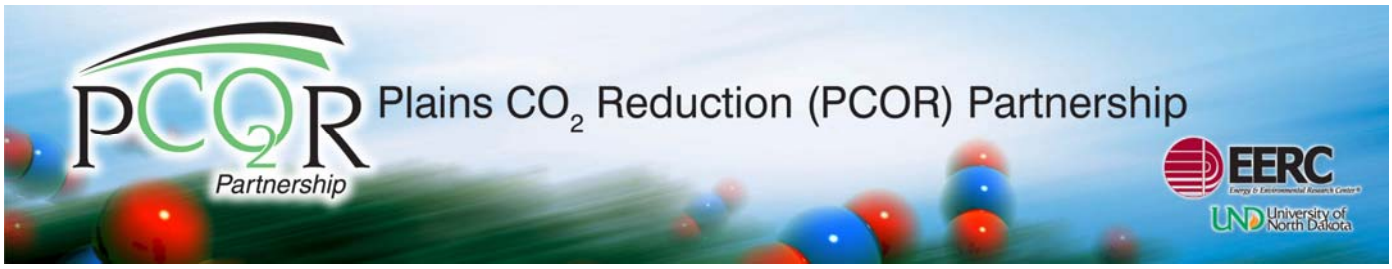

MARKET DEVELOPMENT FOR TERRESTRIAL SEQUESTRATION ON PRIVATE LANDS

Topical Report

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October 2008

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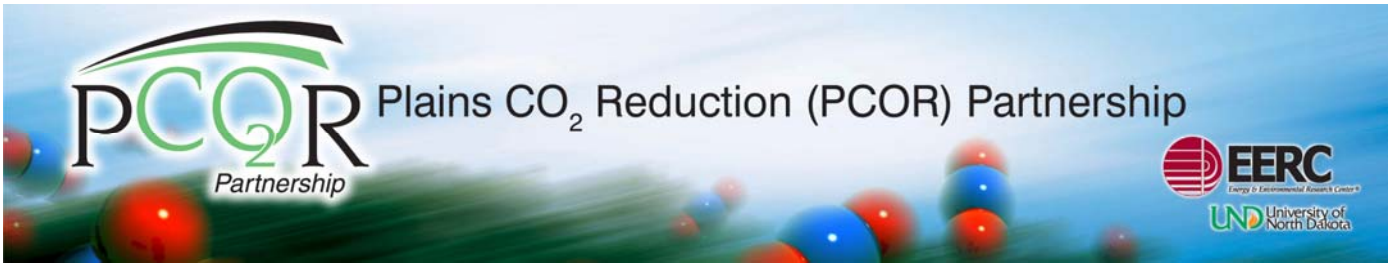

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EXECUTIVE SUMMARY

The North American carbon market presents a growing opportunity for landowners to derive income by implementing land management practices that terrestrially enhance the sequestration and storage of carbon. This market also provides opportunities for companies looking to offset their emissions through the purchase of carbon offsets and for investors speculating on the future value of carbon credits. Without the presence of rigid regulatory oversight, the evolution of the voluntary carbon market in the United States has been largely determined by market participants and their objectives. Landowners and other market participants wishing to participate in the voluntary carbon market find a myriad of greenhouse gas registries, exchange platforms, and voluntary standards in which to enroll. To help navigate through the varied and extensive information, this topical report provides a primer on the business processes surrounding carbon markets and terrestrial sequestration: who is involved, what is being traded, why do buyers want it, and what they are doing with it—all with particular reference to terrestrial sequestration in the Prairie Pothole Region.

Greenhouse gas registries and exchanges play an important role in stimulating carbon offset demand. Currently, five distinct registries and exchanges exist in the United States. The registries each have unique objectives, accounting protocols, criteria for acceptance of different terrestrial offsets, and geographic regions from which projects can be accepted. In relation to terrestrial sequestration, the U.S. Department of Energy (DOE) 1605b program is the most inclusive, allowing for the accelerated registration of forward streams of offsets and recognizing a variety of terrestrial sequestration practices. Most of the other registries, while still in their early development stages, have taken a more conservative approach to terrestrial sequestration, only recognizing forestry or conservation tillage-based projects. However, indications are that the registries are open to exploring additional terrestrial project types in the future.

The business processes of a carbon transaction reveal the interaction between the involved parties and the role that aggregators and/or project developers play in bringing offsets to the

market. Direct access for landowners to most buyers in the voluntary market is constrained by the high transaction and administrative costs that a single project entails for both the landowner and the buyer. Aggregators provide the capability to realize the economies of scale sufficient to lower transaction costs. Aggregators also provide a suite of services such as risk management, legal services, offset tracking, and field-based technical assistance. In recognition of the need for aggregators, the DOE 1605b Program provides special provisions to facilitate aggregator participation in the registry and the enrollment of small-scale projects.

The final process in many carbon transactions is the retirement of offsets in a registry, where they are used to mitigate, or offset, the emissions of the entity that acquired them. To highlight this process, an overview of the DOE 1605b participation process with particular reference to the procedures needed to become an aggregator under the registry are presented. The registry has been undergoing a series of changes since 2002 to improve the functionality, accuracy, and ease of participation in the program. After two periods of public comment, the General and Technical Guidelines for reporting are now finalized and can be used to assist in registry participation.

The information in this report was prepared to support the objectives of the Plains CO_2 Reduction (PCOR) Partnership, a collaborative effort of more than 93 public and private stakeholders working toward a better understanding of the technical and economic feasibility of capturing and storing carbon dioxide (CO_2) emissions from the central interior of North America since its inception in 2003.

ACKNOWLEDGMENTS

The PCOR Partnership is a diverse group of public and private sector stakeholders working toward a better understanding of the technical and economic feasibility of capturing and storing (sequestering) CO_2 emissions from stationary sources in the central interior of North America. It is one of seven regional partnerships funded by DOE's National Energy Technology Laboratory Regional Carbon Sequestration Partnership Initiative, which represents more than 350 organizations in 41 states, three Indian nations, and four Canadian provinces. DOE is focused on understanding the opportunities and issues associated with CO_2 sequestration.

The PCOR Partnership represents public agencies, utilities, oil and gas companies, engineering firms, associations and nonprofit organizations, and universities (see PCOR Partnership list below). The Energy & Environmental Research Center (EERC) would like to thank the following partners who have provided funding, data, guidance, and/or experience to support the PCOR Partnership:

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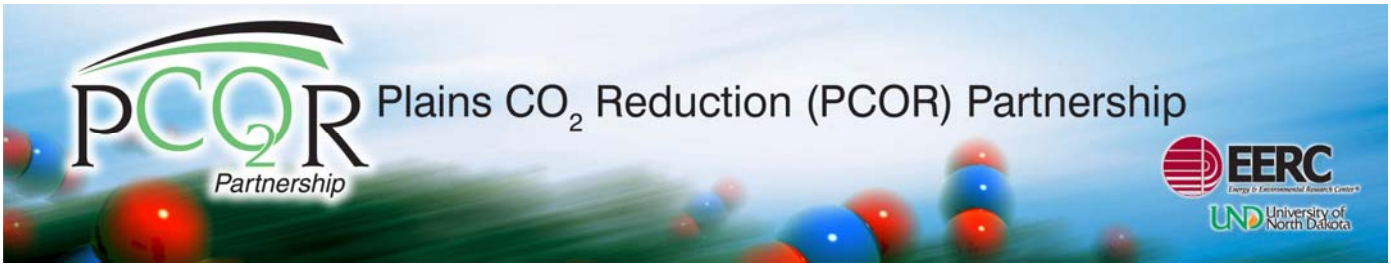

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INTRODUCTION

As one of seven Regional Carbon Sequestration Partnerships, the Plains CO_2 Reduction (PCOR) Partnership is working to identify cost-effective carbon dioxide (CO_2) sequestration systems for the PCOR Partnership region and, in future efforts, to facilitate and manage the demonstration and deployment of these technologies. In this phase of the project, the PCOR Partnership is characterizing the technical issues, enhancing the public's understanding of CO_2 sequestration, identifying the most promising opportunities for sequestration in the region, demonstrating technologies, and detailing an action plan for the implementation of regional CO_2 sequestration opportunities. This report focuses on the current understanding, as documented in the literature, of the economics and policy of carbon sequestration in agricultural soils.

Currently, carbon markets present landowners with a unique opportunity to obtain additional revenue by implementing land management practices that enhance the sequestration and storage of CO_2. The U.S. carbon market is being driven by companies looking to offset their emissions and by investment entities willing to speculate on future regulation. This topical report provides an overview of the business processes involved in the voluntary carbon market.

