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LONG-TERM LIABILITY FOR CARBON CAPTURE AND STORAGE IN DEPLETED NORTH AMERICAN OIL AND GAS RESERVOIRS - A COMPARATIVE ANALYSIS

*Allan Ingelson, Anne Kleffner, and Norma Nielson**

Synopsis: State legislation in North America that addresses whether a government will accept long-term liability for damage arising from the release of carbon dioxide (CO_2) after capture and storage (CCS) in depleted oil and gas reservoirs is in its infancy. Three states have developed legislation that conveys two different approaches to long-term liability. The federal governments in the United States and Canada have not developed legislation to address the issue. This article examines emerging legislative frameworks, in a limited number of jurisdictions, that have been adopted to manage long-term liability: viz., Wyoming, Kansas, Montana, the European Union (EU), and Australia. The majority of state governments to date, including Wyoming, Kansas, and the State of Victoria in Australia, are not prepared to assume long-term liability, while the EU and the State of Montana are prepared to proceed with a conditional transfer of liability from the CCS developer/operator to the government. We conclude that while a model that incorporates a conditional transfer of liability to a "pool," such as in Montana and the EU, may encourage more investment in CCS, such a model does not incorporate the "polluter pays" principle. Arguably the incentive is greater to prevent future gas releases and thereby minimize the long-term risk to the public in jurisdictions such as Wyoming, Kansas, and the State of Victoria, where the CCS developer and/or operator retains long-term liability under the common law. As has been the practice in some jurisdictions in the North American petroleum industry, if the CCS developer/operator is either required to purchase and maintain third party liability insurance, or to post a bond or other form of security with the government for site remediation and reclamation, such an approach will help to minimize the long-term liability for the government and taxpayers. However, in the case of CCS, given the extraordinarily long duration of the risk associated with carbon storage, it is by no means certain that either insurance or bonds can be purchased for such an extended time period. We recommend a pooling approach to the management of remediation and reclamation funds based largely on arguments that it is more economically efficient to do so. While it would be theoretically possible for such a pool to be private, it is likely that the need for independent oversight will

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result in a governmental entity assuming the management function for such a liability/compensation scheme.

I. INTRODUCTION

Carbon dioxide (CO_2) emissions from coal-fired electricity generation plants and the petroleum industry are a major source of greenhouse gas (GHG) emissions in the United States, Canada, China[1], Australia, and some European nations.[2] Global reduction of GHG emissions is an important objective of the

1. NETH. ENVTL. ASSESSMENT AGENCY, CHINA NOW NO. 1 IN CO2 EMISSIONS; USA IN SECOND POSITION, http://www.pbl.nl/en/dossiers/Climatechange/moreinfo/Chinanowno1inCO2emissionsUSAinsecondposition.html (last visited July 6, 2010).

2. Canada contributes 2% of 29,000 million tons of global GHG emissions. Due to coal plant, oil sands, and other emissions, Alberta not only is a leading oil and gas producing province, but also is the largest single provincial emitter with 19% of Canadian emissions. GOV. OF ALTA., ALBERTA'S OIL SANDS: OPPORTUNITY, BALANCE (2008), *available at* http://www.environment.alberta.ca/documents/oil_sands_opportunity_balance.pdf.

United Nations Framework Convention on Climate Change,[3] the Kyoto Protocol to the United Nations Framework,[4] and the Copenhagen Summit. State, provincial, and federal governments are in the process of creating and adopting legislation and regulations to facilitate the management of emissions through CCS in depleted oil and gas reservoirs.[5] It is estimated that CCS could capture from 15% to 55% of the world's GHG emissions.[6] In 2003, in light of concerns reported about CO_2 emissions from oil sands production, the provincial government of the leading oil and gas producing province of Alberta enacted the Climate Change and Emissions Management Act (CCEMA)[7] that requires a 50% reduction in provincial GHG emissions, relative to 1990 levels, by 2020.[8] Since 2007, the Specified Gas Emitters Regulation (SGER)[9] has prescribed immediate reduction of GHG emissions by major emitters in the province. The total annual emissions are referred to as total "direct emissions" and defined as a "release of specified gases from sources actually located at a facility."[10] In 2008, the Government of Alberta released a plan to decrease absolute GHG emissions in the province by 14% by 2050, committing two billion dollars to facilitate a reduction in provincial GHG emissions through processes including CCS.[11] Prior to the investment in CCS technology and facilities, clarification of the long-term liability of developers/operators is essential.[12] According to Accelerating Carbon Capture and Storage in Alberta,[13] resolving the CCS long-term liability issue is an area that needs additional research in order to build a workable public policy in jurisdictions like the United States. In 2010, national U.S. and Canadian GHG emissions targets were harmonized.[14]

As in Wyoming, Kansas, and Montana, there is extensive oil and gas reservoir capacity for CCS in Western Canada as a total of 468,019 oil and gas

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3. U.N. Framework Convention on Climate Change, May 9, 1992, 1771 U.N.T.S. 107, 31 I.L.M. 849 [hereinafter *UNFCCC*] (entered into force Mar. 21, 1994).

4. Kyoto Protocol to the United Nations Framework Convention on Climate Change, Dec. 10, 1997, 1771 U.N.T.S. 148, 37 I.L.M. 22 [hereinafter *Kyoto Protocol*] (entered into force Feb. 16, 2005).

5. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (IPCC) WORKING GROUP I, SUMMARY FOR POLICYMAKERS (2007), *available at* http://www.ipcc-wg1.unibe.ch/publications/wg1-ar4/ar4-wg1-spm.pdf.

6. PEMBINA INSTITUTE, CARBON CAPTURE AND STORAGE FACT SHEET (2008), *available at* http://pubs.pembina.org/reports/ccs-fact-sheet.pdf.

7. Climate Change and Emissions Management Act, S.A. 2003, c. C-16.7 (Can.).

8. *Id.* § 3.

9. Specified Gas Emitters Regulation, Alta. Reg. 139/2007 (Can.).

10. *Id.* at pt. 1.

11. GOV. OF ALTA., ALBERTA'S CLIMATE CHANGE STRATEGY : RESPONSIBILITY, LEADERSHIP, ACTION (2008), *available at* http://environment.gov.ab.ca/info/library/7894.pdf.

12. Paul Zakkour & Mike Haines, *Permitting Issues for CO_2 Capture, Transport and Geological Storage: A Review of Europe, U.S.A., Canada and Australia*, 1 INT'L J. OF GREENHOUSE GAS CONTROL 94 (2007).

13. ALTA. CARBON CAPTURE AND STORAGE DEV. COUNCIL, ALTA. MINISTRY OF ENERGY, ACCELERATING CARBON CAPTURE AND STORAGE IN ALBERTA INTERIM REPORT (2008), *available at* http://www.energy.alberta.ca/Org/pdfs/CCSInterimRept.pdf.

14. The Honourable Jim Prentice, Canadian Fed. Minister of the Env't, Address at the University of Calgary School of Public Policy and Haskayne School of Business Calgary, Alberta (Feb. 1, 2010), http://www.ec.gc.ca/default.asp?lang=En&n=6F2DE1CA-1&news=1E866FB5-273D-46F2-9ED8-5CFFBCE8E069.

wells have been drilled in the region,[15] with most of those wells in Alberta. Also, for several decades sour gas[16] has been produced in significant volumes in Alberta with CO_2 and hydrogen sulphide being re-injected into wells since 1989 to reduce sulphur dioxide emissions.[17] Sam Wong et al., have reported thirty-eight such projects, most of which "can be considered as existing examples of CO_2 geological storage projects."[18]

Projects to transport CO_2 via pipeline in Canada and the U.S. are proceeding. These include a pilot CO_2 injection and monitoring facility, established in Saskatchewan, for enhanced oil recovery, to pipe CO_2 from North Dakota into the province for injection and storage.[19] In light of the number of available wells and depleted oil and gas reservoirs in North America, CCS may become an important process to achieve a significant reduction in U.S. and Canadian CO_2 emissions. The long-term regulatory experience with natural gas production and storage in Alberta can be useful to evaluate long-term CCS liability.

One of the critical issues to be clarified before the private sector will invest significant dollars in commercial CCS facilities is the extent of developer and operator long-term liability for CO_2 leaks from petroleum reservoirs. In 2005, M.A. De Figueiredo, et al., noted that in the United States the "legal liability that private firms will face due to leakage . . . from reservoirs ha[d] received little attention in the literature, but could significantly affect the viability of carbon storage as a long-term solution to climate change."[20] Marston and Moore, in 2008, considered a broad set of legal issues associated with CCS in the United States.[21] Other commentators have provided a general overview of the legal issues posed by CCS development in the United States, Canada, the EU, and Australia.[22]

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15. CANADIAN ASSOCIATION OF PETROLEUM PRODUCERS, *Wells and Metres Drilled in Western Canada* (Table 01-03B) in Statistical Handbook (Apr. 27, 2010), http://membernet.capp.ca/SHB/Sheet.asp?SectionID=1&SheetID=299.

16. Natural gas (primarily methane) with H_2S.

17. Nigel Bankes, Jennifer Poschwatta & E. Mitchell Sheir, *Legal Framework for Carbon Capture and Storage in Alberta*, 45 ALTA. L. REV. 585 (2008).

18. Sam Wong, David Keith, Edward Wichert, Bill Gunter & Tom McCann, *Economics of Acid Gas Reinjection: An Innovative CO_2 Storage Opportunity*, GREENHOUSE GAS CONTROL TECHNOLOGIES (J. Gale & Y. Kaya eds., 2003), *available at* http://people.ucalgary.ca/~keith/papers/56.Wong.2003.EconomicsOfAcidGasReinjection.e.pdf (emphasis omitted).

19. PETROLEUM TECHNOLOGY RESEARCH CENTRE, http://www.ptrc.ca/index.php (last visited Sept. 10, 2010); Press Release, GOV. OF ALTA., New Pipeline Will Enhance Carbon Capture and Storage (Nov. 24, 2009), http://www.alberta.ca/acn/200911/27386278A12C1-C3D7-722E-E591EC672F9FC009.html.

20. M.A. De Figueiredo, D. M. Reiner & H.J. Herzog, *Framing the Long-Term In Situ Liability Issues for Geologic Carbon Storage in the United States*, 10 MITIGATION AND ADAPTATION STRATEGIES FOR GLOBAL CLIMATE CHANGE 647 (2005), *available at* http://sequestration.mit.edu/pdf/Liability_Issue.pdf.

21. Philip Marston & Patricia Moore, *From EOR To CCS: The Evolving Legal and Regulatory Framework for Carbon Capture and Storage*, 29 ENERGY L.J. 421 (2008).

22. Tom Kerr, Ian Havercroft & Tim Dixon, *Legal and Regulatory Developments Associated with Carbon Dioxide Capture and Storage: A Global Update*, 1 ENERGY PROCEDIA 4395 (2009); Jerry Fish & Thomas Wood, *Geologic Carbon Sequestration: Property Rights and Regulation*, 54 ROCKY MT. MIN. L. INST. ch. 3 at 8-10 (2008); Bill Jeffery, *Carbon Capture and Storage: Promising Technology, But Many Legal Questions Remain*, 29 ENERGY & MIN. L. INST. 1 (2008); Owen L. Anderson, *Geological CO_2 Sequestration: Who Owns the Pore Space?*, 9 WYO. L. REV. 97 (2009); Stephan Bachu, *Legal and Regulatory Challenges in*

In this article we analyze different approaches to long-term liability in jurisdictions where CCS is being tested to reduce GHG emissions. We provide an overview of the issues to be considered in the management of long-term liability, propose a set of criteria for evaluating different approaches, and conclude by recommending a long-term liability model for North America. We employ a comparative law methodology as described by John Reitz[23] to identify the best approach to promote CCS investment and minimize the possibility that taxpayers may have to pay unanticipated costs for environmental damage that could arise over centuries due to gas leaking from the storage facilities.

The article is organized as follows: in the next section we identify the risks associated with CCS in depleted oil and gas reservoirs, followed by an assessment of those risks. As some state and provincial governments with significant oil and gas reservoirs have taken the lead in considering creating regimes to address long-term liability, rather than either the U.S. or Canadian federal governments, after describing liability exposures associated with storage, we then describe state and provincial regulatory models for long-term liability, including Wyoming, Montana, Kansas, and Alberta. These jurisdictions have created the most comprehensive liability regimes in North America to date. Then we consider the EU and Australian liability models, and briefly describe models in other industries for other risks that have similar characteristics to CCS. Finally, we propose a model for managing long-term liability based on criteria that include appropriate incentives for loss mitigation, equitable compensation for loss, recognition of the complexities associated with CCS, and utilization of private market capabilities where appropriate.

II. RISKS ASSOCIATED WITH LONG-TERM STORAGE OF CO_2

The CCS process involves three main time periods: before start-up, operations (including closure), and post-closure.[24] Prior to start-up, site selection and risk assessment are critical to reducing risk during the operational and storage periods. Although the deployment of CCS in North America is only at the pilot plant stage, the oil and gas industry has decades of experience with natural gas injection and storage. In addition, some oil and gas operators have injected CO_2 as part of enhanced oil recovery (EOR) programs. Despite the existing technical expertise as it relates to the operational aspects of carbon capture and transport, there is uncertainty about the risks associated with storing CO_2 underground for long periods of time. The focus of the analysis here is only on risks associated with long-term storage, as there is a lack of a comprehensive analysis of this issue in the literature.

