FINANCIAL MECHANISMS FOR LONG-TERM CO_2 STORAGE LIABILITIES

Report: 2012-11

November 2012

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ACKNOWLEDGEMENTS AND CITATIONS

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The report should be cited in literature as follows:

'IEAGHG, "Financial Mechanisms for Long-Term CO_2 Storage Liabilities", 2012-11, November 2012.'

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FINANCIAL MECHANISMS FOR LONG-TERM CO_2 STORAGE LIABILITIES

Background to the Study

Liability, both compensatory and stewardship, is the legal responsibility that one has to another or society, enforceable by civil remedy or criminal punishment. Post-closure (long-term) liability for carbon capture and storage (CCS) is largely related to potential migration (within the subsurface) or potential leakage (to the surface) of the stored carbon dioxide (CO_2). The IPCC Special Report on Carbon Dioxide Capture and Storage (2005) describes potential pathways for such leakage to take place: for example via poorly abandoned wells (the most likely), through pores of low-permeability caprocks, or migration through faults. Such leakage could result in environmental risks (groundwater contamination and risks to the ecosystem), subsurface trespass, and climate effects. Potential CO_2 leakage must also be considered in terms of emissions accounting liability where that applies. It must be recognised that the containment of CO_2 should become safer over time due to geophysical and geochemical processes that can act as trapping mechanisms for the stored CO_2. However, emissions accounting liability under an emissions trading scheme (ETS) can be accumulative and uncertain as to scope and ETS value, which can create great uncertainty for operators and authorities.

During the operational phase of a CCS project until closure (short-term) it is logical to apportion the liability to the operator of the site as they are most able to manage the risk of any leakage occurring (although there could also be a degree of risk sharing with authorities). For the post operational phase (long-term) however, it is possible that the former operator of the site will not be able to be held accountable over much longer timescales and a not-uncommon expectation is that liability will transfer to the state. A major issue on the liability of CO_2 storage is when to set the shift from ‘short-term’ to ‘long-term’.

There are numerous current regulations and emerging CCS-specific regulations that need to be considered when investigating long-term liability mechanisms. The European Commission (EC) adopted a Directive (2009/31/EC) in 2008 to enable environmentally-safe capture and storage of CO_2 in the European Union (EU). The Directive has been accompanied by EC Guidance Documents, which, though not legally binding, provide guidance on risk management, site characterisation, monitoring, corrective measures, transfer of responsibility, and financial security/contribution. These Guidance Documents consider different types of both compensatory and stewardship liability, with financial liability covering post-closure obligations for surrender of emission allowances under the EU ETS, monitoring, and corrective measures (in the event of leakage).. The US Environmental Protection Agency (EPA) rule on CO_2 storage (2010), requires financial support from the operator until the end of post-injection site care and monitoring (suggested as 50 years). Financial instruments allowable include trust funds, surety bonds, letter of credit, insurance, self insurance,

corporate guarantee and escrow account. In the EU, allowable financial mechanisms (described in EC Guidance Document 4) include funds (or deposits), trust funds, escrows, bank guarantees, irrevocable standby letters of credit, and bonds issued by a bank. Financial mechanisms for long-term liability will be responsible to either the operator or competent authority, depending on the regulations of that specific region. Zurich Insurance have developed a number of insurance policies for CCS although currently they do not cover long-term liability. At the time of the development of the EC and EPA regulations it was viewed that there was a need for information and assessment of such financial instruments and their applicability to CCS projects.

Scope of Work

The study aimed to review current laws and emerging CCS specific regulations, in different regions of the world and under different legal frameworks, concentrating on long-term liability aspects. The primary work of the study was to investigate and assess the various potential financial mechanisms for supporting CO_2 liability, including an assessment of their applicability and practicality to all parties concerned, and provide recommendations based on the findings. As well as discussion on important issues such as when and how transfer of liability to the government should occur, and what these liabilities could be, the study focuses primarily on how this liability can be supported.

The specific objectives for this study were as follows:

- Review current CCS and non-CCS regulations in different regions of the world with a focus on financial mechanisms for long-term liability, including government assumption of liabilities.
- Investigate and assess potential financial mechanisms for long-term CCS liability and provide recommendations based on the findings. Clearly explain the strengths and weaknesses of potential financial mechanisms to address facilities' long-term CCS liability concerns.
- Assess liability transfer issues such as when and how transfer of liability to the government can occur, what these liabilities could be, and how liability transfer can be supported financially.

Short-term liability before project closure and applicable financial mechanisms may also represent an important issue for storage operators but was not within the scope of this study. It was ensured that the contractor for this study had a thorough understanding of appropriate liability, insurance, and financial mechanism sectors globally, as well as an understanding of the liabilities associated with CCS.

Findings of the Study

The financial challenge for private and public entities is to make provisions for paying in the future for stewardship responsibilities and compensatory liabilities after CO_2 injection has ceased, which is when the geosequestration facility's revenue stream may be much less. The financial challenge is complicated by the uncertainty of whether any compensation claims will arise, when they might appear, and what their magnitudes might be. Stewardship obligations have two elements that require funding – a steady low-level cost of inspection/monitoring with another element of higher costs (e.g., for remediation of leaks) triggered by physical events affecting the storage facility. Uncertainty affects the financing of both compensatory liabilities and stewardship liabilities, which may continue into perpetuity.

Of particular concern to stakeholders is the lengthy and indefinite timeframe of possible long-term stewardship and size and uncapped compensatory liability at CCS storage facilities. Stakeholders are seeking clarity about how, if at all, regulatory frameworks will incorporate financial requirements for long-term stewardship and compensatory liabilities; which financial mechanisms will regulatory frameworks allow to be used to satisfy financial requirements; and how those options will work (including cost and availability).

This study was conducted because little information of general applicability that responds to these concerns, needs, and beliefs is available to CCS stakeholders.

In general, for facilities posing potential environmental safety and health risks, financial requirements typically apply to one or more of the following liabilities:

- proper closure/decommissioning
- remediation
- aftercare
- rehabilitation/reclamation of affected land for another use
- compensation of bodily injury and property damage/loss to private parties
- compensation of damage/loss to the public's natural resources

Within the EC, the liabilities associated with CCS projects could include the following:

- Monitoring.
- Corrective measures, including measures to protect human health, in the event of leakages or significant irregularities.
- Surrender of emission allowances due to inclusion of the storage site under the ETS Directive.
- Sealing the storage site and removing the injection facilities.
- Operating the site, if the government withdraws the storage permit, if the government decides to continue CO_2 injection temporarily until a new storage permit is issued.

- Making the required financial contribution (FC) for post-transfer liabilities available to the government prior to transfer of responsibility. The EC recommends that the FC obligation be covered by a financial mechanism commencing during the operations period.

According to the US EPA, the CCS liabilities which have to be covered by the financial instruments must cover the following:

- corrective action for plugging of abandoned wells and underground mines in the injection area ,
- injection well plugging,
- post injection site care and site closure,
- emergency and remedial response.

These EPA CCS regulations do not include financial requirements for compensatory liability.

Financial Mechanisms

A financial mechanism refers to one of many instruments that can be used to ensure funding for long-term liabilities. This report identifies and describes eighteen types of financial mechanisms. The report describes the strengths and weaknesses of each type of financial mechanism, including an assessment of its applicability and practicality to all parties concerned.

The description of the mechanisms is provided below, with the summary of the analysis of each for their applicability and practicality in relation to long-term CCS obligations. More detail on the analysis of each is provided in the main report.

Third-Party Mechanisms

Irrevocable Trust Fund: Independent trustee accepts property from owner/operator to manage as a fiduciary for a particular purpose on behalf of a beneficiary (e.g., government regulatory agency). Trustee is a bank or other financial institution that is regularly examined and regulated by an independent financial oversight entity. Once accepted into the trust fund, the property ceases to be owned by the owner/operator, is outside its control and beyond the claims of its creditors. The trust is considered irrevocable because the owner/operator cannot unilaterally terminate the trust and reclaim the property.
Applicability: Trust funds are well suited to provide financial security over the long-term as they are “irrevocable” and protected from claims of creditors.

Practicality: Trust funds are practical for CCS long-term liability because they have low administrative burdens and are available to all operators, regardless of credit-worthiness.

Escrow Account: Agent of the owner/operator manages funds set aside for an explicit purpose. Unlike the trustee for an irrevocable trust fund, the escrow agent does not owe the government beneficiary a fiduciary duty. Instead, the escrow agent is responsible to the party

placing funds into the escrow. Funds in escrow remain the property of the owner/operator, and are subject to the control of the owner/operator and the claims of creditors. .

Applicability: Escrow accounts offer less security compared to other mechanisms due to their revocability and lack of protection from claims of creditors of the owner/operator.

Practicality: Escrow accounts have not traditionally been used to finance long-term obligations and so may not be practical given limited experience.

Bank Demand (Payment) Guarantee, Irrevocable Standby Letter of Credit, Surety Bond (Payment Bond): All three of these mechanisms involve a third party (i.e., bank or surety company) guarantee of payment, up to a specified limit, to the beneficiary (e.g., government) on demand if specified conditions are met. The owner/operator is responsible to reimburse the third-party guarantor. Issuers must be financial institutions that are regularly examined and regulated by an independent financial oversight entity.

Applicability: Well-suited to provide assurance over long time-periods because they can be "irrevocable", automatically renewed, and the amount is easily adjusted.

Practicality: Able to secure high amounts. Financial institutions generally do not expect to incur significant risks from these mechanisms and offer them only to creditworthy parties.

Surety Bond (Performance Bond): Surety company guarantee that it will satisfy the owner/operators obligations as specified in the surety agreement, if the storage site owner/operator fails to perform. Unlike a surety payment bond, the performance bond gives the surety the option to perform the owner/operators' obligations.

Applicability: Well-suited to provide assurance for obligations that can be performed such as stewardship.

Practicality: They are "irrevocable" and automatically renewed. Financial institutions generally do not expect to incur significant risks from these mechanisms and offer them only to creditworthy parties

Prepaid Insurance Policy for Assurance of Closure & Post-closure Monitoring: Insurer guarantees costs of performing closure and post-closure monitoring upon the insured's prepayment of the required premiums. Issuers must be financial institutions that are regularly examined and regulated by an independent financial oversight entity.

Applicability: A prepaid insurance policy can be used for closure and post-closure monitoring, is nearly irrevocable, and places the secured funds beyond the control of the CCS operator, making it an applicable mechanism for long-term CCS liability.

Practicality: The limited availability of prepaid insurance policies to cover CCS closure and post-closure liabilities may make this an impractical mechanism at the current time

Liability Insurance Policy for Payments Due to Losses or Damages: Insurer guarantees payment for losses or damages incurred by others. Scope of liability insurance typically addresses damages or losses to parties other than the owner/operator, including losses/damage to publicly-owned resources. Terms, conditions, definitions, and the like may

restrict coverage to defined amounts, perils (causes), losses, parties, and the like, which may result in insurance that does not fully address financial requirements. Issuers must be financial institutions that are regularly examined and regulated by an independent financial oversight entity. These policies are not irrevocable.

Applicability: Liability insurance might not be available in the marketplace to provide for payments, due to losses or damages incurred by other parties. Liability insurance does not provide financial coverage for long-term stewardship and other first-party liabilities such as corrective measures.

Practicality: The limited availability of liability insurance products for CCS long-term liability makes insurance not a practical mechanism for CCS at this time.

Corporate Guarantee from Non-affiliated Corporation Based on (Annual) Financial Test: A company neither owned by nor having a common owner with the storage facility owner/operator guarantees the owner/operators' obligations. The financial test must be met by the non-affiliated corporate guarantor and may include requirements for net working capital, total assets, tangible net worth, and/or credit ratings.

Applicability: Generators of CO_2 that are not affiliated with the operator can provide guarantees if they can pass the financial test.

Practicality: Corporate guarantees from non-affiliated companies are low cost financial mechanisms for CCS long-term liability.

Third-Party Administered Mutual Industry Pool: Third-party (neither the government nor an owner/operator) manages collective fund into which multiple industry members contribute. The fund is available to pay for long-term stewardship and/or compensation either as a primary funding source or as a back-up if contributors fail to meet their obligations. As a collective fund, industry members do not have individual accounts that limit payments from the fund to the sum of an individual's contributions plus interest. The fund could be organized as a mutual insurer, a group captive, a risk retention group (in the United States), or otherwise.

Applicability: Pools require a number of relatively homogeneous members facing independent financial risks. If CCS operators are not likely to be active and viable during the period after closure in which long-term liabilities could arise, mutual industry pools might not have enough resources to properly address financial requirements, and thus are a poor financial mechanism to assure long-term liabilities associated with CCS.

Practicality: Until there are enough active CCS operators, mutual industry pools will not be a practical option to adequately address long-term financial requirements.

<u>First-Party Mechanisms</u>

Security Interests in Property: Creation of a claim on owner/operator assets to guarantee the performance or payment of an obligation. The government beneficiary of the security

interest has preferential rights, usually the right to seize and sell the property in the event that obligations are not met. The ownership and control of the property remains with the owner/operator and is subject to the claims of other creditors.

Applicability: Security interest in property would not be applicable for recurring stewardship liabilities.

Practicality: Security interests in property would be a high-burden, high-risk, inflexible mechanism for long-term CCS liabilities.

Charge over an Operator's Bank Account: Creation of a claim on an owner/operator bank account to guarantee the performance of an obligation. The government beneficiary of the charge has preferential rights, usually the right to access funds within the bank account in the event that obligations are not met. The ownership and control of the bank account remains with the owner/operator and is subject to the claims of other creditors.

Applicability: A charge over a bank account can last only as long as the account, so this mechanism would not be able to outlast the operator. In the event that liabilities arise after the CCS operator has gone out of business, the government would need to use public money to take on those obligations.

Practicality: Industry could easily establish and maintain this mechanism at low added cost, given existing bank accounts. High burden on the government to continuously oversee the charge makes this mechanism impractical

Corporate Guarantee from Affiliated Company Based on (Annual) Financial Test: A company affiliated (as parent, subsidiary, or having a common parent) with the site owner/operator guarantees the owner/operators' obligations. In this case, the financial test must be met by the affiliated guarantor. A guarantee from a subsidiary of the owner/operator does not provide an independent source of funding because the subsidiary's financial strength is subject to demands from its parent company..

Applicability: Like CCS operators, affiliated companies that make corporate guarantees are at risk of not remaining active and viable for the duration of the longer-term liabilities. Corporate guarantees set aside no actual funds and may not offer a fully independent source of funds due to intercorporate affiliations.

Practicality: Corporate guarantees from affiliated companies based on financial tests could provide low-cost, financial mechanisms for long-term CCS liability. Affiliated companies may be financially strong and relatively independent of the financial condition of the operator.

Self-Guarantee Based on Annual Financial Test: Owner/operator demonstrates ability to pay for obligations using a financial test, which may include requirements for net working capital, total assets, tangible net worth, and/or credit ratings. Not an independent source of funding.

Applicability: Self-guarantee provides no additional financial resources beyond what the operator can raise. CCS operators unlikely to be both active and viable for the potential duration of their long-term liabilities.

Practicality: Government regulators may not have skills and interests required to assess whether the operator's finances pass the financial test.

Self-Guarantee with Internal Account Reserve (Instead of Financial Test): Owner/operator guarantees satisfaction of obligations by designating an internal account for that purpose. The ownership and control of the funds remains with the owner/operator and is subject to the claims of creditors. Not an independent source of funding.

Applicability: Because CCS operators are unlikely to remain active and viable during the period after closure in which long-term liabilities could arise, internal account reserves provide very little financial security for long-term liabilities.

Practicality: Internal account reserves provide a financial mechanism with low cost for a CCS operator to establish and maintain.

Government Mechanisms

Deposits of Cash or Cash Equivalents to Government Authority (GA): The government agency accepts cash or cash equivalent deposits directly from owner/operator to be used later to satisfy owner/operator obligations. GA may create a special account on behalf of the owner/operator or may turn the funds over to the government treasury.

Applicability: A deposit to a GA can last as long as necessary, which makes this mechanism well suited for long-term CCS liabilities.

Practicality: A deposit to a GA may not be a practical mechanism for operators without sufficient assets or cash flow. The GA in some countries may not have an established record of long-term continuity.

Government-Administered Pooled Funds: Government manages pooled fund. Contributions may be received directly from owners/operators or indirectly as fees on injection, electricity use, or fossil fuels purchased for power generation. The fund can be designed either as a primary funding source or as a back-up available to reimburse the government if an owner/operator fails to meet certain obligations and the government becomes responsible to satisfy owner/operator obligations.

Applicability: Government-administered pooled funds can assure coverage for long-term CCS activities, with a sufficient number of financially viable participants and if the funds are protected from being appropriated for other uses. Urgent, non-CCS-related scenarios may arise that result in diversion of funds.

Practicality: Government-administered pooled funds are difficult to set up and maintain. Risk-based fees likely to be more controversial than per unit fees.

Government Guarantees: Government agrees to guarantee payments to claimants for specified liabilities as a back-up. A guarantee is a promise to answer for the debt, default, or other liability of another. A government guarantee about CCS could mean that the government will pay for third-party damage/loss that the responsible owner/operator fails to pay. The payment goes not to the owner/operator (as for indemnification) but from the government to the party that the owner/operator has not paid. Because the government issues it, the guarantee can outlive the owner/operator.

Applicability: Government guarantees are considered secure and likely to last longer than mechanisms provided by private-parties.

Practicality: Government guarantees are commonly used in jurisdictions to foster infrastructure development and industrial activity. This mechanism could be used in countries where the government and its finances are stable enough to guarantee payments over the long timeframe of post-closure CCS activities

Government Assumptions of Liability: Government takes primary responsibility away from the site owner/operator for specified liabilities if pre-determined criteria have been met. Also referred to as "transfer of liabilities."

Applicability: Governments are considered more likely to be active and viable in the long-term than industry. The government could require that an operator fulfill certain safety requirements prior to the govenrment's assumption of liabilities to minimize the risks and magnitudes of long-term liabilities assumed by the government.

Practicality: Government assumption of liability would be an attractive option for operators who may be wary of entering the CCS industry due to the indefinite time-frame and uncertainties of long-term CCS liabilities. The implementation of government indemnities could involve many government departments and legislation, resulting in a high administrative burden. The public and government may be unlikely to be willing to take on liabilities in uncapped amounts.

Government Indemnities: Government agrees to reimburse owner/operator for payments made for specified liabilities. Not a primary funding source. The indemnification payment goes to the owner/operator from the government, unlike for government guarantees where the payment from the government goes to the creditor of the owner/operator. Because indemnification is a duty owed to the owner/operator, that duty ceases if the owner/operator is defunct.

Applicability: Governments are considered more likely to be active and viable in the long-term than industry. The government could require that an operator fulfill certain safety requirements prior to the governments' assumption of liabilities to minimize the risks and magnitudes of long-term liabilities assumed by the government..

Practicality: Government indemnities would be an attractive option for operators who may be wary of entering the CCS industry due to the indefinite time-frame and uncertainties of long-term CCS liabilities. The implementation of government indemnities could involve many government departments and legislation, resulting in a high administrative burden. The

public and government may be unlikely to be willing to indemnify liabilities in uncapped amounts.

Approaches for transfer of long-term liability

The report identifies and analyzes key generic aspects of frameworks for transfer of long-term CCS liability to the government. These aspects are: threshold technical requirements; financial requirements related to liability transfer; post-transfer cost recovery provisions; specification of which and whose liabilities may or must be transferred. For the purposes of summarising the assessments of options of liability transfer frameworks, the following comments are made on the evaluative criteria.

Costs to Industry and Government/Taxpayer Transfer of liability frameworks serve to re-allocate costs of long-term CCS liabilities away from industry and onto government. Part of the rationale for such transfers is that government bodies are more likely than businesses to endure over long time periods. In addition, there may be a net cost savings to society by having government take primary long-term responsibility for CO_2 storage sites, given that the alternative is for industry to have primary responsibility with government exercising oversight.

Incentive Effects. Much of the necessary expertise for large-scale underground CO_2 storage is found in industry. Transfer of liability frameworks are intended to make industry more comfortable with playing a large role in CO_2 geosequestration. Thus, options for liability transfer frameworks have been assessed in terms of their implications for industry participation in CO_2 geosequestration. In addition, the provisions of liability transfer frameworks might affect industry incentives for performing siting, injection, closure, monitoring, and the like, given that liability transfer frameworks are thought to create moral hazard: by transferring long-term liability to government, industry may not perform at the same level that would occur if industry retained subsequent liabilities. It is thought that requiring an owner/operator to retain some long-term liabilities reinforces incentives for proper injection and storage of CO_2 prior to facility transfer. Industry risk-sharing with government may reduce concerns about moral hazard because it creates a disincentive for the owner/operator to perform its technical responsibilities poorly.

Effectiveness of Protection of the Public/Environment. Requiring that facilities achieve high performance standards as a precondition of liability transfer should help reduce future threats to the public and the environment as well as reduce the need for future mitigation or remediation costs to be borne by industry or government. In addition to clear, objective standards (e.g., for closure) that can be assessed and verified prior to transfer of liability, an explicit post-closure monitoring period prior to transfer can assure that the responsible owner/operator has properly closed the site and that it is not leaking CO_2 either to the atmosphere or to underground formations where proper controls may be lacking.

Duration. Liabilities associated with CO_2 storage may persist for hundreds of years, possibly outlasting lifetimes of businesses. This extended duration must be considered in designing a liability transfer framework in order to ensure that liability remains with an entity capable of fulfilling long-term liabilities.

Two Examples of Liability Transfer Frameworks

Framework Aspect	Example Option A	Example Option B
Technical Requirements	Stringent conditions including a post-closure period and performance standard prior to transfer	Stringent conditions including a post-closure period and performance standard prior to transfer
Which Liabilities are Transferred	Some liabilities transferred	All liabilities transferred
Whose Liabilities are Transferred	Owner/Operator	All potentially liable parties
Financial Requirement	Per unit injection fee paid into a fund during operations	Contribution prior to transfer
Cost Recovery Provisions	Post-transfer cost recovery provisions	No post-transfer cost recovery provisions

The report does not seek to recommend any one liability transfer framework option, as this is up to the host country and their national interest and policy situation. However the report does conclude by providing two examples of frameworks which, whilst 'middle of the road', show different balances between the evaluation criteria above, and in particular in balancing the assignment of costs between government and industry, incentives to industry, and providing environmental protection. These examples are shown in the table above.

Expert Review Comments

Expert comments were received from 5 reviewers, representing industry (corporate sponsors of IEAGHG) and academia. The feedback was constructive and supportive of the work that had been carried out, noting the material was overall comprehensive and detailed.

Following the expert review process, improvement to the report was made primarily in particular areas. The scope was extended to explain more what should be covered when considering liabilities and what such liabilities may be (using examples). More conclusion/summary paragraphs were added throughout the paper, in particular after lengthy tables of information, making the report easier to read and understand key points. The contractor also added some additional key references, as recommended by the reviewers, to back key ideas and improve accountability.

Conclusions

Government financial requirements primarily protect the government/taxpayer from the risk of the operator's failing to fulfil its obligations, although some acceptable financial mechanisms also may serve as a funding source for the operator. On the other hand, for the benefit of shareholders/owners, an operator may propose a variety of positions regarding its exposure to long-term CCS liabilities, ranging from use of a financial mechanism to self-insurance without a financial mechanism (subject to agreement by the relevant authorities).

This report identifies and describes eighteen types of financial mechanisms.. The report describes the strengths and weaknesses of each type of financial mechanism, including an impartial assessment of its applicability and practicality to all parties concerned in relation to long-term CCS obligations.

In most cases, industry will finding that self-guarantees and corporate guarantees present the lowest after-tax costs, if these mechanisms are acceptable in the jurisdiction and if the operator or guarantor can pass the associated financial tests of eligibility.

In developing regulatory frameworks for CCS, legislators and regulators should indicate which financial mechanisms will be acceptable for long-term CO_2 storage liabilities. Governments should allow use of multiple, acceptable financial mechanisms in order to provide compliance options to facility operators. Industry's position on financial mechanisms for long-term CCS liabilities may differ when responding to government financial requirements as opposed to when managing those liabilities independently of government financial requirements. Industry may want to propose a package of acceptable financial mechanisms that might involve more than one financial mechanism for a given long-term liability. For example, a "sinking fund" approach involves two mechanisms: (1) a fund that is built up over a given time interval (e.g., 5 years) and (2) a complementary guarantee that decreases in amount as the sinking fund increases. The two mechanisms must together equal or exceed the required amount for covering the obligation. Similarly, when an operator faces financial requirements for two or more long-term liabilities, a package of different types of acceptable financial mechanisms may allow for lower costs and a greater degree of risk-sharing with the government. For example, a package might contain a more conservative financial mechanism for post-closure monitoring combined with a potentially higher risk financial mechanism for post-closure remediation, on the theory that the remediation obligation is more unlikely to arise.

Recommendations

This report provides in one document a review of likely financial mechanisms for long-term liabilities relating to CO_2 geological storage. The report does not seek to recommend any one financial instrument or liability transfer framework option, as this is up to the host country and their national interest and policy situation. Although stakeholders may disagree about

what ought to be done, this study should assist stakeholders to agree on what can be done, recognizing that different approaches may be preferred in different countries and regions.

Discussion will continue to arise around long-term liabilities within the meetings of the IEAGHG storage networks, and the findings of this study should provide some more understanding of what can be done to manage and finance these.

Financial Mechanisms for Long-Term CO_2 Storage Liabilities

Revised Draft Submitted by:
ICF International

Submitted to:
IEA GHG

November 1, 2012

Table of Contents

I. Introduction

A. Background

Increasing use of fossil fuels, the correlated rise in the carbon intensity of primary energy, and various other factors are driving energy-related carbon dioxide (CO_2) emissions towards a path that would double the global 2007 emissions levels by 2050.[1] However, new energy policies and technologies such as carbon dioxide capture and storage (CCS) may be able to reduce these projected emissions. CCS refers to a set of technologies that can reduce carbon dioxide emissions by (1) isolating CO_2 from the emission streams of power plants and other industrial facilities, and then (2) compressing and transporting the CO_2 to an injection site where it is (3) stored in underground geological reservoirs. Of these three processes, geologic storage presents the most novel and complex regulatory challenges.

In order to facilitate the deployment of CCS technologies, governments around the world are developing regulatory frameworks to address the safety, efficacy, and environmental soundness of injecting and storing CO_2 underground. These initiatives often anticipate that industry will conduct CCS under government supervision. The regulatory frameworks include requirements about siting, developing, operating, and closing storage facilities and subsequent monitoring and aftercare; the frameworks also may establish or alter rules about responsibility for compensation of losses or damage resulting from storage activities.

The financial challenge for private and public entities is to make provisions for paying in the future for stewardship responsibilities and compensatory liabilities after CO_2 injection has ceased, which is when the geosequestration facility's revenue stream may be much less.[2] The financial challenge is complicated by the uncertainty of whether any compensation claims will arise, when they might appear, and what their magnitudes might be. Stewardship obligations have two elements that require funding – a steady low-level of inspection/monitoring with another element of higher costs (e.g., for remediation of leaks) triggered by physical events affecting the storage facility. Uncertainty affects the financing of both compensatory liabilities and stewardship liabilities, which may continue into perpetuity.

