California Carbon Capture and Storage Review Panel

TECHNICAL ADVISORY COMMITTEE REPORT

Long-Term Stewardship and Long-Term Liability in the Sequestration of CO_2

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CALIFORNIA CARBON CAPTURE AND STORAGE REVIEW PANEL

Other white papers for the panel will include

Monitoring, Verification, and Reporting Overview

Options for Permitting Carbon Capture and Sequestration Projects in California

Review of Saline Formation Storage Potential in California

Enhanced Oil Recovery as Carbon Dioxide Sequestration

Carbon Dioxide Pipelines

Approaches to Pore Space Rights

Sequestration Risk History

Purpose

This paper[1] addresses some of the issues relating to long-term stewardship and liability that are sometimes viewed as barriers to timely Carbon Capture and Storage (CCS) development projects. The paper examines various approaches for addressing liability over the long-term post-closure phase. This phase is currently of an undetermined duration (i.e., after CO_2 injection wells are capped and permanently closed). Long-term liability is a complex subject that will almost certainly involve new and potentially intractable legal issues that require case-by-case resolution which are beyond the scope of this paper. The issues related to monitoring, verification and reporting (MVR) during the post-closure phase are covered in companion white papers for the California Carbon Capture and Storage Review Panel.

Some confusion results from the observation that the terms "long-term liability" and "long-term stewardship" are often used interchangeably. However, these terms in fact denote distinct concepts that should be kept separate. "Long-term stewardship" is by whom and by what means the actual post-closure operations of a CCS project will be undertaken in the long-term. "Long-term liability", however, is a legal concept involving the issue of who is or will be financially responsible for a project and for any damages attributed to that project following closure.

Responsible and effective CO_2 sequestration requires essentially permanent emplacement of CO_2 underground with no intention of retrieving the carbon or CO_2 thus stored. This paper does not address CO_2 injection for Enhanced Oil Recovery activities. Nor does it address the issue of CO_2 ownership, pipeline transport ownership and CCS injection operator, all of which may or may not be the same entity. For the purpose of this paper, the term "stewardship" means primary responsibility for the ongoing operation, safety and maintenance of the project, and especially the monitoring of CO_2 behavior in the reservoir into which the CO_2 has been injected. "Liability" is taken to denote financial responsibility for a CCS project, either in its individual phases or as a whole. This includes financial responsibility for what can be considered as normal industrial operations of a project, as well as financial responsibility arising out of an event or events that impact the health, safety, and/or well-being of people, including but not limited to impacts to the environment, the quality of drinking water, agricultural resources, and/or wildlife. Liability also includes financial exposure under a regulatory regime if CCS credits are used to meet carbon reduction goals and standards and the sequestration fails through leakage. It should be pointed out that there are a number of industrial analogues that can be compared to all aspects of a CCS project for both liability and stewardship. However, few, if any, appropriate analogues exist for long-term post closure activities and attendant responsibilities._This paper summarizes four key issues:

- Appropriate timeframe(s) for monitoring CO_2 releases during the post-closure phase.

[1] This report necessarily discusses issues that are largely or essentially legal topics, and long-term liability in particular is primarily a legal topic. However, this report should not be considered legal advice, but rather a summary of the available public information concerning these topics. Some of these issues are complex and will take time to resolve. It is therefore beyond the scope of this report to provide definitive "answers" to these issues; instead, the intent of this report is to identify issues and options so to encourage robust discussion of, and further research into, these issues.

- Options for allocating responsibility for long-term stewardship among the participants in a CCS project, including the well/reservoir operator, the property owner, and the state and/or federal government.
- Options for allocating the legal risk among the participants in a CCS project.
- Identifying models and approaches that require further research and examination.

Policy Context

CCS is a technology which allows carbon dioxide to be separated from process and exhaust gases at large industrial facilities, such as power plants, cement plants, and oil refineries, and stored in underground geologic formations. CCS is recognized as one of the technology "tools," along with end-use energy efficiency and renewable energy technologies, for meeting California's long-term greenhouse gas (GHG) reduction goals.

For the demonstration CCS projects, it is important to clarify who is responsible for insuring against the risk of CO_2 leakage or releases into the groundwater or atmosphere. This is especially critical since current commercial insurance companies do not yet cover such occurrences. In addition, because the capture and sequestration of CO_2 involves lasting and permanent storage in underground reservoirs, it is uncertain how long the responsibility for post-closure liability must last to insure against possible leakage.