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the Implementation of CO_2 Geological Storage, 2 INT'L J. OF GREENHOUSE GAS CONTROL 259 (2008); Council Directive 2009/31/EC, 2009, O.J. (L140) 114 (EU) (hereinafter *Council Directive 2009*), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:0114:0135:EN:PDF; Thomas M. Kerr, *Legal Aspects of Storing CO_2 – Update and Recommendations* (2007), *available at* http://www.iea.org/textbase/nppdf/free/2007/legal_aspects.pdf; James McLaren & James Fahey, *Key Legal and Regulatory Considerations for the Geosequestration of Carbon Dioxide in Australia*, 24 AUSTL. RES. & ENERGY L. J. 45 (2005).

23. John C. Reitz, *How to Do Comparative Law*, 46 AM. J. COMP. L. 617 (1998).

24. For a more detailed discussion of the stages, *see generally* Bankes, Poschwatta & Sheir, *supra* note 17, at 587.

The risks associated with long-term carbon storage can broadly be categorized as local, regional, and global environmental effects arising from the release of stored CO_2 to the atmosphere.[25] If leaks do occur a number of hazards exist:

1. potential hazards to human health and safety;[26]
2. hazards to groundwater from CO_2 leakage and brine displacement;[27]
3. hazards to terrestrial and marine ecosystems;[28]
4. induced seismicity;[29] and,
5. implications of gas impurity under circumstances where other gases may be stored along with CO_2 (managing the risk created by the presence of other contaminants that are significantly more toxic than CO_2 is best managed by monitoring of quality as injected).[30]

Although CO_2 is generally regarded as safe and non-toxic, exposure to high concentrations can be harmful and even fatal. Ambient atmospheric concentrations of CO_2 are currently about 370 ppm. Humans can tolerate increased concentrations with no physiological effects for exposures up to 1% CO_2 (10,000 ppm).[31] Therefore, the potential risks associated with leaks from CO_2 storage facilities are an important consideration in facilitating CCS.

Risks from gas leaks associated with public health and environmental damage are generally well understood in light of experience with injection and storing other gases such as natural gas. As noted by Benson:

> For CCS, the highest probability risks are associated with leakage from the injection well itself, abandoned wells that provide short-circuits to the surface and inadequate characterization of the storage site - leading to smaller than expected storage capacity or leakage into shallower geologic formations. Potential consequences from failed storage projects include leakage from the storage formation, CO_2 releases back into the atmosphere, groundwater and ecosystem damage.[32]

Careful site selection, monitoring, and effective regulatory oversight are necessary to reduce the potential risk. In addition, the oil and gas industry already has extensive experience and knowledge about avoiding and managing risks such as damage to an injection well, or leakage up an abandoned well.[33]

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25. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, WORKING GROUP I, *supra* note 5. For a recent discussion of the health and safety risks, *see generally* John Fogarty & Michael McCally, *Health and Safety Risks of Carbon Capture and Storage*, 303 J. AM. MED. ASS'N 67-68 (2010).

26. SEMERE SOLOMON, BEOLLONA REPORT, CARBON DIOXIDE STORAGE: GEOLOGICAL SECURITY AND ENVIRONMENTAL ISSUES-CASE STUDY ON THE SLEIPNER GAS FIELD IN NORWAY 59-60 (2007), *available at* http://www.bellona.org/filearchive/fil_CO2_storage_Rep_Final.pdf.

27. *Id.* at 60.

28. *Id.* at 61-62.

29. *Id.* at 62-63.

30. *Id.* at 63.

31. SALLY M. BENSON, LAWRENCE BERKELEY NATIONAL LABORATORY, CARBON DIOXIDE CAPTURE AND STORAGE IN UNDERGROUND GEOLOGIC FORMATIONS (2004), *available at* http://www.pewclimate.org/docUploads/10-50_Benson.pdf.

32. *Id.* at 9.

33. *Id.*

"[O]ver time, practices and regulations have been put in place to ensure that most of these industrial analogues can be carried out safely.[34]

Although today there is limited experience with long-term CO_2 storage, other closely related experience in the oil and gas industry and other industries, combined with scientific and engineering knowledge, provide a foundation for risk assessments to be made.[35] Specifically, five kinds of evidence are relevant to assessing the probability of CO_2 release from oil and gas reservoirs: 1) data from natural systems, including trapped accumulations of natural gas and CO_2 as well as oil; 2) data from engineered systems (e.g., natural gas storage, gas re-injection for pressure support, or miscible hydrocarbon EOR, disposal of acid gases); 3) fundamental physical, chemical, and mechanical processes regarding the fate and transport of CO_2 in the subsurface; 4) results from numerical models of CO_2 transport; and 5) results from current geological storage projects.[36]

Studies on the long-term environmental impacts of CCS are currently being undertaken in North America (the Weyburn-Midale project in Saskatchewan, Canada, which involves an international CO_2 pipeline across the U.S.-Canadian border).[37] The major problems associated with long-term risk studies can be summarized in two categories.

First, due to the variety of chemicals and physical conditions involved, the ability to replicate them in a laboratory setting is very low, thus requiring extended pilot studies. Second, it is nearly impossible to predict the long-term effects of underground storage under extreme conditions such as earthquakes and other geological upheavals, as well as unforeseen human interventions, such as a terrorist attack or sustained warfare.

Despite the limitations in terms of studying long-term effects, the general conclusion reached after investigating the data is that the risk of CO_2 leakage from properly sited oil and gas reservoirs is very low. For example, "evidence from natural systems demonstrates that reservoir seals exist that are able to confine CO_2 for millions of years and longer."[38] Further, "[n]umerical models show that release of CO_2 by subsurface flow through undisturbed geological media (excluding wells) may be near zero at appropriately selected storage sites and is very likely $< 10^{-6}$ in the few studies that attempted probabilistic estimates."[39]

In summary, "implemented on a small scale, in a well characterized geologic setting, geologic storage poses no unique or poorly understood risks. However, after the best characterized sites are utilized, significant characterization and risk assessment effort will be needed to accommodate additional CO_2 storage."[40] A key premise, however, is that storage sites are

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34. *Id.*

35. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, SPECIAL REPORT ON CARBON DIOXIDE CAPTURE AND STORAGE 250 (2005), *available at* http://www.ipcc.ch/pdf/special-reports/srccs/srccs_wholereport.pdf.

36. *Id.*

37. PETROLEUM TECHNOLOGY RESEARCH CENTRE, IEA GHG WEYBURN-MIDALE CO_2 MONITORING AND STORAGE PROJECT (2010), *available at* http://www.ptrc.ca/siteimages/Brochure_revised_Feb2010.pdf.

38. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE: SPECIAL REPORT, *supra* note 35, at 245.

39. *Id.* at 247.

40. BENSON, *supra* note 31, at 9.

carefully selected. "[S]torage security in mature oil and gas provinces may be compromised if a large number of wells penetrate the caprocks."[41] In addition, "mining or drilling in areas with CO_2 storage sites may pose a long-term risk after site abandonment if institutional [regulator] knowledge and precautions are not in place to avoid accidentally penetrating a storage formation."[42]

Recognizing the risks involved in oil and gas reservoir storage, risk mitigation activities are essential. The Intergovernmental Panel on Climate Change (IPCC) has recommended the following interrelated development and management practices:

- Careful site selection, including performance and risk assessment and socio-economic and environmental factors;
- Monitoring to provide assurance that the storage project is performing as expected and to provide early warning in the event that it begins to leak;
- Effective regulatory oversight;
- Implementation of remediation measures to eliminate or limit the causes and impact of leakage.[43]

It is clear that the likelihood of the risk associated with long-term storage of CO_2 depends on the first time periods for CCS (before start-up and operations, including closure). For the remainder of the paper and for the purposes of discussing the risk associated with long-term liability for CCS, we assume that appropriate risk management is in place, and that due diligence is carried out in order to keep the risks associated with carbon storage to a low level.

We now turn to a discussion of the legal liabilities associated with the potential hazards of long-term carbon storage.

III. PERSONAL INJURY, PROPERTY DAMAGE, AND REMEDIAL LIABILITY FOR LEAKS

This section reviews the potential for liability from gas releases under the common law that can arise from CCS in both the United States and Canada. In the U.S., there has been more litigation than in Canada regarding damage from the injection and release of substances, including gases, and a variety of legal tests have been used by the courts in different states to determine when a trespass has occurred.[44] Some U.S. courts have ruled that a trespass to land occurred with "the entry of invisible gases and microscopic particles where they do harm or cause substantial interference."[45] In *Martin v. Reynolds*,[46] the court ruled the

41. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE: SPECIAL REPORT, *supra* note 35, at 244.

42. *Id.* at 247.

43. *Id.* at 251-52.

44. For subsurface trespass in Texas, see generally *Gregg v. Delhi-Taylor Oil Corp.*, 344 S.W.2d 411 (Tex. 1961); Railroad Comm'n of Texas v. Manziel, 361 S.W.2d 560 (Tex. 1962); Geo Viking Inc. v. Tex-Lee Operating Co., 817 S.W.2d 357 (Tex. App. 1991); Mission Res. v. Garza Energy Trust, 166 S.W.3d 301 (Tex. App. 2005). In Michigan, see generally *ANR Pipeline Co. v. 60 Acres of Land*, 418 F. Supp. 2d 933 (W.D. Mich. 2006). In Ohio, see generally *Chance v. BP Chem. Inc.*, 670 N.E.2d 985 (Ohio 1996).

45. ELAINE L. HUGHES, ALASTAIR R. LUCAS & WILLIAM A. TILLEMAN, ENVIRONMENTAL LAW AND POLICY 108 (3rd ed. 2003).

46. Martin v. Reynolds Metals Co., 342 P.2d 790 (Or. 1959); *see also* Bradley v. American Smelting & Refining Co., 709 P.2d 782 (Wash. 1988).

entry of invisible gases onto land where they caused substantial harm was a trespass. In the context of subsurface injection of substances in the oil industry (hydraulic fracturing), a limited number of cases have considered whether the effect of such a process amounted to a trespass.[47] As in the oil and gas industry, injecting a gas such as CO_2 could displace or combine with in situ fluids or subsurface grains that could result in subsurface, surface, or atmospheric damage.

In Canada, Bankes[48] and Bachu[49] have noted that liability for CO_2 leaks from oil and gas reservoirs can arise both under the common law and statute. Five potential causes of tort action available under the common law include nuisance, trespass, negligence, strict liability,[50] and a cause of action based in riparian rights.[51] As with natural gas storage, after CO_2 is injected into subsurface reservoirs, if it leaks and causes health problems or property damage, liability can arise for different parties including the facility operator. To collect damages for the losses sustained, the injured party must prove specific elements of the relevant tort or torts on a balance of probabilities.

Trespass to land arises from "an intended but unjustifiable interference with another person's possession of land .... Interference with the legal right of possession is sufficient."[52]

> To constitute trespass the defendant must in some direct way interfere with the land possessed by the plaintiff. The requirement of directness differentiates trespass from nuisance, which is committed when the defendant makes a use of his land that indirectly affects the land of the plaintiff.
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> ....
>
> Trespass to land is not limited to a single act, but can be a continuous act. Repeated acts of trespass will give rise to a continuing cause of action.[53]

Liability can arise from a single leak or ongoing releases into the environment that may affect residents and their health, plant and animal species, the soil and crops, and the land surface (heaving). Health and property damage claims may prompt lawsuits based on nuisance. The tort of private nuisance can arise when there is "an unreasonable interference with the use and enjoyment of land that is owned and occupied by another person."[54] In addition, as in the United States, litigation can be initiated for a public nuisance in Canada "to protect the public interest in freedom from dangers to health, safety, mortality,

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47. *Gregg*, 344 S.W. 2d 411; *Geo Viking Inc.*, 817 S.W.2d 357.

48. Bankes, Poschwatta & Sheir, *supra* note 17, at 621.

49. Bachu, *supra* note 22, at 267-68.

50. *Id.* The Canadian Envrionmental Protection Agency Act, 1999 considers CO_2 to be a toxic substance. Canadian Environmental Protection Act, 1999, S.C. 1999, c. 33, § 68, Schedule 1: List of Toxic Substances § 74.

51. Bachu, *supra* note 22, at 268.

52. HUGHES, LUCAS & TILLEMAN, *supra* note 45, at 108; *see also* City of Burnaby v. Thandi, 2005 BCSC 1478, para. 113 (Can.).

53. *City of Burnaby*, 2005 BCSC 1478, para. 113-14 (quoting G.H.L. FRIDMAN, THE LAW OF TORTS IN CANADA 37-38, 40 (2d ed. 2002).

54. HUGHES, LUCAS & TILLEMAN, *supra* note 45, at 93; *see also* Mandrake Mgmt. Consultants Ltd. v. Toronto Transit Comm'n, 102 D.L.R. 4th (Can. Ont. C.A.).

comfort or convenience."[55] As in the petroleum industry, if CCS operations are conducted in a careless manner and later result in leakage from the storage site, liability for negligence can arise for losses due to "unintentional but unreasonable conduct that harmfully affects legally protected interests."[56] In several cases the Canadian courts have imposed liability on oil and gas companies for environmental damage arising from negligent conduct and subsurface leaks.[57]

Liability for damage from CCS has arisen under the doctrine of strict liability, described by Blackburn J. in 1868 in the leading English decision of *Rylands v. Fletcher*:[58]

> We think that the true rule of law is, that the person who for his own purposes brings on his lands and collects and keeps there anything likely to do mischief if it escapes, must keep it in at his peril, and, if he does not do so, is prima facie answerable for all the damage which is the natural consequences of its escape.[59]

The court in *Regina v. Petro-Canada*,[60] ruled that the defendant oil and gas company was liable under strict liability for damage from a pipeline failure, as was *Shell Canada Ltd.*,[61] in a case for subsurface damage from a tank leak on the defendant's property.