Of particular concern to stakeholders is the lengthy and indefinite timeframe of possible long-term stewardship and size and uncapped compensatory liability at CCS storage facilities. Stakeholders are seeking clarity about how, if at all, regulatory frameworks will incorporate financial requirements for long-term stewardship and compensatory liabilities; which financial mechanisms will regulatory frameworks allow to be used to satisfy financial requirements; and how those options will work (including cost and availability). Some stakeholders assume that an insurance-based solution or similar risk-spreading/sharing mechanism will be the least costly approach to long-term CCS financial requirements. In addition stakeholders view other policy

[1] International Energy Agency. 2010. "Energy Technology Perspectives: Scenarios and Strategies to 2050." Available at http://www.iea.org/techno/etp/etp10/English.pdf.

[2] However, the site operator may have multiple lines of business so that revenue continues despite closure of injection operations. Also, the site operator is likely to be part of a larger corporate group that has many other sources of revenue. Another business model would have the generator be the owner/operator of its own storage site, which could mean no revenue streams at all.

tools, such as transfer of liability to a government entity, as a solution for concerns about the long-term stewardship and compensatory liabilities of CCS storage facilities. This study was conducted because little information of general applicability that responds to these concerns, needs, and beliefs is available to CCS stakeholders.

The specific objectives for this study are as follows:

- Review current CCS and non-CCS regulations in different regions of the world with a focus on financial mechanisms for long-term liability, including government assumption of liabilities.
- Investigate and assess potential financial mechanisms for long-term CCS liability and provide recommendations based on the findings. Clearly explain the strengths and weaknesses of potential financial mechanisms to address facilities' long-term CCS liability concerns.
- Assess liability transfer issues such as when and how transfer of liability to the government can occur, what these liabilities could be, and how liability transfer can be supported financially.

Although stakeholders may disagree about what ought to be done, this study should enable stakeholders to agree on what can be done, recognizing that different approaches may be preferred in different countries and regions.

This IEAGHG study of financial mechanisms and long-term liability issues contributes to IEA efforts to support CCS implementation across the world. In the legal/regulatory sphere, important IEA contributions include *Legal Aspects of Storing* CO_2 (2007), *CCS: Model Regulatory Framework* (2010), and *CCS: Legal and Regulatory Review Edition 1* (2010) *and 2* (2011). Other relevant references include the *Report of the U.S. Interagency Task Force on Carbon Capture and Storage* (2010) [3] and the guide prepared by the U.S. Interstate Oil and Gas Compact Commission (2007).[4] The IEA publications include within their scopes material about long-term CCS liabilities, but little information about applicable financial mechanisms. This study squarely addresses that gap and also provides a framework for considering transfer of liabilities, at some point after completion of injection, to governments.

[3] *The Report of the [U.S.] Interagency Task Force on Carbon Capture and Storage* identifies the role of CCS in U.S. climate policy and global initiatives, the state of CCS technology, legal and regulatory barriers to CCS implementation in the U.S., and approaches for legal and regulatory frameworks to overcome barriers to CCS implementation. The Task Force Report provides a comprehensive study of CCS policy and regulatory options for U.S. policymakers.

[4] The U.S. Interstate Oil and Gas Compact Commission (IOGCC) report *A Legal and Regulatory Guide for States and Provinces* provides an analysis of property rights issues in the CCS context and a model of general rules and regulations. The IOGCC report provides perspectives about financial mechanisms and policy options for long-term liabilities. The IOGCC report includes model statutory and regulatory language for financial requirements, and discusses the role of liability transfer in a CCS regulatory framework.

B. How This Study Defines Key Terms

1. Long-Term

This study focuses on long-term CCS liabilities rather than operational CCS liabilities; stakeholders seem more comfortable addressing operational liabilities even though injection operations may be planned to take place over 20- to 50-year time periods. The "long-term" is defined for this study as the time period following completion of injection and proper closure/removal of facilities. This study does not need to define "long-term" either quantitatively or using regulatory terminology, which is not consistent globally.

Regulatory frameworks may subdivide the period after injection permanently ceases to include a specified period with defined responsibilities, whose ending leads to a period of less-defined responsibilities for the storage site. This study considers both periods as "long-term." Some frameworks address the formal transfer of liabilities to the government at some point in time during this period.

CCS will store CO_2 indefinitely, creating an unbounded duration for potential liability. As a result, for the long-term liability phase, it is possible that an owner/operator of a CCS site will not be able to be accountable over this timescale. In the absence of a financially viable owner/operator, other parties will be needed to finance long-term liability.

2. Liabilities

This study defines liabilities to mean legal obligations. These are civil— not criminal— obligations that may be established and enforced by legislatures, courts, government agencies, and, in some cases, private parties. Enterprises engaged in removal of resources from the earth as well as enterprises engaged in placement of materials (usually "wastes") in the earth typically face many different types of liabilities with varying triggers, risk profiles, and durations. Storage of CO_2 underground faces similar types of liabilities as well as some quite special liabilities that are discussed below. The specific nature of these long-term liabilities depends on the legal regime or jurisdiction where CO_2 storage will take place.

This report distinguishes between operational CCS liability and long-term CCS liability. Operational liability arises during the injection period. Post-closure (i.e., long-term) liabilities related to the injection and storage of the CO_2 arise after injection has ceased and the storage site has been closed. Long-term CCS liability includes (1) obligations to perform stewardship (e.g., monitoring) obligations and (2) obligations to compensate private parties and the public for various types and forms of legally-compensable losses or damages.

This study distinguishes between post-closure stewardship liabilities and post-closure compensatory liabilities. Responsibility for the physical monitoring, care, rehabilitation, and remediation (if needed) of the storage site is called "stewardship" in this study. "Compensatory liability" includes responsibility for compensation of damage or losses to persons, their property, and to public resources. Compensatory liabilities can arise from damages/loss due to seismic effects from injection pressures; subsurface movements impairing the quality, access, and value

of subsurface resources including water and energy minerals; contamination of shallower resources such as water from household wells; catastrophic releases of CO_2 causing suffocation or other injuries to the health of people and livestock; release to the atmosphere requiring corresponding reductions in emission reduction credits; and other possibilities. These liabilities are not expected to occur frequently if at all, but CO_2 storage is so new that any "risk profiles" are unproven. Apart from liabilities related to surrender of emission reduction credits/allowances, none of the risks of CO_2 storage are thought to present outsized levels of losses/damages. However, some of the liabilities could occur together in the event of leakage from storage, such as corrective measures and surrenders of credits/allowances. Other compensatory liabilities may arise from the leakage event. On the other hand, the absence of a leakage event does not necessarily mean that no liabilities will arise; claims (e.g., third-party damage claims, corrective measures) can arise from purely subsurface effects of injection and storage.

Liabilities may be subject to various legal conditions, sometimes including "caps" on the amounts of compensatory payments. Discussion of the appropriate structure of liabilities falls outside the scope of this report, which focuses on financial requirements and financial mechanisms. Jurisdictions may select a subset of liabilities to be subject to financial requirements. That subset of liabilities often represents those which an operator may not be able or willing to fulfill because of their magnitude and/or timing.

3. Financial Requirements

Financial requirements, an increasingly common component of industrial regulations, is a regulatory tool aimed at safeguarding the public against the financial risk of an operator's failure to satisfy stewardship obligations or to compensate for harm or losses incurred as a result of any particular activity (in this case, geological storage). Financial requirements attempt to guard against the situation where the responsible party enters bankruptcy, dissolves, or shelters assets elsewhere without satisfying legal obligations.

This study uses the term "financial requirements" generically as a terminology of convenience. For example, what the European Commission (EC) refers to as "financial security" for CCS goes by other names in Member States, and in other jurisdictions – financial responsibility, financial assurance, bonding, surety, financial warranty, and guarantees, among other terms. This study uses generic terminology to prevent confusion due to inconsistencies among varying worldwide terminology.

Financial requirements apply to specific liabilities. For facilities posing potential environmental safety and health risks, financial requirements typically apply to one or more of the following liabilities:

- proper closure/decommissioning
- remediation
- aftercare
- rehabilitation/reclamation of affected land for another use
- compensation of bodily injury and property damage/loss to private parties

- compensation of damage/loss to the public's natural resources

Financial requirements in regulatory frameworks may cover all of the above or specific types of selected liabilities. The regulatory framework established for CCS by the EC, in EC Directive 2009/31/EC on CCS, both establishes specific obligations for storage site operators and also identifies obligations subject to financial requirements. Financial requirements apply not only to obligations created by the CCS Directive but also to certain obligations established under other EC directives. Notably, the EC's Emissions Trading System (ETS) Directive 2003/87/EC requires that, in the event of leakage of CO_2 from sequestration, an equivalent amount of greenhouse gas emissions allowances be surrendered. The CCS Directive required that the obligation to surrender emission allowances must be covered by valid and effective financial mechanisms. The CCS liabilities subject to EC financial requirements include the following:

(1) Monitoring.

(2) Corrective measures, including measures to protect human health, in the event of leakages or significant.

(3) Surrender of emission allowances due to inclusion of the storage site under the ETS Directive.

(4) Sealing the storage site and removing the injection facilities.

(5) Operating the site, if the government withdraws the storage permit, and the government decides to continue CO_2 injection temporarily until a new storage permit is issued. [5]

(6) Making the required financial contribution (FC) for post-transfer liabilities available to the government prior to transfer of responsibility. The EC recommends that the FC obligation be covered by a financial mechanism commencing during the operations period.

The 2009 CCS Directive does not include financial requirements for compensation of liabilities neither for private property damage and personal injury nor for damage to or loss of public resources such as under the EC Environmental Liability Directive. The CCS Directive does not appear to prevent Member States from including financial requirements for such liabilities in addition to the financial requirements in the EC CCS Directive.

4. Financial Mechanisms

A financial mechanism refers to one of many instruments that can be used for long-term liabilities. Financial mechanisms for long-term CCS liabilities include (1) mechanisms for satisfying government financial requirements for specific CCS liabilities and (2) mechanisms that provide an operator with a source of funds to use in satisfying those liabilities. The latter,

[5] Although the CCS Directive refers only to obligations related to CO_2 acceptance criteria during temporary continuation of injection following permit withdrawal, the European Commission believes that temporary continuation of injection will require the government to take over operation of the site as a whole.

termed “funding mechanisms” return funds to operators as payments or reimbursements for operator outlays.

Common obstacles to clarity about financial mechanisms for long-term liabilities and stewardship include specialized terminology and legal/financial jargon. To reduce those obstacles to informed discussion about financial mechanisms, this study describes financial mechanisms in functional terms to focus on the important features of such mechanisms rather than on how they may be labeled in one or more jurisdictions. This study assumes that financial mechanisms are properly drafted (to be legally effective) and robust (i.e., to reflect best practices). .

The study describes the strengths and weaknesses of each type of financial mechanism, including an assessment of its applicability and practicality to all parties concerned. The analysis focuses on the use of each mechanism for coverage of long-term liabilities, utilizing evaluation criteria such as:

- Amount: does the mechanism assure a sufficient amount?
- Availability: who can acquire or establish the mechanism?
- Certainty: will funds be available from the mechanism when needed?
- Cost/Burden: opportunity costs, administrative burden?
- Duration: term of the mechanism and coverage of long-term liabilities?
- Flexibility: can the mechanism be readily amended over time or will an additional mechanism be required?
- Liquidity: difficulty of accessing funds?

Based on the analysis of the strengths and weaknesses of each financial mechanism, the study recommends financial mechanisms for use in the context of long-term CCS stewardship and compensatory liabilities.

5. Transfer of Liabilities

This study equates “transfer of liabilities” with government assumption of responsibility for a facility. The study analyses several key parameters of transfer of liability frameworks, which can differ based on how and when transfer may occur, which liabilities may be transferred, and whether financial mechanisms are involved. The criteria for evaluation include the following:

- cost to government/taxpayer/industry,
- protection of public/environment, and
- incentive effects.

The study considers two different types of incentive effects – incentives for industry to develop CO_2 storage facilities, and incentives affecting the siting, operations, closure, and aftercare of those facilities. One concern about liability transfer is the potential for “moral hazard,” which

refers to decreased levels of care that may be provided when operators are relieved from facing liability for the consequences of their actions.

C. Organization of the Report

This study was developed in a four-step approach. First, CCS and non-CCS regulations[6] from different regions of the world were compiled to provide insight into regulatory approaches to long-term liability. Second, financial mechanisms identified during the first step were analyzed for their strengths and weaknesses as applied to long-term CCS liabilities. Third, liability transfer frameworks identified during the first step were broken into options (e.g., when and how), and each option was analyzed for its strengths and weaknesses as applied to long-term CCS liabilities. Finally, the report recommends both financial mechanisms for long-term liabilities and regulatory frameworks for CCS liability transfer.

This study is organized into the following sections:

Section I provides background information and defines key concepts and terms for regulatory approaches to address long-term CCS liabilities.

Section II provides an overview of CCS and non-CCS regulatory frameworks from different regions of the world as they relate to long-term liability.

Section III identifies, analyzes, and recommends financial mechanisms for long-term CCS liability.

Section IV identifies, analyzes, and recommends liability transfer options for long-term CCS liability.

Appendix A: Review of International CCS and Non-CCS Frameworks presents the detailed research with program summaries and citations for each CCS and non-CCS program reviewed.

Appendix B: Financial Mechanisms Assessment presents the detailed evaluation of 18 types of financial mechanisms based on the following criteria: administrative burden, amount, certainty, cost, duration, flexibility and liquidity.

Appendix C: *Financial Mechanisms Strengths and Weaknesses* summarizes the strengths and weaknesses of the 18 types of financial mechanisms

Appendix D: Options for Transfer of Long-Term Liability summarizes provisions identified in various jurisdictions that illustrate options for transfer of liability with respect to: (1) threshold technical requirements, (2) financial requirements, (3) post-transfer cost recovery provisions, (4) which liabilities must (or may) be transferred, and (5) whose liabilities must (or may) be transferred.

[6] Select non-CCS regulations for industrial operations with long-term liabilities analogous to CCS were included in this study.

Appendix E: Strengths and Weaknesses of Options for Transfer of Long-Term CCS Liability summarizes the strengths and weaknesses of options assessed in Section IV.

II. Review of International CCS and Non-CCS Regulatory Frameworks for Long-Term Liabilities

This section provides an overview of CCS and non-CCS legislation worldwide illustrating how various jurisdictions use financial requirements and transfers of liability to address long-term liabilities.

A. Methodology

In order to assess how jurisdictions from around the world address long-term liability, the following types of programs were researched and reviewed:

- Enacted CCS-specific programs
- Enacted programs applicable to types of facilities that are potentially analogous to CCS, including underground injection of liquid waste, solid waste landfills, and geologic disposal of radioactive wastes

Research resources used to identify potentially relevant enacted laws and programs included LexisNexis, EUR-LEX, and ECOLEX.

After identifying potentially relevant programs that directly address long-term liabilities, the following information was extracted as focal points of the legislative reviews:

- **Responsible Party** - The party responsible for fulfilling long-term liability obligations. Although terminology varies across jurisdictions, for the purposes of this report, the entity with control over the injection during the operational phase of the facility is termed the "owner/operator," unless specified otherwise.
- **Scope of Long-Term Liability** - Liability for long-term stewardship is distinguished from long-term compensatory liability because laws frequently distinguish financial requirements or liability transfer requirements along these lines. Only where no statutory provisions further delineated the scope of long-term liability is the term "long-term liability" used.
- **Explicit Post-Closure Period** – Does the legislation create specific obligations that must be performed during a defined post-closure period immediately following closure? In some frameworks, legislation provides benchmark durations (e.g., X years) while in others the length of the post-closure period is to be specified by the regulatory agency.
- **Financial Requirements During Post-Closure Period** – If the legislation includes financial requirements after closure, which parties are responsible for compliance, which liabilities are subject to financial requirements, and which financial mechanisms are acceptable?

- **Owner/Operator Retention of Indefinite Long-Term Liability** –Regardless of any explicit post-closure period(s), does legislation release the owner/operator from liability whether through transfer to the government or other statutory provisions?
- **Indemnification** – The reviews sought to determine which laws had provisions about government indemnification of long-term liabilities.
- **Long-Term Liability Transfer** – The reviews focused on conditions and procedures for official transfer of liability from a responsible party to the government, not on conditions and procedures for transfer of permits and liabilities between entities in the marketplace.

B. Regulatory Reviews and Findings

The reviews were not meant to be a comprehensive summary of all current worldwide CCS and non-CCS programs but instead provide examples of how various regulatory frameworks address long-term liability. Exhibit 1 presents an overview of the CCS programs reviewed and Exhibit 2 presents an overview of the non-CCS programs reviewed. Exhibits A1 and A2 in *Appendix A* present the detailed research for CCS and non-CCS programs respectively, with program summaries and citations. These exhibits summarize:

(1) whether owners/operators have long-term liability for an explicit post-closure period (e.g., X years); and if so, whether financial requirements apply to some or all of these long-term liabilities

(2) whether long-term liability may be transferred to the government; and if not, whether owner/operator retention of long-term liabilities is coupled with government indemnification

Exhibit 1 of the CCS regulatory review shows the following:

- All CCS frameworks reviewed, except for one, identified the owner/operator as the responsible entity. The one exception included the generator as a liable party.
- The programs reviewed varied greatly in the scope of liability covered: 4 programs covered long-term compensatory liability only; 3 programs covered long-term compensatory liability and stewardship; 9 programs covered long-term stewardship only; and 3 programs covered long-term liability generally without specifying compensatory or stewardship liabilities.
- Just less than half of the frameworks reviewed provided for explicit post-closure periods (8 frameworks). Minimum periods range from about 15 years to about 50 years. Most of the frameworks (6 of 8) with provisions for explicit post-closure periods also had post-closure financial requirements.
- Similarly, just less than half of the frameworks had financial requirements for the post-closure period (9 frameworks). Most of the frameworks with post-closure financial requirements (6 of 9) also had provisions for explicit post-closure periods.

- Two frameworks addressed the owner/operator's retention of long-term liability after post-closure.
- Only 1 framework addressed indemnification.
- Most of the CCS frameworks (15of 19 frameworks) included provisions for transfer of long-term liability.

Exhibit 2 of the regulatory review of non-CCS regulatory frameworks shows that:

- All but two of the frameworks identified the owner/operator as the responsible party. Frameworks for nuclear/radioactive waste included generators as responsible parties.
- The scope of liability covered: 13 programs addressed stewardship only, 3 programs included both stewardship and compensation, 3 programs covered long-term liability generally, and 2 of the programs addressed compensation liability only.
- Half (10 of 20 frameworks) had provisions for explicit post-closure periods. Minimum periods range from about 15 years to 60 years (no information found in the frameworks for nuclear/radioactive wastes). Most of the frameworks (7 of 10) with provisions for an explicit post-closure period also had financial requirements.
- Half also included a financial requirement during the post-closure period. The majority of these frameworks were for solid waste facilities. Most of the frameworks (7 of 10) with financial requirements during post-closure also had provisions for explicit post-closure periods; two of the three exceptions related to nuclear/radioactive waste.
- One framework addressed the owner/operator's retention of long-term liability after post-closure
- Of the 20 non-CCS frameworks reviewed, no frameworks addressed indemnification.
- A minority (6 of 20) frameworks addressed transfer of long-term liability, with all three areas of non-CCS regulations contributing to this category at least once.

In most respects, the reviews found similar results for CCS and non-CCS programs. The major difference was the greater prevalence of provisions for transfer of liability in the CCS laws compared to the non-CCS laws. Based on the regulatory reviews performed for this study, including reviews of long-term liability frameworks for CCS and non-CCS programs, long-term liability is generally addressed in one of two ways:

(1) either an owner/operator retains responsibility for the storage facility in perpetuity without transfer to the government, or

(2) provision is made for transfer of responsibility to a government authority.

Both scenarios generally include a post-closure period for which the owner/operator must provide a financial mechanism to ensure that funding is available for long-term liability. However, jurisdictions greatly vary as to the financial requirements during the post-closure

period, the length of the post-closure period, conditions that must be met prior to transfer of liability, and the specific liabilities transferred.

Exhibit 1. Example CCS Regulatory Frameworks Relating to Long-Term Liability, Financial Requirements, and Transfer of Liability

Owner/Operator Scope of Long-Term Liability	Explicit Post-Closure Period	Financial Requirements During Post-Closure Period	Owner/ Operator Retention of Long-Term Liability after Post-Closure Period	Indemni-fication	Long-Term Liability Transfer
Australia-National: long-term compensatory liability	X		X	X	
Australia-National: long-term stewardship					X
Australia-Victoria 2008: long-term stewardship		X			
Australia-Queensland 2009: long-term compensatory liability		X			X
Australia-Victoria 2010: long-term stewardship					X
Belgium: long-term compensatory liability	X				X
Belgium: long-term stewardship	X	X			X
Canada-Alberta: long-term stewardship					X
Canada-Saskatchewan: long-term stewardship		X			
France: long-term compensatory liability and stewardship	X	X			X
Scotland: long-term compensatory liability and stewardship	X	X			X
Spain: long-term liability					X
Spain: long-term stewardship	X	X			X
United Kingdom: long-term compensatory liability and stewardship					X
United States-National: long-term stewardship	X	X	X		
Untied States-Kentucky: long-term liability					X
United States-Louisiana: long-term liability*					X
United States-Montana: long-term stewardship	X	X			X
United States-North Dakota: long-term compensatory liability					X

*****Responsible entity includes generator

Exhibit 2. Example Non-CCS Regulatory Frameworks Relating to Long-Term Liability, Financial Requirements, and Transfer of Liability

Owner/Operator Scope of Long-Term Liability	Explicit Post-Closure Period	Financial Requirements During Post-Closure Period	Owner/Operator Retention of Long-Term Liability after Post-Closure Period	Indemni-fication	Long-Term Liability Transfer
Underground injection of liquid waste					
Australia: long-term stewardship					X
Poland: long-term compensatory liability		X			
Poland: long-term stewardship	X				
United States: long-term stewardship	X	X			
Solid waste landfills					
Canada-British Columbia 1988: long-term stewardship					X
Canada-British Columbia 1993: long-term stewardship	X	X			
India: long-term stewardship	X				
Netherlands: long-term compensatory liability and stewardship					X
Norway: long-term stewardship	X	X			
Philippines: long-term stewardship	X	X			
Poland: long-term compensatory liability	X	X			
Poland: long-term stewardship	X				
United Kingdom: long-term stewardship	X	X			
United States: long-term stewardship	X	X			
Geologic disposal of nuclear wastes or other radioactive wastes					
China: long-term liability*			X		
France: long-term stewardship		X			
France: long-term stewardship*		X			
Germany: long-term liability					X
South Africa: long-term compensatory liability and stewardship					X
United States: long-term compensatory liability and stewardship					X

*Responsible entity is the generator

III. Assessment of Financial Mechanisms for Long-Term CCS Liabilities

Based on the worldwide CCS and non-CCS regulatory reviews, this section identifies and analyzes eighteen (18) distinct types of financial mechanisms for potential use in the context of long-term CCS liabilities. See Exhibit 3.

Exhibit 3. Financial Mechanism Options

Third-Party Mechanisms
1. Irrevocable (Private) Trust Fund
2. Escrow Account
3. Bank Demand (Payment) Guarantee; Irrevocable Standby Letter of Credit; Surety Bond (Payment Bond)
4. Surety Bond (Performance Bond)
5. Prepaid Insurance Policy for Assurance of Closure and Post-Closure Monitoring
6. Liability Insurance Policy (for Payments Due to Leakages)
7. Corporate Guarantee from Nonaffiliated Corporation Based on (Annual) Financial Test
8. Third-Party Administered Mutual (Collective) Industry Pool
First-Party Mechanisms
9. Security Interests in Property
10. Charge over an Operator's Bank Account
11. Corporate Guarantee from Affiliated Company Based on (Annual) Financial Test
12. Self-Guarantee Based on Annual Financial Test
13. Self- Guarantee with Internal Account Reserve (Instead of Financial Test)
Government Mechanisms
14. Deposits of Cash or Cash Equivalents to Government Authority (GA)
15. Government-Administered Pooled (Collective) Trust Funds
16. Government Guarantees
17. Government Assumptions of Liability
18. Government Indemnities

Purely as a matter of organizational convenience, the financial mechanisms are presented in three groups. Among the eighteen identified, eight are classified as third-party mechanisms, five as first-party mechanisms, and five as government mechanisms. These classifications are based on the entity responsible for guaranteeing that funds will be available if needed in the future. Third-party mechanisms involve a guarantor other than the government regulator or the CCS owner/operator. First-party mechanisms are guaranteed by the CCS owner/operator, and government mechanisms are guaranteed by a government entity. How the mechanisms are classified is not essential, and opinions may differ over the appropriate classification of some of the mechanisms. Of greater significance are certain features that distinguish the mechanisms such as:

- how revocable is the mechanism?
- does the mechanism offer protection from the claims of the operator's creditors?
- does the mechanism leave funding subject to reappropriation for other purposes by the owner/operator or the government?
- does the mechanism secure actual funds or is it purely a guarantee of funds?
- does the mechanism represent an independent source of funds?

A. Financial Mechanisms Briefly Defined

The financial mechanisms in this report are each functionally defined below in order to avoid inconsistent terminology or legalisms.

1. Third-Party Mechanisms

- **Irrevocable Trust Fund**: Independent trustee accepts property from owner/operator to manage as a fiduciary for a particular purpose on behalf of a beneficiary (e.g., government regulatory agency). Trustee is a bank or other financial institution that is regularly examined and regulated by an independent financial oversight entity. Once accepted into the trust fund, the property ceases to be owned by the owner/operator, is outside its control and beyond the claims of its creditors. The trust is considered irrevocable because the owner/operator cannot unilaterally terminate the trust and reclaim the property.
- **Escrow Account**: Agent of the owner/operator manages funds set aside for an explicit purpose. Unlike the trustee for an irrevocable trust fund, the escrow agent does not owe the government beneficiary a fiduciary duty. Instead, the escrow agent is responsible to the party placing funds into the escrow. Funds in escrow remain the property of the owner/operator, and are subject to the control of the owner/operator and the claims of creditors.
- **Bank Demand (Payment) Guarantee, Irrevocable Standby Letter of Credit, Surety Bond (Payment Bond)**: All three of these mechanisms involve a third party (i.e., bank or surety company) guarantee of payment, up to a specified limit, to the beneficiary (e.g., government) on demand if specified conditions are met. The owner/operator is responsible to reimburse the third-party guarantor. Issuers must be financial institutions that are regularly examined and regulated by an independent financial oversight entity.
- **Surety Bond (Performance Bond)**: Surety company guarantee that it will satisfy the owner/operator's obligations as specified in the surety agreement, if the storage site owner/operator fails to perform. Unlike a surety payment bond, the performance bond gives the surety the option to perform the owner/operator's obligations.
- **Prepaid Insurance Policy for Assurance of Closure & Post-closure Monitoring**: Insurer guarantees costs of performing closure and post-closure monitoring upon the insured's prepayment of the required premiums. Issuers must be financial institutions

that are regularly examined and regulated by an independent financial oversight entity.