The current overriding federal legislation that controls the injection of CO_2 is Part C of the Safe Drinking Water Act, which is regulated by the U.S. EPA's Underground Injection Control policies and regulations that ensure that injection activities do not contaminate underground sources of drinking water. There are currently five Underground Injection Control (UIC) classes and a sixth is in the process of being proposed that is specifically targeted at injection for CO_2 sequestration. As part of the sixth class, the US Environmental Protection Agency (US EPA) lays out general requirements for financial responsibility that may "…include provisions requiring owners and operators demonstrate and maintain financial responsibility during operation, closure and the post-injection site care period."

Background

In the atmosphere, where it is normally present in low concentrations, CO_2 is harmless. CO_2 is non-flammable and inert. In that CO_2 is 1.5 times denser than air, there is tendency under stagnant conditions for any CO_2 leaking to collect in hollows or other low-lying confined spaces, which may create a hazardous situation due to CO2 being odorless, colorless, and tasteless. The full impact of CO_2 on groundwater (where it increases the acidity) requires more research to better constrain the risk profile. It is a benign gas when compared with other gases historically stored in underground formations, such as natural gas, which is flammable and potentially explosive. As with all compounds, if it accumulates at high enough concentrations it will become a risk to animal life, but reaching such concentrations is exceedingly rare. Where they have naturally occurred is in gas emissions from volcanic provinces.

The process of injecting liquid CO_2 under pressure into the ground involves risks normally associated with analogous types of industrial and oil field activities. These risks are both well understood and insurable. The ability to quantify these known risks is due to the ability to utilize statistics from these similar activities (which would also include natural gas storage or

recovery of naturally occurring carbon dioxide resources) as analogues for carbon dioxide injection and storage in sub-surface formations. Additionally, due to the interest in CCS, since 1995 a significant amount of research, modeling, and testing has been done to document the behavior of CO_2 in various subsurface environments. Despite the generally high level of scientific comfort with this technology, it is difficult to assign a quantitative risk profile to the long-term behavior of CO_2.

Potential operators for a CCS project seek to define risk for their insurers during site preparation, injection operations, and post-closure monitoring. Responsible oversight and liability for payment are considered and agreed upon in advance, during the planning phase. But the time period commencing with post-closure monitoring into an undefined future is an institutional, financial, and regulatory challenge to CCS operations. There is a distinction between initial small-scale CCS pilot projects that might be considered exploratory and mature larger-scale commercial CCS operations for which the liability and stewardship issues may be treated differently, at least initially.

