TOWARDS A LONG-TERM LIABILITY FRAMEWORK FOR GEOLOGIC CARBON SEQUESTRATION

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ABSTRACT

The liability regime governing geologic carbon sequestration will shape the technology's cost-effectiveness and overall attractiveness. Key cradle-to-grave issues affecting liability include choice of liability regime, mandates for corrective action in case of leakage or accident, the need for insurance, and determination of potentially responsible parties. Rather than assuming that the existing liability regime continues to govern, we investigate regulatory analogs (natural gas, radon, low-level radioactive waste, and hazardous waste) and compare the liability issues to the current state and possible evolution of liability for sequestration projects.

INTRODUCTION

The way that long-term liability is treated could significantly affect the viability of carbon sequestration. A liability regime that imposes significant costs may deter firms from pursuing carbon sequestration. Similarly, a liability framework could be used to assist firms to decrease their private risk and increase market penetration. In this paper, we consider how a long-term liability regime may impact the future of geologic carbon sequestration. We begin by reviewing potential sources of liability. We then investigate several case studies that may be relevant from a regulatory standpoint. Finally, we consider the implications for carbon sequestration and issues that policymakers may need to consider in the future.

SOURCES OF LIABILITY

Liability for geologic carbon sequestration derives from three major sources: liability from operational impacts, liability from *in situ* risks, and liability associated with deviations from the goal of permanent storage. The transportation, injection and storage of carbon dioxide has been commonplace in oil and gas production for decades, and the liability associated with operational impacts is managed today.[1] Liability from *in situ* risks includes formation leaks to the surface, migration of carbon dioxide within the formation, and seismic events.[2] These risks may lead to public health impacts or environmental and ecosystem impacts. Finally, there exists a liability associated with future carbon regimes and how to

[1] Benson, S., J. Apps, R. Hepple, M. Lippman and C.F. Tsang, "Health, Safety and Environmental Risk Assessment for Geologic Storage of Carbon Dioxide: Lessons Learned from Industrial and Natural Analogues," Lawrence Berkeley National Labs, 2002 available at http://www.co2captureproject.org/reports/reports.htm.

[2] Heinrich, J.J., H.J. Herzog and D.M. Reiner, "Environmental Assessment of Geologic Storage of CO_2," *Second Annual Conference on Carbon Sequestration*, Alexandria, VA, May (2003).

account for any leakage from storage reservoirs.[3] We limit our scope to liability associated with *in situ* risks.

LIABILITY IN THE CONTEXT OF REGULATORY ANALOGS

In this paper, we investigate four "regulatory analogs" to geologic carbon sequestration: natural gas transport and storage, radon, low-level radioactive waste storage and disposal, and hazardous waste storage and disposal.[4] Regulatory analogs should not be confused with natural or technical analogs. Natural analogs tend not to be regulated; one would be hard pressed to find regulatory regimes for a volcano or bacterium! Analogs with similar technical challenges may not be an appropriate comparison for regulatory purposes. In our use of regulatory analogs, we focus on relevant regulatory characteristics such as stakeholders, institutions and legislation. A summary of the regulatory analogs analyzed is shown in Table 1.

Table 1: Summary of Regulatory Analogs

Regulatory Analog	Key Issues	Implications for Carbon Sequestration
Natural gas transport and storage	• "Routine activities" (not abnormally dangerous)	• Carbon sequestration a part of everyday life? • How would common law apply to carbon sequestration?
Radon	• Strict liability • Implied warranties	• CO_2 leakage as a design defect • Conducting a reasonable inspection • Dealing with unknown risks (e.g. abandoned mines)
Low-level radioactive waste storage and disposal	• Interstate agreements	• Placing responsibility with federal government versus state • Liability regimes may discourage storage
Hazardous waste storage and disposal	• Strict liability • Joint and several liability • Retroactive liability	• Who should be held liable for leakage? • Liability may change over time

Natural gas transport and storage serves as our example of how liability is handled in "routine" situations. The U.S. Natural Gas Pipeline Safety Act allows the federal government to regulate interstate transportation and storage of natural gas.[5] State governments are allowed to regulate intrastate pipelines as long as their regulations meet and do not conflict with minimum federal regulations. All legal remedies are handled via "common law". Common law is the field of law shaped by judicial precedents, rather than by legislatures.[6] The operation of natural gas pipelines is not considered by the courts to be an abnormally dangerous activity.[7] This means that the public benefits associated with natural gas are considered to outweigh the potential risks. Therefore, in the case of natural gas leakage, one must show that the responsible party exhibited negligence. Negligence is the failure of exercising reasonable care toward others.[8] The liability regime of carbon sequestration may parallel natural gas transport and storage if sequestration becomes a part of everyday life. This would be a situation where some local concerns exist, but there is no higher level demand for creating a statutory authority.