- **Liability Insurance Policy for Payments Due to Losses or Damages**: Insurer guarantees payment for losses or damages incurred by others. Scope of liability insurance typically addresses damages or losses to parties other than the owner/operator, including losses/damage to publicly-owned resources. Terms, conditions, definitions, and the like may restrict coverage to defined amounts, perils (causes), losses, parties, and the like, which may result in insurance that does not fully address financial requirements. Issuers must be financial institutions that are regularly examined and regulated by an independent financial oversight entity. These policies are not irrevocable.
- **Corporate Guarantee from Nonaffiliated Corporation Based on (Annual) Financial Test**: A company neither owned by nor having a common owner with the storage facility owner/operator guarantees the owner/operator's obligations. The financial test must be met by the nonaffiliated corporate guarantor and may include requirements for net working capital, total assets, tangible net worth, and/or credit ratings.
- **Third-Party Administered Mutual Industry Pool**: Third-party (neither the government nor an owner/operator) manages collective fund into which multiple industry members contribute. The fund is available to pay for long-term stewardship and/or compensation either as a primary funding source or as a back-up if contributors fail to meet their obligations. As a collective fund, industry members do not have individual accounts that limit payments from the fund to the sum of an individual's contributions plus interest. The fund could be organized as a mutual insurer, a group captive, a risk retention group (in the United States), or otherwise.

2. First-Party Mechanisms

- **Security Interests in Property**: Creation of a claim on owner/operator assets to guarantee the performance or payment of an obligation. The government beneficiary of the security interest has preferential rights, usually the right to seize and sell the property in the event that obligations are not met. The ownership and control of the property remains with the owner/operator and is subject to the claims of other creditors.
- **Charge over an Operator's Bank Account**: Creation of a claim on an owner/operator bank account to guarantee the performance of an obligation. The government beneficiary of the charge has preferential rights, usually the right to access funds within the bank account in the event that obligations are not met. The ownership and control of the property remains with the owner/operator and is subject to the claims of other creditors.
- **Corporate Guarantee from Affiliated Company Based on (Annual) Financial Test**: A company affiliated (as parent, subsidiary, or having a common parent) with the site owner/operator guarantees the owner/operator's obligations. In this case, the

financial test must be met by the affiliated guarantor. A guarantee from a subsidiary of the owner/operator does not provide an independent source of funding.

- **Self-Guarantee Based on Annual Financial Test**: Owner/operator demonstrates ability to pay for obligations using a financial test, which may include requirements for net working capital, total assets, tangible net worth, and/or credit ratings. Not an independent source of funding.
- **Self-Guarantee with Internal Account Reserve (Instead of Financial Test)**: Owner/operator guarantees satisfaction of obligations by designating an internal account for that purpose. The ownership and control of the funds remains with the owner/operator and is subject to the claims of creditors. Not an independent source of funding.

3. Government Mechanisms

- **Deposits of Cash or Cash Equivalents to Government Authority (GA)**: The government agency accepts cash or cash equivalent deposits directly from owner/operator to be used later to satisfy owner/operator obligations. GA may create a special account on behalf of the owner/operator or may turn the funds over to the government treasury.
- **Government-Administered Pooled Funds**: Government manages pooled fund. Contributions may be received directly from owners/operators or indirectly as fees on injection, electricity use, or fossil fuels purchased for power generation. The fund can be designed either as a primary funding source or as a back-up available to reimburse the government if an owner/operator fails to meet certain obligations and the government becomes responsible to satisfy owner/operator obligations.
- **Government Guarantees**: Government agrees to guarantee payments to claimants for specified liabilities as a back-up. A guarantee is a promise to answer for the debt, default, or other liability of another. A government guarantee about CCS could mean that the government will pay for third-party damage/loss that the responsible owner/operator fails to pay. The payment goes not to the owner/operator (as for indemnification) but from the government to the party that the owner/operator has not paid. Because the guarantee is a duty owed to a claimant and not the owner/operator, the guarantee can outlive the owner/operator.
- **Government Assumptions of Liability**: Government takes primary responsibility away from the site owner/operator for specified liabilities if pre-determined criteria have been met. Also referred to as "transfer of liabilities."
- **Government Indemnities**: Government agrees to reimburse owner/operator for payments made for specified liabilities. Not a primary funding source. The indemnification payment goes to the owner/operator from the government, unlike for government guarantees where the payment from the government goes to the creditor of the owner/operator. Because indemnification is a duty owed to the owner/operator, that duty ceases if the owner/operator is defunct.

This study evaluates these financial mechanisms assuming that they are properly drafted to be legally valid and robust.[7] For example, with regard to cancellation, termination, voiding, rescission, and similar means of an issuer to end a mechanism, proper drafting would require

- advance notice by the issuer of its intent to cancel or non-renew
- time-limited opportunity for owner/operator to provide an alternate mechanism, and
- drawing on the mechanism before cancellation is effective if the owner/operator does not provide a substitute mechanism by the deadline

In addition, this study assumes that issuers of financial mechanisms must satisfy appropriate eligibility requirements, such as financial institutions being subject to regular independent oversight (e.g., supervision, examination) by a financial regulator and corporate/municipal guarantors being subject to meeting prescribed financial tests.

Most of the financial mechanisms described in this study can be drafted to cover long-term stewardship liabilities, long-term compensatory liabilities, or both. Few of the mechanisms are suitable for addressing only one type of liability. For example, liability insurance may not be applicable to all types of long-term CCS liabilities just as prepaid insurance is not particularly suitable for contingent liabilities that may not arise at specified points in time. Legal peculiarities in a given jurisdiction may affect the use of other financial mechanisms for specific liabilities, but those will be the exceptions not the rule.

Not included in this report is the use of a Certified Emission Reduction (CER) reserve as a mechanism although it is included in the agreed rules for CCS in the Clean Development Mechanism (CDM) from The United Nations Climate Change Conference, Durban 2011. The CER reserve is not included in the analysis because it is only for the operation period. It is noted here because it is an example of how such a reserve would be drawn down in the event of leakage. Upon submission of required documentation, 5 percent of the CERs will be issued to a reserve account of the CDM registry. This reserve account is established for the CCS project activity for the purpose of accounting for any net reversal of storage (e.g., seepage from the geological storage site). When a net reversal of storage has occurred as a result of seepage, the CDM Registry Administrator cancels the CERs from the reserve account up to the amount of the net reversal. A reserve is established for each project, not as a pooled account.

B. Evaluation of Financial Mechanisms in the Context of Long-Term CCS Liabilities

In order to evaluate financial mechanisms for long-term CCS liability, each financial mechanism was assessed based on the following criteria:

- **Administrative Burden**: what is the administrative burden in demonstrating and

[7] A robust financial mechanism need not require the owner/operator to, in effect, pay twice for an obligation. Mechanisms into which funds are placed for later use (e.g., trust funds, escrows, deposits) can be tapped either to reimburse operators or to pre-pay operators for their expenses. The reimbursement approach, although commonly used, does require an extra outlay of cash by the operator.

verifying financial security using the mechanism?

- **Amount**: how completely does the mechanism provide the required amount of coverage?
- **Certainty**: is the mechanism enforceable and effective in assuring the availability of funds when needed?
- **Cost**: what is the cost to the operator to use mechanism?
- **Duration**: what is the typical term of the mechanism and how easily can it be renewed or replaced?
- **Flexibility:** how easy is it to modify the amount of the mechanism?
- **Liquidity**: are funds easily accessible when needed?

That initial assessment can be found in *Appendix B, Financial Mechanisms Assessment*. Next, the strengths and weaknesses of each financial mechanism were summarized based on the 7 criteria shown above as well as three additional criteria:

- **Applicability**: how well can the financial mechanism respond to long-term CCS liability (e.g., timescale of CCS operations)?
- **Availability**: what is the current market and availability of the mechanism for CCS operators?
- **Practicality**: how likely that an issuer will provide and an operator successfully implement each financial mechanism for long-term CCS liability?

Appendix C, Financial Mechanisms Strengths and Weaknesses, summarizes the strengths and weaknesses of the 18 types of financial mechanisms.

The remainder of this section describes recommended financial mechanisms by focusing on the evaluation criteria that are most relevant to long-term CO_2 liability. These criteria include: certainty/duration, liquidity, and cost/burden. The certainty and duration sub-section analyzes the ability of each mechanism to work in the timescale associated with long-term CCS liability. Then, the liquidity sub-section describes the liquidity of those mechanisms with strong levels of certainty and duration. Finally, the cost/burden sub-section describes the relative cost/burden of the mechanisms that appear satisfactorily certain/durable and liquid.

1. Certainty and Duration

The ability of a financial mechanism to remain effective for a long period of time is very important in the context of long-term CCS liabilities. The indefinite term of storage necessary for geosequestration may necessitate financial mechanisms that are long-lasting. Certainty and duration are both relevant to this discussion because certainty addresses the availability of financing and duration addresses the timescale.

Irrevocable trust funds are well suited to long-term periods by being "irrevocable." Additionally, irrevocable trust funds can be structured to minimize exposure to high risk investments. In many jurisdictions, trust funds are unavailable to claims of owner/operator creditors making trust funds highly certain financial mechanisms. Money in trust funds is outside of the direct control of the CCS operator and the government, which reduces the risk of reappropriation/misappropriation, making the likelihood that the funds will be available when needed more certain. Similarly, ***deposits of cash (or cash equivalents)*** directly to the government can last as long as needed. However, to assure long-term certainty, the deposits must be protected from reappropriation/misappropriation by the government agency custodian.

Prepaid insurance policies for the assurance of closure and/or post-closure monitoring are nearly irrevocable in that the insurer would have to seek "rescission" (voiding) of the insurance agreement and return the premiums paid in order to terminate the insurance contract. Prepaid insurance policies for the assurance of closure and/or post-closure monitoring also place funds beyond the control of the CCS operator and the government and can be structured so that insured funds are not available to claims of creditors in the event of bankruptcy. Policies cover the entire duration of post-closure monitoring.

Bank demand guarantees, irrevocable standby letters of credit, surety bonds (payment and performance) also are well suited to provide financial security over long time-periods because they are outside the control of the CCS operator, can be automatically renewed, and are easily adjusted for any required amount. Because bank demand guarantees, irrevocable standby letters of credit, and surety bonds are based on assessments of creditworthiness, issuers will periodically want to re-evaluate the creditworthiness of a CCS operator, increasing the likelihood that funding will be available if needed.

Corporate guarantees from nonaffiliated corporations based on (annual) financial tests should be considered highly certain financial mechanisms that do not depend on the financial strength of the CCS operator. Properly designed corporate guarantees also can be effectively irrevocable and legally binding, which further increases the certainty that funds will be available when needed, as long as the guarantor is around. Funds secured by a corporate guarantee from a nonaffiliated company are protected from claims of the operator's creditors and are outside of the direct control of the operator and the government. Certainty is closely tied to the strength of the financial test of the nonaffiliated corporation's creditworthiness.

Government guarantees, ***indemnities***, and ***assumptions of liability*** are potentially strong financial mechanisms for long-term liabilities because governments are generally considered stable, long-lasting social institutions, likely to be viable for the foreseeable future, with the power to tax to raise necessary funds. Because governments are believed likely to exist longer than CCS operators and firms that issue financial mechanisms, government mechanisms are more certain to last for a longer duration than guarantees by the operator, its corporate affiliates, or a third-party guarantor. However, government mechanisms are not necessarily irrevocable, which can reduce the certainty of these mechanisms. Historically, most government guarantees and indemnity agreements have been finite, in terms of amount and/or duration. Similarly, a ***government-administered fund*** is thought to be durable because governments generally have longer lives than both facility operators and firms that issue financial mechanisms; however,

government-administered funds are not protected from appropriation by the government for other uses. These funds are not necessarily irrevocable, reducing certainty and duration.

In comparison, ***escrow accounts*** and ***liability insurance policies for payments due to CO_2 leakages*** offer less certainty and duration compared to other mechanisms due to their revocability, and consequently may not be suited for long-term CCS liabilities.

For a ***mutual industry pool***, certainty and duration depend upon the number of members, the structure of the pool, and the finances of each member. Mutual industry pools for environmental liabilities are uncommon and can require much time to establish.[8] Duration of the mechanism depends on whether participants can easily opt out of the pool and whether new participants can be added. At the present time, a mutual industry pool is a relatively uncertain mechanism for funding long-term CCS liabilities.

Other financial mechanisms that may not be sufficiently certain for long-term CCS liabilities include ***corporate guarantees from affiliated companies based on (annual) financial test***, ***self-guarantees based on (annual) financial test***, or ***self-guarantees based on internal account reserves***. During the period after closure in which long-term liabilities could arise, self-guarantees or affiliated company guarantees based on financial tests or internal account reserves may not be available because CCS operators and their affiliates may not be active or viable (e.g., bankrupt). Self-guarantees or affiliated company guarantees based on internal account reserves do not cover long-term liabilities that arise after the CCS operator or affiliated corporate guarantor has gone out of business.

Similarly, ***a charge over an operator's bank account*** cannot outlast the CCS operator and therefore would not be a suitable mechanism to cover long-term liabilities that may arise after the CCS operator has gone out of business. In addition, the operator's bank account would not likely be protected from the claims of an operator's creditors or from re-appropriation by the operator.

Security interests in property also are not recommended financial mechanisms for long-term CCS liabilities because of the highly variable value of property over the long-term. Few properties can be used as security that do not have the potential to be significantly devalued over time. With the exception of land (which can greatly vary in value over time) other forms of property tend to have finite lives (e.g., 50 years or less) making the availability of funds secured by the property very uncertain for long-term CCS liabilities, which could arise far after the finite life of the property. Additionally, property may be subject to claims of creditors and re-appropriation by owners.

[8] The CCS and non-CCS reviews rarely identified a mutual industry pool as an acceptable mechanism. In Victoria, Australia, financial requirements for landfill remediation encouraged compliance through a mutual pool. Establishing the pool required over 7 years of study and negotiation during which the proposed membership of the pool declined from 10 to 5 landfills.

2. Liquidity of Low-Risk Financial Mechanisms

Independent of its long-term certainty and duration, a financial mechanism must ensure that funds are easily accessible when needed. Liquidity is a characteristic of a low-risk mechanism because mechanisms that are highly liquid provide the greatest ease of access to funds whenever needed to address whatever obligation has arisen. Over long-term periods, the funds secured by the mechanism will need to be accessible at any time (i.e., in the short-term, the long-term, and any time in between).

Bank demand guarantees, irrevocable standby letters of credit, and ***surety bonds (payment and performance)*** usually provide highly liquid funds on demand. Funds drawn from these mechanisms typically are available immediately and are paid in cash or cash equivalents, as long as the liquidity of the issuer is not in question. Surety bonds may have somewhat less liquidity because sureties traditionally can challenge a claim for funds. A surety bond can be drafted to limit this risk and to allow direct action on the part of the government claimant.

Deposits of cash (or equivalents) to a government agency are highly liquid unless the government agency must obtain prior approval to access or use the funds.

Irrevocable trust funds and ***government-administered funds*** can be highly liquid depending on the liquidity of the investments within the funds.

Government guarantees/indemnities and ***government assumptions of liability*** can be liquid sources of funds because governments are generally considered able to pay on-demand. However, actual funds may not be set aside by the government, and therefore liquidity of these mechanisms would depend on the liquidity of the government. If actual funds are set-aside by the government, liquidity will be improved; however, the potential for government re-appropriation of such funds for other uses may reduce certainty.

The liquidity of ***a prepaid insurance policy for assurance of closure and post-closure monitoring*** depends on the policy terms and conditions governing payouts and on the liquidity of the insurer.

In comparison, ***corporate guarantees from nonaffiliated corporations based on (annual) financial tests*** are not highly liquid mechanisms because the liquidity of the non-affiliated guarantor company can vary given different economic and industry conditions. Non-affiliated guarantors also may have less incentive to make good on their promises, which can affect liquidity and certainty. Additionally, non-affiliated corporate guarantors rarely set aside funds in advance to cover these guarantees.

Similarly, ***self-guarantee based on (annual) financial test***, ***affiliated company corporate guarantee based on (annual) financial test***, and ***self-guarantee or affiliated company corporate guarantees based on internal account reserve instead of financial test*** are not considered to be liquid because no funds need to be set aside to cover potential liabilities even in the case of accounting "reserves," which may be unfunded. The liquidity of these mechanisms depends on the liquidity of the operator or the affiliated corporate guarantor.

3. Cost/Burden of Low Risk Financial Mechanisms

The cost or administrative burden of a financial mechanism has two elements – the cost/burden to the CCS operator, and the cost/burden to the government. With many mechanisms, there is a tradeoff between costs or administrative burdens to the operator and those to the government.

Irrevocable trust funds have low fees. The administrative burden also is low because the only major on-going responsibility of the operator and the government is monitoring the trust fund balance. Although the fees and administrative burden are low, the actual out-of-pocket cost and the opportunity cost to the CCS operator can be substantial. Costs to the operator depend upon the structure of the pay-in period – due to the time value of money, a shorter period (i.e., where more of the funding is provided upfront) presents a larger cost than a longer pay-in period where the payments are made over time. In addition the operator incurs an opportunity cost from placing property in a low risk (hence, low return) mechanism.

Bank demand guarantees, ***irrevocable standby letters of credit***, and ***surety bonds*** tend to be low cost for creditworthy applicants, although issuers of these mechanisms can require collateral, which creates an opportunity cost for the CCS operator. The administrative burden for these mechanisms is relatively low, particularly if established using standardized forms and if automatically renewable.

In comparison, ***prepaid insurance policies*** have a fairly high cost for CCS operators because typically they require that the full premium be paid within a few years, creating an opportunity cost. Government oversight would be required to confirm that terms and conditions of coverage were acceptable. Standardized wording may reduce the burden of evaluating policy details.

Government guarantees, ***indemnities***, and ***assumptions of liability*** have a low cost to the CCS operator, possibly including an administrative fee. However, these mechanisms present high costs to the government and taxpayers, who may be required to fund future long-term CCS liabilities. Because costs of long-term CCS liabilities would fall to the government, these mechanisms could reduce the CCS operator's incentive to properly site, operate, and close its facility (termed "moral hazard").

Deposits of cash or cash equivalents to a government agency and ***government-administered funds*** have very high administrative burdens on government entities because they will have to set-up a system to verify, manage, and properly protect the funds held for future long-term CCS liabilities.

C. Recommendations for Government and Industry about Financial Mechanisms for Long-Term CCS Liabilities

1. For Legislators and Regulators

In developing regulatory frameworks for CCS, legislators and regulators should indicate which financial mechanisms will be acceptable for long-term CO_2 storage liabilities. In doing so,

government bodies may want to differentiate between compensatory and stewardship liabilities because different approaches may be considered desirable for each type of long-term liability. On the other hand, most of the financial mechanisms reviewed in this report can be designed to cover either or both types of liabilities.

Specifying financial requirements for long-term CCS liabilities would occur in the context of operational financial requirements for storage site operations and closure, on the one hand, and options, if any, for subsequent post-closure transfer of long-term liabilities to a government from the storage facility operator, on the other hand. Because of similarities between certain operational liabilities and related post-closure liabilities, some financial mechanisms used during the operational period also may be applicable during the post-closure period to address long-term liabilities. Although this may not be true for all CCS regulatory frameworks, the EC post-closure financial requirements for monitoring, corrective measures, and surrender of allowances in case of any leakages under the EC's CCS Directive, continue the financial requirements for monitoring, corrective measures, and surrender of allowances that an operator must satisfy during injection operations.

Government financial requirements should define an initial duration for post-closure financial mechanism coverage as well as any criteria for lengthening or shortening the required post-closure period of financial coverage.

After setting requirements for duration of financial mechanisms for long-term liabilities, government bodies should identify acceptable types of financial mechanisms as well as mechanisms not considered as acceptable. Those decisions should be based on an understanding of how various financial mechanisms operate in the jurisdiction, focusing on the jurisdiction's specific laws about bankruptcy, ownership and control of financial mechanisms and secured funds, and any legal limits on allowable durations of financial mechanisms. Some jurisdictions may follow old rules limiting the duration of trust funds, for example. Government bodies may want to assess experience using similar financial mechanisms in their jurisdictions for assuring long-term liabilities of waste disposal sites, mining sites, and other analogous activities. Laws eliminating problematic financial mechanisms from being used for CO_2 storage can save time and effort later during permitting. Similarly, government agencies should avoid accepting novel and/or complex financial mechanisms. Legislators and safety regulators do not have the expertise to evaluate and monitor such mechanisms, and use of such mechanisms can impede transparency and mask potential risk.

Governments should allow use of multiple, acceptable financial mechanisms in order to provide compliance options to facility operators. This includes allowing an operator to use multiple financial mechanisms for a single storage site. Similarly, governments should allow an operator to use multiple financial mechanisms for a single obligation (e.g., post-closure monitoring) at a facility. Best practice is to provide rules for coordinating multiple mechanisms. In some cases, financial mechanism options may not be available due to higher-level policies. For example, restrictions on providing state aid in the European Union means that government financial mechanisms may not be allowed for storage facilities subject to EU law.

Government bodies may intentionally limit choices of financial mechanisms to only the "safest" one(s), which also may be the most costly. For example, a government body may consider a financial mechanism with the characteristics of a trust fund (as described above) the only acceptable financial mechanism for long-term or perpetual liabilities in a jurisdiction, once an analysis of the alternatives and the consequences has been made.

Some governments may have reservations about allowing the use of self-guarantees based on financial statements, even with a financial test requirement. Developing an appropriate financial test, apart from reliance on credit ratings and clean opinions of independent auditors, may be difficult for government agencies responsible for regulation of CO_2 storage. A self-guarantee, often the least expensive mechanism, does not provide an independent source of funds and may leave taxpayers with the financial responsibility should the operator cease business. In some jurisdictions, similar reservations may also affect government willingness to accept "captive" insurance from an insurer which is a subsidiary of the operator. The rationale for excluding such captive insurance is that the insurer, as a subsidiary of the operator, provides no independent source of funding apart from the operator itself.

Similar reservations may be raised regarding guarantees from corporate parents and affiliates of the operator, although such guarantors may constitute a more or less independent source of finances. As a matter of overall corporate risk management or for other reasons, operators may be organized as a separate subsidiary of a larger group; this often protects the assets of other businesses in the larger corporate group from having to satisfy liabilities of the separate subsidiary established to be the facility owner/operator. The financial independence of corporate group guarantors that are not subsidiaries of the operator requires case-by-case consideration.

Guarantees from non-affiliated companies do not raise the same concerns about independence from the operator; but reliance on financial statements in the absence of a solid financial test may, nevertheless, call these mechanisms into question in some jurisdictions.

Although government bodies may be leery of financial mechanisms solely based on financial statements, government bodies may hold unrealistic expectations about insurance as a financial mechanism that commercially available insurance may not be able to satisfy.

In particular, insurers may lack interest in covering all types of CCS liabilities, especially during post-closure. And for the liabilities for which insurers develop products, their policies may contain terms and provisions which would not be acceptable for government financial requirements due to various limitations and exclusions in coverage. A commercially sound insurance product must offer potential coverage benefits commensurate with its costs; but need not offer coverage that would satisfy government CCS financial requirements but cost too much. Insurers might eventually become more comfortable with additional CCS risks over time, which is how insurance markets develop.

For many years, insurers have offered insurance covering "control of well" (also termed "operator's extra expense") for companies engaged in oil and gas extraction; this coverage can address underground blowout, redrilling expense, seepage and pollution, evacuation expense, and making wells safe, as described in applicable policy terms and conditions. This form of

coverage, albeit limited in amount, can serve as a possible basis for CO_2 storage insurance during the injection period. Note that insurers of oil and gas extraction wells do not cover post-closure issues because these types of extraction operations do not have such issues; rather, when extraction ceases, wells typically are plugged and abandoned with no post-closure requirements. Thus, insurers offering control of well coverage currently have little if any experience in tailoring policies for a post-closure period.

Zurich Financial Services Group announced in 2009 a liability insurance product designed for the needs of CCS that includes coverage for pollution event liability, business interruption, control of well, transmission/transportation liability, and geomechanical liability. Zurich has indicated that its CCS liability insurance is designed for the operational phase of geosequestration; liability coverage during closure and post-closure is "possible."

2. For Industry Facility Operators

Industry's position on financial mechanisms for long-term CCS liabilities may differ when responding to government financial requirements as opposed to when managing those liabilities independently of government financial requirements. Government financial requirements primarily protect the government/taxpayer from the risk of the operator's failing to fulfill its obligations, although some acceptable financial mechanisms also may serve as a funding source for the operator. On the other hand, for the benefit of shareholders/owners, an operator may take a variety of positions regarding its exposure to long-term CCS liabilities, ranging from use of a financial mechanism to self-insurance without a financial mechanism; larger corporate entities tend to prefer the latter approach because of its negligible costs. The discounted present value of long-term liabilities may be negligible because of the planned length of injection operations and higher discount rates used by industry compared to government. Nevertheless, to protect itself, an operator could purchase a commercial insurance policy that, because of limits and coverage gaps would not be acceptable for complying with government financial requirements but works for the facility operator, in terms of the insurance policy's costs and benefits.

When evaluating alternative financial mechanisms for complying with government financial requirements, an industry operator will consider their respective after-tax costs. This is particularly important for financial mechanisms that entail putting funds aside, such as the trust fund, escrow, and deposits with the government. The net costs of such financial mechanisms vary greatly depending on the tax deductibility of the payments. Although building up funds in advance of when they are needed appears prudent and harnesses the prospect of compounded interest as a means to attain required amounts of money, most public and private entities will choose "pay-as-you-go" approaches to long-term liability, when given that option. The latter has the advantage of greater leverage of capital.

In most cases, industry will finding that self-guarantees and corporate guarantees present the lowest after-tax costs, if these mechanisms are acceptable in the jurisdiction and if the operator or guarantor can pass the associated financial tests of eligibility. If industry proposes a newly established "shell company" to be the facility operator that lacks substantial assets or even independently audited financial statements, then it may want to select financial mechanisms that the government views as low risk. Conversely, if the proposed industry operator has substantial

ongoing businesses and clean auditor opinions, industry may have a stronger case that the government should accept financial mechanisms that pose lower costs to the operator.

Industry may want to propose a package of acceptable financial mechanisms that might involve more than one financial mechanism for a given long-term liability. For example, a "sinking fund" approach involves two mechanisms: (1) a fund that is built up over a given time interval (e.g., 5 years) and (2) a complementary guarantee that decreases in amount as the sinking fund increases. The two mechanisms must always together equal or exceed the required amount for covering the obligation.

