation,[177] the Report of the Interagency Task Force on Carbon Capture and Storage, and the CCS Regulatory Project model legislation all advocate transferring liability to a federal entity, whereas the Interstate Oil and Gas Compact Commission (IOGCC) model legislation and existing state legislation advocate transferring liability to a state entity. It should be noted that emerging state legislation currently accepts liability because there is not another option, as there is not yet a procedure by which the federal government would assume liability post-transfer. Some state legislation explicitly addresses this. For example, in Montana, managing the geologic storage reservoir post-transfer is the state's responsibility "until the federal government assumes liability."[178]

Even where states or the federal government assume liability, operators may still be liable under existing federal environmental legislation, from which states cannot provide exemption. Thus, while states can lessen potential liability for operators, they cannot provide total indemnification. The EPA is currently considering how RCRA hazardous waste requirements should apply to CO_2 injectate.[179] One option is to exclude CO_2 injectate from the definition of solid waste. The EPA has followed this approach for domestic sewage, wastes associated with the production of oil and gas, and certain mining and nuclear wastes.[180] In 1980, Congress exempted waste produced

175. H.B. 149, 79th Leg. (Tex. 2006); S.B. 1704, 97th Gen. Assemb. (Ill. 2007).

176. S.B. 698, 2009 Leg. (Mont. 2009).

177. Press Release, United States Senator Jay Rockefeller, Rockefeller, Voinovich Unveil Bill to Develop and Deploy Carbon Capture and Sequestration Technologies (Mar. 22, 2010), *available at* http://rockefeller.senate.gov/public/index.cfm/press-releases?ID=dda6a330-947f-42e6-8f99-ce480172a8a7. (Senators John D. Rockefeller IV (D-WV) and George V. Voinovich (R-OH) released draft legislation to promote Carbon Capture and Storage (CCS), called The Carbon Capture and Storage (CCS) Deployment Act of 2010 on March 22, 2010.)

178. S.B. 498, 2009 Leg. (Mont. 2009).

179. TASK FORCE REPORT, *supra* note 18, at 60.

180. Resource Conservation and Recovery Act, 42 U.S.C. § 6921 (2000).

during the exploration, development and production of crude oil, natural gas and geothermal energy from the requirements of RCRA due to the importance of these products to the public welfare.[181] A similar exemption could be made for the geologic sequestration of CO_2 due to the importance of reducing greenhouse gas emissions without burdening the energy sector with regulations that would interfere with power generation.

It is also possible that CO_2 injectate would qualify for a recycling exemption from RCRA to the extent that it is being stored underground for later use in EOR operations.[182] To meet the recycling exemption, the waste must be a substitute for a commercial product or raw material. This would not exempt the majority of injected CO_2, however, as EOR's demand for CO_2 would not be enough to account for all injected CO_2. A final option is for facilities capturing CO_2 to adjust their process so that the resulting injectate does not contain impurities above the toxicity characteristic concentrations allowed in RCRA and CERCLA, which would exempt the waste stream from classification as a hazardous waste or substance.[183] The federal government could define a level of purity above which RCRA and CERCLA would not apply to facilitate this final option.

A similar issue to long-term liability, and one that policymakers are likely to manage with a similar mechanism, is long term stewardship of the sequestration site, including plugging and abandoning the well after injection is completed, monitoring, measuring and verifying the CO_2 plume, and taking corrective action to remediate any problems that arise. The issue that needs clarification regarding stewardship is twofold: who will be responsible for carrying out site stewardship for an indefinite period of time, and who will bear the cost?

A potential approach to funding long-term stewardship and liability is to create a specialized fund, financed by the operators of the sequestration facilities. This fund would pool the risks of geologic sequestration. Similar funds include the Superfund, the Oil Spill Liability Trust Fund, and the National Flood Insurance Act of 1968. Contributions would be made to the fund based on an injection fee on a per-ton-of-carbon-sequestered basis,[184] and could be weighted according to the level of risk at the particular

181. Regulatory Determination for Oil and Gas and Geothermal Exploration, Development and Production Wastes, 53 Fed. Reg. 25,446, 25,446 (July 6, 1988).

182. Klass, *supra* note 72, at 126.

183. *See* TASK FORCE REPORT, *supra* note 18, at F-4; CARBON DIOXIDE CAPTURE AND STORAGE RD&D ROADMAP, *supra* note 5.

184. Klass, *supra* note 72, at 174.

site.[185] The fund could be administered by the state or federal government or by a certified private third party.

