The Carbon Markets:

Forests, Credits, and Uncertainty

A Report for the Connecticut Forest and Park Association

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Foreword and Objective

This report and the research on which it is based have been carried out on behalf of the Connecticut Forest and Park Association (CFPA). The primary objectives of the research are:

- to provide useful background information for staff members at CFPA about the current state of the carbon markets as of May 2007
- to provide a reference document for the staff at land conservation organizations allied with CFPA
- to summarize the key players – organizations and people – who are working on the ever-evolving issues presented herein
- to raise some ideas about the ways in which land conservation organizations may be able to benefit by trading carbon in the carbon markets.

The report has been written for a reader who has had some experience with carbon markets but is not an expert in the field. It restates and summarizes information that appears elsewhere in many different forms, particularly on the topic of regulation and the regulatory context, so as to function as a standalone document that can be a useful reference tool for employees of CFPA and other land trusts who are seeking to learn more about carbon markets and the role of land trusts.

Significant work has been done, and is still in progress, on the science of carbon sequestration, particularly the ability of forests in the northeast to serve as carbon sinks. I will only touch on this issue where it contributes substantially to the frameworks presented, and to the discussion of the carbon markets.

As a final note, the information contained in this report reflects the views of the author and, where noted, of the interviewees who are cited. It should be taken in that context, and should not be construed as legal advice.

Background[2]

The Connecticut Forest and Park Association is Connecticut's oldest nonprofit conservation organization. Founded in 1895, its work focuses on the management and protection of the state's land, water, and wildlife resources.

CFPA focuses its work in four primary areas:

- **Natural Resources Management**: ensuring that public and private natural resources on Connecticut's 1.8 million acres of forest land are protected and enhanced through proper state and local land use planning, policies, laws, regulations, and on-the-ground practices.
- **Promoting Recreational Opportunities**: maintaining 800 miles of trails and encouraging their responsible use by publicizing their existence, coordinating group outings, producing printed guides, and working to establish new parks, trails, and greenways throughout the state.
- **Land Preservation**: working to increase the amount of land in Connecticut that is protected from future development, through conservation arrangements or outright land purchases.
- **Education and Outreach**: coordinating ongoing environmental education programs and special events, targeted at CFPA members, landowners, municipalities, teachers, students, and the general public.

By working with state and local agencies, landowners, and community land trusts, CFPA is committed to a collaborative approach that ensures the efficient use of resources across the State.

CFPA owns or owns easements on 1200 acres of land in the state of Connecticut, or approximately 0.04% of the state's total land area. As we will see, while its land holdings provide one possible point of entry into the carbon markets, CFPA's many strengths outside of land stewardship offer a number of other ways in which the evolution of carbon markets can provide significant new opportunities for CFPA to pursue its mission. Among these strengths are expertise in conservation and advocacy, significant exposure to the general public, capital, and a strong network of people and organizations with complementary goals.

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[2] Portions excerpted from CFPA's website at http://www.ctwoodlands.org.

Carbon Markets: An Overview[3]

A carbon market is a system in which buyers and sellers come together to trade quantities of emissions, measured in units of CO2-equivalent (CO2e) and denominated according to the standards of the exchange on which the trading takes place. Markets to trade CO2 have emerged relatively recently, but we have seen emissions traded as a commodity since the advent of sulfur dioxide trading in the early 1990s as a means of tackling the problem of acid rain. This section presents the history behind carbon markets, explains their mechanics, and defines some important industry terms.

Why should land trusts care about carbon markets?

- Provides a new source of private revenues to fund land deals
- Creates revenues to help pay for stewardship
- Creates access to a larger set of government incentives
- Helps land trusts become involved in provision of climate control, in addition to biodiversity, water quality, and open space
- Expands the value proposition of land trusts beyond old models, enabling connection to broader base of constituents

A Market Evolution Framework

In a recent talk at Yale the founder of the Chicago Climate Exchange, Richard L. Sandor, presented a model for the evolution of markets that offers a useful analytical pretext to this discussion of carbon markets. Sandor put forth a seven-stage model to explain the driving factors behind the evolution of markets. The device can help us understand the state of the current carbon markets.

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[3] A word on notation. Throughout this report I will use the word "carbon" to denote "carbon dioxide," which is the common unit of trade that has emerged in markets related to greenhouse gases. Where the markets are dealing with a gas that is not CO2, the unit is CO2e, or tons of CO2 equivalent. In the U.S., some transactions count CO2 in metric tons (tonnes), while others count it in short tons. I have made an effort to make my units clear, as appropriate.

The seven stages are as follows:

1. A structural change takes place
2. A definable commodity emerges
3. Evidences of ownership are created for the commodity
4. Informal trading of the commodity commences
5. Formal trading commences and commodity exchanges develop
6. Trading commences on derivatives for the commodity
7. Deconstruction of markets

For the purposes of this discussion I will focus on the first five of these stages, with the goal of orienting the reader within the lifecycle of carbon markets. I will argue that carbon markets today have made it through each of these five stages, but that the absence of a single governance regime has created inefficiencies along the way, with important implications for the way CFPA and land trusts should think about participation in the carbon markets.

Stage One: Structural Change

The structural change is the most important catalyst in triggering the formation of markets: the spark that lights the fire. In the case of carbon markets the major structural change has been the emergence of new, convincing knowledge about the scope and science of climate change.[4] This knowledge has led to many significant efforts to understand the economic and social impacts of climate change, which in turn have helped set the political stage for efforts – in both developed and developing countries, and the public and private sectors – to reduce and compensate for GHG emissions. The result is a complex and disjointed set of legislated and unlegislated drivers for the existence of markets on which carbon, as a commodity, can be traded.

[4] There is plenty of information about climate change available elsewhere. As that is not the focus on this report, I will leave it at that. I have included in Appendix A links to some useful resources for learning about climate change, for readers who are interested.

Formal agreements that drive the carbon markets

Throughout this discussion of the agreements that are driving the carbon markets it is important to bear in mind that the markets are in their infancy. Each of these agreements will undergo many iterations and revisions before the world has a well-functioning, efficient market. The following formal agreements have made significant contributions to the shape of existing markets but there is much more to be done.

> ***What is cap-and-trade?***
>
> Briefly, a cap-and-trade program for emissions establishes a unit of emissions – in the case of RGGI this is one short ton of CO2 – along with a group of "covered emissions sources" that will be included in the program and a cap on the total amount of emissions from these sources. For RGGI, covered sources include electricity generation facilities that produce more than 25 megawatts of power by burning fossil fuels.[1] Each of these emissions sources is assigned a certain number of emissions allowances, which are either sold or given to the emitters by a regulating agency. Each source is allowed to emit one ton of CO2 for every one-ton allowance that it owns, and the total emissions from all sources are limited to the total "cap". The system allows sources to buy and sell their allowances as needed in order to help them meet their targets. It also allows the purchase of "offsets," which will be described later.

Regional Greenhouse Gas Initiative[5]

For land conservation groups in the northeast, the Regional Greenhouse Gas Initiative (RGGI) hits closest to home. RGGI is the first market-based cap-and-trade program in the U.S. Its participants include ten eastern states: Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont.

Each of these states has its own targets for emissions, and the agreement sets out several phases for meeting those targets. The first phase of RGGI begins January 1, 2009 and ends December 31, 2014. During this phase, total emissions in the RGGI region will be capped approximately at current (2007) levels. During the next phase, which starts in 2015 and runs through 2018, states will be held to reduction commitments of 2.5% per year. Member states have until the end of 2008 to write their own implementation plans for the RGGI Model Rule, which contains RGGI's core mandates and the guidelines for meeting them.[6]

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[5] Information in this section was extracted in part from personal communication with Heather Kaplan at the Northeast States for Coordinated Air Use Management (NESCAUM), 30 March 2007.

[6] Environment Northeast maintains a rich library of information pertaining to the mechanics, history, and implementation of RGGI. In addition, the RGGI website is a useful source of information. Links to both of these resources appear in Appendix A.

Several key points about the design of RGGI have a direct bearing on land conservation efforts in the northeast.

First: the RGGI program allows emitters to meet their targets either by trading emissions allowances, or by purchasing emissions offsets. Offsets are created by projects that result in the direct reduction of emissions and that are outside the scope of the emitters' normal operations. Five categories of offsets are permissible under RGGI; one of them is related to forestry.[7] Afforestation projects require that a long-term conservation easement be placed on lands that are planted and then managed for sequestration according to the forest management guidelines outlined in the Model Rule.[8] A project generates an amount of carbon offsets equal to the amount of carbon sequestered by the afforested lands. By funding an afforestation project that leads to the sequestration of 10 tons of CO_2 emissions, a covered emissions source could neutralize the effect of 10 tons of CO_2 emissions and receive credit that counts toward its overall abatement targets.

Afforestation or Reforestation?

There is no standard definition for the terms afforestation and reforestation. The details differ depending on whether you are talking about the Kyoto Protocol, RGGI, or another scheme. But generally, afforestation is the practice of planting trees on sites that have no evidence of having been forested in the past. Reforestation is the act of restoring native trees to areas where trees have been absent for a relatively long period of time. Under RGGI, if a site has had no trees for more than 10 years, a tree-planting project can qualify as an eligible offset project.

Second: a portion of the total regional emissions allowances under RGGI has been assigned to each state, which in turn is responsible for distributing the allowances to covered sources of emissions. States can choose whether to sell (auction) the allowances or give them away for free. At a minimum, states are required to auction 25% of their allowances to generate revenue for programs that will benefit consumers: energy efficiency, rebates, incentives, and energy technology investments. As of the time of this writing, Vermont, New York, Maine, Massachusetts, and Connecticut have signaled their intentions to sell 100% of their allowances at auction, but much remains to be decided. Emitters and brokers will campaign hard to talk each state into giving away for free a certain percentage

[7] The other four categories of offsets are: capture/burning of landfill gas, sulfur hexafluoride capture/recycling, energy efficiency, and methane digestion on farms.

[8] Information on forestry guidelines can be found in the RGGI Model Rule, which at the time of this writing was available at http://www.rggi.org/docs/model_rule_corrected_1_5_07.pdf, pp. 124-132.

of allowances. To the extent that states decide to use allowance sales to generate revenues, land conservation groups may be able to advocate the use of a portion of these revenues to fund land conservation efforts.

Third: the timing of RGGI is such that market activity will heat up around the beginning of 2009. Between now and then it will be tremendously important for land conservation organizations that are looking to raise money in the RGGI offset market to get their arms around the incentive structure and understand the criteria for entering the market. In addition, during this period before the "go-live" date it is likely that emitters will be requesting proposals for offset projects to help them identify the best and least expensive sources of offsets. This may present an opportunity for CFPA and other land trusts looking to participate in the market through offset projects.