Similarly, when an operator faces financial requirements for two or more long-term liabilities, a package of different types of acceptable financial mechanisms may allow for lower costs and a greater degree of risk-sharing with the government. For example, a package might contain a more conservative financial mechanism for post-closure monitoring combined with a potentially higher risk financial mechanism for post-closure remediation, on the theory that the remediation obligation is more unlikely to arise.

IV. Assessment of Approaches for Transfer of Long-Term CCS Liability

This section identifies and analyzes key aspects of frameworks for transfer of long-term CCS liability to the government. The following subsections describe the research and analysis performed, provide an assessment of the relative strengths and weaknesses of frameworks for long-term liability transfer, and recommend options for transfer of long-term CCS liability.

Just as stakeholders may have different opinions about financial mechanisms for long-term CCS liabilities, they also may hold a range of opinions concerning transfer of long-term CCS liabilities to a government body after injection has ceased. Reasonable minds can differ about whether government should offer to assume long-term liabilities of CO_2 storage facilities, technical requirements for such a transfer, the scope of liabilities to be transferred or retained, post-transfer cost recovery (if any), and appropriate financial mechanisms to support liability transfers.

Until recently, policies for transfer of long-term liabilities of storage or disposal sites from the owner or operator to a government have received relatively little attention around the world apart from sites for highly-radioactive materials and CO_2 storage facilities. Other analogous areas such as deep subsurface disposal of liquid wastes and shallow subsurface disposal of solid wastes (whether hazardous, inert, or in between) exhibit little use of liability transfers; instead, the owners or operators of these sites typically retain liability for at least as long as they remain the sites' owners or operators. In the early 1980s, the U.S. embarked on an ambitious scheme to assume post-closure liabilities of all regulated hazardous waste disposal facilities using an associated financial mechanism (a government-administered fund) to collect, invest, and disburse funds (based on tons disposed during site operations) for the liabilities assumed. After a few years, the U.S. reversed course and eliminated the liability transfer framework and its associated financial mechanism so as to not encourage further land disposal of hazardous waste.

Interest in liability transfer schemes for underground CO_2 storage is both widespread and unprecedented. Notably, the European Commission (EC) issued a directive for CCS that includes both liability transfer and an associated financial requirement. Liability transfer for CO_2 storage facilities also has found traction in other jurisdictions worldwide, but has not been universally adopted.

A main driver for liability transfer of CO_2 storage facilities appears to be concerns about long-term liabilities, including both long-term stewardship and compensatory payments for any losses or damages due to injection and storage over the long-term. To encourage industry to develop CO_2 storage facilities, some jurisdictions' regulatory frameworks include liability transfer.

Many proposed concepts for liability transfer frameworks for CO_2 storage include their own financial mechanisms, often "pooled" funds collecting per ton fees on injected CO_2 from multiple sites during their operations. Such a pooled fund presupposes more of an underground CO_2 storage industry than exists at the end of 2011 and is anticipated in the near future. Pooled funds, whether administered by the government or a private party, are very sensitive to the number of participants, their financial resources, and their long-term liability needs. Attempts to risk-inform these mechanisms (e.g., risk-based fees) can be very controversial and time-

consuming. This report believes that given the current state of the CO_2 storage industry, it is premature to implement pooled financial mechanisms.

A. Methodology

Based on the results of the CCS and non-CCS regulatory reviews, this assessment of options for transfer of liability focuses on the following five aspects:

(1) threshold technical requirements, referred to as "conditions" for liability transfer,

(2) financial requirements related to liability transfer,

(3) post-transfer cost recovery provisions,

(4) specification of which liabilities must (or may) be transferred, and

(5) specification of whose liabilities must (or may) be transferred.

For each of the five aspects, a spectrum of options was developed, drawing upon examples found in the regulatory reviews.

The strengths and weaknesses of each option were assessed based on five criteria: (1) costs to the government and/or taxpayers, (2) costs to industry, (3) effectiveness in protecting the public and the environment, (4) incentive effects, and (5) duration. The five criteria used in assessing the strengths and weaknesses are defined below:

(1) Costs to Government/Taxpayer. An option is considered weak when it has high levels of costs transferred to the government/taxpayers instead of remaining with the operator. In comparison, low costs to the government/taxpayer are considered strengths.

(2) Costs to Industry. High industry costs are seen as a weakness, while low industry costs are considered a strength.

(3) Effectiveness of Protection of Public/Environment. Options that account for this protection are considered to be stronger than those that fail to effectively protect the public or the environment. An option is weak if the transfer of liability does not account for the protection of the public and environment.

(4) Incentive Effects

a. *Industry Performance*. Options that encourage protection of the public/environment and reduce the possibility of "moral hazard" are considered to be stronger.

b. *Industry Participation*. Options that encourage industry participation in CCS are considered to be stronger than those that do not incentivize industry participation in CCS.

(5) Duration. Options that effectively cover the duration of long-term CCS liabilities are considered to be stronger than those that are able to effectively manage CCS liabilities only in the shorter term.

Fundamentally, transfer of liability involves moving future costs away from industry operators and onto governments. Requirements for industry operators to make pre-transfer financial contributions to governments can more or less offset the cost-shifting effects of liability transfer depending on the size and scope of the financial contribution. An industry operator benefits even when the required financial contribution equals the full expected value of the liabilities being transferred because the operator would no longer face uncertainty about the magnitude of its long-term liabilities. However, industry may well question the value of liability transfers that must be paid for through pre-transfer financial contributions.

Other considerations complicate the design of liability transfer programs. Of greatest importance may be the effect, if any, of liability transfer on the total amount of post-closure liabilities. Economists point out that relief from post-closure liabilities should adversely affect how operators site, manage, and close their facilities despite regulatory frameworks that reduce operator discretion in conducting those activities. This is termed "moral hazard" and applies whenever parties are insulated from the consequences of their actions. Liability transfer has been identified as a source of moral hazard, and various related provisions that can mitigate moral hazard from liability transfer are examined in the following section.

B. Strength and Weaknesses of Options for Long-Term CCS Liability Transfer

The following sections describe five different aspects of legal frameworks for the transfer of long-term CCS liability:

(1) Technical requirements to be met prior to transfer;
(2) Financial requirements for liability transfer;
(3) Post-transfer cost recovery;
(4) Which liabilities are transferred; and
(5) Whose liabilities are transferred.

Each section identifies different program design options and their respective strengths and weaknesses.

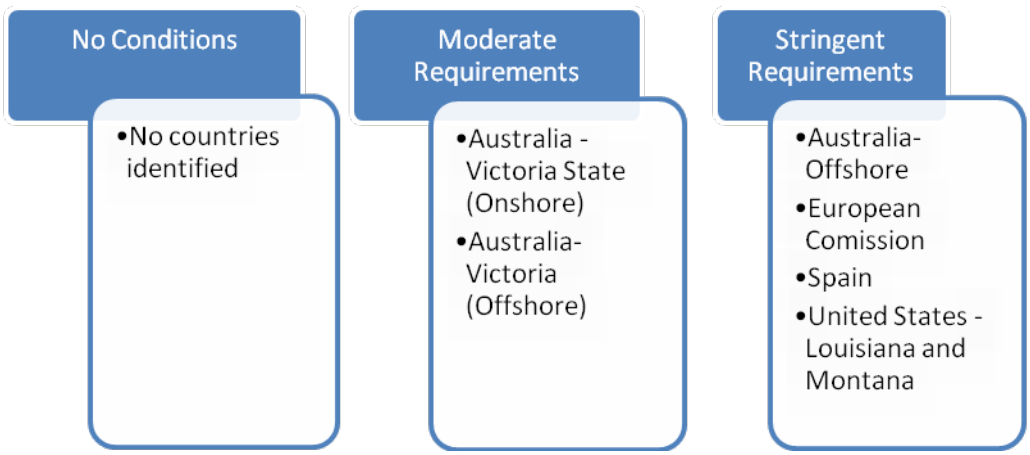
1. Technical Requirements to be Met Prior to Transfer

Governments may set conditions that must be met prior to transfer of liability. A best practice is to establish conditions and technical requirements for transfer prior to commencement of storage facility operations and based on a variety of criteria, such as siting, operation, closure, and monitoring. Frequently, these conditions are linked to a specified pre-transfer post-closure period. Conditions that must be met before transfer of liability often include:

- Cleanup and remediation of leaks

- Mitigation of risks (e.g., preventative measures for leaks and contamination)
- Monitoring and reporting for a specified period
- Protections of the environment and human health (e.g., through proper closure)
- Site stabilization

Periods of pre-transfer post-closure care can be established as a minimum, a maximum, a fixed period, open ended and/or dependent on conditions and technical requirements being fulfilled. The following sections compare frameworks with varying lengths of legally required pre-transfer post-closure care periods and differing technical conditions and requirements for liability transfer. Additional details of the programs reviewed appear in *Appendix D*.



Exhibits E-1A–E-1C in *Appendix E* summarize the strengths and weaknesses of three different options for technical requirements.

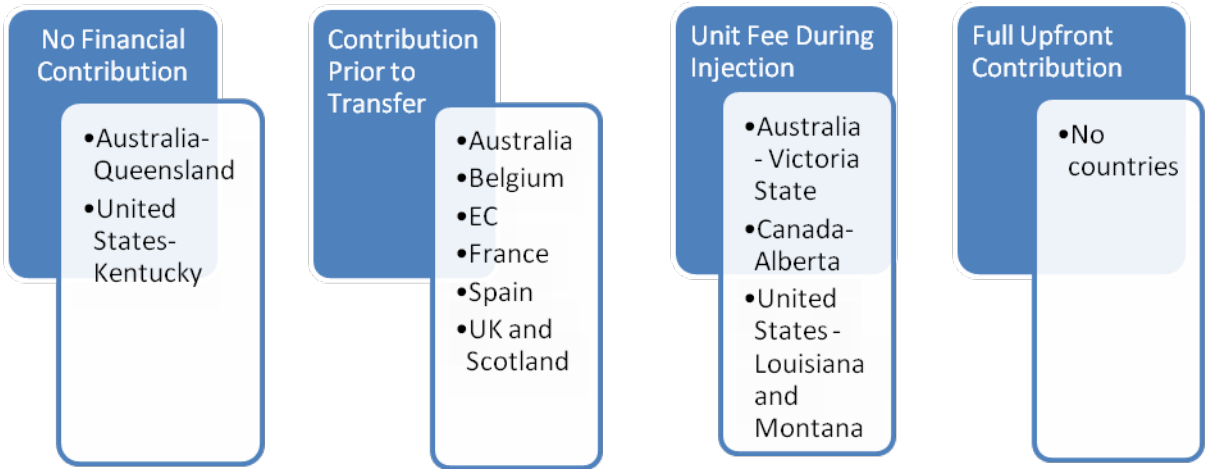
2. Financial Requirements for Liability Transfer

Financial requirements can play a variety of roles in connection with liability transfer schemes for CO_2 storage facilities. For example, a liability transfer framework could include a financial requirement that any pre-existing financial mechanisms established during operations for post-closure monitoring, corrective measures, and surrender of allowances must be used to provide post-transfer funding assurance before a government body must tap its own financial resources.

A government may instead require the transferor to provide a "financial contribution" prior to government assumption of liabilities in order to cover all or some portion of anticipated post-transfer costs. The framework approach taken by the EC for a financial contribution to the government in connection with liability transfer requires a financial contribution to provide funding for a minimum of 30 years of low-level monitoring after transfer of site responsibility. EC Member States (MS) may require the contribution to provide more financial coverage of costs for post-transfer obligations but need not do so. Apart from the financial contribution received from the operator, the government is expected to arrange its own financing for post-transfer storage facility obligations.

MS may pursue different policies within the design of the EC's CCS Directive. MS that are not comfortable with the concept of assuming financial responsibility for post-transfer obligations, can require a more complete financial contribution applicable to the full-range of potential post-transfer obligations. This position affords benefits and incentives for facility owners or operators because they will be relieved of the uncertainty of long-term liabilities while making a contribution intended to cover the government's expected costs. On the other hand, a lesser contribution reduces the burden on owners or operators while increasing the post-transfer cost burden for government bodies. The EC Directive does not appear to allow MS to relieve owners or operators from making any contribution for post-transfer responsibilities, because the financial contribution must cover at least 30 years of monitoring costs. However, jurisdictions outside the EC, may choose to implement frameworks for transfer of long-term liabilities without requiring any financial contribution from facility owners or operators. In other words, some jurisdictions may not view financial requirements as necessary elements of liability transfer frameworks.

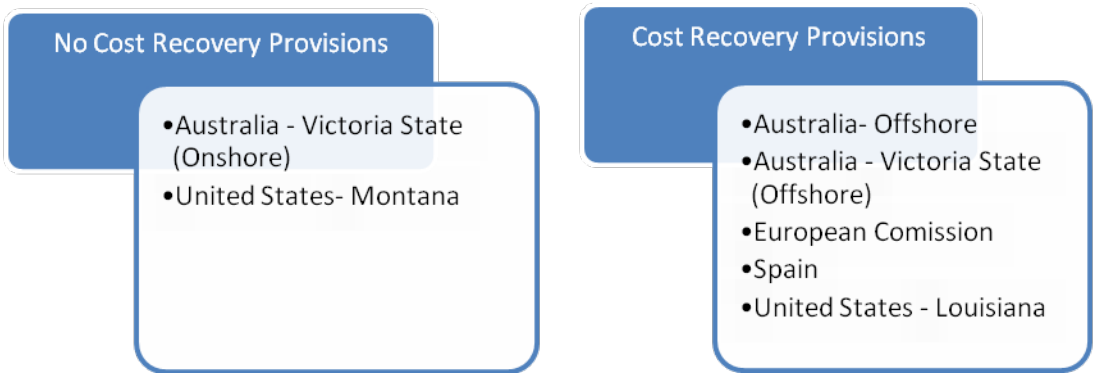
Current CCS frameworks range from no required financial contribution, to requiring a financial contribution immediately prior to transfer, to requiring a per-unit injection fee, to a contribution secured early in the life of the facility, to cover all post-transfer site care, which may include an amount for possible remediation. Additional details of the frameworks reviewed appear in *Appendix D*.



Exhibits E-2A–E-2D in *Appendix E* summarize the strengths and weaknesses of four options for a financial contribution, including the option of no required contribution.

3. Post-Transfer Cost Recovery

Cost recovery provisions allow for the recovery of post-transfer costs by the government that result from a prior, undiscovered failing by the site owner/operator. Common post-transfer cost recovery provisions include gross negligence or willful deceit by the operator during the operational and pre-transfer monitoring phases of a CCS project. Cost recovery provisions help reduce moral hazard concerns associated with transferring liabilities from the private sector to the public sector. Absent a statute of limitations, cost recovery provisions mean that an operator may never be able to disentangle itself entirely from the potential for site-related liability. Additional details of the frameworks reviewed appear in *Appendix D*.

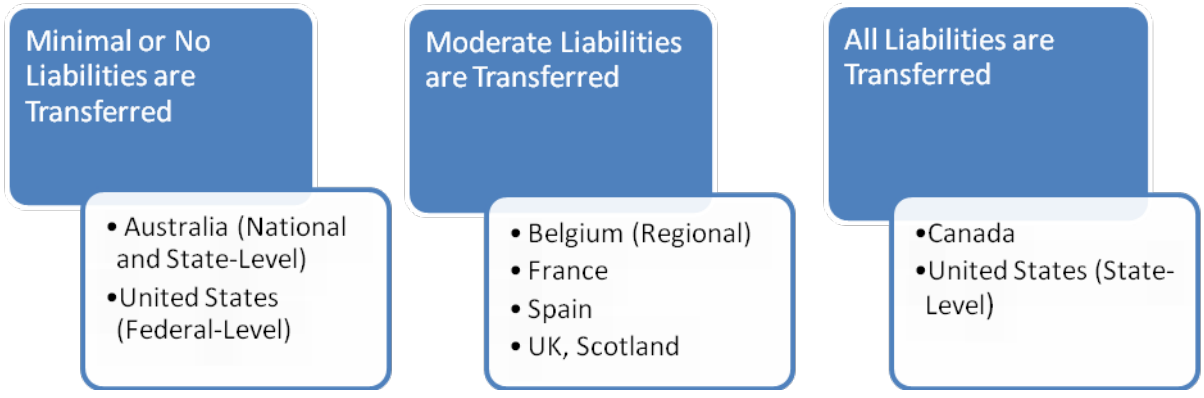


Exhibits E-3A–E-3B in *Appendix E* summarize the strengths and weaknesses of two post-transfer cost-recovery options, including the option of no post-transfer cost recovery.

4. Which Liabilities Are Transferred

CCS frameworks for liability transfer should specify which liabilities are to be transferred to the government. The scope of liabilities transferred under current CCS regulatory frameworks ranges from prohibiting the transfer of any liabilities to a government to allowing the transfer of all liabilities to a government. Some frameworks expressly distinguish among types of liabilities (e.g., monitoring, stewardship, remediation, compensatory), but different jurisdictions may define these types of liability in different ways.

Specification of which liabilities may or may not be transferred can be presented in the form of a "black list" (i.e., liabilities that the government refuses to assume) or a "white list" (i.e., liabilities that the government affirmatively assumes). Additional details of the following frameworks appear in *Appendix D*.



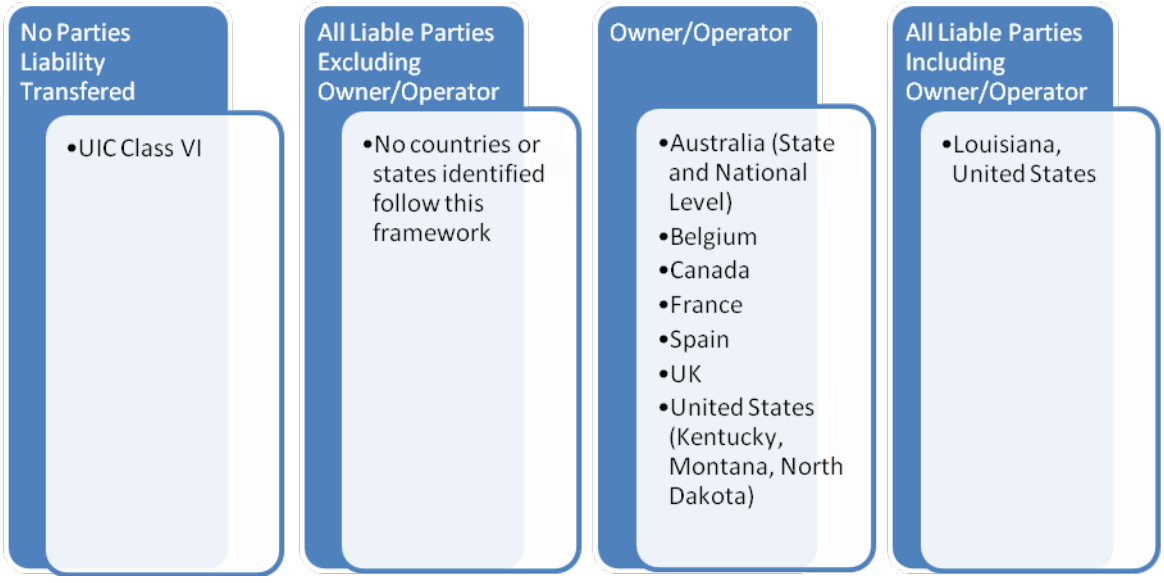
Exhibits E-4A–E-4C in *Appendix E* summarize the strengths and weaknesses of three options for which liabilities are transferred, ranging from no liabilities transferred to all liabilities transferred.

5. Whose Long-term Liabilities Are Transferred

In current CCS legal frameworks, long-term liabilities may be transferred from one entity (e.g., the storage operator) or from multiple entities (e.g., the owner/operator and/or CO_2 generators) to the government. The options considered in this analysis include:

- ***No Parties' Liability Transferred***: Long-term liability is not explicitly transferred away from any potentially liable parties.
- ***All Parties' Liability Transferred Excluding Owner/Operator***: Long-term liability for all potentially liable parties (e.g., CO_2 generator, land owner, owner of CO_2) except for facility owners/operators is explicitly transferred to the government.
- ***Only Owner/Operator Liability Transferred***: Long-term liability of the owner/operator of the storage facility is transferred to the government. However, under this option, long-term liability of other potentially liable parties (e.g., CO_2 generator, land owner) is not explicitly transferred. Therefore, the government may be able to hold potentially liable parties other than the owner/operator responsible for long-term CCS liabilities.
- ***All Parties' Liability Transferred Including Owner/Operator***: Long-term liability for all potentially liable entities (e.g., owner/operator, CO_2 generator, land owner) is transferred to the government.

Additional details of the frameworks reviewed appear in *Appendix D*.



Exhibits E-5A–E-5D in *Appendix E* summarize the strengths and weaknesses of four different options for whose long-term liabilities are transferred.

C. Evaluation of Liability Transfer Options

The exhibits in this section uses the information gained from the process of analyzing strengths and weaknesses and applies the evaluation criteria to each liability transfer option in order to show how different choices could impact costs, protection of the environment, incentives, and management over the duration of long-term liability. The comparison highlights the most or least stringent options although several cases have a continuum of policy options.

Exhibit 4. Costs to Government

Liability Transfer Option	Highest Cost	Lowest Cost
Technical Requirements	No technical requirements for transfer	Extensive technical requirements and pre-transfer monitoring period prior to transfer
Financial Mechanisms	No financial contribution	Most stringent financial requirements
Cost Recovery Provisions	No cost recovery provisions	Broadest cost recovery provisions
Which Liabilities are Transferred	All or many liabilities transferred	No or minimal liabilities transferred
Whose Liabilities are Transferred	Everyone's liability is transferred	No parties liabilities transferred

Exhibit 5. Costs to Industry

Liability Transfer Option	Highest Cost	Lowest Cost
Technical Requirements	Extensive technical requirements for transfer	No technical requirements for transfer
Financial Mechanisms	Most stringent financial requirements	No financial contribution
Cost Recovery Provisions	Broadest cost recovery provisions	No cost recovery provisions
Which Liabilities are Transferred	No or minimal liabilities transferred	All or many liabilities transferred
Whose Liabilities are Transferred	No parties' liabilities transferred	Everyone's liability is transferred

Exhibit 6. Protection of Public/Environment

Liability Transfer Option	Highest Protection	Lowest Protection
Technical Requirements	Extensive technical requirements for transfer	No technical requirements for transfer
Financial Mechanisms	Most stringent financial requirements	No financial contribution
Cost Recovery Provisions	Broadest cost recovery provisions	No cost recovery provisions
Which Liabilities are Transferred	None or few transferred	All or most transferred
Whose Liabilities are Transferred	No parties liabilities transferred	Everyone's liability is transferred

Exhibit 7. Incentive Effects

Liability Transfer Option	Incentives	Disincentives
Industry Participation Incentives		
Technical Requirements	No technical requirements for transfer	Extensive technical requirements for transfer
Financial Mechanisms	No financial contribution	Most stringent financial criteria
Cost Recovery Provisions	No cost recovery provisions	Broadest cost recovery provisions
Which Liabilities are Transferred	All or many liabilities transferred	No or minimal liabilities transferred
Whose Liabilities are Transferred	Everyone's liability is transferred	No parties liabilities transferred
Industry Performance Incentives		
Technical Requirements	Extensive technical requirements for transfer	No technical requirements for transfer
Financial Mechanisms	Most stringent financial criteria	No financial contribution
Cost Recovery Provisions	Broadest cost recovery provisions.	No cost recovery provisions
Which Liabilities are Transferred	No or minimal liabilities transferred	All or many liabilities transferred
Whose Liabilities are Transferred	No parties liabilities transferred	Everyone's liability is transferred

Exhibit 8. Duration

Liability Transfer Option	Longest Duration	Shortest Duration
Technical Requirements	Extensive technical requirements for transfer	No technical requirements for transfer
Financial Mechanisms	Upfront or full coverage	No financial contribution
Cost Recovery Provisions	Broadest cost recovery provisions	No cost recovery provisions
Which Liabilities are Transferred	All or many liabilities transferred	No or minimal liabilities transferred
Whose Liabilities are Transferred	Everyone's liability is transferred	No parties liabilities transferred

D. Recommended Aspects of Liability Transfer Frameworks in the Context of Long-Term CCS Liabilities

Key features of liability transfer frameworks and the design options available for consideration by government legislators and regulators include technical requirements that are preconditions for site transfer, financial requirements, any cost recovery provisions, the specific liabilities to be transferred (or retained), and whose liabilities are transferred to the government (or retained). For each of these features, the report identifies a range of options and assesses their strengths and weaknesses. The following evaluative criteria guided the assessments:

Costs to Industry and Government/Taxpayer
Transfer of liability frameworks serve to re-allocate costs of long-term CCS liabilities away from industry and onto government. Part of the rationale for such transfers is that government bodies are more likely than businesses to endure over long time periods. In addition, there may be a net cost savings to society by having government take primary long-term responsibility for CO_2 storage sites, given that the alternative is for industry to have primary responsibility with government exercising oversight.

Incentive Effects
Much of the necessary expertise for large-scale underground CO_2 storage is found in industry. Transfer of liability frameworks are intended to make industry more comfortable with playing a large role in CO_2 geosequestration. Thus, options for liability transfer frameworks have been assessed in terms of their implications for industry participation in CO_2 geosequestration.

In addition, the provisions of liability transfer frameworks might affect industry incentives for performing siting, injection, closure, monitoring, and the like, given that liability transfer frameworks are thought to create moral hazard: by transferring long-term liability to government, industry may not perform at the same level that would occur if industry retained subsequent liabilities. It is thought that requiring an owner/operator to retain some long-term liabilities

reinforces incentives for proper injection and storage of CO_2 prior to facility transfer. This arrangement may reduce concerns about moral hazard because it creates a disincentive for the owner/operator to perform its technical responsibilities poorly.

Effectiveness of Protection of the Public/Environment
Requiring that facilities achieve high performance standards as a precondition of liability transfer should help reduce future threats to the public and the environment as well as reduce the need for future mitigation or remediation costs to be borne by industry or government. In addition to clear, objective standards (e.g., for closure) that can be assessed and verified prior to transfer of liability, an explicit post-closure period prior to transfer can assure that the responsible owner/operator has properly closed the site and that it is not leaking CO_2 either to the atmosphere or to underground formations where proper controls may be lacking.

Duration
Liabilities associated with CO_2 storage may persist for hundreds of years, possibly outlasting lifetimes of businesses. This extended duration must be considered in designing a liability transfer framework in order to ensure that liability remains with an entity capable of fulfilling long-term liabilities.

The following example options aim to find a balance between assigning costs to government and industry, incentivizing industry participation and performance, promoting effective public and environmental protection, and providing for long durations of coverage.