THE CARBON MARKETS

Most prominent among carbon markets is the Kyoto-driven European Union Emission Trading Scheme (EU ETS), as stipulated by the United Nations Framework Convention on Climate Change (UNFCCC). Terrestrial sequestration via afforestation and reforestation are UNFCCC-recognized sinks under the Land Use and Land Use Change and Forestry (LULUCF) sector and eligible for clean development mechanism (CDM) verifiable emission reductions (VERs). However, the EU ETS does not recognize LULUCF CDM projects. Currently, the only market for CDM-verified LULUCF projects are Kyoto-compliant nations or voluntary buyers.

Access of carbon offsets derived from terrestrial sequestration projects in the Prairie Pothole Region to the international Kyoto market is further limited by the non-participation of the United States in the treaty. North American investors and politicians have instead demonstrated a strong desire to invest and act domestically, accommodating a much more robust portfolio of terrestrial sequestration strategies. While there may be possible linkages to international markets in the future with the development of federal climate and energy legislation, the most immediate and greatest opportunity for U.S.-based private landowners and investors is currently in the domestic voluntary market.

The advent of the voluntary carbon market is a relatively recent development, providing new income opportunities for terrestrial sequestration on private lands. The voluntary nature of the domestic market has produced many mixed signals, with few comprehensive sources of carbon market activity available to date. An important aspect of market development will be the emergence of greenhouse gas (GHG) registries and their provisions for terrestrial carbon offsets. The following provides an overview of the business processes involved in bringing terrestrial offsets to market, with particular reference to the U.S. Department of Energy (DOE) 1605b program.

Market Participants

An overview of market participants is useful in understanding the dynamics of the voluntary carbon market. Terrestrial carbon market participants include project sponsors, project developers, aggregators, brokers, verifiers, and buyers. Market supply is derived from project sponsors, project developers, and aggregators. Project sponsors are the owners of land or a business that undertake an activity or adopt a practice that sequesters carbon or reduces emissions. A project developer is responsible for all aspects of the delivery of the carbon offset, including the development of project methodologies, baseline determinations, additionality analysis, and monitoring plans. Aggregators may share similar functions while also bringing together smaller projects in marketable volumes to buyers, brokers, or exchanges. Project developers (also known as offset providers) may decide to enlist the services of a broker to market offsets and to act as an intermediary with potential buyers. Brokers sort through potential investment opportunities for buyers and create portfolios scalable for large investor demand.

An integral process in the establishment of carbon offset quality and project integrity is independent verification of project offsets by a third-party agent. Verifiers may conduct field-based carbon measurements or perform remote audits of entity reports, verifying that registry or standard measurement protocols have been followed during the development of the project and implementation of monitoring, mitigation, and verification.

Buyers in the voluntary market fall into three primary categories: retail, industrial, and investment. Ultimately, the majority of transacted offsets are reported to a GHG registry or exchange, where they are retired to mitigate an entity’s GHG emissions.

What Is Being Traded?

Offsets

The term "carbon offset" is used generically to refer to a ton of CO_2 equivalent (CO_2e). An offset negates the effects of carbon emitted in one place by avoiding the release of a ton of carbon elsewhere or absorbing/sequestering a ton of CO_2e that would have otherwise remained in the atmosphere. As a unit of measurement, CO_2e is used as the internationally recognized unit for GHG emissions, since CO_2 is the most abundant GHG. An equivalency measure creates a standard metric, allowing for the conversion of other GHGs, such as methane and hydrofluorocarbons, into a common unit. Emission reductions or GHG mitigation efforts achieved by an outside party that are transferred to an entity that purchases and/or reports the efforts are termed offsets. Eligible offset projects vary by registry, but some common forms include terrestrial or biological sequestration, agricultural and methane capture, and energy end-use efficiencies. The CDM and Joint Implementation of the Kyoto Protocol are also considered offsets since they are emission reduction efforts undertaken by a third party. The term "carbon credit" is often used in the same way, although a credit is technically designated as a unit of trade. A ton of CO_2e can be created, certified, or transacted in several different manners and, depending upon the combination of these factors, affect the terminology that a carbon credit may take on. Generally, in a voluntary market, all credits are project-based offsets since mandatory emission caps are needed for the creation of allowances.

Allowances

Under regulatory schemes, emitters are allocated a specified number of allowances, representing tonnes of CO_2e they may legally emit. An entity that can reduce its annual emissions below the number of allowances received may bank the credits for future compliance or sell the credits/allowances to other entities whose emissions exceed annual allowances. Allowances may include emission reductions or offsets and are generally defined as acceptable emission units recognized by a registry. If the allowances are used toward entity compliance, they are retired as a carbon credit and unavailable for trade.

Emission Reductions

Emission reductions are the quantifiable reduction in emissions attributable to an activity or technology. When an independent outside party verifies an emission reduction claim against a recognized GHG protocol methodology, the reduction becomes a VER. VERs generally receive a certificate representing an emission reduction verified by an independent third party but are not registered with a registry. Once a standard or registry conducts its own review of the emission reduction claim with the opinion of the verifier, a VER can become certified by the standard or registry, becoming a certified emission reduction, or CER.

Attributes

Important attributes of offsets and emission reductions are the clear demonstration of project additionality, permanence, and leakage. Additionality is the demonstration that the

project would not have occurred under a business-as-usual scenario. Common barrier tests used to demonstrate additionality include financial barriers—i.e., implementing a project would be feasible without sponsor finance—or institutional barriers that already mandate the project to be implemented. In both cases, the emission reductions and carbon sequestered are not additional. Of particular importance to terrestrial offsets is project permanence. In order to have a contributable impact on atmospheric GHG concentration, offset and emission reduction projects have to remove GHGs permanently. For terrestrial projects, a perpetual conservation easement provides the needed legal protection of terrestrial carbon stocks and assuages permanence concerns. Impermanent carbon that is later emitted is an example of project leakage, where the GHG benefit achieved by the project is diminished by emissions outside of the project boundary (geographically and temporally). A common cause for leakage in terrestrial sequestration projects occurs when a farmer compensates retiring land for the benefit of sequestration by bringing other retired land into production. Accounting for leakage provides the true net benefit of a sequestration project.

Voluntary Market Demand

The variation in carbon credit terminology does not adequately capture the variation in possible carbon credit attributes. Although carbon credits can be a homogeneous and commoditized good, offsets can have a suite of unique environmental and social attributes. The characteristic of each offset variety make them attractive to different sectors of the market. Commoditized offsets guarantee that a basic level of offset permanence, additionality, and verification has occurred, providing a basic transferable unit of trade to accommodate GHG accounting and trading. Demand for commoditized offsets is largely from a compliance-driven market sector, predicated upon the expectation of future mandatory regulation. Conversely, a burgeoning voluntary "gourmet" sector, composed of philanthropic and morally motivated buyers, has emerged both in regulated Europe and in North America. Gourmet, or "charismatic," carbon buyers demonstrate a preference for offsets with appealing social and environmental attributes (Bayon et al., 2007). The loosely defined criteria associated with gourmet offsets ensure that a vibrant, evolving market with access to small, creative projects will provide an opportunity for innovation in new GHG mitigation strategies. While the voluntary gourmet sector will provide an opportunity for innovation, standardized credits provide the fungibility needed for a credible carbon registry and market.

The distinction in carbon grades also contrasts the three primary buyers active in the voluntary carbon market: retail, investment, and industrial. An overview of buyer motivations, market activity, and use of terrestrial offsets is provided below.

Retail

The most visible opportunity for terrestrial offsets is in the retail market, made up primarily of online providers selling "carbon neutrality" products. Retail outlets operate by providing carbon calculators or generic offset packages representative of the "carbon footprint" for an individual, household, businesses, other institution, or event. Emission-conscious consumers can then buy offsets, typically for \$4–\$25/MTCO_2e, to become carbon neutral (Clean Air – Cool Planet, 2006). These retail operations include both for profit and nonprofit operations

and are based throughout the world. An independent review of this market analyzed 30 companies offering carbon neutrality products and ranked the programs based on transparency of projects and offset quantification and availability of educational materials (ibid). Of the 30 providers, 15 offer terrestrial offsets, all reforestation, of which only one terrestrial provider earned the top tier ranking, Climate Trust. At present, access of terrestrial offsets to this market is limited by low overall consumer demand. Offset providers occasionally solicit bids for new carbon projects, but the manner in which most acquire their offsets remains nontransparent, as is the total number of terrestrial offsets sold.

Investment

An expanding component of the voluntary market is the growth in investment demand by hedge funds, brokerage firms, private equity groups, and other members of the financial community. Forward-looking investors watching the growth of the European and global market see a pre-regulated U.S. carbon market as a great speculative opportunity, and for good reason. In 2006, the global carbon market was worth an estimated $30 billion. The bulk of volume and value so far has come from the EU ETS, which has seen a 200-fold increase in the value of allowances traded through exchanges and brokers in 2006 from its inception in 2004 (Point Carbon, 2007). Encouraged by market growth and increasing demand pressure, carbon credit prices in North America are expected to follow a similar rate of growth. Projections by the UN Intergovernmental Panel on Climate Change estimate that by 2030, carbon credit prices will reach $5–$65 ton/CO_2e (Intergovernmental Panel on Climate Change [IPCC], 2007a). In addition to speculative demand, the investment industry has also created a vibrant secondary market, acquiring portfolios of carbon assets. Buyers find these products useful since they diversify risk and provide a low-cost alternative to acquiring the in-house experience needed to solicit carbon projects and assets.