Fourth: RGGI was designed with an eye toward the energy sector, which is responsible for the greatest amount of total emissions in any sector. Regulating a few large sources is more cost-effective than dealing with a larger number of smaller emitters. The high degree of certainty that is possible in measuring energy sector emissions has led policy-makers to favor emissions reductions that come with an equally high degree of certainty. This is why the allowable list of offsets favors energy-related projects: policymakers aimed to avoid "squishyness" by sticking with concrete, measurable sources.[9] Forestry projects, particularly those that involve avoided deforestation or avoided development, have not yet been deemed to be sufficiently quantifiable to meet the "squishyness" standard. Improved science and greater certainty will be critical success factors.

As a final point, a high level of uncertainty surrounds the outcomes of RGGI. Connecticut has one of the most comprehensive implementation plans underway of any state. But it is incumbent on CFPA and other land conservation groups to assert themselves strategically so as to make their interests known. Given the speed at which the initiative is taking shape, it will not be long before uncertainty turns to certainty. Later in this report I will provide additional context for Connecticut activities and suggest some ways that CFPA can best apply its efforts and resources.

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[9] Chris Nelson, Connecticut DEP, presentation at the Yale School of Management, 25 April 2007.

New England Governors and Eastern Canadian Premiers Climate Change Action Plan[10]

In 2000, the Conference of New England Governors and Eastern Canadian Premiers (NEG/ECP) adopted Resolution 25-9 on global warming and its impacts on the environment. The Plan set forth nine action items that included:

- Establish a regional GHG inventory
- Establish a plan for reducing emissions and conserving energy
- Promote public awareness
- Create state and province mandates for investments in energy efficiency
- Reduce greenhouse gases from the electricity sector
- Reduce total energy use through conservation
- Develop climate change adaptation strategies
- Decrease transportation sector's GHG emissions
- Explore trading mechanisms for greenhouse gases

The Plan sets the tone for regional collaboration but it does not establish an implementation arm or enforcement mechanism. It calls for a phased reduction in GHG emissions: 1990 levels by 2010, 10% below 1990 levels by 2020, and further longer-term reductions. NESCAUM is involved in policy analysis related to the Plan but little work is currently being done to build on the Plan as a governance mechanism.[11] It is therefore best regarded as an agreement whose intent is being fulfilled through other more binding and more enforceable policy mechanisms.

The Connecticut Climate Change Action Plan (CCCAP)[12]

Connecticut Public Act 04-252 made a major contribution to Connecticut's progress toward meeting the goals of the NEG/ECP Plan by calling for, among other things, the creation of a

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[10] The full plan can be accessed at http://www.negc.org/documents/NEG-ECP%20CCAP.PDF.

[11] Heather Kaplan, NESCAUM, personal communication, 30 March 2007.

[12] The entire CCCAPlan can be viewed at http://www.ctclimatechange.com/StateActionPlan.html.

climate change action plan for the State. The result was the Connecticut Climate Change Action Plan of 2005. Authored in close collaboration with the governor's office, the Plan set forth 55 goals in five topic areas. Although the plan focuses primarily on the energy sector, two recommendations in the section on Agriculture, Forestry, and Waste are directly related to CFPA and to land conservation: Action #38 and Action #40. Action #38 calls for a program to "support a research program to examine Connecticut's public and private forests and determine how they could be best managed to maximize carbon sequestration and to develop markets for offsets from terrestrial carbon sinks." Action #40, Forest and Agricultural Land Preservation, calls for a program to "support the protection of forestland and agricultural land preserves and the carbon absorption capacity of existing forest and agricultural lands, enabling continued carbon sequestration from the atmosphere. The goal is to preserve existing forest and agricultural land in CT." In addition, recommendations on urban tree-planting (#39) and the use of durable wood products (#41) may also motivate state-funded land conservation efforts. The most recent (2006) update on the status of CCCAP implementation further highlights the connection between the Plan and land conservation, stating a goal to "work with land conservation organizations to promote carbon sequestration as a criteria/benefit in addition to traditional land preservation goals."

Other State-Based Climate Actions

From California's AB 32, which establishes a state-wide emissions cap, to Wisconsin's mandatory GHG reporting, to vehicle performance standards in New Jersey and Washington, a variety of state-specific bills have signaled states' collective interest in getting a head start on U.S. government policy. The landscape of state actions beyond the RGGI region is ever-changing but lies beyond the scope of this report.

U.S. Climate Legislation under Consideration

At the time of this writing, five bills advocating a cap-and-trade-based approach to regulating greenhouse gases are being discussed in the U.S. Congress. These include bills from Senator Bingman (NM), Senators Feinstein (CA) and Carper (DE) (S. 317), Senators Kerry (MA) and Snowe (ME), Senators McCain (AZ) and Lieberman (CT), and Senators Sanders (VT) and Boxer (CA). The Pew Center on Global Climate Change publishes policy research and analysis and

would be a useful resource for any questions that CFPA or other organizations have about current pending legislation at both the state and federal levels. [13]

The Kyoto Protocol

The Kyoto Protocol is certainly the grandest of the formal agreements, but because the U.S. has not yet ratified it, it has had no direct effect on forcing emissions reductions within the United States. That being said, the existence of the Protocol, the examples it has set, and the likelihood of the U.S. signing onto some future commitment have all played a role in building the foundation for carbon markets within the U.S. As with RGGI, there is an exhaustive amount of literature on the Protocol, some of which I have catalogued in Appendix A. Like RGGI, the Kyoto Protocol sets emissions caps and targets, but as currently written does not create any formal trading exchanges. To that extent Kyoto has created conditions that favor the evolution of carbon markets without explicitly establishing them.

Like RGGI, Kyoto allows emitters to accomplish a share of their abatement activities through the purchase of offsets, but the Kyoto offset scheme for forestry-related offsets is more nuanced than that of RGGI. Whereas RGGI currently creates incentives for afforestation credits, the Clean Development Mechanism (CDM) and Joint Implementation (JI) mechanism take a wider approach. The CDM, which facilitates the purchase of offsets by "Annex 1" countries (developed countries listed in Annex 1 of the Protocol) from non-Annex 1 countries, allows for projects in afforestation and reforestation. The JI allows for projects that generate Removal Units (RMUs) from Land Use, Land Use Change, and Forestry.

As mentioned, the Kyoto Protocol is important because it is the most wide-scale driver of climate change policy at a global level. If a global commodities market for carbon offsets takes shape, its DNA will lie in the precedent markets and frameworks. The mechanisms established by the Protocol will have a direct bearing on the way standards are established for such a market.

[13] The Pew Center on Global Climate Change can be accessed at http://www.pewclimate.org.

The EU Emissions Trading Scheme (ETS)

The Kyoto Protocol sets the cap on carbon emissions among participating countries but does not establish regional implementation strategies. In the EU that effort has been carried out under the ETS, a coordinated plan that calls for member countries to design and promulgate emissions reduction plans. The EU ETS covers roughly 50% of the GHG emissions in the EU.[14] Like RGGI, the ETS focuses on the energy sector, covering more than 11,500 energy-intensive facilities across the 25 EU member countries, including oil refineries, power plants over 20 megawatts (MW) in capacity, coke ovens, and iron and steel plants, along with cement, glass, lime, brick, ceramics, and pulp and paper installations. Trading under the ETS began January 1, 2005 for the first phase, which will end in 2007. A second trading period is scheduled to begin in 2008, with a third one planned for 2013.[15]

Informal agreements that drive the carbon markets

One of the more confusing drivers behind the current carbon markets is the array of informal agreements that have emerged in response to the growing scientific certainties around climate change. In fact, a majority of news-making activity around carbon trading in the U.S. has sprung up as a result of such covenants. This is especially problematic because there is no unifying policy instrument or economic motive behind such agreements.

Goods traded on markets tend to possess measurable economic value: $4 for a bushel of corn on a commodities market in Chicago, $20 for a share of stock on the London Stock Exchange, and so on. In a coordinated market the price of carbon is a reflection of the shadow price of carbon-abating activities, together with any constraints in structure or supply. Buyers will pay for carbon offsets up until the point where it is cheaper for them to reduce carbon emissions on their own. The formal agreement – e.g. an emissions cap under RGGI – is designed to push the external costs of climate change back to the emitter, making it costly to emit carbon. This cost, then, creates economic value for carbon trading.

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[14] http://ec.europa.eu/environment/climat/emission/pdf/etsreview/ecofys_review.pdf.

[15] "Climate Change: The European Union's Emissions Trading System (EU-ETS)," July 31, 2006, Larry Parker, Specialist in Energy Policy, Resources, Science, and Industry Division, Congressional Research Service, Library of Congress, http://vienna.usembassy.gov/en/download/pdf/eu_ets.pdf.

Informal agreements around carbon emissions have sprung up as an increasing number of individuals, businesses, and government agencies gain awareness about climate change and make a deliberate choice to internalize at least a portion of the social costs of their own greenhouse gas emissions. The fabric of these agreements is woven out of diverse strands: concern for public relations, shareholder pressure, competitive pressure, the desire to get a jump up the learning curve, business opportunity, social pressure, fashion trends, ethical concern, guilt, and plenty of other forces. The end result is a complex series of unwritten agreements, expectations, and emergent systems of norms between and among a diverse group of emitters and stakeholders both small and large. Motivated by these informal agreements, the parties make commitments to purchase carbon offsets through a growing number of markets that will be the focus of discussion later in the report. It is through these markets that land conservation organizations may have the greatest potential to tap into the growing interest in carbon, the new commodity.

Stage Two: Definable Commodity Emerges

Following the completion of structural changes such as those outlined above, the second stage in the development of markets is the emergence of a definable commodity. For a commodities market to function efficiently, all market participants must understand and share a common system for defining quantity, type, and quality. Without standards it is impossible to agree on a single value for a unit of the good. Since carbon dioxide is the most widely-emitted contributor to climate change, it has become the standard unit of quantity in GHG markets. Gases such as methane that have greater global warming potential (GWP) than CO_2 are traded as tons of CO_2 equivalent (CO_2e), which has become a convenient standard unit for a variety of emitted products.

There has been further standardization in cap-and-trade market design around two types of products: emission allowances, which are created by a regulatory body and allocated or auctioned to emitters of pollution; and emission reduction credits, which give the holder credit for reductions in emissions that have been generated by a surrogate entity. For emission allowances to be meaningful there must be a consistent definition of the commodity on both the supply side and the demand side – e.g. 10 tonnes of allowances must be consistently defined and matched to 10 tonnes of emissions. When emissions are easy to measure and verify, the market exchange becomes efficient and feasible.

This is why, under RGGI, regulators chose initially to limit the list of "covered emitters" to those large sources that already had sophisticated emissions monitoring technology in place. It would be far more costly and difficult to capture accurate emissions data on automobiles, household chimneys, or any of millions of other small mobile sources in a given region. Costlier still would be the process of creating a mandatory market for the individuals responsible for the millions of tons of emissions coming from these sources.