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[3] Herzog, H., K. Caldeira, and J. Reilly, "An Issue of Permanence: Assessing the Effectiveness of Temporary Carbon Storage," *Climatic Change,* (forthcoming 2003).
[4] For more information on the use of regulatory analogs in carbon sequestration, see: Reiner D.M. and H.J. Herzog, "A Search for Regulatory Analogs to Carbon Sequestration," *presented at the Sixth International Conference on Greenhouse Gas Control Technologies,* Kyoto, Japan, October 1-4, (2002).
[5] 49 U.S.C. § 1671 *et seq*.
[6] Posner, R., "Property," *Economic Analysis of Law, 4th Edition*, Little, Brown and Company: Boston, p. 31 (1992).
[7] "Some degree of risk of natural gas pipeline leaks will always be present" – *Moore v. Sharp Gas* (C.A. 90-504, 1992 U.S. Dist. LEXIS 9380)
[8] Posner, R., "Tort Law," *Economic Analysis of Law, 4th Edition*, Little, Brown and Company: Boston, p. 167 (1992).

The case of radon shows a more stringent liability application of common law. Radon is a colorless, odorless gas created by the radioactive decay of uranium in the ground. Radon may migrate to the air above, and can be found in significant concentrations when the gas is trapped in a poorly ventilated and enclosed space. Radon exposure is a leading cause of lung cancer deaths in the United States. While there are no specific regulations governing liability for radon in one's home, courts have historically used principles of implied warranty of habitability and strict liability.[9] Implied warranty of habitability is the idea that a buyer assumes that a dwelling is habitable when he/she buys it. The agent for the seller has a responsibility to conduct a reasonably competent and diligent inspection for radon, otherwise he/she can be found liable. The agent may warn the buyer of a potential risk, which may limit, or possibly remove, the agent's liability. The courts may apply strict liability, in the sense that radon is a "defect" in the product—in this case, a house. Potential damages that a plaintiff might recover include property damages (e.g., cost of radon mitigation, lost value of home) and health damages (e.g., increased risk of cancer, pain and suffering). The potential issues for carbon sequestration are several. There is a parallel between the unknown risk of radon and unknown risks of carbon sequestration, such as in the case of unknown abandoned mines. Carbon sequestration could ostensibly be governed under a regime of strict liability, with carbon dioxide leakage viewed as a defect of the system. Agents representing potential carbon dioxide reservoirs may need to conduct reasonable inspections (show that they upheld a standard of reasonable care).

Low-level radioactive waste (LLRW) storage and disposal demonstrates the case where liability is assigned to the state. LLRW is most easily defined by what it is not. It is neither spent nuclear fuel nor waste from nuclear weapons. LLRW is generally all remaining radioactive waste, including machine parts from nuclear reactors, clothing worn by workers in radioactive facilities, medical waste, and waste from university research laboratories. LLRW is governed by the Low Level Radioactive Waste Policy Act (LLRWPA), as amended in 1985, dictates that states are responsible for the disposal of LLRW generated within their borders.[10] The Act allows states to enter into compacts to control disposal facility access. The unintended effect of the LLRWPA has been that no new LLRW facilities have been built, largely because no state regulatory agency will approve a disposal facility within its borders![11] The case is relevant to carbon sequestration in deciding whether liability should be defined by the federal government or states; federal government may be able to legislate in cases that produce a stalemate in states. The case also shows that liability regimes may discourage storage.

Our final case, hazardous waste storage and disposal, is the most stringent of the cases considered here. Hazardous waste is governed by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).[12] As part of CERCLA, a National Priorities List is created of the most hazardous sites based on a criteria hazard ranking system.[13] Cleanup costs are funded through a Hazardous Substance Response Trust Fund (or "Superfund") that is replenished by potentially responsible parties (PRPs).[14] PRPs include the current owner or operator, prior owners or operators at time of disposal, generators of hazardous waste, transporters of hazardous waste, and even entities that arranged for transportation.[15] All PRPs are held to strict, retroactive, and joint and several liability. As stated earlier, strict liability applies to abnormally dangerous activities, and does not require proof of negligence. Strict liability means that the PRP is liable, even if the hazardous substance release problems were