Industrial

A third component of the voluntary carbon market is derived from the demand by industrial actors, such as utilities, corporations, and other energy-intensive industries looking to reduce emission liabilities and to minimize future regulatory compliance costs. Participation in the early stages of the carbon market and the regulatory process provides opportunities to participate in protocol and registry formulation and enhance the recognition of already-acquired offsets for early action status under mandatory regulation. Other motivations for participation include corporate sustainability practices, public relations, GHG accounting and market experience, and gaining first actor advantages. Domestically, industrial demand has been the strongest and most consistent source of carbon offset transactions. Utilitree and Powertree, large consortiums of utility companies, have already acquired over 3 and 1.6 million tonnes of CO_2e, respectively, through forest restoration activities.[1] The Oregon Climate Trust has also been a strong stimulant for industrial demand: purchasing approximately 650,000 MTCO_2e from afforestation projects on behalf of the state's energy companies.

A survey conducted in 2007 by the Ecosystem Marketplace of 70 global voluntary carbon market participants highlighted some important motivations and trends in the voluntary market

[1] www.powertreecarboncompany.com/projects/facts.pdf (accessed May 2007)

(Hamilton et al., 2007). On the demand side, buyer composition is dominated by businesses, accounting for 80% of purchased offsets, with 12% purchased by governments and only 5% by individuals. Of this total volume, 68% of offset buyers were in the United States with 28% coming from the regulated EU. A surprising discovery of the survey is that buyer motivations are most strongly influenced by corporate responsibility goals for sustainable reporting and public relation purposes, not regulatory concerns as is commonly assumed. Desirable offset attributes identified include social and environmental cobenefits, independent verification, quality of information provided by seller, transparency of accounting, and provision of insurance measures. However, the most important offset attribute identified was additionality—demonstration that the emission reductions would not have occurred in a business-as-usual scenario. From the supply side, North America is also an active player, producing 43% of global offset supply in 2006. Of these, over 56% came from forestation projects, with the next largest offset type being industrial gas capture.

COMPARISON OF REGISTRIES

GHG registries provide the necessary tools and protocol for nations, states, businesses, and other institutions to inventory their emissions over time. Registries serve the dual purpose of providing an accounting framework and also in providing emission reduction targets that can be imposed either voluntarily or compulsorily. Reduction targets can be in either absolute emissions or emission intensity levels calculated as the number of emissions per unit of output. The functionality of the registries varies from the voluntary reporting of emission reduction efforts to trading platforms under a cap-and-trade program. Presently, the void of federal mandatory GHG emission regulations in the United States has led to the development of several emissions reduction programs and associated registries and an exchange that functions as a registry. Efforts are also under way to link two of the registries into one. The U.S. registries vary in terms of objectives, regional and industrial coverage, allowance of offset projects, accounting procedures, and registration requirements (Table 1). Currently, the DOE 1605b Registry and the California Climate Action Registry (CCAR) are not structured to handle carbon offset transactions, nor do they function as trading platforms. The largest voluntary carbon offset trading platform operating in North America is the Chicago Climate Exchange (CCX), providing another venue for businesses and other institutions to report on emission reduction action activity.

Carbon Offset Registries

Department of Energy 1605b Voluntary Reporting of Greenhouse Gases Program (Section 1605b of the Energy Policy Act of 1992)

The DOE program is a voluntary emission reduction program, cataloging entity emission reductions. Initiated in 1994, efforts were undertaken in 2002 to improve registry measurement accuracy, verification, and reliability in support of the Federal Climate Change Initiative. A key objective of the Initiative, and the Registry, is to voluntarily reduce 2002 domestic emission intensity levels 18% by 2012. Since the program is voluntary, the guidelines are intended to be flexible so as to encourage the greatest amount of participation.

Table 1. Comparison of Registry Terrestrial Guidelines and Offset Determination

	Department of Energy 1605b	Regional Greenhouse Gas Initiative (RGGI)	California Climate Action Registry	Chicago Climate Exchange
Allowable Terrestrial Projects	Afforestation, reforestation, forest management and preservation, grassland restoration, land pasture management	Afforestation.	Afforestation, existing forest management, forest conservation.	Grassland restoration, range/grass management, afforestation, reforestation, forest management, and forest conservation.
Geographic Region from Which Projects Can Be Accepted	Global, however, projects outside the United States need to be noted.	Participating states and states with a memorandum of understanding (MOU) with the RGGI Regulatory Agency.	California.	**Forestry:** Canada, United States, Mexico, Costa Rica, and Brazil. **Grass:** Approved states and provinces in the U.S. and Canada.
Offset Additionality Requirements/Tests	None.	Projects must occur on lands that have been in a nonforested state 10 years prior to project commencement.	Project must not be mandated by any law. Afforestation must occur on lands that have been deforested for a minimum of 10 years.	**Forest:** Project developers must sign attestation that a project's primary purpose is carbon sequestration. Land must have been in a nonforested state prior to January 1, 1990.
Baseline Requirements	Employs a start year approach, which can be a single or 4-year average of site carbon stocks. Forest carbon estimates can be quantified by direct sampling, approved models such as COLE, or reference tables provided by the U.S. Forest Service in Appendix I. Grass restoration baseline can be direct-sampled, estimated with approved model such as COME-VR, or by using a default look-up table.	**Quantitative:** Direct sampling no more than 12 months prior to project start date.	**Quantitative:** Direct sampling in addition to submission of a forest inventory plan. **Qualitative:** A 100-year projection of the forest entity's management practices without the project. Reforestation projects must demonstrate a nonforested condition for at least the last 10 years.	**Forestry:** Projects larger than 12,500 $MTCO_2e$/year require direct sampling by CCX-approved verifier. For forestation projects, this will be zero since only live tree biomass is counted. Not required for smaller forestry or grass projects.
Frequency of Monitoring and Verification	**Forestry:** Every 5 years recommended. **Grass:** Frequency of 3–5 years.	Verification and direct sampling not less than every 5 years.	Verification and direct sampling every 5 years.	**Forestry:** Monitoring every year for all projects. All projects outside the United States and U.S. projects over 12,500 $MTCO_2e$/year must be verified annually. **Grass:** None, but subject to investigation by CCX.
Insurance Requirement (reserve)	None.	Purchase third-party insurance or withhold a 10% carbon stock reserve.	None. Declines in carbon stock must be reported.	A 20% reserve of all earned credits is required, released to project owners at end of the CCX phase.
Project Length (years offsets can be registered)	**Forestry:** Accelerated registration allows 50 years of estimated, discounted 50%, to be registered at project inception. Otherwise, offset registration commencement with measurement and verification. **Grass:** 20 years for restoration.	Potential of 60 years. Prior to Years 20 and 40, a consistency application must be filed for the continual award of offsets.	No limit on project length. However, if an annual report is skipped, all previous offsets are void.	Dependent upon CCX phase, currently until 2010.
Eligible Biomass Pools for Forestry Projects	**Recommended:** Live trees, understory vegetation, standing dead trees, down dead wood, forest floor, soil carbon, and harvested wood mass.	**Required:** Live above and below ground biomass, soil carbon, and dead organic matter. **Optional:** Live aboveground nontree biomass, dead organic matter, forest floor.	**Required:** Living tree biomass, standing dead biomass, lying dead wood. **Optional:** Herbaceous understory, litter, soil carbon, wood products.	**Required:** Aboveground living biomass. Other pools are approved by the CCX offset committee on a case-by-case basis.
Performance Requirements	**Forestry:** Permanent conservation easement or other deed restriction. **Grass:** None, but emissions from cultivation must be reported.	Permanent conservation easement stipulating land is managed in accordance with sustainable environmental standards and carbon stocks protected in perpetuity.	Perpetual easement dedicating the land to a forestry land use.	**Forestry:** Permanent conservatory easement, or transfer of land to a land trust, approved NGO, or government agency. **Grass:** None.
Cap on Use of Emissions to Assist Member Reductions	NA	An entity may cover 3.3% of initial emissions with the use of project offsets. The allowance of offsets increases to 5% and 10%, respectively, for Stage One and Stage Two trigger events.	NA	None for aggregated projects. Emission reductions that can be sold or used that were produced on company-owned or -operated land and is limited to 5% of total CCX baseline, distributed over 4 years.
Platform Facilities Trading	Unclear.	Yes.	Encourages.	Yes.

