Navigating the Legal Landscape

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A legal framework governing carbon sequestration will need to be put in place before major carbon capture and storage (CCS) projects can get underway. A final rule issued under the Safe Drinking Water Act sets minimum requirements, but this is just a starting point, and other laws will likely come into play.

The technologies enabling carbon capture and storage (CCS) are currently undergoing rapid development. For these technologies to be used on a large scale, however, a regulatory framework governing carbon sequestration activities must be developed at an equivalent pace.

This framework started to take shape on Dec. 10, 2010, when the U.S. Environmental Protection Agency (EPA) promulgated final regulations governing the geologic sequestration (GS) of carbon dioxide in accordance with the Safe Drinking Water Act (SDWA). The rule addresses the risks to underground sources of drinking water associated with long-term storage of CO_2 and sets minimum requirements for well site selection and modeling, construction materials, operation and monitoring of the GS project, and site testing during and after injection stops, among other things.

The SDWA, however, is too limited in scope with respect to GS to resolve the legal issues that will arise if a large-scale CCS program is to develop. Additional challenges include formulating a regulatory construct for transporting the CO_2 to the sequestration site, securing rights to use the subsurface for permanent CO_2 storage, resolving conflicts between the owners of the surface estates and mineral rights, assigning liability for potential damages, and applying existing common law to claims of trespass, nuisance, property damage and other allegations to deal with potential future CO_2 releases.

Other federal statutes that could be applied to GS to deal with these challenges include: the Clean Air Act (CAA); the Resource Conservation and Recovery Act (RCRA); the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA); the National Environmental Policy Act (NEPA); the Endangered Species Act (ESA); and the Hazardous Liquid Pipeline Safety Act (HLPSA).

SDWA and carbon sequestration

The EPA has regulated injection wells for 30 years, as part of the SDWA underground injection control (UIC) program. However, it was not until 2010 that wells used to inject CO_2 into subsurface geologic formations for long-term storage, designated Class VI wells, became subject to the rule (Table 1).

The regulation governing Class VI wells was needed to address the risks presented by the emerging CCS technology. For example, the pressure created by underground injection could push brine through geological formations into drinking water sources, rendering them unusable. The acids that form when CO_2 contacts water could leach minerals (*e.g.,* arsenic, lead) and organic compounds from the rock formations, contaminating groundwater. This concern could be exacerbated by the contaminants found in the injected waste streams, such as hydrogen sulfide or mercury *(1–3)*.

The rule sets minimum technical criteria for Class VI wells, including *(1)*:

- geologic site characterization to ensure that wells are located in suitable formations and are constructed to prevent fluid movement
- modeling of the site to account for CO_2 properties
- construction requirements, including the use of materials that are compatible with CO_2 over the lifetime of the GS project, and the use of alarms and shutoff systems to prevent fluid movement into unintended zones
- regulatory oversight of ongoing GS projects and operation through project management plans
- periodic evaluation of monitoring and operational data indicative of CO_2 subsurface movement to verify predicted CO_2 movement
- testing and monitoring of each GS site that includes mechanical integrity of the well, groundwater monitoring, and tracking of the CO_2 subsurface, during and after operation, until site conditions demonstrate that drinking water sources would not be impacted by subsurface CO_2 migration.

While many were concerned about EPA's initially proposed financial-assurance requirements, the final rule provides clarification and additional flexibility for potential future corrective action, well plugging, post-injection site care, closure, and emergency and remedial response.

Finally, the rule contemplates transitioning Class II enhanced recovery (ER) UIC wells to GS Class VI UIC wells, based upon considerations arising when transitioning from enhanced recovery to long-term storage. Significantly, Class VI GS requirements do not apply to Class II ER wells while oil or gas production is occurring, but do apply after the oil and gas reservoir is depleted. Although traditional ER projects are not impacted by the SDWA rule, owners and operators of Class II wells that are injecting CO_2 for the primary purpose of long-term storage into an oil and gas reservoir must obtain a Class VI permit, because the larger volumes of CO_2 to be injected pose more risk to USDWs than traditional Class II operations.

Table 1. Underground injection wells are regulated under the SDWA UIC program according to well class.