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[9] Hoyden, C.K., "Indoor Radon: Regulating a Blameless Cause," *Buffalo Environmental Law Journal* 3: 181 Fall (1995).
[10] 42 U.S.C. § 2021b *et seq*.
[11] U.S. General Accounting Office, *Low-Level Radioactive Wastes: States Are Not Developing Disposal Facilities*, Report No. GAO/RCED-99-238, September 17 (1999); and Reiner, D.M. and H.J. Herzog, "A Search for Regulatory Analogs to Carbon Sequestration," *presented at the Sixth International Conference on Greenhouse Gas Control Technologies,* Kyoto, Japan, October 1-4, (2002).
[12] 42 U.S.C. § 9601 *et seq*.
[13] U.S. Environmental Protection Agency, *National Priorities List* [Updated April 7, 2003], available online from: http://www.epa.gov/superfund/sites/npl/index.htm.
[14] Applegate, J.S., S.M. Wesloh, "Short Changing Short-Term Risk," *Yale Journal on Regulation* 15: 269, Summer (1998).
[15] Menell, P.S., "The Limitations of Legal Institutions for Addressing Environmental Risks," *The Journal of Economic Perspectives* 5(3): 93-113, Summer (1991).

unforeseeable, the people acted in good faith and according to law at the time, or state-of-the-art practices were used at the time the materials were disposed of.[16] Retroactive liability is the idea that even though dumping hazardous waste may not have been illegal in the past, the PRP can still be held liable now.[17] Joint and several liability makes any PRP liable for the full costs of cleanup, regardless of relative impact.[18] Superfund has led firms to build new, costly, and environmental burdensome infrastructure in pristine areas, in order to avoid liability that might be incurred by rehabilitating existing sites.[19] In addition, lenders have been reluctant to invest in Superfund projects due to liability.[20] Hazardous waste raises the question of defining potentially responsible parties for carbon sequestration, and is a prime example of liability rules that change over time.

LESSONS FOR CARBON SEQUESTRATION

The sources of liability and regulatory analogs raise some important questions for carbon sequestration. First, what is the goal of the liability regime? Liability can be used to reduce accidents, or to reduce the costs of accidents.[21] Reducing accidents would involve placing liability on those best able to alter behavior. Reducing costs of accidents, however, would imply placing liability on those best able to pay (i.e., the wealthy). Second, what should be the role of insurance? Insurance could ostensibly take the form of private insurance, compulsory insurance, or "government" insurance. Insurance companies will gravitate to situations where they can pool risk categories (i.e. predict the likelihood of accidents). The predictability of carbon sequestration leakage is unclear. Finally, who should be responsible for liability? Potentially responsible parties for carbon sequestration could include storage site landowners, operators, transporters, generators, lenders, and contractors.

There are several potential options that might remedy the liability situation: first party insurance, direct government regulation coupled with insurance, payments out of the tax system, liability caps, or a system of guaranteed benefits. First party insurance, as alluded to earlier, could be used if it is possible to estimate the likelihood of risk. Direct government regulation, coupled with insurance, is another possibility, with the insurance being first party, compulsory, or government-provided. Payments out of the tax system could be used if government wishes to bear full liability for an accident. Liability caps, similar to what is done for high-level radioactive waste, would make firms liable for accidents, but only up to a specified amount. Finally, a system could be envisioned that provides a schedule of guaranteed benefits in the case of leakage.

CONCLUSION

Long-term liability is nothing new; it has already been dealt with in several analogous cases. Liability schemes could be created that encourage carbon sequestration…or discourage sequestration! The degree of stringency varies across our regulatory analogs from a fairly unregulated approach in natural gas to a more structured approach in hazardous waste. The more structured approaches deal with "abnormally" dangerous substances. The cases also show variation in the government's role for managing risk.

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[16] US Environmental Protection Agency, *Superfund Liability* [Updated April 8, 2003], available online from: http://www.epa.gov/compliance/cleanup/superfund/find/liability.html.
[17] Plater, Z., R. Zigmunt, W. Goldfarb and R. Graham, *Environmental Law and Policy,* West Group: Saint Paul, p. 823 (1998).
[18] Blackmon, G. and R. Zeckhauser, "State Tort Reform Legislation: Assessing Our Control of Risks," in *Tort Law and the Public Interest* (P. Schuck, ed.), W.W. Norton: New York, p. 273 (1991).
[19] Power, C.W. and M.R. Chertow, "Industry Ecology" in *Thinking Ecologically* (M.R. Chertow and D.C. Esty, eds.), Yale University Press: New Haven, p. 23 (1997).
[20] Turner, J. and J. Rylander, "Land Use" in *Thinking Ecologically* (M.R. Chertow and D.C. Esty, eds.), Yale University Press: New Haven, p. 65 (1997).
[21] Calabresi, G., *The Costs of Accidents: A Legal and Economic Analysis*, Yale University Press: New Haven (1970).

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