Quality is just as difficult to measure as quantity. Perhaps the most important concept that land conservation groups must keep in mind is that of "additionality." Held as a key mark of quality under Kyoto, RGGI, and most other regulatory schemes, additionality refers to the question of whether the emissions reductions that led to the creation (and subsequent sale) of an emission credit would have happened even in the absence of a market for those reductions. Consider, for example, a credit that was generated through the carbon sequestered by trees planted in an afforestation project. The group that generated the credit by planting trees could sell the credit on a carbon market. If that same group would have planted the same trees without the revenues from selling the credit, the project could not be considered additional. This is important attribute will determine, in part, the types of projects for which land conservation groups can earn—and then sell—emission reduction credits. I will again defer to the extensive set of literature that deals with offset quality, rather than attempting to provide exhaustive commentary here. The important point is that carbon market designers face a challenge in agreeing on definitions for both quantity and quality, and until they do so an efficient market will remain elusive.

Emission Registries

Numerous governing bodies have taken steps to establish standards both for quantifying emissions and for the production and verification of emissions credits. GHG emission registries play an important role in ushering in the definable commodity: they establish the technical accounting rules that standardize GHG and carbon accounting. Acting as a centralized data repository, registries determine what gets listed as a tradable commodity and how it needs to be measured in order to be listed. Registries play an important role in creating common standards for emitters and generators, buyers and sellers.

Many registries use standards derived from the Greenhouse Gas Protocol, which is the predominant global set of guidelines for quantifying emissions.[16] The GHG Protocol defines rules for GHG accounting and reporting and provides standards for defining carbon in a wide range of sectors. The main U.S. registries include the California Climate Action Registry, the Climate Registry, the Department of Energy's 1605b Voluntary Reporting of Greenhouse Gases program, and the Chicago Climate Exchange registry.[17] The Climate Registry is a brand-new effort, launched in May 2007, which merges the former Eastern Climate Registry with efforts from as many as 30 U.S. states.

A Connecticut land trust could utilize and benefit from a registry in two ways. First, by reviewing emissions listed on a registry, the trust could quickly identify the largest GHG emitters in a particular region and target any offset marketing efforts at those emitters. Second, if the registry lists qualified forestry-based emissions reduction projects, the land trust could list an afforestation project and benefit from the credibility that comes from meeting the registry's standard.

Offset or Credit?

The term "offset" is used generically to refer to any emission reduction credit. As the market for offsets has exploded, the term has assumed a negative connotation to some. Offsets vary widely in their quality, origins, and market price; those that are established under the terms of a formal agreement tend to be more expensive and more easily verified than those that have not been created under the terms of a formal agreement. Increasing scrutiny of the offset industry, however, is leading to greater monitoring and more third-party verification, and ultimately will facilitate convergence to a single set of standards.

In general, forestry-based offsets can be achieved through four methods: afforestation, reforestation, forest management, and forest conservation projects, although what is acceptable under one regulatory framework may not be acceptable under another.

A single U.S. or global market for carbon will depend on consistent, reciprocal standards between each of these registries or the merger of the different schemes. In the meantime, registries will continue to provide significant advantages to all participants in the nascent carbon markets by helping establish a common definition for the commodity.

[16] The GHG Protocol, a joint effort of the World Resources Institute and the World Business Council for Sustainable Development, is at http://www.ghgprotocol.org.

[17] Links to information on each of these can be found in Appendix A.

Stage Three: Evidences of Ownership are Created

Traders of a commodity almost always trade certificates rather than the commodity itself. In a classic example this allows traders to trade pork bellies without having the unenviable burden of carrying around the actual product. Evidence of ownership in GHG-related commodities is defined by the particular market scheme under which the commodities are traded. The evidence is a contract that verifies an emission reduction credit or authorizes an emitter to emit a certain amount of GHG. Depending on the rules of the market scheme, the contract may offer a strong guarantee as to the owner's right to the commodity – or no guarantee at all.

Evidences of ownership have different names under different exchanges. On the Chicago Climate Exchange the commodity is represented with Carbon Financial Instruments (CFIs).[18] In the European Union, market participants trade allowances, Removal Units (RMUs), Certified Emission Reductions (CERs), and Emission Reduction Units (ERUs). On the informal exchanges such as the retail brokers described in the next section, there are no evidences of ownership; rather, transactions for a chosen number of tons of CO_2e are conducted in good faith between the buyer and seller.

For forest and land-related carbon sequestration projects, the most basic evidence of ownership is the emission reduction credit, which may take any number of different names, including CERs, ERUs, and so on. After registering with an exchange, a land management organization would be able to sell the carbon sequestration value of its property in the form of emission credits. The entire transaction would look like this:

Easement placed on land -> Land manager registers forestry project for a certain volume of emission reduction credits -> credits sold -> evidences of ownership delivered in the form agreed to in the transaction -> money funds the qualifying forestry project -> long-term stewardship ensues ➔ Carbon Sequestered.

[18] The attributes of CFIs are outlined at http://www.chicagoclimateexchange.com/trading/contractspecs.html.

Stage Four: Informal Trading Commences

I will refer in this document to two types of markets: informal "over-the-counter" (OTC) exchanges, and formal exchanges. Carbon is currently traded over both types of exchanges. Trading activity on either type of exchange may be either compulsory – required under one of the "formal agreements" mentioned above – or voluntary, motivated by an "informal agreement". The existence of a formal agreement, such as the Kyoto Protocol, does not imply the existence of a formal exchange, but Kyoto and other accords have precipitated the move from OTC to formal exchanges around the world. It is likely that the majority of trading under formal agreements will take place on formal exchanges, while the majority of trading under informal agreements will take place on OTC exchanges. I have not found any data to support this hypothesis beyond the intuition that formal agreements will favor the more tightly regulated environments of formal exchanges.

Market Size

According to Ecosystem Marketplace estimates, the voluntary market traded approximately US $100M in the first three quarters of 2006.[1] The size and recent growth rates of this market attest to the widespread high levels of interest in carbon markets.

Buyers and sellers in the OTC markets can enter the markets in one of two ways: through **retail exchange**, or through **direct exchange**. Retail providers link purchasers with entities that manage emission reduction projects. As an example, retailer CarbonFund.org markets and coordinates transactions with retail consumers, and works with managers of forestry projects to secure emission reduction credits. The Climate Trust serves as an advisor to entities that wish to purchase offsets. The Trust has placed more than $4 million in screened offset projects on behalf of its clients.[19] Direct exchanges take place when a project manager – a land trust managing a forestry project, for example – connects directly with a buyer of emission credits and structures an exchange. Several examples of this type of exchange will be given below.

[19] "The Climate Trust Announces $4.3 million Available for Offset Projects," accessed May 2007 at http://www.ewire.com/display.cfm/Wire_ID/2619.

The following table summarizes some key distinctions between retail and direct exchanges:

Retail Exchange	***Direct Exchange***
Low transaction costs	High transaction costs
Repeat transactions likely	Usually (but not always) a one-shot deal
Buyers tend to purchase in small volumes that constitute a fraction of total project value	High-volume purchases
Retailers extract a brokerage fee; reduces share of revenues applied to project	Greater share of the revenues likely to be directed to project
Buyer depends on full disclosure from seller	Buyer depends on shared sense of trust between organizations
Project verification is at the discretion of the retailer	Project verification likely to be negotiated between buyer and seller
Single buyer purchases from single reseller, who purchases from multiple wholesalers	Takes place between a buyer or small coalition of buyers, and seller or small coalition of sellers
Buyer has little or no say over project characteristics	Buyer typically takes an interest in the specific project characteristics
There is no resale value to offsets purchased	Structuring of resale at the discretion of the parties involved

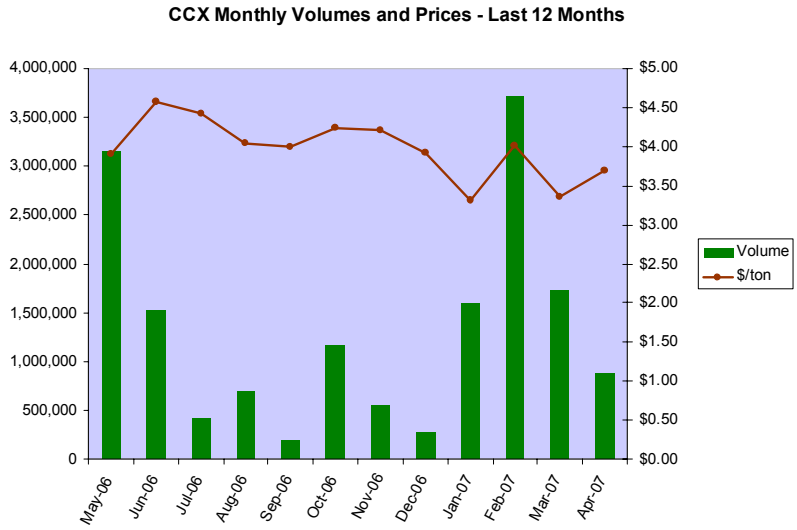
The final section of this report contains recommendations for CFPA and other land conservation groups on selecting a path to market entry.

Stage Five: Formal Trading Commences

Significant amounts of carbon are currently traded on informal exchanges, but that carbon trading has made it all the way to formal exchanges in a relatively short period of time is an indication of the high level of global demand for the commodity. A number of formal exchanges have emerged.

Chicago Climate Exchange

By far the largest formal exchange in the U.S. is the Chicago Climate Exchange. The exchange enables members to trade Carbon Financial Instruments (CFIs) in units of 100 metric tonnes of CO2. The total dollar volume of trading on the CCX during the year ended April 30, 2007 was just over $62 million. The graph at right shows monthly volumes and average prices.[20] Of particular note is the relatively stable price level despite high volatility in trading volumes. The uncertainty surrounding climate change policy in the U.S. helps explain this volatility in part, but it is interesting to see that the market has found a fairly narrow price band in spite of this.



Members of the CCX have the option of four categories of membership:

- Members – direct emitters of GHGs
- Associate Members – carbon-neutral entities
- Participant Members – offset providers and brokers
- Exchange Participants – entities that purchase and retire Carbon Financial Instruments

Full-fledged members agree to a voluntary cap on carbon emissions, modeled after Kyoto targets and timelines, and then take advantage of the ability to trade allowances on the exchange to manage their own costs of abatement. Although members' commitments are purely voluntary, once they join they are committed to their targets. In that way the CCX provides a tidy

[20] CCX trading data obtained on the CCX website, http://www.chicagoclimateexchange.com/trading/marketData.html, accessed 1 May 2005.

simulation of what a broader, federally-mandated cap-and-trade program might look like in the U.S.

The CCX has its own set of standard rules for the production of carbon credits through both forestry and agriculture. For U.S.-based projects these include:

- **Agriculture**: Committing land to continuous no-till, or ridge-till cropping in the central U.S.; initiating grass cover planting in specified states, counties, and parishes in the U.S.
- **Forestry**: Initiating forestation and forest enrichment projects

Listing on the CCX registry and participating in the exchange require annual verification of projects, which is carried out by a list of approved verifiers.[21] The verification process depends on the size of the project: "small" forest carbon projects include those that sequester less than 2,000 metric tons of carbon per year; "medium" are measured at between 2,000 and 12,500 metric tons; "large" projects sequester over 12,500 metric tons.