Notes: The CCAR uses reforestation to describe the establishment of tree cover on a site that had been deforested for the last 10 years, while RGGI uses afforestation to describe the same forest practice. For ease of reporting, afforestation is used for both registries.

In an effort to encourage wider participation, the Registry distinguishes between large emitters (10,000 $MTCO_2e$/year or more) and small emitters and in the registration and reporting of offsets. These distinctions are intended to make participation easier for small emitters and either large or small entities wishing to report reductions, while allowing for more stringent entitywide requirements for large emitters intending to register emission reductions. The

Technical Guidelines provide calculation methods for common emission reduction activities. Small emitters may elect to report on a single activity and register emission reductions, whereas a large emitter has to conduct an entitywide emission inventory if reductions are to be registered. Offsets acquired from another entity do not count toward entity emissions or emission reductions.

Regional Greenhouse Gas Initiative

The RGGI, the first state-level mandatory cap-and-trade program in the United States, is to be implemented January 1, 2009. A collaboration of ten Northeastern and Mid-Atlantic states, RGGI assists member states toward the achievement of state-specific emission reduction targets. In the initial phase of the registry, only electric producers generating 25 megawatts or greater andthat also burn greater than 50% fossil fuel a year are to be regulated. Offset projects from outside the RGGI region are eligible for registration if a cooperating regulatory agency in the state in which the project occurs has an MOU with the RGGI regulatory body. To facilitate the expansion of eligible RGGI-linked states, a task force has been established to pursue MOUs with other states. Currently, only forestry projects are recognizable as a form of terrestrial sequestration under RGGI.

California Climate Action Registry

The CCAR is a nonprofit registry created to provide businesses and organizations operating in the state of California detailed guidance on conducting and reporting entitywide emission inventories. The registry has been strengthened by the passage of Assembly Bill 32, or the California Global Warming Solution Act of 2006, mandating annual GHG reporting by significant sources and statewide reductions in absolute emission levels by 2020 to 1990 levels. Accounting for emission activity is governed by the General Reporting Protocol and four industry-specific protocols, including a forest sector protocol. The State of California has put its support behind the registry, promising to exert its influence to make sure participants receive appropriate consideration for early action under any future state or federal regulation. Currently, only forestry projects in California are certifiable under the Registry.

The Climate Registry

A group of 31 states, two Canadian provinces, and a tribal nation established the Climate Registry in early 2007. Participating states, provinces, and first nations have since increased. The Climate Registry incorporates the CCAR, the Western Regional Air Partnership, the Eastern Climate Registry, and the Lake Michigan Air Directors Consortium. PCOR Partnership member states participating in the Climate Registry include Minnesota, Missouri, Montana, Wisconsin, Wyoming, and the Canadian province of Manitoba. A primary objective of the Climate Registry is to develop a standardized registry that harmonizes the different state and regional registries and that is stringent enough to meet the standards of international registries. The registry has indicated that the World Resources Institute/World Business Council for Sustainable Development Protocol (WRI/WBCSD) *GHG Protocol Corporate Standard*, ISO 14064-3, the California Registry, and Eastern Climate Registry (RGGI) all serve as high-quality models in its effort to establish minimum data quantification standards. Incorporation of the minimum data

quantification standards into any future mandatory programs has also been indicated as an important motivation for the registry. The Registry is policy-neutral, allowing states to adopt the Registry in either a voluntary or mandatory context. An important aspect is that the registry will provide for entitywide GHG reporting, mandating independent third-party verification for a mandatory program and strongly recommending verification for a voluntary program. A draft of the General Protocol was released in late 2007 and does not address offsets or accounting for terrestrial projects and offsets. Citing strong constituent interest, a rigorous accounting framework for terrestrial sinks will be included in the future.

Chicago Climate Exchange

The CCX is North America's only active voluntary trading platform. Participation comprises private companies, cities, universities, a state, and NGOs (nongovernmental organizations) that have made a voluntary but legally binding agreement to reduce absolute entity emissions 6% by 2010, relative to a 1998–2001 base period. Participants exceeding their emission targets, or aggregators bringing offsets to the CCX, are then allowed to auction their offsets to members unable to meet their reduction obligations. The unit of trade on the exchange is a carbon financial instrument, equivalent to 100 $MTCO_2e$, which are demarcated by vintages ranging from 2003 to 2010. The CCX provides the only transparent carbon price in North America, where prices have historically fluctuated from \$1 to \$5 $MTCO_2e$. The CCX recently entered its second phase in 2007, which will continue through 2010. For terrestrial projects in the PCOR Partnership region, the National Farmers Union has been the most active in this sector, enrolling 2.5 million acres of no-till and seeded grassland through October 2007 and allotting over \$2.5 million in payments (North Dakota Farmers Union [NDFU], 2007). Other aggregators of terrestrial projects in the PCOR Partnership region active in the CCX include the Iowa Farmers Bureau[2] and the Delta Institute.[3]

Registry Linkages to International Markets

Expansion of independent, regionally operating markets into an integrated market will allow greater opportunities for comparative advantages to be realized, enhancing overall emission reductions and lowering the economic cost of action. The majority of existing registries have demonstrated a desire to see registry linkages and to enhance the fungibility of carbon assets. An explicit objective of the Climate Registry is to link existing American registries and to link those efforts with international registries and markets. Registry participant California has already undertaken efforts to link a proposed state trading platform with the EU ETS, creating a market advisory committee and sending a delegation to meet with EU ETS and EU Parliament officials. The state-created Market Advisory Committee (MAC) has also recommended that linkages with the RGGI platform be encouraged (MAC, 2007). RGGI has also indicated a desire to see international linkages in protocol and trading and has provisions for the recognition of Kyoto CDM credits and EU allowances under certain market conditions.

The most direct linkage between North American markets and international markets may exist with the CCX. The first transatlantic carbon transaction occurred in May 2006, when CCX

[2] www.iowafarmbureau.com/special/carbon/default.aspx (accessed May 2007).
[3] http://p2e2center.org.

member Baxter Healthcare Corporation transferred EU ETS allowances from a facility owned in Ireland to the company's CCX account (International Emission Trading Association [IETA], 2006). This tie was later severed, as the CCX in December of 2006 blocked the entrance of European Union Allowances (EUAs) to prevent them from flooding the exchange following the persistent decline of EUA prices (Capoor and Ambrosi, 2007). Currently, the CCX allows crediting of CDM projects provided they are not double-registered and still conform to CCX rules. In August of 2007, a futures contract for Kyoto-compliant certified emission reductions was established, the first in North America. Institutionally, the CCX is linked to fellow Climate Exchange Plc subsidiaries the European Climate Exchange (ECX) and the Montreal Climate Exchange. The ECX, established in 2005, has already become the largest trading platform of EU ETS allowances, accounting for over 75% of all exchange-traded allowances in 2006 (Point Carbon, 2007). There are, however, no trade linkages between the CCX, the ECX, or other members of the Climate Exchange family as of yet.

CARBON OFFSET STANDARDS

Concerns about the quality of offsets in the voluntary market, the general lack of transparency, and the large variation of offset types and quality have motivated efforts to create offset quality standards. A standardized carbon credit promotes credibility among registries and projects, enhancing investor confidence. However, for all the benefits that a standardized offset or project might confer, in a voluntary market they provide no guarantee that offsets will be recognized in existing or possible future registries. Further, some investors are deterred by the additional paperwork and transaction costs that project certification standards entail (Ecosecurities, 2006).

Carbon market standards can be applied in two primary fashions: process-based guidelines for entities or registry protocols (WRI, ISO 14064) and offset and project certification guidelines (Gold Standard, Voluntary Carbon Standard). The U.S. Department of Agriculture (USDA) has also announced that the 2007 Farm Bill will include the formation of a committee to develop standards for the quantification, evaluation, and auditing of environmental services and certification options for ecological markets such as carbon.

Process-based standards do not directly certify offsets or projects, but rather provide the standards for the development of GHG accounting guidelines. An influential process-based standard is the WRI/WBCSD. The WRI/WBCSD protocol was created to provide a harmonized accounting protocol for future emission exchanges, registries, and other emission reduction initiatives. To accomplish this task, two protocols were developed: the "Corporate Accounting and Reporting Standards" and a "Project Accounting and Reporting Standard." In 2006, a supplement to the "Project" was released: "The Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting," providing further guidance for quantifying and reporting GHG reductions from terrestrial sequestration projects (WRI, 2006). The guidelines can be applied to all LULUCF project activities but focuses on reforestation and forest management. It can also be used for avoided deforestation, although this is not specifically addressed in the guidelines. The WRI/WBCSD Business Standard is employed by the CCX,

CCAR, EU ETS, and the U.S. Environmental Protection Agency Climate Leaders Program, among others (www.ghgprotocol.org).