Exhibit 9. Two Example Options of Liability Transfer Frameworks

Framework Aspect	Example Option A	Example Option B
Technical Requirements	Stringent conditions including a post-closure period and performance standard prior to transfer	Stringent conditions including a post-closure period and performance standard prior to transfer
Which Liabilities are Transferred	Some liabilities transferred	All liabilities transferred
Whose Liabilities are Transferred	Owner/Operator	All potentially liable parties
Financial Requirement	Per unit injection fee paid into a fund during operations	Contribution prior to transfer
Cost Recovery Provisions	Post-transfer cost recovery provisions	No post-transfer cost recovery provisions

Example Option A includes facility standards that require operators to take measures that reduce future costs and burdens and provide public and environmental protection. Some liabilities are transferred; industry is required to retain some liabilities. For example, liability transfer to the government may include only the transfer of monitoring responsibility. Cost recovery provisions are included in Option A that require industry to retain liability in particular circumstances after

liability transfer. A per unit injection fee is required of industry to accumulate funds for the liabilities to be assumed by government. This recommended framework should incentivize industry participation in CCS by providing for long-term liability transfer.

Example Option B also includes facility standards that require operators to take measures that reduce future costs and burdens and provide public and environmental protection. Option B would transfer all liabilities of all potentially liable parties, thus "channeling" long-term liability claims to the government body. Option B does not include any post-transfer cost recovery provisions thus eliminating the prospect of owner or operator responsibility for any long-term liabilities. Option B requires owners or operators to make a financial contribution toward post-transfer costs to be incurred by government; however, the financial contribution need not be accumulated, secured, or made available to the government until just prior to the transfer of responsibility, which provides greater flexibility and lower costs to owners or operators at some increased risk to governments. Option B also should incentivize industry participation in CCS by providing for liability transfer.

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Appendix A

Review of International CCS and Non-CCS Frameworks

Exhibit A-1. International CCS Statutes Relating to Long-Term Liability, Financial Mechanisms (FM), and Transfer of Responsibility

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
Australia National - Offshore Petroleum and Greenhouse Gas Storage Act.			
Owner/operator Long-term compensatory liability OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2006, CH.3, PART 3.4, DIV 8, § 399 (AUSTRAL).	**Explicit Post-Closure Period:** Injection license holder may be indemnified at the end of the closure assurance period, at least 15 years after the issuance of the site closing certificate. OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2006, CH.3, PART 3.4, DIV 8, § 399 (AUSTRAL). **Owner/Operator Liability Retention:** Owner/Operator retains liability indefinitely.	**Allowable Mechanisms:** No statutory provisions requiring FM for long-term compensatory liability were found. **Indemnification:** At the end of the closure assurance period (minimum 15 years), the Commonwealth must indemnify the license holder against liability for (1) damages, (2) liability attributable to an act done or omitted to be done in the carrying out of operations authorized by the license in relation to the formation; and (3) liability incurred or accrued after the end of the closure assurance period as long as (a) the injected greenhouse gas is behaving as predicted; and (b) there is no significant risk that the injected greenhouse gas will have a significant adverse impact on geotechnical integrity, the environment, or on human health or safety. OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2006, CH.3, PART 3.4, DIV 8, § 400 (AUSTRAL).	No statutory provisions relating to transfer of compensatory liability were found.
Owner/operator Long-term stewardship OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2006, CH.3, PART 3.4, DIV 7, § 391 (AUSTRAL).	**Explicit Post-Closure Period:** There is no statutory language describing an explicit post-closure period. **Owner/Operator Liability Retention:** Injection license holder long-	No statutory provision on financial mechanisms, amounts, or indemnification was found.	The Commonwealth will assume long-term stewardship responsibility as specified in the injection license holder's application for site closure. OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2006, CH.3, PART 3.4, DIV 7, § 391 (AUSTRAL).

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
	term stewardship obligations will cease upon Commonwealth assumption of long-term stewardship obligations. OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2006, CH.3, PART 3.4, DIV 7, § 391 (AUSTRAL).		**Financial Contribution Requirement:** The required financial contribution is specified by the Commonwealth in the pre-certificate notice provided to the applicant seeking site closure. OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2006, CH.3, PART 3.4, DIV 7, § 391 (AUSTRAL).
Australia State – Victoria Offshore Petroleum and Greenhouse Gas Storage Act 2010.			
Owner/operator Long-term stewardship OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2010, CH 3, §426 (VICTORIA).	**Explicit Post-Closure Period:** There is no statutory language describing an explicit post-closure period. **Owner/Operator Liability Retention:** Injection license holder's long-term stewardship obligations will cease upon transfer of liability to the Commonwealth.	No statutory provision on financial mechanisms, amounts, or indemnification was found.	The Commonwealth will assume long-term stewardship as specified in the injection license holder's application for site closure. OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2010, CH 3, §426 (VICTORIA). **Financial Contribution Requirement:** The required financial contribution is specified by the Commonwealth in the pre-certificate notice provided to the applicant seeking site closure. OFFSHORE PETROLEUM AND GREENHOUSE GAS STORAGE ACT, 2010, CH 3, §426 (VICTORIA).
Australia State – Victoria Greenhouse Gas Geological Sequestration Act 2008.			
Owner/operator Long-term stewardship: Liable for rehabilitation work,	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found.	**Allowable Mechanisms:** Insurance or mechanism acceptable to the Minister.	No statutory provision relating to transfer of long-term stewardship was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
including clean-up work or pollution prevention work GREENHOUSE GAS GEOLOGICAL SEQUESTRATION ACT, 2008, PART 13, DIV 3, §220 (VICTORIA).	**Owner/Operator Liability Retention:** No statutory language describing owner/operator release from long-term stewardship obligations was found.	GREENHOUSE GAS GEOLOGICAL SEQUESTRATION ACT, 2008, PART 13, DIV 2, §218-219 (VICTORIA). **Required Amount:** Amount acceptable to the Minister. GREENHOUSE GAS GEOLOGICAL SEQUESTRATION ACT, 2008, PART 13, DIV 3, §219 (VICTORIA). **Indemnification:** No statutory provision relating to indemnification was found.	
Australia State – Queensland Greenhouse Gas Storage Act 2009; Greenhouse Gas Storage Regulations 2010.			
Owner/operator Long-term compensatory liability GREENHOUSE GAS STORAGE ACT, 2009, CH. 5, PART 6, §269 (QUEENSLAND).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** License holder retains liability until: (a) GHG tenure ends; (b) the land on which the well is located ceased to be in the GHG tenure's area; or (c) the well is transferred to the State. GREENHOUSE GAS STORAGE ACT, 2009, CH. 5, PART 6, §269 (QUEENSLAND).	**Allowable Mechanisms:** Cash; check; electronic transfer of funds ; unconditional security issued by a financial institution in favor of the State of Queensland and payable on demand with no expiration date; or any combination of the above. GREENHOUSE GAS STORAGE REGULATIONS, 2010, PART 8, §32(1)(QUEENSLAND). **Required Amount:** For a GHG permit or proposed permit: at least $12,360. For a GHG lease or proposed GHG lease: at least $36,050. GREENHOUSE GAS STORAGE ACT, 2009, CH. 5, PART 6, §271(QUEENSLAND). **Indemnification:**	All injected GHG becomes the property of the State regardless of land ownership. GREENHOUSE GAS STORAGE ACT, 2009, CH. 3, PART 7, §181(QUEENSLAND). **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
		No statutory provision relating to indemnification was found.	
Belgium Flemish Region - Decree Concerning the Deep Underground July 8, 2009.			
Owner/operator Long-term compensatory liability Art. 53, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45971.	**Explicit Post-Closure Period:** The site may be transferred to the Flemish Region after a minimum of 20 years, unless the region determines that the containment of the CO2 is permanent. Art. 53, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45969. **Owner/Operator Liability Retention:** License holder retains compensatory liability until the responsibilities associated with the storage site are transferred to the Flemish Region. Art. 53, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45971.	No statutory provision on financial mechanisms, amounts, or indemnification was found.	The license holder's obligations for compensatory liability cease when the responsibilities for the storage site are transferred to the Flemish Region. Art. 53, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45971. **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.
Owner/operator Long-term stewardship: Monitoring and remedial measures, including all obligations listed in the storage permit Art. 57, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6,	**Explicit Post-Closure Period:** The FM must remain effective until (1) after closure of a disposal site and until the responsibilities for the storage site are transferred to the Flemish Region or (2) after the withdrawal of a storage permit.	Allowable Mechanisms: A guarantee or equivalent security established in favor of the Flemish Government. Art. 57, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45970. Required Amount: Amount must be sufficient to meet all	After the Flemish Government approves that transfer conditions have been met, Flemish Government assumes all legal requirements for monitoring and remedial measures upon closure and transfer. Art. 53, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45969.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
2009, p. 45970.	Art. 57, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45970. **Owner/Operator Liability Retention:** The owner/operator is no longer liable once transfer conditions have been met.	requirements of the storage permit, including requirements for the post-closure period. Art. 57, DÉCRET CONCERNANT LE SOUS-SOL PROFOND, M.B. July 6, 2009, p. 45970. **Indemnification:** No statutory provisions relating to indemnification were found.	**Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.
Canada Alberta- Mines and Minerals Act: Revised Statutes of Alberta 2000 Ch. M-17; Carbon Sequestration Tenure Regulation Alberta Regulation 68/2011.			
Owner/operator Long-term stewardship MINES AND MINERALS ACT, R.S.A., ch. M-17 (2010) 121(1); 132(2).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** Owner/operator is no longer liable for long-term stewardship after the Crown issues a closure certificate.	No statutory provision on financial mechanisms, amounts, or indemnification was found.	The Crown becomes the owner of the injected CO2, and assumes all obligations of the lessee upon issuance of a closure certificate to the lessee. MINES AND MINERALS ACT, R.S.A., ch. M-17 (2010) 121(1). **Financial Contribution Requirement:** Long-term stewardship fund: - Funded by lessee fees - Used to pay for monitoring and other assumed responsibilities MINES AND MINERALS ACT, R.S.A., ch. M-17 (2010) 122(1). **Required Amount:** The fund is funded by a per ton fee determined by the Minister. CARBON SEQUESTRATION TENURE REGULATION, (2011) 20.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
Canada Sasketchewan- The Oil and Gas Conservation Act: The Revised Statutes of Saskatchewan, Ch. O-2 (1978); Bill 157, The Oil and Gas Conservation Amendment Act, 2010; The Oil and Gas Conservation Regulations, Ch.O-2 Reg 1 (1985).			
Owner/operator Long-term stewardship: Abandonment, restoration, remediation, and reclamation of wells and facilities, and sites of wells and facilities MINES AND MINERALS ACT, R.S.S., ch. O-2 (2007) 15(1).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** On the written request of a depositor, the minister may return the security deposit if the licensee or its agent has met all of the obligations and corrected any infractions, non compliance, deficiencies, threats or problems and carried out all of the activities with respect to which the security deposit was provided. Oil and Gas Conservation Regulations, Ch.O-2 Reg 1 (1985), 18.2(6).	The minister may require FM of a licensee before the license is issued, if the licensee fails a liability test, or if at any time the drilling, construction, or operation of a well poses a risk. Oil and Gas Conservation Regulations, Ch.O-2 Reg 1 (1985), 18.2(2). **Allowable Mechanisms:** Letter of Credit or any other form satisfactory to the minister. Oil and Gas Conservation Regulations, Ch.O-2 Reg 1 (1985), 18.2. **Required Amount:** Minister-determined amount to ensure all obligations are met. MINES AND MINERALS ACT, R.S.S., ch. O-2 (2007) 15(1). **Indemnification:** No statutory provision relating to indemnification was found.	No statutory provision relating to transfer of liability was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
France France Ordinance No. 2010-1232 of 21 October 2010 transposing European measures in the area of environment into French law. Environmental Code Book II Physical environments, Title II Air and the atmosphere Chapter IX Greenhouse effect. Article 5 Section 6. Environmental Code; Book V Prevention of pollution, risks and nuisances Physical environments, Title I Classified facilities for the protection of the environment Chapter VI Financial Provisions.			
Owner/operator Long-term compensatory liability and stewardship: • Compensatory liability (for leakage, greenhouse gas emission credits) • Surveillance of the site • Safety of the facility • Interventions in case of a post-closure accident • Rehabilitation after closure C. Env. Art.L 519-1.	**Explicit Post-Closure Period:** Long-term liabilities remain with the operator in the post-closure period. C. Env. Art. L. 516-1. **Owner/Operator Liability Retention:** After shutdown, the operator remains responsible for the site until conditions of transfer are met. C. Env. Art. L.299-46.	**Allowable Mechanisms:** The Conseil d'Etat decree determines the nature of the FM for all long-term liabilities. C. Env. Art. L.516-1. **Required Amount:** The Conseil d'Etat decree determines the amount of the FM for all long-term liabilities. C. Env. Art. L.516-1. **Indemnification:** No statutory provision relating to indemnification was found.	The transfer of responsibilities applies only to the surveillance, prevention and repair of the risk of leaks or leaks of CO2, the implementation of the remedies in the post-closure plan as necessary to maintain the safety of the site and stop leaks, and restitution in case of leaks and the resulting loss of emissions credits in greenhouse gas emissions. C. Env. Art.L. 229-47-II. **Financial Contribution Requirement:** In order to secure transfer, the operator must pay the state, in cash, the estimated cost of monitoring the site for 30 years. C. Env. Art.L. 229-47-II.
Scotland The Storage of Carbon Dioxide (Licensing etc.) (Scotland) Regulations 2011; The Storage of Carbon Dioxide (Termination of Licences) Regulations 2011; The Environmental Damage (Prevention and Remediation) Regulations 2009.			
Owner/operator Long-term compensatory liability and stewardship: Owner/operator is not liable for preventive or remedial measures if s/he can demonstrate that the damages were caused by a third-party, or resulted from compliance	**Explicit Post-Closure Period:** Liability remains with the operator in the post-closure period until the lease is terminated. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES)	**Allowable Mechanisms:** FM include a charge over a bank account or any other asset, a deposit of money, a performance bond or guarantee, an insurance policy or a letter of credit. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (LICENSING ETC.) REGULATIONS 2010, (2011) SI 2221/	Liability and stewardship transfer occurs immediately after the termination of the license; however, the government authority does not assume liability for leakages which was payable by the license holder before the termination of the license; or is payable by the license holder after the termination of the license but at a time which is certain.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
with a compulsory order or instruction. Owner/operator is not liable for remedial measures if s/he can demonstrate that s/he was not at fault or negligent. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (LICENSING ETC.) REGULATIONS 2010, (2011) SI 2221/ 8(7)(5)(Scotland).	REGULATIONS 2011, (2010) SI 2221/ 8(14) (Scotland). **Owner/Operator Liability Retention:** Liability remains with the operator in the post-closure period until the lease is terminated. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES) REGULATIONS 2011, (2010) SI 2221/ 8(14) (Scotland).	1(Scotland). For environmental damages, financial compensation and compensatory remediation (non-financial) are eligible instruments. ENVIRONMENTAL PROTECTION, (2011) SI 2221/ 8(5)(1) (U.K.). **Required Amount:** The operator must maintain FM that is of an amount sufficient to ensure compliance with all license obligations. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (LICENSING ETC.) REGULATIONS 2010, (2011) SI 2221/ 8(7)(1). **Indemnification:** No statutory provision relating to indemnification was found.	ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES) REGULATIONS 2011, (2010) SI 2221/ 8(14-15) (Scotland). **Financial Contribution Requirement:** At the time of transfer, the government authority must determine the amount of financial contribution from the operator to cover expected post-transfer costs. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES) REGULATIONS 2011, (2010) SI 2221/ 8(14) (Scotland).
Spain 40/2010 of December 29th on the Geological Storage of Carbon Dioxide.			
Owner/operator Long-term liability: No statutory provision defining the scope of liability was found. B.O.E. 2011, 317, Art. 12(6); Art.23(1)(c).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** Liability will remain with owner/operator until closure of a storage site, transfer to the competent authority, and revocation of the concession.	No statutory provisions on FM, amounts, or indemnification were found.	Liability will remain with owner/operator until closure of a storage site, transfer to the competent authority, and revocation of the concession. B.O.E. 2011, 317, Art. 12(6); Art.23(1)(c). **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
	B.O.E. 2011, 317, Art. 12(6); Art.23(1)(c).		
Owner/operator Long-term stewardship Monitoring and maintenance B.O.E. 2010, 317, Art. 23(5).	**Explicit Post-Closure Period:** Owner/operator long-term stewardship obligations will be established by regulation and will extend at least 30 years. B.O.E. 2010, 317, Art. 12(3). **Owner/Operator Liability Retention:** Liability remains with the operator in the post-closure period until the site closure and revocation of an injection concession.	**Allowable Mechanisms:** Specified allowable mechanisms will be established by regulation. B.O.E. 2010, 317, Art. 12(2). **Required Amount:** To determine the required amount, the competent bodies take into account the costs of (1) decommissioning injection and sealing of the storage site and (2) storage capacity of the place and the cost of greenhouse gases allowance. **Indemnification:** No statutory provision relating to indemnification was found.	Following the closure of a storage site and revocation of an injection concession by the Ministry of Industry, Tourism, and Trade, the Ministry of Environment and Rural and Marine Affairs will be responsible for: (a) monitoring and corrective action, (b) fulfilling obligations related to the surrender of allowances in case of leaks, (c) sealing storage, and removal of the injection facilities, and (d) compliance with preventative measures and repairs. B.O.E. 2010, 317, Art. 23(5). Owner/operator will continue to be liable for long-term stewardship costs that exceed the FM amount in cases of poor data presentation, hidden relevant information, negligence, intentional deception, or lack of due diligence. B.O.E. 2010, 317, Art. 24(6). **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.
United Kingdom The Storage of Carbon Dioxide (Licensing etc.) Regulations 2010; The Storage of Carbon Dioxide (Termination of Licences) Regulations 2011; The Environmental Damage (Prevention and Remediation) Regulations 2009.			
Owner/operator Long-term compensatory liability and stewardship ENVIRONMENTAL PROTECTION:	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability**	No statutory provisions on FM, amounts, or indemnification were found.	Liability transfer occurs immediately after the termination of the license; however, the government authority does not assume liability for leakages, which was payable by the license holder before the termination of the license; or is payable by the license holder

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES) REGULATIONS 2010, (2010) SI 2221/ 8(14)(1)-(2) (U.K.).	**Retention:** Owner/operator liability ceases when transfer to the government authority occurs. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES) REGULATIONS 2010, (2010) SI 2221/ 8(14)(1)-(2) (U.K.).		after the termination of the license but at a time which is certain. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES) REGULATIONS 2011, (2011) SI 2221/ 8(14-15) (U.K.). **Financial Contribution Requirement:** Financial contribution may be made in the form of a charge over a bank account or any other asset, a deposit of money, a performance bond or guarantee, an insurance policy, or a letter of credit. ENVIRONMENTAL PROTECTION: STORAGE OF CARBON DIOXIDE (TERMINATION OF LICENCES) REGULATIONS 2010, (2010) SI 2221/ 8(1)(3) (U.K.). **Required Amount:** At the time of transfer of obligations/liabilities, the government authority must determine the amount of financial contribution from the operator to cover expected post-transfer costs. ENVIRONMENTAL PROTECTION, (2010) SI 2221/ 8(6)(6) (U.K.).
United States National - Underground Injection Control Program for Carbon Dioxide (CO2) Geologic Sequestration Wells (2010).			
Owner/operator Long-term stewardship	**Explicit Post-Closure Period:** Approximately 50 years of required long-term stewardship. 40 CFR § 146.93(b).	**Allowable Mechanisms:** Trust funds, surety bonds, letter of credit, insurance, self insurance (i.e., financial test and corporate guarantee), escrow account, or any other instrument(s) satisfactory to the	Under current U.S. Safe Drinking Water Act (SDWA) provision, no authority is provided for the transfer of liability from one entity to the federal government.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
	Owner/Operator Liability Retention: Owner/Operator retains long-term stewardship liability indefinitely.	director. 40 CFR § 146.85(a). **Required Amount** Sufficient to cover the cost of corrective action, injection well plugging, post injection site care and site closure, and emergency and remedial response. 40 CFR § 146.85(b). **Indemnification:** No statutory provision relating to indemnification was found.	
United States Kentucky Division of Oil and Gas within the Department for Natural Resources- Demonstration or pilot scale geologic storage of carbon dioxide (2011).			
Owner/operator Long-term liability No statutory provision defining the scope of liability was found.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** Liability for the stored carbon dioxide remains with the storage operator until a transfer is completed. KY. REV. STAT. ANN. § 353.810(5).	No statutory provisions on financial mechanisms, amounts, or indemnification were found.	The ownership and liability for a storage facility may be transferred to: (a) the federal government if a federal program exists or (b) the Kentucky Finance and Administration Cabinet if a federal program does not exist. KY. REV. STAT. ANN. § 353.810(3). **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.
United States Louisiana Office of Conservation, Department of Natural Resources- Louisiana §§ 30: 1101-1111 (2009).			
Owner/operator, all generators of any injected carbon dioxide, all	**Explicit Post-Closure Period:** No statutory language	No statutory provisions on financial mechanisms, amounts, or indemnification	Upon the issuance of the certificate of completion of injection operations, the storage

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
owners of carbon dioxide stored in the storage facility, and all owners otherwise having any interest in the storage facility [owner/operator and/or generators] Long-term liability No statutory provision defining the scope of liability was found. LA. REV. STAT. ANN. § 30:1109(A).	describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** The owner/operator and/or generators remain liable until the issuance of the certificate of completion of injection operations. LA. REV. STAT. ANN. § 30:1109(A).	were found.	operator, all generators of any injected carbon dioxide, all owners of carbon dioxide stored in the storage facility, and all owners otherwise having any interest in the storage facility, will be released from all liability associated with or related to that storage facility which arises after the issuance of the certificate of completion of injection operations. LA. REV. STAT. ANN. § 30:1109(A)(1). Once the commissioner has approved the site-specific trust account, and the account is fully funded, the party transferring the storage facility site is relieved of liability. LA. REV. STAT. ANN. § 30:1111(F). The owner/operator and/or generators remain liable if the trust fund lacks adequate funds. The owner/operator and/or generators also remain liable if information is concealed or misrepresented. LA. REV. STAT. ANN. § 30:1109(A). **Financial Contribution Requirement:** Pooled trust fund "Carbon Dioxide Geologic Storage Trust Fund," which is administered by the State. LA. REV. STAT. ANN. § 30:1110. Site-specific trust account, funded by the transferring party.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
			LA. REV. STAT. ANN. § 30:1111(F). **Required Amount:** The commissioner is authorized to levy on storage operators fees for the purpose of funding the Carbon Dioxide Geologic Storage Trust Fund. LA. REV. STAT. ANN. § 30:1110(C). No statutory provision describing the amount required for site-specific trust-fund accounts was found.
United States Montana Department of Natural Resources and Conservation, Division of Oil & Gas Conservation- Montana §§ 82-11-180 to 82-11-184 (2009).			
Owner/operator Long-term stewardship Operate and manage a carbon dioxide injection well, geologic storage reservoir, and the carbon dioxide stored in the reservoir and to properly plug and reclaim each injection well. Mont. CODE ANN. § 82-11-123(1)(f).	**Explicit Post-Closure Period:** After issuing a certificate of completion, the board will ensure adequate monitoring by the operator of the wells and reservoir for 15 years. Mont. CODE ANN. § 82-11-183(6). **Owner/Operator Liability Retention:** FM for long-term monitoring will not be released until the operator transfers liability to the state. Mont. CODE ANN. § 82-11-183(7).	**Allowable Mechanisms:** Bond or other surety. Mont. CODE ANN. § 82-11-123(f). **Required Amount:** No statutory provision describing the required amount of the FM was found. **Indemnification:** No statutory provision relating to indemnification was found.	Following the issuance of a certificate of closure (at least 15-years after injection cessation) and the 15-year monitoring and verification requirement and subject to requirements for transfer of ownership to the state (a total of at least 30 years post-injection cessation), the geologic storage operator may transfer title to the geologic storage reservoir and to the stored carbon dioxide to the state including all rights and interests in and all responsibilities associated with the site. Mont. CODE ANN. § 82-11-183(3-11). **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM)/Indemnification	Liability Transfer
	Owner/Operator Liability Retention: If the operator does not transfer liability to the state, then the operator indefinitely accepts liability for the stored carbon dioxide and the geologic storage reservoir. Mont. CODE ANN. § 82-11-183(9)-(10).		
United States North Dakota Industrial Commission- **North Dakota 38-22 (2009).**			
Owner/operator Long-term compensatory liability: Any damage the carbon dioxide may cause, including damage caused by carbon dioxide that escapes from the storage facility N.D. CENT. CODE § 38-22-16.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** Owner/operator is released from long-term liability after the commission issues a certificate of project completion. N.D. CENT. CODE § 38-22-16.	No statutory provisions on FM, amounts, or indemnification were found.	The state assumes all responsibilities associated with the stored carbon dioxide. N.D. CENT. CODE § 38-22-17(6)(b). **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.