In the United States a majority of courts have adopted the *Rylands* rationale and imposed strict liability in cases of abnormally dangerous activities, normally defined in accord with factors identified the Restatement (Second) of Torts section 520 as follows: a high degree of risk of some harm; likelihood of serious harm; risk not eliminated even by due care; activity not a matter of common usage; inappropriateness of the activity; and the extent to which the value of the activity to the community is outweighed by its dangerous attributes.[62]

The precedents suggest that, notwithstanding different tests in a variety of states and provinces, tort liability from gas releases, including CO_2, can arise

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55. HUGHES, LUCAS & TILLEMAN, *supra* note 45, at 100 (quoting O.M. Reynolds, *Public Nuisance: A Crime in Tort Law*, 31 OKLA. L.R. 318 (1978)); *see also* Hickey v. Electric Reduction Co. of Can. (1970), 21 D.L.R. 3d 368 (Can. Nfld. S.C. T.D. 1970).

56. HUGHES, LUCAS & TILLEMAN, *supra* note 45, at 88; *see also* Smith Bros. Excavating Windsor Ltd. v. Camion Equip. & Leasing Inc. (1994), 21 C.C.L.T. 2d 113 (Can. Ont. Gen. Div.) (arising from contamination due to the release of methanol from storage tanks).

57. Restaurant Lepoirer Ltee. v. Foulem, [1983] 51 N.B.R. 2d 435, (Can. N.B. Q.B.); Bennett v. Imperial Oil Ltd. (1960), 28 D.L.R. 2d 55 (Can. Nfld. Sup. Ct.); Downey v. Irving Oil Ltd. (1980), 79 A.P.R. 69 (Can. Nfld. Dist. Ct.); Sturge v. Imperial Oil Ltd. (1970), 1 Nfld. & P.E.I.R. 279 (Can. Nfld. Sup. Ct.).

58. Rylands v. Fletcher, [1866] L.R. 1 Ex. 265 (Eng.).

59. *Id.* at 279.

60. Regina v. Petro-Canada (2003), 4. C.E.L.R. 3d 167 (Can. Ont. C.A.); *see also* Regina v. Petro-Canada (2003), 63 O.R. 3d 219 (Can. Ont. C.A.).

61. British Columbia Tel. Co. v. Shell Canada Ltd. (1987), 13 B.C.L.R. 2d 210 (Can. B.C. Sup. Ct.); Doherty v. Allen (1987), 55 D.L.R. 4th 746 (Can. N.B. C.A.) (holding liability was based on nuisance, negligence, and strict liability).

62. RESTATEMENT (SECOND) OF TORTS § 520 (1977); *see also* Charles E. Cantú, *Distinguishing the Concept of Strict Liability for Ultra-Hazardous Activities from Strict Products Liability Under Section 402A of the Restatement (Second) of Torts: Two Parallel Lines of Reasoning That Should Never Meet*, 35 AKRON L. REV. 31, 35-37 (2001); Luthringer v. Moore, 31 Cal. 2d 489, 498-99, 190 P.2d 1, 7 (1948) (example of abnormally dangerous activities including the use of poisonous gases); Langan v. Valicopters, Inc., 567 P.2d 218, 220-21 (Wash. 1977) (crop dusting contaminated adjoining lands); Green v. Gen. Petro. Corp., 250 Cal. 328, 333-35, 270 P. 952, 955 (Cal. 1928) (drilling for oil).

under nuisance, negligence, trespass, and strict liability in both countries. In addition to surface damage from CO_2 releases, inadvertent damage to subsurface oil and gas reservoirs from CO_2 injection and storage activities may also prompt lawsuits in both the United States and Canada.

IV. RECENT STATE INITIATIVES TO ADDRESS LONG-TERM LIABILITY

This section examines the legislation that has been developed in the three states that have considered this issue. Wyoming, Kansas, and Montana have adopted frameworks to manage CCS long-term liability in depleted oil and gas reservoirs; these states have either enacted or are in the process of adopting CCS legislation.

A. Wyoming

In February 2009, Governor Dave Freudenthal signed H.B. 58 that clarifies the ownership and liability for sequestered CO_2 in Wyoming. Section one provides:

> All carbon dioxide, and other substances injected incidental to the injection of carbon dioxide, injected into any geologic sequestration site for the purpose of geologic sequestration shall be presumed to be owned by the injector of such material and all rights, benefits, burdens and liabilities of such ownership shall belong to the injector. This presumption may be rebutted by a person claiming contrary ownership by a preponderance of the evidence in an action to establish ownership.[63]

The law provides that persons holding rights to oil and gas reservoirs, pore space, or other interests in the land will not be liable for damages relating to the sequestration "solely by virtue of their interest or by their having given consent to the injection."[64] The State of Wyoming has moved in a direction that limits any state responsibility for long-term liability and clearly places the burden on the parties that will inject the CO_2. Wyoming Statute section 35-11-313, enacted in 2008, requires CCS operators to obtain a permit from the Wyoming Department of Environmental Quality (DEQ).[65] The statute requires the DEQ "administrator of the water quality division" to recommend "regulations and standards" for the "content of applications for geologic sequestration permits."[66] The applications are to include "[p]roof of bonding or financial assurance to ensure that geologic sequestration sites and facilities will be constructed, operated and closed in accordance with the purposes and provisions of this act."[67] The Wyoming law also required that:

> As soon as practicable and prior to September 30, 2009, the state oil and gas supervisor, the state geologist and the director [of the DEQ] shall convene a working group for the purpose of developing an appropriate bonding procedure and other financial assurance methods to assure that adequate financial resources are provided to pay for any mitigation or reclamation costs that the state may incur as a result of default by the permit holder. The bond or other financial assurance shall be required

63. 2009 Wyo. Sess. Laws 121.
64. *Id.* §1(b).
65. WYO. STAT. ANN. § 35-11-313(a) (2008).
66. WYO. STAT. ANN. § 35-11-313(f)(ii) (2008).
67. WYO. STAT. ANN. § 35-11-313(f)(ii)(K) (2008).

> during the operating life of the sequestration project and throughout the post-closure care period in order to abate or remedy any violation of a permit, standard or rule established under . . . this act . . . . At a minimum, the bond or other financial assurance shall provide assurance for closure and reclamation costs, post-closure inspection[s] and maintenance costs and environmental monitoring, verification and control costs.[68]

According to a Wyoming DEQ press release, a state working group met on June 17, 2009, "to continue work on its recommendation of acceptable financial assurance methods and liability systems for carbon sequestration activities in Wyoming."[69] The working group forwarded its report to the Wyoming legislature in September 2009, in which it recommended financial assurance through traditional performance bonds, and against third-party claims public liability insurance. A special revenue account funded by project operators to cover DEQ's costs in monitoring and verification during the long-term stewardship period was recommended.[70] The Wyoming State Legislature established in March 2010 the Wyoming geologic sequestration special revenue account in Wyoming Statute section 35-11-318. The legislation sets out the requirements for public liability insurance policies in Wyoming Statute section 35-11-313(f)(ii)(O), and requires the DEQ to adopt rules and regulations requiring bonding and financial assurance for geologic sequestration site permit holders in new paragraphs (vi) and (vii) of Wyoming Statute section 35-11-313(f).[71]

The Wyoming Government has adopted a CCS liability scheme that imposes all liability on the parties injecting CO_2. In 2008, it developed laws to provide for the creation of bonding or financial assurance requirements. H.B. 58 adopted in 2009, provides for the injector to retain all liability. Rob Huress, the energy advisor to Governor Freudenthal, noted that H.B. 58, and the other carbon sequestration bills passed in February of 2009, are an extension of existing CCS laws in the state.[72] Rep. Tom Lubnau, "a prime architect of Wyoming's carbon storage laws," declared that in order to make CCS an attractive and viable industry, the developers and operators require unambiguous liability rules.[73] He alluded to the importance of certainty in the liability framework for those in the industry considering whether or not to proceed with a CCS project, "[t]o do one of these projects, they say that if they know who the liability belongs to, then they can assess it and figure our [sic] what the financial

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68. WYO. STAT. ANN. § 35-11-313(g) (2008), *repealed by* 2010 Wyo. Sess. Laws 51.

69. News Release, Wyoming Dep't Envtl. Quality, Carbon Sequestration Working Group Meeting in Cheyenne (Jun. 15, 2009), *available at* http://deq.state.wy.us/out/downloads/Carbon%20Group%20Meeting%20June%202009.pdf.

70. WYOMING DEP'T OF ENVTL. QUALITY, REPORT AND RECOMMENDATIONS OF CARBON SEQUESTRATION WORKING GROUP TO THE JOINT MINERALS, BUSINESS AND ECONOMIC DEVELOPMENT COMMITTEE AND THE JOINT JUDICIAL COMMITTEE OF THE WYOMING STATE LEGISLATURE 37-43 (2009) http://www.deq.state.wy.us./out/downloads/1%20FinalReport081909.pdf.

71. 2010 Wyo. Sess. Laws 242-45, *available at* http://deq.state.wy.us/out/downloads/1%20FinalReport081909.pdf.

72. Ben Neary, *Panel Backs CO_2 Storage Bills*, TRIB.COM (Dec. 29, 2008), http://www.trib.com/articles/2008/12/29/news/wyoming/5a393af771a41de18725752f00038495.txt.

73. *Id.*

assurances are that they need . . . . It's the uncertainty that kills the market."[74] It would appear that the approach to liability in Wyoming is based on the assumption that CCS projects will be economically attractive to industry notwithstanding that the private sector will assume liability in perpetuity. It is unclear whether CCS projects will be economically attractive to potential developers and operators in the state.

B. Kansas

In 2007, the Kansas State Government enacted the Carbon Dioxide Reduction Act.[75] The statute empowers the Kansas Corporation Commission (KCC) for the state to create rules for a broad range of issues related to CCS, including fees, "closure and abandonment requirements," and financial assurances.[76] The statute provides that "[a]ny company or operator receiving a permit under the provisions of this act shall demonstrate annually to the commission evidence, satisfactory to the commission, that the permit holder has financial ability to cover the cost of closure of the permitted facility as required by the commission."[77]

The legislation creates a Carbon Dioxide Injection Well and Underground Storage Fund (the Fund),[78] which will receive the funds generated under the act, including fees for CO_2 permitting and storage.[79] The fund may be used for a variety of purposes including "mitigation of adverse environmental impacts" and "emergency or long-term remedial activities," relating to CCS.[80]

The KCC has developed and proposed regulations for CO_2 Storage Facilities which entered into force on February 26, 2010.[81] The proposed regulations outline the approach the state government will adopt for long-term liability of CCS projects. The regulations contemplate a permitting system that requires "a demonstration of financial responsibility to ensure proper operation and closure of the CO_2 storage facility," annual safety reviews and inspections,[82] and fees which included a $4,500 permit application fee, an annual $1,000 fee per well and a quarterly "fee of five cents per ton of CO_2 injected."[83] The fees are to be held in the Fund and can be used for remediation of sites.[84]

Under the regulations CCS operators will apply for approval to "decommission and abandon [a] storage facility."[85] An application is to include "a schedule for abandoning the storage facility, including when and how all

74. *Id.*
75. KAN. STAT. ANN. § 55-1636 to -1640 (2007).
76. KAN. STAT. ANN. § 55-1637(2), (3)(b)-(c) (2007).
77. KAN. STAT. ANN. § 55-1637(3)(e) (2007).
78. KAN. STAT. ANN. § 55-1638(a)(1) (2007).
79. *See* KAN. STAT. ANN. § 55-1638(a)(2) (2007).
80. KAN. STAT. ANN. § 55-1638(b)(8)-(9) (2007).
81. KAN. ADMIN. REG. §§ 82-3-311a, -1100 to -1120 (2010), *available at* http://www.kcc.state.ks.us/conservation/index.htm (follow the Rules and Regulations for the Conservation of Oil and Natural Gas hyperlink; located at G-10, O-1 to O-17); 29 Kan. Reg. 182-190 (Feb. 11, 2010), *available at* http://www.kssos.org/pubs/register%5C2010%5CVol_29_No_06_February_11_2010_p_165-196.pdf.
82. KAN. ADMIN. REG. § § 82-3-1101(15), -1109 to -1111 (2010).
83. *Id.* § 82-3-1119.
84. *Id.*
85. *Id.* § 82-3-1116.

equipment and buildings will be abandoned and when the CO_2 storage wells will be plugged."[86] The application would also state "the method of monitoring to demonstrate the containment, pressure, and position of the CO_2 plume during the closure period."[87]

Under the proposed regulations the operator would apply for a "postclosure determination,"[88] and demonstrate the following:

> The CO_2 storage facility operator shall demonstrate that both of the following conditions are met before postclosure status may be granted:
> (1)The CO_2 plume has stabilized, is contained within the storage reservoir, and is not a threat to public health and safety and usable water.
> (2)The CO_2 storage reservoir is stable.
> If the application is denied, the closure period activities shall continue . . . . Upon written approval of postclosure status, the operator shall plug the remaining monitor wells . . . . After the remaining monitor wells are plugged, the CO_2 storage facility permit shall be revoked.[89]

In Wyoming, the minimum time period for applying has not yet been determined.

