Property Rights and the Legal Framework for Carbon Sequestration on Agricultural Land

STEVEN A. KENNETT, ARLENE J. KWASNIAK AND ALASTAIR R. LUCAS*

Kyoto Protocol Annex 1 Parties can elect to include carbon sequestered on agricultural land in calculating their net greenhouse gas emissions. Canada has proposed in its Climate Change Plan to include such carbon sinks as a source of greenhouse gas offsets. This raises questions about the design of a Canadian legal and institutional framework necessary to facilitate investment in sequestration projects on agricultural land. Focus of the article is on (1) definition of underlying legal rights to sequestration potential and sequestered carbon and (2) establishment of a property rights regime for sequestered carbon. A major conclusion is that common law property rights and the statutory regime for conservation easements do not provide an adequate legal basis for sequestration transactions, with the consequence that specific property rights legislation is required. Clarity is necessary on initial ownership of sequestration potential and sequestered carbon, and a property rights regime is needed to facilitate transfer of interests in carbon assets. Criteria are identified to guide the design of such a property rights regime.

Les parties visées à l'annexe 1 du Protocole de Kyoto peuvent choisir d'inclure le carbone séquestré sur des terres agricoles dans le calcul de leur émission nette de gaz à effet de serre. Le Canada a proposé dans son Plan d'action sur le changement climatique d'inclure les puits de carbone de ce genre en tant que source de compensation des gaz à effet de serre. Cela soulève des questions concernant la conception au Canada de l'encadrement juridique et institutionnel nécessaire pour faciliter l'investissement dans des projets de séquestration du carbone sur les terres agricoles. L'article traite en particulier de (1) la définition des droits légaux sous-jacents au potentiel de séquestration et au carbone séquestré et (2) de l'établissement d'un régime de droit des biens relativement au carbone séquestré. Un point important ressort de cette étude : le régime de droit des biens de la common law et le régime législatif relatif aux servitudes de conservation ne fournissent aucun fondement juridique adéquat aux transactions liées aux séquestrations. Il y a donc lieu de légiférer en matière de ces droits de propriété particuliers. Il faut des dispositions claires concernant la propriété initiale du potentiel de séquestration et du carbone séquestré ; il faut aussi un régime de droit des biens qui facilite le transfert des intérêts dans les biens de la nature du carbone. Des critères sont présentés pour guider la conception d'un tel régime de droit des biens.

---

* Steve A. Kennett, Canadian Institute of Resources Law, Calgary, Alberta.
Arlene J. Kwasniak, Faculty of Law, University of Calgary.
Alastair R. Lucas, Faculty of Law, University of Calgary.
The authors would like to acknowledge the generous research funding provided by the BIOCAP Canada Foundation and Alberta Environment. Arlene Kwasniak thanks the Institute for Sustainable Energy, Environment and Economy, Calgary, Alberta, for research funding assistance.

Table of Contents

Property Rights and the Legal Framework for Carbon Sequestration on Agricultural Land

STEVEN A. KENNETT, ARLENE J. KWASNIAK AND ALASTAIR R. LUCAS

I. INTRODUCTION

Carbon sequestration on agricultural land is now a recognized component of climate change strategies at the international level and within Canada. The seventh Conference of the Parties to the *United Nations Framework Convention on Climate Change*,[1] held at Marrakesh in 2001, produced an agreement that Annex I countries[2] can elect to include carbon fluxes resulting from revegetation, cropland management and grazing land management when calculating their net greenhouse gas (GHG) emissions pursuant to Article 3(4) of the Kyoto Protocol.[3] Under Article 3(3), the parties also clarified the rules regarding reforestation and afforestation, activities that could sequester carbon on some land currently used for agriculture.[4] Within Canada, carbon sinks on agricultural land are identified as sources of GHG offsets in the federal government's *Climate Change Plan for Canada*[5] and in Alberta's climate change strategy.[6]

Biotic carbon sequestration is clearly not a complete solution to the problem of anthropogenic climate change.[7] It is, however, an interim strategy for lowering the trajectory of increasing atmospheric GHG concentrations in the relatively short term

---

1. *United Nations Framework Convention on Climate Change* 9 May 1992, 1771 U.N.T.S. 165, Can. T.S. 1994 No. 7 (accession by Canada 4 December 1992, entered into force 21 March 1994), online: <http://unfccc.int/resource/docs/convkp/conveng.pdf> [*UNFCCC*]; United Nations Framework Convention on Climate Change, *Report of the Conference of the Parties*, 7th Sess., Addendum, Part Two: Action Taken by the Conference of the Parties, Volume 1, Decision 11/CP.7, UN Doc. FCCP/CP/2001/13/Add.1 at 54-63, online: <http://www.unfccc.int/resource/docs/cop7/13a01.pdf>.
2. Annex I to the *UNFCCC*, *ibid.*, includes developed countries and countries in transition to market economies.
3. *Kyoto Protocol to the United Nations Framework Convention on Climate Change*, 11 December 1997, U.N. Doc. FCCC/CP/1997/L.7/Add.1, 37 I.L.M. 22.
4. *Ibid.*
5. Environment Canada, *Climate Change Plan for Canada* (Ottawa: Government of Canada, 2002) at 39-40 [Canada, *Climate Change Plan*], online: <http://www.climatechange.gc.ca/english/publications/plan_for_canada/plan/pdf/full_version.pdf>.
6. Alberta Environment, *Albertans and Climate Change: Taking Action* (Edmonton: Alberta Environment, 2002) at 35-37, online: <http://www3.gov.ab.ca/env/climate/docs/takingaction.pdf>.
7. See David Lashof & Bill Hare, "The Role of Biotic Carbon Stocks in Stabilizing Greenhouse Gas Concentrations at Safe Levels" (1999) 2 Environmental Science & Policy 101.

(i.e. several decades to a century), thereby slowing climate change and buying time for the technological advances, roll-over of capital stock and changes in human behaviour that will be necessary to break the nexus between economic development, human well-being and fossil carbon emissions.[8] While carbon sequestration is no substitute for aggressive efforts to reduce total GHG emissions from fossil fuel combustion, sinks-based offsets may offer a cost-effective means to assist Canada and some other countries in bringing their net emissions within prescribed limits during the transition to a less carbon-intensive economy.[9] The protection and enhancement of carbon sinks can also yield collateral benefits for agricultural production, environmental management and sustainable development.[10]

Despite the entry into force of the Kyoto Protocol and despite generally supportive domestic policy, it is still far from certain that Canada will capitalize on its "green advantage"[11] by giving carbon sequestration on agricultural land a prominent role in its climate change strategy. A daunting array of scientific, technical, economic, legal and institutional challenges remain to be addressed. These challenges relate to issues such as project design, measurement and verification of carbon fluxes, direct and opportunity costs of sequestration projects, monitoring and enforcement of sequestration agreements, risk management, project "leakage"[12] and transaction costs.[13] Although the Government of Canada has been a strong proponent of biotic sinks in international negotiations, much work remains to be done at the domestic level in order to make large-scale carbon sequestration a reality.[14]

---

8. See generally The International Geosphere-Biosphere Programme (IGBP) Terrestrial Carbon Working Group, "The Terrestrial Carbon Cycle: Implications for the Kyoto Protocol" (1998) 280 Science 1393; Ian Noble & R.J. Scholes, "Sinks and the Kyoto Protocol" (2001) 1 Climate Policy 5.
9. Gregg Marland, Bruce A. McCarl & Uwe Schneider, "Soil Carbon: Policy and Economics" (2001) 51 Climatic Change 101 at 108.
10. See Intergovernmental Panel on Climate Change, *Land Use, Land-Use Change, and Forestry* (Cambridge: Cambridge University Press, 2000) at 104-118 [IPCC Report]; R. Lal, R.F. Follett & J.M. Kimble, "Achieving Soil Carbon Sequestration in the United States: A Challenge to the Policy Makers" (2003) 168 Soil Science 827 at 838-840; Pete Smith, "Carbon Sequestration in Croplands: The Potential in Europe and the Global Context" (2004) 20 European Journal of Agronomy 229 at 234-235.
11. This term is used by the BIOCAP Canada Foundation to highlight Canada's comparative advantage in biosphere GHG management, including carbon sequestration, the conservation of terrestrial carbon stocks and the use of renewable biomass. See BIOCAP Canada Foundation, online: <http://www.biocap.ca>.
12. Leakage can be defined as "the unanticipated decrease or increase in GHG benefits outside of the project's accounting boundary (the boundary defined for the purposes of estimating the project's net GHG impact) as a result of project activities." See IPCC Report, *supra* note 10 at 308.
13. These and other issues relating to the sinks provisions in the Kyoto Protocol are discussed in: IPCC Report, *supra* note 10; Bernhard Schlamadinger & Gregg Marland, *Land Use and Global Climate Change: Forests, Land Management, and the Kyoto Protocol* (Arlington, Va.: Pew Center on Global Climate Change, 2000), online: <http://www.pewclimate.org/docUploads/land_use.pdf>; Noble & Scholes, *supra* note 8; German Advisory Council on Global Change (WBGU), *The Accounting of Biological Sinks and Sources Under the Kyoto Protocol: A Step Forwards or Backwards for Global Environmental Protection?* (Bremerhaven: WBGU, 1998) at 37, online: <http://www.wbgu.de/wbgu_sn1998_engl.pdf>.
14. Steven A. Kennett & Alastair R. Lucas, "Transaction Costs and Other Issues for Carbon Sequestration on Agricultural Land: Defining the Legal and Policy Agenda" (2004) 14 J. Envtl. L. & Prac. 47.

Progress in this area will require an interdisciplinary effort involving government, industry, university-based researchers and other interested parties.[15] Designing the appropriate legal and institutional structure is a key part of this enterprise. The broader legal and policy agenda for carbon sequestration on agricultural land has been examined elsewhere[16] and we will not revisit it here in detail. This article focuses on the domestic legal framework that will be needed to facilitate investments in sequestration projects on agricultural land and in the generation of sinks-based emissions offsets. Our particular objective is to explore the role of law in two key areas: (1) the definition of underlying legal rights to sequestration potential and sequestered carbon; and (2) the establishment of a property rights regime for "sequestration transactions." The article focuses on the legal building blocks for defining and transferring sequestration rights through contractual arrangements relating to the ownership and the use of the following tangible and intangible assets: agricultural land, sequestration potential, biotic carbon sinks (i.e. soil and vegetation), sequestered carbon and sinks-based emissions offsets. Although the broader set of issues relating, for example, to project certification, risk allocation and management, liability rules and contractual mechanisms should also be addressed within a legal and institutional framework for carbon sinks, they are largely beyond the scope of this article.

Section 2 of this article summarizes the role of a legal framework for carbon sequestration on agricultural land; Section 3 examines the ownership of sequestration potential and sequestered carbon; the legal basis for transferable sequestration rights is considered in Section 4; and Section 5 provides brief concluding comments.

II. The Role of a Legal Framework for Carbon Sequestration

Large-scale carbon sequestration on agricultural land in Canada will require the use of private land,[17] much of which is held in relatively small parcels by farmers and ranchers.[18] Sequestration will be achieved through changes in land use that increase the carbon content of the soil (e.g. switching from conventional tillage to low- or no-till farming) and, in some cases, through changes in land use that also

---

15. An interdisciplinary research program on biosphere GHG management in Canada is being led by the BIOCAP Canada Foundation. See BIOCAP Canada Foundation, "Research," online: <http://www.biocap.ca/index.cfm?meds=category&category=22>.

16. Kennett & Lucas, *supra* note 14; Steven A. Kennett, "Carbon Sinks and the Kyoto Protocol: Legal and Policy Mechanisms for Domestic Implementation" (2003) 21 Journal of Energy & Natural Resources Law 252.

17. Carbon sequestration could also occur on public land leased for agricultural uses (e.g. grazing leases). Since the use of public land for carbon sequestration raises a distinct set of legal, regulatory and policy issues, this article focuses on private land.

18. According to the federal government, there are over 240,000 farms in Canada: Working Group on Offsets, *Offset System Discussion Paper* (Ottawa: Environment Canada, 2003) at 41, online: <http://www.climatechange.gc.ca/english/publications/offset_dp/dp/dp_e.pdf> [*Offset System Discussion Paper*].

increase carbon stored in above-ground and below-ground biomass (e.g. conversion of cropland to perennial cover, planting of trees or shrubs).[19]

While governments could use regulatory requirements or subsidies to achieve these changes in land use, emerging policy in Canada and elsewhere identifies market mechanisms as the primary drivers of sequestration.[20] The market for sinks-based offsets will, of course, be a direct product of regulatory requirements limiting GHG emissions. Once restrictions are in place, market incentives are expected to spur innovative approaches to achieving least-cost reductions in emissions, including the creation of offsets through sequestration projects and the trading of emission rights and certified carbon credits.