Class	Description
I	Wells in which hazardous and nonhazardous wastes are injected into deep, isolated rock formations that are thousands of feet below the lowest USDW
II	Wells used for fluids associated with oil and natural gas production
III	Wells used for fluids to dissolve and extract minerals, such as uranium, salt, copper, and sulfur
IV	Shallow wells used to inject hazardous or radioactive wastes into or above a geologic formation that contains a USDW
V	Wells used to inject nonhazardous fluids underground that could pose a threat to ground water quality if managed improperly
VI	Wells used for injection of CO_2 into underground subsurface rock formations for long-term storage (geologic sequestration)

USDW = underground source of drinking water

Source: Underground Injection Control Program, Classes of Wells, www.epa.gov/ogwdw000/uic/wells.html

The CAA and carbon sequestration

In 2007, the U.S. Supreme Court ruled that greenhouse gases (GHGs), including CO_2, are "pollutants" under the CAA. This decision paved the way for several new EPA CAA regulations governing GHGs, including CO_2, that affect CO_2 sequestration — setting requirements for permitting and reporting under the CAA *(4)*.

EPA's new CAA GHG requirements represent a profound departure from historical policy approaches to GHG emissions and regulation, and will increase the cost and complexity of CAA permitting for large CO_2 emission sources. Assuming Congress does not intervene legislatively, and assuming the EPA's recent rulemaking survives judicial scrutiny, CO_2 emissions are currently, and will continue to be, regulated pursuant to the CAA. CO_2 capture, to the extent it constitutes CO_2 emission reductions, are "regulated" indirectly, in two ways.

First, GHG emissions are now subject to permit limits and emission reduction requirements imposed through EPA's implementation of the Prevention of Significant Deterioration (PSD) Program and Title V Operating Permit Program. If a new or modified facility is a major source, as defined by the CAA, it must obtain a construction permit. In areas that meet the national ambient air quality standards (NAAQS) for all regulated air pollutants to be emitted by a new or modified source, a PSD review is required, and the construc-

1930s
First documented disposal of oil field brine into source formation in Texas. Injection first used to enhance oil and gas recovery.

1940s
Oil refineries begin to inject liquid wastes.

1950s
Chemical companies begin injecting industrial waste into deep wells. Many states establish regulations for brine disposal.

1960s
Deep well injection in Colorado causes earthquakes. First documented cases of contamination of potential drinking water sources.

tion permit will require the use of the best available control technology (BACT).

Second, volumes of CO_2 captured, sequestered, or injected must be reported under EPA's Mandatory Greenhouse Gas Reporting Rule (MRR). The MRR, which became effective Dec. 29, 2009, with additional subparts promulgated on Dec. 1, 2010, requires annual reports of GHG emissions, including CO_2 emissions *(5, 6)*. The MRR now mandates reporting of captured CO_2 (Subpart PP), geologically sequestered CO_2 (Subpart RR), and injected CO_2 (Subpart UU). On Mar. 18, 2011, EPA extended the deadline for GHG reporting for the first reporting year (2010) to Sept. 30, 2011, because of delays in the development of the electronic reporting software.

Other environmental laws

As noted earlier, several other federal environmental laws could indirectly impact CO_2 sequestration, including RCRA, CERCLA (Superfund), NEPA, and ESA.

RCRA. The Solid Waste Disposal Act as amended by RCRA imposes federal requirements on solid waste and much more stringent requirements on solid wastes that are considered hazardous waste. Because injection is considered to be a type of disposal, RCRA probably applies to sequestered carbon.

It is unlikely that CO_2 will be considered a hazardous waste, but other hazardous contaminants of a power plant's emission stream could render the sequestered material hazardous. Thus, in March 2010, the EPA announced that it would consider exempting CO_2 waste streams from RCRA's hazardous waste requirements to encourage CCS projects *(7)*.

CERCLA. This law provides for the cleanup of contamination by hazardous substances that occurred in the past from activities that include industrial waste disposal. CERCLA defines hazardous waste in a broad way that could include sequestered waste streams from electric power plants. The law applies to "releases" of "hazardous substances," and even though disposal is clearly a release, CO_2 is not listed as a hazardous substance under CERCLA.

However, the EPA's endangerment finding for CO_2 under the CAA could trigger CERCLA liability. Additionally, while CERCLA exempts federally permitted releases from CERCLA liability and CO_2 sequestration would be permitted under the final UIC Class VI GS rule, hazardous substances "along for the ride" in the CO_2 waste stream could trigger CERCLA liability *(8)*.