After initial indications that the state of Kansas would assume long-term liability, the Carbon Dioxide Reduction Act was amended in 2010 to limit the liability of the state by the insertion of subsection (h) in Kansas Statute section 55-1637; the Regulations have been changed accordingly to omit one sentence of the earlier proposal "[All] [f]uture remediation or monitoring activities shall be performed by the State," using funds from the commission's CO_2 remediation fund.[90]

When the Carbon Dioxide Reduction Act and the regulations proposed in Kansas are compared with the Wyoming CCS framework, both state governments are not prepared to assume long-term liability.[91] This is the same approach adopted in March 2010 by the State of Victoria, Australia, for onshore CCS.[92] Section seven of the Victoria Greenhouse Gas Geological Sequestration Act[93] provides that the objectives of the legislation include "encouraging and facilitating greenhouse gas sequestration operations," and at the same time

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86. *Id.* § 82-3-1116(c).

87. *Id.* § 82-3-1116(f).

88. *Id.* § 82-3-1117.

89. *Id.* § 82-3-1117.

90. H.B. 2418, 2010 Leg., Reg. Sess., § 3(h) (Kan. 2010); Doug Louis, *Carbon Dioxide Injection in Kansas*, Kansas Corporation Commission - Conservation Division (June 4, 2010) at 5, 8, *available at* http://kcc.ks.gov/conservation/kgs_co2_field_conf_060410.pdf; Letter from Thomas Wright, Chairman, to Carol Homes, Chairman, Kansas Corporation Commission, Joint Committee on Administrative Rules and Regulations (Oct. 13, 2004), *available at* http://skyways.lib.ks.us/ksleg/KLRD/Resources/Testimony/EEP/10_09/13aWright_CO2.pdf.

91. KAN. ADMIN. REG. § 82-3-1117; *see also* Kansas Corporation Commission, Notice of Hearing on Proposed Administrative Regulations (Jan. 16, 2009), *available at* http://kcc.ks.gov/conservation/hearing_032609.htm (mentioning that the state will perform remediation activities using the CO2 remediation fund, but that fund is not described in the statues or proposed regulations).

92. *Greenhouse Gas Geological Sequestration Act 2008* (Vict.) s 67 (Austl.); Blake Dawson & Robert Jamieson, *Victoria Enacts Greenhouse Gas Storage Legislation for Its Offshore Waters*, BLAKE DAWSON (May 27, 2010), http://www.blakedawson.com/Templates/Publications/x_article_content_page_all.aspx?id=58795#page=1.

93. *Greenhouse Gas Geological Sequestration Act 2008* (Vict.) s 7(a), (d).

"ensur[e] that greenhouse gas sequestration operations are conducted in accordance with the principles of sustainable development."[94]

C. *Montana*

In May 2009, Governor Schweitzer approved a new law for CCS in Montana,[95] which provides more options for companies injecting CO_2 than are found in Wyoming and Kansas. The approach to CCS in Montana appears to incorporate elements from the Wyoming and Kansas systems discussed above. Section two of the Montana law provides for the establishment of an account into which a "[g]eologic storage reservoir administrative fee" will be deposited.[96] As in Kansas, CO_2 injectors will pay a fee per ton and the fees will be deposited in the account.[97] The fees are to be used "for the purpose of carrying out the state's responsibility to monitor and manage geologic storage reservoirs."[98] In addition, any funds obtained from bonds, insurance, or other financial instruments are to be added to the account.[99]

Liability is addressed in section three which provides that the injector is "liable for the operation and management of the carbon dioxide injection well, the geologic reservoir, and the injected or stored carbon dioxide."[100] The Montana CCS regulatory framework imposes liability on a broader basis than in Wyoming and Kansas. In Montana, the injector is to remain liable "[u]ntil the certificate of project completion is issued . . . and title to the stored carbon dioxide and geologic storage reservoir is transferred to the state."[101] As with Wyoming and Kansas, Montana requires a bond or some financial instrument to ensure that the state is covered for the costs and liabilities arising from CCS,[102] and as in other states the funds will be deposited into a CCS account. Also, as in other states and the province of Alberta, bonds or equivalent financial security are required to address the financial responsibilities of an injector during the term that it assumes liability for a CCS project.[103]

The Montana Act provides for the transfer of liability associated with the CCS project from the injector to the state. Pursuant to section four, fifteen years

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94. *Id.*

95. Charles S. Johnson, *Governor Signs Carbon Dioxide Storage Bill*, HELENAIR (May 6, 2009), *available at* http:/helenair.com/news/local/govt-and-politics/article_c5ae6b6c-e58b-531d-9918-f9d075fb22a9.html.

96. S.B. 498, 61st Leg. § 2 (Mont. 2009).

97. *Id.* § 2(2) (establishing that "[t]here is a geologic storage reservoir program account in the special revenue fund"). Section 2(3)(a) requires the fees collected to deposited in the account.

98. *Id.* § 2(1)(a) (stating that the fees will be established by the Board of Oil and Gas Conservation and are to reflect "the anticipated actual expenses that the board will incur in monitoring and managing geologic storage reserves during their post closure phases"); *see also id.* § 2(b)(c).

99. *Id.* § 2(3)(b).

100. *Id.* § 3(1).

101. *Id.*

102. *Id.* § 3(2); *see also id.* § 17(f) (amending MONT. CODE ANN. § 82-11-123(1)(f) (2009) to require "[t]he furnishing of reasonable bond or other surety for a carbon dioxide injection well, geologic storage reservoir, and the carbon dioxide stored in the reservoir with good and sufficient surety for performance of the duty to operate and manage a carbon dioxide injection well . . . . The bond or surety may be forfeited in its entirety by the board for failure to perform the duty to properly manage and operate a well, reservoir, and stored carbon dioxide or to plug a well.").

103. *Id.* § 3(2).

after an operator has stopped injecting CO_2, it may obtain a "certificate of completion" from the Montana Board of Oil and Gas Conservation (MBOGC) if it:

> (a) is in full compliance with regulations governing the geologic storage reservoir . . . ;
> (b) shows that the geologic reservoir will retain the carbon dioxide stored in it;
> (c) shows that all wells, equipment, and facilities to be used in the postclosure period are in good condition and retain mechanical integrity;
> (d) shows that it has plugged wells, removed equipment and facilities, and completed reclamation work as required by the board;
> (e) shows that the carbon dioxide in the geologic storage reservoir has become stable, which means that it is essentially stationary or chemically combined or, if it is migrating or may migrate, that any migration will not cross the geologic storage reservoir boundary; and
> (f) shows that the geologic storage operator will continue to provide adequate bond or other surety after receiving the certificate of completion for at least 15 years following issuance of the certificate of completion and that the operator continues to accept liability for the geologic reservoir and the stored carbon dioxide.[104]

Therefore, in addition to the initial post-injection fifteen-year period during which the operator/injector must retain liability and financial sureties, the operator must assume liability and provide sureties for an additional fifteen years after it secures a certificate of completion from the government.[105] At that point in time, i.e., after a minimum of thirty years have passed since CO_2 injection ceased, the operator may with the consent of the state regulator, "transfer title to the geologic storage reservoir and to the stored carbon dioxide to the state."[106] The operator will be able to transfer title if during the fifteen years after issuance of the certificate of completion, the state's monitoring of the wells have adequately demonstrated the following: "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."[107]

In situations where the title is transferred, it will be "without payment or any compensation," and the state will acquire "all rights and interests in and all responsibilities associated with the geologic storage reservoir and the stored carbon dioxide."[108] The former operator is "released from all regulatory requirements and liabilit[ies] associated" with the CCS project, and the bonds will also be released.[109] Under the Montana law, liability of the state is described as follows: "monitoring and managing the geologic storage reservoir and the stored carbon dioxide is [then] the state's responsibility to be overseen by the board until the federal government assumes responsibility for the long-

104. *Id.* § 4(4)(a)-(f). Before issuing the certificate, the Board must consult with the Montana Department of Environmental Quality (DEQ). *Id.* § 4(5)(a).

105. *Id.* § 4(6).

106. *Id.* § 4(7)(a).

107. *Id.* § 4(7)(b). Prior to transferring title, the Board must again consult with the DEQ, and then Board will make a recommendation concerning the transfer to the Board of Land Commissioners (BLC), and the BLC will make the "final decision." *Id.* § 4(7)(c).

108. *Id.* § 4(8)(a)-(b).

109. *Id.* § 4(8)(c)-(d).

term monitoring and management of geologic storage reservoirs and stored carbon dioxide."[110]

Alluding to the possibility that the federal government will assume liability underlines the uncertainty that state government may encounter when developing CCS legislation. The Environmental Protection Agency (EPA) is in the process of establishing rules for CSS, and probably liability. Therefore, states such as Wyoming may be hesitant to assume any liability if the federal government is prepared to do so in the future.

On July 25, 2008, the EPA published a proposed rule under the Safe Drinking Water Act Underground Injection Control Program to create a new class of injection well (Class VI) for geological sequestration of CO_2.[111]

After a period of public consultation the EPA is currently developing a long-term management framework for permitting commercial scale CCS projects.[112] Part of this long-term management framework includes regulations for owners and operators of wells injecting CO_2.[113] The EPA estimates it will complete the framework by December 2010.[114]

D. Wyoming, Kansas, and Montana: A Comparison

The Montana CCS framework incorporates elements of the Kansas and Wyoming systems. The Montana state government allows injectors to transfer liability to the state after demonstrating that the CO_2 has been stored effectively and will not pose a danger. In Montana, a CO_2 injector has the option of retaining liability in perpetuity as is required in Wyoming. The Montana CCS law states: "If the operator does not transfer title to the state . . . the operator indefinitely accepts liability . . . ."[115] In Montana, if an operator decides to assume long-term liability, the fees for monitoring and management will be returned to the operator.[116] If an operator does not satisfy the requirements and must retain liability, the fees are not returned.[117] In addition, after the requisite thirty years have elapsed since the cessation of CO_2 injection, an operator has the option to petition to have its liability transferred to the state.[118] The petitions can be made every fifteen years, but in this situation the fees will be retained by the government to offset the costs of monitoring that have and will continue to be incurred.[119]

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110. *Id.* § 4(8)(e).

111. Proposed Rulemaking, Federal Requirements Under the Underground Injection Control (UIC) Program for Carbon Dioxide (CO_2) Geologic Sequestration (GS) Wells, 73 Fed. Reg. 43,492, 43,534-41 (2008) (to be codified at 40 CFR pts. 144, 146).

112. EPA, REPORT OF THE INTERAGENCY TASK FORCE ON CARBON CAPTURE AND STORAGE 13 (2010), *available at* http://www.epa.gov/climatechange/policy/ccs_task_force.html.

113. *Id.* at 63.

114. EPA, SEMIANNUAL REGULATORY AGENDA (2010), Sequence Number 903 at 154, *available at* www.epa.gov/lawsregs/documents/regagendabook-spring10.pdf.

115. S.B. 498, 61st Leg. § 4(9)(a) (Mont. 2009).

116. *Id.* § 2(1)(a).

117. *Id.*

118. *Id.* § 4(10).

119. *Id.*

The Montana framework is more flexible than in Wyoming or Kansas with regard to the long-term liability that an operator is to assume. The operator could pay the specified fees and obtain bonds for the active life of the CCS well and for as little as thirty years thereafter.[120] At that point, if there are no problems, the operator could transfer all liability to the state.[121] On the other hand, the operator can decide to retain the liability in perpetuity, although it will still need to retain adequate bonds or other financial instruments.[122] Whether the operator chooses to retain liability or not will likely depend on the size of the fees and the operator's assessment of the risks associated with CCS. More flexibility is built into the Montana state system than in Wyoming or Kansas, as an operator that retained liability has the opportunity to transfer liability to the state at different time intervals. Arguably, the more flexible approach of the State of Montana to the transfer of liability should be more attractive to CO_2 developers and operators, assuming the fees are reasonable. Given the uncertainty surrounding CCS, an interested company may well prefer the option to determine its level of risk. In Montana, an operator can make the decision as many as thirty years after injection operations have stopped, which will give the operator more time to evaluate the risk and its best course of action.

In both Kansas and Montana, the government systems require two steps to complete the liability transfer. There is a decommissioning and abandonment phase in Kansas, followed by a post-closure phase with monitoring requirements. Both of these phases are initiated on the application of the injector.[123] The Montana Government will allow an injector to apply for a certificate of completion fifteen years after CO_2 injection has stopped.[124] This period is followed by another fifteen-year period in which the wells are monitored.[125] Both states require the operator to demonstrate that the CO_2 storage facility is stable and will not pose a danger to the public.[126] It is not clear whether there is any real difference between the systems, other than Montana requires that certain time periods elapse before the state assumes liability. The minimum time periods appear to be important, as they will compel the CCS operator to demonstrate that the CO_2 has been stored safely for a significant period of time.

With regard to the possibility of a catastrophic disaster and the associated significant damage that could be caused by the release of significant quantities of sequestered CO_2, it is not clear that any of the three selected states has addressed the issue on a comprehensive basis. Each state's CCS framework that we have discussed appears to assume that the bonding requirements will be sufficient to cover any damages while the operator retains liability in each respective system. The Montana and Wyoming governments have accepted that in the long-term,

120. *Id.* § 4(7)(a).

121. *Id.*

122. *Id.* § 4(9)(a).

123. DOUG LOUIS, KCC-CONSERVATION DIVISION, CO2 SEQUESTRATION: KANSAS RULES AND REGULATIONS, KCC-CONSERVATION DIVISION (2008), *available at* http://www.kcc.state.ks.us/co2/121608/louis_121608.pdf.

124. S.B. 498, *supra* note 115, § 4(3).

125. *Id.* § 4(4)(f).