The market for sinks-based offsets could be structured in several ways. In a study conducted for Alberta's Climate Change Central, Ingrid Liepa identified three models:

> **Private Model**—owners of facilities subject to GHG emission limits purchase offsets that meet government criteria from parties that have sequestration capacity or that act as intermediaries in offset transactions;
>
> **Trust Model**—facility owners pay a set amount of money for each ton of emissions to be offset to a trust organization that is established to find and manage offset projects;
>
> **Emissions Trading Model**—government establishes a GHG emissions trading system for the purchase and sale of carbon credits in a transparent market.[21]

As Liepa notes, these models have somewhat different implications for the role that government will play through legislation and policy. While government must set criteria for emissions offsets, more elaborate legal and institutional frameworks will be required for the use of trust organizations as market intermediaries and for the establishment of an efficient market for trading sinks-based carbon credits. For all models, however, a legal framework is essential to establishing underlying ownership of sequestration potential and of sequestered carbon, to facilitating private sector investment in sequestration projects, and to the use of market mechanisms for trading emissions offsets.

---

19. Graham Stinson & Bill Freedman, "Potential for Carbon Sequestration in Canadian Forests and Agroecosystems" (2001) 6 Mitigation and Adaptation Strategies for Global Change 1 at 17; Lal, Follett & Kimble, *supra* note 10.
20. Canada, *Climate Change Plan*, *supra* note 5 at 17, 29-33, 40; Alberta Environment, *Albertans and Climate Change: A Plan for Action* (Edmonton: Alberta Environment, 2002) at 14-15, 23-25 [Alberta, *Plan for Action*]; Emission Reduction Trading Protocol Team, *A Basis for Greenhouse Gas Trading in Agriculture* (Calgary: Climate Change Central, 2002), online: <http://www.climatechangecentral.com/resources/discussion_papers/basis_for_grnhse_trading.pdf>.
21. Ingrid Liepa, *Greenhouse Gas Offsets: An Introduction to Core Elements of an Offset Rule* (Calgary: Climate Change Central, 2002) at s. 3.0, App. A, online: <http://www.climatechangecentral.com/resources/discussion_papers/GHG_offsets.pdf>.

Legal aspects of carbon sequestration have received only limited attention from policy makers in Canada. The establishment of a legal framework is included as one of the "core design elements" in the June 2003 version of the Government of Canada's *Offset System Discussion Paper*.[22] However, the discussion is largely confined to issue identification. The Government of Alberta has acknowledged both the need for "clear policy direction" on the ownership of carbon in soil and vegetation, and the importance of developing mechanisms to facilitate sequestration transactions.[23] Also, the Alberta Legislature has enacted legislation defining "sink" and "sink right" in general terms, and stating that "[a] sink right is a property right."[24] However, this statute does not elaborate on the characteristics of these rights or on the legal basis for sequestration transactions.

There is also commentary on the range of issues to be addressed in a legal framework for carbon sequestration on agricultural land. Alberta's Climate Change Central concluded, for example, that the most significant risks associated with the emerging trade in agricultural carbon credits "stem from the current lack of regulatory rules" to address uncertainties regarding the ownership of soil carbon, and regarding the implications of sequestration transactions for issues such as flexibility of land use, risk management and liability for the release of carbon stores.[25] Responses to the Government of Canada's *Offset System Discussion Paper*[26] also underlined the need for clarity on ownership of sinks-based offsets and the importance of legal mechanisms to increase certainty and reduce transaction costs in the definition and transfer of interests in sequestration projects.[27]

The first step in sorting out these interrelated issues is to identify the core functions of the framework of legal rights and mechanisms that will be needed to support carbon sequestration on agricultural land. This framework should:

1. clarify the initial ownership of sequestration potential and of carbon sequestered on private land;

2. provide legal mechanisms to define and to transfer ownership interests related to sequestration potential, carbon sinks, sequestered carbon and sinks-based offsets—referred to collectively as "carbon assets"; and

3. establish the legal and institutional bases for issuing and trading certified carbon credits.

---

22. *Offset System Discussion Paper*, *supra* note 18 at 7.
23. Alberta, *Plan for Action*, *supra* note 20 at 24-25.
24. *Climate Change and Emissions Management Act*, S.A. 2003, c. C-16.7, ss. 1(e)-(f), 9.
25. Janet Piece, "Carbon as a Commodity: Challenges and Risks" *C3 Views: Climate Change Central Newsletter* (April 2002) at 1, online: <http://www.climatechangecentral.com/resources/c3views/C3Views200204_issue3.pdf>.
26. *Offset System Discussion Paper*, *supra* note 18.
27. See e.g. Bob Page, *TransAlta's Response to the Federal Offsets Paper: Creating the Balance Between Market Forces and Regulation* (Calgary: TransAlta, 2003) at 2-3, 9; Western Canadian Offsets Team, *Input to the Federal Offset Discussion Paper (June 2003)* (2003) at 4; AgCert Canada, *Comments on the Government of Canada's Offsets Discussion Paper* (Edmonton: AgCert, 2003) at 5.

The rest of this article focuses on the first two functions, both of which are concerned directly with the ownership and control of agricultural land and associated carbon assets.[28] The primary objective is identifying key characteristics of the legal framework of property rights in these two areas.

This discussion is guided by two general questions. First, is the existing body of common law and legislation likely to be adequate to support the emergence of a market for sinks-based offsets on agricultural land? Second, if there are deficiencies in the existing common law and statutes, what models or mechanisms could provide the basis for establishing a statutory framework for carbon sequestration on agricultural land?

III. Ownership of Sequestration Potential and Sequestered Carbon

This section addresses the following questions: (1) what is the legal character of the sequestration potential of land and sequestered carbon, and (2) who owns these underlying rights? Sequestration rights are novel and have not been explicitly recognized by the courts or characterized in ways that permit them to be fitted into the scheme of the common law of property. Traditional property law analysis is used to test whether the new rights should be classified to fit within an established real property category—particularly whether they are an inseparable part of the landowner's core fee simple absolute interest, part of the fee simple absolute but within a recognized severable category (i.e. mineral rights)—or whether they should be classified as personal property rights rather than real property rights.

Implicit in these questions is the matter of adequacy of legal definition. Does the common law define these rights with sufficient clarity and precision? If not, legislative clarification is required.

A. *Implications of Divided Ownership Rights*

It is worthwhile distinguishing the "sequestration potential" of land—the ability of soil and vegetation that can be grown on the land to absorb and retain atmospheric carbon—from "sequestered carbon," that is, carbon *actually* retained by the soil and its vegetation. The former is a potential "product" or value of the land; the latter is an existing attribute or product of the land. Unlike other products of the land, for which the realization of ultimate value requires removal, the essential value of carbon sequestration is in retention.

---

28. Full implementation of carbon credit trading raises a distinct set of legal, institutional and policy issues that will not be examined here.

On agricultural land, particularly cropland or rangeland, the primary carbon reservoir is the soil through the incorporation of organic matter. On treed land, usually valued for forestry purposes, the primary mechanism for carbon storage is the vegetation and its root systems.

The legal issue is: who has the legal title to the stored carbon and to the carbon sequestration potential that permits this carbon storage to be realized? This issue may be considered either in terms of individual components—soil, trees, roots and other biomass—or in terms of rights that encompass these elements and the sequestration potential.

Clarity of ownership is critical for any carbon sequestration initiative. It determines the initial allocation of rights—the beginning state of play for a system of agricultural land sequestration rights, and of transfer and trading based on these rights.[29] Security of legal title means that owners know the value of their rights and are in a position to market them. Buyers of these rights are assured of the sellers' good title and consequently of the value of their acquisitions. Clear ownership is also key for the integrity and overall objectives of a sinks policy and offset trading system. Without it, double counting of sinks-based offsets may create erroneous signals and compromise the operation of the system.[30]

Of course, like purchasers of surface land, these purchasers must exercise due diligence to ensure that a purported vendor does, as a matter of law, own the carbon sequestration rights in question. One would expect a title investigation and opinion that may be bolstered by reliance on a land registration system.[31] Without some means of reliably ascertaining ownership of carbon sequestration rights, there would be little incentive for potential purchasers to risk investment.

The question of ownership in any given case is complicated by the potential for different owners, since carbon sequestration may be developed and managed by a person who is not the owner of the core fee simple absolute interest.[32] There is nothing new in this—land is often leased for agricultural operations—but legal interests such as agricultural leases are common and well understood. The problem here is the novel nature of the carbon sequestration right. Complexity may be further increased where the title to particular land is already split in various ways through grants of surface and mineral rights.

Rosenbaum, Schoene and Mekouar have outlined the various ownership possibilities for carbon sequestration potential. The first is that the landowner (the fee simple absolute owner) owns the sequestration potential. In this case, the carbon sequestration rights may either:

> (a) not be separate property rights, but nonetheless be the subject of related property rights such as easements or restrictive covenants;

---

29. Liepa, *supra* note 21.
30. *Ibid.*
31. As under the *Alberta Land Titles Act*, R.S.A. 2000, c. L-4 [*ALTA*].
32. Emission Reduction Trading Protocol Team, *supra* note 20 at 10.

> (b) be separate real property rights that may be characterized as coming within a recognized category of property rights such as *profit à prendre*; or
>
> (c) be forms of personal property or of another category of property other than real property.[33]

The second possibility is that carbon sequestration potential and stored carbon are a "public good," either (a) incapable of ownership, such as air, or (b) owned by the level of government with property ownership under relevant constitutional documents or principles. This idea of a public good is discussed below.[34]

Here, attention is given to the first possibility, particularly to the legal character of the original or "core" carbon sequestration right. Is it a property right, and if so, is it a newly identified part of the core fee simple absolute,[35] capable of separation from the landowner's fee simple estate (discussed below under "The Legal Basis for Sequestration Transactions")? Is it a variety of a recognized property right, such as a mineral right, separable from the core right? Or is it a personal property right?

B. *Part of the "Fee Simple Absolute"?*

A landowner's legal interest, in property law terms, a fee simple absolute estate, includes the soil, vegetation growing in the soil and underlying minerals. This has been expressed by the ancient maxim, *cujus est solum, ejus est usque ad coelum et ad inferos*—"the owner . . . has everything 'up to the sky and down to the centre of the earth'."[36] According to Cheshire and Burn's, these rights are "as extensive as common law and statute permit."[37]

The fee simple absolute right contemplates use of the land—realization of its potential—for growing crops and timber, grazing animals, development (including building structures), and the removal of minerals and organic matter. These land uses are subject to legislative planning and other regulatory restrictions, but in the absence of such restrictions, the rights to remove material such as soil or peat, and to till, plant, tend to and harvest crops, provide strong argument to support the inclusion of carbon sequestration in the landowner's bundle of property

---

33. Kenneth L. Rosenbaum, Dieter Schoene & Ali Mekouar, *Climate Change and the Forest Sector: Possible National and Subnational Legislation* (Rome: Food and Agriculture Agency of the United Nations, 2004) at 32-33, online: <ftp://ftp.fao.org/docrep/fao/007/y5647e/y5647e00.pdf>.
34. *Ibid.* at 33.
35. That has been characterized as "perpetual": Rt. Hon. Sir Robert Megarry & Sir William Wade, *The Law of Real Property*, 6th ed. by Charles Harpum, Malcolm Grant & Stuart Bridge (London: Sweet & Maxwell, 2000) at 64.
36. *Ibid.* at 56-57 [footnotes omitted]; Edward H. Burn, ed., *Cheshire and Burn's Modern Law of Real Property*, 16th ed. (London: Butterworths, 2000) at 172 [Cheshire & Burn]. Note, however, that this maxim has not been applied without limit to air space and has been described as "a useful point of departure" for courts, but a colourful and "fanciful phrase" of limited utility: Bruce Ziff, *Principles of Property Law*, 3rd ed. (Toronto: Carswell, 2000) at 86.
37. Cheshire & Burn, *ibid.* at 172.

rights.[38] Sequestration involves management of the soil and may involve planting followed by no-till management. In contrast with mineral rights, underlying strata that are physically separate from and therefore more easily severable from the surface land are not involved.[39]

C. *Surface and Mineral Rights*

Another possible legal characterization of carbon sequestration rights is as mineral rights, that is, as a part of the mineral estate that has long been recognized as a real property right.[40] Mineral ownership is a consequence of everything below the surface being presumed to belong absolutely to the fee simple owner of the land.

