

Financial Risk Management for Geological Storage

By Brad Handler, Lindene E. Patton, Siddhant Kulkarni, Felix Ayaburi, and Darshil Shah

The U.S. government has implemented several policies designed to position Carbon Capture and Storage (CCS) projects for growth. These include a regulatory framework and financial incentives such as Internal Revenue Service Section 45Q tax credits and grants. Potential project developers are responding positively, as evidenced, for example, by Class VI well permit applications that have been discussed elsewhere in this series of papers.

Project developers of geological storage projects must, however, navigate potential liabilities that can manifest through the project lifecycle¹. Federally approved projects must also meet rigorous requirements, which extend for at least 50 years after injection of CO₂ into the storage site has finished, to assure regulators that financial resources are available to respond to such liabilities should they emerge.

Thus, the U.S. government policy actions designed to grow the CCS industry appear, in part, to butt heads with the federal environmental policies that seek to assure that any polluter remains strictly liable for damages caused, no matter how far in the future such latent liability may emerge. Unfortunately, no capital in the marketplace has a long-enough tenor to support (i.e., provide cover for) many decades of such liability from any activity, let alone for projects with limited demonstrated implementation success at scale. So, current government policies solve one financial barrier to scaling CCS, but not the other.

In this paper, financial risk mitigation requirements and options are considered to address issues that cause bodily injury or property/other economic damage that might arise during geological storage projects. These do not obviate the need for any of the design, engineering or operational steps to minimize such risks. Rather, the financial mechanisms are enabled by such steps.

In the process of describing financial risk management options, the paper considers the challenges faced by the commercial insurance industry to provide coverage for environmental liabilities of CCS projects and their developers. These challenges are exacerbated as nearly 1/3 of the current slate of U.S. prospective project developers lack commercial/large project management experience (as discussed in the companion [operational risks mitigation](#) paper); these developers are

¹ These risks take different forms, including but not limited to the physical risks of leakage of CO₂ or induced seismicity that could result in damages to property, bodily injury, and/or to the reversal of project revenues earned through tax or carbon credits. The *Operational Risk Management* companion paper published earlier in this series reviews the various risks associated with geological storage of CO₂ and the “physical”, i.e. engineering and operational, steps that are being taken to mitigate those risks.

looking to finance their CCS projects via project finance, i.e., without the benefit of a large balance sheet.

Note: this paper addresses financial risk management during three of the four phases of the CCS geological storage project lifecycle: construction, injection, and post injection/site care (PISC). Liabilities that might arise during the fourth and final phase, Long Term Stewardship (LTS) are addressed in a separate companion paper.

REGULATORY REQUIREMENTS

Financial safeguards are mandated by the EPA's [UIC Class VI requirements](#); that is, project developers must demonstrate they have adequate financial resources (Financial Assurance, or FA) to repair or compensate for certain damages. More specifically, the FA requirements are designed to assure adequate funding for safe closure of the facility; monitoring for leakage detection (including during a time-defined period that follows site closure); and remediation of potential liabilities if something goes wrong at the site that requires emergency response.

The regulatory schema allows a permittee to satisfy FA requirements in several ways:

- **Demonstrating Adequate Capitalization.** Accomplished through maintaining sufficient cash reserves dedicated to these operations and providing evidence of assets, income streams, or other financial resources that can be drawn upon.
- **Trust Fund.** A dedicated financial mechanism to ensure sufficient funds are available. Operators are typically required to contribute a pre-determined amount based on quantity of CO₂ sequestered; this Trust can be funded over time, for example through a “tipping fee”².
- **Surety Bonds.** A contract between three parties: the project operator (principal), the 3rd party entity issuing the bond (surety company), and the regulatory authority requiring the financial assurance. The surety company provides a bond to the operator, which guarantees that funds will be made available to the regulatory authority to cover potential long-term costs if the operator fails to fulfill its obligations related to the storage site.
- **Letters of Credit.** A binding commitment from a bank to pay a specified sum of money to a beneficiary (typically the regulatory authority overseeing the project) if the operator fails to fulfill their obligations related to the storage site.
- **Insurance.** A contract providing indemnity for named perils up to a limit of liability to the Named Insured, Additional Insureds and regulatory bodies (as specified beneficiaries) with specifically prescribed wording for this purpose.