126. *Id.* § 4(7)(b).

the state is likely going to have to assume that risk and are collecting fees to compensate for that risk.[127] It would appear that the Wyoming state government has not addressed the situation in which the bonds are insufficient. If the costs are in excess of what is prescribed, the additional remediation and reclamation expenses may well be borne by the taxpayers.

V. MINIMIZING UNANTICIPATED TAXPAYER LIABILITY FOR FUTURE CCS DEVELOPMENT - DRAWING ON THE ALBERTA OIL AND GAS RECLAMATION EXPERIENCE

Problems with the enforcement of remediation and reclamation laws for oil and gas industry well sites in the 1980's culminated in a decision by the highest court in Alberta in 1992. The Alberta Court of Appeal, in *Panamericana de Bienes y Servicos SA v. Northern Badger Oil & Gas Limited (Panamericana)*,[128] decided the first Canadian case that confirms secured creditors can be liable for well abandonment costs to prevent environmental contamination. In the *Panamericana* dispute, secured creditors objected to the court-appointed receiver-manager for an insolvent oil company from authorizing funds to plug and properly abandon seven wells to prevent environmental contamination, as ordered by the Energy Resources Conservation Board (ERCB), the provincial oil and gas industry regulator. Chief Justice Laycraft on behalf of the highest court in the province stated:

> [T]he direct issue in this litigation, in my opinion, is whether the *Bankruptcy Act* requires that the assets . . . of an insolvent well licensee should be distributed to creditors leaving behind the duties respecting environmental safety, which are liabilities, as a charge to the public.
>
> . . . .
>
> The statutory provisions requiring the abandonment of oil and gas wells are part of the general law of Alberta, binding every citizen of the province. All who become licensees of oil and gas wells are bound by them. Similar statutory obligations bind citizens in many other areas of modern life. Rules relating to health, or the prevention of fires, or the clearing of ice and snow, or the demolition of unsafe structures are examples which come to mind . . . . The duty is owed as a public duty by all of the citizens of the community to their fellow citizens.[129]

The court then concluded that provincial environmental protection legislation that provided for the plugging and abandonment of oil and gas wells to prevent groundwater contamination was an act of general application for safe operating practices and protection of the public.[130] The appellate court affirmed the constitutional validity of the ERCB order that prompted the receiver-manager to release funds from the bankrupt company to plug the wells to prevent environmental contamination.[131]

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127. Wyoming law does provide for a permit fee, see *id.* § 2(1)(a), but this fee is the type normally associated with permit applications and is not like the per-ton fee Montana and Kansas have instituted.

128. Panamericana v. Northern Badger Oil & Gas Ltd. (1991), 117 A.R. 44, para. 29, 33 (Can. Alta. C.A.).

129. *Panamericana*, 117 A.R. at para. 33.

130. *Id.* at para. 63.

131. *Id.*

After the liability problem that arose in the *Panamericana* dispute, the Alberta Government created an "orphan well" fund in 1994, financed by an oil and gas industry levy.[132] The Oil and Gas Conservation Act (OGCA)[133] and regulations[134] require a well operator to post security with the government. Sections twenty-seven and thirty of the OGCA provide that it is the responsibility of the well or facility licensee and/or the working interest owners to remediate and reclaim the site to the standard stipulated by the government. Section twenty-nine of the OGCA states that "[a]bandonment of a well or facility does not relieve the licensee, approval holder or working interest participant from responsibility for the control or further abandonment of the well or facility . . . or for the responsibility for the costs of doing that work."[135] In *Dalhousie Oil Company Limited*,[136] the ERCB reviewed long-term liability for well abandonment costs and confirmed that the current working interest participant of an abandoned well has a continuing responsibility to pay for the re-abandonment costs associated with that well in accordance with their proportionate share in the well even though the well had not produced since the 1926.[137] As Professor Nigel Bankes notes:

> The industry argues that the storage entity cannot accept long-term liability for such possible storage failures because it is an unknown and unquantifiable risk, and because after a period of time there is the further risk that the storage entity will be defunct. This decision demonstrates that in the conventional oil and gas business (and not just the conventional business because the ss. 28 – 30 OGCA obligations apply, for example to acid gas disposal wells), the industry in practice operates within a rule system that leaves liability on a long-term and on-going basis firmly with owners and operators, and only secondarily with the industry fund; and only if that were to turn out to be under-capitalized would there then be recourse to general revenues (and then only as a matter of policy and discretion and not as a matter of law).[138]

If the responsible party designated by the government fails to reclaim the site, under section 28 of the OGCA, the regulator can make arrangements for a contractor to perform the obligations for the account of the responsible party and bill that party. In the event that the government is unsuccessful in collecting the costs from a responsible party (due to the bankruptcy of all of the parties), as a last resort under sections 68 and 70(1) of the OGCA the costs may be recovered from the Orphan Fund.[139]

In Alberta every oil and gas well licensee is obligated to pay the annual levy, calculated on the licensee's proportionate share of deemed liabilities for the

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132. *See generally* Canadian Association of Petroleum Producers, http://capp.ca/environmentCommunity/land/Pages/RestoringLand.aspx#OpTaAOhPtCJF (last visited Sept. 9, 2010).

133. Oil and Gas Conservation Act, R.S.A. 2000, c. O-6 (Can. Alta.).

134. *Id.*; Alberta Oil and Gas Conservation Regulations, Alta. Reg. 151/71, s. 16.640 (Can.).

135. Oil and Gas Conservation Act, s. 29.

136. Energy Res. Conservation Bd., *Dalhousie Oil Co.*, ERCB.CA (May, 18, 2010), *available at* http://www.ercb.ca/docs/documents/decisions/2010/2010-019.pdf.

137. *Id.* at paras. 4, 5.5.

138. Nigel Bankes, *A Century of Liability for an Abandoned Well*, ABLAWG, p. 3 (Jun. 10, 2010), *available at* http://ablawg.ca/wp-content/uploads/2010/06/blog_nb_dalhousie_june 2010.pdf.

139. Oil and Gas Conservation Act ss. 68, 70(1); Oil and Gas Conservation Act Regulations, Alta. Reg. 151/71, s. 16.647 (Can.).

whole oil and gas industry in the province.[140] An Orphan Well Association monitors the number of well abandonments in the province and manages the fund under the auspices of the ERCB. A Licensee Liability Rating (LLR) Program in the province was created in September 2005 to minimize payouts from the orphan well fund, under which the wells are monitored and managed.[141] The ERCB determines the LLR rating of oil and gas operators by calculating the value of a corporation's hydrocarbon production in Alberta, and offsetting that amount against the estimated abandonment and reclamation costs. The financial responsibility of well licensees and large facility operators is assessed monthly. Operators are expected to maintain an LLR rating of more than one. In the event that a proposed well transfer would result in a rating of less than one, an operator will be required to post a security deposit with the ERCB. The regulator will hold the deposit until the operator achieves an LLR rating of one. As of June 5, 2010, the ERCB held 46.6 million dollars in security deposits.[142]

Under sections 73 and 74 of the OGCA, in determining the annual levy, the type of well and facility (except pipelines) are considered along with sites that have not yet been reclaimed by a licensee. The levy is calculated by considering "each company's proportion of deemed liabilit[y] to the total oil and gas industry . . . liability."[143] Under the LLR program, on a monthly basis the ERCB evaluates the ability of the licensee to meet its remediation and reclamation liability by comparing its deemed assets and liabilities. In regard to the approach of the Alberta Government to environmental problems from the injection of H_2S and CO_2 on provincial Crown lands (public lands) to date, the Mines and Minerals Act provides that any person "shall indemnify the Crown in right of Alberta for loss or damage suffered by the Crown in respect of any claims or demands made by reason of anything done by that person or any other person on that person's behalf in the exercise or purported exercise of that right."[144] This includes the right to inject gas. In 2007, the ERCB issued a directive[145] that further details the regulatory requirements for suspension of inactive wells. Effective December 31, 2007, wells inactive for a period of ten consecutive years must satisfy the provincial government suspension requirements which include a minimum expenditure of $36,000 on each inactive well.[146]

Governments in other Canadian oil and gas producing provinces, such as Saskatchewan and British Columbia (B.C.), have adopted programs modeled after the Alberta orphan well program to prevent taxpayers from incurring the expense arising from plugging oil and gas wells and reclaiming well sites. The Saskatchewan Government has adopted an "Orphan Well and Facility

140. Energy Res. Conservation Bd., *Directive 006*, ERCB (Sept. 15, 2009), *available at* http://www.ercb.ca/docs/documents/directives/Directives006.pdf; Energy Res. Conservation Bd., *Bulletin 2007-01*, ERCB (Jan. 23, 2007), *available at* http://www.ercb.ca/docs/documents/bulletins/bulletin-2007-01.pdf.

141. *Directive 006*, *supra* note 140, para. 1.

142. Energy Res. Conservation Bd., http://www.ercb.ca (last visited Sept. 10, 2010).

143. Joseph Castrilli & Gary Scandlan, *Creating A Legal Regime to Fund Cleanup of Orphaned and Abandoned Mines in Canada: A Task Past Due*, 23 C.E.L.R. (3d) 72 (2008).

144. Mines and Minerals Act, R.S.A., 2000, c. M-17, s. 56(2) (Can. Alta.).

145. Energy Res. Conservation Bd., *Directive 013*, ERCB (July 24, 2007), http://www.ercb.ca/docs/documents/directives/Directive013.pdf.

146. *Id.*

Program",[147] and in 2005 the B.C. Government approved an orphan site reclamation fund.[148] In contrast to the Canadian approach outlined above, the iconic oil producing state of Texas does not have a similar approach to orphan wells. Rather the Railroad Commission of Texas since 2006 has managed an orphaned well reduction program that "includes procedures, requirements and incentives for a person to assume the operatorship and regulatory responsibility for orphaned oil and gas wells."[149] The incentives include non-transferable payments from the Commission and non-transferable exemptions from remediation fees and severance taxes.

As suggested by Professor Nigel Bankes and Jenette Poschwatta in 2008, the current Alberta orphan fund could be modified to manage long-term liability issues for CCS facilities:

> [F]urther thought will have to be given to the design of a liability scheme. Even if it is proposed to retain a scheme that is similar to that currently in force under the OGCA it seems likely that we will need a different orphan fund if only to identify and tap into the broader range of industries that will be contributing to the CO_2 waste stream. Both fairness and efficiency require that these industries should be required to contribute to (and thereby internalize) these long-run liabilities.[150]

In light of the anticipated CO_2 storage period of centuries or eons, state regulators should carefully consider the liability that can arise in the post CO_2 injection phase after the storage facility has closed as it can be difficult to identify the responsible parties as has been the experience in the North American oil and gas industry. It is also uncertain as to which party will remain responsible for long-term monitoring of the storage facility.

In addition to the orphan well fund administered by the ERCB, under the Environmental Protection and Enhancement Act[151] (EPEA), the Alberta Department of the Environment (ABENV) administers the legislation and associated regulations along with the ERCB, the main oil and gas industry regulator. ABENV is responsible for regulating the environmental impacts from CCS projects. With regard to CO_2 releases, subsection 109(2) of EPEA provides that "[n]o person shall release or permit the release into the environment of a substance in an amount, concentration or level or at a rate of release that causes or may cause a significant adverse effect."[152] In addition, subsection 108(1) provides that "[n]o person shall release or permit the release of a substance into the environment in an amount, concentration or level or at a rate that is in excess

147. Franklin Foster, *Orphan Well and Facility Program*, HEAVY OIL SCIENCE CENTRE (2006), http://www.lloydministerheavyoil.com/orphanwellsaskhtm; Bob Ellis, *Saskatchewan Introduces New Orphan Oil and Gas Well and Facility Program*, GOV. OF SASK. (July 23, 2007), http://www.gov.sk.ca/news?newsId=f3c908dc-534f-4d30-b615-5a674a30afa3.

148. Jake Jacobs, *Industry Funds Closure, Cleanup of Orphan Well Sites*, GOV. OF B.C. (Oct. 29, 2005), http://www2.news.gov.bc.ca/news_releases_2005-2009/2005EMPR0045-000924.htm.

149. Orphan Well Reduction Program, R.R. COMM'N OF TX. (May 20, 2009), http://www.rrc.state.tx.us/compliance/orphanwells/reductionprogram.php.

150. Nigel Bankes & Jenette Poschwatta, *Carbon Capture and Storage in Alberta: Learning From Acid Gas Disposal Analogy*, 97 CANADIAN INST. OF RES. LAW 1, 5 (2007), *available at* http://www.law.ucalgary.ca/system/files/Resources97.pdf.