The mineral estate may be severed from the surface estate. In Alberta, severance depends on whether the original Crown grant reserved mines and minerals (or some minerals) to the Crown. Since Crown grants typically reserved some or all minerals after the 1880s, only about 10% of Alberta land in private hands includes surface and minerals. As owner of the remaining mineral rights, the Alberta government grants limited mineral rights under Crown "leases" as provided by the *Mines and Minerals Act*.[41]

Did these original mines and minerals reservations include carbon sequestration potential and sequestered carbon? The courts have said that "mines and minerals" are not definite terms; they are presumed to be used in the widest sense. Ultimately, their meanings depend on the context and on the intentions of the parties to the granting document.[42] The meanings must reflect the idea of substances exceptional in value, and particular words are taken to be used in the vernacular meaning at the time the grant or reservation was made.[43]

For Alberta mineral rights, rooted as they are in late nineteenth and early twentieth century Crown grants and mineral reservations, the focus on the vernacular meaning of the language used by the drafters seems to exclude the possibility that

---

38. In *Earl of Falmouth v. Thomas* (1832), [1824-34] All E.R. Rep. 357, 1 Cr. & M. 89 (Ex. Ct.), the court held that the right to crops and the benefit of work, labour, and material that are incorporated into the land are inseparable from it and are interests in land. Numerous cases have found that profits of the soil, such as trees, forage, mines, minerals, peat, or the soil itself, are part of the realty and are interests in land. The owner of the fee may separately convey the right to remove these interests. The right to remove a profit is called a "*profit à prendre*": Cheshire and Burn, *ibid.* at 614-619. For further discussion of *profits à prendre*, see Section IV.C, below.

39. See *Mines and Minerals Act*, R.S.A. 2000, c. M-17, s. 1(1)(p), which includes metallic minerals, hydrocarbons, building stone and aggregates, and specifically includes sand, gravel, clay and marl in the definition of "minerals." However, the definition goes on to exclude peat and sand, gravel, clay and marl that belong to the surface owner under sections 57 and 58 of the *Law of Property Act*, R.S.A. 2000, c. L-7. Thus, while not direct authority, it can be seen that the statutory treatment of soil aggregates is consistent with landowners' rights including all of the soil—organic soil and associated carbon, as well as aggregate components.

40. Cheshire & Burn, *supra* note 36 at 172.

41. *Supra* note 39.

42. *Attorney General v. Earl of Lonsdale* (1827), [1824-34] All E.R. Rep. 666, 57 E.R. 518 (Ch.); Bennet Jones & Nigel Bankes, eds., *Canadian Oil and Gas*, 2nd ed., looseleaf (Toronto: Butterworths, 1993) at para. 3.112.

43. Jones & Bankes, *ibid.* at para. 3.113.

the early twenty-first century concept of carbon sequestration was contemplated as part of "mines and minerals".

Alberta legislation has addressed potential disputes concerning ownership of surface minerals by declaring that sand, gravel, clay and marl belong to the surface owner[44] and that a group of enumerated substances are and have been minerals.[45] No listed substance contemplates carbon sequestration potential and sequestered carbon.

Another perspective is that the term "mines and minerals" in a grant or reservation is likely to be interpreted to include not just the minerals, but also the strata of land in which they are contained.[46] This approach would not be feasible for carbon sequestered in topsoil and vegetation growing in it, suggesting that carbon rights would not be contemplated in a grant or reservation of mines and minerals.

It is also instructive to assess the general approach taken by the courts to the determination of disputes about ownership of mineral substances where the mineral estate has been split into separate oil and natural gas titles. Although this issue arose early in the development of Alberta's oil and gas industry, the court in *Borys v. C.P.R. Co. et al.*[47] did not attempt to state broad principles or develop a general theory of ownership. It merely settled the specific dispute by ruling that the owner of oil in a particular reservoir was entitled to all liquid hydrocarbons in the reservoir, and that ownership of the oil implied the right to work and produce the substance, even if some natural gas were incidentally produced. The court did not explicitly decide whether hydrocarbons could be owned *in situ* (in the reservoir). Nearly 50 years later, the Supreme Court of Canada in *Anderson v. Amoco Canada Oil and Gas*[48] adopted the same approach, confirming that ownership is determined on the basis of the phase of the hydrocarbon (liquid or gas) under the initial reservoir conditions at the time of the original grant or reservation. Phase changes as a result of drilling into the reservoir have no effect on ownership. The Court specifically stated that issues of "broad ownership theory [are] not required to be determined in this appeal".[49]

These cases indicate that even if an ownership dispute over carbon sequestration rights were to arise in the early stages of the development of the "industry," it is unlikely that courts would address the general question of the legal character of carbon sequestration rights. Rather, they would likely focus on the rights created by the parties under the legal instrument they chose to use. Courts cannot be expected to expound any ownership theory that would definitively determine whether carbon sequestration rights are or are not mineral rights. In oil and gas cases, the courts were acutely aware that their private law function was to resolve private disputes. To do this

---

44. *Mines and Minerals Act*, *supra* note 39, ss. 57-58.
45. *Ibid.*, s 1(1)(p).
46. Jones & Bankes, *supra* note 42 at paras. 2.12-2.14.
47. [1953] A.C. 217, [1953] 2 D.L.R. 65 (P.C.).
48. [2004] 3 S.C.R. 3, 241 D.L.R. (4th) 193.
49. *Ibid.* at para. 36.

they considered the industry context and the desirability of facilitating efficient oil and gas development as well as the science of hydrocarbon reservoir dynamics. But they could not lay down general rules; only the legislature can do that.

D. *Personal Property?*

Are carbon sequestration rights personal property or a separate category, other than land? Personalty, unlike real property, is usually not fixed and finite.

Historically, the English common law's distinction between real (land rights) and personal property (property other than land) was based more on civil procedure rules than on the character of the particular property. Anything that could be recovered in a "real" form of action (for the recovery of property) was real property; everything else was personal property (chattels) for which damages could be obtained in a "personal" action. Realty was protected by a "property rule" and personal property by a "liability rule" based on wrongful interference.[50]

The legal principles show that this real and personal property distinction was not completely rigid. Leases developed as contractual rights, and thus could not fit into the real property category. They were therefore considered to be personalty. But the law developed to give tenants real property remedies, the courts recognizing that leases of property are essentially concerned with real property and should be viewed as estates in land.[51] They remain technically personalty, but came to be referred to as "chattels real".

Carbon sequestration rights may be created by contract. The "sequestration potential" element gives them an intangible or "incorporeal" flavour. But incorporeal interests, such as *profits à prendre*, have long been recognized as property rights. Judicial focus is likely to be on the physical character of the right and its function, as the oil and gas rights cases discussed above show. All of this points to characterization of carbon sequestration rights as part of the core fee simple absolute property right, and not personal property. In any event, there is evidence that the laws governing real and personal property are merging[52] so that, for most purposes, the characterization as either realty or personalty may not be significant. For example, whether or not a carbon sequestration right is registrable under the *Alberta Land Titles Act*[53] depends not on traditional legal categories, but on whether, as a matter of interpretation, the right is within the scope of the *Act*.

E. *Sequestered Carbon as a Public Good*

It has been suggested that sequestered carbon including sequestration potential of land may be a species of "public good".[54] The issue is not whether it is a "pub-

---

50. Ziff, *supra* note 36 at 73 [footnotes omitted].
51. Megarry & Wade, *supra* note 35 at para. 3-009.
52. Ziff, *supra* note 36 at 75.
53. *Supra* note 31.
54. Rosenbaum, Schoene & Mekouar, *supra* note 33 at 33; Emission Reduction Trading Protocol Team, *supra* note 20 at 10.

lic good" in the economic sense of being indivisible and non-excludable. Rather, the legal ownership question involves two main possibilities: (1) that it is public property—property for which legal title is vested in the Crown (federal or provincial, or in a municipal government)[55] and (2) that it is common property that may be used by, and in a sense, owned by the public or a significant group in the public. Environmental resources or media such as clean air are sometimes cited as examples of common property.[56] It has been suggested that it may be more accurate to think of these resources as non-property.[57] At common law, flowing water cannot be owned although the right to appropriate and the right to use it can be owned and are therefore recognized property rights.[58] However, this does not aptly describe sequestration rights because they are not open-access resources. Surface landowners have rights of exclusion.[59] There is authority concerning the limits of private rights to air space in which courts have attempted to balance landowner needs and the public interest in maintaining common use of air space.[60] There are virtually no cases concerning the extent of subsurface private rights.[61] However, the absolute right "to the centre of the earth" presumption has dominated, so that in a classic US case, the fee simple surface owner prevailed against an adjacent owner who wished to utilize caves located under the first owner's land, but accessible only from the property of the second.[62]

It can be seen that the law places a high value on the clarity and security of the fee simple landowner's rights and thus on the landowner's individual autonomy.[63] Thus, it is doubtful that a claim to open public access to sequestration potential and sequestered carbon would prevail. Given the close functional association between carbon rights and the soil and vegetation itself, and given the newness of the concept and its dependence on international and domestic instruments recently created (or proposed) by governments, it is unlikely that courts would conclude that it is a common right that, like flowing water, is potentially available to any public or private party that takes steps to appropriate it.

---

55. A claim to government ownership of sequestration potential and sequestered carbon on private land raises legal and policy issues beyond the scope of this article.
56. See for example International Institute for Sustainable Development, "On the Great Plains: Use of Common Property," online: <http://www.iisd.org/agri/gpcommonprop.htm>.
57. Ziff, *supra* note 36 at 7.
58. *Miner v. Gilmour* (1859), 12 Moo. P.C. 131 at 156, 14 E.R. 861; David R. Percy, "Water Rights in Alberta" (1977) 15 Alta. L. Rev. 142 at 143.
59. For a discussion in relation to water rights, see Austl., Commonwealth, Department of Agriculture, Fisheries and Forestry, *An Effective System of Defining Water Titles* (Research Report) (ACIL Tasman in association with Freehills) at 17-19, online: <http://www.lwa.gov.au/products_list.asp>.
60. To a reasonable height that can be occupied: Ziff, *supra* note 36 at 87, citing *Didow v. Alberta Power Ltd.* (1988), 88 A.R. 250, [1988] 5 W.W.R. 606 (C.A.); citing also *Manitoba v. Air Canada*, [1980] 2 S.C.R. 303, 111 D.L.R. (3d) 513; citing also *Bernstein of Leigh (Baron) v. Skyviews & General Ltd.*, [1978] Q.B. 479, [1977] 2 All E.R. 902.
61. Ziff, *supra* note 36 at 89.
62. *Edwards v. Sims*, 24 S.W.2d 619 (Ky. C.A. 1929).
63. Ziff, *supra* note 36 at 90.
64. *Supra* note 21.

F. *Conclusions on Ownership*

Property law analysis suggests that, in the absence of legislation, it is unlikely that courts will characterize sequestration potential and sequestered carbon as new property rights separate from the basic fee simple absolute interest in agricultural land. Rather, they are likely to be considered real, not personal property rights that are elements of the fee simple absolute. The legal nature of mineral rights and the principles of interpretation for property-granting instruments provide little support for the possibility that sequestration rights will be recognized as mineral rights. Furthermore, although sequestration potential and sequestered carbon may have the economic characteristics of public goods, several factors, including the physical association of carbon with soil and vegetation and the way the law has treated air and subsurface rights, suggest that, in legal terms, they are not common property incapable of ownership. It is likely, therefore, that in the absence of a specific agreement to the contrary, sequestration rights will normally be the property of the surface landowner—the agricultural proprietor.

While the legal analysis points to this conclusion, it is based on inference from established legal principles rather than on direct authority. As a result, it is not absolutely certain. Carbon sequestration rights raise novel fact situations and legal issues that may ultimately require determination by judicial decisions. There are no decisions on point to date and judicial clarification of these issues will depend on fortuitous circumstances—whether individual disputes arise and, if so, whether they proceed to final judicial decision. Furthermore, courts generally decide specific issues and are reluctant to state general rules or to discuss potential issues. These uncertainties suggest that legislation is necessary to specify clearly the legal nature of ownership rights in sequestration potential and sequestered carbon on private agricultural land.

IV. The Legal Basis for Sequestration Transactions

The establishment of a mechanism for defining and transferring sequestration rights is the second key component of the legal framework for carbon sequestration on agricultural land. This section begins with an overview of sequestration transactions. It then identifies six characteristics of the property rights regime that is required to support these transactions. These characteristics provide the point of departure for examining three legal models that might be used to establish transferable sequestration rights. The section concludes by briefly summarizing the case for a clear statutory basis for sequestration transactions.

A. *An Overview of Sequestration Transactions*

As noted above, the key assumption is that market incentives operating in the context of regulatory limits on GHG emissions will be the driving force for sequestration. Private investment in sequestration projects and the use of offset trading to achieve efficient reductions in GHG emissions are expected to follow from regula-

tions that make sequestered carbon a valuable commodity.

Agricultural landowners may enter sequestration transactions with several types of parties. Companies in need of GHG offsets may develop the in-house expertise to negotiate contracts directly with landowners. Investors may fund and acquire interests in sequestration projects to obtain a positive return on capital when emissions offsets are sold. Individuals or companies may assist with the design and implementation of sequestration projects in exchange for interests in these projects and in the resulting emissions offsets. Project aggregators, offset banks, sequestration trust organizations and other market intermediaries may bring specialized expertise and economies of scale to the design and implementation of sequestration projects and to the marketing of offsets or of certified carbon credits. Sequestration transactions can thus fit within the private, trust and emissions trading models for offsets identified by Liepa[64] and described in Section II, above.

