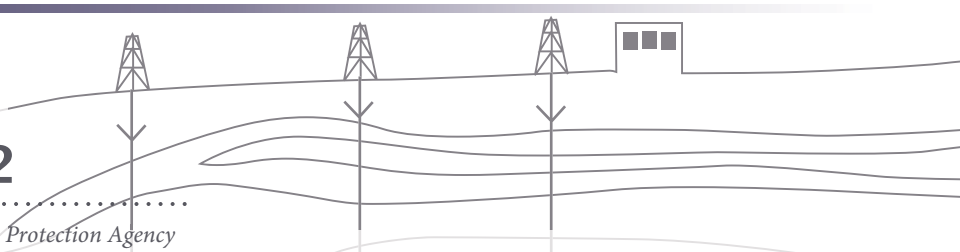
Regulating Geologic Sequestration of CO_2



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In 1974, the Safe Drinking Water Act (SDWA) authorized the U.S. Environmental Protection Agency to establish an Underground Injection Control (UIC) program to protect underground sources of drinking water (USDW) from endangerment by fluids injected into wells. USDWs are defined as aquifers containing less than 10,000 milligrams per liter (mg/l) of total dissolved solids. The UIC program has regulatory authority over the construction, operation, permitting, and closure of injection wells from the well head down.

States and tribes may choose to apply for primary enforcement authority, or primacy, to implement the UIC program within their respective borders. A state or tribal UIC program must meet all federal requirements in order to obtain primacy; otherwise, EPA implements the program directly.

Underground Injection of CO_2

Geologic sequestration of carbon dioxide (CO_2) through well injection meets the definition of "underground injection" as outlined in the SDWA, and therefore is regulated under the UIC program. However, the current UIC regulations were not specifically designed for the injection of CO_2. Thus, EPA has developed new regulations for this type of injection to prevent endangerment of USDWs.

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EPA is moving rapidly to develop federal regulations for CO_2 geologic sequestration wells under the UIC program. Proposed July 25, 2008 regulations would revise the UIC program's regulatory framework to address the unique nature of CO_2 injection. The proposal creates a new geologic sequestration well class, Class VI. EPA is also conducting research related to USDW protection as well as other potential environmental impacts associated with CO_2 geologic sequestration.

Geologic sequestration of CO_2 differs from other types of injection activities currently regulated under existing UIC requirements. There are specific characteristics of CO_2 geologic sequestration that warrant the tailored requirements in the July 2008 proposal. It is predicted that over time, the CO_2 plume and pressure front associated with a full-scale geologic sequestration project will be much larger than those of other types of UIC operations. In addition, the relative buoyancy and complex behavior of the CO_2 in the subsurface suggest that the area of influence will be noncircular. Therefore, the traditional area-of-review delineation methods such as a fixed radius or simple mathematical computation would not be sufficient to predict the extent of CO_2 movement.

The July proposal includes enhancements to typical deep-well construction and operation requirements to provide additional barriers to CO_2 leakage outside of the injection zone due to CO_2's buoyancy. The potentially corrosive nature of the injectate (when in contact with water) is also being addressed in the proposed regulations. For example, a leaking annulus would be a significant migration pathway for CO_2. Therefore, the quality of the well materials, proper well construction, composition and placement of appropriate cement along the wellbore, and appropriate maintenance are crucial components being addressed.

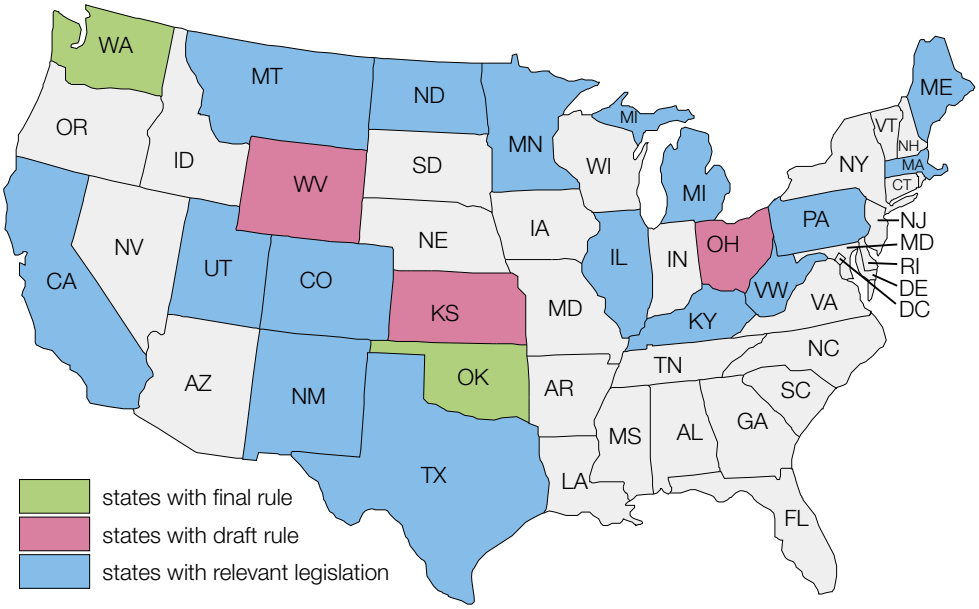
EPA is coordinating with the Department of Energy's Regional Carbon Sequestration Partnership as it conducts pilot projects to determine the most suitable technologies and specific infrastructure needs for carbon capture and storage (CCS) in various areas of the country. The research is funded through an interagency agreement with DOE for work on the potential groundwater quality impacts of CO_2 injection at the Lawrence Berkeley National Lab (LBNL) in California. EPA is also working with U.S. Geological Survey, Department of Interior, Department of Treasury, states, tribes, industry, NGOs and international organizations.