151. Environmental Protection and Enhancement Act, R.S.A. 2000, c. E-12 (Can. Alta.).

152. *Id.* at s. 109(2).

of that expressly prescribed by an approval or the regulations."[153] The term "substance" is defined in subsection 1(mmm) of the Act as:

> any matter that is capable of becoming dispersed in the environment, or (B) is capable of becoming transformed in the environment into matter referred to in paragraph (A), any sound, vibration, heat, radiation or other form of energy, and any combination of things referred to in subclauses (i) and (ii).[154]

We submit that carbon dioxide falls under the broad definition of substance in EPEA subsection 1 (mmm) of EPEA that applies to the release of substances. The EPEA lists different parties that the Alberta Government can pursue when there is a release of a substance. Subsection 107(1)(a) defines the "owner of the substance" as the "owner of the substance immediately before or during the release of the substance."[155] In subsection 107(1)(b) the "person having control of a substance" is defined as "the person having charge, management or control of the substance."[156] In the case of a "contaminated site," subsection 107(1)(c) lists six potential parties that the Alberta Government lists as the "person responsible" for such a site. The responsible parties that the government may pursue include the following:

> (i) a person responsible for the substance that is in, on or under the contaminated site,
> (ii) any other person who the Director [with ABENV] considers caused or contributed to the release of the substance into the environment,
> (iii) the owner of the contaminated site,
> (iv) any previous owner of the contaminated site who was the owner at any time when the substance was in, on or under the contaminated site,
> (v) a successor, assignee, executor, administrator, receiver, receiver-manager or trustee of a person referred to in any of subclauses (ii) to (iv), and
> (iv) a person who acts as the principal or agent of a person referred to in any of subclauses (ii) to (v).[157]

Subsection 112(1) provides that:

> Where a substance that may cause, is causing or has caused an adverse effect is released into the environment, the person responsible for the substance shall, as soon as that person becomes aware of or ought to have become aware of the release,
> (a) take all reasonable measures to
> (i) repair, remedy and confine the effects of the substance, and
> (ii) remediate, manage, remove or otherwise dispose of the substance in such a manner as to prevent an adverse effect or further adverse effect, and
> (b) restore the environment to a condition satisfactory to the Director.[158]

Section 113 of the EPEA, provides ABENV with the authority to issue an "environmental protection order."[159] Such an order was issued to an oil well owner, "the person responsible," to clean up a spill that had migrated and contaminated land for decades in *Legal Oil & Gas Ltd. v. Alberta (Minister of*

153. *Id.* at s. 108(1).
154. *Id.* at s. 1(mmm).
155. *Id.* at s. 107(1)(a).
156. *Id.* at s. 107(1)(b).
157. *Id.* at s. 107(1)(c).
158. *Id.* at s. (112)(1).
159. *Id.* at s. 113(1).

Env't).[160] The oil company appealed the environmental protection order to the Alberta Environmental Appeal Board, arguing that the contamination had occurred before the legislation was enacted and prior to when the current owner had taken possession of the well. The Board affirmed the order, the Minister of the Environment adopted the board's recommendation, and the company then applied for a judicial review of the Minister's decision.[161] In regard to the company's argument about retrospectivity, the Alberta Court of Queen's Bench stated:

> The Applicants . . . argue that as the Act does not expressly state that it operates with respect to transactions which occurred prior to its enactment, the Board should have applied the presumption against retrospective application . . . . However, the Board . . . concluded that to the extent the [order] has a retrospective element, s. 102 of the Act is intended to operate in that fashion
>
> . . . .
>
> I do not consider the conclusions of the Board in relation to this issue to be patently unreasonable, particularly given that the Supreme Court of Canada has recognized an exception to the presumption against retrospective application when the purpose of the provision is to protect the public rather than to punish. . . . Section 102 of the Act certainly falls in the 'protection of the public' category.[162]

As has been the case with operators of natural gas storage and production facilities, when there are CO_2 releases in the future, EPEA provides for joint and several liability in regard to enforcement orders. Section 215 of EPEA states: "Where an enforcement order is issued to more than one person, all persons named in the order are jointly responsible for carrying out the terms of the order and are jointly and severally liable for . . . of the costs of doing so, including any costs incurred by the Director . . . ."[163]

Section 217 of the EPEA provides that enforcement action by the Alberta Government should not affect the ability of parties that sustain a loss to pursue civil remedies in tort or breach of contract actions.[164] As provided under subsection 228(1) of EPEA, the maximum corporate fine for contravention of the Act is $1,000,000, an amount that can be levied on a daily basis when there is an ongoing offence.[165]

In addition, if there is an uncontrolled release of substances from an oil or gas well, a release from a pipeline that transports the gas or a leak from a storage facility, liability can arise when the well licensee does not comply with an order from the ERCB to control the well and mitigate the damage from a release.[166]

VI. LONG-TERM LIABILITY IN THE EU

The basic approach to long-term liability in Montana with a conditional transfer of liability is the same as was adopted in the EU in 2008. However, the EU regime is more comprehensive than the system adopted in Montana. The

160. Legal Oil & Gas Ltd v. Alberta, 2000 ABQB 388, paras. 1, 12 (Can. Alta. Q.B.).
161. *Id.* at para. 1.
162. *Id.* at paras. 47, 49, 50 (internal citation omitted).
163. Environmental Protection and Enhancement Act, s. 215.
164. *Id.* at s. 217.
165. *Id.* at s. 228(1)(b).
166. *Id.* at s. 108(1).

European Commission released a "Climate and Energy" package that included a proposal for a directive on CO_2 storage for CCS projects. It sets out a common framework for inter alia site selection, exploration and storage permits, monitoring and reporting, operation, closure and post-closure obligations, third-party access, and the ultimate transfer of long-term responsibility to the state.[167] Directive 2009/31/EC of the European Parliament and of the Council on geological storage of carbon dioxide was published in the Official Journal of the European Communities on June 5, 2009, and entered into force on June 25, 2009.[168] Member States must bring into force their laws, regulations and administrative provisions to comply with the Directive by June 25, 2011, and communicate the text of those measures forthwith to the Commission.[169]

The Directive indicates that provisions are required by Member States pertaining to liability for damage to the local environment and climate, resulting from any failure of permanent containment of CO_2. Liability for environmental damage such as damage to protected species and natural habitats, water and land is addressed under Directive 2004/35/EC of the European Parliament and Council for the prevention and remediation of environmental damage, which should also apply to the operation of CSS sites under the more recent directive.[170] CCS operators are responsible for removing injection equipment and sealing storage sites.[171] A provisional post-closure plan must be submitted to the competent authority for approval.[172] Before a site is closed, the provisional plan must be updated and submitted to the authority for approval as a final plan after completing a risk analysis, and considering technological improvements and best practices.[173]

Liability for climate damage as a result of a CO_2 leak is addressed by the inclusion of storage sites in Directive 2003/87/EC that requires operators to surrender their emissions trading allowances if there are CO_2 emissions from leaks.[174] In addition, the Directive imposes an obligation on the CO_2 storage site operator to take corrective measures when there are leaks. Corrective measures plans are to be submitted and approved by the competent national authority. When an operator fails to take the required corrective measures, the competent authority is to proceed with the corrective action and recover the costs from the CCS operator.[175]

A. Transfer of Operator Liability to the State After Site Closure

In response to a request from the operator a CO_2 storage site can be closed if the conditions in the permit have been satisfied, and the competent authority authorizes the closure. After the site closure, an operator in the EU will remain responsible for the maintenance, monitoring and control of the site, reporting on

167. *Council Directive 2009*, *supra* note 22.
168. *Id.*
169. *Id.* at art. 39.
170. Council Directive 2004/35/CE, 2004 O.J. (L143) 56 (EU) (hereinafter *Council Directive 2004*).
171. *Council Directive 2009*, *supra* note 22, at art. 17, para. 2.
172. *Id.* at art. 17, para. 3.
173. *Id.*
174. *Id.* at no. 30.
175. *Id.*

the site, and for corrective measures on the basis of the post-closure plan submitted to and approved by the competent authority and for all ensuing obligations under other relevant Community legislation, until the responsibility for the storage site is transferred to the competent authority.[176]

Alternatively, the storage site can be closed if a competent authority decides to assume liability after the withdrawal of a storage permit.[177] Responsibility for the CO_2 storage site, including legal obligations, should be transferred to the competent authority, if and when all available evidence indicates that the stored CO_2 will be completely and permanently contained. The operator is to submit a report to the competent authority for approval of the transfer. After the transfer of responsibility, monitoring can be decreased to a level that still facilitates leak detection, but the level of monitoring should be increased when there are leaks.[178] There will be no recovery of costs incurred by the competent authority from a former operator after the transfer of responsibility, except in the case of fault on the part of an operator before the transfer of responsibility for the storage site.[179]

Financial security is required by the member governments to ensure that closure and post-closure obligations will be satisfied.[180] Member States should ensure that financial security is provided by the potential operator and effective before commencement of CO_2 injection.[181] After the transfer of responsibility for the site to the state, national authorities may have to bear monitoring costs for the CO_2 storage.[182] Therefore, a financial contribution should be required from the operator to the competent authority before the transfer of responsibility occurs and on the basis of arrangements to be decided by Member States.[183] At a minimum, the financial contribution should cover the anticipated cost of monitoring for CO_2 leaks and related problems for a period of thirty years. The amount of the financial contribution should be determined on the basis of guidelines to be adopted by the Commission to help ensure consistency in implementation of the requirements of the CCS Directive across the EU.[184]

In the event of CO_2 leaks or significant storage irregularities, the operator shall immediately notify the competent authority, and proceed with corrective measures including those to protect human health.[185] The competent authority may at any time require the operator to take the necessary corrective measures, and measures for the protection of human health. At a minimum, the action expected from the operator shall correspond to a corrective measures plan submitted by the operator and approved by the competent authority. There may be different and additional measures required from those outlined in the corrective measures plan. The competent authority may also at any time take

176. *Id.* at no. 32.
177. *Id.* at no. 33.
178. *Id.* at no. 35.
179. *Id.*
180. *Id.* at no. 36.
181. *Id.*
182. *Id.* at no. 37.
183. *Id.*
184. *Id.*
185. *Id.* at art. 16, para. 1.

corrective measures itself, and if the operator fails to take the prescribed corrective measures, the competent authority shall take the necessary measures itself and recover the costs incurred from the operator.[186]

B. Closure and Post-Closure Obligations

Articles 17-20 pertain to the closure, post-closure, and transfer of responsibility for CCS facilities, and the provision of financial security by the operator. Closure is defined as "the definitive cessation of CO_2 injection into the storage site.[187] The term "storage site" is defined as "a defined volume area within a geological formation used for the geological storage of CO_2 and associated surface and injection facilities."[188] Article 3, no. 21 of the directive defines post closure as "the period after the closure of a storage site."[189] In the EU a storage site can be closed if the conditions stipulated in the facility permit have been satisfied. Storage permit is defined in article 3, no. 11, "a written and reasoned decision or decisions authori[z]ing the geological storage of CO_2 in a storage site by the operator, and specifying the conditions under which it may take place, issued by the competent authority pursuant to the requirements of this Directive."[190] The Directive provides that a storage site shall be closed:

> (a) if the relevant conditions stated in the permit have been met;
> (b) at the substantiated request of the operator, after authori[z]ation of the competent authority; or
> (c) if the competent authority so decides after the withdrawal of a storage permit . . . After a storage site has been closed pursuant to points (a) or (b) . . . , the operator remains responsible for monitoring, reporting and corrective measures . . . , and for all obligations relating to the surrender of allowances in case of leakages pursuant to Directive 2003/87/EC and preventive and remedial actions pursuant to Articles 5 to 8 of Directive 2004/35/EC until the responsibility for the storage site is transferred to the competent authority pursuant to Article 18(1) to (5) of this Directive. The operator shall also be responsible for sealing the storage site and removing the injection facilities.[191]

These obligations shall be fulfilled on the basis of a post-closure plan designed by the operator based on best practice and in accordance with the requirements laid down in Annex II of the Directive. "A provisional post-closure plan shall be submitted to and approved by the competent authority . . . ."[192]

After the competent authority withdraws a storage site permit and the site is closed as provided under paragraph (c), the competent authority shall be responsible for monitoring and corrective measures pursuant to the requirements laid down in this Directive, and for all obligations relating to the surrender of allowances in case of leakages pursuant to Directive 2003/87/EC, and preventive and remedial action pursuant to Articles 5(1) and 6(1) of Directive 2004/35/EC.[193] The post-closure requirements pursuant to this Directive shall be

186. *Id.* at no. 30.
187. *Id.* at art. 3, para. 20.
188. *Id.*, at art. 3, para. 3.
189. *Id.* at art. 3, para. 21.
190. *Id.* at art. 3, para. 11.
191. *Id.* at art. 17, para. 2.
192. *Id.* at art. 17, para. 3.
193. *Id.* at no. 30.

fulfilled by the competent authority on the basis of the provisional post-closure plan.[194]

In regard to paragraph (c) above, a permit may be withdrawn by the regulator if there is a leak, failure to comply with the conditions of the permit, or if there are "significant irregularit[ies]."[195]

After a storage site is closed under Article 17 (1)(a) or (b), the operator will remain liable for monitoring and reporting on the site, and taking remedial and corrective measures if there is a leak(s), as provided under Articles 5-8 of Directive 2004/35/EC,[196] until the storage site is transferred to the competent authority under Article 18 (1)-(5) of Directive 2009/31/EC.[197] The competent authority can recover from the operator the costs incurred in relation to the corrective measures, including by drawing on the financial security pursuant to Article 19.[198]

C. *Transfer of Responsibility*

After a CCS facility is closed, if all of the following conditions are satisfied, responsibility for the site may be transferred to the government at the request of an operator or at the initiative of the government:

> (a) [A]ll [of the] available evidence indicates that the stored CO_2 will be completely and permanently contained;
> (b) [The] minimum period, to be determined by the competent authority has elapsed. This minimum period shall be no shorter than 20 years, unless the competent authority is convinced that the criterion referred to in point (a) is complied with before the end of that period;
> (c) [T]he financial obligations referred to in Article 20 have been fulfilled;
> (d) [T]he site has been sealed and the injection facilities have been removed.[199]

The operator must prepare a report that substantiates that the condition referred to in paragraph 1(a) above has been satisfied, and it must submit the report to the government for consideration and approval of the transfer of responsibility. The report must also demonstrate, at a minimum:

> "(a) the conformity in the actual behavior of the injected CO_2 with the modelled behaviour;
> (b) the absence of any detectable leakage;
> (c) that the storage site is evolving towards a situation of long-term stability."[200]

When a CCS site has been closed, under Article 17(1)(c), the transfer of responsibility shall be deemed to take place if and when all of the available evidence indicates that the stored CO_2 will be completely and permanently contained, and after the site has been sealed, and the injection facilities have been removed.[201] After the transfer of responsibility, routine inspections shall

194. *Id.* at art. 17, para. 3.
195. *Id.* at art. 3, para. 17.
196. *Council Directive 2004*, supra note 170, arts. 5-8.
197. *Council Directive 2009*, *supra* note 22, at art. 18, paras. 1-5.
198. *Id.* at art. 19, para. 3.
199. *Id.* at art. 18, para. 1 (a-d).
200. *Id.* at art. 18, para. 2.
201. *Id.* at art. 17, para. 1(c).

terminate, and monitoring may be reduced to a level which allows for detection of leaks or significant irregularities. If any leaks or significant irregularities are detected, monitoring shall be intensified as required to assess the scale of the problem and the effectiveness of corrective measures.