The legal framework for these transactions should provide the parties with tools to protect their interests and respond effectively to market incentives. Agricultural land is generally an important capital asset and carbon sequestration will usually be a secondary land use. Since the protection and enhancement of carbon sinks and reservoirs will entail restrictions on land use, farmers and ranchers are likely to be concerned about the implications of sequestration contracts on their flexibility to manage, and perhaps sell or lease, their land.[65] However, the other parties to sequestration transactions will seek to ensure that changes in land use do not compromise the value of carbon assets—sequestration potential, carbon sinks, sequestered carbon and sinks-based emissions offsets. The maintenance of terrestrial carbon stores will be a significant concern since sequestration on agricultural land can be rapidly reversed through human activities and natural processes.[66]

When negotiating sequestration contracts, both the landowner and the party acquiring sequestration rights will therefore have interests centering on the present and future uses of the land and associated carbon assets. These interests will relate to issues such as control over land uses, the possibility of conflicting uses, the landowner's ability to sell or lease the land, and the duration of the obligation to maintain sinks and sequestered carbon. A property rights regime provides the means to define these interests and to grant them legal protection. The role of property law reflects the fact that the subject matters of sequestration transactions are, as noted above, tangible and intangible property in the form of agricultural land and carbon assets.

---

65. See John Bennett & David Mitchell, "Emissions Trading and the Transfer of Risk: Concerns for Farmers" in J.M. Kimble, R. Lal & R.F. Follett, eds., *Agricultural Practices and Policies for Carbon Sequestration in Soil* (Boca Raton, Fla.: Lewis, 2002) 349; Emission Reduction Trading Protocol Team, *supra* note 20 at 9.

66. Paul .J. Thomassin, "Canadian Agriculture and the Development of a Carbon Trading and Offset System" (2003) 85 American Journal of Agricultural Economics 1171 at 1174-75. There is an extensive literature dealing with the 'permanence' issue for sequestered carbon. See e.g. Gregg Marland, Kristy Fruit & Roger Sedjo, "Accounting for Sequestered Carbon: The Question of Permanence" (2001) 4 Environmental Science & Policy 259.

67. *Supra* note 33 at 39.

As a practical matter, defining the parties' interests in relation to this property gives rise to a number of specific questions regarding the implications of a transfer of ownership of sequestration potential from *A*'s land to *B*. In an article that surveys legal issues relating to biotic carbon sequestration, Rosenbaum, Schoene and Mekouar enumerate several of these questions:

> Can *B* force *A* to manage the forest to maintain or enhance the potential?
> Can *B* enter the land and assess the potential?
> Can *B* enter and actively manage the land?
> If *A* then sells the underlying land to a new owner *C*, does *C* bear any obligations towards *B*?
> Can *B* transfer the ownership and all it entails to a stranger, *D*?[67]

The property rights regime for sequestration transactions should provide the legal basis for answering these types of questions.

B. *Characteristics of the Legal Basis for Sequestration Transactions*

The operation of market mechanisms driving carbon sequestration on agricultural land will depend on the ability of the parties to address the issues and to answer the questions identified in the previous section. Interests in carbon assets must therefore be legally recognized as property rights. Furthermore, the mechanisms for defining and transferring these rights must be suited to the sequestration context. To achieve these objectives, the property rights regime for sequestration transactions should have six general characteristics.

1. *Separation of Transferable Sequestration Rights From the Ownership of Land*

The first characteristic is that parties to sequestration transactions should be able to define and freely transfer legal interests in carbon assets (i.e. sequestration potential, sinks, sequestered carbon and sinks-based offsets) that are carved out of the ownership of the land in question. This is important because of the complexity in the common law distinctions between property and other types of legal interests (e.g. licences, permits and other non-transferable personal interests).[68] Since this complexity can create uncertainty regarding the characterization of new types of legal interests as property, property rights in carbon assets should be given a clear legal basis.

Australian commentators touch on this issue in relation to the establishment of property rights in forest sinks. Lim and Giskes note, for example, that the common law in Australia—and, presumably, that in Canada—may not recognize owner-

---

68. See Brad Wylynko, "On the Road to Greenhouse Gas Emissions Trading" [2000] Australian Mining and Petroleum Law Association Yearbook 359 at 370-73; John Taberner, "Climate Change and the Kyoto Protocol: Practical Domestic Legal Issues" [1998] Australian Mining and Petroleum Law Association Yearbook 479. Taberner states: "For most lawyers, 'property' is a difficult, ambiguous and elusive concept. In the author's opinion, in the absence of a statutory framework, a carbon credit *is not* something that the law would recognize as property. Until a carbon credit is created by statute, a carbon credit is *not* something which is capable of being assigned because it is not 'property.'" (*ibid.* at 490, emphasis in original).

69. Austl., Queensland Parliamentary Library, *Carbon Commodities on Leasehold Land Under the Natural Resources and*

ship rights to carbon assets, notably sequestration potential and sequestered carbon, as separate from ownership of land, soil, and other resources on the land.[69] Specific legislation may therefore be required to ensure that sequestration rights have the legal status of property. Furthermore, Butt has argued that even if the separation of the ownership of carbon assets (e.g. trees as carbon sinks) from the underlying ownership of the land were possible under the common law, it could give rise to "potential complexities [that] would make the title to the land intricate in the extreme."[70]

A GHG emitter or an investor in sequestration projects could, of course, acquire sequestration rights for agricultural land by purchasing the land outright.[71] However, acquiring a fee simple interest for this purpose would likely make sense only when the price of carbon is sufficiently high to make carbon sequestration the primary use of the land in question. This scenario seems improbable for most agricultural land.

Since carbon sequestration will generally be a secondary land use achieved through changes in agricultural practices, farmers and ranchers will usually maintain underlying ownership and primary control over the land in question. Property rights in carbon assets will therefore be carved out of the landowner's fee simple interests.

2. *Direct Versus Indirect Definition of Sequestration Rights*

The second characteristic of the property rights regime for sequestration transactions is that it should enable parties to define their interests directly in terms of the carbon assets that are important to them. While this point may seem obvious, it is significant because sequestration rights might be defined in an indirect manner that would make interests in carbon assets derivative of legal rights, instead of central to them.

The indirect definition of sequestration rights would focus exclusively on the landowner's positive or negative obligations regarding land use (e.g. the obligation to practice no-till or low-till farming, or to abstain from clearing vegetation or otherwise adversely affecting carbon sinks or reservoirs). The rights of the purchaser of sequestration services or sequestered carbon would then take the form of a measure of oversight or control relating to land use practices, as well as of a remedy if the obligations are not met. In effect, the legal regime would create land use rights that incidentally give rise to carbon sequestration.

Other Legislation Amendment Bill 2004 (Qld) (Research Brief No. 2004/03) by Sarah Lim & Renee Giskes (Brisbane: Queensland Parliamentary Library, 2004) at 6, online: <http://www.parliament.qld.gov.au/publications/view/publications/documents/research/ResearchBriefs/2004/200403.pdf>.

70. Peter Butt, "Carbon Sequestration Rights—A New Interest in Land?" (1999) 73 The Australian Law Journal 235 at 235.

71. See James T. Bryce, "Legal Issues Arising from Using Soil as a Greenhouse Gas Sink" in Joanne Kowalski, ed., *Climate Change Handbook for Agriculture 2000* (N.p: University of Saskatchewan, 2000) c. 4 at 24, online: <http://www.csale.usask.ca/PDFDocuments/cchLegal.pdf>.

72. See Marland, Fruit & Sedjo, *supra* note 66; Roger A. Sedjo & Gregg Marland, "Inter-trading Permanent

This indirect approach would not, however, give full legal recognition to the fact that regulatory limits on GHG emissions will make sequestered carbon, and hence carbon assets, valuable and marketable commodities in themselves. Making land use practices the primary focus of legal rights and obligations might create uncertainty regarding the transferability and ultimate ownership of carbon assets, particularly the sinks-based offsets resulting from sequestration projects.

3. *Flexibility for the Parties to Define the Implications of Sequestration Rights*

The third characteristic is that a property rights regime should allow the parties to sequestration transactions considerable flexibility to define the terms of their contractual relationships. The rights and obligations created through sequestration transactions could vary considerably in the degree of land and resource use control granted to the rights holder. At one end of the spectrum, a leasehold interest would permit the rights holder to take temporary possession of the land and undertake sequestration projects directly. At the other end, the landowner may simply be required to undertake certain practices to enhance sequestration, for example, when planting crops or managing rangeland.

The obligations defined through sequestration transactions are also likely to be limited in time. Although it would be possible for landowners to agree to provide carbon sequestration in perpetuity, a more likely scenario is that sequestration transactions will involve "rental" arrangements whereby sequestration potential or sequestered carbon are provided by landowners for fixed periods of time.[72]

Temporary carbon "rental" facilitates risk management by both parties. Landowners will likely want to avoid long-term encumbrances on their land, and exposure to uncertain future liability leading to replacement of emissions offsets in the event that sequestered carbon is released to the atmosphere prematurely.[73] Purchasers of sequestration rights may also prefer a fixed-term contract, as opposed to the assumption of responsibility for monitoring and for enforcement over a period of several decades or more. In sum, rental arrangements are appropriate in a context where it may be impossible or undesirable to provide guarantees that biotic carbon stocks will be maintained indefinitely.[74]

The property rights regime for sequestration transactions should therefore accommodate the establishment of a broad range of specific rights and obligations relating to the use of agricultural land and its associated carbon assets. The parties' flexibility in this area might, however, be limited by legislation for two reasons. The first reason is to reduce transaction costs by providing a standard contractual model

---

Emissions Credits and Rented Temporary Carbon Emissions Offsets: Some Issues and Alternatives" (2003) 3 Climate Policy 435.

73. See Bennett & Mitchell, *supra* note 65 at 353-54.

74. Marland, Fruit & Sedjo, *supra* note 66 at 265.

75. For example, certification requirements for sinks-based offsets may specify a minimum time commitment

for sequestration transactions. The second reason is that the national and international rules for carbon accounting, and the certification requirements for carbon credits, may have implications for the underlying structure of sequestration rights.[75]

4. *Sequestration Rights as Legal Interests That Run With the Land*

The fourth characteristic of the property rights regime is that the parties to sequestration transactions should be able to establish a legal nexus between sequestration rights and the agricultural land in question. The landowner could, of course, agree to provide sequestration services through a contractual undertaking. This type of arrangement, following principles of contract law, would be binding only to the parties to the contract.[76] Relying entirely on contractual rights as the legal basis for these transactions is problematic, however, because carbon sequestration is inextricably linked to the use of the land.

The length of time required to sequester significant amounts of carbon on agricultural land, and the need to maintain these terrestrial carbon reservoirs in order to produce recognized emissions offsets, mean that sequestration transactions will involve restrictions on land use over specified time periods. Since agricultural land and its carbon content constitute capital assets, the parties to a sequestration transaction will want to ensure that they can manage these assets, protect their interests in them, and perhaps even dispose of these assets during the term of their contract.

In this context, contractual rights that are binding only to the parties to sequestration transactions can limit flexibility and increase risk. Both parties' interests would be better served if the sequestration rights and associated obligations "run with the land", thereby binding subsequent purchasers. For the farmer or rancher, this type of property right preserves the flexibility to sell the land without being burdened by ongoing personal liability for the sequestration obligations. For the holder of sequestration rights, it ensures that the direct connection with the land and the specific sequestration project in question will not be severed in the event that this land comes under new ownership.

The recognition of sequestration rights as interests that run with the land also provides the legal basis for their disposition by the rights holder, thereby ensuring that interests in carbon assets can be treated as capital assets that have value. Furthermore, this type of property interest has the advantage that it can generally be registered on title.[77] Since registration permits ownership to be easily verified, and ensures that other parties acquiring interests in the land in question have notice that sequestration rights have been granted, it contributes to reducing transaction costs, a topic returned to below.

---

for the maintenance of sequestered carbon.

76. See Bryce, *supra* 71 at 27.

77. Legislation in each jurisdiction will establish specific rules governing the registration of interests in land.

78. Taberner, *supra* note 68 at 491.

5. *Overlapping and Conflicting Interests*

The fifth characteristic of the property rights regime for sequestration transactions is that it should be structured in a manner that reduces the likelihood of overlap or conflict between sequestration rights and other legal interests. This type of problem has been addressed in other contexts, notably where two or more surface interests are created in a given property (e.g. a freehold interest subject to an easement or a *profit à prendre*), or where surface rights and subsurface mineral rights are owned by different parties. Experience in these contexts shows how the substantive law governing the definition of overlapping property rights, and the procedures for registering these rights and for resolving disputes, can be structured to address the potential for conflicts between rights holders.