What States Need to Know

The federal rule issued by the EPA is intended to provide minimum requirements for state implementation and enforcement. To issue UIC Class VI permits, states must apply to EPA for primacy within 270 days of the Dec. 10, 2010 date of promulgation and receive approval. Until a state receives primacy approval, EPA will create and implement the UIC Class VI permit program.

NEPA. Some aspects of CCS projects will likely trigger the NEPA, which applies to "major federal actions." The EPA's UIC permitting process itself is specifically exempted from formal NEPA review. However, other aspects of CCS projects may have major effects and may involve significant federal involvement with respect to financing, assistance, or approvals. For example, CCS pipelines may be sited on federal or tribal land, making them subject to NEPA review.

The NEPA process requires that the responsible federal agency examine the impacts of the project, and if the potential impacts are significant, then an environmental impact statement (EIS) must be developed to evaluate the impacts and alternatives. Although it is possible to streamline this process, it involves public comment and significant interagency coordination, and thus should be considered early in the planning process *(2, 3)*.

Land use and carbon sequestration

The Bureau of Land Management (BLM) within the U.S. Dept. of Interior (DOI) has jurisdiction over CO_2 injected on federal lands. BLM does not regulate pipelines, but does grant rights-of-way for the placement of pipelines on federal lands. It has not yet been resolved which federal agency will have oversight over long-term liability for sequestration or other aspects of the program *(9)*.

The Energy Independence and Security Act of 2007 directs DOI to report on its framework for managing geological sequestration on public lands. DOI must: develop a methodology for assessing the potential for geologic storage of CO_2 and use the methodology to assess the nation's capacity for storage; assess the capacity of ecosystems to sequester carbon; and maintain records and an inventory of

1970s Waste released from abandoned oil well traced to distant paper mill injection well.

1974 Congress passes the SDWA, giving EPA authority to regulate underground injection to protect USDWs.

1980s EPA issues UIC regulations defining five classes of injection wells.

2008 EPA proposes a new well class for geologic sequestration of CO_2.

2010 EPA issues final regulations adding a new well class (Class VI) for geologic sequestration.

the quantity of CO_2 stored within federal mineral leaseholds.

The DOI has recommended criteria for identifying potential sites for geological carbon sequestration and proposed a regulatory system for leasing public lands for sequestration *(10)*. It also identified four challenges that need to be addressed in developing a regulatory system:

• categorization of CO_2 as a commodity, resource, contaminant, waste, or pollutant, and distinguishing between pure CO_2 and the mixtures containing contaminants that can be expected to be found in sequestered CO_2 streams

• potential conflicts with other land uses, including mining, oil and gas production, coal production, geothermal development, and groundwater use, as well as potential impacts on surface land uses and community development

• long-term liability, including its scope and the terms of stewardship, and the potential conflict between sequestration and the BLM mandate to manage public lands for multiple uses

• jurisdictional and property rights disputes arising from geological carbon sequestration on public lands that involve split estates or lands where the surface is managed by agencies other than BLM.

No existing law provides the specific authority that would allow BLM-administered lands to be leased for CCS. However, the Federal Land Policy and Management Act (FLPMA) authorizes the Secretary of Interior to issue leases, permits, and easements for the use and development of the public lands, to which the provisions of the Mineral Leasing Act (MLA) will be applicable.

The Endangered Species Act (ESA) is another statute that could pose barriers to CCS projects, particularly pipeline construction. The purpose of the ESA includes conservation of ecosystems upon which endangered and threatened species depend. The ESA requires all federal departments and agencies to use their authority to conserve endangered and threatened species and to cooperate with state and local agencies to resolve water issues to conserve these species *(11)*.

Legal requirements for CO2 transport

After CO_2 is removed from the exhaust gas stream, it must be concentrated into a stream of nearly pure CO_2, and then compressed to a supercritical fluid before it is transported to the injection site. Pipelines will likely be the primary method of transporting supercritical CO_2 liquid to a sequestration site. Thus, for large-scale CCS to become a reality, a dedicated pipeline network will need to be built.