However, in situations where there has been fault on the part of an operator, including cases of deficient data, concealment of relevant information, negligence, wilful deceit, or a failure to exercise due diligence, the government shall recover from the former operator the costs incurred after the transfer of responsibility.[202] Without prejudice to Article 20, there shall be no further recovery of costs after the transfer of responsibility.[203]

D. Financial Security

Financial security, or the equivalent, has to be provided by a potential operator as part of the application for a storage permit.[204] This is to ensure that all obligations arising under the permit issued pursuant to this Directive, including closure and post-closure requirements, may be satisfied. The financial security shall be valid and effective before commencement of injection.

The operator will have to make a financial contribution available to the competent authority before the transfer of responsibility has taken place.[205] The contribution from the operator shall take into account the criteria referred to in Annex I and elements relating to the history of storing CO_2 relevant to determining the post-transfer obligations, and cover at least the anticipated cost of monitoring for a period of thirty years.[206] This financial contribution may be used for costs incurred by the competent authority after the transfer of responsibility to ensure that the CO_2 is completely and permanently contained in geological storage sites after the transfer of responsibility.

The EU regulatory scheme provides for transfer of long-term liability from the site developer/operator to the state.[207] The uniform regional framework adopted in Europe that covers numerous countries with different national and economic interests could provide for consistent state, provincial, and federal standards in North America if there is the political willingness to adopt such a scheme. In light of the existing international CO_2 pipeline that runs from North Dakota into Saskatchewan, and given the willingness of the Canadian federal government to harmonize national GHG targets with U.S. targets, a common CCS framework could be established among the United States, Canada, and Mexico that would reflect the North American Agreement on Environmental Cooperation. Such a framework would help facilitate more certain and predictable state, provincial, and federal CCS standards in both countries, and would reflect the spirit of the North American Agreement on Environmental Cooperation.

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202. *Id.* at art. 18, para. 7.
203. *Id.*
204. *Id.* at art. 19.
205. *Id.* at art. 20.
206. *Id.*
207. *Id.*

VII. LIABILITY MODELS

Most of the challenges relating to evaluating the potential long-term risks from CCS deployment are not unique. Indeed, most have been considered previously in other industries such as nuclear, medicine, and security (anti-terrorism). The combinations of challenges are different, but the ideas developed to address them may provide valuable insight. In addition to models described above that are specific to CCS, we examine in this section liability models that have been developed to address concerns regarding the following characteristics:

- to spur innovation in desirable technologies;
- to address the lack of sufficient information to forecast losses;
- to address risks with extremely long-term life-cycles; and
- to address concerns about catastrophic risks.

A. Modification of Liability as a Means to Spur Innovation

A half-century ago the nuclear industry was deploying new technology, as is the case with CCS today. In order to promote investment in the emerging nuclear industry to generate electricity, in 1957 the U.S. Government, limited the total liability of companies that handled or managed nuclear materials.[208] In another American example, the National Childhood Vaccine Injury Act of 1986 replaces the system of tort liability with a no-fault compensation system for children who suffer injuries as a result of receiving one of seven mandatory childhood vaccinations.[209] A more recent example from the U.S. was the Support Anti-Terrorism by Fostering Effective Technologies Act (the SAFETY Act). Enacted in 2002, the SAFETY Act provides liability protection for providers of "qualified anti-terrorism technologies."[210]

In each of these industries, as well as the CCS models described earlier, in the case of transfer of liability to the state, a social judgment is being made that there are risks that society should encourage companies to take.

B. Risks with Insufficient Information

The availability of commercial insurance generally depends on data that can support a quantitative assessment of the losses that are likely to appear in the future. In the context of CCS, for certain risks, such as new technology and climate change, there is little historical data that can inform that risk assessment process.

Terrorism offers another dramatic example of a risk for which reliable loss forecasts are not easily produced. To address that problem, the British government in 1993 created Pool Reinsurance Company Limited (Pool Re) to be a reinsurer of last resort. Pool Re is mutually owned by participating insurers, who may reinsure their risks from terrorism for commercial property losses and

208. Price-Anderson Act, 42 U.S.C. § 2210 (2006).

209. National Childhood Vaccine Injury Act of 1986, 42 U.S.C. §§ 300aa-1 to 300aa-34 (2006).

210. Support Anti-Terrorism by Fostering Effective Technologies Act of 2002 (the SAFETY Act), 6 U.S.C. §§ 441-444 (2006); Final Rulemaking, Regulation Implementing the Support Anti-Terrorism by Fostering Effective Technologies Act of 2002 (the SAFETY Act), 71 Fed. Reg. 33,147 (June 8, 2006) (to be codified at 6 C.F.R. pt. 25).

losses from business interruption.[211] Pool Re coverage begins after a primary insurer's losses reach its loss retention (a variable amount depending upon the size of the company's terrorism insurance portfolio). The government accepts liability for all claims above Pool Re's ability to pay. Pool Re pays the government a premium for this guarantee and would have to repay any amounts received from the guarantee.

C. Extremely Long-Term Risks

In addition to having been one of the first instances of liability being modified to encourage new technology, the nuclear power industry also shares another characteristic in common with CCS. It needs to store hazardous substances for an extremely long period. In Canada, the federal government has jurisdiction over the nuclear industry and has adopted the polluter pays principle under which it has assigned liability in regard to radioactive waste to nuclear plant operators. The Nuclear Waste Management Office recommended:

> [W]aste owners will share the cost of development, licensing, construction and operation of the facility. The cost to each waste owner will generally be proportional to the number of fuel bundles to be stored in the facility, with special adjustments for factors such as differences in timing of shipping, transportation, [and] fuel characteristics, etc.[212]

The federal government has assumed liability for "historic" low level radioactive waste "for which the original producer cannot reasonably be held responsible," or when the producer no longer exists.[213]

U.S. law combines the issues of waste storage with the potential for a nuclear incident. The joint system provides that all public liability claims larger than those covered through private financial protection would be indemnified by the U.S. Federal Government to the maximum limit specified by the Government.[214] The resulting model includes three tiers:

Tier one (individual financing) requires an individual nuclear plant to obtain primary insurance coverage up to a mandated level (currently $300 million) from private sources. All claims filed to date have been covered through the individual financing under Tier 1.

Tier two (pooled-industry insurance) requires payment of "retrospective premiums" of $15 million per year up to a maximum of $95.8 million per incident for each of its plants, in the event that claims exceed the Tier 1 limit.[215] This industry pooling is achieved through a joint underwriting association called the American Nuclear Insurers. Licensees are required to maintain one of six types of guarantees for payment of retrospective premiums (e.g., surety bonds).

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211. The program does not cover personal losses or losses from workers compensation.

212. NUCLEAR WASTE MGMT. OFFICE, IMPLEMENTING ADAPTIVE PHASED MGMT. 2009 TO 2013 (2009), *available at* http://nwmo.ca/implementationplan.

213. Low Level Radioactive Waste Mgmt. Office, Frequently Asked Questions, http://www.llrwmo.org (last visited Sept. 10, 2010).

214. Price-Anderson Act, 42 U.S.C. § 2210 (2006).

215. *Id.* § 2210(b).

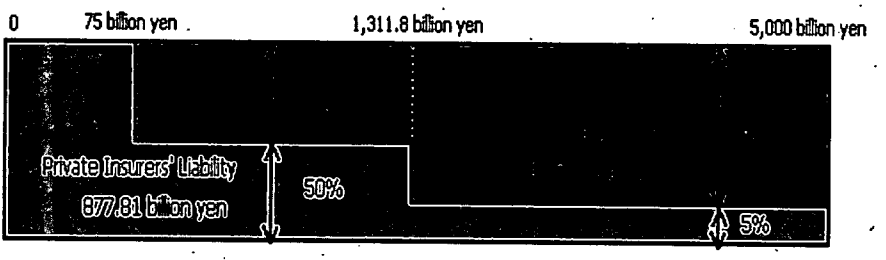
Over the years, that available limit has increased the insurance pool to over $10 billion.[216]

Tier three (federal indemnity) indemnifies licensees from liability arising from nuclear incidents once the individual and industry caps are reached.

D. Liability Model for Catastrophic Risks

Based on current knowledge, CCS presents a low probability of a catastrophic event, and inherently is less hazardous than other exposures, such as a sour gas leak. However, the potential for a catastrophic loss still does exist. Japanese earthquake risk is another example of a model for sharing the potential for catastrophic risk. To encourage private earthquake insurance in markets where private insurers are reluctant to assume risks that could significantly impact their solvency, insurers' liability was capped and the government steps into the important role of reinsurer. The Japan Earthquake Reinsurance Company (JERC) was created to address the catastrophic loss potential and the potential impact on the private market.[217] In the resulting model, all earthquake risks written by direct insurers are wholly reinsured with JERC. The aggregate loss is capped at ¥5000 billion with the government bearing about 85% of that aggregate liability in the progressive manner shown in Figure 1.

Figure 1: Japanese Earthquake Insurance



(A)Up to 75 billion yen ····· Private insurers liable for 100%
(B)Over 75 b yen up to 1,311.8 b yen ····· Government liable for 50% (618.4 b yen)
Private insurers liable for 50% (618.4 b yen)
(C)Over 1,311.8 b yen up to 5,000 b yen ····· Government liable for 95% (3,503.79 b yen)
Private insurers liable for 5% (184.41 b yen)

Source: General Insurance Association of Japan (http://www.sonpo.or.jp/en/faq/004.html)

The four models discussed above provide examples of different risk-sharing arrangements for "difficult to insure" liability risks. Caps on liability, no-fault compensation, and government insurance are all mechanisms for addressing these difficulties.

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216. U.S. NUCLEAR REG. COMM'N. FACT SHEET ON NUCLEAR INS. AND DISASTER RELIEF FUNDS, http://www.nrc.gov/reading-rm/doc-collections/fact-sheets/funds-fs.html (last visited Sept. 10, 2010).

217. Japan Earthquake Reinsurance Company (JERC) (Apr. 1, 2005), http://www.nihonjishin.co.jp/english/index.html.

VIII. HOW SHOULD LONG-TERM LIABILITY RISK FOR CCS BE ALLOCATED?

The long-term liability model for CCS should seek to optimally allocate the risk. Optimization, however, requires an understanding of both costs and benefits. An important question to ask is whether the operator is the party who should be liable, in the very long-term. In 2008, Barrymore noted that:

> The appropriate treatment of long-term liability arising out of CCS activities has been the subject of extensive debate in Australia and elsewhere. Initially, the Government declined to accept the transfer of long-term liability, stating that it would lengthen closure periods and increase the complexity of the closure process. That approach had the potential to hinder investor confidence, particularly given that it is a new and developing technology.[218]

However, in March 2010, as in Wyoming and Kansas, the Victoria State Government in Australia decided that it was not prepared to accept long-term liability for onshore CCS.[219]

In some jurisdictions several stakeholders have offered reasons why it may not be optimal to have the operator remain liable. One reason is the difficulty of obtaining compensation under a tort system from insolvent or bankrupt entities, a problem that becomes much greater when one considers the significant time period over which the CO_2 is to be stored. Another key issue is the possibility of industry refusing to invest in the technology if the uncertainty and cost of risk associated with emerging CO_2 storage industry is too great. Further, the public good aspect associated with reducing atmospheric CO_2 provides a strong rationale for the shifting of liability from private operators to some type of public entity. We propose, however, to re-examine the question beginning with the extensive literature that deals with optimal allocation of risk. The principal advantage of that approach is to give appropriate consideration to the desirability of designing a system that provides optimal incentives for loss prevention.[220] It also allows us to bring in the important consideration of how the liability will be financed or guaranteed.

Four key points discussed by Gollier[221] on optimal allocation of risk are relevant to the discussion of long-term liability for CCS. First, liability for environmental harm and injury to persons is often determined by the polluter pays principle.[222] This forces firms to internalize the costs of their actions, yet limited liability implies that indemnification for loss is only possible up to the value of the firm's assets. This raises two important questions: how to provide compensation to those who are injured, and how to design a system that

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218. Stuart Barrymore and Ann-Maree Mathison, *Update: Offshore Petroleum Amendment (Greenhouse Gas Storage Act 2008)*, 27 AUSTRALIAN RES. AND ENERGY L. J. 469, 471 (2008).