Projects that offer less than 10,000 metric tons/year need to be sold through an aggregator. For reference, estimates of Connecticut's annual forest carbon emissions rate range from -2.71 million metric tons of CO2e (MMTCO2e) to 0.98 MMTCO2e, where negative numbers refer to amounts sequestered, and positive numbers refer to amounts emitted.[22] If we use an average estimate of -1.0 MMTCO2e per year, fully 10% of Connecticut's existing forested area would have to be committed before a project manager could list directly on the CCX.

Other types of sequestration-based credits that are tradable on the CCX include agricultural soil carbon offsets, agricultural methane emissions offsets, landfill methane emissions offsets, and renewable energy emission offsets. Of these, the first holds the greatest relevance to land trusts, although currently only agriculture soils projects from the Midwestern U.S. are listed on the exchange. Eventually, Connecticut farmland preservation efforts may have value in carbon markets, through either the CCX or another exchange, but no opportunities currently exist.

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[21] The list of verifiers can be found at http://www.chicagoclimateexchange.com/environment/offsets/approved_verifiers.html.

[22] Environment Northeast, Climate Change Roadmap for New England and Eastern Canada, p. 207. Accessed February 2007 at http://www.env-ne.org/ENE_Climate_Change_Roadmap_New_England_Canada.htm.

European Climate Exchange

Roughly 80% of the exchange-traded volume of carbon traded in the EU is traded on the European Climate Exchange (ECX).[23] Unlike Kyoto, which has provisions for forestry-based offsets, the ETS does not permit the use of forestry sinks for carbon in achieving emissions reduction targets. As a result, no forestry credits are traded on the ECX. Because member states can purchase emission credits through the CDM and the JI mechanisms, trading on the ECX is fairly active.[24] The absence of forestry from the list of acceptable offset methods shows the importance of having favorable, complementary legislation at every level. Even though Kyoto permits forestry offsets and there may be significant market demand for forestry credits within the EU system,[25] forestry was left out of the design process that led to the creation of the ETS. If future regional or national legislation in the U.S. calls for localized implementation, the same gap could form, leading to the same difference in specifications.

UK Emissions Trading Scheme

The United Kingdom ran an emissions trading system from April 2002 through December 2006. Although its trading has moved to the EU exchanges, market designers have learned valuable lessons from watching this exchange.

Other Exchanges

Other emissions trading schemes have been set up by government and quasi-government institutions. The Emission Reduction Procurement Tender (ERUPT) and the Certified Emission Reduction Procurement Tender (CERUPT) are a pair of Dutch exchanges set up to facilitate trading under the JI and CDM provisions, respectively, of the Kyoto Protocol. The World Bank has established the Prototype Carbon Fund (PCF), which is an investment vehicle through which emitters can access projects under the CDM and JI.

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[23] More information about the ECX can be found at http://www.europeanclimateexchange.com/index_flash.php.

[24] http://europa.eu/rapid/pressReleasesAction.do?reference=MEMO/05/84&format=HTML&aged=1&language=EN&guiLanguage=en.

[25] "Should Temporary CERs be Included in the EU ETS Linking Directive?" Ecosecurities Consult, March 2006.

Summary and Key Takeaways

Carbon markets today are highly fragmented and governed by an array of different and non-reciprocal standards. Markets can be either "formal" or "over-the-counter". Buyers and sellers in carbon markets trade either emission allowances that have been issued under a regulatory authority such as the EU Emissions Trading Scheme (a formal agreement), or emission reduction credits, which may be recognized and valued on both formal and informal exchanges, and created under either formal or informal agreements.

Land conservation groups stand to benefit from trading emission reduction credits because of the new revenue streams that may result from sequestration. Participation begins by identifying a project that qualifies for trading on an exchange, quantifying the amount of carbon in that project, completing any necessary registration processes required by the exchange, and submitting to any periodic verification that is required by the exchange.

Carbon Markets for Connecticut Land Managers

After the preceding discussion about the evolution and current state of carbon markets, the next logical question for CFPA and stakeholders in land conservation in the State of Connecticut is whether carbon markets can provide new opportunities and new revenue streams. This is best addressed in two parts:

- Are the markets ready for CFPA and the CT land conservation community?
- Are CFPA and the land conservation community ready for the markets?

The next two sections will address the first question, and the final section will address the second question.

Let's begin with a further breakdown of the markets into the following pieces:

- **The sequestration potential**: do northeast forests have the potential to bring a measurable amount of emission reduction credits on to the market?
- **The addressable market**: how much demand is there for Connecticut-based sequestration projects?
- **The market price of carbon**: how much would land managers be compensated for sequestration projects?

Sequestration Potential in Connecticut

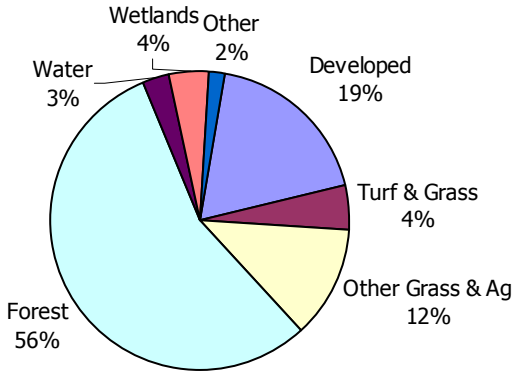
As mentioned above, a wide range of estimates about the sequestration potential for Connecticut forests averages out to 1.0 MMTCO2e per year of net carbon capture, or 0.53 MtCO2e per acre per year. The state is approximately 57% forested at present, and roughly 10 square miles of the state have been converted from forestland each year since 1985.[26]

[26] Data on CT state landcover from the University of Connecticut Center for Land Use Education and Research, accessed April 2007 at http://clear.uconn.edu/projects/landscape/statewide_landcover.htm; also from Don Smith, CT State Forester, personal communication, 11 May 2007.

The RGGI Model Rule as currently written only permits sequestration credits from afforestation projects in the participating states. Some insight into the sequestration potential can be gleaned from a back-of-the-envelope estimation of the sequestration value for afforestation in Connecticut.

Rough Estimation of Potential

Lands available for afforestation could come from only three categories: Developed, Turf & Grass, and Other Grass & Agriculture, which together account for 35% of the state. We must assume that only a fraction of the land within each category is actually convertible – for this discussion, assume 10% of Developed land and 25% of Turf & Grass and Other Grass & Ag lands. This amounts to 5.9% of the state's land area, or a potential 10.5% increase (197,904 acres) over what is currently forested. Assuming that the average sequestration potential for forested lands is equal across the state, and is on the order of 0.53 MtCO2e per acre, the annual sequestration potential within the hypothetical newly-forested area would be 105,000 MtCO2e. At a conservative market price of $3 per ton the carbon value of this land would be $315,000 per year, or $1.59 per acre – before subtracting management, verification, and project costs. Even at an aggressive market price of $27 per ton the value of the carbon would be just over $14 per acre per year. Using the same assumptions and a moderate market price of $10, CFPA's total land holdings of 1200 acres would generate just over $6,000 per year in revenue from carbon credits.[27]



Connecticut Land Cover estimates, 2002. (Data: Univ. of Connecticut CLEAR)

This simple exercise ignores the complexities of forest carbon science but helps illustrate the magnitude of the numbers that CFPA and other land conservation groups should keep in mind when considering whether now is a favorable time for market entry. A quick sensitivity analysis

[27] An analysis performed by forestry consultants at Forecon, which assumed roughly 1.5 MtCO2e captured per acre of northeastern forest, estimates the present value of carbon-oriented forests at roughly $6 per acre, net of expenses. Forecon Ecomarket Solutions, "Carbon Market May Offer Opportunities for Forest Landowners," March 2007, accessed May 2007 at http://www.mfpp.org/Data/carbonmarket.forestry_source_2007.pdf

can show what parameters would place the outcome within a reasonable range. Sufficient adjustments to the assumptions about sequestration capacity per acre, market price per ton, stewardship costs, or available land may in fact indicate favorable economics for sales of carbon credits by land trusts.

This example also illustrates the importance of the policy drivers. If RGGI is amended to include projects beyond the limited afforestation work that could take place in Connecticut, an entirely new set of incentives would emerge. Credits for avoided deforestation or development could be sold to generate revenues from the existing forested lands. Layered together with other incentives, this could provide a very attractive opportunity for land conservation organizations.

Quantification and scientific uncertainty

Existing data on forest carbon potential are fraught with estimation error. Because of this uncertainty the CCCAP has called for more research on the topic; this research is being managed by the state DEP and by a loose network of academic researchers throughout the state. A significant amount of work has been done to assess the carbon capture value of different tree species and timber management plans. Scientific research is outside the scope of this paper, but I will call attention to the following noteworthy examples of research:

- At the Maine Forest Service, researchers working to assess "MegaCarbon" potential have calculated that even at a $4 price per metric ton for CO2, many trees are worth more left standing than as saw timber or pulpwood.[28]
- The U.S. Forest Service recently released a software tool, STRATUM, which enables urban forest managers to calculate the benefits of trees on city streets. The model uses a range of parameters to identify a value for trees. A team in New York City applied the model and found that each dollar of tree maintenance generates $5.60 in social value.[29]
- Researchers at Environmental Defense have looked at methane emissions from forests to determine whether claims that methane from decaying biomass actually outpace forests' carbon sequestration work. If this were the case, forests would have net positive

[28] Kenneth Laustsen, Maine Forest Service, personal communication, 11 April 2007. The team has put together several detailed and useful models to aid their calculations.

[29] Information on STRATUM is available at http://www.fs.fed.us/psw/programs/cufr/stratum.shtml. The report on NYC trees can be found at http://www.fs.fed.us/psw/programs/cufr/products/2/psw_cufr687_NYC_MFRA.pdf.

emissions of GHG gases. The report, however, concluded that forest methane does not in fact neutralize the sequestration potential.[30]

- William Bentley, consultant to CFPA, is currently working on a report on the science and potential of forest carbon in Connecticut.

Further uncertainty is created by the problem of "leakage". An important term for carbon markets, leakage refers to the fact that when a piece of land is converted to forest, or kept from development, an indeterminable amount of development (and resulting emissions) will shift to another land area, rather than simply being averted. Leakage makes project standards hard to design and makes project impacts hard to measure accurately. And it makes our assessment of the sequestration potential difficult—even after the science is certain. For this reason, markets for forestry-based carbon offsets cannot be designed without due consideration for statewide open space plans, agricultural land preservation, and smart growth incentives.[31]

Finally, total sequestration potential will be a function of emission reduction project duration. Whereas many traditional forest models value forests on a 20- or 40- or even 100-year time horizon, and land conservation organizations think in terms of perpetual preservation and stewardship of land, a regulatory scheme such as the Kyoto Protocol that only persists until 2012 limits the long-term value of forest carbon. Projects end up being valued on a five- or 10-year time horizon, and the broader goals of avoided development are met only for the short term. Sales of carbon capture services on an annual basis must be bundled with easements if the long-term conservation goals are to be met.