Exhibit A-2. International Non-CCS Statutes Relating to Long-Term Liability, Financial Mechanisms (FM), and Transfer of Responsibility

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
Underground injection of liquid waste			
Australia New South Wales: Waste Recycling and Processing Corporation (Authorized Transaction) Act 2010 No 8.			
Waste Assets Management Corporation (WAMC) Long-term stewardship: Rehabilitation and future maintenance of landfill sites. N.S.W. Stat 2010 No. #8 § 4,8, Part 2 (6)-(7). WAMC has all the entitlements and obligations of the transferor in relation to those assets, rights and liabilities that the transferor would have had but for the order, whether or not those entitlements and obligations were actual or potential at the time the order took effect. N.S.W. Stat 2010 No. #8 § 4,8, Part 2 (6)-(7).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** Owner/Operator retains liability until transfer.	No statutory provisions on FM, amounts, or indemnification were found.	Liability is transferred to the WAMC Landfill Rehabilitation Fund. N.S.W. Stat 2010 No. #8 § 4,8, Part 2 (4)-(5). **Financial Contribution Requirement:** WAMC Landfill Rehabilitation Fund. There is to be established in the Special Deposits Account a fund called the WAMC Landfill Rehabilitation Fund ("the Fund"). The Fund is to be administered by the Treasurer. N.S.W. Stat 2010 No. #8 § 4,8, Part 2 (6)-(7). **Required Amount:** Upon transfer to WAMC, all outstanding WAMC landfill liabilities must be paid into the WAMC Landfill Rehabilitation Fund. N.S.W. Stat 2010 No. #8 § 4,8, Part 2 (6)-(7).
Poland Geological and Mining Law of February 4, 1994 (consolidated text Dz.U. 2005 vol. 228 item 1947).			
Owner/operator Long-term compensatory liability Art. 17(1).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability**	**Allowable Mechanisms and Required Amount:** Determined by: - type of activity - area covered by a license - period for which a license has been issued;	No statutory provision relating to transfer of long-term compensatory liability was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
	Retention: License-issuing authority determines the duration for which FM must be demonstrated when they make a decision on license withdrawal or revocation. Art. 29(3).	and - extent of potential environmental impact. Art. 17(2). **Indemnification:** No statutory provision relating to indemnification was found.	
Owner/operator Long-term stewardship Regulation of Minister of Environment concerning underground waste storage of June 16, 2005, Dz.U. 2005 vol. 110 item 935, Art. 15(1).	**Explicit Post-Closure Period:** Long-term stewardship monitoring is required for at least 30 years from the date of license expiration or revocation, and may be extended after migration of dangerous substances. Long-term stewardship is required for at least 10 years after a negative environmental impact is removed. Regulation of Minister of Environment concerning underground waste storage of June 16, 2005, Dz.U. 2005 vol. 110 item 935, Art. 15(1); Art. 15.4 and Art. 15.5. **Owner/Operator Liability Retention:** Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.	No statutory provision on FM, amounts, or indemnification were found.	No statutory provision relating to transfer of long-term stewardship obligations of the storage operator was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
United States Class I Hazardous Waste Injection Wells (1984).			
Owner/operator Long-term stewardship 40 C.F.R. § 146.72(a).	**Explicit Post-Closure Period** FM covering long-term stewardship is required until an independent registered professional engineer certifies that post-closure obligations have been met. 40 C.F.R. § 144.63(i). **Owner/Operator Liability Retention**: The obligation of the owner or operator to implement the post-closure plan and maintain FM for post-closure monitoring and maintenance survives the termination of a permit and the cessation of injection activities. 40 C.F.R. § 146.72 – 146.73. Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.	**Allowable Mechanisms:** Trust fund, surety bond, letter of credit, financial test, insurance, or corporate guarantee. 40 C.F.R. § 146.73. **Required Amount:** Estimated cost of post-closure care. 40 C.F.R. § 146.72. **Indemnification:** No statutory provision relating to indemnification was found.	No statutory provision relating to transfer of long-term stewardship obligations of the owner or operator was found.
Solid waste landfills			
Canada British Columbia: Environmental Management Act – Hazardous Waste Regulation (1988).			
Owner/operator Long-term stewardship B.C. Regs Div 6 (27)9-10.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found.	No statutory provision on FM, amounts, or indemnification were found.	Owner must transfer title of the property to the State after closure. B.C. Regs Div 6 (27) 10.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
	Owner/Operator Liability Retention: No statutory language describing release of owner/operator from long-term stewardship obligations was found.		No statutory provision describing the impact transfer of title has on long-term liability were found.
Canada British Columbia: Landfill Criteria For Municipal Solid Waste (1993).			
Owner/operator Long-term stewardship LANDFILL CRITERIA FOR MUNICIPAL SOLID WASTE, 8.1.	**Explicit Post-Closure Period:** Long-term stewardship must be performed for a minimum of 25 years. LANDFILL CRITERIA FOR MUNICIPAL SOLID WASTE, 8.1. **Owner/Operator Liability Retention:** Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.	**Allowable Mechanisms:** FM to cover post-closure monitoring and maintenance must be demonstrated by establishing a Closure Fund in a form acceptable to the Government Manager, such as upfront security or a fund financed on a charge per ton of waste disposed basis. LANDFILL CRITERIA FOR MUNICIPAL SOLID WASTE, 8.2. **Required Amount:** Must meet or exceed the currently estimated post-closure costs as outlined in the closure plan plus a reasonable contingency for any remediation which may be required. LANDFILL CRITERIA FOR MUNICIPAL SOLID WASTE, 8.2. **Indemnification:** No statutory provision relating to indemnification was found.	No statutory provision relating to transfer of liability of the owner was found..

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
India Municipal Solid Wastes (Management and Handling) Rules (2000).			
Owner/operator Long-term stewardship MUNICIPAL SOLID WASTES (MANAGEMENT AND HANDLING) RULES, 2000. S.O. 908(E).	**Explicit Post-Closure Period:** Post-closure care and monitoring must be performed for at least 15 years. MUNICIPAL SOLID WASTES (MANAGEMENT AND HANDLING) RULES, 2000. S.O. 908(E). **Owner/Operator Liability Retention:** Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.	No statutory provision on FM, amounts, or indemnification was found.	No statutory provision relating to transfer of liability of the operator was found.
Netherlands Environmental Management Act			
Owner/operator Long-term stewardship and compensatory liability Environmental Management Act, May 1, 2004, Bulletin of Acts and Decrees 2002, no. 239, § 8.49.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** The operator will no longer be responsible for long-term stewardship or liable for damage caused by that landfill site after the declaration of closure has been issued. Environmental Management Act, May 1, 2004, Bulletin of	No statutory provision on FM, amounts, or indemnification was found.	The operator will no longer be responsible for long-term stewardship or liable for damage caused by that landfill site after the declaration of closure has been issued. Environmental Management Act, May 1, 2004, Bulletin of Acts and Decrees 2002, no. 239, §§ 8.50, 15.49. **Financial Contribution Requirement:** Compensation fund will cover long-term stewardship and long-term compensatory liability. The injured party will be compensated from a compensation fund.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
	Acts and Decrees 2002, no. 239, §§ 8.50, 15.49.		Environmental Management Act, May 1, 2004, Bulletin of Acts and Decrees 2002, no. 239, §§ 15.44, 15.49. **Required Amount:** The amount of the levy must be set at such a level that the revenue from the levy and the related interest and investment income defray the costs that are expected to be associated with the implementation of the after-care plan. Environmental Management Act, May 1, 2004, Bulletin of Acts and Decrees 2002, no. 239, § 15.45.
Norway Waste Regulations, Chapter 9. Landfilling of Waste (1981).			
Owner/operator Long-term stewardship Waste Regulations Section 9-15, Appendix III.1.	**Explicit Post-Closure Period:** Post-closure requirements extend for a 30-year minimum. Waste Regulations Section 9-10. **Owner/Operator Liability Retention:** Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.	**Allowable Mechanisms:** A satisfactory financial guarantee or similar security. Waste Regulations Section 9-10. **Required Amount:** All costs involved in the operation of a landfill will be covered by the price to be charged by the operator for the depositing of waste at the landfill. Includes the costs of FM and the estimated costs for the closure and after-care of the site for a minimum period of 30 years. Waste Regulations Section 9-10. **Indemnification:** No statutory provision relating to indemnification was found..	No statutory language relating to transfer of liability of the operator was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
Philippines Ecological Solid Waste Management Act Of 2000. Implementing Rules And Regulations Of Republic Act 9003, Rules XIV Operations of Sanitary Landfills.			
Owner/operator Long-term stewardship General upkeep of the landfill, maintaining all of the landfill's environmental protection features, operating monitoring equipment, remediating groundwater should it become contaminated, and controlling landfill gas migration or emission. Rep. Act 9003, Article 6, §41 (a) – (g).	**Explicit Post-Closure Period:** Post-closure care period will be a 15-year period. Rule XIV, § 1(y). **Owner/Operator Liability Retention:** Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.	**Allowable Mechanisms:** Department of Environmental and Natural Resources must establish post-closure guidelines and requirements for FM mechanisms within one year. Rule XIV, § 1(y). **Required Amount:** No statutory provision specifying the required amount of FM were found. **Indemnification:** No statutory provision relating to indemnification were found.	No statutory provision relating to transfer of liability of the owner was found.
Poland Act on Waste of 2001 (amended several times, the last amendment made in Sep. 2010).			
Owner/operator Long-term stewardship Regulation of Minister of Environment concerning scope, timing, method, and conditions of monitoring a landfill of December 9, 2002, Dz.U. vol. 220 item 1858; Art 2.	**Explicit Post-Closure Period:** Post-closure monitoring is to be undertaken for 30 years from the date of obtaining a decision on landfill closure. Regulation of Minister of Environment concerning scope, timing, method, and conditions of monitoring a landfill of December 9, 2002, Dz.U. vol. 220 item 1858; Art 2. A decision on landfill closure provides a schedule of required activities connected with the	No statutory provision on FM, amounts, or indemnification were found.	No statutory provision relating to transfer of liability of the landfill manager was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
	reclamation of a waste landfill, and terms and conditions of supervising the reclaimed waste landfill (including monitoring and its execution) Art. 54(4). **Owner/Operator Liability Retention:** Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.		
Owner/operator Long-term compensatory liability Compensation of claims for negative environmental impacts Environmental Protection Law of April 27, 2001, consolidated text, Dz.U. 2008 vol. 25 item 150), Art. 198(2).	**Explicit Post-Closure Period:** FM for claims for negative environmental impacts must be maintained until the fulfilment of obligations, including post-closure monitoring, specified in the decision on landfill closure. Art. 54(15). **Owner/Operator Liability Retention:** Owner/operator long-term stewardship obligations cease upon the end of the post-closure period.	**Allowable Mechanisms:** Deposit, bank guarantee, insurance guarantee, or insurance policy. Environmental Protection Law of April 27, 2001, consolidated text, Dz.U. 2008 vol. 25 item 150, Art. 187(2). **Required Amount:** The minister pertinent to environmental matters may issue a regulation describing methods of calculating required amount. In 2006, the Foundation of Environmental and Natural Resources Economists issued non-binding guidelines for public authorities. Environmental Protection Law of April 27, 2001, consolidated text, Dz.U. 2008 vol. 25 item 150, Art. 187(6). **Indemnification:** No statutory provision relating to	No statutory provision relating to transfer of liability of the landfill manager was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
		indemnification was found.	
United Kingdom Environmental Permitting (England and Wales) Regulations 2010, Schedule 10 – Landfill. Guidance on Financial Provision for Landfill			
Owner/operator Long-term stewardship, including monitoring and analysing landfill gas and leachate from the site and the groundwater regime in the vicinity of the site. European Council Directive 99/31/EC, as cited in Guidance on Financial Provision for Landfill, Section 1.2.	**Explicit Post-Closure Period:** The Environmental Agency believes 60 years to be an appropriate estimate for the post-closure care period, but shorter periods may be agreed where an effective mechanism for the rapid stabilisation of the landfill waste mass is proved. Guidance on Financial Provision for Landfill, Section 4.4. **Owner/Operator Liability Retention:** FM for post-closure care must be demonstrated until the permit is surrendered. Post-closure care is required for as long as the competent authority considers that a landfill is likely to cause a hazard to the environment and without prejudice to any Community or national legislation as regards liability of the waste holder. European Council Directive 99/31/EC, as cited in Guidance	**Allowable Mechanisms:** Renewable bonds, escrow accounts, cash deposits, local authority deed agreement, trust based investment portfolios (described as "the principal mechanisms accepted"). The mechanism must be: i) secure, ii) sufficient, and iii) available. Guidance on Financial Provision for Landfill, Section 5.1; 5.3. **Required Amount:** FM should be sufficient to meet all post-closure obligations including environmental monitoring; capping and cap maintenance; leachate, landfill, and surface water management; security; production of site reports; and specified events. Guidance on Financial Provision for Landfill, Section 4.13. Required amount includes a contingency sum to ensure that once the period estimated for post-closure care is over, there are funds available should continued site management be necessary.	No statutory provision relating to transfer of liability of the site operator was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
	on Financial Provision for Landfill, Section 1.2.	Guidance on Financial Provision for Landfill, Section 4.10. **Indemnification:** No statutory provision relating to indemnification was found. **Other:** The site operator can normally access funds secured by FM after work has been done and in accordance with the agreed cost estimate to assist in meeting the obligations of the permit. Guidance on Financial Provision for Landfill, Section 3.	
United States Criteria for Municipal Solid Waste Landfills			
Owner/operator Long-term stewardship 40 C.F.R. § 258.61.	**Explicit Post-Closure Period:** Post-closure care must be conducted for 30 years, except as provided under paragraph (b). (b) The length of the post-closure care period may be: (1) Decreased if the owner or operator demonstrates that the reduced period is sufficient to protect human health and the environment; or (2) Increased if the State determines that the lengthened period is necessary to protect human health and the environment.	**Allowable Mechanisms:** Trust fund, surety bond guaranteeing payment or performance, letter of credit, insurance, corporate financial test, local government financial test, corporate guarantee, local government guarantee, or state-approved mechanism. 40 C.F.R. § 258.74. **Required Amount:** The owner or operator must have a detailed written estimate of the cost of hiring a third party to conduct post-closure care. The cost estimate must be based on the most expensive costs of post-closure care during the post-closure care period. The owner or operator must increase the	No statutory provision on transfer of liability of the owner or operator was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
	40 C.F.R. § 258.61(a). **Owner/Operator Liability Retention:** The owner or operator must provide continuous coverage for post-closure care until released from FM requirements for post-closure care. 40 C.F.R. § 258.72 (a).	amount of FM provided if changes in the post-closure plan or MSWLF unit conditions increase the maximum costs of post-closure care. 40 C.F.R. § 258.72 (a). **Indemnification:** No statutory provision relating to indemnification was found.	
Geologic disposal of nuclear wastes or other radioactive wastes			
China Prevention And Control of Radioactive Pollution Law - 2003.			
Generator of solid radioactive waste Long-term liability No statutory provision defining the scope of liability was found. P.R.C. LAW PREVENTION AND CONTROL OF RADIOACTIVE POLLUTION LAW, ARTICLE 45.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** No statutory language describing generator retention of liability was found.	**Allowable Mechanisms:** Administrative measure for collection and use of fees for disposal of solid radioactive waste shall be formulated by the department of finance and the department for pricing, in conjunction with the administrative department for environmental protection under the State Council. P.R.C. LAW PREVENTION AND CONTROL OF RADIOACTIVE POLLUTION LAW, ARTICLE 45. **Required Amount:** No statutory provision describing the required amount were found. **Indemnification:** No statutory provision relating to indemnification were found.	No statutory provision relating to transfer of liability was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
France The 2006 Programme Act on the Sustainable Management of Radioactive Materials and Wastes.			
Owner/operator of radioactive waste disposal installation Long-term stewardship Law No. 2006-739 of June 28, 2006, Art. 20.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** No statutory language describing owner/operator retention of liability was found.	**Allowable Mechanism:** Operators must establish reserves, which must present a sufficient degree of security and liquidity to meet their purpose. Law No. 2006-739 of June 28, 2006, Art. 20. **Required Amount:** Amount must cover the costs of final closure, maintenance, and monitoring and earmark the necessary assets for the exclusive coverage of these reserves. Law No. 2006-739 of June 28, 2006, Art. 20. **Indemnification:** No statutory provision relating to indemnification was found.	No statutory provision relating to transfer of liability was found.
Generator of radioactive waste Long-term stewardship, including the construction, operation, final closure, maintenance, and monitoring of intermediate- or high-level long-lived waste storage or disposal installations built or operated by the agency. Law No. 2006-739 of June 28, 2006, Art. 16.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** No statutory language describing generator retention of liability was found.	**Allowable Mechanism:** A fund, financed by basic nuclear installation operators. Law No. 2006-739 of June 28, 2006, Art. 16. **Required Amount:** Amount is defined by agreements between agency and basic nuclear installation operators. Law No. 2006-739 of June 28, 2006, Art. 16.	No statutory provision relating to transfer of liability was found.

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
		Indemnification: No statutory provision relating to indemnification was found.	
Germany Act on the Peaceful Utilization of Atomic Energy and the Protection against its Hazards (Atomic Energy Act). Repository Prepayment Ordinance.			
Generator of radioactive waste Long-term liability No statutory provision defining the scope of liability was found. Repository Prepayment Ordinance**,** April 28, 1982, amended July 6,2004 § 2(1).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** If radioactive waste that has to be delivered to a final repository has accumulated, the liability to make prepayments will persist even if a license no longer exists. If due to a licensed practice, radioactive waste has accumulated, and both a former licensee and a current licensee are liable to make prepayments, they are jointly and severally liable. Repository Prepayment Ordinance**,** April 28, 1982, amended July 6,2004 § 2(1).	No statutory provisions on FM, amounts, or indemnification were found.	Whoever holds radioactive waste must surrender such waste to either state collection facilities for the interim storage of the radioactive material generated in their borders or Federal facilities for safekeeping and final disposal of radioactive waste. Atomic Energy Act, December 23, 1959, amended April 22, 2002, Federal Law Gazette, Part I, p. 814, § 9a. **Financial Contribution Requirement:** Repository fund Repository Prepayment Ordinance**,** April 28, 1982, amended July 6,2004 § 2(3). **Required Amount:** Expenses will be distributed in proportion to the amount of radioactive waste that has accrued and presumably will accrue at the single waste generator. Repository Prepayment Ordinance**,** April 28, 1982, amended July 6,2004 § 2(3).

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
South Africa National Radioactive Waste Disposal Institute Act, 2008.			
Generator of radioactive waste Long-term stewardship and compensatory liability National Radioactive Waste Disposal Institute Act of 2008 s. 25.	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** The generator of radioactive waste is no longer liable after the radioactive waste has been received and accepted in writing by the Institute, following an inspection. National Radioactive Waste Disposal Institute Act of 2008 s. 25.	No statutory provisions on FM, amounts, or indemnification were found.	The Institute becomes liable when the radioactive waste has been received and accepted in writing by the Institute, following an inspection. National Radioactive Waste Disposal Institute Act of 2008 s. 25. **Financial Contribution Requirement:** No statutory language requiring a financial contribution prior to transfer was found.
United States Nuclear Waste Policy Act (1982).			
Generators of nuclear waste and spent fuel Long-term liability No statutory provision defining the scope of liability was found. 42 U.S.C. 10161(a)(5).	**Explicit Post-Closure Period:** No statutory language describing an explicit post-closure period was found. **Owner/Operator Liability Retention:** The generator and owner of nuclear waste and spent fuel are released from long-term liability upon the acceptance by the Secretary of the radioactive material.	No statutory provisions on FM, amounts, or indemnification were found.	Delivery and acceptance by the Secretary, of any high-level radioactive waste or spent nuclear fuel for a repository constructed under this subtitle will constitute a transfer to the Secretary of title to such waste or spent fuel. 42 U.S.C. 10143. **Financial Contribution Requirement:** Establishes a Nuclear Waste Fund, composed of payments made by the generators and owners of such waste and spent fuel that will ensure that the costs of carrying out activities relating to the disposal of such waste and spent fuel will be borne by the persons responsible

Responsible Entity & Scope of Long-Term Liability	Duration	Financial Mechanisms (FM) / Indemnification	Liability Transfer
	42 U.S.C. 10143.		for generating such waste and spent fuel. 42 U.S.C. 10131(b)(4). **Required Amount:** No statutory provision describing the cost of FM was found.

Appendix B

Financial Mechanisms Evaluation

Exhibit B-1. Financial Mechanisms Evaluation Matrix

Financial Mechanism	Certainty	Amount	Liquidity	Duration	Flexibility	Cost	Administrative Burden
Third-Party Mechanisms							
1. Irrevocable Trust Fund	Excellent if property in the trust fund is not subject to claims of creditors and consists of cash or cash equivalents.	Very good for fully funded trust and where trust is not invested in securities issued by the operator and its corporate affiliates. Subject to risks of investments. Sinking fund approach increases risk in proportion to length of build-up period.	Depends on requiring trust investments to be liquid.	Excellent. Trust can last as long as needed.	Excellent. Amount of trust can be easily adjusted without need for another mechanism.	High cost. Sinking fund approach stretches out payments over time; the longer the pay-in period, the less the effective cost.	Low. Monitor fund balance, including if payments made over time.
2. Escrow Account	Lacking, if escrow deposits are subject to claims of creditors and remain under the ownership and control of the operator.	Very good for fully funded escrows and where escrow is not invested in securities issued by the operator or its corporate affiliates. Sinking fund approach increases risk in proportion to length of build-up period.	Depends on liquidity of property put in escrow and investment restrictions.	Good, although escrows typically are not long-term mechanisms.	Excellent. Amount of escrow can be easily adjusted without need for another mechanism.	High cost. Sinking fund approach stretches out payments over time; the longer the pay-in period, the less the effective cost.	

Financial Mechanism	Certainty	Amount	Liquidity	Duration	Flexibility	Cost	Administrative Burden
3. Bank Demand (Payment) Guarantee; Irrevocable Standby Letter of Credit; Surety Bond (Payment Bond)	Excellent unless available to claims of creditors. Certainty also depends on financial strength and supervision of issuing institution.	Excellent.	Excellent. Designed to pay on demand.	Good, although guarantees typically are not long-term mechanisms.	Good. Amount can be adjusted if mutually agreeable without need for another mechanism.	Low cost. Fees for creditworthy parties run 0.5% to 3% of amount assured, exclusive of collateral.	Low. Monitor continuity of coverage in the event of proposed cancellation or termination by the issuer.
4.Surety Bond (Performance Bond)	Excellent. Certainty also depends on financial strength and supervision of issuing institution.	Excellent.	Excellent. Designed to pay on demand.	Excellent.	Good.	Low cost.	Moderate. May require substantial oversight of surety efforts to satisfy performance obligations.
5. Prepaid Insurance Policy for Assurance of Closure and Post-closure Monitoring	Good unless available to claims of creditors and depending on policy terms and conditions. Certainty also depends on financial strength and supervision of issuing institution.	Good, depending on terms and conditions of payout for early closure.	Good, depending on terms and conditions of payout for early closure and payouts for annual post-closure monitoring.	Excellent. Can last as long as needed.	Good. Amounts can be adjusted if mutually agreeable without need for another mechanism as long as adjustments are made sufficiently before scheduled closure.	High cost. Typically, total premium must be paid within 1 to 3 years.	Low. Monitor complete payment of premiums if spread over time.
6. Liability Insurance Policy for Payments Due to Leakages	Lacking, depending on policy terms and conditions, which may not cover all causes of leakages. Certainty also depends on financial strength and supervision of issuing institution.	Good, depending on terms and conditions of payouts.	Good, subject to insurer claims management and payout practices.	Good, although liability insurance policies typically are subject to termination, cancellation, and the like.	Excellent. Amount can be adjusted if mutually agreeable without need for another mechanism.	Moderate cost. Depending on availability and terms of coverage, total premium might be up to 9% of amount of coverage for a 5 year coverage.	Moderate. Government must evaluate policy terms and conditions and ensure continuity of coverage in the event of proposed cancellation or termination by insurer.

Financial Mechanism	Certainty	Amount	Liquidity	Duration	Flexibility	Cost	Administrative Burden
7. Corporate Guarantee from Nonaffiliated Corporation Based on Annual Financial Test	Good if protected from claims of the operator's creditors. Certainty also depends on stringency of required financial test.	Excellent if guarantor can pass the required financial test.	Depends on guarantor's liquidity.	Excellent. Can last as long as needed, if mutually agreeable, and as long as guarantor can satisfy the financial test.	Excellent. Amount can be easily adjusted if mutually agreeable without need for another mechanism as long as guarantor can satisfy the test.	Low cost, similar to guarantee from affiliated company, with a potential onetime fee.	Moderate. Government must monitor company finances in order to ascertain solvency and ability to pay.
8. Third-Party Administered Mutual Industry Pool	Considered risky if pool assets are subject to claims of creditors and remain under the ownership and control of the pool participants.	Good if pool is well funded and has many participants but may be insufficient if multiple claims made against the pool in a certain time period.	Depends on the stability of the industry pool and the quality of its finances.	Depends on stability and size of the industry and its finances (e.g., liquidity of investments).	Good. Amount can be easily adjusted through agreement with pool participants.	Costly to establish. Members pay premiums based on the amount of coverage required.	Low. Government must monitor pool balance, including if required payments are made over time.

Financial Mechanism	Certainty	Amount	Liquidity	Duration	Flexibility	Cost	Administrative Burden
First Party Mechanisms							
9. Security Interests in Property	Good if the security interest is properly created, perfected, and duly recorded and the property itself is protected so as to retain value.	Good, depending on the continuing appraisals of the property.	Depends on the liquidity of the secured property.	Considered risky because value of collateral depreciates over time	Low. Amount is tied to value of property and cannot be easily adjusted without need for another mechanism..	Moderate cost due to need for reappraisals and maintaining security.	High. Annual review and monitoring of required property appraisals, other security interest on the property (i.e. a second mortgage on a property), and security of the property itself (e.g., from vandalism, theft, accidents).
10. Charge Over an Operator's Bank Account	Medium if a charge over a bank account is registered. However, a charge is not secured by a third party.	Depends on quality of the operator's finances.	Good assuming the company's cash balance is sufficient to cover the needed amount.	May be risky because it depends on the operator's financial stability and is not backed by a third party.	Good. Amount can be adjusted through agreement with operator.	Low cost to establish and maintain. Cost may increase in event of company bankruptcy.	High. Government must monitor company finances in order to ascertain solvency and ability to pay.
11. Corporate Guarantee from Affiliated Company Based on Annual Financial Test	Consider risky due to lack of protection from potential claims of the operator's creditors and potential high degree of financial connection between operator and affiliated guarantor. Certainty also depends on stringency of required annual financial test.	Excellent if guarantor can pass the required annual financial test.	Depends on liquidity of affiliated guarantor.	Excellent. Can last as long as needed, if annual financial test is satisfied.	Excellent. Amount can be easily adjusted without need for another mechanism if guarantor can pass the financial test for adjusted amount.	Low cost, similar to self-assurance with additional paperwork.	Moderate. Government must monitor company finances in order to ascertain solvency and ability to pay.

Financial Mechanism	Certainty	Amount	Liquidity	Duration	Flexibility	Cost	Administrative Burden
12. Self-Assurance Based on Annual Financial Test	Considered the most risky option because no independent source of funds and no protection from claims of creditors. Certainty also depends on stringency of required financial test.	Excellent if operator can pass the required financial test.	Depends on the operator's liquidity.	Excellent. Can last as long as needed, if annual financial test is satisfied.	Excellent. Amount can be easily adjusted without need for another mechanism if operator can pass financial test for the adjusted amount.	Low cost. Especially for companies with independently audited financial statements and/or applicable credit ratings. The only requirement would be a nominal annual fee	Moderate. Annual review required of financial statements and/or applicable credit ratings.
13. Self-Assurance with Internal Account Reserve Instead of Financial Test	Poor. Subject to claims of creditors, remains under ownership and control of the operators, and may be used for other purposes. Certainty depends on financial stability and of operator.	Excellent. Absent a financial test, operators can set up the account for any amount.	Depends on the company's liquidity (e.g., available cash); accounting reserves are not typically "funded".	Excellent. Can last as long as needed.	Good. Amount can be easily adjusted through agreement with operator.	Low cost to establish and maintain.	Moderate. Government must monitor company financial statements in order to ascertain solvency and ability to pay.

Financial Mechanism	Certainty	Amount	Liquidity	Duration	Flexibility	Cost	Administrative Burden
Government Mechanisms							
14. Deposits of Cash or Cash Equivalents to Government Authority (GA)	Excellent if deposits are not subject to claims of creditors of the operator. Very small risk of sovereign default.	Excellent for deposits of full FS amount. No investment risk for deposits of cash or cash equivalents. Sinking fund approach increases risk in proportion to length of build-up period	Excellent unless CA must obtain approval (e.g., legislative) to access or use funds.	Excellent. Can last as long as needed.	Excellent. Amount can be easily adjusted without need for another mechanism.	High cost. Sinking fund approach stretches out payments over time; the longer the pay-in period, the less the effective cost.	Low. Must keep track of deposits, especially if payments made over time.
15. Government Administered Funds	Considered risky depending on the protection of the government funds from appropriation for other uses.	Good for fully funded trust. Subject to risks of investments. Sinking fund approach increases risk in proportion to length of build-up period.	Depends on funds liquidity and predictability of earnings on fund balances.	Considered risky because depends on stability of the government and its finances because funds may be appropriated for other uses.	Excellent. Amount can be easily adjusted without need for another mechanism.	High cost. Sinking fund approach stretches out payments over time; the longer the pay-in period, the less the effective cost	Low. Monitor fund balance, including if payments made over time.
16. Government Guarantees	Good, depending on the stability of the government and the quality of its finances.	Excellent.	Good, depending on the stability of the government and the quality of its finances.	Good, government guarantees typically are not long-term mechanisms (e.g., 10-50 years).	Excellent. Amount can be easily adjusted without need for another mechanism.	Low cost. Administrative fees may be required.	Low. Government must comply with accounting and transparency requirements, if any, for issuing guarantees.