This issue has received particular attention in relation to carbon sinks on forested land.[78] For example, a study conducted for the United Nations Environment Programme (UNEP) identified "legal title disputes" as a source of risk associated with sequestration projects in the absence of "legislation recognizing emission reduction rights".[79] The report provides the following illustration of how these disputes might arise:

> . . . in the case of forestry projects, where land on which forest grows is leased and there has been no attempt to contractually or legislatively allocate carbon rights, the legal title to sequestered carbon could be the subject of dispute. Theoretically it could be possible for a different person to own the land, the trees and the sequestered carbon. While general legal principles may assist, they remain largely untested and uncertain. This is especially a problem in relation to projects involving carbon sequestration, where a significant portion of the carbon is stored in the soil and the tree root system even after the trees are felled, giving rise to potential disputes with the land owner, lease holder or owner of the physical trees or forest.[80]

This type of segmentation of rights on agricultural land could occur in instances where plantation forestry is used to sequester carbon.

In most situations, private agricultural land is less likely than forested land to give rise to complex patterns of conflicting surface rights. Nonetheless, the exercise of subsurface rights could have adverse effects on sequestration projects, particularly where mining or oil and gas development create significant surface impacts. It is also possible that existing property interests may have implications for the negotiation of sequestration rights between the landowner and another party.

For example, different parties might claim ownership of sequestration potential and associated terrestrial carbon stores where a farmer or rancher has granted a *profit à prendre* in vegetation (e.g. grass or trees) or has granted a conservation ease-

---

79. UNEP, *Legal Issues Guidebook to the Clean Development Mechanism* (Roskilde, Denmark: UNEP Riso Centre, 2004) at 92, online: <http://www.uneptie.org/energy/publications/pdfs/CDMLegalIssuesguidebook.pdf>.

80. *Ibid.*

81. In Torrens jurisdictions, priority is based on time of registration, unless a later registered interest holder has

ment designed to maintain certain land uses or landscape characteristics (e.g. native rangeland, forest cover or wetlands). Where the land in question can also be used to generate sinks-based emissions offsets, can the agricultural landowner enter sequestration transactions independently with other parties, or do the holders of the existing legal interests also have an interest in carbon assets? If sequestration occurs as a result of activities associated with the *profit à prendre* or with the conservation easement, who owns the resulting emissions offsets?

These questions are not easy to answer in the abstract, although they may be addressed explicitly in conservation easement agreements that are negotiated after sequestration is generally recognized as an important land use. In the meantime, it is possible that the respective interests of the parties could be clarified by an analysis of their contracts and by the application of relevant legal principles from contract and property law. The overlap of these existing interests with sequestration rights may also be a function of the specific techniques to be used to protect and enhance carbon sinks and reservoirs. However, relying on this type of analysis to sort out ownership rights could increase transaction costs by creating legal uncertainty and litigation risk.

Rather than leaving it to the parties and the courts to wrestle with the relationship between existing interests in land and the ownership of newly created sequestration rights on a transaction-by-transaction basis, a generic legislative solution may be preferable. Sequestration rights legislation could, for example, state that a farmer or rancher with freehold title to agricultural land is deemed to hold the underlying rights to sequestration potential and sequestered carbon, unless these rights have been explicitly granted to another party. The legislation could also specify that sequestration transactions, and the associated restrictions or obligations relating to land use, must be structured either to respect existing interests in land or to provide compensation in the event that sequestration activities adversely affect other rights.

Mechanisms could also be provided to establish priorities among rights, to ensure adequate notice of pre-existing rights when new interests are being negotiated, and to resolve any disputes. Public registries of property rights could address the first two issues. Priority could be based on the time of registration and title searches could be used to identify encumbrances on land.[81] Where direct conflicts arise, dispute resolution and compensation mechanisms could be developed. For example, sequestration rights could be explicitly recognized in the processes that are used to address conflicts between surface and sub-surface rights holders and to determine appropriate compensation in cases where the exercise of sub-surface rights adversely affects surface interests.[82]

---

obtained a postponement from earlier registered interests in favour of a later registered interest holder. In registry systems, priority might not be so clear.

82. The Surface Rights Board in Alberta is an example of this type of process. If a sequestration contract holder is a registered interest holder, then (at least in Alberta) the holder should receive notice of proposed subsurface exploration or development. As well, the holder should be entitled to compensation. See Arlene Kwasniak, *Conservation Easement Guide for Alberta* (Edmonton: Environmental Law Centre, 1997) at 26-28.

83. "The Alberta government owns 81 per cent of the province's mineral rights. . . . The remaining 19 per

The extent to which overlapping and conflicting interests will complicate sequestration transactions is difficult to predict. For example, in Alberta, because about 81% of mineral acreage is Crown-owned,[83] there is potential for interference with sequestration activities through surface operations carried on to explore for or to develop minerals. Other than surface interests acquired to exploit subsurface interests, complex overlays of surface rights seem unlikely to be the norm for most agricultural land. Nonetheless, the property rights regime for sequestration transactions should include substantive and procedural provisions that will reduce uncertainty in this area.

6. Legal Certainty and Transaction Costs

The final characteristic of the property rights regime for sequestration transactions is that it should be designed to reduce transaction costs. High transaction costs relative to the value of sequestered carbon are widely recognized as a potential obstacle to the use of market mechanisms in obtaining large-scale carbon sequestration on agricultural land.[84] Uncertainty regarding the creation, continuance, transfer and enforcement of sequestration rights may be a significant source of transaction costs, particularly if the legal framework leaves many fundamental issues to be resolved by the parties on a project-by-project basis. Furthermore, the adoption of a legal model for sequestration rights that brings with it a high degree of uncertainty, or that incorporates complex and technical doctrines that are poorly adapted to this context, will increase transaction costs and is therefore inadvisable.

The property rights regime will address transaction costs through the establishment of clearly defined legal categories and simple mechanisms for creating and transferring legal interests in carbon assets. Consequently, many of the specific characteristics of this regime, reviewed above, are directed to the more general problem of transaction costs.

For example, guidance could be provided on the types of restrictions on land use and the other rights and obligations set out in these transactions. Statutory provisions could provide a template or set of standard requirements for sequestration contracts. The advantages of a detailed statutory framework for sequestration transactions should be weighed against the need to retain flexibility for the parties to structure contractual relationships to meet particular needs and circumstances. Substantive legal guidance could be complimented by procedures for registering

---

cent are owned by individuals and companies or by the federal government on behalf of First Nations and national parks." See *Alberta Ministry of Energy 2003-2004 Annual Report* (N.p.: Alberta Energy, 2004) at 12, online: <http://www.energy.gov.ab.ca/docs/aboutus/pdfs/AR2004.pdf>. Accordingly, split title—meaning title where the surface interest is owned privately, but subsurface interests are Crown-owned—is common in the province.

84. Thomassin, *supra* note 66 at 1172. This issue is discussed in more detail in Kennett & Lucas, *supra* note 14 at 56-66.

85. Rosenbaum, Schoene & Mekouar, *supra* note 33 at 34.

property rights in carbon assets through the land titles system. Public registry of these rights could reduce legal risks and associated transaction costs.

The broader regulatory framework for carbon sequestration could also contribute to reducing transaction costs through mechanisms such as government certification of sequestration projects and the provision of assistance with the monitoring and verification of carbon fluxes. Furthermore, normal contractual remedies could be enhanced by providing a regulatory backstop for enforcing sequestration rights.[85] The general issue of transaction costs thus has implications that link the property rights regime for sequestration transactions with the broader legal, institutional and policy framework for carbon sequestration on agricultural land.[86]

7. *Criteria for the Establishment of Transferable Sequestration Rights*

The characteristics identified above are intended to inform the analysis of options for establishing a property rights regime for sequestration transactions. They can be captured in the following six criteria:

- Sequestration rights should be distinct legal interests that are separate from ownership of land on which sequestration activities will take place and that are freely transferable.

- Sequestration rights should be defined directly as legal interests in carbon assets (i.e. sequestration potential, carbon sinks, sequestered carbon and sinks-based emissions offsets) that have implications for the control over land use, as opposed to relying on indirect mechanisms that merely create rights and obligations relating to land use.

- Parties to sequestration transactions should have considerable flexibility to determine the nature and extent of their respective rights and obligations relating to land use.

- Sequestration rights and the associated obligations regarding land use should "run with the land," binding subsequent purchasers and allowing parties to sequestration transactions to transfer their respective interests in carbon assets.

- The substantive definition of sequestration rights and the associated procedural mechanisms should be designed to reduce the risk of overlap and conflict with other property interests and associated land uses.

- The substantive and procedural components of the property rights regime and the broader legal framework for carbon sequestration on agricultural land should be designed to reduce legal uncertainty and other sources of transaction costs.

Since carbon sequestration is a new type of land use, there is no pre-existing legal category that creates transferable sequestration rights directly. The elements of this property rights regime will therefore have to come from existing common law

86. See Kennett & Lucas, *supra* note 14.

87. Rosenbaum, Schoene & Mekouar, *supra* note 33 at 32.

or legislation, or from new legislation that establishes the substantive rights and procedural infrastructure for sequestration transactions. The following discussion examines both options.

C. *Common Law Mechanisms*

The common law is the logical starting point when considering options for a property rights regime for sequestration transactions. Rosenbaum, Schoene and Mekouar note, for example, that a landowner might be able to grant a covenant relating to sequestration potential and that sequestration rights may take the form of easements or *profits à prendre*.[87] These mechanisms all establish distinct legal interests that are separate from ownership of the land in question, which are transferable and run with the land in some circumstances. Common law property rights could thus meet some of the criteria identified above. However, closer analysis shows that none of them provide a satisfactory basis for sequestration transactions.

While the common law rules relating to covenants, easements and *profits à prendre* are complex,[88] a detailed discussion of them is not required here. The relevant deficiencies of these mechanisms have been examined in detail in a paper discussing carbon sequestration on agricultural land[89] and in an extensive literature that thoroughly reviewed and unequivocally rejected their use to establish interests in land for the purpose of private conservation.[90] The private conservation analogy, which is discussed in a separate section below, has many parallels with the creation of sequestration rights, notably the need for legal interests that run with the land, are transferable and have significant implications for land use.

The principal obstacles to the use of the common law as a legal basis for sequestration transactions can be briefly summarized with reference to the criteria for the property rights regime identified above. Since covenants and easements have somewhat different characteristics than *profits à prendre*, they are treated separately.

Covenants (sometimes referred to as restrictive covenants) and easements could be used to create legal interests that constrain and direct land use in ways that promote carbon sequestration on agricultural land. There are, however, significant barriers to their use for this purpose that relate to the creation and transfer of these interests. The most important barrier is that each common law covenant and easement must benefit another property, referred to as the dominant tenement that is owned by the rights holder.[91] Sequestration rights, however, are not intended to ben-

---

88. See Ziff, *supra* note 36 at 337-81.

89. Bryce, *supra* note 71 at 25.

90. See, for example, Arlene J. Kwasniak, "Facilitating Conservation: Private Conservancy Law Reform" (1993) 31 Alb. L. Rev. 607; David Loukidelis, *Using Conservation Covenants to Preserve Private Land in British Columbia*, ed. by Ann Hillyer (Vancouver: West Coast Environmental Law Research Foundation, 1992); Andrew Dana & Michael Ramsey, "Conservation Easements and the Common Law" (1989) 8 Stan. Envtl. L.J. 2.

91. Ziff, *supra* note 36 at 339, 365.

efit other property and it would be highly artificial to characterize them in this way.[92] Furthermore, a requirement that the holder of sequestration rights be a landowner would restrict the transfer of these rights and is therefore inconsistent with the efficient operation of market incentives for carbon sequestration on agricultural land. This common law requirement is in itself sufficient to disqualify these instruments as a basis for sequestration rights.

These legal interests would also constitute an indirect means of establishing sequestration rights if they focused exclusively on positive and negative obligations regarding land use. As noted above, sequestration rights should be defined directly in terms of the ownership of carbon assets. Restrictions on land use would then be incidental to these core rights.

Finally, a complex web of common law rules surrounds the types of obligations that may be imposed through these mechanisms, the conditions under which they will "run with the land" so as to bind subsequent purchasers and the types of benefits that may be assigned. One author politely referred to these rules as "elusive common law conditions."[93] Others have been more direct in their criticism of the common law in this area.[94]

The common law of covenants and easements does not, therefore, facilitate the efficient resolution of many of the basic issues relating to sequestration transactions. There is a significant risk that the parties' ability to shape their contractual relationships, to ensure that sequestration rights run with the land and to transfer property rights in carbon assets could not be guaranteed under the common law (and equitable) rules. Relying on complex and arcane legal doctrines promises to create uncertainty, increase transaction costs and frustrate the use of market incentives to achieve carbon sequestration on agricultural land.