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[30] James Wang and Bill Chameides, "Emerging science on methane emissions from forests: Do forestation projects designed to slow global warming still make sense?" Environmental Defense Analysis, January 2006. Accessed March 2007 at https://secure.environmentaldefense.org/documents/4982_EDAnalysisMethaneEmissions_Forests.pdf.

[31] CCCAP, p. 159.

The Addressable Market

Actual demand for forestry-related emission reduction credits is unknown. Trading on the CCX offers a window into overall demand from a subset of U.S. entities, but at present there is simply no way to tell how much demand there is.[32] This is partly a function of the lack of regulatory systems, and partly a function of the inefficiency of the markets. As has been demonstrated in the EU, demand will increase once a scheme is developed and implemented. Buyers and sellers will be able to connect and trade more readily in an efficient market. If the growth of voluntary trading volumes in the U.S. over the past few years is any indication of what's to come, demand will not be a limiting factor.

The Market Price of Carbon

Just as there is no accurate measure of current or future demand, there is no single market price of carbon.[33] The various formal and informal agreements that have led to trading on formal and informal exchanges create multiple definitions of the commodity. One MtCO2e in the EU is not the same as one MtCO2e on the CCX, even though on paper they may look the same. Until there is as much consistency in the market as there is with other globally-traded commodities, prices will vary widely.

As shown above, the market price of carbon has important implications for project feasibility. In evaluating a potential project, recent market prices from comparable transactions or exchanges offer the best source of insight into how much revenue the project may be able to generate per unit of CO2e.

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[32] Ellen Hawes, Environment Northeast, personal communication, 13 April 2007.

[33] James Cameron, "Carbon market prices show Kyoto is working," The Financial Times, letter to the Editor, 8 May 2007.

Carbon Trading: Case Examples

I have claimed that the markets for carbon are their infancy: highly fragmented, deeply dependent on emerging regulatory frameworks, and currently trading only a fraction of their potential volume. In order to illustrate this more fully, and to move toward generating ideas for CFPA and other land conservation organizations, I have selected a series of real-world examples of carbon trades. Each of these relies on an over-the-counter exchange, some involving a direct contract between buyer and seller and some involving a broker who links supply with demand. Each project will provide an idea of what is actually possible, who are the parties involved, and how the bargains have been structured.

Example 1: Utilitree[34]

In 1995 the Edison Electric Institute (EEI), an industry association for the electric power sector, led the formation of a coalition between 40 U.S. utilities. Their goal was to collaborate on investments in a portfolio of forest-based carbon sequestration projects within and outside of the U.S.

Twelve years after its formation, Utilitree has a portfolio of six U.S. carbon projects and two more outside of the U.S. According to Utilitree literature, "the goals of the program are to advance the state of knowledge regarding options for managing greenhouse gases via forestry; to establish low-cost forestry options; to implement projects; and to promote environmental stewardship by the electric utility industry."

This is a nice example of an aggregator – EEI – achieving scale efficiencies by bringing together multiple investors and multiple projects.

Example 2: American Electric Power in Michigan

American Electric Power, one of the country's largest electric utilities, has funded numerous conservation efforts. One of these was a 110-acre parcel in Michigan on which the company

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[34] Information about Utilitree found at http://carbonsequestration.us/News&Projects/htm/EEI-utilitree.pdf.

funded tree-planting efforts because it sought to add a Michigan property to its portfolio of projects.[35] A description of the project portfolio appears in the company's corporate stewardship report, which lists projects as small as 4.3 acres.

Example 3: The Trust for Public Land – Tensas River Refuge

In 2005 the Trust for Public Land completed the purchase of 2,900 acres of land to be added to the Tensas River National Wildlife Refuge. Funding for the project came from Entergy Corporation, which invested $1.5 million to help acquire, reforest and manage the new 2,900-acre tract, the Federal Land and Water Conservation Fund, and the Migratory Bird Conservation Fund. TPL was able to structure the deal such that Entergy retained the carbon rights from the project, which is expected to result in 760,000 tons of sequestered carbon dioxide over the next 70 years.[36]

Example 4: The Conservation Fund[37]

The Conservation Fund, a land and water conservation organization operating around the U.S., has successfully added messaging around carbon sequestration to their fundraising efforts. Their Go Zero program allows people to visit their website and calculate their climate impact, and then make a donation denominated in tons of CO2. The funds raised go to support hardwood reforestation projects in the Lower Mississippi River Valley. They have also partnered with e-Blue Horizons, an offset retailer, to provide customers the choice of purchasing forestry offsets in addition to energy-based offsets.

While the Conservation Fund uses a third-party verifier to validate the quality of its offsets, the notable aspect of their business is the way they have take a successful conservation model and adapted it to take advantage of the emerging carbon markets, avoiding high transaction costs by

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[35] Don Morrow, The Trust for Public Land, personal communication, 1 March 2007.

[36] Trust For Public Land press release, accessed May 2007 at http://www.tpl.org/tier3_cd.cfm?content_item_id=19580&folder_id=211.

[37] Information on Go Zero is at http://www.conservationfund.org/gozero.

creating an informal carbon exchange that dovetails with their existing fundraising efforts – a tactic that every land conservation organization should think about.

Example 5: Pitney Bowes in Connecticut

Pitney Bowes Inc., of Stamford, began purchasing renewable energy credits in 2004. For the past two years they have bought renewable energy credits equivalent to 10% of their US and UK home office electricity use. In addition, Pitney Bowes was a founding member of the Green Power Market Development Group. This group is comprised of 12 leading corporations and the World Resources Institute devoted to building corporate markets for clean energy. The Group's goal is to develop corporate markets for 1,000 megawatts of new, cost competitive clean energy by 2010. Pitney Bowes Inc. serves as a national leader in combating climate change and has set the bar for other businesses with an estimated greenhouse gas reduction equivalent to 10,579,080 pounds of carbon dioxide. For their commitment to address climate change, Pitney Bowes Inc. received the CT Climate Change Leadership Award from the Governor's Steering Committee on Climate Change in April 2006. [38]

Example 6: Tribal Lands in Idaho[39]

Farmland in a Nez Perce reservation in Idaho is being preserved and reforested using revenues from carbon. The project has an 80-120 year duration, and carbon credits provide up-front cash to the tribes living on the land so that they do not have to sell the land. The project is being coordinated by the National Carbon Offset Coalition (NCOC), a quasi-government organization that publishes standards, acts as a clearinghouse for information on sequestration, and brokers offset projects.

A similar effort to list and disseminate offset programs, called The Offset Opportunity Program, is being carried out in West Virginia.[40]

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[38] Press release accessed April 2007 at http://www.ctclimatechange.com/documents/PitneyBowesCommitstoCleanEnergy.pdf.

[39] Robbins, Jim, "Sale of Carbon Credits Helping Land-Rich, but Cash-Poor, Tribes," The New York Times, May 8, 2007, accessed online at http://www.nytimes.com.

Example 7: Pacific Forest Trust's Forest Forever Fund[41]

The Pacific Forest Trust represents landowners who are able to produce forest-based carbon credits from a growing portfolio of private forestlands in the Pacific Northwest. Through incentives for conservation easements and revenues from carbon rights, the Trust has been able to assemble different sources of financing for their acquisitions. Green Mountain Energy (VT), among others, has purchased carbon credits to offset emissions from electricity generation. Carbon credits are secured by permanent conservation easements owned and managed by PFT.

PFT is also very active in advancing standards for the California Climate Action Registry, and has voiced support for expanding the scope of acceptable forestry projects under RGGI.[42]

Example 8: BioCarbon Fund - The World Bank[43]

The BioCarbon Fund is an investment vehicle established by the World Bank to facilitate investment in land use, land-use change and forestry (LULUCF) projects that receive credit under the Kyoto Protocol. After receiving 150 proposals for projects in the first round of investment, the Fund selected 20 projects in Central & South America, Africa, China, and the Phillippines. A chief component of the Fund's objective is to demonstrate the value of forestry- and agriculture-based emission reduction projects, particularly in developing countries.

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[40] http://www.offsetopportunity.com/Common/GeneralInfo.aspx.

[41] "Mining Nature's Bounty: Tapping Markets for Ecosystem Services," presentation at LTA Rally, Peter Howell & Abigail Weinberg, Open Space Institute, October 15th, 2005. Information on the Fund is at http://www.pacificforest.org/services/forever.html.

[42] "Comments from The Pacific Forest Trust on the Regional Greenhouse Gas Initiative Revised Staff Working Group Package Proposal," December 2005, accessed at http://www.rggi.org/docs/comments_pac_forest_trust.pdf.

[43] http://carbonfinance.org/Router.cfm?Page=BioCF&ft=Projects.

Recommendations for CFPA

The objective of this report has been to provide an overview of carbon markets, to show some examples of people and parties who are currently participating, and to provide ideas for CFPA and the land conservation community. Much of this report has dealt with questions of market evolution and design. Since the markets are so young and dynamic, now is the time to get them right. An overarching recommendation is for CFPA to keep abreast of policy changes and participate in dialogue where possible. This will not only benefit the organization in the long term; it will also ensure that the voice of an important Connecticut land steward is heard when it counts.

Following is a series of specific suggestions that CFPA may consider going forward:

- Join with other NGOs Environmental Defense, The Nature Conservancy, Environment Northeast, and the Wilderness Society in lobbying efforts to support the expansion of qualified forestry offset project criteria under RGGI. Each of these organizations has voiced support for avoided deforestation credits.[44] Given the state of land use in Connecticut, carbon markets would be able to bring significantly more value to land stewards if avoided deforestation were to be added to the qualified project list.

- Become a political aggregator for Connecticut-based land trusts. With over 120 land trusts operating in the state of Connecticut, there is a significant opportunity for state-wide coordination of local efforts. To begin, broad support for expansion of the forestry credit provisions under RGGI would help the lobbying effort that is being led by Environment Northeast and the Maine Forest Service.[45] A coalition of environmental NGOs throughout the state would provide additional support and a degree of concentrated influence that might otherwise be lost.

- Become an information aggregator for Connecticut-based land trusts. Among the state's many land conservation groups and volunteers there are many that have heard about carbon markets, but not all of them know what they are or have time to find information. After assembling an informal coalition of these organizations, CFPA could play a vital role in disseminating information and organizing educational seminars to help land trusts understand how carbon markets affect them.

- Become a carbon aggregator for Connecticut-based land trusts. Although this would take a significant amount of effort, CFPA would be able to function as a state-level

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[44] Ellen Hawes, Environment Northeast, personal communication, 13 April 2007.

[45] Alec Giffen, Maine Forest Service, personal communication, 11 April 2007.

consolidator of carbon credits. The credits could be listed in project registries or traded on a formal or informal exchange.