The U.S. Surface Transportation Board (STB) has authority to regulate pipelines used exclusively for CO_2 transport, but this is narrower than the Federal Energy Regulatory Commission's (FERC) authority to regulate natural gas and oil pipelines. The STB cannot regulate pipeline construction, does not have eminent domain authority, and cannot require companies seeking to build pipelines to obtain certificates of public convenience and necessity *(12)*.

Safety regulations for interstate CO_2 pipelines fall within the jurisdiction of the Dept. of Transportation's (DOT) Pipeline and Hazardous Materials Safety Administration (PHMSA). The Hazardous Liquid Pipeline Safety Act regulates interstate pipelines and provides minimum standards for states that regulate intrastate pipelines. PHMSA regulates the design, construction, operation and maintenance, and spill-response planning for pipelines. The PHMSA will need to reevaluate its legal requirements for pipelines if a large-scale sequestration program is to develop, and it will need to deal with cross-jurisdictional issues involving multiple federal agencies as well as state agencies. Federal legislation may be needed to specify which agency will regulate pipelines used for CO_2 transport and to expand its authority.

Despite the overlay of federal regulation and jurisdiction, site approval is based primarily on state law, which is intertwined with local concerns and may involve a complex and protracted process. If pipelines are to be constructed, opposition is possible and should be considered in project planning.

Ownership and liability issues

In addition to following regulations of CO_2 emissions and reductions, and CO_2 transportation, entities undertaking carbon sequestration must acquire the legal right to occupy the subsurface formation, or pore space, with the CO_2. However, envisioning the dynamic interaction of property rights law in each state is akin to playing three-dimensional chess where the bottom tier is neither visible nor static.

First, the question of who owns the pore space must be answered. Pore space, like property law in general, is an issue of state law. While surface owners traditionally own property from the center of the earth to the top of the sky, surface owners may own title to property subject to prior transfer of the mineral rights to a separate party, and thus, merely own the surface rights. In deciding whether the pore space is owned by the owner of the mineral rights, or by the owner of the surface estate, most state courts have held that the pore space is owned by the owner of the surface estate, even when the mineral rights have been severed, unless the contract conveying the mineral rights expressly includes the pore space as well *(13)*.

However, given that the mineral estate is a separate and dominant estate in many states, the question then becomes how to apply prior case law resolving issues arising between surface estate owners and mineral rights owners in cases of oil, natural gas, coal, or coal-bed methane production to permanent subsurface CO_2 storage, especially considering the potentially unpredictable behavior of subsurface CO_2.

Common-law claims that may be available to those damaged by subsurface storage of CO_2 include subsurface trespass, nuisance, negligence, unlawful taking of property without just compensation, and even strict liability for ultra-hazardous activity. The primary challenge in maintaining any of these claims is demonstrating that some measure of harm has resulted from the activity. Quantifying actual damages could serve to limit recoveries, as it has in analogous case law involving natural gas storage, enhanced oil recovery, wastewater storage and hydraulic fracturing *(13, 14)*.

Financial liability and insurance

While the EPA has provided a means to monitor and track potential risks from permanent geologic CO_2 sequestration and addressed issues of financial assurance in its final UIC rule, unless a broad indemnification program is created to limit the risk associated with unforeseen environmental consequences from CCS, it is unlikely that major sequestration projects will proceed. The operator is expected to have primary responsibility for the life of the facility and a post-closure period. The time frequently mentioned for post-closure industry supervision is about 30 years. After that, the government would take responsibility for long-term monitoring and remediation if needed.

The Southern Company, Duke Energy, the Environmental Defense Fund, and Zurich Financial Services (an insurance company that offers policies to protect against liability risks associated with CCS projects) have developed a plan that they are urging Congress to codify into law. It calls for a four-tiered liability program for CCS operations. Under the first tier, each CCS operator would be liable for $50 million (or more as determined by Congress). The second tier would be an industry-wide pool to which each CCS operator contributes $12.5 million; as CCS operation grows, this would become a substantial source of additional coverage. The third tier would consist of a government-funded insurance program with a lifetime cap for each CCS operator of $300–$900 million. The fourth tier would require the operator to cover any liabilities that exceeded the first three tiers of coverage.

Final thoughts

The legal requirements for geological sequestration are complex but well within the ability of the legal system to resolve. The major issue continues to be whether the cost of GS can be reduced or the cost of CO_2 emissions can be increased through government action so that GS becomes an attractive option to the electric power industry. CEP

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