States also are moving toward the regulation of geologic sequestration (see map, above right). Several state legislatures have recently enacted laws aimed at accelerating efforts to reduce carbon emissions and are working to publish regulations for geologic sequestration this year. If state or tribal UIC regulations are issued prior to EPA regulations and determined by EPA to be less stringent, then the state or tribe will be required to revise their regulations to obtain EPA primacy approval.

Challenges of Nationwide Regulation

In developing the proposed rule for nationwide regulation of geologic sequestration, EPA and stakeholders have considered a number of challenges.

Geologic Variability: The proposed rule limits CO_2 injection to formations beneath the lowermost USDW. The eastern United States is well-suited for this requirement because most eastern USDWs are shallow and the salinity of geologic formations typically increases with depth. Some saline formations along the Gulf Coast of Texas and Louisiana, however, transition into USDWs within very short distances due to nearby aquifer recharge zones. In the West, the occurrence of USDWs is far more complex. For example, USDWs are found at depths greater than 10,000 feet in the Powder River Basin of Wyoming and 6,500 feet on the North Slope of Alaska. In such areas,



Graphic by: Chris Guzzetti, EPA Region 8

Status of state carbon capture and storage regulations, as of June 2009.

aquifers that are not of drinking water quality—and thus might be potential geologic sequestration sites—are typically sandwiched between those that are. Given this variability, the proposed requirement would severely limit the deployment of geologic sequestration in some parts of the western United States and Alaska.

Financial Responsibility: The proposed rule requires operators to provide financial assurance mechanisms to ensure that adequate resources are available for corrective action, the plugging and abandonment of injection wells, post-injection site care and site closure, and for emergency and remedial response for failed injection wells. EPA held three webcasts during spring 2009 to discuss potential financial responsibility mechanisms for geologic sequestration wells with the aim of leveraging the experience of states, regions, and other stakeholders to determine which fiscal responsibility instruments and mechanisms are appropriate for Class VI wells. A summary of the webcasts is available in the rulemaking docket at *www.regulations.gov*.

Long-Term Liability: During the public comment period for the proposed rule, EPA received numerous comments regarding long-term liability of geologic sequestration sites. The unusually large volume and the nature of the injectate were identified as two primary concerns. Due to the volume of injected fluid, commercial-scale sequestration projects have the potential to impact very large geographic areas. The increased pressure in receiving formations could cause the displacement of native brines and the migration of CO_2 plumes over considerable distances, potentially affecting USDWs at great distances from the injection well. Research has shown that eventually these large plumes will stabilize and be trapped through natural physical and chemical processes. However, due to the time scale at which these processes occur, some stakeholders have suggested transferring liability to either state or federal entities. This issue is under discussion both within and outside the federal government, and strategies continue to emerge as the process moves forward.

Conversion from Enhanced Oil Recovery to Geologic Sequestration: Current practices for enhanced oil recovery (EOR) include the injection of CO_2. Following publication of the proposed rule, many operators have expressed the need for regulatory certainty for wells that both enhance oil recovery and sequester CO_2. Stakeholders are concerned that it may be difficult to clarify the distinction between a well used for EOR (Class II) and a well used for geologic sequestration (Class VI). While many suggestions have been offered concerning schemes for transitioning between well classes, EPA is still evaluating this issue.

Other Challenges: Some sequestration-related issues being discussed are currently outside SDWA authority, but are nevertheless important, including the use and ownership of pore space, potential impacts to mineral rights, and the application of eminent domain. For example, reservoir interference and pore-space rights have traditionally been managed by the states. However, areas-of-review for full-scale projects are predicted to cover large areas and may involve transboundary concerns, such as CO_2 influences that cross national, state, tribal, or federal boundaries.

Another topic under discussion is the potential for geologic sequestration injection in proximity to other resources such as oil- and gas-bearing formations. Resource extraction and processing procedures must be developed and used where these situations occur. Drilling procedures and operations associated with resource extraction will need to be developed to prevent injected CO_2 from escaping to the atmosphere. ■

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