- Integrate "carbon messaging" into CFPA's statement of mission. With 1,200 acres of land under easement or ownership, CFPA is already playing an important role in sequestering carbon. By communicating the value of this work in terms of climate change impact, CFPA will have a compelling story for donors. CFPA may consider packaging gift opportunities in terms of their carbon sequestration value – for example, "your $1000 gift for land stewardship will be used support the preservation of valuable carbon sinks."

- Conduct educational programs on climate change issues. With a significant percentage of resources and time dedicated to public education and outreach, CFPA is in a powerful position to build public awareness of climate change. Informational placards at trailheads throughout Connecticut that are already maintained by CFPA would be inexpensive to post and highly informative to trail users.

- Gather data at trailheads. Offer hikers a logbook and/or website in which to record observations from their hikes along Connecticut trails. Over time this will provide interesting information about the effects of climate change on the state's ecosystems. Moreover, it will encourage members of the general public to take notice of their surroundings, and build awareness of the fact that climate change effects are already visible on the east coast.

- Adjust CFPA's land acquisition strategy to favor parcels with high long-term sequestration potential. As activity on informal carbon markets gains momentum, CFPA should be poised to capture the maximum amount of value during future land and easement acquisitions.

- Review existing easements to determine ownership of carbon rights under current contracts. If avoided deforestation is given value under RGGI or on any other exchange, CFPA needs to be positioned to benefit from the value of the credits that could be issued on its owned and eased land.

- Partner with a retailer. Three retailers – Carbonfund.org, the Climate Trust, and the Conservation Fund – work specifically with U.S. landowners on forestry offset projects. As carbon markets mature, retailers will be looking for a greater number and wider range of offset projects. CFPA may be able to raise money for state-wide acquisitions by partnering with a retailer that is able to package and market carbon credits from Connecticut forests.

- Monitor RFPs for offset projects. The Climate Trust is often enlisted by offset buyers to identify sellers of offsets. A large, multi-megaton project can be fulfilled by a portfolio of projects. By keeping an eye and ear out for RFPs, CFPA can ensure it does not miss an opportunity to put its carbon capture value to work.

- Approach the mayor's office in one or more Connecticut cities. As of May 3, 2007, 496 mayors across the U.S. had signed the Mayors Climate Protection Agreement. This list includes 13 mayors from Connecticut:[46]

John M. Fabrizi	Bridgeport
Wiliam J. Kupinse, Jr.	Easton
Kenneth A. Flatto	Fairfield
Carl Amento	Hamden
Eddie A. Perez	Hartford
Susan B. Mendenhall	Ledyard
Elizabeth C. Paterson	Mansfield
Domenique S. Thornton	Middletown
James L. Richetelli, Jr.	Milford
John De Stefano, Jr.	New Haven
Dannel P. Malloy	Stamford
James R. Miron	Stratford
R. Scott Slifka	West Hartford

  The Agreement sets non-binding objectives for each of the participating mayors' cities; one of these objectives is to "promote healthy urban forests; promote tree planting to increase shading and to absorb CO2." Salt Lake City has engaged with an organization called Pax Natura to purchase forestry-based offsets. Other cities are working on energy reduction plans. A forestry-based project with CFPA would benefit local ecosystems and help cities fulfill their commitments under the Agreement.

- Approach Connecticut companies directly and sell avoided deforestation credits to fund stewardship. A number of large U.S. companies have made efforts to reduce their emissions through carbon sequestration in forests. This list includes AEP, Alcoa, Baxter, BP, Cinergy, DTE Energy, Entergy, Exelon, Interface, Ontario Power Generation, TransAlta, and Wisconsin Energy Company. Appendix D lists the 100 largest companies in Connecticut, many of which have published environmental policies. By working with large Connecticut companies, CFPA could encourage local investment in land preservation, and provide companies with an attractive press opportunity.

This list of suggestions was inspired by the research conducted for this report. Based on a gap analysis performed on CFPA's capabilities, there are five areas in which the organization may have an opportunity to use its in-house capabilities more efficiently: public education and

[46] Information about the Mayors Climate Protection Agreement and the full text is at http://www.seattle.gov/mayor/climate/default.htm#cities.

outreach, land stewardship, active forest management, lobbying ad the state and local levels, and forest science analysis. For the most part the recommendations above are intended to draw on the underutilized strengths of CFPA, with the hope that untapped potential may be put to use in the best long-term interest of the organization. A similar analysis may be useful for other land conservation groups as they determine their priorities for carbon market participation.

	[A]	[B]	[A]-[B]	
Task	**Capabilities**	**Capacity**	**Gap**	**Skills-to-Capacity**
Public education and outreach	5	3	2	Underutilized
…publications	5	4	1	Slightly underutilized
Membership recruitment	3	2	1	Slightly underutilized
Trail maintenance	5	5	0	Matched
Property acquisition	4	4	0	Matched
…sourcing	4	4	0	Matched
…financing	4	4	0	Matched
Land stewardship	5	2	3	Highly underutilized
Active forest management	5	2	3	Highly underutilized
Fundraising				
…through membership base	5	5	0	Matched
…through donors/foundations	5	5	0	Matched
…from other sources	3	3	0	Matched
Grantwriting	2	2	0	Matched
Policy analysis				
…state and local	3	2	1	Slightly underutilized
…regional	3	2	1	Slightly underutilized
…federal	3	2	1	Slightly underutilized
…international	3	2	1	Slightly underutilized
Lobbying	5	2	3	Highly underutilized
…rel'ships w/ state and local	4	2	2	Underutilized
Building grassroots support	4	3	1	Slightly underutilized
Scientific analysis	3	2	1	Slightly underutilized
…biodiversity	3	3	0	Even
…forestry	5	3	2	Underutilized
Managing research efforts	4	3	1	Slightly underutilized

CFPA Gap Analysis, conducted April 2007.

Conclusion

Several themes have characterized this discussion:

- There is widespread uncertainty in the carbon markets, particularly as it relates to the markets for forestry-based offsets
- In light of the procedural hurdles surrounding the verification of forestry offsets, an organization seeking to bring carbon credits to market will benefit from experience and scale
- Concerns around additionality, leakage, monitoring, and the science of quantification create very high transaction costs for forest carbon credits
- The formal agreements that drive carbon markets are critically important both now and as they continue to evolve
- The short time horizons of some existing policy frameworks clash with the long time horizons of traditional forestry

Land trusts would be well advised to keep a keen watch on carbon markets. On the one hand the emergence of myriad formal and informal agreements is putting value on the table for landowners and land managers, and the most savvy land trusts will be the ones who benefit. On the other hand, the high degree of volatility and uncertainty in the markets today are a cause for concern. It would be unfortunate for resource-constrained land trusts to dedicate time and attention to the pursuit of projects just for the sake of carbon revenue streams, only to see them fail. Efforts to get involved in the market should be weighed in careful consideration of the opportunity costs that are involved.

Throughout the shifting markets, land trusts such as CFPA would do well to stay committed to the multi-faceted mandate that they have served so well until now. Efforts to monetize carbon sequestration potential should complement efforts to preserve biodiversity, open space, habitat, water quality, and recreational value. It is through such an approach that land stewards will ultimately create the greatest amount of value for society.

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Appendix A: Additional Materials/Useful Links

Connecticut Climate Initiatives

Connecticut Climate Change Action Plan – 2005. Agriculture, Forestry, and Waste Sector.

Implementing Connecticut's Climate Change Action Plan: 2006 Progress Report. http://www.ctclimatechange.com/ReportOnProgressin2006.html

Carbon Markets

Carbon Sequestration Role in State and Local Actions, Melissa Chan and Sarah Forbes, January 2005. US Department of Energy – National Energy Technology Laboratory. http://www.netl.doe.gov/energy-analyses/pubs/slfinal_1.pdf

"Mining Nature's Bounty: Tapping Markets for Ecosystem Services," presentation at LTA Rally, Peter Howell & Abigail Weinberg, Open Space Institute, October 15th, 2005.

Carbon Market North America – Point Carbon, March 14, 2007. http://www.pointcarbon.com/getfile.php/fileelement_104162/Carbon_Market_North_America_14_March_2007.pdf

Climate Registries

California Climate Action Registry: http://www.climateregistry.org/

U.S. Department of Energy – 1605b Voluntary Reporting of Greenhouse Gases Program: http://www.pi.energy.gov/enhancingGHGregistry/index.html

The Climate Registry: http://www.theclimateregistry.org

The Chicago Climate Exchange: http://www.chicagoclimateexchange.com

Measuring and Accounting for Carbon

The Land Use, Land-Use Change, and Forestry Guidance for GHG Project Accounting. WRI / World Business Council for Sustainable Development. http://www.ghgprotocol.org/plugins/GHGDOC/details.asp?type=DocDet&ObjectId=MjE3NzA

The GHG Protocol for Project Accounting. WRI / World Business Council for Sustainable Development. http://www.ghgprotocol.org/templates/GHG5/layout.asp?type=p&MenuId=OTAy&doOpen=1&ClickMenu=Project%20Protocol

Emerging science on methane emissions from forests: Do forestation projects designed to slow global warming still make sense? Environmental Defense. James Wang and Bill Chameides, January 20, 2006. https://secure.environmentaldefense.org/documents/4982_EDAnalysisMethaneEmissions_Forests.pdf

Tool for the demonstration and assessment of additionality. UNFCCC/CCNUCC. http://cdm.unfccc.int/methodologies/PAmethodologies/AdditionalityTools/Additionality_tool.pdf

U.S. Greenhouse Gas Inventory, U.S. EPA. http://www.epa.gov/climatechange/emissions/usinventoryreport.html

Political process related to RGGI, Kyoto, and the EU ETS

Comments from The Pacific Forest Trust on the Regional Greenhouse Gas Initiative Revised Staff Working Group Package Proposal, Submitted December 19, 2005. http://www.rggi.org/docs/comments_pac_forest_trust.pdf

UNFCCC – Clean Development Mechanism Executive Board - Meeting Documents. http://cdm.unfccc.int/EB/index.html

Should Temporary CERs be Included in the EU ETS Linking Directive? An EcoSecurities market demand survey, March 2006. http://www.climate-standards.org/images/pdf/EcoSecurities-demand-survey-March06.pdf

RGGI Stakeholder Process Outline. http://www.rggi.org/stakeholder.htm

Appendix B: Land Use Changes in Connecticut, 1985-2002

	1985		1990		1995		2002	
	sq. miles	% of CT	sq. miles	% of CT	sq. miles	% of CT	sq. miles	% of CT
Developed	811	16.30%	874	17.60%	895	18.00%	930	18.70%
CAGR				1.51%		0.48%		0.77%
Cumulative chg.				7.77%		10.36%		14.67%
Turf & Grass	223	4.50%	221	4.50%	223	4.50%	223	4.50%
CAGR				-0.18%		0.00%		0.00%
Cumulative chg.				-0.90%		0.00%		0.00%
Other Grass & Ag	553	11.1%	567	11.4%	580	11.7%	595	12.0%
CAGR				0.50%		0.45%		0.51%
Cumulative chg.				2.53%		4.88%		7.59%
Forest	2,945	59.3%	2,865	57.7%	2,825	56.9%	2,773	55.8%
CAGR				-0.55%		-0.42%		-0.35%
Cumulative chg.				-2.72%		-4.07%		-5.84%
Water	164	3.3%	164	3.3%	159	3.2%	151	3.0%
CAGR				0.00%		-0.62%		-1.03%
Cumulative chg.				0.00%		-3.05%		-7.93%
Wetlands	222	4.5%	220	4.4%	219	4.4%	221	4.5%
CAGR				-0.18%		-0.14%		-0.03%
Cumulative chg.				-0.90%		-1.35%		-0.45%
Other	51	1.0%	57	1.2%	68	1.4%	76	1.5%
CAGR				2.25%		3.59%		2.25%
Cumulative chg.				11.76%		33.33%		49.02%