This approach could work in tandem with a transfer of liability and stewardship responsibility to the state or federal government. Because the costs would be paid by the industry in advance, the problem of an entity no longer existing at the time liability is incurred would be avoided. The fund could also be used to finance federal or state oversight and monitoring activities, which, if conducted properly, could lessen the need for emergency response funding. It would minimize taxpayer subsidy of liability, which would bode well for public perception of geological sequestration.[186] This approach would also be beneficial to injured parties, who would not need to trace their injury to specific operator as long as they could show that their injuries resulted from the negligence of *some* operator, as all operators would be paying into the fund.[187]

Disadvantages of this approach include the cost of establishing and administering the fund, which would add to the cost of CCS activities, and the difficulty of maintaining such a funding mechanism for an undetermined period of time, which could possibly be centuries long. This approach would require maintaining large sums of money over long periods of time, which could have significant opportunity costs.

The Oil Pollution Act's (OPA) Trans-Alaska Pipeline Liability Fund (TAPL Fund) uses a variation the industry-funded trust fund.[188] This system creates a fund for the prompt payout of claims, but also allows claimants to seek tort damages, including punitive damages, in excess of the fund's maximum payout.[189] This "compensation fund plus tort liability" approach is advocated in some academic writing as a way to avoid the moral hazard associated with indemnifying facility operators while still providing them some predictability. It is also suggested that the liability cap within the fund be lowered for early projects ("first movers") to facilitate the quick transition from demonstration projects to commercial deployment.[190]

Although the risks associated with the long-term sequestration of CO_2 are small in comparison to the risks associated with the long-term storage of nuclear waste, the

185. Level of risk analysis might include the physical characteristics of the reservoir and its proximity to population centers.

186. Mark Anthony de Figueiredo, *The Liability of Carbon Dioxide Storage* 392 (Feb. 2007) (Mass. Inst. of Tech. Ph.D. Dissertation).

187. Flatt, *supra* note 114, at 227.

188. Oil Pollution Act, 33 U.S.C. §2701 et. seq (1990).

189. *See* 33 U.S.C. §§ 2717–2718.

190. Klass, *supra* note 72, at 171.

similarities between the two provide an informative comparison. Both require careful site selection to ensure secure storage over a vast time frame and the allocation of financial responsibility for long-term liabilities. Policymakers may determine, as it was with nuclear, that the federal government is best equipped to handle the long-term stewardship and liability issues presented by CCS and could pass legislation to occupy the field, preempting existing state regulation of long-term liability. In this case, long-term liability and stewardship would fall squarely on the federal end of the cooperative federalist continuum.

It is also possible that states could regulate long-term liability and stewardship. An argument against this approach is the fact that states to not seem to want responsibility for these issues, as is evidenced by their reluctance to address the issue in legislation or to specify that liability will pass to the federal government if and when that is an option. If long-term liability is regulated solely at the state level and some states cannot regulate this issue due to political or fiscal realities, this could limit CCS geographically.[191] The states cannot exempt owners and operators from liability under federal laws such as CERCLA and RCRA, and thus a liability regime managed purely at the state level would not provide complete indemnification for operators.

Due to the drawbacks of a solely federal or state approach to long-term stewardship and liability, a cooperative federalist approach is likely to be the most efficient, with the federal government stepping in to assist the states on the issues that they are unwilling or unable to legislate, or that would be more effectively managed at the federal level. For example, providing a federal liability cap would help to create certainty for the industries involved in CCS as well as the insurance industry, which would facilitate the widespread deployment of CCS as well as a financial instrument for managing liability. It is possible that federal legislation could allow the states to choose whether to manage long-term stewardship and liability on their own or to opt into a federal program. As with the UIC permitting program, if states were ineffective in their stewardship, the federal government would assume such responsibility.

VI. CONCLUSION

Coal continues to play a major role in electricity production in the United States and internationally, and deployment of CCS technologies is a necessary step to limit anthropogenic CO_s

191. TASK FORCE REPORT, *supra* note 18, at 110.

emissions—a major cause of climate change. Regulation of CCS networks raises numerous legal issues, some of which are already governed by state or federal law. Over half of the U.S. states have some type of CCS legislation on the books, and the EPA recently finalized a rule governing injection of CO_2 for CCS. The EPA's rule follows a cooperative federalism framework, with the Agency creating the standards and allowing the states to implement the rule and create more stringent standards if necessary. Numerous other legal issues related to CCS remain unresolved. These too will likely follow the cooperative federalism approach, with the federal government regulating some areas and the states taking responsibility for others. The application of this framework will likely differ, however, depending on the specific issue. With the CCS regulatory framework in the early stages, lawmakers have the opportunity to consider which level of government is best suited to address which issues, taking into consideration, for example, existing law, areas of traditional state authority, the need for a single national standard, and funding requirements. A deliberate approach to these legal challenges can help facilitate construction of an efficient CCS system in a reasonable timeline, thereby reducing overall system costs and providing a significant tool to mitigate climate change.