Financial Mechanism	Certainty	Amount	Liquidity	Duration	Flexibility	Cost	Administrative Burden
17. Government Assumptions of Liability	Good; unless, liability transfer is not guaranteed if transferee does not comply with transfer requirements.	Excellent.	Good, depending on the stability of the government and the quality of its finances.	Excellent. Can last as long as government exists.	Excellent. Amount can be easily adjusted without need for another mechanism.	Low cost, although some operators may be required to provide funds for monitoring and maintenance costs prior to liability transfer.	High. Government will incur all costs assumed.
18. Government Indemnities	Good, depending on the stability of the government and the quality of its finances.	Excellent.	Good, depending on the stability of the government and the quality of its finances.	Excellent.	Excellent.	Low cost, similar to government guarantees.	Low.

Appendix C

Financial Mechanism Strengths and Weaknesses

Exhibit C-1. Irrevocable Trust Fund

Strengths

Amount
- Trust fund can provide assurance in any specified amount.

Availability
- Anyone with sufficient funds can establish an irrevocable trust fund regardless of their creditworthiness.

Certainty
- Highly certain because not subject to claims of creditors or invested in high-risk investments.
- Trust funds are as secure as the ability of the independent trustee institution to manage and honor them. Eligible banks and financial companies managing trust funds should be subject to government oversight.
- The fiduciary trustee must look out for the interests of the beneficiaries rather than the CCS owner/operator and consequently is more independent than an escrow agent.

Cost/Burden
- Low service fees associated with trust fund.
- Administrative burden of a trust fund is low, including monitoring of balance and/or payments. Use of standardized trust fund wording reduces the administrative burden.

Duration
- Trust funds are irrevocable, meaning they cannot be cancelled or terminated [or drawn upon] without consent from the beneficiary.

Flexibility
- The amount can be easily adjusted without need for another financial mechanism.

Liquidity
- Excellent if the property held within the trust fund consists of cash or cash equivalents (liquid investments) as opposed to illiquid investments.

Weaknesses

Amount
- Pay-in schedules under which the trust fund balance reaches the required amount over a pre-defined period of time are more risky than those that are fully funded upfront. If funds are needed before the trust fund balance reaches the required amount, sufficient funds may not be available to fully cover liabilities.

Certainty
- Access to funds is considered risky if the property in the trust fund is placed in high-risk investments, or if the trust fund is invested in securities issued by the operator and its affiliates.

Cost/Burden
- High opportunity cost to operator of property placed into the mechanism. Pay-in schedules stretch out payments over time reducing the effective cost; the longer the pay-in period, the smaller the total costs.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Trust funds are well suited to provide financial security over the long-term as they are "irrevocable" and protected from claims of creditors.

Practicality
- Trust funds are practical for CCS long-term liability because they have low administrative burdens and are available to all operators, regardless of credit-worthiness.

Exhibit C-2. Escrow Account

Strengths

Amount
- Escrow accounts can provide assurance in any specified amount.

Availability
- Escrow accounts should be available to any operator with sufficient funds, regardless of creditworthiness.

Certainty
- Funds are certain if escrow is fully funded upfront and funds are not invested in high-risk investments.
- Banks and financial institutions holding escrow accounts should be overseen by government regulators.

Cost/Burden
- Low fees to establish and maintain.
- Administrative burden is low include monitoring of balance (if payments are made over time) and payments made by escrow agent.

Flexibility
- The amount can be easily adjusted without need for another financial mechanism.

Liquidity
- Highly liquid if funds in escrow accounts are cash or cash equivalents.

Weaknesses

Amount
- Pay-in schedules under which the escrow balance reaches the required amount over a pre-defined period of time are more risky than those that are fully funded upfront. If funds are needed before the escrow balance reaches the required amount, sufficient funds may not be available to fully cover liabilities.

Certainty
- Escrow accounts remain under the ownership and control of the operator.
- Escrow agent must look out for the interests of the owner/operator and consequently is not as independent as a trustee of a trust fund.
- Revocable after the term agreed to in the escrow agreement or if the operator fails to pay service fees.
- Funds remain legal property of the owner or operator and are not protected from the claims of creditors in the event of bankruptcy.

Cost/Burden
- High opportunity cost to operator.
- Pay-in scshedules stretch out payments over time reducing the effective cost; the longer the pay-in period, the smaller the total costs.

Duration
- Escrows typically are not long-term financial mechanisms.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Escrow accounts offer less security compared to other mechanisms due to their revocability and lack of protection from claims of creditors of the owner/operator.

Practicality
- Escrow accounts have not traditionally been used to finance long-term obligations and so may not be practical given limited experience.

Exhibit C-3. Bank Demand (Payment) Guarantee; Irrevocable Standby Letter of Credit; Surety Bond (Payment Bond)

Strengths

Amount
- Can assure a high amount.
- No deductible or co-payment and applies from the first dollar of liability.

Certainty
- Certainty is enhanced when the mechanism lacks a termination date and by restrictions on the issuer's ability to cancel or terminate the mechanism.
- Funds secured by these mechanisms are beyond the control of the CCS operator.
- Based on historical usage, these mechanisms are highly certain.

Cost/Burden
- Low cost. The fees for a creditworthy applicant typically range from 0.5% to 2% of the assured amount per year, exclusive of any collateral.

Duration
- Well-suited to provide assurance over long-term, because irrevocable and automatically renewed ("evergreen").

Flexibility
- The amount secured by these mechanisms can be easily adjusted or another mechanism added.

Liquidity
- *Irrevocable Standby Letter of Credit and Bank Demand Guarantee*: Excellent because funds drawn from the mechanism are available immediately and are paid in cash or cash equivalents.

Weaknesses

Availability
- Only available to creditworthy businesses.

Certainty
- Depends on the financial strength and government supervision of the issuer.

Cost/Burden
- The issuer may require the posting of collateral, creating an opportunity cost for the CCS operator.

Duration
- *Irrevocable Standby Letter of Credit*: An "evergreen" standby letter of credit may set a finite term on the letter to allow the issuing bank to periodically review the creditworthiness of the operator.
- *Surety Bond*: Sureties also may set a finite term on the bond because the creditworthiness of an operator may change. Bond terms of 5 to 10 years are common.
- *Bank Demand Guarantee*: Guarantees normally are not long-term mechanisms.

Liquidity
- *Surety Bond*: Funds drawn are not necessarily available immediately because the surety can contest claims.
- May depend on liquidity of issuer.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Well-suited to provide assurance over long time-periods because they can be "irrevocable,"automatically renewed, and the amount is easily adjusted.

Practicality
- Able to secure high amounts.
- Financial institutions generally do not expect to incur significant risks from these mechanisms and offer them only to creditworthy parties.

Exhibit C-4. Surety bond (Performance Bond)

Strengths

Amount
- Can assure a high amount of obligations.
- No deductible or co-payment.

Certainty
- Certainty is enhanced when the mechanism lacks a termination date and by restrictions on the surety's ability to cancel or terminate the mechanism.
- Funds secured by these mechanisms are beyond the control of the CCS operator.
- Protected from the claims of creditors in the event of bankruptcy.
- Based on historical usage, this mechanism is highly certain.

Duration
- Well-suited to provide assurance over long-term, because "irrevocable" and automatically renewed.

Liquidity
- Sureties' liquidity enhanced by government supervision.

Weaknesses

Availability
- Only available to creditworthy businesses.

Certainty
- Depends on the financial strength and government supervision of the surety.

Cost/Burden
- The surety may require the posting of collateral, creating an opportunity cost for the CCS operator.
- May require substantial oversight by government to ensure satisfactory performance by surety.

Duration
- Sureties may set a finite term on the bond because the creditworthiness of an operator may change. Bond terms of 5 to 10 years are common.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Well-suited to provide assurance for obligations that can be performed such as stewardship.

Practicality
- They are "irrevocable" and automatically renewed.
- Financial institutions generally do not expect to incur significant risks from these mechanisms and offer them only to creditworthy parties.

Exhibit C-5. Prepaid Insurance Policy for Assurance of Post-closure Monitoring

Strengths

Amount
- Prepaid insurance policies provide assurance for the expected cost of post-closure monitoring.

Certainty
- Depends on insured funds not being available to claims of creditors.
- Prepaid policies are difficult to cancel – an insurer would have to seek rescission of the contract and return all premiums paid in order to terminate the contract.

Duration
- Prepaid insurance policies can be offered for as long as needed.

Liquidity
- Liquidity depends upon the policy terms and conditions of payouts.
- Depends on liquidity of insurer, which should be subject to government oversight.

Weaknesses

Availability
- Currently, limited availability of prepaid insurance products to cover CCS post-closure liabilities, such as monitoring.

Certainty
- Depends on the financial strength and supervision of the insurer.
- Prepaid insurance policies may remain legal property of the owner or operator and may not be protected from the claims of creditors in the event of bankruptcy.

Cost/Burden
- The cost to the operator is high and all premiums must usually be paid within 1-3 years.
- High administrative burden on government to evaluate policy terms and conditions.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- A prepaid insurance policy can be used for post-closure monitoring, is nearly irrevocable, and places the secured funds beyond the control of the CCS operator, making it an applicable mechanism for long-term CCS liability.

Practicality
- The limited availability of prepaid insurance policies to cover CCS post-closure liabilities may make this an impractical mechanism at the current time.

Exihbit C-6. Liability Insurance Policy

Strengths

Amount

- Insurance policies can be stacked to provide targeted amount if beyond the capacity or appetite of a single insurer.

Certainty

- Not subject to claims of creditors.

Duration

- Liability coverage can be renewed over time, allowing the coverage to function for long-term CCS liability.

Liquidity

- Depends on liquidity of insurer, which should be subject to government oversight.

Weaknesses

Availability

- Currently, there is limited availability of insurance products to cover long-term CCS liabilities.

Certainty

- Because insurers can contest claims, liability insurance does not provide as much certainty for payment as other financial mechanisms.
- The scope of CCS liability policies is unlikely to cover all CCS liabilities:
- Limits, terms and conditions, exclusions, and definitions may reduce the certainty provided by insurance.
- Insurers might allege misrepresentation/misconduct on the part of the insured, potentially negating insurance policy.

Duration

- Liability insurance coverage is subject to termination, cancellation, or refusal to renew by the insurer.
- Typical 10-50 years maximum duration.

Analysis in Relation to Long-Term CCS Obligations

Applicability

- Liability insurance might not be available to provide coverage for long-term stewardship and other first-party liabilities such as corrective measures.

Practicality

- The limited availability of liability insurance products for CCS long-term liability makes insurance not a practical mechanism for CCS at this time.

Exhibit C-7. Corporate Guarantee from Non-affiliated Corporation Based on (Annual) Financial Test

Strengths

Amount

- Can provide any amount of assurance.

Certainty

- Corporate guarantees are legally binding and can be structured to be effectively irrevocable.
- A non-affiliated company is an independent source of funds, which can increase certainty because funding does not depend on the financial health of the CCS operator.
- Not subject to claims of the operator's creditors.
- Outside of the control of the operator.

Cost/Burden

- Guarantees have nominal fees and avoid the opportunity costs required for other financial mechanisms.

Duration

- Can last for as many years as the non-affiliated company can pass the test.

Weaknesses

Availability

- Limited availability because non-affiliated companies have no obligation to issue a guarantee.

Certainty

- Weak financial test criteria could reduce the certainty that funds will be available if needed.
- Provides less certainty compared to financial mechanisms which set aside actual funds.
- A non-affiliated guarantor may have less incentive to make good on its promises.

Liquidity

- Liquidity can be enhanced by financial test criteria.
- Corporate guarantees do not set aside any actual funds.

Analysis in Relation to Long-Term CCS Obligations

Applicability

- Generators of CO_2 that are not affiliated with the operator can provide guarantees if they can pass the financial test.

Practicality

- Corporate guarantees from non-affiliated companies are low cost financial mechanisms for CCS long-term liability.

Exhibit C-8. Third-Party Administered Mutual Industry Pools

Strengths

Amount
- Good if the mutual industry pool is well capitalized and has many participants.

Cost/Burden
- Administrative burden on government is low, requiring only that the government monitor the pool balance and ensure that proper payments from the pool are made over time.

Duration
- As long as there are multiple pool members with adequate finances, the pool should remain viable into the foreseeable future.

Flexibility
- Changing amount of financial security provided by a mutual industry pool may require agreement of all pool participants or by adding another mechanism.

Liquidity
- Depends on the industry pool holding liquid assets and/or its members being liquid.

Weaknesses

Amount
- The pool might be insufficient if multiple claims are made in a short time period or if there are not enough members.

Availability
- Not available unless multiple CCS operators are interested in participation.

Certainty
- Risky if pool assets are subject to claims of creditors and remain under the ownership and control of the pool participants.
- Depends on the number of members, the assets of each, pool inflows/outflows, and the terms and conditions of the pool.

Cost/Burden
- Significant costs to set up and administer mutual industry pools. Once established, members may premiums and provide various indemnifications.
- Opportunity costs of capital contributions.
- Diffiult for government to determine pool viability.

Duration
- Mutual industry pools can become insolvent if there are not enough active pool members or too many claims.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Pools require a number of relatively homogenous members facing independent financial risks. If CCS operators are not likely to be active and viable during the period after closure in which long-term liabilities could arise, mutual industry pools might not have enough resources to properly address financial requirements, and thus are a poor financial mechanism to assure long-term liabilities associated with CCS.

Practicality
- Until there are enough active CCS operators, mutual industry pools will not be a practical option to adequately address long-term financial requirements.

Exhibit C-8. Security Interest in Property

Strengths

Availability

- Security interests in property should be available to any operator that owns property of value.

Weaknesses

Amount

- The value of the security interest may fluctuate with the value of the property, based on fluctuating appraisal amounts.

Certainty

- A security interest in property may remain legal property under the control of the owner or operator and may not be protected from the claims of creditors in the event of bankruptcy.

Cost/Burden

- Must be properly created, perfected, and duly recorded to be enforceable.
- Regular independent property appraisals needed to ensure that an adequate amount of coverage is being provided.
- High administrative costs to oversee the security agreement and the property.

Flexibility

- Because the amount of financial security provided is tied to the value of the property, any increase in the required amount would necessitate an additional mechanism.

Duration

- Property other than land tends to be finite (50 years or less) and depreciate.

Liquidity

- Limited by regulatory bodies' ability to seize and sell the collateral.

Analysis in Relation to Long-Term CCS Obligations

Applicability

- Security interest in property would not be applicable for recurring stewardship liabilities.

Practicality

- Security interests in property would be a high-burden, high-risk, inflexible mechanism for long-term CCS liabilities.

Exhibit C-9. Charge over an Operator's Bank Account

Strengths

Amount

- Charge over a bank account can provide assurance in any specified amount up to the value of the bank account.

Cost/Burden

- Low burden and cost to set up and maintain mechanism, requiring only an agreement with the CCS operator and that the charge be registered.

Flexibility

- Amount can be adjusted easily by adding funds to the bank account.

Weaknesses

Certainty

- Funds remain legal property under the control of the operator and are not protected from the claims of creditors in the event of the operator's bankruptcy.
  - If the charge is a fixed charge, then the government may have priority over preferred creditors at the time of bankruptcy.
  - If it is a floating charge, then the government would be paid after preferred creditors in bankruptcy proceedings.

Cost/Burden

- High burden to the government, requiring continuous oversight of registration of charges.
- Opportunity costs of funds in the account.

Duration

- A charge over a bank account cannot outlast the CCS operator.

Analysis in Relation to Long-Term CCS Obligations

Applicability

- A charge over a bank account can last only as long as the account, so this mechanism would not be able to outlast the operator. In the event that liabilities arise after the CCS operator has gone out of business, the government would need to use public money to take on those obligations.

Practicality

- Industry could easily establish and maintain this mechanism at low added cost, given existing bank accounts. High burden on the government to continuously oversee the charge makes this mechanism impractical.

Exhibit C-10. Corporate Guarantee from Affiliated Company Based on (Annual) Financial Test

Strengths

Certainty

- A corporate guarantee from an affiliated company, unlike self-assurance, involves a source of financial security other than the CCS operator.
- Corporate guarantees are legally binding and effectively irrevocable.
- A stringent financial test should decrease the likelihood that an affiliated company will be unable to provide funds due to bankruptcy.

Cost/Burden

- Low cost to operator.

Duration

- A corporate guarantee can last only as long as the affiliated company can pass the financial test.

Liquidity

- Elements of the required "financial test" could address liquidity.
- Depends on liquidity of affiliated company guarantor.

Weaknesses

Availability

- Only affiliated companies that pass the financial test can use this mechanism. The more stringent the financial test, the less available is the guarantee.

Certainty

- A weak "financial test" could decrease certainty of funds BEING available if needed.
- Corporate guarantees do not set aside money, giving less certainty compared to other financial mechanisms that set aside actual funds.
- The financial strength of the affiliate guarantor is not necessarily independent of the operator, which can decrease the certainty of payment.

Liquidity

- No funds must be set aside in advance to cover long-term CCS liabilities.

Analysis in Relation to Long-Term CCS Obligations

Applicability

- Like CCS operators, affiliated companies that make corporate guarantees are at risk of not remaining active and viable for the duration of the longer-term liabilities. Corporate guarantees set aside no actual funds and may not offer a fully independent a source of funds due to intercorporate affiliations. .

Practicality

- Corporate guarantees from affiliated companies based on financial tests would provide low-cost, financial mechanisms for long-term CCS liability. Affiliated companies may be financially strong and relatively independent of the financial condition of the operator.

Exhibit C-11. Self-guarantee Based on (Annual) Financial Test

Strengths

Certainty
- A stringent financial test should reduce the possibility that CCS operators with insufficient finances provide self-guarantees.

Cost/Burden
- Low cost to operator.

Liquidity
- Elements of the financial test can address liquidity
- Depends on liquidity and the operator.

Weaknesses

Availability
- Available only to operators who can pass the financial test.

Certainty
- Weak financial test criteria can decrease the certainty of whether funds will be available if needed.
- Self-guarantee does not set aside money, which provides less certainty compared to other financial mechanisms that set aside actual funds.

Duration
- Operators are thought unlikely to be viable for the duration of long-term CCS liability.

Cost/Burden
- High administrative burden to the government, requiring regular monitoring of company financial statements in order to ascertain whether company passes the teste.

Liquidity
- No funds must be set aside in advance to cover long-term CCS liabilities.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Self-guarantee provides no additional financial resources beyond what the operator can raise. CCS operators unlikely to be both active and viable for the potential duration of their long-term liabilities.

Practicality
- Government regulators may not have skills and interests required to assess whether the operator's finances pass the financial test.

Exhibit C-12. Self Guarantee with Internal Account Reserve

Strengths

Availability
- Greater availability if operators need not pass a financial test.

Amount
- Account can be set up for any amount.

Cost/Burden
- Low cost and burden to operator to establish and maintain account reserve.

Flexibility
- Amount of the account reserve can be easily adjusted.

Weaknesses

Cost/Burden
- High burden to government, requiring monitoring of company accounts in order to ascertain solvency and ability to pay.

Certainty
- Subject to claims of creditors.
- Reserve remains under ownership and control of the operator and may be used for other purposes.
- Absent a financial test, certainty is reduced.

Duration
- Duration same as for CCS operators.

Liquidity
- Depends on the company's liquidity because accounting reserves are not typically "funded".
- Absent a financial test, self assurance can be used by operator's with poor liquidity.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Because CCS operators are unlikely to remain active and viable during the period after closure in which long-term liabilities could arise, internal account reserves provide very little financial security for long-term liabilities.

Practicality
- Internal account reserves provide a financial mechanism with low cost for a CCS operator to establish and maintain.

Exhibit C-13. Deposits of Cash or Cash Equivalent to a Government Authority (GA)

Strengths

Amount
- Deposits of cash (or cash equivalent) can provide assurance in any specified amount.

Availability
- Deposits of cash (or cash equivalent) can be used by businesses regardless of their creditworthiness.

Certainty
- High level of certainty if deposits are not subject to claims of creditors of the operator, nor subject to reappropriation by MS for other purposes.

Cost/Burden
- No transaction fee associated with cash deposits makes this mechanism less expensive than other mechanisms.
- The administrative burden to an operator and the government is low. Administrative responsibilities include tracking deposits if payments are made over time.

Duration
- A deposit can last as long as needed.

Flexibility
- The amount can be easily adjusted without need for another mechanism.

Liquidity
- Deposits should be highly liquid.
- Depends on liquidity of the government.

Weaknesses

Certainty
- Risk of sovereign default.
- Funds may remain legal property of the owner or operator and may not be protected from the claims of creditors in the event of bankruptcy.

Amount
- A pay-in period lowers the certainty of fund availability.

Cost/Burden
- High opportunity cost to operator.
- Pay-in periods stretch out payments over time reducing total cost; the longer the pay-in period, the smaller the cost.
- Government must set up a system to record, verify, manage, and protect the deposited funds.

Liquidity
- Less liquidity if the GA must obtain prior approval to access and use the deposited funds.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- A deposit to a GA can last as long as necessary, which makes this mechanism well suited for long-term CCS liabilities.

Practicality
- A deposit to a GA may not be a practical mechanism for operators without sufficient assets or cash flow.

Exhibit C-14. Government-Administered Pooled Funds

Strengths

Amount
- Government-administered pooled funds can provide assurance in any specified amount as long as there is a sufficient number of parties willing to pay into the fund.

Certainty
- Highly certain if sufficient balance is protected from government appropriation for other uses and from high-risk investments.

Duration
- Available until money runs out.

Flexibility
- Amount of coverage usually can be adjusted without the need for an additional mechanism.

Liquidity
- Depends on the liquidity of the investments within the fund, the fund balance, number of members, and inflows/outflows.

Weaknesses

Availability
- Governments might be unwilling to administer pooled funds for CCS operators due to associated administrative burdens and potential government liabilities.
- Government may put conditions on whether operators can access funds.

Cost/Burden
- High initial cost for government to set up system.
- Operators required to cover administrative fees and capitalize the fund.
- Governments will have significant administrative responsibilities including monitoring the fund balance, deposits, pay-outs, and investments.

Certainty
- Funds may be appropriated by MS for other uses.
- The available amount in the fund is subject to risks associated with investments and claims' magnitude and frequency.
- Potential for fund insolvency if withdrawals exceed inflows.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Government-administered pooled funds can assure coverage for long-term CCS activities, with a sufficient number of financially viable participants and if the funds are protected from being appropriated for other uses. Urgent, non-CCS-related scenarios may arise that result in diversion of funds.

Practicality
- Government-administered pooled funds are difficult to set up and maintain. Risk-based fees likely to be more controverisla than per uint fees.

Exhibit C-15. Government Guarantees

Strengths

Amount
- Governments generally have authority to guarantee large amounts sufficient to cover all obligations.

Certainty
- Government guarantees are considered secure, even if not "irrevocable."
- Government power of taxation can be used to fund government guarantees if necessary.

Cost/Burden
- Low cost to operators who generally do not have to pay for the government guarantee.
- Low burden to government.

Duration
- Can last as long as the government itself.

Flexibility
- Amount can usually be adjusted easily without the need for an additional mechanism.

Liquidity
- Governments generally are able to pay on-demand in cases where public health and welfare is threatened.

Weaknesses

Availability
- Governments might be unwilling to provide guarantees for long-term CCS liabilities.

Certainty
- Government guarantees may be revocable.

Cost/Burden
- High cost to government and taxpayers required to cover long-term CCS liabilities.

Duration
- Government guarantees typically have a life span of up to 50 years.

Liquidity
- Lengthy procedural requirements prior to payment may reduce liquidity.
- Depends on the government's liquidity.
- Actual funds will likely not be set aside by the guarantor government.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Government guarantees are considered secure and likely to last longer than mechanisms provided by private-parties.

Practicality
- Government guarantees are commonly used in jurisdictions to foster infrastructure development and industrial activity. This mechanism could be used in countries where the government and its finances are stable enough to guarantee payments over the long timeframe of post-closure CCS activities.

Exhibit C-16. Government Assumptions of Liability

Strengths

Amount
- Governments generally have authority to assume large amounts of liability.

Certainty
- Government assumptions of liability are considered secure, even if not irrevocable.
- Government power of taxation can be used to satisfy government assumptions of liability.

Cost/Burden
- Low cost and minimal administrative burden for the CCS operator.

Duration
- Can last as long as the government itself.

Flexibility
- The government usually can take on all liability regardless of amount.

Liquidity
- Depends on liquidity of the government

Incentives
- Government assumption of liability should encourage operators to enter the industry.

Weaknesses

Availability
- Governments might be unwilling to assume liabilities of CCS operators.

Amount
- The public and government are unlikely to be willing to take on unlimited liabilities.

Certainty
- A new government or administration could cancel or change the assumption of liability.
- Sovereign risk.

Cost/Burden
- High cost on the government and taxpayers.

Liquidity
- Depends on the government's liquidity, as actual funds unlikely to be set aside.

Incentives
- Government assumption of liability could create "moral hazard" by reducing the incentive for a CCS operator to properly site, operate, and close a facility.

Analysis in Relation to Long-Term CCS Obligations

Applicability:
- Governments are considered more likely to be active and viable in the long-term than industry.
- The government could require that an operator fulfill certain safety requirements prior to the government's assumption of liabilities to minimize the risks and magnitudes of long-term liabilities assumed by the government.

Practicality
- Government assumption of liability would be an attractive option for operators who may be wary of entering the CCS industry due to the indefinite time-frame and uncertainties of long-term CCS liabilities. The implementation of government indemnities could involve many government departments and legislation, resulting in a high administrative burden. The public and government may be unlikely to be willing to take on liabilities in uncapped amounts.

Exhibit C-17. Government Indemnities

Strengths

Amount
- Government indemnities (if not capped) can provide payment for any amount of eligible claims.

Certainty
- Government indemnities are considered secure, even if not irrevocable.
- Government power of taxation can be used to satisfy government indemnities if necessary.

Cost/Burden
- Low cost/burden to CCS operator.

Duration
- If no sunset date, can last as long as the government itself.

Liquidity
- Depends on the liquidity of the government.

Weaknesses

Amount
- Government indemnities may be capped in amount.

Availability
- Only governments can provide government indemnifications.
- Governments might be unwilling to provide indemnities for CCS operators.