Determination of Appropriate Timeframes for MMV

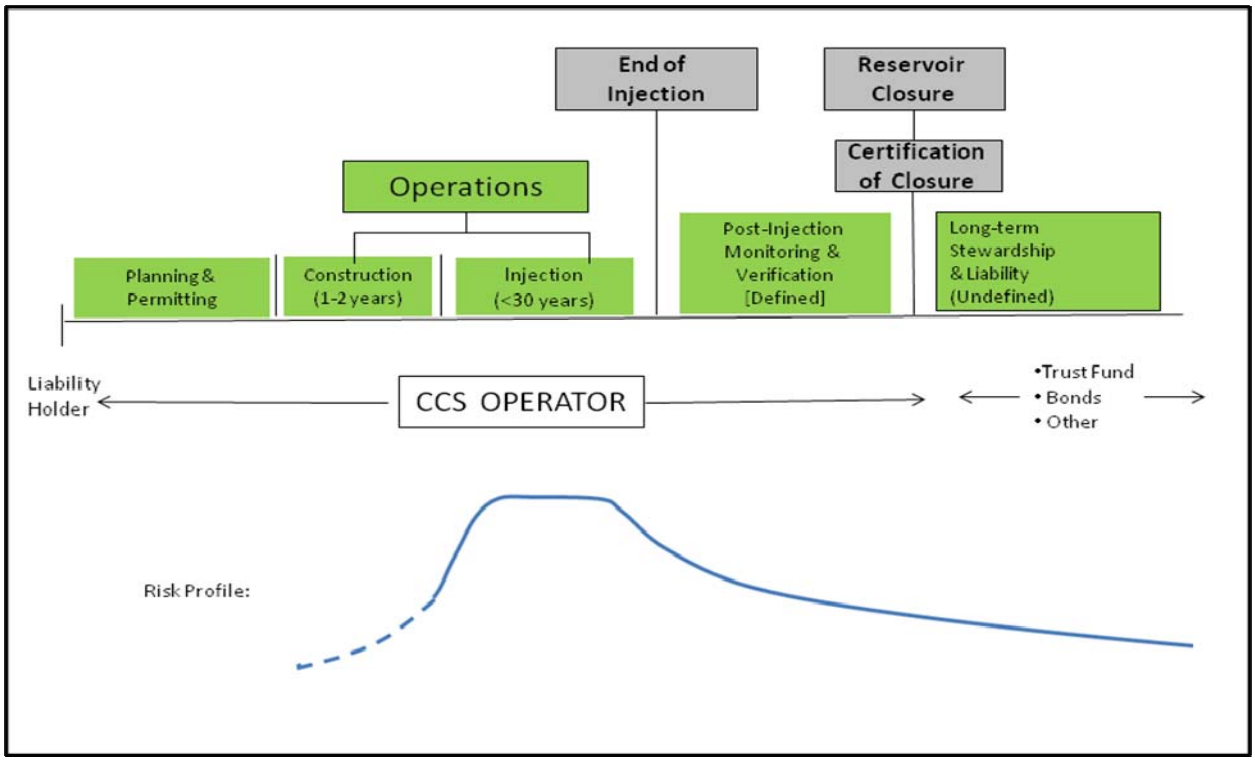

Figure 1 A schematic diagram that attempts to characterize the phases in a CCS project. This paper addresses the final (far right) phase. (After Benson & Cook, 2005).

After the multi-year injection activities for CO_2 and the well closure process have been successfully completed, there is an extended period during which the behavior of the CO_2 in the subsurface should continue to be monitored in order to track the size and location of the CO_2 plume, its movement, and ultimate stabilization (see Figure 1). It is the intention that this will demonstrate that CCS is effective and, thus, provides a basis for determining whether any environmental credits may be claimed. Without accurate and reliable long-term monitoring, verification, and remediation (MVR), CCS may not be successful.

There is not yet a widespread consensus on how long the post-closure MVR phase should be, with opinions ranging from 10 to 50 years. The variation in the suggested monitoring time frames arises from the fact that CCS technology is still relatively new and there have not been enough large-scale demonstration projects to conclusively answer the question in all circumstances due to variables in the particular location and types of geologic storage formations involved. The appropriate length of time for long-term MVR would be based on scientific verification of plume stabilization. Once it has been reliably established that the plume has stabilized and no further plume migration will occur, MVR may be reduced or eliminated. However, premature cessation of MVR could render CCS potentially pointless and unreliable, even counterproductive to GHG reduction efforts since the expense will have been incurred, but the result not guaranteed.

The frequency of monitoring and whether it should be conducted by a public agency or a private entity is an additional factor to be resolved. A number of states have become more proactive in developing regulations that address this issue without waiting for federal guidance or regulation. For example, Montana has established in state law that the period be 15 years (Montana SB498, 2008). Long–term oversight during the post-closure phase might exceed the corporate lifespan of a commercial CCS operator, perhaps invoking another entity, private or public, to undertake this post-closure activity. The requirements associated with long-term monitoring are important as issues of financial responsibility and liability associated with continued ownership may affect how projects are to be financed and what organizations are willing to take on project risk.

Distinction Between Liability and Stewardship

The terms "long-term liability" and "long-term stewardship" are often used interchangeably. From a legal and practical standpoint, the concepts are separate, but related, and should be considered as separate. In the wider context of contracting, financing, banking, and law, these concepts are distinct, particularly as CCS moves from research and small-scale demonstration phases to large-scale implementation. Conflating the two issues may lead to confusion.

"Long-term stewardship" defines what entity will carry out the post-closure operations of a CCS project. While this may appear to be less a legal issue than an operational issue, the determination of operational “ownership” will certainly carry a degree of liability. However, there may be numerous different parties that share or assume stewardship responsibilities over the duration of the project based on future developments in institutional and governmental requirements and regulations. Conversely, "long-term liability" should be regarded as a specific legal issue that concerns which institutional entity will be legally and financially responsible if something goes wrong.

Long-term stewardship requires funding for administrative oversight of post-closure MMV, an amount for which a general budget may reasonably be established. Long-term liability, however, does not have a defined cost, but instead a risk factor that balances likelihood of an event against the monetary consequences of that event. This latter cost is currently rather difficult to establish, which is the reason that no insurance company to date has promoted plans for insuring long-term post-closure operations.

To exemplify this distinction, one might invoke the current situation of the Gulf of Mexico oil spill (not strictly analogous, but exemplary). Several entities, including at least three major

private companies and the federal government, shared operational stewardship of that project. The government had a role in regulating it. The three main companies had primary responsibility for day-to-day operations and, presumably, for having risk management plans and procedures to prevent and/or stop a blow out. Now that a spill has occurred, the question is who will be financially responsible for the damages caused by the spill and for the cost of the clean up. The ultimate decision of liability will very likely be a legal determination by a court of law or by legal settlement.