CREDIT CLAWBACK RISK

With FA successfully demonstrated as part of the permitting process, a developer may desire to also protect against other sources of potential loss. For example, it might seek to protect its revenue streams in the event of CO₂ leakage outside of the designated storage zone (referred to as “reversal”); these streams can include 45Q tax credits and the proceeds from carbon credits sold

² An advantage of establishing a tipping fee is that it sets aside funds that can be used to transfer to a governing body for risk management if the developer is to be released from liability at some point in the future. This transfer of liability is discussed in detail in the *LTS Risk Mitigation* companion report.

through the voluntary carbon markets (VCM)³. Developers have financial risk management options for handling these reversal risks, including:

- **Doing nothing.** The developer remains fully exposed to the adverse event.
- **Reserving a portion of the credits/benefits.** The developer does not use all the tax or carbon credits it is eligible to receive or sell, respectively, and instead holds some in reserve. These reserved credits can be used to replace those “lost” through CO₂ reversal.
- **Creating a fund (e.g. through a Tipping Fee).** The developer takes a portion of the revenues it is generating and puts it in a fund to be used in the event of CO₂ reversal.
- **Securing commercial insurance.** This is discussed as part of the insurance section below.

THE COMMERCIAL INSURANCE INDUSTRY PERSPECTIVE

Some project developers would like commercial insurance to be a source of risk management assistance. There are areas for which the insurance industry is already widely prepared to offer coverage. Common business risks — e.g., slips, trips & falls; property damage; errors and omissions — can be covered in today’s marketplace⁴, beginning with the construction phase and continuing through PISC.

Additionally, over the past year insurance has emerged for underproduction/under-delivery of carbon credits (storing fewer credits than promised) or loss of carbon credits because of leakage. Firms including [Kita](#) and [Oka](#) are working towards making carbon credit insurance products available in the US. And there has been at least [one policy placed in the U.S.](#) to cover lost tax credits in the event of reversal. This suggests that insurance industry is progressing towards offering such policies (see Exhibit 1).

Regarding environmental liability, some project developers submitting applications for Class VI well permits have received [premium indications](#) (not policies) as a form of pre-commitment. These are generally of the (annually renewable) Sudden and Accidental insurance policy type. The insurance policies are meant to be part of such developers’ Financial Assurance package as discussed above. This is encouraging, but until there is evidence of capital commitments, it cannot be said that commercial insurance is available (see Exhibit 1).

Exhibit 1: Insurability by Category and by CCS Project Phase

	Construction	Injection	PISC
Worker Injury	☑	☑	☑
General Liability	☑	☑	☑
Induced Seismicity	✘	✘	N/A
Leakage – Credit Loss	N/A	☑	☑
Leakage – Environmental Liability	N/A	☐	☐

Source: *The Payne Institute, Earth & Water Law Group*

³ Carbon credits are issued on the VCM if it can be established that they are necessary for the project to proceed, i.e. that they are additional, and, by implication, that the tax credits are insufficient. Buyers of carbon credits in the VCM use them to report climate action beyond their own, internal efforts to reduce their carbon footprint.

⁴ It is worth noting that the purpose of traditional insurance is to indemnify the insured from fortuitous risks, e.g. the unexpected and unintended loss or damage; but insurance does not broadly provide indemnity for merely unwanted loss or damage.