Appendix C: Additional Sequestration Project Examples

The following table of sequestration examples was compiled by the National Energy Technology Laboratory of the U.S. Department of Energy:

Table 3. Sampling of Carbon Sequestration Projects Underway around the U.S.*

Project	Location	Size and Lifetime	Expected Carbon Sequestered	Participants	Remarks
Reforestation in Eastern Washington			250,000 tons	Tenaska Inc. PacifiCorp Trexler and Associates UtiliTree	
Pacific Forest Stewardship			240,000 tons	UtiliTree Pacific Forest Trust Oregon State University	The Pacific Forest Trust is a nonprofit conservation organization that works to protect and grow forests on private land by developing partnerships with landowners, forest managers, government agencies, local communities, and private investors. The Pacific Forest Trusts' Stewardship Forestry program works to manage private and commercial forests in an environmentally benign manner.
Mississippi River Valley Bottomland Hardwood Forest Restoration Project	Alluvial plan stretching from Illinois to Louisiana.	32 hectares 70 years	50,000 tons	The Conservation Fund UtiliTree Environmental Synergy Inc. AEP Dynegy Chevron Texaco Prima Klima Future Forests Winrock Intl.	Project is being managed by Environmental Synergy Inc. Tree planting is implemented in cooperation with state and federal agencies. Monitoring and verification of sequestration is managed by Winrock Int'l. Locations of reforestation under the program include Upper Ouachita, Overflow, and Bayou Cocodrie National Wildlife Refuges. The Overflow National Wildlife Refuge in Arkansas will be a 160 hectare project, with a 70 year lifetime that will sequester 240,000 tons of carbon. The Upper Ouachita River Valley project will reforest 400 hectares in the Upper Ouachita National Wildlife Refuge of Louisiana over 70 years and is expected to sequester 240,000 tons[a] – 600,000 tons[b] of carbon. The 160 hectares of land in the Bayou Cocodrie National Wildlife Refuge in Louisiana will sequester 240,000 tons of carbon over 70 years.
Forest Resource Trust Carbon Offset Project			45,000 tons	PacifiCorp Forest Resource Trust Trexler and Associates	The Forest Resource Trust was originally established by the 1993 Oregon Legislature with goals of conserving soil, restoring fish and wildlife habitat, increasing future timber availability, creating job opportunities and recreation.
Klamath Climate Cogeneration Plant Project			66,000 tons	PacifiCorp Trexler and Associates	
Western Oregon Carbon Sequestration Project		120 hectares 65 years	200,000 tons	UtiliTree Trexler and Associates Oregon Woods Inc.	
Tensas National Wildlife Refuge		70 years	881,000 tons	Chevron Texaco	
Salt Lake City			5,000 tons	PacifiCorp	

Project	Location	Size and Lifetime	Expected Carbon Sequestered	Participants	Remarks
Urban Tree				Tree Utah Trexler and Associates	
Midwest Forest Restoration	Nature Conservancy reserves and State land in Indiana and Ohio	4856 hectares 40 years	150,000 tons	The Nature Conservancy Cinergy Corporation	The project aims to restore 1,000 acres of native forest in Ohio and Indiana. Currently, the project will plant 27,000 oak and walnut trees at Ohio Brush Creek, and reforest parcels around old-growth hemlocks at the Big Walnut Nature Preserve in Indiana.
Iowa Farm Bureau Carbon Credit Aggregation	Iowa	Goal of 100,000 acres 4 years[d]		Iowa Farm Bureau Federation Chicago Climate Exchange	Iowa Farm Bureau Federation manages the program, aggregating carbon credits from enrolled farmers. The Iowa Farm Bureau Federation monitors land, and pays farmers for the credits that are consequently sold on the Chicago Climate Exchange.
National Carbon Offset Coalition, formerly known as the Montana Carbon Offset Coalition	Montana	Varies			The National Carbon Offset Coalition is in development, and has received a grant from the State of Montana. The Coalition is working to become an aggregator of carbon offset from projects undertaken in Montana. To date, it has plans for 35 projects; it assembles its portfolio of offset projects based on initial proposals by potential project managers. Based on buyer interest, a project plan is made to create the carbon offsets. The Coalition hopes to accrue enough carbon offset and reserves to participate in the Chicago Climate Exchange[e].
Kansas Farm Bureau Federation					
Western Oregon Carbon Sequestration Project	Oregon	300 acres 65 years	200,000 tons	UtiliTree	Project will plant trees on over 300 acres of unforested, non-industrial timberland in western Oregon.
Obion Creek Wildlife Management Area	Kentucky	900 acres 70 years	292,000 tons	Cinergy Kentucky Dept. of Fish and Wildlife Resources Environmental Synergy, Inc. The Conservation Fund	Cinergy is funding The Conservation Fund to undertake reforestation in the Obion Creek.

[a]Information from this table includes World Resources Institute carbon sequestration project descriptions, and personal correspondence with project managers.

[b]Edison Electric Institute

[c] World Resources Institute

[d] Iowa Farm Bureau Spokesman Online, October 20, 2003

[e]Personal correspondence with Neil Sampson, The Sampson Group, advisor to the National Carbon Offset Coalition, August 16, 2004.

Appendix D: Comparison of GHG Registry Systems

Program Element/Issue	1605(b) Voluntary Registry*	The Climate Trust - 2007 RFP	California Climate Action Registry*	Regional Greenhouse Gas Initiative
Project Eligibility	These guidelines are primarily geared toward entity reporting, not projects. Project activities can be reported within an entity, or from outside sources as offsets.	All offset project types located within the US are eligible including afforestation, reforestation and forest management. Projects must be implemented in the future, after an emissions reduction purchase agreement is negotiated.	Reporting entity must own 100+ acres of non-commercial or commercial trees. Eligible activities include forest conservation, conservation-based management, and reforestation. Project must be secured with conservation easement. Only California projects are eligible to register.	Eligible activities include afforestation only, require management in accordance with sustainable forest practices. If harvesting will be conducted certification by the Forest Stewardship Council, Sustainable Forests Initiative or other accepted program is required.
GHG Reporting	Guidelines cover only CO2, measured as changes in total carbon stock in forests, forest products, or ag soils. If other GHG's are more than 3% of total emissions, they should be reported, but no guidelines exist yet.	All gases are eligible, but not required. Options include: CO2, CH4, N20, SF6, hydroflourocarbons and perflourocarbons.	Projects must quantify emissions and sinks of biological and non-biological changes. Only CO2 needs to be reported for 3 years; in the 4th year, all Kyoto GHGs are to be reported.	All GHGs are eligible.
Measuring, Monitoring, Verification requirements	Annual reports are certified by entity official as true, which creates a legal obligation under US law; Annual 3rd party verification audits are recommended but not required. Extensive guidance on measuring stock changes in agricultural soils and forests is provided in technical guidelines. Methods include default values, look-up tables, models, and direct measurements. Methods are rated A to D, and reporter must use methods averaging B to register reduction amounts.	Require projects have a system or process in place to quantify, monitor and verify GHG offsets have occurred. Applicant must present a monitoring and verification plan.	There is extensive guidance on measuring forest carbon changes. Approved 3rd party certifiers must audit reported GHG data in years 1 and 5, and every 5 years thereafter. Reported data must be within 15% of certifier findings. Ag soils are not included at this time.	Monitoring and verification of carbon pools must occur at least every 5 years and be in accordance with the sampling protocols listed in the RGGI Model Rule. The 1605b sampling guidelines are referenced.
Baseline Setting	Entities report annual change in emissions relativeto a Base Value, calculated as the emissions in the year prior to reporting, or an average of up to 4 prior years.	Baseline setting must outline the most probable without project scenario and the emissions reductions/carbon sequestration expected under this business as usual scenario. Additionality will be calculated as carbon sequestered above this without project baseline.	Baselines on projects must reflect management over time (under CA Forest Practices Act as a minimum) and corresponding quantification of carbon stocks. Baseline initiation can be year of entry in the Registry or, until 2008, any year after 1998. For forest conservation, county default baselines are available.	Baseline must be established based on site specific measurements conducted no more than 12 months prior to project commencement. Carbon content in following pools should be included: above and below ground living biomass, soil, dead organic matter and coarse woody debris.
Calculating Additionality	Additionality not specifically required. All stock changes after base year are considered (implied) additional.	Encourage use of a barriers test to demonstrate additionality. Potential barriers include: financial/investment, technological and institutional barriers. Must be in addition to regulatory requirements and current management practices.	Additionality calculated by subtracting baseline carbon, estimated above, from project carbon.	Additionality determined using a base year approach, where the amount of carbon sequestered is measured as a net increase in carbon relative to the baseline measurement.
Calculating Leakage	Small emitters must certify that reported reductions weren't from activities likely to cause increases elsewhere in the entity. No guidelines for calculation. No requirement for external leakage calculation.	Applicants are required to discuss the potential for leakage outside of the project boundaries.	Activity-shifting leakage within entity boundaries must be quantified. If forest products are reported, market leakage estimation is encouraged.	No specific leakage issues addressed in the Model Rule.
Permanence (Duration)	Carbon stocks are to be fully accounted in periodic inventories, which has the effect of netting out gains and losses. Casualty losses do not need to be reported, but regrowth after casualty cannot be reported until the original stock is replaced.	Risks must be addressed, such as environmental/natural disasters, but no specific requirements for how this risk is mitigated are outlined.	Project area must be secured by a perpetual conservation easement. Sequestration is credited on the year it occurs, and must be maintained thereafter without additional credit. If entity stops reporting, reductions are no longer valid.	Project area must be secured by a conservation easement, and enforcability of easement must be certified by an attorney. Easement must include a requirement that carbon density within the project boundary be maintained at long-term intervals.