Another commonly cited process-based standard used in the development of registry protocol is the International Organization for Standardization (ISO) 14064-2 and 14064-3. The ISO 14064 is somewhat of a hybrid, functioning as a process-based guideline with emission and project certification. The 14064-2 protocol provides project-level guidance for quantification, monitoring, etc., while 14064-3 is devoted to providing guidance on validation and verification of GHG assertions. The creation of the ISO 14064 came from the same realization that the WRI/WBCSD had observed—that governments, businesses, and other institutions and emission reduction initiatives were all employing different approaches to account for entitywide and project-based emissions. ISO 140464 organizational-level protocol is consistent with the WRI/WBCSD Corporate Protocol (Kook Weng and Boehmer, 2006). As a supplement to 14064-2 and 14064-3, 14065 was created to provide a protocol for the validation of accreditation or certification bodies.

A common framework for most offset and project certification guidelines is the Kyoto CDM standards, used for Kyoto-recognized certified emission reductions. Eligible terrestrial projects under the CDM are afforestation and reforestation, with CDM standard certification limited to projects undertaken in developing (Kyoto non-Annex B) nations. However, the creation of supplemental CDM standards to recognize and promote high-quality projects that have ancillary community, socioeconomic, or biological impacts beyond emission reductions can also be adopted for voluntary projects. Three of the most prolific of these voluntary standards are the CDM Gold Standard, the Voluntary Carbon Standard, and the Climate Community and Biodiversity Standard. Although the Gold Standard is considered the standard of excellence for the certification of renewable energy and energy efficiency projects, it does not certify land-based projects.

Specific to terrestrial projects, the Climate Community and Biodiversity Standard is a voluntary set of standards intended to supplement CDM standards for terrestrial projects. The standard was developed by the Climate, Community and Biodiversity Alliance (CCBA)—a partnership between leading companies, NGOs, and research institutes seeking to promote integrated solutions to land management. The CCBA standard was created after a lengthy stakeholder process, including members from academia, business, environmental groups, and developers, conducting field trials on four continents (www.climate-standards.org). There are 15 core requirements under the categories of General, Community, Climate, and Biodiversity that a project must satisfy in order to achieve CCBA certification, as verifiable by an independent auditor. Additionally, projects that achieve at least one bonus point under three of the categories are eligible for silver status, and projects with six bonus points under all four categories are eligible for gold certification. Released for use in 2005, the standard approved its first two projects in January of 2007, occurring in Peru and China.

Unlike the previously discussed standards, the Voluntary Carbon Standard (VCS) is explicitly designed to verify non-CDM voluntary projects and offsets for the voluntary carbon market. The VCS was created by the International Emissions Trading Association (IETA), the Climate Group, and the World Economic Forum and is distinguishable by its intentions to

function as a more general standard, providing a minimal threshold of offset quality to produce a globally standardized unit of trade. Projects satisfying the VCS are certified as voluntary carbon units (VCUs) and eligible for registration with approved VCU registries. The VCS guidelines are available at www.v-c-s.org.

Third-Party Verification

A prerequisite for standard approval and offset registration amongst several of the registries is independent third-party verification of projects and offsets. An independent audit provides the authenticity needed to ensure objective offset reporting and high-quality project implementation. Many of the registries and standards have a list of approved verifiers familiar with the appropriate guidelines and measurement protocol particular to the registry/standard and terrestrial carbon stock. Links to program approved verifiers are presented below.

Registry Verifiers

CCAR
www.climateregistry.org/SERVICEPROVIDERS/Certifiers/

CCX
www.chicagoclimatex.com/content.jsf?id=102

DOE
The DOE 1605b program has embraced a case-by-case certifier approval process, with desired certifier qualities listed in Section 300.11 of the General Guidelines.

RGGI
The RGGI has not approved verifiers as of yet. The RGGI Model Rule, Section 10.6, details the requirements that an RGGI-accredited verifier will need to possess and the process needed to gain approval by the RGGI Regulatory Agency.

Carbon Standards Verifiers

VCS
The VCS has expressed that qualified independent third-party verifiers, or Certification Entity, should be accredited by 1) a designated operating entity by the CDM Executive Board, 2) an independent entity by the Joint Implementation Supervisory Committee, or 3) certification bodies of the CCAR (link provided above).

Approved CDM-designated operating entities can be found at http://cdm.unfccc.int/DOE/list/index.html.

CCBA
Independent auditors can be either a CDM-accredited DOE- or a Forestry Stewardship Council (FSC)-approved auditor (Janson-Smith, 2007).

BUSINESS PROCESSES FOR TERRESTRIAL OFFSETS ON PRIVATE LANDS

From beginning to end, many business actions must occur between carbon market participants in order to complete a terrestrial offset transaction. At the basis of any scalable terrestrial project in the PCOR Partnership region is active participation by private landowners. As landowners weigh the benefits of enrolling in a carbon program, the returns of doing so will have to compete with other land uses and income opportunities. Aggregators and project developers play an important role as intermediaries between offset buyers and landowners, minimizing the risk of both parties as well as maximizing the benefits of a mutually beneficial carbon program. Among the services that aggregators and project developers provide are risk mitigation solutions that would be too great for landowners or buyers to assume on their own. Finally, and perhaps most importantly, numerous legal documents must be prepared for a successful and smooth carbon transaction. An overview of the business processes of landowners, aggregators and project developers and the risk management options and legal documents that they follow is provided below.

Landowner Perspective

In the Prairie Pothole Region, landowners are increasingly aware of possible income opportunities from terrestrial carbon sequestration projects. The NDFU Program has provided welcome income to no-till operators but has not yet catalyzed a major shift in land use practices that provide permanent carbon storage. Robust landowner participation in a terrestrial carbon program will require that, on a per-acre basis, income derived from terrestrial carbon sequestration is, at a minimum, competitive with potential alternative land uses. Past research has found that carbon prices will have to reach \$10/ton C (\$2.73/MTCO_2e) for conservation tillage and \$25/ton C (\$6.83/MTCO_2e) for afforestation to become economically attractive to landowners in the Great Plains region (Lewandarski et al., 2004). As carbon prices rise, terrestrial sequestration practices will face competition among each other, with afforestation providing the greatest per acre carbon benefit and highest potential return at higher carbon prices.

Traditionally, agricultural activities, such as cropland and livestock production, have been the most lucrative uses of rural land in the PCOR Partnership region. The number of acres under production, and corresponding fluctuations in rental rates and property values, has been historically linked to the ebb and flow of commodity prices and availability of farm support programs. Recently, interest in corn-based ethanol as a fuel alternative has put strong upward pressure on agricultural land prices, expanding corn production into historically unprofitable areas. However, not all agricultural activities preclude long-term terrestrial sequestration. In much of the PCOR Partnership area, grass-based economies dominate the landscape with activities such as haying and grazing to support livestock production. Additionally, research has shown that haying and grazing activities can continue without detrimentally impacting soil carbon sequestration rates or storage (Liebig et al., 2005). Rental rates and land values are much lower in these regions, providing a lower opportunity cost for terrestrial carbon projects. Other lands with sufficiently lower opportunity costs include marginal agricultural lands poorly suited to crop production. These areas are usually ecologically sensitive and include areas such as

wetlands, riparian corridors, or sharply sloped lands easily susceptible to erosion and other ecological degradation.

Landowners interested in protecting ecologically sensitive areas can currently seek compensation from government conservation programs such as the USDA's Conservation Reserve Program (CRP), Grassland Reserve Program (GRP), or the Wetland Reserve Program (WRP). These programs typically offer a form of cost-share arrangement for the habitat restoration and an annual rent payment to cover the cost of a conservation easement. Landowner receptiveness to the programs has been positive, with available program funds unable to meet landowner supply in recent years. A private carbon market will mean that CRP, GRP, and WRP will become competing land uses for carbon sequestration, even though each provides similar landscape and carbon sequestering benefits. The income stream provided by these programs, and the proportion of marginal land they occupy, will have a direct influence on the adoption of terrestrial sequestering practices for a private carbon market.

The Role of Aggregators

The aggregator of terrestrial offsets has a symbiotic relationship with landowners and buyers, providing numerous services that become economically feasible when conducted at a scale much larger than any landowner or group of landowners can conduct on their own. These services include risk management, offset marketing, landowner outreach, restoration guidance, legal support, offset tracking, monitoring and verification of offsets, and ensuring administrative compliance. From an industrial buyer or investor's perspective, aggregators are essential for transacting terrestrial offsets. Industrial offset demand is typically in the magnitude of hundreds of thousands, if not millions, of tons of CO_2 while the most productive terrestrial projects only produce a few hundred offsets per acre over a 100-year time span.

Despite what appear to be market deterrents, demand for terrestrial offsets remains high for several reasons. Terrestrial carbon sequestration is one of many ecological services provided by habitat restoration, producing a suite of environmental and economic cobenefits to the region. Financially, terrestrial offsets are desirable since the cost of producing a terrestrial offset is currently less than geologic or technology-based offsets. While cleaner technologies are being advanced, terrestrial offsets will remain a cost-efficient emission reduction strategy. Aggregators for terrestrial offsets will be required in order for land-based sequestration projects to achieve scales that result in viable GHG reductions.