Why CCS Is Challenging For The Insurance Industry

The progress towards offering more insurance for CCS liabilities notwithstanding, CCS presents challenges for the insurance industry, for several reasons:

- **Lack of historical experience with CCS projects.** There is limited medium-to-long term proven performance of project success, and so limited actuarial data, for CCS. There are also — admittedly very few — examples in which CCS projects have not performed in line with expectations, including injection rates falling short of anticipated levels (this is discussed more thoroughly in the *Operating Risk Management* paper).
- **Limited developer operating history.** Insurers' traditional decision-making about what and how to insure depends largely on the project developer's history; this includes the developer's technical, financial and management qualifications and experience with the project type. Insurance is far more likely to be made available to well financially qualified entities with sound operational history and demonstrated ability to run profitable businesses and/or projects. However, insuring project developers with limited or no business history, with a never-commercially-deployed technology is a challenge that makes risk management in all forms difficult.
- **Subsidized business models.** To make matters more challenging for underwriters, the business models for CCS rely on government tax breaks and/or carbon crediting for profitability. As such, should the subsidy disappear, so will the financial stability of the project operation.

The Particular Problem of Duration

Insurers are indicating that project developers are seeking longer term policies for geological storage project coverage. The demand for these long-term policies appears to stem from two sources. The first is regulatory requirements. As noted above, the EPA's Class VI well application includes FA requirements to cover as much as 80 years of potential liability (e.g., injection for 30 years followed by 50 years of PISC).

Second but related, some project developers — particularly those incorporating for this purpose — seek to terminate developer liability at the conclusion of the injection period. This is consistent with the use of [Project Finance](#) to support CCS projects including Special Purpose Vehicles (SPVs). Put differently, because they are dependent on the capital markets, these developers feel they need an exit path from the liability and desire longer term insurance policies to facilitate that project exit.

This ask for long duration policies is particularly problematic for the insurance industry, for several distinct reasons:

- **Conflicting governmental policy.** The CCS project dynamic is driven by incentivizing government policy on the one hand (45Q tax credits) but tempering government environmental policy on the other hand (long duration FA requirements). While insurance can, and does, resolve such conflict in many public policy settings⁵, this has come when the insurance industry has been a highly involved participant in that policy development. By contrast, insurers can be forgiven for thinking that CCS policy makers seem to expect insurance to help manage a risk, again in which it has no history, with little engagement or concern about insurance's overarching priority to preserve capital.

⁵ One example is regulation of worker safety and the use of workers compensation coverage and regulation of driving and other modes of transportation.

- **Lack of availability of long-term capital.** The ask for long-term policies flies in the face of an important constraint for insurers: raising money in the capital markets. Capital in the property and casualty insurance markets is not generally made available on a long-term basis (with few exceptions⁶). Thus, while it is true that insurers carry long term capital, so termed because its obligations are potentially spread out over decades, CCS lacks the history to permit the development of financial instruments necessary to hedge long term obligations related to CCS operations. Hence, long-term CCS policies threaten to burden the insurer with a significant risk of mis-pricing risk against CCS premiums.
- **Risks of this sort are generally held by the operator.** Insurers “see” projects in which the bulk of the activity (and therefore risk) relates to operations (i.e. the proper injection of and then continued storage of CO₂). This suggests to insurers that traditional operations policies are more appropriate — in which insurance is generally provided on an annual basis and for which operating history and ongoing risk management safeguards can be reviewed to support annual renewal and pricing — rather than long-duration policies.

Putting all these challenges together, many insurers believe the industry is simply not in a position, without substantive public policy adjustments, from scope to regulation, to provide long term coverage.

It is worth noting that some of the emerging credit compensation and environmental insurance policies being considered for offer do have a [10-year duration](#). The caveats, however, are important. For now, these are being considered for non-U.S. projects only, and then only in jurisdictions where (1) the tort-based liability risk is deemed to be significantly different than the U.S. or simply non-existent and/or (2) where the sovereign has agreed to a liability cap or indemnity schema for the project developers. It remains to be seen how much capital insurers are willing to commit for these policies even in jurisdictions where liability is limited largely to property damage without tort liability.