219. Meredith Gibbs & Robert Jamieson, *Victoria Enacts Greenhouse Gas Storage Legislation*, BLAKE DAWSON, May 27, 2010, http://www.blakedawson.com/Templates/Publications/x_article_content_page.aspx?id=58629.

220. This concern alone would lead us to reject the model that shifts all liability to the state (as adopted by Texas and Illinois for CCS) because it provides inadequate incentives for the operators to minimize the potential for loss.

221. CHRISTIAN GOLLIER, CENTER FOR ECONOMIC STUDIES AND IFO INSTITUTE, SOME ASPECTS OF THE ECONOMICS OF CATASTROPHE RISK INSURANCE, WORKING PAPER NO. 1409, *available at* http://SSRN.com/abstract=668384.

222. *Id.* at 10-12.

encourages optimal loss prevention by firms.[223] Two strategies have been used to deal with this issue: compulsory insurance and creation of a "deep pocket" for decision makers (e.g., banks that loan money to the firm that has the potential liability).[224] Due to extensive bankruptcy costs, "catastrophe risks [sometimes] cannot be insured without the government paying [sic] the role of reinsurer of last resort."[225]

A second problem is the lack of predictability in terms of the loss distribution.[226] For any new technology, including CCS, the loss distribution is unknown due to a lack of historical data and/or imperfect scientific knowledge.[227] This ambiguity creates problems for pricing insurance or other financial guarantees. Insurers will add an "ambiguity premium" which may result in the buyer being unwilling to purchase the insurance.[228] In cases of extreme ambiguity, insurers may be unwilling to provide insurance at any price. A third challenge relates to the fact that over time, information is revealed about the nature of particular risks.[229] Such information influences the assessment of the risk and will influence the price charged for insurance. Hence, for such long-term risks, it is necessary to establish long-term relationships between buyer and seller that prevent one party from reneging at the revelation of new information.[230] Given the nature of CCS and the requirement of storing carbon indefinitely, the difficulty of enforcing contracts over such a period is a major barrier to insurance.

Finally, insurance for long-term storage of CCS is difficult due to the inability of insurers to adequately diversify the risk.[231] Most insurance policies are written on an annual basis and insurers achieve diversification by having many similar risks and/or by spreading their risks geographically. However, when risks are correlated or concentrated, as with catastrophic risks, insurability is a problem. "When catastrophic risks are difficult to insure, time diversification may provide a good substitute."[232] The government may be in the best position to organize time diversification due to its "credit worthiness and the long time horizon" required to diversify the risk efficiently.[233] The government can play the role of reinsurer of last resort.

Given these considerations, the characteristics of the CCS risk strongly suggest that the retention of liability by the operator for an indefinite period is unlikely to be optimal. After reviewing a variety of liability models in the United States, the EU, and Australia, we propose the following model for CCS in depleted North American oil and gas reservoirs.

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223. *Id.* at 11.
224. *Id.* at 11-12.
225. *Id.* at 11.
226. *Id.* at 12.
227. *Id.*
228. *Id.* at 13.
229. *Id.* at 14-15.
230. *Id.* at 15.
231. *Id.* at 15-16.
232. *Id.* at 16.
233. *Id.*

IX. A PROPOSED MODEL FOR LONG-TERM LIABILITY

Certainty is required to promote investment in any new technology, including CCS. When there is health or environmental damage, the debate begins by questioning why the approach to CO_2 releases from CCS sites should be different than the approach used in the oil and gas industry to natural gas releases. The answer to the question is twofold:

- The objective of CCS to mitigate climate change by its very nature makes that technology a societal good. As such, it may warrant a greater allocation of risk to society than do exploration and extraction processes.
- Some of the risk management techniques (e.g., developer liability, insurance, and bonds) are subject to credit risks that mean they may not provide the same level of financial protection to society. Practically speaking, an insurer or issuer of a surety bond will not issue instruments that extend centuries into the future. Indeed, these entities may be no more certain to survive than is the developer.

In light of these facts, public policy still must balance the need to (a) protect the public from the long-term damage posed by greenhouse gases by facilitating the introduction of CCS technology; and (b) protect the public from any damage posed by that new technology. Indeed different policymakers may balance these two objectives differently.

The criteria we use to assess these objectives include: economic efficiency, cost-effectiveness, equity, transparency, and feasibility. Review of the existing literature has allowed us to identify a series of characteristics we deem desirable for the liability regime tailored for CCS. From our review, we have determined that the regime should meet the following criteria:

(1) Provide incentives for appropriate levels of care in selecting the injection and storage site, operation, and long-term management of any CCS facility.

a) The key is to incorporate all appropriate costs into the financial system and assign them to the appropriate party. This concept is reflected in the polluter pays principle.[234] Based on this principle the CCS developer and or operator which profit from CCS must also pay the long-term costs from CO_2 leaks, site remediation, and reclamation.

b) Ensuring that contributions to any operating/monitoring fund should reflect the different risks posed by different locations and technologies;

(2) Provide mechanisms to address the potential for both personal or property injury from a CCS leak as well as potential environmental damage from leakage;

(3) Acknowledge the inherent complexity of CCS operation;

a) the extended time frame involved with CCS;

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234. Some authors have stated unequivocally, "If any transition to public responsibility of CCS projects is to occur, it must be accompanied by sufficient funds to cover costs of long-term stewardship." Elizabeth J. Wilson, Alexandra B. Klass & Sara Bergan, *Assessing a Liability Regime for Carbon Capture and Storage*, 1 ENERGY PROCEDIA 4575, 4581 (2009). These authors find it not to be an economic imperative, but rather a question of public policy.

b) the current limitations in our knowledge about CCS, i.e., that the technology for injection and detection is likely to evolve rapidly from the current state of knowledge;

c) the complexity and difficulty in tracking the source of any gas leak that causes harm;

d) the existence of trans-boundary pipelines that can prompt local, regional or international jurisdictional questions;

(4) Utilize private market capabilities while recognizing private market limitations;

a) limitations on the capacity to provide compensation in the event of a catastrophe;[235]

b) limitations on the capacity of private guarantees over extended periods of time.

As we seek to achieve the proper balance between the benefits of the technology and the costs associated with its risks, we also recognize that, in the absence of newly created legislation and regulations, CCS developers or operators who will remain liable in three of the five jurisdictions which have adopted legislation for the damage from gas leaks under the common law. A fundamentally different approach has been adopted in the other two states in which governments have addressed the long-term liability issue. The Wyoming, Kansas, and the Victoria State governments are not prepared to assume long-term liability. The EU and the State of Montana are prepared to provide for a conditional transfer of long-term liability. The first approach appears to minimize the potential for taxpayers ultimately paying for the long-term costs that may arise from CCS so as long as adequate security has been collected. It has been the practice in several jurisdictions in the North American petroleum industry to require the purchase of third-party liability insurance and/or the posting of a bond or other form of security with the government for site remediation and reclamation. However, given the extraordinarily long nature of the risk associated with CCS storage, it is likely to prove extremely difficult to purchase either insurance or bonds that would cover liability for decades or centuries. Furthermore, it is by no means certain that corporations issuing such instruments would be able to pay decades or centuries into the future.

X. SPECIFIC ELEMENTS OF A CCS REGULATORY MODEL FOR JURISDICTIONS IN NORTH AMERICA

The proposed model incorporates the polluter pays principle, but tempers that with additional public policy and practical concerns. This model further assumes an environment of continuing liability for the CCS operator under the Common Law as an incentive to undertake operations in a prudent manner.

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235. The so-called *"congruence between liability and coverage"* recognizes this limitation explicitly in the "internationally agreed pillars of nuclear liability law." NORBERT PELZER, INTERNATIONAL POOLING OF OPERATORS' FUNDS: AN OPTION TO INCREASE THE AMOUNT OF FINANCIAL SECURITY TO COVER NUCLEAR LIABILITY? Part 1.1.1 (2007) (emphasis added). The amount of compensation allowed is linked directly to the amount of insurance that can be purchased.

A. Phase One: Active Operation. Liability: Operator/Emitter

To minimize the potential for taxpayers assuming liability, as in the Alberta oil and gas industry, the licensee and/or operator of CCS wells, pipelines, and storage facilities should be liable for property damage and bodily injury from the CCS activities.

In the event of CO_2 leaks, the responsible party or parties as defined in legislation, such as the Alberta Environmental Protection and Enhancement Act (EPEA), must take prompt action to minimize the damage and implement remediation. This approach is similar to one adopted in the EU, that draws upon existing environmental protection legislation.

A strict liability standard should be adopted in order to avoid complicated and costly litigation arising from the difficulty in proving damage and causation from CCS facilities and the appropriate technology that may well evolve.

Joint and several liability will apply to CCS licensees and operators as it does for natural gas drilling and gas storage in the oil and gas industry under EPEA. An injured person can pursue individual, several, and all defendants for the total damages sustained from CCS development including operations and storage.

B. Phase Two: Closure. Liability: Operator/Emitter

Until such time as responsibility for the facility may be transferred to the government, CCS facility operators must continue to provide financial security to the government. The amount of security must be sufficient to cover health and property damage claims, remediation, and reclamation costs of the facility based on the best available information at the time the assessment is made and/or can be adjusted periodically by the regulator. The security can take the form of cash, securities or third party liability insurance.

C. Phase Three: Post Closure. Liability: Government Agency

If the injection site meets specified criteria (e.g., a minimum time period has passed and the CO_2 plume is stable), operators can apply for a release of liability and responsibility for the facility can be transferred to the government, liability can be managed through a risk-sharing pool that provides a more economically efficient mechanism to cover low probability, high severity events for all operators together, rather than to require each operator to tie up sufficient capital to cover their own risk independently. In principle, such a pool could be private or government-based. However, because a CCS monitoring system will be needed in order to minimize losses and measure exposure levels that may be tied to eligibility for compensation, a desirable characteristic will be independence from the operator(s). Therefore, we expect a governmental entity to assume the monitoring function. Efficiency arguments then suggest that the logical body to manage the liability/compensation scheme is a government agency.

XI. CONCLUSION – RECOMMENDATIONS FOR A NORTH AMERICAN LONG-TERM LIABILITY MODEL

The long-term subsurface storage of CO_2 raises complex liability issues and can prompt costly litigation if there is loss of CO_2 containment and harm results

to human health, the environment, or property. Certainty in the legal framework about whether the developer and operator will assume long-term liability, or the government, is crucial to investment and successful implementation of CCS. Some deviation from the current approach to natural gas releases in the oil and gas industry may be warranted because of the challenges presented by the much longer-term duration of CCS. Specifically, to the extent CCS is viewed as a societal good, it may warrant a greater allocation of risk to society than do hydrocarbon exploration and extraction processes. And, practically speaking, any required CCS insurance or bond may be unavailable in insurance markets for the much longer period that carbon is to be stored than with natural gas.

Two fundamentally different approaches to long-term liability have been adopted in the states and countries that we have examined. CCS developers, operators, and their counsel should become appraised of which approach has been adopted by the legislature in the jurisdiction in which the CCS operations will proceed and determine whether the CCS developer and/or operator will retain the liability, or if a conditional transfer of liability is available. The approach to liability in three of the five jurisdictions reviewed (Wyoming, Kansas, and the State of Victoria) is that the government is not prepared to assume a conditional transfer of long-term liability. The legislation in these states incorporates the polluter pays principle and is consistent with the approach to both near term and long-term liability that has been used by numerous state and provincial governments and by the U.S. and Canadian federal governments to regulate oil and gas development in North America. The highly publicized BP well blowout in the Gulf of Mexico is the most recent example of a case in which both the federal government and state governments have applied the polluter pays principle in response to the oil and gas release. In Wyoming, Kansas, and the State of Victoria, arguably the retention of long-term liability by the developer and/or operator provides more incentive to minimize the risk of future CO_2 releases than does the model adopted in Montana or the EU.

The second approach to long-term liability adopted in the EU, and by the Montana State Government, provides that government is conditionally prepared to assume long-term liability. This approach may encourage more investment and CCS development in these jurisdictions; however, in the event of damage from CO_2 releases in future decades and centuries, that government assumption of long-term liability means an increased possibility that the taxpayer may ultimately bear the costs. Similar public costs have been experienced after oil and gas companies in North America have declared bankruptcy and when the funds held by the government to pay for site remediation and reclamation costs were insufficient. However, as noted earlier, the fact that CCS is a societal good may justify the potential cost being borne by taxpayers.

Clearly, even if a government does not explicitly accept a conditional transfer of long-term liability for CCS, the risk remains that the CCS developer and operator can declare bankruptcy with residual risk and costs defaulting to that same government. Therefore, we propose a long-term CO_2 liability system that builds upon existing oil and gas regulatory experience. To address the issue of CCS developer and operator bankruptcy in Wyoming, Kansas, and the State of Victoria, where the governments refuse to assume long-term liability, as in Alberta, the state governments require bonds or security to be provided to the government to minimize the long-term risk associated with remediation and

reclamation of sites to taxpayers. We recommend a pooling approach to the management of remediation and reclamation funds based largely on arguments that it is more economically efficient to do so. While it would be theoretically possible for such a pool to be private, it is likely that the need for independent oversight will result in a governmental entity assuming the management function for a liability/compensation scheme.

The focus of this article has been long-term liability arising from CCS in depleted onshore oil and gas reservoirs. In light of the presence of offshore reservoirs in the United States, Canada, and Mexico, and the potential for these depleted reservoirs to be used for CCS, we recommend the creation of a long-term liability model for offshore CCS that builds upon the one we have proposed for the terrestrial environment, but one that will address additional environmental and jurisdictional issues that can arise in the marine setting.

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