The determination of who was responsible for the day-to-day operations (stewardship) of the project is an important factor in deciding who will pay for the cleanup. But it is not the only factor, possibly not even the determinative factor. As a simple but illustrative example, if Company A is ultimately found to have had primary stewardship responsibility for the part of the project that went wrong, it may be Company A's insurance company, not Company A, that will be legally liable for the costs.

Long-Term Stewardship

Institutional and regulatory changes will be required to define the parameters associated with long-term stewardship. Long-term stewardship should be part of the initial planning and permitting activity, but it comes into effect when a sequestration project has been completed, has been monitored over the regulatory-approved time period by the operator, and has been certified as safe by a public agency. Subsequent monitoring and possible remediation, if required, would be transferred to another entity for execution and oversight. The design of the certification for closure would have basic federal requirements, but a designated state agency may impose further requirements based on special state environmental regulations and on the particular characteristics of a geological formation and other variables. Any compensation claims may be set according to local conditions and might not be appropriate to be set at a uniform federal level.

Legal issues invoked during CCS operational and immediate post-injection activities would in all likelihood be similar to those that arise in similar industrial operational analogues. These issues may include the risk of CO_2 trespassing under other owners' properties, thus, the "physical damage or actual interference with the reasonable and foreseeable use of the properties", "nuisance," and "stigma" issues, and the potential for groundwater contamination. Although current regulations being utilized for CCS are based on water quality parameters, the standards for carbon dioxide in groundwater are unclear. For a risk-based approach to be effective, a "trigger level" of CO_2 in groundwater may be considered, but the human health factor would generally be the trigger for litigation and regulatory reaction. If human health is not protected, tort liability may be invoked in addition to regulatory penalties. The migration of groundwater across ownership boundaries is an issue that will require careful monitoring and for which a resolution framework might be considered useful. The issues related to this point, particularly pore space ownership and relevant regulations are covered in a separate white paper.

A recommendation identifying responsibility for long-term MVR for any post-closure operation would be a useful outcome for this effort. Policymakers will need to provide technically grounded guidance on acceptable levels of CO_2 leakage from storage and on definitions of leakage. One proposal is that a federal agency would have oversight, both operational and policy management, for all geological sequestration undertakings. A different option is for a

federal agency to have only policy oversight, but that the administration should be at the state level by a state agency or possibly a private company under contract by a state agency. The federal role in the operational aspects of long-term sequestration, such as monitoring and claims, has yet to be determined.

One model for funding long-term stewardship activities is the creation of a trust fund administered by the host state, one that is provisioned by fees from the CCS operator during the injection phase and from permits. Creating a trust fund for long-term monitoring, mitigation, and remediation would be tied to site-specific criteria, with the fee assessed and the fund size in proportion to the projected and potential needs. If fees are set too high and the trust fund becomes too large for the perceived need, a financial disincentive is created. This could be ameliorated by a capped fee structure. The fund itself should be subject to strong oversight, including periodic valuation of funds collected relative to the risk profile of pooled sites for geological sequestration. In this prevailing economic climate, isolation of such a fund from attempts to repair state deficits would be desirable, and would need to be specified in state legislation.

Long-Term Liability

This is a complex legal topic that is not amenable to one-size-fits-all resolution. In the absence of an affirmative government (any government on a federal, state, or local level) policy decision to take on liability that it otherwise would not have, liability issues are typically resolved either by resort to normal common law principles already in place or in special cases by negotiation on a case-by-case basis for particular contracts. In other words it would be incumbent upon the operator to justify the need for public indemnity in a specific project. It may be ill-advised to invoke blanket public indemnity where, in individual cases, such may not be required. Much discussion of liability has been in the context of limiting a company's exposure to long-term liability in order to promote the development of this technology in the "public interest". However, an alternate goal of creative risk techniques, such as insurance, bonding, and pooled federal funding might encourage CCS development but also preserve federal and state liability frameworks to promote safe practices. Rigorous site selection, assiduous project management, and a well developed and executed MVR plan would influence the risk profile of a CCS project during its entire lifespan, which are currently often part of permitting documentation. A regulatory and legal balance that protects the development of this industry, yet also protects the public and environment from potential dangers, must be recognized.