The Competition for Underwriting Dollars

The final observation about the insurance landscape, which compounds the challenge further, is the fact that CCS falls into a specialty underwriting area within the insurance industry called Commercial Excess and Surplus (E&S) lines insurance. [Less than approximately 15%](#) of the direct written premiums in the North American insurance marketplace are derived from all manner of specialty risks, including but not limited to railroad, hospitals, directors and officers, rep and warranty, professional liability, oil and gas, environment and more (see Exhibit 2).

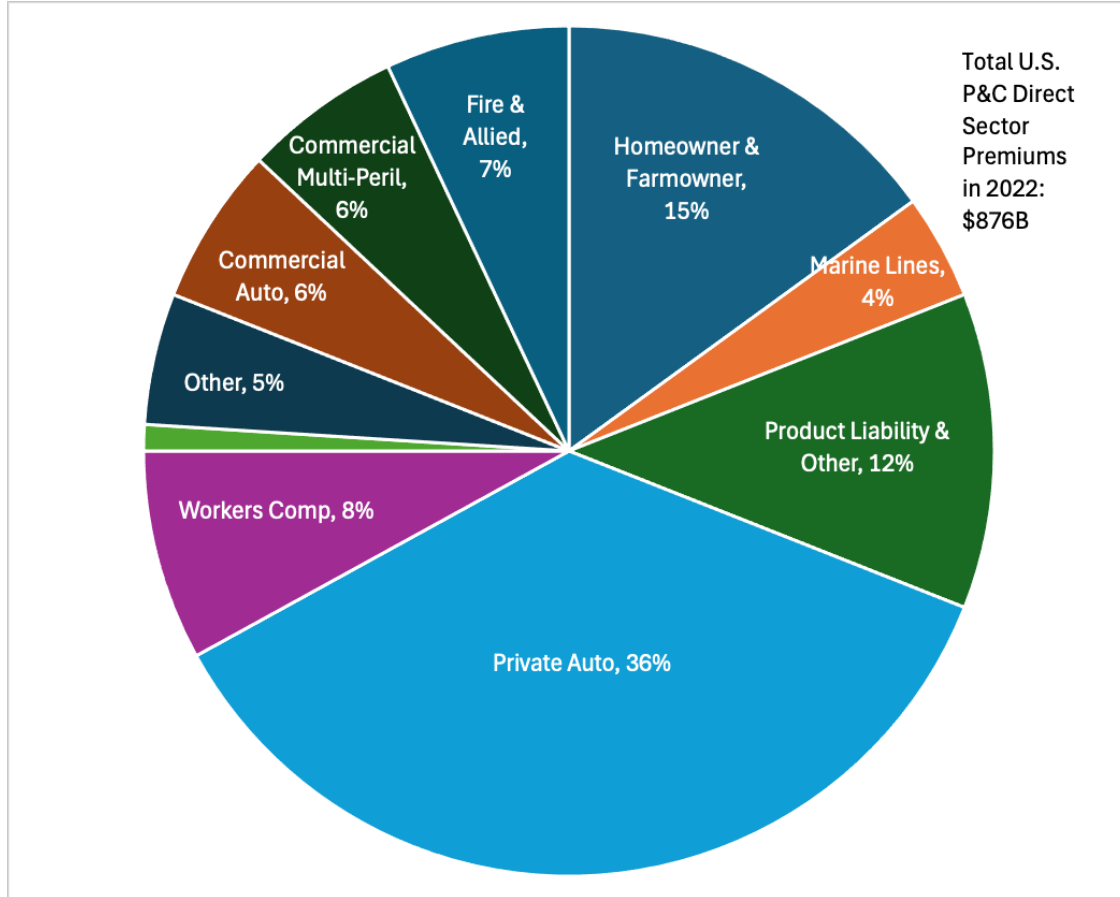
Further, the Commercial E&S market has both limited risk capital allocations and very limited human resources (let alone human resources qualified to analyze CCS project risks). This creates the challenge for CCS that it must compete for capital with established, much better understood sectors such as automobile, property, and workers compensation. To find capacity for CCS in a constrained market, displacement of currently underwritten business must occur. However,

⁶ Today, the only long term funds in the capital marketplace are those securitized by government enabled structures and / or government funds such as those used to create the mortgage marketplace – and to a limited extent, some capital made available in the life insurance marketplace – but life insurance is supported by statistically robust expected life tables – a data source not available to CCS projects now or anytime in the next 50+ years.

such re-allocation would require training of underwriters and creation of all manner of analytic tools sufficient to meet the operational metrics and fiduciary duty of the insurers taking such risks.