An additional common law mechanism that should be considered is the *profit à prendre*, described as a right to take from someone else's land a "profit" that is capable of being owned.[95] *Profits à prendre* have been recognized in relation to minerals,

---

92. Rosenbaum, Schoene & Mekouar, *supra* note 33 at 35. Note that Costa Rica addressed the requirement that easements or servitudes must directly benefit a dominant estate by adopting "the minor fiction that a conservation easement is for the benefit of (and so attaches to) nearby reserved natural areas." In the United States, both easements and restrictive covenants may exist in gross, meaning that they may be owned and may run with the land where there is no benefiting dominant estate. See Richard R. Powell, *Powell on Real Property*, looseleaf, revision ed. by Patrick J. Rohan (New York: Matthew Bender, 1994) vol. 3 at 34-17 to 34-22, vol. 5 at 60-41 to 60-46.

93. Arlene J. Kwasniak, "Legal Mechanisms for Private Land Conservancy in Alberta: A Call for Law Reform" in Arlene J. Kwasniak, ed., *Private Conservancy: The Path to Law Reform. Proceedings of a Conference Held January 13, 1994* (Edmonton, AB: Environmental Law Centre, 1994) at 53.

94. Loukidelis, *supra* note 90 at 106 (comparing equitable rules governing covenants to Charles Dickens' caricature of the law of equity in *Bleak House*); Susan F. French, "Toward a Modern Law of Servitudes: Reweaving the Ancient Strands" (1982) 55 S. Cal. L. Rev. 1261, quoted in Ziff, *supra* note 36 at 381 (referring to "rigid categories, silly distinctions and unreconciled conflicts over basic values . . ." in the law of freehold covenants).

95. Cheshire & Burn, *supra* note 36 at 614-33; Arlene J. Kwasniak, *Reconciling Ecosystem and Political Borders: A Legal Map* (Edmonton: Environmental Law Centre, 1997) at 101-02.

oil, stones, trees, grass, wildlife and similar products from the land. This mechanism would thus provide a direct means of creating a legal interest in sequestered carbon and potentially other carbon assets, assuming that the common law could be extended to recognize terrestrial carbon sinks, stores and the resulting emissions offsets as products of the land that are capable of ownership.

Profits à prendre are transferable legal interests that do not require a dominant tenement and can run with the land.[96] They thus satisfy some of the key criteria for a legal framework for sequestration transactions. Nonetheless, they are unlikely to provide an adequate mechanism to create rights in sequestration potential and sequestered carbon.

The major deficiency with *profits à prendre* is that they have been used to secure a right to collect and remove things. Sequestration potential, however, is an intangible characteristic of the land that is influenced by the use to which that land is put. While sequestered carbon more closely resembles a product of the land, terrestrial carbon reservoirs cannot be captured and removed because they are found not only in trees and other vegetation above the surface, but also in roots, plant litter and the soil itself. In fact, the essence of sequestration is to fix carbon in the land, not to take anything away.[97]

The courts and commentators have stated that the *profit à prendre* is not a closed category,[98] so this common law mechanism could conceivably be extended to carbon assets such as sequestration potential and sequestered carbon. This outcome, however, is far from certain. The legal risk associated with reliance on a common law doctrine that is untested in the context of sequestration rights is a strong reason to reject this approach. In fact, as discussed below, several Australian states have enacted carbon rights legislation to create specially defined *profits à prendre*, rather than relying on the common law principles. This choice presumably reflects a determination that the common law *profit à prendre* cannot provide the legal basis for sequestration transactions without statutory support and modification.

The inadequacy of the common law means that legislation is necessary to establish a property rights regime for sequestration transactions. One option is to adopt, with or without modification, an existing statutory framework. The most likely candidate for this approach in Canada is legislation authorizing the creation of conservation easements. A second option is to look to the experiences of other countries with statutory frameworks for sequestration rights. In particular, Australian carbon rights legislation warrants attention. Both of these options are examined below.

---

96. Cheshire & Burn, *ibid.*

97. David Jones, "The Kyoto Protocol, Carbon Sinks and Integrated Environmental Regulation: an Australian Perspective" (2002) 19 *Envtl. & Planning L. J.* 109 at 123. The difficulties of classifying sequestration rights as *profits à prendre* are discussed in Wylynko, *supra* note 68 at 365-67.

98. Wylynko *supra* note 68 at 367.

D. *Conservation Easement Model*

A statutory mechanism recently introduced in Canada may serve as a model for a statutory mechanism for the establishment of sequestration rights. This is the conservation easement.

1. *Conservation Easements as a Model for Establishing Sequestration Rights*

Conservation easements are statutorily created property interests by which a landowner grants to another person rights in land and takes on certain obligations with respect to the land. The rights and obligations relate to the conservation of the land in accordance with the agreement as authorized by statute. When registered, the interest runs with title and is enforceable against subsequent owners. All of the provinces except for Newfoundland and Labrador (and Yukon) have passed some form of conservation easement legislation.[99] In the legislation, the statutory interests come under various names including conservation "easements," "covenants," "servitudes" or "agreements." For convenience, this article refers to them as "conservation easements."[100] No matter the jurisdiction, conservation easement legislation contain provisions that:

- enable a landowner (the "grantor") to grant an interest in all or part of their property to a specified qualified holder (the "grantee") for purposes set out in the legislation;

- set forth who may be granted a conservation easement—depending on the legislation, this may be a provincial Minister or agency, a municipality or non-governmental organizations meeting specified criteria;

---

99. Proceeding from the west, the 1996 amendments to the British Columbia *Land Title Act*, R.S.B.C. 1996, c. 250, s. 219(3) authorize covenants for conservation purposes. The 2000 amendments to the Alberta *Environmental Protection and Enhancement Act*, R.S.A. 2000, c. E-12, ss. 22-24 [*EPEA*] authorize conservation easements. The 1996 *The Conservation Easements Act*, S.S. 1996, c. C-27.01 enables conservation easements in Saskatchewan. Manitoba authorizes conservation agreements in *The Conservation Agreements Act*, C.C.S.M. c. C173. Ontario's *Conservation Land Act*, R.S.O. 1990, c. C.28, enables conservation covenants. The Quebec *Natural Heritage Conservation Act*, R.S.Q., c. C-61.01 which replaced *An Act respecting nature reserves on private land*, R.S.Q., c. R-26.2 authorizes conservation servitudes. New Brunswick's *Conservation Easements Act*, S.N.B. 1998, c. C-16.3, allows the creation of conservation easements. Nova Scotia's *Conservation Easements Act*, S.N.S. 2001, c. 28, which replaced the *Conservation Easements Act*, S.N.S. 1992, c. 2, authorizes conservation easements. Prince Edward Island's *Natural Areas Protection Act*, R.S.P.E.I. 1988, c. N-2 authorizes restrictive covenants to protect natural values. The covenants are tantamount to conservation easements in that the legislation states that such "restrictive covenants" may be positive or negative, and do not require a dominant tenement (s. 5). Ss. 76 to 80 of the *Environment Act*, S.Y. 1991, c. 5, authorize the granting of conservation easements in the Yukon Territory.

100. For general information on conservation easement-type interests in Canada see North American Wetlands Conservation Council (Canada) & Canadian Wildlife Service, Environment Canada, *Conservation Easements, Covenant and Servitude in Canada, A Legal Review* (Report No. 04-1) by Judy Atkins, Ann Hillyer & Arlene Kwasniak (Ottawa: North American Wetlands Conservation Council (Canada) & Environment Canada, 2004), online: North American Wetlands Conservation Council <http://wetlandscanada.org/conseasecov04-1.pdf>. The text provides an overview of conservation easement legislation throughout Canada, and includes information on related topics, including drafting conservation easements, drafting conservation easement legislation, income and property tax implications, the US experience and caselaw on conservation easements.

- establish purposes for which a conservation easement may be granted;

- regard the possible terms for a conservation easement—normally conservation easements may be granted for a limited term or in perpetuity;

- remove all or many of the common law barriers associated with restrictive covenants and easements;[101]

- make the interest run with the land so that it binds future owners; and that

- concern amendment and termination.

The six bullets below illustrate how conservation easements meet many of the characteristics of a property rights regime for sequestration rights[102] and comment on how conservation easement legislation shows some promise as a model for legislative provisions creating sequestration rights.

- The first characteristic is that sequestration rights be distinct legal interests that are separable from the fee and freely transferable. Conservation easements are property rights that may be carved out of and separated from the fee interest. Although, as set out in section IV. D. 2., legislation normally limits assignment and transferability potential, legislation creating sequestration rights need not do so.

- The second characteristic is that sequestration rights be defined directly as legal interests in carbon assets that have implications for the control over land use. A conservation easement is a legal interest in retaining and enhancing conservation values and assets, and not carbon assets. Nevertheless, conservation easement legislation could serve as a model for sequestration legislation in that it enables agreements to specify required land use controls and sets out who is responsible for the controls and how monitoring and enforcement will secure land use obligations.

- The third characteristic is that parties to sequestration transactions should have considerable flexibility to determine the nature and extent of their rights and obligations relating to land use. Conservation easement agreements may allow for considerable flexibility with two important limitations. First, the agreement cannot be so flexible that statutory requirements are not clearly met; and second, as is a concern with all contracts, terms cannot be so flexible so as to create uncertainty.

- Conservation easements meet the fourth characteristic in that they "run with the land," binding subsequent purchasers.

- The fifth characteristic is that the definition of sequestration rights and the associated procedural mechanisms be designed to reduce the risk of overlap and conflict with other property interests and associated land uses. Conservation easement legislation typically is drafted to overcome uncertainties relating to similar common law interests, and some

101. See Section IV. C. above, for more information on this topic.
102. See Section IV. B. 1, above, for more information on this topic.

provisions go beyond this by clarifying the relationship between conservation easements and other property interests.[103] Moreover, a decade of experience with conservation easements in connection with other property interests and land uses will help inform how sequestration rights legislation should be drafted in this regard.

- The sixth characteristic is that the substantive and procedural components of the property rights regime and the broader legal framework for carbon sequestration on agricultural land be designed to reduce legal uncertainty and other sources of transaction costs. Conservation easement legislation on the whole reduces legal uncertainties, but experience has shown that some still exist. For example, it is not clear whether Alberta's conservation easement legislation permits conservation easements to be held jointly by two or more qualifying organizations. Developers of sequestration legislation can learn from such uncertainties in order to avoid them during the drafting process.

Although conservation easement legislation shows promise as a model for legislation that establishes and governs sequestration rights, it is not a perfect prototype. The following sections highlight some limitations of conservation easements. It also sheds light on policy implications of the limitations for the development of a regulatory model for sequestration rights.

2. *Limited Purposes of Conservation Easements*

Authorizing legislation limits the purposes for which conservation easements may be granted. For example, the Alberta *Environmental Protection and Enhancement Act* provides that conservation easements may be granted for the primary purpose of protecting, conserving and enhancing the environment, including biological diversity, or natural or aesthetic values. The legislation allows secondary purposes such as research, recreation and protection of open space, but only if such uses do not compromise the primary purpose.[104] Accordingly, the legislation would not normally be suitable to the establishment of sequestration rights in Alberta for two reasons.

First, the provisions do not appear to authorize the protection of agricultural land as a primary purpose, unless the protection is to preserve natural values, such as rangeland ecology. Second, it appears that the Legislature intended that conservation easements primarily be used to protect existing undeveloped environments from development. Sequestration agreements would normally anticipate conversion of conventionally cultivated agricultural land to no- or low-till farming, to reduced summer fallow or to perennial cover, such as trees or shrubs. Even if the provisions could be applied in particular instances so that a valid conservation easement is created, obliging the grantor to change land management practices in order to increase the carbon content, the legislation would not meet the requirements of the second

103. For example, the Alberta legislation deems conservation easements to be restrictive covenants for the purposes of some sections of the *ALTA*, *supra* note 31. Because of this a conservation easement will survive a tax sale of the parcel of land to which it relates.

104. *EPEA*, *supra* note 99 s. 22(2)(c).

characteristic, namely that the interest created by the legislation is a sequestration right and not something else.

Although Alberta conservation easement legislation could be amended to include the purpose of creating carbon sinks and other carbon assets, there are two problems with this solution. First, in this writer's experience, directly authorizing conservation easements to protect agricultural landscapes is a political hot potato and such an amendment would likely meet resistance.[105] Second, as the next few sections will show, even if the creation and continuance of carbon sinks and other carbon assets were proper subjects of a conservation easement, numerous limitations make conservation easements inappropriate for sequestration rights. In the end, rather than toying with conservation easement legislation, it would be more efficient to create legislation specifically designed to define and transfer carbon assets.

3. *Limitations on Who May Hold a Conservation Easement*

A shortcoming of conservation easement legislation is that it authorizes only certain classes of grantees. For example, in Alberta, conservation easements may only be granted to a "qualified organization". "Qualified organization" means the provincial government, a provincial government agency, a local authority including a municipality, or a body corporate that is a registered charity under the *Income Tax Act*[106] that is constituted to hold conservation property interests and meets other conditions set out in the legislation.[107] There are good policy reasons for limiting who may hold a conservation easement. It serves the public interest to allow only persons or organizations that can demonstrate an appropriate mandate and sufficient capacity to own interests that require land to remain in an undeveloped state, usually in perpetuity.