Since there are analogous, insurable industrial activities for most of the CCS processes, only the long-term liability is considered here. Prior to the start of any project, the project developer accepts liability associated with all operations, as well as post-injection monitoring, using financial mechanisms such as insurance. If public indemnity is, at the planning stage, assumed, caution may be required to guard against a reduced incentive to ensure post-closure responsibility. There are no obvious existing activities for long-term storage with which to draw comparisons. From siting to post-injection monitoring is the length of time for which the private market can be expected to operate and, under proper regulatory oversight, be responsible for the sequestration of CO_2. There is no mature private market that will accept longer-term liabilities where risk uncertainty is essentially unknowable and for which a risk profile has not been established. It is for this reason that discussion of the topic has veered to

some type of state or federal acceptance of liability once the injection process has been completed and has been certified as safe.

There is general agreement in the scientific community that the risk of CO_2 migration decreases with time as a result of geochemical and geophysical mechanisms (beyond the scope of this paper) that occur to supercritical CO_2 under pressure at the geologic depths appropriate for CCS. If the CO_2 plume becomes stable after 30-100 years (and probably within five-ten years according to modeling experiments), that is a time frame that the legal, lending, and insurance systems may address.

There are some roughly analogous precedents from which to draw, such as the Price-Anderson Act (which enabled the nuclear power industry) and the national flood insurance program. The scenario that would be likely to succeed would probably be a multi-faceted approach that would include the following attributes:

- Redundant project engineering
- A highly reliable monitoring process during the injection phase that identifies and quantifies all leaks and plume migration;
- Clearly-defined comprehensive milestones for CCS contractors to meet;
- All milestones strictly-enforced and completion verified by (state) inspectors;
- A lengthy (decades) monitoring period after well closure;
- A suite of risk-mitigation instruments for private contractors such as insurance and bonds to cover the initial post-injection MVR phase;
- Establishment of a common risk-mitigation pool fund to address leakage and well failures in CCS projects;
- Federal or state assumption of liability only after successful completion and verification of all above factors, and only if either (1) specifically negotiated or (2) as part of a formally-adopted comprehensive federal or state policy to encourage and support wide-spread implementation of CCS during its early development period until the potential risks and liabilities of CCS are more fully understood.

Various combinations of the above factors may be appropriate for different projects, depending on the specific risk profile of each project. Some of the above factors may be inappropriate in other instances. In the absence of overriding state or federal legislation, such issues will need to be addressed on a case-by-case basis.

Interest has been shown in current federal programs that concern the regulation and cleanup of "hazardous materials" under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) known as the Superfund law for remediation of hazardous waste sites. CERCLA is a complex program that could form the basis of specialized legal analysis that could provide a useful framework for CCS liability management. The way the Superfund liability is traced is quite different than in some other programs. The current hazardous waste site operator often has not born the liability. Instead, EPA has gone after the original owners of the waste regardless of who has had custody since then. If used for CCS, this would make the CO_2 generators retain the liability instead of the sequestration site operators. The role and definition

of CO_2 either as a waste or a useful commodity may impact the relevance of CCS in the Resource Conservation and Recovery Act, which is the regulation designed to control the current disposal of hazardous materials.

State common law seeks redress against claims of trespass, nuisance, strict liability, and potential for damages may be independent of federal statutes that broadly address long-term liability. Thus, certification[2] could be issued by USEPA or a state. Precedent has been set by state legislation in Montana, Kansas, Louisiana, North Dakota, Wyoming, and, to a lesser extent, Texas. A special situation arose when the states of Illinois and Texas accepted long-term liability in their competitive proposals specifically for and limited to the FutureGen project. The Casey-Enzi (S.1503) and the Bingaman (S.1462) bills both contain language for federal government acceptance of long-term liability for geological sequestration projects. S.1503 offers full indemnity for all appropriate projects, while S.1462 offers this for up to ten DOE-funded demonstration projects. The Bingaman bill, which is part of the American Clean Energy Leadership Act, requires a per-ton sequestration fee to be accrued by the Treasury in a DOE-administered trust fund to compensate any future claims. Precedent has been set by the Norwegian and Australian governments for commercial geological sequestration projects (Sleipner and Gorgon, respectively).

The rationale for a government role in indemnifying long-term liability is due to the belief that CCS is in the public interest and that long-term liability issues should not, at this early stage in the development of the industry, be a barrier to further development. In the case of FutureGen, the acceptance of long-term liability became a one-time competitive tool for the states in question and was deemed beneficial to the competing states. This was a specific case and extrapolating this into general policy should be viewed with caution.