Program Element/Issue	Chicago Climate Exchange*	WRI/WBCSD Project Protocol*	Climate, Community and Biodiversity Alliance**
Project Eligibility	Members can utilize a limited set of sequestration projects (afforestation, conservation tillage, and forest conservation) in some regions as offsets to meet a portion of their emission reduction targets.	These protocols focus on the planning and documentation requirements of all types of projects, including terrestrial sequestration. Eligibility would be determined by the individual programs to which the projects apply.	Must demonstrate net positive climate impacts. In addition, projects must address how the project will benefit the community and how community grievances will be addressed. Projects are required to have a plan in place for capacity building within the community. No genetically modified organisms are permitted to supply GHG benefits. Eligibility determined by individual programs.
GHG Reporting	Only CO2 emissions and sinks are included in current trading regime for the pilot period.	The protocol does not address reporting requirements, assuming those will be established by registries or trading systems.	If there is evidence of non-CO2 GHG (CH4, N20) in excess of 15% of the projects overall GHG impact in the baseline and project scenarios they must be estimated and accounted for.
Measuring, Monitoring, Verification requirements	Large projects (>12,500 tCO2e/yr) must use CCX approved verifier (Winrock) to verify reported amounts. Projects measure aboveground tree carbon in forest projects. Small (<2,000 tCO2e/yr) and medium projects can use either direct measures or CCX approved default tables. Ag soil projects use CCX default tables. All projects subject to CCX audit and verification.	Guidance given for carbon pool measurement including aboveground, belowground, dead biomass, and soil carbon, where a pool is thought to be subject to change as result of the project. In forestry projects, measuring soil carbon may or may not be prudent. Methods recommended include direct sampling and appropriate models.	Accounting must follow the IPCC Good Practice Guidelines for LULUCF projects. A monitoring plan to quantify project related carbon pools must be in place before certification will be granted. Requires third party evaluation and verification. In addition, standards require a high degree of transparency and all project documentation must be publicly available at the project site.
Baseline Setting	Base year measurements establish the base value, and annual carbon stock changes are reported.	Forward-looking baseline scenarios are recommended for each project. There can be several candidate baselines, and there is guidance on picking the most appropriate. Baselines can be either project specific or, where available, based on a performance standard for a representative cohort group.	Forward looking baseline scenarios are required for each project. Includes estimations of without project carbon, biodiveristy, soil and water impacts on the environment.
Calculating Additionality	All registered credits must be declared additional. All stock changes after base year are considered (implied) additional.	Additionality calculated by subtracting baseline carbon, estimated above, from project carbon.	Additionality calculated by subtracting without project baseline from with project carbon results. Economic/ Financial models that demostrate project would not have occurred w/o carbon benefit strongly suggested.
Calculating Leakage	Project owner must attest that all forest land outside the project, but within their control, is managed sustainably (internal leakage).	Leakage may occur from secondary effects, upstream-downstream effects, or market effects. These are to be identified for both baseine and project scenarios, then compared to determine extent of leakage.	Project developer must calculate anticipated leakage resulting from the project and propose methods for mitigating this leakage. Any unmitigated leakage will be subtracted from the net GHG impact of the project.
Permanence (Duration)	Credits are based on annual amount sequestered and once used, must be permanently retired. Projects place 20% of earned credits in a reserve pool to cover potential shortfall at the end of the reporting period. Conservation easement or other proof that forest will be maintained is required.	Project should develop a Carbon Reversibility Management Plan: Identify and assess reversible elements; Describe actions to reduce or eliminate reversibility; Methods to compensate; Monitoring plan.	Projects must identify potential climatic variability and changes that will affect the projects performance. Projects should have a management strategy to mitigate any negative impacts anticipated. Suggested that projects withold 10% of credits from regulatory markets to be sold on voluntary markets or retired.

Information in this table taken from: Sampson, R. Neil. 2007. Terrestrial Carbon Sequestration Activities, Voluntary GHG Registries, and Market Trading Programs. The Sampson Group Inc. Compiled by Sara Eisenstat and Thomas Hodgman, Yale University School of Forestry and Environmental Studies.

Appendix E: Connecticut's 100 Biggest Companies - 2007

Rank	Company Town	Sales (in Millions)	Product or Service
1	General Electric Co. Inc. Fairfield	$149,700	diversified manufacturing and technology
2	United Technologies Corp. Hartford	$42,700	aerospace, defense, building products
3	The Hartford Hartford	$27,100	insurance, financial services
4	Aetna Inc. Hartford	$22,500	managed health care
5	Xerox Corp. Stamford	$15,700	copier, office products and systems
6*	Gerald Metals Inc. Stamford	$9,300	nonferrous and precious metals
7	Praxair Inc. Danbury	$7,700	industrial gases
8	Northeast Utilities Berlin	$7,400	electricity
9	Terex Corp. Westport	$6,400	heavy construction equipment
10	MedWestvaco Corp. Stamford	$6,200	paper and packaging
11	Pitney Bowes Inc. Stamford	$5,500	office machines
12	W.R. Berkley Corp. Greenwich	$4,990	property casualty insurance
13	EMCOR Group Inc. Norwalk	$4,700	mechanical, electrical services
14	United Rentals Inc. Greenwich	$3,600	heavy-equipment rentals
15	The Stanley Works New Britain	$3,300	tools, hardware, specialty hardware
16	Chemtura Corp. Middletown	$2,990	specialty chemicals, plastic additives
17	Phoenix Companies Inc. Hartford	$2,600	insurance, financial services
18	OdysseyRe Stamford	$2,580	reinsurance
19	Silgan Corp. Stamford	$2,500	metal, plastic and paper products
20	United Natural Foods Dayville	$2,400	groceries, related products
21	Citizens Communications Stamford	$2,200	electric, telephone, natural gas, water
22	Hubbell Inc. Orange	$2,100	electrical parts
23	Crane Co. Stamford	$2,000	diversified manufacturing
24	Applera Corp. Norwalk	$1,900	life-science systems, genetic databases
25	UST Inc. Greenwich	$1,851	tobacco, wine and other products
26*	Mashantucket Pequot Gaming Enterprises Inc. Mashantucket	$1,850	gaming and entertainment

27	Amphenol Corp. Wallingford	$1,800	electronic cables, connectors
28	Magellan Health Farmington	$1,800	managed mental-health care services
29	IMS Health Inc. Westport	$1,790	pharmaceutical, health-care research
30	Blyth Industries Inc. Greenwich	$1,586	housewares, scented candles
31*	Conair Corp. Stamford	$1,490	kitchen and personal-care products
32	Studen Loan Corp. Stamford	$1,460	student loans
33	ADVO Inc. Windsor	$1,444	direct-mail marketing
34*	Retail Brand Alliance Enfield	$1,440	clothing retailer
35*	Purdue Pharma Stamford	$1,400	pharmaceuticals
36*	Towers Perrin Stamford	$1,395	human-resources consulting
37*	Knights of Columbus New Haven	$1,390	insurance
38*	Mohegan Tribal Gaming Authority Uncasville	$1,331	gaming and entertainment
39	Arch Chemicals Inc. Norwalk	$1,305	specialty chemicals
40	Star Gas Partners LP Stamford	$1,259	fuel oil, propane
41*	Interactive Brokers Group Greenwich	$1,220	investment services
42*	Affinion Group Norwalk	$1,200	business services
43	Barnes Group Inc. Bristol	$1,102	springs and metal components
44	Kaman Corp. Bloomfield	$1,101	advanced technology products
45	Hexcel Corp. Stamford	$1,074	engineered metals
46*	Bozzuto's Inc. Cheshire	$1,080	wholesale groceries, convenience stores
47	Ethan Allen Inc. Danbury	$1,066	furniture and household products
48*	Esselte Corp. Stamford	$1,000	office supplies
49	Gartner Inc. Stamford	$980	computer research, analysis
50	priceline.com Inc. Stamford	$963	internet consumer services
51	Vertrue Inc. Stamford	$659	membership services, recruitment
52	OMI Corp. Stamford	$652	seagoing vessels
53	Playtex Corp. Westport	$644	personal-care products
54*	Unimin Corp. New Canaan	$550	mining, minerals
55	Gerber Scientific Inc. Town	$530	scientific instruments

56*	Noth Castle Partners Greenwich	$520	food and health products
57*	Doctors Associates Inc. Milford	$507	Subway fast-food franchises
58	Photronics Inc. Brookfield	$441	semiconductor and microelectric parts
59*	Lance Construction Corp. Meriden	$430	heavy construction
60*	Chase Enterprises Hartford	$425	real estate, diversified holdings
61	World Wrestling Entertainment Inc. Stamford	$400	professional wrestling, related products
62	TRC Companies Inc. Windsor	$388	environmental services
63	FactSet Research Systems Norwalk	$387	online database service
64	Genesse & Wyoming Inc. Greenwich	$385	freight rail operator
65	Rogers Corp. Killingly	$356	manufacturing
66*	Oakleaf Waste Management East Hartford	$315	waste management services
67*	Swisher International Group Darien	$310	cigars
68	Lydall Inc. Manchester	$307	fiber materials, components
69	Proliance International Inc. New Haven	$297	auto cooling systems
70	Independence Holding Co. Stamford	$296	insurance
71*	Stew Leonard's Norwalk	$292	retail groceries and dairy
72*	Standyne Automotive Corp. Windsor	$290	diesel-fuel injection equipment
73	ATMI Corp. Danbury	$282	semiconductors
74	RBC Bearings Inc. Oxford	$274	ball bearings
75*	Tauck Holdings Inc. Westport	$270	tour operators
76*	Ulbrich Stainless Steel & Special Metals North Haven	$240	steel
77	MTM Technologies Inc. Stamford	$237	technology services
78	Hometown Auto Retail Watertown	$233	new and used automobiles
79*	Brant-Allen Industries Greenwich	$225	paper mills, management services
80	Familymeds Group Farmington	$216	pharmacies, pharmaceuticals
81*	O&G Industries Inc. Torrington	$215	nonresidential construction
82*	Heartland Industrial Partners Greenwich	$213	aerospace, auto parts
83*	Simkins Industries Inc.	$210	paperboard mills

	New Haven		
84	Clayton Holdings Shelton	$208	financial services
85	Open Solutions Inc. Glastonbury	$194	business services
86*	Newman's Own Westport	$190	food products
87	The Aristotle Corp. Stamford	$189	educational and health products
88*	R.T. Vanderbilt Co. Inc. Norwalk	$185	chemicals, mining
89	Baldwin Technology Co. Shelton	$179	controls and accessories for printing
90	Zygo Corp. Middlefield	$168	measurement and automation devices
91	Sturm, Ruger & Co. Fairfield	$155	firearms
92*	Moran Towing Corp. New Canaan	$150	tugboats, towing services
93	Axsys Technologies Inc. Rocky Hill	$134	precision opticals
94	First Aviation Services Westport	$132	services to aircraft operators
95*	The Lee Co. Westbrook	$127	diversified manufacturing
96	Jupitermedia Corp. Darien	$125	internet publishing, digital assets
97*	Guida-Seibert Dairy New Britain	$123	dairy products
98	Eastern Co. Naugatuck	$109	locks and industrial hardware
99	Darwin Professional Underwriters Inc. Farmington	$90	insurance
100	Greenfield Online Inc. Wilton	$89	marketing data

Source: Connecticut Magazine, Accessed June 2007 at
http://www.zwire.com/site/news.cfm?newsid=17747943&BRD=2329&PAG=461&dept_id=600736&rfi=6