The developers of sequestration interest legislation must bear in mind policy considerations for limitations on who may hold sequestration rights. Although facilities that offset carbon emissions by purchasing sequestration rights are the most likely grantees of interests, the marketability of rights would be hampered if legislation limited qualified holders. Nevertheless, sequestration rights only serve their purpose while carbon is sequestered in accordance with sequestration agreements. This underlines the need for provisions in sequestration agreements and overarching legislation to secure the performance of sequestration obligations.

---

105. The writer of this part of the article (Arlene Kwasniak) was involved in the development of the Alberta conservation legislation in the early 1990s. In the context of discussions among government officials, municipalities and other stakeholder organizations regarding including the protection of agricultural lands as a valid purpose for conservation easements, it was apparent that such inclusion would have hampered the law reform process because of its controversial nature. Indeed, although many US states have legislation that authorize agricultural easements, in Canada, as of March, 2004, only Ontario had directly taken this step with the *Agricultural Research Institute of Ontario Act*, R.S.O. 1990, c. A.13, s. 3(f). which enables agricultural preservation covenants.

106. R.S.C. 1985 (5th Supp.), c. 1.

107. *EPEA*, *supra* note 99 s. 22 (1) (e). In Alberta, generally recognized non-governmental qualified organizations include the Nature Conservancy of Canada, the Alberta Fish and Game Association, Ducks Unlimited Canada, the Alberta Sports Recreation Parks and Wildlife Foundation, the Alberta Conservation Association, Southern Alberta Land Trust Society and others.

4. *Limitations on Transferability of Conservation Easements*

Conservation easements are not freely transferable. Although legislation varies throughout Canada, they usually may be transferred only to persons or organizations that are qualified under the Act to hold them. Comparable limitations on transferability of market instruments such as sequestration rights would not be acceptable. This observation reveals a key difference between conservation easements and sequestration rights: although conservation easements may offer market incentives since they enable financial benefits for the conservation of environmental values,[108] they are not tradable market instruments. Hence, limitations on tradability are not controversial. Nevertheless, the policy behind limitations is illuminating and it raises policy issues regarding a proper regulatory model for sequestration rights.

The policy behind limits on the transferability of conservation easements ensures that the transferee will enforce the grantor's obligations to conserve natural values and manage land in accordance with the conservation easement agreement. Part of the reason for this policy is that gifting a conservation easement can result in income tax benefits for the grantor.[109] Limits on transferability avoid abuse, such as allowing the grantor to be effectively relieved of conservation obligations by transfer of the interest to a person who will not enforce them for reasons of lack of mandate, capacity or accountability.[110] A regulatory model for sequestration rights probably should not limit transferability since sequestration rights, unlike conservation easements, are market instruments. Nevertheless, developers of the model must consider how the model will secure the performance of obligations under the agreement.

5. *Enforcement of Conservation Easements*

Legislation establishing conservation easements sets out how they may be enforced. For example, the Alberta legislation provides that a conservation easement may be enforced by the grantee, a qualified organization appointed in writing by the grantor other than the grantee, or by both the grantee and the appointed qualified organization.[111] Some jurisdictions specifically allow the grantor to enforce grantee

---

108. Conservation easements may be sold for value or donated to conservation organizations that are recognized by the Canada Customs Agency as registered charities or to a level of government. Where a conservation easement is donated, the donor may be eligible for a charitable receipt that may be used to reduce income taxes.

109. See Atkins, Hillyer & Kwasniak, *supra* note 100 at 71-79.

110. Entities that issue tax receipts for gifts of conservation property are accountable to the federal government. For example, the federal Ecological Gifts Program gives special tax treatment to qualifying donations of conservation land or lesser interests such as conservation easements. This treatment includes a reduction in capital gains realized on the disposition of ecologically sensitive land and the provision of a tax credit or a deduction to donors, up to 100% of their net income. See Environment Canada, *Ecological Gifts Program*, online: Environment Canada <www.cws-scf.ec.gc.ca/ecogifts/intro_e.cfm>. The federal government has taken steps to curb abuse of the program by requiring government approval for any disposition of a conservation interest or change of land use. Non-approved changes could result in a penalty to the holder of the interest equal to 50% of the fair market value of the interest at the time of the disposition or change of land use. See *Income Tax Act*, *supra* note 106, s. 207.31.

111. *EPEA*, *supra* note 99 s. 22(3).

obligations. Legislation throughout Canada normally limits third party enforcement. Enforcement mechanisms themselves are set out in agreements, as authorized by legislation, and typically include a range of court remedies, including injunctions and often mediation and arbitration.

Effective sequestration rights legislation must include appropriate enforcement provisions. Like conservation easements, these should enable the grantee to enforce sequestration obligations. However, grantee enforcement alone is not sufficient. Facilities holding sequestration rights might not have the personnel to carry out monitoring and enforcement activities, though this might change if a sequestration rights market is established. As well, accommodation must be made to ensure effective enforceability following a transfer of rights. Although the value and viability of carbon credits, emissions offsets or other carbon assets depend on the grantor honoring land use and management obligations, which requires effective enforcement provisions, this article will not attempt to make detailed suggestions for such provisions. However, unlike most conservation easement legislation, the provisions should allow for third party enforcement. If a market for sequestration rights develops, an enforcement services industry may be established. As with other industries, qualification and other standards will likely emerge.

6. *Modification and Termination Provisions of Conservation Easements*

Conservation easements may be modified and terminated in accordance with authorizing legislation. For example, in Alberta, a conservation easement may be modified or terminated by agreement between the grantor and the grantee, or by the order of the Minister of Environment acting in the public interest.[112] As well, they may be modified or terminated by court order on proof that the modification will be beneficial to the persons principally interested in its enforcement or on proof that the easement conflicts with a land use by-law or statutory plan under Part 17 of the *Municipal Government Act*.[113]

Most of the policy reasons behind these provisions do not appear readily applicable to a regulatory model for sequestration rights. First, consider modification or

---

112. *Ibid.* s. 22(7).

113. R.S.A. 2000, c. M-26 [*Act*]; *ibid.*, s. 24(3) states that s. 48(4) of the *ALTA*, *supra* note 31, applies. Courts have interpreted this *ALTA* provision in respect of restrictive covenants, which are similar in relevant ways to conservation easements. The decisions state that the provision does not grant authority to modify or terminate a condition simply because the land use by-law or statutory plan is more permissive than the covenant. In order for a court to have the right to modify or terminate, the covenant must directly conflict with the land use by-law or statutory plan, for example, where complying with the covenant would lead to a violation of a by-law. To illustrate, a court could not modify or terminate a covenant limiting building heights to two storeys where the by-law would allow three storeys. However, it would have the right to modify or terminate a covenant restricting building height to more than two storeys, where a by-law restricts building height to two storeys. Cases that have considered the *ALTA* provision in respect of restrictive covenants are *Seifeddine v. Hudsons Bay Traders* (1980), 22 A.R. 111, 108 D.L.R. (3d) 671 (Alta. C.A.); *Rockyview (Municipal District No. 44) v. Prince*, [1996] A.J. No. 1347 (Alta Q.B.) (QL) and *Crump v. Kernahan*, (1995), 173 A.R. 123, 48 R.P.R. (2d) 231.

termination by agreement between the grantor and the grantee. This right mirrors the common law right to modify or terminate restrictive covenants. Regarding sequestration rights legislation, although it would be acceptable to allow some grantor/grantee modifications (for example, to improve sequestration techniques), it would not be acceptable to allow modifications that reduce sequestration obligations or termination where carbon credits have been issued on the basis of the agreement.

The second method is termination or modification by the Minister in the public interest. The policy reason for this method, as the writer understands it, is to ensure that if conservation of land is no longer possible or feasible, or if other government designs for land far outweigh conservation values, there is some way for the government to deal with the land, short of expropriation. That policy reason does not seem applicable to sequestration rights and in any event would detract from the certainty of sequestration rights. Nevertheless, developers of sequestration legislation might consider enabling the government to step in, if required, to ensure the long term viability of sequestration agreements.

The third method is by court ordered modification to benefit persons principally interested in enforcement of the interest. This provision also mirrors the law as it applies to restrictive covenants. Because the grantor and grantee may jointly modify the interest, this right would apply to situations where only one of the grantor or grantee, or someone other than the grantor or grantee, desires modification to enhance enforceability. For example, someone whose land serves as connective habitat to conservation easement land might have a legitimate interest in the enforceability of the conservation easement agreement even though they are not a party to it. By analogy, the holder of a carbon credit may have a legitimate interest in the enforceability of a sequestration rights agreement even though this person is not a party to the agreement. This is because the viability of carbon credits as tradable market instruments depends on the continued existence of the carbon assets underlying them. Developers of sequestration rights legislation should consider giving persons other than the parties to agreements rights to apply for a court ordered modification to better ensure enforceability.

Fourth, court ordered modification or termination, where there is an inconsistency with land use by-laws or plans, also mirrors the rules for restrictive covenants. This provision ensures that courts have some control over private land use arrangements that directly conflict with publicly imposed local regulations. Although its use has been severely restricted by courts,[114] it still casts a degree of uncertainty on the continued existence of conservation easements and restrictive covenants. As sequestration rights are economic instruments, it is preferable to avoid such uncertainty. Nevertheless, developers of sequestration rights legislation should bear in

114. *Ibid.*

mind the implications of municipal land use plans and by-laws for landowners who want to turn their property into carbon sinks.

Consider, for example, Alberta's land use legislation, the *Municipal Government Act*[115]. A change in the use of land normally constitutes a "development" for the purposes of the legislation and may require a development permit from the local municipality.[116] Under the *Act*, no use of land may be made in a land use district unless it is a permitted or a discretionary use. If the use of land as a carbon sink can be considered an agricultural use, then a change in land management practices to effect carbon sequestration should not involve a change of use. However, a change of use likely would be involved if, for example, an industrial site was to be converted into a carbon sink. Here, unless the governing land use by-law authorizes agriculture use or another appropriate category, the sink could not be legally established without a zoning change or a change of authorized land uses for the district. Developers of sequestration rights legislation should consider what powers municipalities have and should have over the location and management of carbon sinks.

7. *Conclusion*

Numerous aspects of conservation easement legislation may serve as a model for legislation in the creation and governing of sequestration rights. However, conservation easement legislation cannot serve as a complete prototype. Differences between conservation easements and sequestration rights, especially because the latter are intended to be economic instruments, point to the need for the creation of legislation that meets the specific requirements of sequestration rights. However, analyzing the limitations of conservation easement legislation and considering the policy behind these limitations brings to light numerous policy considerations for the development of sequestration rights legislation.

E. *Australian Carbon Rights Legislation*

Australia has led the way in the development of carbon rights legislation.[117] The objective of this legislation is to create legal rights in carbon sequestered by trees and forests; it has generally been enacted through amendments to forestry statutes. Many of the underlying issues addressed in Australian legislation are nonetheless relevant to the legal basis for sequestration transactions relating to agricultural land. A detailed examination of this law is beyond the scope of this article. However, a selective review highlights how Australian statutes satisfy some of the key criteria identified above for a property rights regime for sequestration transactions.[118]

---

115. *Ibid.*.

116. *Ibid.* s. 616(b) (definition of "development").

117. David Brand, "Current Status of Forest-based Carbon Sinks" (2004) February/March Australasian Emissions Trading Forum Review 6, online: Australasian Emissions Trading Forum <http://aetf.emcc.net.au/ContentStore/pdf/ReviewFebMar2004.pdf>.

118. See Lim & Giskes, *supra* note 69 at 6-19; Jones, *supra* note 97 at 122-24 (descriptions of carbon rights legislation in Australia).