A case could be made for arguing that federally administered trust funds dispersing damage claims is not an efficient model, exemplified by Hurricane Katrina. One possible organizational approach is for joint administration of a trust fund, overseen by a federal agency that may exert emergency authority as the need arises. While no trust fund is evident, this is part of the Federal Emergency Management Agency (now part of Department of Homeland Security) activity in areas such as flood insurance and in monitoring emergency response activities as part of either natural (such as hurricanes and earthquakes) or man-made (such as oil spills and radiological releases) disasters. These programs respond retroactively, whereas CCS seeks a proactive framework, such as a process associated with the Nuclear Waste Fund. This fund provided for some of the construction costs for Yucca Mountain and operated by collecting a small millage from nuclear-generated electricity. Similarly, a small millage was also employed for decommissioning and decontamination procedures associated with the dismantling of nuclear power plants after their useful life – an activity that has been employed in at least one instance to date.

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[2] Certification of a CCS project requires that after a defined period, CO2 has been shown to have stabilized and behaved as predicted according to rigorous monitoring and verification, and that any required surface and subsurface remediation has been completed. It is therefore reasonably predicted that the mechanical integrity of the reservoir and the CO2 will remain in place. Certification may be awarded by a designated state agency or by the US EPA

There are California examples, such as the Laws for Conservation of Petroleum & Gas Section 3205.5, which has a bond requirement for each well. The bond is released when the operator properly closes, plugs, and abandons the well. California Laws for Conservation of Petroleum & Gas Section 3206 (b) - Hazardous & Idle-Deserted Well Abatement Fund allows for the collection of annual fees on idle wells into an escrow account. California Laws for Conservation of Petroleum & Gas Section 3262 - Acute Orphan Well Account provides for the administration of orphan wells by California and is overseen by Conservation Committee of Oil and Gas Producers. Operators pay a fee (based on the amount injected) that is deposited in interest-bearing account for use during the post-closure period. There are provisions for the State accepting indemnity in special cases subject to review by the State Department of General Services, Office of Risk and Insurance Management.

Where there is evidence of willful neglect of regulations or purposely providing misleading information, liability should be sought from the operator or descendents by the post-closure administrator. However, this is potentially difficult to determine (as exemplified by some of the CERCLA projects), hence the desirability of a trust fund of some type.

Summary

For CCS to be effective, CO_2 must remain underground for a long period - hundreds to thousands of years. This is well beyond the historic life-span of companies and most governments. This requires institutional, administrative, and regulatory approaches for long term stewardship of these sites to protect the public and to properly assess the efficacy of the removal of carbon dioxide from the atmosphere. Another major barrier (perhaps *the* major barrier) for industry to undertake CCS projects is the undefined and open-ended liability for the site.

Although operational risks associated with the transport and injection of CO_2 in the subsurface during EOR operations have been successfully managed for many years, the long-term liability for CCS sites - post-closure – may be unique to CCS. It is important to note that the entity accepting the liability will likely (without the development of institutional initiatives) be responsible for expenses of continuing MVR activities, any mitigation or remediation required, and compensation for any damages if leakage occurs.

One option is for government agencies to take on the long-term responsibilty for CCS sites. Some states have adopted legislation to accept limited liability, but there has been little consistency in the time frames or agreement as to where the liability should ultimately reside. In some cases the risk and performance of the CCS site is linked to liability transfer.

Another option is to create an industry fund. At the federal level, bills have been introduced that would establish a carbon storage stewardship trust fund financed by fees from operators to ensure compensation for potential damages. At least one private insurer is making short term insurance policies available. Long-term liability schemes have been adopted for other industries, including bond provisions by the UIC program, trust accounts funded through fees to operators that are administered by state or industry organizations such as the Acute Orphan Well Account, the Price-Anderson indemnity program that pools risk for the nuclear industry, or the National Flood Insurance Program that is federally funded.

Examples from other states

Many states, including oil-producing states like Texas and Louisiana and coal-producing states like Wyoming and Montana, have enacted laws relating to CCS development. Based on a review of these statutes, there are some common elements:

- State policy declaration that CO_2 is a valuable commodity and that CO_2 storage provides a public benefit by reducing GHG emissions and reducing reliance on higher carbon fuels, like natural gas and coal.
- A fee-based structure to cover the state's responsibility for administering long-term monitoring and oversight of CO_2 injection and storage.
- Post-closure monitoring by the drilling or reservoir operator for a period of 10 years or longer.
- A certificate of completion to be issued by a designated state or federal agency, following permanent closure.
- In some cases, a transfer of the state's responsibility for long-term (post-closure) MVR to the federal government after a designated period of years (e.g., 10 years or longer).

A more complete listing of these selected state laws are provided in Appendix A.

Federal statutes have also been proposed that provide a regulatory framework for addressing long-term liability, many of which have not yet been enacted, but are being debated in the U. S. Congress as part of national energy or climate change legislation. Appendix B lists some of these activities as well as established laws.