Risk Management

Like any activity, terrestrial sequestration projects are subject to a number of risk factors that can be minimized if managed properly. A carbon credit insurance industry has already arisen to provide such risk management. However, with a knowledgeable project developer and proper project design, risk factors can be managed to an acceptable level by all involved parties. The most risk-adverse strategy from a buyer's perspective is a pay-as-you-go scheme or ex post accounting method, where offsets are transferred to the purchaser only after the carbon has been verified. Under this scheme, offset providers are only liable for offsets already produced. Buyers find this delivery mechanism appealing because payment is for services rendered with no risk of

delivery default. The downside of the pay-as-you-go delivery system for terrestrial sequestration is that carbon accumulation can be a lengthy process, and project developers are generally unwilling to incur the long delay in recovering project costs.

An alternative to the pay-as-you-go agreement is the front-end, upfront payment option, or the ex ante accounting method. A front-end payment structure is characterized by payment for the full amount of offsets transacted in the first few years of the project, before all of the offsets have accumulated or been verified. Some form of a front-end payment structure will be required for most terrestrial projects because of the rate of carbon accumulation and the financial structure of these projects. Front-end transactions are a common practice because buyers find these delivery structures desirable, as they provide access to a steady stream of offsets and hedge risk against future price increases. Financial risk from a front-end payment structure can be managed by discounting future carbon benefits.

Project default associated with front-end payment can be successfully managed in several ways. One form of risk management is to have the project developer cash-flow the project, by assuming all or part of initial project expenses, thereby inheriting a portion of the default risk. Full payment is then conferred after the project has been implemented, verifiable by the establishment of the terrestrial ecosystem and the registration of a property easement. Another popular risk strategy is a stepwise payment and delivery structure, where total offset delivery is distributed into phases. Payment for offsets are made prior to project implementation, but only for the offsets produced from that phase. After offsets have been secured from the initial phase, payment is conferred to undertake additional rounds of offset production. Project default can also be addressed legally if delivery contracts contain stipulations that project developers replace offsets not produced or are accountable to provide the buyer financial compensation for offsets not produced.

Uncertainty and Spatial Heterogeneity of Sequestration Rates

The amount of carbon physically sequestered at any location is dependent upon a myriad of interactions between site-specific characteristics and weather events, leading to interannual and intra-annual variation in the rate at which carbon is sequestered. This risk is addressed in two primary ways: frequent measurement and monitoring of terrestrial stocks and/or discounting the sequestration rate. Frequent measurement and monitoring provide strong guarantees that an offset transacted equals the same amount of carbon terrestrially sequestered. However, monitoring is expensive, and interannual variability in some ecosystems, such as grasslands, only produces discernible carbon accumulation at a multiyear frequency. This makes offsets more expensive and deliverable over an undesirable time period.

Fortunately, considerable research and effort has gone into developing models and lookup tables that provide estimates of carbon accumulation at a regional scale that reflect a number of land use and ecological conditions. With a high degree of certainty, the total carbon accumulation of a project can be estimated and transacted up-front. Additional monitoring can be used to verify the accuracy of projected accumulation rates and to adjust sequestration rates as needed. An up-front delivery scheme expedites the delivery process of carbon offsets but also has increased delivery risk. This risk can be addressed by conservatively discounting

sequestration rates and by holding any excess offsets in reserve. Offsets held in reserve are then available to the buyer to cover potential delivery shortfalls for periods where measured carbon is less than the projected accumulation. A typical offset discount rate applied to forward streams of carbon offsets ranges from 10% to 25%.

Permanence

Terrestrially sequestered carbon can be considered permanent with a high degree of certainty if human and natural disturbances are managed properly. In order for carbon offsets to have a tangible impact on GHG reductions, it is imperative that offset reductions are permanently removed from the atmosphere and not released at a later date. Offset buyers also need confidence that the offsets they purchase represent real reductions and will not pose future liabilities. Human disturbances of terrestrial carbon stocks can be negated with the placement of a perpetual conservation easement on project land. A perpetual conservation easement, or deed restriction, prohibits landowners and others from conducting land use or land management practices that are harmful to terrestrial carbon stocks. Project monitoring ensures that easement terms are adhered to, and legal repercussions to enforce easement terms further encourage landowner compliance.

Natural disturbances may be less predictable than human disturbances, but can still be sufficiently minimized with proper land management practices that reduce the risk of fire, flood, or pest damage to terrestrial carbon stocks. An effective management practice is the restoration of native species well suited to local ecological conditions. Persistent monitoring and management also ensure fully functioning ecosystems, resilient to potential disturbance impacts. Of terrestrial sequestration practices, grassland preservation and restoration are among the most protected terrestrial carbon stocks. The underground storage of carbon in root and soil matter by grasslands protects carbon stocks from fire and other aboveground disturbances.

The UNFCCC has adopted a different approach on how to account for permanence of terrestrial stocks for afforestation and reforestation projects. In recognition that forest stocks are impermanent compared to other CDM projects, CERs accredited to a forestation project are deemed temporary credits. The temporary status of the credits requires replacement at the expiration of a project period. The temporary credits can be accounted for in two ways: as either short-term CERs (tCER) or long-term CERs (lCER). Short-term CERs are valid only for a single commitment period of 5 years, but credits for the entire carbon stock can be counted in ensuing commitment periods. The primary strength of the tCER is that there is no project liability since declines in carbon stocks are adjusted to reflect harvest or natural disturbances. Conversely, temporary credits may also be accredited as CERs, verifiable for the increase in carbon stock occurring during the commitment period and valid until the end of the project crediting period. The project crediting period may range up to 60 years total, following renewal(s) at either 20- or 30- year increments (Neeff and Sanders, 2007).

Legal Requirements

The development of the voluntary carbon market has also created a demand for new legal instruments. The abstract nature of GHG as a property right prohibits a single straightforward

agreement and requires several distinct agreements. Although a carbon transaction may appear as one transaction between an aggregator and a landowner, the clear conveyance of carbon rights and the perpetual protection of terrestrial stocks require several distinct agreements between the involved parties. At the front-end of a transaction, a document is needed to convey the rights to the GHG offsets from the property to the project developer. The landowner conveyance agreement serves several purposes. First, it allows Project Developers to market and transact the offsets in the market and removes any contact between the landowner and end buyer. Stipulations of the agreement also prohibit the landowner, or any other party, from registering the reductions on his/her own behalf or selling the offsets to another party, preventing the double counting of offsets. A second agreement needed between the landowner and the project developer is a permanent conservation easement, or deed restriction, perpetually restricting the property's land use to the specified terrestrial sequestration practice and allowable management practices. These practices can be included as part of a habitat management plan. The easement is registered with the local city, county, or state courthouse so that the terms of the easement are transferred to future landowners. The distinction of carbon rights and permanent easement rights allows the transference of the easement to other entities such as conservation groups or government agencies, without implicating the entity in a carbon transaction. A perpetual conservation easement provides a legal guarantee that terrestrial carbon stocks will be protected perpetually and are a project requirement for most of the GHG registries and voluntary standards.

The interaction between project developers and end buyers requires a separate set of legal documents to convey the rights and to specify each parties' obligations. A Bill of Sale, or conveyance document, provides the needed legal recognition of the end buyer's GHG rights. A Bill of Sale between the project developer and end buyer serves the same purpose as the landowner–project developer conveyance document: providing a traceable record of the offset creation and preventing the double counting of offsets. An Executed Carbon Agreement is a separate contract between the project developer and the end buyer containing financial obligations, delivery schedules, monitoring requirements, legal repercussion for project noncompliance, etc.

Because of the fluid evolution of the market and the limited number of transactions performed to date, few legal firms have experience in providing adequate legal counsel and producing the needed agreements for landowners, developers, and buyers. For project developers and buyers, finding qualified legal counsel is a difficult process. However, the creation of the Sulfur Dioxide, or Acid Rain, trading program in the 1990s has provided some legal precedence.

DETAILS OF THE DOE VOLUNTARY 1605B PROGRAM

Procedures to Become an Aggregator under the DOE 1605b Program

The DOE 1605(b) Program can seem perplexing and intimidating to the uninitiated, but with some guidance, the participation process can be greatly simplified. The initial step in 1605b participation is the completion of a Start Year report, composed of an Entity Statement and

Emissions Inventory provided in Form EIA-1605.[4] The Start Year report provides the baseline to which future emission reductions will be compared and can be a single year or the average emissions of up to 4 years. Entities intending to report emissions can use a base period of no earlier than 1990 and those intending to register reductions no earlier than 2002. However, the final year of the chosen base period must immediately precede the year that emission reductions are to be reported or registered.