Cost/Burden
- High cost/burden to government if operator defaults.

Certainty
- Government indemnifications not irrevocable.

Flexibility
- Amount could be difficult to amend once issued.

Liquidity
- Depends on the government's liquidity because actual funds are usually not set aside.

Incentives
- Owner/operators may be vulnerable to "moral hazard" from government indemnification.

Analysis in Relation to Long-Term CCS Obligations

Applicability
- Government indemnities can be applied to CCS long-term liability.
- Because governments are more likely to be active and viable in the future than operators, government indemnification can provide long-term financial security for CCS long-term liabilities.

Practicality
- The implementation of government indemnities could involve many government departments and legislation, resulting in a high administrative burden.
- The public and government may be unlikely to be willing to take on liabilities in uncapped amounts.
- Government indemnities would be an attractive option for operators who may be wary of entering the CCS industry due to the indefinite time-frame and uncertainties of long-term CCS liabilities.

Appendix D

Approaches for Transfer of Liability

A. Technical Requirements to be Met Prior to Transfer

No Conditions for Transfer

This report does not identify any CCS programs that involved an unconditional transfer of long-term site responsibility from the operator to the state or national government.

Moderate Conditions

Australia–Victoria State Onshore. Transfer of an injection and monitoring license and long-term liability ("license surrender") is contingent upon meeting specified conditions for closure as determined by the State such as removal of all property, plugging of all wells, remediation of surface and sub-surface soil, and the protection and conservation of natural resources. The license holder must prepare a long-term monitoring and verification plan including an estimate of the cost of carrying out the activities in the plan, which must be approved by the Minister prior to surrender of the license. The monitoring and verification plan implementation will be paid for by the license holder and carried out by the State. This regulation has no specified closure period.

Australia-Victoria State Offshore. The Victoria state regulations above are based on the Australian National offshore regulations (discussed below) and include the same basic language and requirements for transfer. The Victorian offshore regulation differs from the Australian National Offshore regulation in that only monitoring and verification responsibilities are transferred to the Victoria State government. The other long-term liabilities of the CCS operation remain unaffected under this regulation. Additionally, there is no closure period.

Stringent Conditions

Australia-National Offshore. An operator must be issued an active site closure certificate prior to transfer of responsibilities. The process of obtaining a site closure certificate includes many conditions such as the removal of all property from the licensed area, plugging and closing wells, protection and conservation of natural resources, remediation of any damage to the seabed or subsoil, and undertaking activities to prevent, manage or remediate any risks to navigation, fishing, pipeline operations, the enjoyment of native title rights, or the conservation or exploitation of natural resources. Additionally, there should be no significant risks of adverse impacts to either the environment or human health and safety prior to issuance of a site closure certificate.

The operator must prepare a long-term monitoring and verification plan including an estimate of the cost of carrying out the activities in the plan, which must be approved by the Minister prior to transfer of long-term liabilities. Finally, there must be a minimum post-closure period of 15 years following the issuance of a site closure certificate prior to transfer. Once there is a valid site closure certificate and a declared closure assurance period (of 15 years), the Commonwealth is required to indemnify the injection licensee against specified liabilities.

European Commission. Long-term liability can be transferred to the competent authority (CA) of the Member State after a minimum post-closure period, to be determined by the CA, has elapsed and closure conditions have been met. This minimum period must be no shorter than 20 years following site closure, unless the CA is convinced that all available evidence indicates that the stored CO_2 will be completely and permanently contained.

Following the closure of a storage site and until the responsibility is transferred to the CA, the operator will be responsible for:

- Corrective measures
- Monitoring and reporting requirements
- Obligations to surrender allowances in case of leakages
- Preventive and remedial actions
- Sealing the storage site and removing the injection facilities.

These obligations must be fulfilled according to a post-closure plan prepared by the operator and approved by the CA and prior to final approval of transfer of responsibility by the CA.

Spain. The Spanish regulations are based on the EC directive and include the same basic language and requirements for transfer.

United States–State of Louisiana. After an operator ceases injection operations, the operator must meet specific conditions prior to site closure. The criteria for completion and closure require that the operator plug the wells to prevent the escape of carbon dioxide out of one stratum to another; that there will be no contamination of fresh water, oil, gas, or other commercial mineral deposit; that the proposed storage will not endanger human lives or cause a hazardous condition to property; and other monitoring and reporting requirements. Additionally, the operator must provide evidence that that the reservoir is reasonably expected to retain mechanical integrity and that the carbon dioxide will reasonably remain emplaced, at which time ownership of the remaining project, including the stored carbon dioxide, transfers to the state. If the established conditions (presented above) for closure are met, the state may issue a certificate of completion for injection operations 10 years after cessation of injection. If the certificate of completion of injection operations is issued, ownership of the remaining project (and associated liabilities), including the stored carbon dioxide, transfers to the state.

United States–State of Montana. Conditions that must be met to receive a certificate of completion include that wells have been plugged, equipment and facilities removed, reclamation work completed, and the geologic storage reservoir is stable and will retain the carbon dioxide stored. A certificate of completion may not be issued until all conditions listed above have been met, and at least 25-years after injections ceased. Following the issuance of the certificate of completion, an additional 25-year monitoring period is performed by the operator at which point is continuing to accept the liability for the CCS operation. Following the 25-year period of monitoring and verification (a total of at least 50 years post-injection cessation), the responsible state agency may approve the transfer of title of the geologic storage reservoir and the stored carbon dioxide to the state if the reservoir and wells are in full compliance with regulations and the reservoir will maintain its structural integrity and will not allow carbon dioxide to move out of one stratum into another or pollute drinking water supplies.

B. Post-Transfer Cost Recovery

No Cost Recovery Provisions

Australia–Victoria State Onshore. There are no cost recovery provisions in this regulation.

United States–State of Montana. There are no cost recovery provisions present in this regulation.

Post-Transfer Cost Recovery Provisions

Australia-National Offshore. The Commonwealth may recover costs that exceed the estimated costs in the monitoring and verification plan (specified prior to site closure).

Australia-Victoria State Offshore. The State of Victoria may recover costs that exceed the estimated costs established in the monitoring and verification plan (specified prior to site closure).

European Commission. After transfer, the CA may not recover any costs from the operator unless there are leakages or significant irregularities as a result of the operator's negligence, concealment of data, willful deceit, or failure to exercise due diligence.

Spain. The Spanish regulations are based on the EC directive and include the same basic cost recovery provisions described above.

United States–State of Louisiana. A release from liability will not apply to the CCS operator if it is demonstrated that the operator knowingly concealed or intentionally and knowingly misrepresented material facts related to the mechanical integrity of the storage facility or the chemical composition of any injected carbon dioxide.

Additionally, a release from liability will not apply to the CCS operator if the Carbon Dioxide Geologic Storage Trust Fund has been depleted of funds such that it contains inadequate money to address or remediate any duty, obligation, or liability that may arise after issuance of the certificate of completion of injection operations.

C. Financial Requirements for Liability Transfer

No Financial Contribution Related to Transfer

Australia–Queensland. No financial requirement as a condition of transfer of liability to the government.

United States–State of Kentucky. No financial requirement as a condition of transfer of liability to the government.

Contribution Made Available Prior to Transfer

Australia. Prior to the government issuing a site closing certificate and transferring the liability, the operator must provide the government with "financial security" in an amount sufficient to cover the entire estimated cost to the government of carrying out a "program of operations" to

monitor the CO_2. The cost estimate must incorporate an annual rate of increase of monitoring costs.

Belgium. The operator must pay a "financial contribution" to the government to cover costs expected to be incurred to ensure the full and permanent containment of CO_2. The amount must cover at least the costs of monitoring for 30 years.

European Commission. The EC requires a minimum financial contribution from the operator to cover 30 years of monitoring made available before transfer occurs.

France. The operator must pay in cash to the state the estimated cost of monitoring the site for 30 years.

Spain. A financial contribution to cover at least 30 years of monitoring is required prior to transfer.

United Kingdom and Scotland. The government must require the CCS site operator to make a financial contribution to cover the expected post-transfer costs. The government would determine the amount and form of the contribution.

Financial Contribution Based on Per-Unit Fees During Injection

Australia–Victoria State. A CCS operator must pay an annual installment of the estimated long-term monitoring and verification costs in the approved injection and monitoring plan. If, prior to transfer to the government, the license holder has not paid the entire estimated cost of the long-term monitoring and verification, the license holder must pay the remaining cost.

Canada-Province of Alberta. The government assumes liability for the captured CO_2 after site closure, and may require the license holder to pay fees into a post-closure stewardship fund. The amount of the required fees is not specified.

United States-State of Louisiana. In Louisiana, the state government will require the operator to pay an unspecified per-ton fee into the Carbon Dioxide Geologic Storage Trust Fund. The total fees per operator will be collected over a period of 120 months or more and will not exceed a total of five million dollars until the state has begun to disburse funds on behalf of the facility, at which point the fee may be reinstated in order to replenish the fund up to five million dollars per operator.

United States–State of Montana. The operator must pay a fee on each ton of CO_2 injected for the purpose of carrying out the state's responsibility to monitor and manage geologic storage reservoirs. The amount must be based on the anticipated actual expenses that the state agency will incur in monitoring and managing geologic storage reservoirs during their post-closure phases. If the operator chooses not to transfer liability to the state, then these fees will be remitted to the operator.

Full Upfront Financial Requirement

While no programs were identified with this option, an operator could be required to contribute the entirety of the expected costs of post-transfer liabilities to the government as a condition of transfer.

D. Which Liabilities Are Transferred

Minimal or No Liabilities are Transferred

Australia. Only monitoring responsibilities are transferred under the national offshore program (National Offshore Petroleum and Greenhouse Gas Storage Act) and under state-level programs including the Victoria Greenhouse Gas Geological Sequestration Act 2008 and Victoria Offshore Petroleum and Greenhouse Gas Storage Act 2010.

United States-Federal. Under the federal law that addresses underground injection of carbon dioxide (i.e., Safe Drinking Water Act), the government is prohibited from allowing the transfer of liability from one entity to another. The site may undergo closure; however, the liable entity remains liable indefinitely.

Moderate Liabilities are Transferred

Belgium. The following liabilities are transferred:

- legal requirements for CCS monitoring
- remedial measures.

France. The following liabilities are transferred:

- monitoring
- remediation
- restitution in case of leaks and the resulting loss of GHG emissions credits

Spain. The government assumes liability for:

- monitoring, maintenance, and corrective action
- fulfilling obligations relating to surrender of allowances in case of leaks
- compliance with preventative measures and repairs

The government does not assume liability for monitoring and maintenance costs that exceed the amount of funds contributed by the owner/operator into a financial instrument transferor in cases of: (1) poor data presentation, (2) hidden relevant information, (3) negligence, (4) intentional deception, or (5) lack of due diligence.

United Kingdom (UK). The regulations do not state which liabilities specifically are transferred but do state that the government does not assume liability for leakages.

All Liabilities are Transferred

Canada. The government assumes all obligations of the lessee upon transfer.

Louisiana, United States. In Louisiana, the state government releases parties from all liability associated with or related to storage facilities which arise after transfer.

E. Whose Liabilities Are Transferred

All Liable Parties Excluding Owner/Operator

No jurisdictions identified that follow this liability framework

Owner/Operator

Australia. The injection license holder's monitoring responsibilities are transferred under the national offshore program (National Offshore Petroleum and Greenhouse Gas Storage Act) and under state-level programs including the Victoria Offshore Petroleum and Greenhouse Gas Storage Act 2010.

Belgium. The storage license holder transfers legal responsibilities for monitoring and remedial measures.

Canada. The owner/operator transfers all obligations.

France. The operator transfers the responsibilities of surveillance, prevention, and repair of potential leaks of CO_2, the implementation of the remedies in the post-closure plan as necessary to maintain the safety of the site and stop leaks, and restitution in case of leaks and the resulting loss of GHG emissions credits.

United Kingdom. The storage operator's liability is transferred.

Multiple States, United States. In Kentucky, the storage operator may transfer its liability for a storage facility.

In Montana, the storage operator may transfer title to the storage reservoir and to the stored carbon dioxide, including all rights and interests in and all responsibilities for the site.

In North Dakota, the storage operator may transfer all of its responsibilities for the stored CO_2.

Spain. The owner/operator may transfer some liability.

All Liable Parties Including Owner/Operator

Louisiana, United States. In Louisana, the storage operator, all generators of any injected carbon dioxide, all owners of carbon dioxide stored in the storage facilities, and all owners otherwise having any interest in the storage facility may transfer all liability.

Appendix E

Strengths and Weaknesses of Options for Transfer of Long-Term CCS Liability

Exhibit E-1A. Liability Transfer Framework Option: Technical Requirements to be Met Prior to Transfer – No Pre-Conditions

Strengths

Costs to Industry

- Least cost to industry because the operator can immediately transfer liabilities after site closure and incur no costs of adhering to technical conditions of transfer.

Incentives for Industry Participation

- Highest incentive for industry participation.

Weaknesses

Costs to Government/Taxpayer

- Least administrative cost to government.
- Absent technical pre-conditions, long-term liabilities may be greater in frequency and magnitude.

Effectiveness of Protection of Public/Environment

- Least protection of public/environment.
- Absent technical pre-conditions, long-term liabilities may be greater in frequency and magnitude.

Incentives for Industry Performance

- Lowest incentive for industry performance due to risk of moral hazard.
- Operators could be less attentive during the operational and closure phase due to moral hazard issue, reducing an operator's incentive to properly maintain the site.

Exhibit E-1B. Liability Transfer Framework Option: Technical Requirements to be Met Prior to Transfer – Moderate Pre-Conditions

Strengths

Costs to Government/Taxpayer

- Potentially less future costs to the government/taxpayer (compared to no conditions) associated with transferring liabilities based on a CCS operator's meeting specific pre-conditions or requirements for closure and monitoring prior to transfer. Pre-conditions and requirements for site closure and monitoring should mitigate potential problems due to the CCS operation.

Costs to Industry

- Greater costs to industry because operators cannot immediately transfer their liabilities and must incur the costs of pre-conditions of transfer (such as monitoring or site care) over a post-closure period.

Effectiveness of Protection of Public/Environment

- Greater protection of the public/environment from meeting specific conditions and requirements prior to site transfer.

Incentives for Industry Performance

- CCS operators will have incentives to maintain standards throughout operations in order to have their sites satisfy all pre-conditions and requirements for transfer. Moral hazard could arise if sites are transferred without conditions.

Duration

- Requirements prior to transfer increases the likelihood that the operational phase of a CCS operation will be managed properly and that subsequent long-term liabilities will be minimized as a result.

Weaknesses

Costs to Industry

- Conditions and requirements for site closure prior to transfer will increase the cost of a CCS operation.

Duration

- Conditions and requirements that are mandated for site closure prior to transfer could be inefficient in mitigating long-term liabilities and responsibilities.

Exhibit E-1C. Liability Transfer Framework Option: Technical Requirements to be Met Prior to Transfer – Stringent Conditions

Strengths

Costs to Government/Taxpayer

- Low cost to government/taxpayer for future liabilities.
  - Conditions and requirements for site closure should mitigate potential problems associated with the CCS operation, and subsequently money needed for remediating problems post-transfer.
  - Mandating a specified period of post-closure time prior to transfer of responsibilities will provide an opportunity for potential issues with a CCS site to appear prior to transfer. If issues are noted prior to transfer, CCS operators would be responsible hence, relieving the government/taxpayer of those burdens.

Effectiveness of Protection of Public/Environment

- Greatest protection of public/environment.
- Stringent conditions and requirements for transfer could mitigate potential leaks and damages to the public and the environment as well as mitigate concerns of moral hazard.

Incentives for Industry Performance

- Highest incentive for industry performance because CCS operators must have their sites satisfy stringent pre-conditions and requirements prior to transfer.

Duration

- Longest duration.
- Mandating a specified period of time prior to transfer provides a safeguard period expected to reduce long-term liabilities.

Weaknesses

Costs to Government/Taxpayer

- Verifying that a CCS operator has met all of the technical requirements imposes a high administrative burden on the government and requires a high level of expertise.

Costs to Industry

- Highest cost to industry.

Incentives for Industry Participation

- Lowest incentive for industry participation due to potential for high cost or failure to transfer site.

Duration

- Liabilities could still occur over the long-term despite the presence of conditions or requirements for closure and a specified period of time prior to transfer.

Exhibit E-2A. Liability Transfer Framework Option: Financial Requirements – No Financial Requirements

Strengths

Costs to Industry

- Lowest cost for industry.

Incentives for Industry Participation

- Highest incentive for industry participation.

Weaknesses

Costs to Government/Taxpayer

- Highest cost to government/taxpayer because requiring no financial contribution prior to site transfer obligates the government/taxpayer to pay in full for all post-transfer liabilities.

Effectiveness of Protection of Public/Environment

- Not requiring any financial contribution could result in less money available for post-transfer site care and response to or prevention of releases.

Incentives for Industry Performance

- CCS operators would have a reduced incentives (moral hazard) to effectively manage CCS sites for long-term liabilities because they would not have to pay for the consequences of site management in the post-transfer period.

Duration

- Would not help the government to cover the duration of long-term CCS liabilities because no additional funds would be provided. Long-term liability would be entirely funded by the government.

Exhibit E-2B. Liability Transfer Framework Option: Financial Requirements – Contribution Prior to Transfer

Strengths

Costs to Government/Taxpayer

- Requiring a contribution prior to transfer from the CCS operator reduces costs to the government/taxpayer, and can ensure that the operator pays for an agreed share of costs associated with the CCS facility in the post-transfer period.

Effectiveness of Protection of Public/Environment

- A required contribution prior to transfer offers assurance that funds will be available to protect public/environment.

Incentives for Industry Performance

- Can provide an incentive for proper site selection and care prior to transfer.

Duration

- Absent using mechanisms of financial security, there is risk that operators will not have access to funds to make the contribution after injection has ceased.

Weaknesses

Costs to Government/Taxpayer

- If the CCS operator is insolvent at the time the contribution is required, then the government/taxpayer is left with all of the cost burden.

Costs to Industry

- A financial contribution immediately prior to liability transfer imposes costs on CCS operators, particularly if the contribution must be made after revenue from CCS operations has ceased.

Exhibit E-2C. Liability Transfer Framework Option: Financial Requirements – Per Unit Fee During Injection

Strengths

Costs to Government/Taxpayer

- A per unit fee with receipts put into a financial mechanism or paid directly as a government deposit reduces the risk that financial contribution will not be available prior to transfer.

Costs to Industry

- A per unit fee spreads the cost of the financial contribution over the operational life of the facility when most revenues are generated.
- The cost to industry is less than the cost of full upfront security for the financial contribution because the per unit fees are collected over time.

Effectiveness of Protection of Public/Environment

- A per unit fee over time offers assurance that funds will be available to protect public/environment.

Incentives for Industry Performance

- A required financial contribution can provide an incentive for proper site care prior to transfer.

Weaknesses

Costs to Industry

- Payment of a per unit injection fee as a contribution to liability transfer imposes costs on CCS operators.
- The cost to industry is greater than the cost of providing funds just prior to transfer.

Duration

- Contribution can last until exhausted by government expenditures.

Incentives for Industry Participation

- Any required financial contribution can reduce the number of firms willing to enter the market by increasing the cost of doing business.

Exhibit E-2D. Liability Transfer Framework Option: Financial Requirements – Upfront Financial Contribution

Strengths

Costs to Government/Taxpayer

- An upfront financial contribution (required prior to injection or early in the operational life of the facility) would reduce the costs to government/taxpayer by reducing the risk that the operator might go out of business prior to contributing the full amount.

Effectiveness of Protection of Public/Environment

- A required upfront contribution offers assurance that funds will be available after site transfer.

Duration

- Contribution can last until exhausted by government expenditures.

Weaknesses

Costs to Industry

- An upfront financial contribution could pose a significant burden to CCS operators because it would not be spread over time and would be required before revenues began to accrue from injection.

Incentives for Industry Participation

- An upfront contribution could deter firms from entering the CCS industry.
- A required financial contribution upfront provides no incentive for proper site care prior to transfer.

Exhibit E-3A. Liability Transfer Framework Option: No Post-Transfer Cost Recovery Provisions

Strengths

Costs to Industry

- Lowest cost to industry.

Incentives for Industry Participation

- Absence of cost recovery provisions should reduce uncertainty and incentivize industry participation.

Weaknesses

Costs to Government/Taxpayer

- Highest cost to government/taxpayer because without cost recovery provisions, the government/taxpayer may be responsible for payments due to prior gross misconduct or intentional misinformation by the operator.

Effectiveness of Protection of Public/Environment

- Moral hazard could result in damages to the public/environment because operators will not be financially responsible for accidents caused by their gross misconduct or willful deceit.

Incentives for Industry Performance

- Absence of cost recovery provisions reduces incentives for CCS operators to properly manage their sites.

Duration

- Over the long-term, CCS liabilities could be left uncompensated if there are no cost recovery provisions.

Exihbit E-3B. Liability Transfer Framework Option: Post-Transfer Cost Recovery Provisions

Strengths

Costs to Government/Taxpayer

- With cost recovery provisions, the government/taxpayer is not responsible for payments due to gross misconduct or intentional misinformation by the operator prior to transfer.

Effectiveness of Protection of Public/Environment

- Cost recovery provisions could reduce moral hazard because damages operators will be responsible for post-transfer damages caused by their gross misconduct or willful deceit.

Incentives for Industry Performance

- Cost recovery provisions could incentivize CCS operators to better manage their sites.

Duration

- Cost recovery provisions can have a long duration.

Weaknesses

Costs to Industry

- Cost recovery provisions may increase costs and uncertainty for CCS operators.

Incentives for Industry Participation

- Cost recovery provisions may be a disincentive for industry participation.

Exhibit E-4A. Liability Transfer Framework Option: Which Liabilities are Transferred- Minimal or No Liabilities Are Transferred

Strengths

Costs to Government/Taxpayer

- Lowest cost to government/taxpayer if no or minimal liability transfer occurs.

Incentives for Industry Performance

- CCS operators have the strongest incentive to maintain standards throughout their operations because they retain full long-term liability.

Weaknesses

Costs to Industry

- Highest cost to industry for retaining all or most long-term CCS liabilities.

Effectiveness of Protection of Public/Environment

- Depends primarily on commitment of govenrment.

Duration

- If liabilities are retained by operators, availability of funds in the long-term depends on the longevity and viability of the responsible operators.

Incentives for Industry Participation

- With no or minimal transfer of liabilities, operators have the least incentive to participate in CCS.

Exhibit E-4B. Liability Transfer Framework Option: Which Liabilities are Transferred- Moderate Liabilities Are Transferred

Strengths

Costs to Industry

- The transfer of moderate liabilities to the government can reduce post-closure costs for CCS operators.

Incentives for Industry Performance

- CCS operators have incentive to perform at a level adequate to ensure the transfer of the moderate liabilities to the government.

Weaknesses

Costs to Government/Taxpayer

- Moderate costs if moderate liabilities are transferred to the government.

Effectiveness of Protection of Public/Environment

- Protection of the environmental and human health could become problematic if the transferee is less equipped (e.g., capital, resources, technological knowledge) to handle long-term CCS liabilities.

Incentives for Industry Participation

- CCS operators have greater incentive to participate in the industry.

Exhibit E-4C. Liability Transfer Framework Option: Which Liabilities are Transferred- All Liabilities Are Transferred

Strengths

Costs to Industry

- Least cost to industry.

Effectiveness of Protection of Public/Environment

- Public health and the environment may be better protected if all liabilities are transferred to the government, because responsibility for protection of the public/environment will be clearly assigned and extensive government resources will be available.

Duration

- Liability transfer, while not irrevocable, can last as long as the government.
- Governments likely to outlast the individual companies who would be the transferors.

Incentives for Industry Participation

- Operators have the greatest incentive to participate in the industry.

Weaknesses

Costs to Government/Taxpayer

- Highest cost to government if all liabilities are transferred.

Effectiveness of Protection of Public/Environment

- Protection of the environmental and human health could become problematic if the transferee government is less equipped (e.g., capital, resources, technological knowledge) to handle long-term CCS liabilities.

Incentives for Industry Performance

- Least incentive ("moral hazard") for CCS operators to provide for the protection of public health and/or the environment because all of their post-transfer liabilities will be assumed by the government.

Exhibit E-5A. Liability Transfer Framework Option: Whose Liabilities Are Transferred – No Parties' Liability Transferred

Strengths

Costs to Government/Taxpayer

- Lowest cost to government/taxpayer if no liability transfer occurs.

Incentives for Industry Performance

- CCS operators have the strongest incentives because they retain full long-term liability.

Weaknesses

Costs to Industry

- Highest cost to industry for retaining all long-term liabilities.

Effectiveness of Protection of Public/Environment

- Businesses may be more concerned with bottom line profits than achieving a high level of protection of public health and the environment.

Duration

- If liabilities are retained by operators, availability of funds in the long-term depend on the longevity and financial strength of the responsible parties.

Incentives for Industry Participation

- With no transfer of long-term liabilities, operators have the least incentive to participate in CCS.

Exhibit E-5B. Liability Transfer Framework Option: Whose Liabilities Are Transferred – All Liable Parties Excluding Owner/Operator

Strengths

Costs to Government/Taxpayer

- Low cost to government/taxpayer because the liabilities of the owner/operator are retained rather than transferred to the government/taxpayer.

Incentives for Industry Performance

- Low incentive for moral hazard because the owner/operator is not relieved of its long-term liabilities.

Duration

- Liability transfer, while not irrevocable, can last as long as the government.

Weaknesses

Costs to Industry

- High cost to industry because the owner/operator would retain financial responsibility for long-term liabilities.

Incentives for Industry Participation

- Incentives for industry participation are low.

Exhibit E-5C. Liability Transfer Framework Option: Whose Liabilities Are Transferred – Owner/Operator Only

Strengths	Weaknesses
Costs to Industry • Costs to the owner/operator are decreased when its long-term liability is transferred to the government/taxpayer. **Duration** • Liability transfer, while not irrevocable, can last as long as the govenrment. **Effectiveness of Protection of Public/Environment** • Depends on government capabilities and resources.	**Costs to Government/Taxpayer** • Most long-term liability costs would be transferred to the government/taxpayer. **Incentives for Industry Performance** • Incentives for moral hazard because the owner/operator is relieved of its long-term liability at a certain point.

Exhibit E-5D. Liability Transfer Framework Option: Whose Liabilities Are Transferred – All Liable Parties Including Owner/Operator

Strengths	Weaknesses
Costs to Industry • Lowest cost to industry through liability transfer to the government/taxpayer. **Duration** • Liability transfer, while not irrevocable, can last as long as the govenrment. **Incentives for Industry Participation** • Incentives for industry participation in CCS are highest because costs related to long-term liabilities are transferred to the government.	**Costs to Government/Taxpayer** • Highest cost to government/taxpayer. **Effectiveness of Protection of Public/Environment** • Depends on government capabilities and resources. **Incentives for Industry Performance** • This option creates moral hazard concerns because all liable parties are relieved of their obligations at a certain point.