Appendix B

Risks of Geological Sequestration

Numerous sources outline the risks posed by geological sequestration of captured carbon dioxide.[1] The main ways in which geological sequestration can cause harm are as follows:

- escape to the surface of the sequestered CO_2;
- unpredicted and uncontrolled migration and effects of the sequestered CO_2; or
- unpredicted and uncontrolled effects of the pressure front.

The main categories of harm are as follows:

- Harm to human health
    - Escape to the surface of the sequestered CO_2 could harm the general public or employees. One study suggests there may be a significant local hazard to humans in the event of a CO_2 well failure, but that this risk is largely contained in the immediate vicinity of the well. There is minimal or no risk presented to humans beyond the first few hundred meters from the well.[2]
- Geological hazards
    - Changes in subsurface pressure due to CO_2 injection could lead to seismic events, a phenomenon known as induced seismicity, or to ground heave.[3]
- Ecological harms
    - Groundwater contamination:
        - The sequestered CO_2 or the pressure front might force brine into fresh water formations, thereby adversely impacting drinking water.[4]

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[1] *See* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CARBON DIOXIDE CAPTURE AND STORAGE 242-53 (Bert Metz et al. eds., 2005) [hereinafter "IPCC Report"]; Elizabeth J. Wilson, Alexandra B. Klass, and Sara Bergan, *Assessing a Liability Regime for Carbon Capture and Storage*, 1 ENERGY PROCEDIA 4574 (2009); Elizabeth J. Wilson et al., *Liability and Financial Responsibility Frameworks for Carbon Capture and Sequestration*, WRI Issue Brief: Carbon Capture and Sequestration, No. 3, December 2007 [hereinafter "WRI Issue Brief"]; Chiara Trabucchi and Lindene Patton, *Storing carbon: Options for liability risk management, financial responsibility*, BNA National Environment Daily, Sept. 3, 2008; David Gerard and Elizabeth J. Wilson, *Environmental Bonds and the Problem of Long-Term Carbon Sequestration*, available at http://www.docstoc.com/docs/32241076/Environmental-Bonds-and-the-Problem-of-Long-Term-Carbon-Sequestration; EPA, "Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration Wells," 73 Fed. Reg. 43491 (July 25, 2008) [hereinafter, "Proposed Class VI UIC Requirements"]; International Risk Governance Council, *Regulation of Carbon Capture and Storage*, Policy Brief, 2008; Donna M. Attanasio, *Surveying the risks of carbon dioxide: Geological sequestration and storage projects in the United States*, 29 ENVTL. L. REP. NEWS & ANALYSIS 10376 (2009); Ken Hnottavange-Telleen, Ivan Krapac, Claudia Vivalda, *Illinois Basin-Decatur Project: initial risk-assessment results and framework for evaluating site performance*, 1 ENERGY PROCEDIA 2431 (2009).

[2] *See* International Risk Governance Council, *supra* note 1; Roger D. Aines et al., *Quantifying the potential exposure hazard due to energetic releases of CO_2 from a failed sequestration well*, 1 ENERGY PROCEDIA 2421 (2009).

[3] *See* WRI Issue Brief, *supra* note 1.

[4] *See* Proposed Class VI UIC Requirements, *supra* note 1; WRI Issue Brief, *supra* note 1.

        - The sequestered CO_2 may also alter the pH of subsurface water, leading to mobilization of metals and/or organic compounds that may contaminate underground sources of drinking water.[5]
        - Co-contaminates in the injected CO_2 could also harm underground sources of drinking water.[6]
    - Harms specific to offshore sequestration:[7]
        - CO_2 releases could increase the acidity of the water at the site of the leakage. The resulting changes in pH in sediments and seawater could lead to effects on speciation, mobility or bio-availability of metals, nutrients and other compounds.
        - High CO_2 levels and changes in marine chemistry may have effects on metabolism of marine organisms.
        - CO_2 releases could kill benthic organisms.
    - Natural resource damages
        - Escape to the surface of sequestered CO_2 could cause adverse impacts to natural resources such as forests.
- Harm to property
    - Migration of the sequestered CO_2, or the pressure front, could cause:
        - property damage to mineral reserves and/or oil and gas reservoirs;
        - diminution of value, for properties in the vicinity of sequestration sites; or
        - business interruption of neighboring properties if remediation is required.[8]
    - Escape to the surface of the sequestered CO_2 could also lead to:
        - adverse impacts to commercially exploitable resources, such as forests and croplands; or
        - restrictions to land use activities.[9]
- Adverse impacts on climate change
    - Escape to the surface of the sequestered carbon dioxide would adversely impact climate change.

If the harms listed above were to occur, they could lead to the following types of liability for the sequestration site owner/operator:

- tort liability, including trespass, nuisance, and negligence;

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[5] *See* Proposed Class VI UIC Requirements, *supra* note 4, at 43497; WRI Issue Brief, *supra* note 1.

[6] *See* Proposed Class VI UIC Requirements, *supra* note 4, at 43497.

[7] *See* IPCC Report, *supra* note 1 at 246, 248; 1996 Protocol to the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, November 2, 2006.

[8] *See* International Risk Governance Council, *supra* note 1.

[9] *See* Trabucchi and Patton, *supra* note 1.

- statutory liability, such as a violation of the Safe Drinking Water Act, Resources Conservation and Recovery Act ("RCRA"), or Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA");
- regulatory liability if the harm resulted from the violation of the permit that the sequestration facility is operating under, or violation of a future cap-and-trade regime; and/or
- contract liability.[10]

In addition, in the absence of a liability framework for sequestration, other actors in addition to the sequestration site owner/operator could incur liability. For instance, landowners could be held liable for responsibility under RCRA or CERCLA, in the absence of clarification regarding whether and under what circumstances captured CO_2 is a hazardous waste under RCRA or a hazardous substance under CERCLA.

[10] *Id.*