Australian legislation addresses directly the first two criteria for a property rights regime by establishing distinct legal interests, separate from land ownership, that are linked directly to carbon assets. The rationale for these statutes speaks to the deficiencies of the common law and the pre-existing statutory mechanisms in this area: "In the absence of specific legislation, there is legal uncertainty as to whether carbon storage capabilities of trees can be owned as a commodity on land separate to the ownership of the land itself, or ownership of trees on the land."[119] As reflected in this quotation, the approach adopted in Australia has generally been to structure the legal hierarchy of rights by distinguishing between underlying ownership of the land, ownership of the "forest property" and ownership of "CS rights."[120]

The legal regimes in New South Wales, Queensland, South Australia and Tasmania have adopted the *profit à prendre* to define property rights in carbon assets. Incorporation of this concept into legislation was explicitly intended to address the risk that carbon sequestration would not be recognized by the courts as coming within the common law concept of *profit à prendre* because "it is impossible to enter and take carbon sequestered from trees on another's land, separately from taking the timber on the land."[121] The *profit à prendre* is described in legislation as a "forestry right" or a right to a "natural resource product," both of which are linked explicitly to carbon sequestered in trees and by forests.[122] These property rights are created through agreements referred to as "forestry covenants" or "forest property agreements."[123]

The states of Victoria and Western Australia have created statutory carbon rights without incorporating the concept of a *profit à prendre*.[124] In functional terms, however, these rights appear comparable to those in the other states. In Victoria, for example, carbon sequestration rights are legally recognized interests that are derived from the broader rights of the forest property owner.[125]

Australian legislation defines legal interests directly in terms of carbon assets (e.g. sequestration potential and sequestered carbon), while giving the parties considerable flexibility to specify their respective rights and obligations regarding land use. For example, the legislation in New South Wales distinguishes between the basic carbon sequestration right, which entitles the holder to the "legal, commercial or other benefit (whether present or future) of carbon sequestration by any existing or future tree or forest on the land after 1990," and the forestry right that may include a carbon sequestration right but can also encompass the interest in the establishment and maintenance of a crop of trees.[126] The obligations that can be imposed through

---

119. Lim & Giskes, *ibid.* at 6.
120. *Ibid.* at 16 (referring to legislation in Victoria).
121. Austl., Tasmania, House of Assembly, *Parliamentary Debates* (23 April 2002) at 43-103, online: Parliament of Tasmania <http://www.hansard.parliament.tas.gov.au/isysquery/irl7017/1/doc>.
122. Lim & Giskes, *supra* note 69 at 12-16.
123. *Ibid.*
124. *Ibid.* at 16-19.
125. *Ibid.* at 16.
126. *Ibid.* at 12.

forestry covenants may include requirements relating to "the provision of access to, or the maintenance of, trees or forests on land that is the subject of any carbon sequestration; or the ownership of any tree or trees on land that is the subject of a forestry right to be vested in the person who owns the forestry right."[127]

Carbon rights legislation in South Australia provides a somewhat more detailed enumeration of the issues that may be addressed by the parties to sequestration transactions, stating:

> A forest property agreement may[:]
>
> confer on the forest property owner rights to enter the land to plant, maintain and harvest forest vegetation;
>
> require the owner of the land and/or the forest property owner to take specified action for cultivation, maintenance and care of the forest vegetation;
>
> deal with the duty of care to be exercised by each party to the other; and
>
> deal with any other incidental matter. . . .[128]

The legislation thus provides some guidance regarding the matters that may be addressed, while leaving the details of sequestration transactions to be determined by the parties.

Australian legislation is also explicit that carbon rights run with the land. *Profits à prendre* are recognized in land titles legislation as legal interests that can be registered, assigned and run with the land.[129] By deeming sequestration rights to be *profits à prendre*, this established set of characteristics and the associated legal infrastructure (e.g. the land titles system) could be relied on without modification. However, states that rejected the *profit à prendre* approach also provided for the registration of carbon rights on title.

The issue of overlapping or conflicting rights also has been addressed in Australian legislation. The separation of forestry and sequestration rights could, under some circumstances, give rise to separate ownership of the trees and the sequestered carbon on a given property. The potential for conflict between these rights is addressed in Victoria, where only the forest property owner can enter into a carbon rights agreement. When asked about this restriction during debate on the legislation, the then Minister for Environment and Conservation responded as follows:

> A question was asked about why the land-holder will not be allowed to enter directly into an agreement on carbon rights. The answer is that that would establish competing rights over the same trees. The most effective way of avoiding such a conflict of interest between the management of trees for timber and for carbon is to make the rights derive

---

127. *Ibid.* at 12-13.
128. *Ibid.* at 14.
129. *Ibid.* at 7; Wylynko, *supra* note 68 at 365.

> from the forest property agreement. Otherwise there would be two classes of carbon right—one derived from the forest property right and the other from the independent right. That would lead to a difficult and confusing situation.[130]

For any regime where forestry and carbon sequestration rights are capable of separate ownership, attention to the avoidance of, or resolution of conflicts between rights holders is clearly desirable.

This brief summary shows that Australian legislation satisfies, at least to some degree, many of the general criteria for the establishment of transferable sequestration rights that were outlined above in Section IV. B. These statutes could, therefore, serve as models when developing a property rights regime for carbon sequestration on agricultural land. Some caution is advisable, however, when transferring the Australian models to the Canadian context.

First, attention should be paid to both the benefits and the risks associated with incorporation of the common law concept of *profit à prendre* into carbon rights legislation. The adoption of pre-existing legal categories does have the appeal of familiarity and avoids the necessity of amending other components of the property law regime (e.g. land titles legislation). Since Australian sequestration policy is directed primarily to carbon storage in trees and other vegetation, the analogy with the "products" of the land that are recognized in traditional *profits à prendre* is fairly close.

However, there may be advantages in starting with a clean conceptual slate when defining sequestration rights. Carbon sequestration, particularly in soil on agricultural land, remains an awkward fit with traditional applications of the *profit à prendre* concept. There may also be a risk that the courts will interpret the use of that category as an invitation to apply arcane common law reasoning. Resulting complexity and uncertainty could contribute to transaction costs. These concerns may explain why some Australian states have rejected the modified *profit à prendre* approach and decided instead to establish sequestration rights as an entirely new legal category.

A second important point is the relatively narrow focus of Australian carbon rights legislation. These statutes anticipate reforestation, including plantation forestry as the means for carbon sequestration. This focus is driven by both the opportunities for sequestration on deforested land in Australia and the ancillary environmental benefits from promoting large-scale reforestation.[131] While there is some variation in the scope of definitions, these statutes do not appear to apply to carbon sequestered in agricultural land through techniques such as no-till farming and improved nutrient management. For example, some Australian legislation characterizes the sequestra-

---

130. Austl., Victoria, Legislative Assembly, *Parliamentary Debates* (22 March 2001) at 459, cited in Lim & Giskes, *ibid.* at 17.

131. David Jones, "Trading for climate without trading off on the environment: An Australian perspective on integration between emissions trading and other environmental objectives and programs" (2003) 3S2 Climate Policy S125 (Elsevier Science).

tion right as a property right in trees.[132] The legal framework for sequestration transactions in Canada should be broad enough to capture the full range of land uses and should recognize that the terrestrial carbon reservoir includes the soil itself as well as vegetation.

F. *Summary and Conclusion*

The establishment of a property rights regime to permit the definition and transfer of legal interests in carbon assets is necessary if market mechanisms are to drive carbon sequestration on Canadian agricultural land. Common law property rights and the statutory regime for conservation easements have some of the required characteristics, but do not provide an adequate legal basis for sequestration transactions. The experience with carbon sequestration legislation in Australia confirms that a statutory property rights regime is required and highlights some elements that could be included in such a regime. These statutes do not, however, provide a directly transferable legal template.

It follows from this analysis that Canadian governments wishing to promote carbon sequestration on agricultural land will likely be obliged to develop custom-made property rights legislation. While many complex issues must be addressed, some of the groundwork for this process exists already. General principles to guide the design of a property rights regime—such as the six criteria set out above—can readily be identified from the literature and from a comparative analysis of property rights regimes. A menu of specific legal tools can also be drawn from the common law, existing statutory schemes, such as conservation easement legislation, and experience with carbon rights legislation in Australia. The key elements of a property rights regime for carbon sequestration on agricultural land can therefore be identified at the outset. What remains to be completed is the detailed work of putting these elements together into a workable legislative package.

V. CONCLUSION

The challenges of using large-scale biotic sequestration to offset anthropogenic GHG emissions are substantial. This article has focused on two of the conditions that must be met from a legal perspective if private investment in carbon sequestration on agricultural land is to occur at the level needed to make a significant contribution to meeting Canada's international commitment to reducing GHG emissions. First, clarity is needed regarding the initial ownership of sequestration potential and sequestered carbon. Second, a property rights regime is required for defining and transferring interests in carbon assets. The analysis presented here suggests that

---

132. Butt, *supra* note 70 at 235-36; Brand, *supra* note 117.

the common law and statutory mechanisms currently available in Canada in relation to these two conditions do not provide an adequate legal framework for carbon sequestration on agricultural land. The solution to this problem is the enactment of customized legislation to provide the legal basis for sequestration transactions.

Given Canada's active promotion of biotic carbon sequestration in international climate change negotiations, it is remarkable how little effort Canadian governments have devoted thus far to developing the required legal framework. The only statute that touches on this issue, Alberta's *Climate Change and Emissions Management Act*, barely sets the stage for the eventual establishment of a legal basis for sequestration transactions.[133] Even at the level of government discussion papers and broad policy statements, there has been little attention to the establishment of a domestic legal regime. The contrast with the enactment of carbon rights legislation in Australia—which has subsequently withdrawn its support for the Kyoto Protocol—is striking. If Canadians are serious about including carbon sequestration on agricultural land within their broader climate change strategy, establishing the domestic legal framework for sequestration transactions should be a priority.

VI. Carbon Sequestration Glossary[134]

Afforestation

Planting of new forests on lands that historically have not contained forests. For a discussion of the term forest and related terms such as afforestation, reforestation, and deforestation, see the IPCC Report[135].

Anthropogenic

Resulting from or produced by human beings.

Atmosphere

The gaseous envelope surrounding the Earth. The dry atmosphere consists almost entirely of nitrogen (78.1% volume mixing ratio) and oxygen (20.9% volume mixing ratio), together with a number of trace gases, such as argon (0.93% volume mixing ratio), helium, and radiatively active greenhouse gases such as carbon dioxide (0.035% volume mixing ratio) and ozone. In addition, the atmosphere contains water vapour, whose amount is highly variable but typically 1% volume mixing ratio. The atmosphere also contains clouds and aerosols.

---

133. Kennett & Lucas, *supra* note 14.

134. All entries are excerpted from Intergovernmental Panel on Climate Change, *Glossary of Terms used in the IPCC Third Assessment Report*, online: Intergovernmental Panel on Climate Change <http://www.ipcc.ch/pub/syrgloss.pdf>.

135. *Supra* note 10.

Biomass
The total mass of living organisms in a given area or volume; recently dead plant material is often included as dead biomass.

Biosphere (terrestrial and marine)
The part of the Earth system comprising all ecosystems and living organisms in the atmosphere, on land (terrestrial biosphere), or in the oceans (marine biosphere), including derived dead organic matter such as litter, soil organic matter and oceanic detritus.

Carbon cycle
The term used to describe the flow of carbon (in various forms, e.g. as carbon dioxide) through the atmosphere, ocean, terrestrial biosphere and lithosphere.

Carbon dioxide (CO_2)
A naturally occurring gas, also a by-product of burning fossil fuels and biomass, as well as land-use changes and other industrial processes. It is the principal anthropogenic greenhouse gas that affects the Earth's radiative balance. It is the reference gas against which other greenhouse gases are measured and therefore has a Global Warming Potential of 1.

Climate change
Climate change refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer). Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Deforestation
Conversion of forest to non-forest.

Flux adjustment
To avoid the problem of coupled atmosphere-ocean general circulation models drifting into some unrealistic climate state, adjustment terms can be applied to the atmosphere-ocean fluxes of heat and moisture (and sometimes the surface stresses resulting from the effect of the wind on the ocean surface) before these fluxes are imposed on the model ocean and atmosphere. Because these adjustments are pre-computed and therefore independent of the coupled model integration, they are uncorrelated to the anomalies which develop during the integration. In Chapter 8 of the IPCC Report it is concluded that present models have a reduced need for flux adjustment.[136]

---

136. *Ibid.*

Greenhouse gas

Greenhouse gases are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. Moreover there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine- and bromine- containing substances, dealt with under the Montreal Protocol. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).

Kyoto Protocol

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) was adopted at the Third Session of the Conference of the Parties to the UNFCCC, in 1997 in Kyoto, Japan. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the Protocol (most countries in the Organisation for Economic Cooperation and Development, and countries with economies in transition) agreed to reduce their anthropogenic greenhouse gas emissions (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) by at least 5% below 1990 levels in the commitment period 2008 to 2012.

Land use

The total of arrangements, activities and inputs undertaken in a certain land cover type (a set of human actions). The social and economic purposes for which land is managed (e.g. grazing, timber extraction and conservation).

Land-use change

A change in the use or management of land by humans, which may lead to a change in land cover. Land cover and land-use change may have an impact on the albedo, evapotranspiration, sources and sinks of greenhouse gases, or other properties of the climate system and may thus have an impact on climate, locally or globally.

Reforestation

Planting of forests on lands that have previously contained forests but that have been converted to some other use.

Reservoir
A component of the climate system, other than the atmosphere, which has the capacity to store, accumulate or release a substance of concern (e.g. carbon, a greenhouse gas or a precursor). Oceans, soils and forests are examples of reservoirs of carbon. Pool is an equivalent term (note that the definition of pool often includes the atmosphere). The absolute quantity of substance of concerns, held within a reservoir at a specified time, is called the stock.

Sequestration/Uptake
The addition of a substance of concern to a reservoir. The uptake of carbon containing substances, in particular carbon dioxide, is often called (carbon) sequestration.

Sink
Any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas or aerosol from the atmosphere.