Options

Long-term liability and long-term stewardship involve a degree of technical knowledge and experience, but they primarily require legal and financial expertise to research the issues further. The references in Appendix C go into more depth in these areas. There are several existing approaches for addressing long-term liability that have been used by the federal government to reduce the financial risk of development projects. In addition, other states have enacted legislation affecting CCS development which may be examined further. At present, there is no one-size-fits-all approach or solution that can be recommended, since in the absence of special legislation, liability protection is evaluated and negotiated on a project-by-project basis. **Again, the focus of these options is on long-term liability which commences after injection and after post-injection MVR**. Some of the options include:

Liability:

- Private and self insurance to guard against the financial risk of an accident or release, to be paid by the project developers. Self-insurance is standard in the oil and gas industry and its terms are well understood.
- A federal insurance program, such as the Price Anderson Act indemnity program for nuclear power plants or the National Flood Insurance Program, which are financed by taxpayers.

- A state administered insurance program, which assesses fees on well operators or developers, similar to the well cleanup or abandonment fund for California's orphan wells.
- Other bonding or insurance mechanisms funded by industry.
- Assumption of all liability by the state (or federal government).

Stewardship:

- Identify a lead state agency charged to administer and oversee long-term MVR and to certify post-injection site closure.
- The lead state agency for administering long-term MVR and for certifying well closure would also be responsible for initial permitting of the CCS project.
- Create a fee-based geological sequestration Trust Fund administered by the state (or contractor thereof), the provisions for which would be solely for long-term MVR - and remediation if necessary. An independent, scientific framework for designing and conducting post-closure MVR would need to be established.

Appendix A: Examples from other states

The following are examples of current legislation in selected other states. The situation in these states may differ in numerous ways from those in California, and the information below is provided to assist in the assessment of California's direction on CCS strategies.

Illinois

Illinois House Bill 3854 creates the Carbon Capture and Sequestration Legislation Commission that will consist of 11 members (membership defined) to report by 31 December 2010. The report will address ownership of CO_2, liability for release of CO_2, acquisition and ownership of pore space, procedures and safeguards for the transportation and sequestration of CO2, methodology to establish any necessary fees, cost or offsets, potential use of CO2, construction of pipelines, and coordination with federal law and regulatory commissions.

During the competition for Illinois to host the FutureGen Clean Coal project, the state offered to accept all title, rights, and liabilities associated with the sequestered gas, including any current or future benefits, and that the State of Illinois would indemnify the operator from all public liability action except where willful misconduct is demonstrated.

Kansas

Kansas's statutes establish a CO2 Injection Well and Underground Storage Fund with funds from permit fees. This Fund will cover oversight of the operational phase, including mitigation of adverse environmental impacts, emergency or long-term remedial activities, and administrative costs. This state emphasizes operations concerns and to a far lesser degree the longer term issues. But it has offered assumption of long-term ownership and liability.

Louisiana

Louisiana has declared (HB661 2009) that CO_2 storage will benefit the state and that CO_2 is a valuable commodity to its citizens. It identifies its responsibility for assuring compliance with the federal Safe Drinking Water Act. This Bill lays out in more detail than other states the long-term issues for CCS, notably that (1) there is liability transfer from the operator to the state after ten years since injection cessation upon certification, (2) the liability release will only be permitted if the Trust Fund has sufficient resources and the operator has not intentionally mis-represented relevant information, (3) liability by the state is not automatic upon issuing a certification of completion, (4) liability caps for various noneconomic loss situations are described, (5) a CO_2 Geologic Storage Trust Fund is established with a formula defining the fee structure, with a fee cap, and instructions for activities for which the Fund can be used. It further allows for site-specific funds to be established. The Fund provides for long-term monitoring and remediation.

Montana

Montana enacted legislation (SB 498) with regard to Carbon Capture and Sequestration (CCS) that includes provisions for long-term stewardship and long-term liability for which the Montana Board of Oil and Gas Conservation is the regulating agency. A fee would need to be created to cover the state's responsibility for administering the long-term oversight of the wells. Post-closure, the operator will be responsible for monitoring and maintaining the