Convincing insurers to make that swap is a hard sell, given that many other industries have a long history, well developed analytics and loss history, existing knowledgeable human resources and use largely short term (3 year or less) policies.

Exhibit 2: U.S. Insurer Property & Casualty Sector, % Direct Premiums Written by Segment, 2022



Source: Federal Insurance Office, U.S. Department of Treasury (data from S&P Global)

ABOUT THE AUTHORS

Brad Handler

Payne Institute Program Manager, Sustainable Finance Lab, and Researcher

Brad Handler is a researcher and heads the Payne Institute's Sustainable Finance Lab. He is also the Principal and Founder of Energy Transition Research LLC. He has recently had articles published in the Financial Times, Washington Post, Nasdaq.com, Petroleum Economist, Transition Economist, WorldOil, POWER Magazine, The Conversation and The Hill. Brad is a former Wall Street Equity Research Analyst with 20 years' experience covering the Oilfield Services & Drilling (OFS) sector at firms including Jefferies and Credit Suisse. He has an M.B.A from the Kellogg School of Management at Northwestern University and a B.A. in Economics from Johns Hopkins University.

Lindene E. Patton

Partner at Earth and Water Law, L.L.C., an adjunct professor at the George Washington University School of Law

Lindene E. Patton is a partner at Earth and Water Law, L.L.C., an adjunct professor at the George Washington University School of Law; and a real estate agent licensed in Virginia and Maryland. She is a transactional attorney with extensive experience in the business of insurance, InsurTech, environment and data technology, including IP, privacy and related compliance matters. She is a globally recognized expert in risk management, data, resilience and related risk management solutions, insurance policy and other financial services product development, including insurance supporting energy transition technologies like CCS.

Before joining E&W Law, LLC she served as Global Head of Hazard Products for Corelogic; Chief Climate Product Officer for Zurich Insurance Group, and division general counsel for a large global insurer, as well as associate general counsel for engineering and land fill design companies.

Siddhant Kulkarni

MS Student, Mineral and Energy Economics, Colorado School of Mines

Siddhant is a student researcher at The Payne Institute at Colorado School of Mines. Currently pursuing his M.S in Mineral and Energy Economics, his research focuses on the commercial and insurance side of CCS projects and their risk management, as well as government incentive programs and schemes promoting the use of renewable energy. Additionally, he holds a B.S Honors in Economics from Symbiosis School of Economics, Pune. He is dedicated to advancing energy transition to renewables while addressing the various societal challenges that may come with it.

Felix Ayaburi

PhD Student, Operations Research with Engineering, Colorado School of Mines

Felix Ayaburi is a Ph.D. Student in Operations Research with Engineering at the Colorado School of Mines. He holds an MS in Mineral and Energy Economics from the same institution. His research interests include the application of optimization methods in underground mine planning, electric vehicle deployment and responsible sourced gas.

ABOUT THE AUTHORS (Continued)

Darshil Shah

Consultant, Rystad Energy

Darshil Shah joined Rystad Energy in 2024 as a consultant, specializing in corporate strategy, financial and economic analysis in the oil & gas sector, energy policy, and clean technologies. Before joining Rystad, he focused on topics such as carbon markets, CCUS, and mining policy during his research assistantship at the Payne Institute while completing his Master's in Mineral & Energy Economics at the Colorado School of Mines (Dec '23). Darshil has gained valuable experience through roles at Enverus, where he honed his skills in private equity and energy markets, and at the American Petroleum Institute (API), where he engaged in energy-related economic and regulatory analysis. His areas of interest include economic modelling, carbon markets, CCUS, and energy market trends.

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