The DOE 1605(b) program differentiates between large and small emitters (those emitting more or less than 10,000 $MTCO_2e$) and between registering reductions and less rigorously reporting them. The Simplified Emission Inventory Tool, or SEIT, can be used to determine an entity's large or small emitter status, but the more detailed emission inventory is still required (Schedule 1, Parts B and C of Form EIA 1605). Conducting the initial emission inventory is an onerous but potentially rewarding task of DOE 1605(b) registration. A full account of an entity's emissions provides opportunities to discover operational inefficiencies and provides a voluntary environment to gain emission accounting practice. The Technical Guidelines provide suggested estimation methods and tools for major emission sources and sinks, as well as demonstrative examples. Estimation methods are ranked on an A, B, C, and D scale, with a B average required for entities intending to register reductions.

Either small or large emitters may act as aggregators, registering or reporting offset reductions on the behalf of a nonparticipating third party. In recognition that a functioning carbon registry would require aggregators and that most aggregators would be small emitters, the guidelines give special treatment to small emitters that serve as aggregators. Aggregators may register third-party offset reductions without reporting on their own emissions or reductions, provided that they have already submitted an entity statement and an emission inventory demonstrating total emissions of less than 10,000 $MTCO_2e$/year. However, an entity statement and emission inventory must still be filed on behalf of the third-party entity, and the third party must meet all of the requirements as if it were to report the reductions on its own behalf. Additionally, an agreement with the third party allowing the aggregator to register/report emission reduction activities on the third-party's behalf is required.

The DOE 1605(b) registry is not intended to function as an emission trading platform but does accommodate the registration or reporting of offsets and reductions achieved by parties other than the reporting entity. Emission offsets may be acquired from a reporting entity, such as an aggregator, assuming that the offset provider includes these reductions in its annual report. The offsets can then be distributed to other reporting entities, as long as the relevant information is entered into Addendum B1–B16 and Column 3 of Schedule III of the acquiring entity's annual report.

DOE Guidelines for Terrestrial Offset Determination

Terrestrial sequestration is a recognized form of emission reduction action in the Technical Guidelines of the DOE 1605(b) Program. Forest- and agriculture-specific sections detail eligible terrestrial sequestration practices, project requirements, and how offsets are to be quantified. In

[4] The EIA forms and SEIT are available at www.eia.doe.gov/oiaf/1605/Forms.html.

relation to terrestrial sequestration, the agricultural section is specific to grassland, pasture, and conservation tillage activities. The forestry guidelines are broader in application, referencing "terrestrial carbon stocks" and "native habitat" to describe certain management practices. For example, the preservation of existing terrestrial carbon *stocks* can be reported or registered as a forest management practice if restrictions are placed on the land to ensure that human-caused releases of carbon do not occur in the future. Options include permanent conservation easements and deed restrictions. Another section of the forestry guideline applicable to general terrestrial projects is the treatment of natural disturbances, i.e., insects, epidemics, drought, or wildfires. Specifically, natural disturbance-induced carbon stock decreases may be excluded from registered emissions and reductions, provided that the entity cannot report gains in sequestration until the carbon stock has returned to the predisturbance level.

As discussed in the risk management section, an issue with terrestrial offsets from restoration projects is the relatively long term over which carbon is sequestered. Terrestrial projects on private land have significant up-front costs for the acquisition of land or rights to the land, restoration costs, and carbon payments to landowners. The DOE guidelines accommodate these concerns by allowing for the accelerated registration of native habitat restoration activities. Under this stipulation, 50 years of expected carbon accumulation, discounted 50%, can be registered at project inception if native habitat is restored and administrative restrictions are placed on the land. Administrative restrictions can either be permanent conservation easements or deed restrictions that are registered with the county, state, or other government entity. The 50% discounting of the 50-year carbon stock increases closely approximates the present value of a 50-year stream of annual benefits discounted at a rate of 3% a year. However, no additional changes in the carbon stock attributable to these lands may be reported in the future.

The restoration of terrestrial ecosystems has a twofold impact on GHG mitigation: the sequestration and storage of carbon and the avoidance of emissions associated with agricultural production. Conventional agricultural production creates emissions from the usage of farm machinery and the application of nitrogen- and lime-based crop-enhancing amendments. Assuming that no on-site leakage occurs, the removal of land from agricultural production will lead to a reduction in overall emissions. Emission reductions from the decline in farm equipment use can be reported to the Registry but not registered since entity output cannot decline to register emission reductions with the Change in Absolute Emissions method. Farm equipment emissions can be calculated by Part D, Mobile Sources, Subsection 1.D.3.1.2 Off-Road Vehicles Including Diesel Locomotives of the Technical Guidelines. Nitrogen and lime application emissions, as well as the emissions of leguminous crops, can be estimated with an inference and activity-specific calculation method. An additional reporting requirement for recording emission reductions from the displacement of agricultural activity is that entity output, in terms of agricultural production, would have to be reported in both a reporting year and base period (U.S. DOE, 2006a).

Grassland Sequestration

Grassland restoration, preservation, and enhanced management of existing stocks are all recognized forms of terrestrial sequestration under the DOE Technical Guidelines. The quantification of carbon sequestered via grassland restoration on croplands can be determined

following the protocol under Section H Agricultural Emissions and Sequestration of the Technical Guidelines. Grassland restoration is assumed to take place on locations that have been under cultivation for at least several years prior to the base period. Soil carbon sequestered can be determined in three primary ways: default emission and sequestration figures, modeling (COMET-VR), and direct sampling.

Default sequestration figures for grassland restoration are an easy-to-use method but are a C ranking estimation method because of the large degree of uncertainty and site-to-site variations. Under this method, default sequestration rates are subtracted from default emission rates to provide the net CO_2 balance. Soil emissions are assumed to only occur in the first year of cultivation, accounting for approximately a 40% loss of soil carbon, with no emissions reported thereafter. Table 1.H.22 (DOE Technical Guidelines) provides soil and climate specific emission estimates. Sequestration coefficients for soil carbon can only be used for 20 years, after which no annual changes in the soil carbon stock can be reported. The default sequestration rate for the establishment of natural vegetation on former cropland is 2800 $kg/CO_2/ha/year$ or 1.13 $MTCO_2e/ac/year$ (source: Table 1.H.23 Potential Rates of Carbon Sequestration, DOE Technical Guidelines [U.S. DOE, 2007]).

Model-based estimates of carbon sequestered, such as COMET-VR, are another easy-to-use and inexpensive quantification method. The Web-based program allows users to enter basic management and soil information, calculating an estimated carbon sequestration value. Based on an uncertainty analysis of how well site soil and management characteristics match the model, COMET-VR-based estimates are either an A or B ranking method. More information and access to the model can be found at www.cometvr.colostate.edu.

The most intensive, site-specific, and expensive estimation method for soil carbon is direct sampling, which is ranked as either an A or B estimation method. The specifics of a sampling plan are beyond the scope of this report, and references to appropriate textbooks or protocols can be located in the Technical Guidelines, Section 1.H.4.3.2.3. For reporting requirements, sampling should be conducted every 3 to 5 years. Estimation of soil carbon content from samples can only be conducted at certified laboratories, such as a local land grant university.

Forestry

Although touched on briefly under the General Terrestrial Guidelines Section, the DOE 1605(b) program recognizes a robust portfolio of forest management practices. Eligible forestry projects include afforestation, reforestation, urban forestry, forest preservation, modified forest management, agroforestry, mine reclamation, short rotation biomass energy plantations, and timber product end-use management. The DOE 1605(b) guidelines are not discriminatory on forestry projects, as they are intended to serve as accounting guidelines for forestry owners, both private and commercial.

Unlike grassland and agricultural offsets that sequester the bulk of their carbon in belowground soil, forests sequester the majority of their carbon in aboveground biomass. Estimation methods suitable for forest project carbon estimation include the stock-change and net-flow approach. The stock-change entails an initial measure of carbon pools with successive measurements recommended every 5 years since annual variations in certain carbon pools are

not likely to be significant. A net-flow approach involves estimating the annual increase in carbon based on models or lookup tables. Estimation methods are detailed in section 1.I.2.6 of the Technical Guidelines.

The U.S. Forest Service (USFS) assisted in the development of the Forestry Technical Guidelines, producing a set of lookup tables provided in Appendix I of the Technical Guidelines. The tables provide carbon stock measurements by carbon pool, age class, species composition, and geographic region. Lookup table estimates are ranked A, B, C, or D depending on how well management and site-specific conditions match those of the tables.

Models provide another user-friendly estimation method, provided they have undergone a scientific peer review, a quantitative comparison of model outputs to field results, and a sensitivity analysis. A model developed by the USFS and eligible for DOE 1605b reporting is the carbon online estimator (COLE). The COLE model is based on the lookup tables provided in the aforementioned appendix, calibrated to the county level, and accounting for a greater variety of management conditions and forest species composition. The use of COLE with verified site data is considered an A ranking estimation method, whereas the general use of COLE is considered a B ranking estimation method. The most accurate method is direct measurement. Entities wishing to conduct a direct-measurement need to develop a measurement plan by delineating forest area, determining the number of samples needed to provide an accurate estimate, and which carbon pools are to be measured. It is oftentimes easier for entities to hire an outside party to perform these tasks.