	CO_2 sequestration site to ensure that there is no risk. For Montana, the time line for corporate responsibility is 15 years, after which the operator can transfer the liability and title to the state.
New York	This state is proposing, among other items, that post-closure liability shall be transferred to the state after demonstrating no migration following a ten-year monitoring period.
North Dakota	SB2095 (2009) creates an (1) CO_2 administrative fund to pay for regulating storage sites during their construction, operations and preclosure phases, (2) a CO_2 Trust Fund to defray expenses incurred in long-term monitoring and management of the closed facility. This Bill also finds that title to the CO_2 injected into and stored in a storage reservoir remains with the operator until a certificate of completion has been issued, when the title transfers to the state. The monitoring and managing of the storage facility is the state's responsibility "…until such time as the federal government assumes responsibility for the long-term monitoring and management of the storage facilities."
Texas	Liability has been established for the operational phase only for which a fund has been established from permitting fees for injection long-term monitoring, repairs, and enforcement. The Texas Railroad Commission regulates CO_2 storage in oil and gas field and saline formations directly above and below oil and gas field. The state assumes liability for offshore sequestration.
Washington	Owner will be liable in perpetuity.
Wyoming	The 2010 session of the Wyoming legislature (HB0017) establishes a Wyoming Geologic Sequestration Special Revenue Account "…to measure, monitor and verify Wyoming geologic sequestration sites following site closure certification, release of all financial assurance instruments and termination of the permit". However, this Fund does "…not constitute a waiver by the state…of its immunity from suit, nor does it constitute an assumption of any liability by the state for…sites or the CO_2 and associated constituents injected into those sites."

Appendix B: Examples of federal statutes, congressional initiatives, and international activities that could relate to CCS

- CERCLA - Role of the Comprehensive Environmental Response Compensation and Liability Act provides the regulatory framework for long-term liability.
- Price-Anderson Act, 1957 – This Act was intended to encourage the development of the nuclear industry by partially indemnifying the nuclear industry. It requires that the nuclear industry maintain certain levels of insurance and contribute to a trust fund in case of a nuclear accident. With spent nuclear fuel deposition still unresolved, the comprehensive outcome of this Act may benefit from close analysis.
- DOE CCS Roadmap 2007: This provides proposed guidance for DOE-funded demonstration projects.
- Casey-Enzi Bill (S.1502) offers full indemnity to all projects after closure. This Bill authorises a sequestration fee to collect into a DOE-administered fund to cover long-term stewardship liabilities.
- Congress recognizes indispensability of policies that promote CCS to support continued coal use for its energy provision (50%).
- National Flood Insurance, Terrorism Risk Insurance not particularly useful models for CCS. The inherent weakness of this analogue, as manifest mainly by the imbalance between looses paid and premiums collected, is that there is no control over the risk creator. Natural hazards may often be mitigated (e.g., building levees), but this is not analogous to careful site selection and monitored CO_2 injection.
- A reasonable model is the Oil Production Act of 1990 that establishes a national Oil Spill Liability Trust Fund (in 1986) managed by the National Pollution Funds Center, an independent unit reporting directly to the Coast Guard Chief of Staff. The balance of this fund is mandated to be between $2.5B-$2.7B (notable in light of the approximate $20B oil spill in the current Gulf of Mexico spill).
- Examples from overseas include Norway's government acceptance of long-term liability from Statoil for the West Sleipner project. Australian federal and state governments jointly accepted long-term liability for the Gorgon facility.
- The European Parliament issued in 2009 Directive 2009/31/EC on the geological storage of carbon dioxide. The provisions in this Directive are similar to those outlined in this paper: in particular financial security must be established for the operations and an anticipated post-injection phase of a minimum of 30 years. Liability may be transferred to a "competent authority" after a minimum of 20 years. "Competent authority" is not defined.

Appendix C: Further Reading

Benson, S. and Cook, P. 2005. Intergovernmental Panel on Climate Change, Special Report on Carbon Capture and Storage, Chapter 5, 196-276.

Eames, F.R. 2010. Addressing Long-Term Stewardship of Carbon Storage. The National Law Journal. February 8 Issue.

Klass, A.B. & Wilson, E.J. 2008. Climate Change and Carbon Sequestration: Assessing a Liability Regime for Long-Term Storage of Carbon Dioxide.

McCoy, S. 2009. Compensation, Liability and Long-Term Stewardship for CCS. CCSReg Policy Brief, 11 pp.

Moore, J. 2007. The Potential Law of On-Shore Geologic Sequestration of CO2 Captured from Coal-Fired Power Plants. Environmental Law Journal 28, 443-487.

Trabucchi, C & Patton, L. 2008. Storing carbon: options for liability risk management, financial responsibility. Daily Environment Report, 2008, No. 170, 1-22. (Bureau of National Affairs, Inc.)

United States Environmental Protection Agency, 2008. Approaches to geologic sequestration site stewardship after site closure. 26pp. (EPA 816-B-08-002)

Wilson, E.J., et al. 2007. Liability and financial responsibility frameworks for Carbon Capture and Sequestration. World Resources Institute Issue Brief CCS No. 3.