Not all forests are subject to annual reporting of carbon stock changes. Forests placed under a sustainable forestry plan, as certified by the Sustainable Forestry Initiative, Forest Stewardship Council, American Tree Farm System, etc., are assumed to have no long-term declines in carbon stocks. The annual variation in a sustainably managed forest is, therefore, assumed to be de minimis and does not require further measurement.

GENERAL TERRESTRIAL SEQUESTRATION MARKET CONCERNS

Preservation

A common terrestrial sequestration strategy favored by the conservation community and others is the allowance of the preservation or conservation of existing terrestrial carbon stocks. Opponents of preservation argue that such measures do not contribute to additional GHG abatement, although approximately 25% of anthropogenic emissions are caused by Land Use and Land Use Change, primarily from deforestation (IPCC, 2007b). The preservation of threatened terrestrial stocks where the threat can be documented and quantified provides a viable greenhouse gas mitigation option. Opportunities and the need for grassland preservation in the PCOR Partnership region are particularly strong. An analysis of global biome risk found North American temperate grasslands to be the most threatened global biome out of 13 terrestrial biomes and 810 ecoregions (Hoesktra et al., 2005).

Currently, the CCAR, CCX, and DOE are the only registries to explicitly recognize the conservation of terrestrial stocks. The DOE 1605b guidelines recognize forest preservation as a form of forest management, requiring only that a conservation easement or deed restriction be placed on the land. The CCAR and CCX protocols provide detailed instruction on how forest preservation offsets are to be quantified. An overview of these methods is presented as guidance on how future preservation guidelines may develop for additional terrestrial ecosystems such as grasslands.

The CCAR employs two methods to determine a forest preservation baseline: the immediate site-specific conversion trend and the land use conversion trend. The immediate site-specific conversion trend method requires objective documentation describing a specific threat to the land and demonstration that the site will be converted within 5 years without project implementation. Acceptable documentation includes a copy of a bid for the land from a developer, a plan to subdivide the project area, a request from the California Department of Forestry (CDF) to convert the site to a nonforest use, a permit from CDF allowing the site to be converted to a nonforest use, or a request to rezone the site with the county (CCAR Forest Project Protocol).

The second CCAR forestry preservation method, the land use conversion trend, is based on forest conversion rates at the county level. Conversion rates are updated every 5 years as forest survey results become available. Project carbon is determined by the multiplication of the forestland conversion rate by project acres. The carbon available on-site is the difference between initial carbon stock (forest) and project carbon after land conversion. If conversion estimates do not exist for a particular county, then only the immediate site-specific conversion method is allowed. Both forms of projects are required to demonstrate that there are no legal requirements requiring the protection of the project area. Additionally, an assessment of potential leakage effects is also required.

The CCX forest conservation method is similar to the land use conversion trend of the CCAR. However, in order for forest conservation offsets to be recognized by the CCX, conserved forests must be contiguous with reforestation projects. To date, only forest conservation projects in Brazil have been approved. Project carbon from forest conservation is determined by multiplying project baseline carbon (live aboveground tree biomass) by 90% and then multiplying further by county-level annual deforestation rates (ADR), as provided by the CCX. In each subsequent year, the ADR is compounded, further reducing baseline carbon to reflect the downward adjustment of carbon quantity from the increase in protected forests.

Quantification of Offsets

A key factor in determining the profitability of terrestrial sequestration projects to both landowners and buyers is the number of offsets quantified on a per-acre basis. Central to project offset quantification are the biomass pools eligible for quantification, the time period for which sequestration can be counted, and when the offsets are verified. The registries have each taken a different approach in addressing these issues, and depending under which registry's auspices a project falls, total project carbon can vary significantly, as seen in Table 2.

An equally important aspect in project quantification not captured in Table 2 is the temporal recognition of offsets and how or if they are discounted for time. Therefore, a registry accommodating long periods of sequestration and a greater number of eligible carbon pools may be less favorable than a registry allowing rapid registration of offsets sequestered over a shorter period of time. Again, the registries have taken different approaches in the recognition of accelerated registration, with the DOE 1605b program accommodating the most accelerated registration.

CONCLUSION

Market Barriers for PCOR Partnership Area Terrestrial Offsets

The voluntary carbon market has struggled to find a successful trade-off between transparent and verifiable quantification and cost-effectiveness. Compliance with the more stringent standards appears to be extremely cost-prohibitive to the average offset buyer, based on the limited number of standard approved projects to date. Of the established voluntary standards, the CDM Gold Standard has only approved one project to date, and the Climate, Community, and Biodiversity Standard has approved two projects since its formation in 2004. The increased transaction cost of invoking standard certification is attributable to the hiring of auditors to conduct monitoring and offset verification. Greater permanence and additionality requirements are needed, but tools and accepted methodologies, such as models or reference tables, are required to minimize excessive monitoring and verification costs.

Table 2. Total Project Carbon

Grass Restoration				
	DOE	DOE 50/50	CCX	
Annual Sequestration Rate ($MTCO_2e$/acre/year)	1.13	1.13	1.0	
Years Counted	20	20	4	
Project Size (acres)	100	100	100	
$MTCO_2e$/Year 1	113.0	1130.0	100.0	
$MTCO_2e$/Year 2	113.0	0.0	100.0	
$MTCO_2e$/Year 3	113.0	0.0	100.0	
$MTCO_2e$/Year 4	113.0	0.0	100.0	
$MTCO_2e$/Year 5	113.0	0.0	0.0	
Total Project Carbon	2260.0	1130.0	400.0	
Afforestation with Spruce–Balsam–Fir in Lake States (MN, WI)				
	DOE	DOE 50/50	CCX*	RGGI
Annual CO_2e Sequestration	N/A	N/A	3.61	N/A
Years Counted	100	50	5	60
Total Eligible Carbon	331.13	213.79	18.05	248.62
Insurance Reserve	0%	50%	20%	10%
Total Project Carbon per acre	331.13	106.90	14.44	223.76

* Afforestation carbon figures from DOE 1605(b) Technical Guidelines Appendix I, Forestry, pg 121 (U.S. DOE, 2006b).

The greatest impediment to advanced carbon sequestration model development is the lack of scientific understanding of terrestrial carbon cycling in various ecosystems. Because of the amount of research on forest-carbon dynamics, forestry offsets are the most commonly recognized terrestrial offset. If the carbon values of other ecosystems are to be fully recognized, greater amounts of research will have to be conducted. First among candidate ecosystems for the PCOR Partnership region are seasonal wetlands. Initial research conducted by the PCOR Partnership has found wetlands to be significant terrestrial sinks and a large potential source of emissions if exposed to cultivation (Gleason et al., 2005). PCOR Partnership partners continue to monitor prairie wetland carbon fluxes, but greater policy advocacy and dissemination of research results will be needed to alert policy makers of the GHG mitigating potential of prairie wetlands.

As buyers look to diversify their carbon assets and hedge investment risk, a fixed proportion of available carbon investment funds will be available for terrestrial projects, of which North America must compete against international terrestrial projects. Investments in international terrestrial projects are very compelling since many of the world's poorest nations have natural resource-dependent economies with few other opportunities to participate in the carbon market beyond land-based projects. The warm climates of these regions also allow for rapid biomass growth and high sequestration rates, a relative advantage compared to the Great Plains region's sequestration rates inhibited by cool and long winters. Finally, saving famous and appealing ecosystems such as the Amazon has a certain emotional value associated with its conservation that most people fail to equate with prairie grassland ecosystems.

International terrestrial projects are not without their risks, however. Monoculture agroforestry plantations are prevalent in much of the developing world, maximizing carbon sequestration, but impairing the region's waterways (Jackson et al., 2005). Another concern is the degree of regulatory protection and political stability afforded by the host country. The combination of these factors can prevent the transfer of project benefits to local communities or the realization of project emission reduction benefits. North American projects may not provide as compelling socioeconomic benefits as helping subsistence farmers in sub-Sahara Africa, but they do inject socioeconomic and environmental benefits into the local communities around them, supporting the rural North American landscape.

Specific to the DOE guidelines, a relaxing of the third-party reporting requirements for aggregators is needed if terrestrial sequestration is to accomplish its potential as a GHG mitigation method and for the robustness of the 1605 program. The current requirements of an emission inventory and entity statement place a significant burden on small landowners wishing to participate in the registry. As long as these requirements remain in place, the reluctance of landowners to participate in the program will negate the need for aggregators and minimize the role that PCOR Partnership region terrestrial projects can contribute to the success of the registry.

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