CHAPTER EIGHT
Emerging Markets for Carbon Stored by Northwest Forests

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Forests, particularly the long-lived, carbon-rich forests in the Pacific Northwest, have a significant role to play in mitigating greenhouse gas emissions. In this chapter we explore how this carbon storage value can be turned into a marketable product, and examine the state of development of emission trading markets and the role that forest carbon plays in them. Relative to other emission reduction strategies – such as energy efficiency, renewable energy, or shifting to lower carbon energy sources – carbon sequestration in forests poses some unique challenges, but also offers some unique benefits.

After exploring these, we describe how the Climate Trust –an Oregon-based non-profit and the largest institutional buyer of carbon offsets in the United States – chooses among projects, and how it selected and funded one of the first forest carbon purchases involving reforestation under a regulatory system. We conclude with some thoughts about the role forest carbon offsets might play in forest management in the region, and the steps needed to develop robust markets.

Do Forests Matter?

How significant is forest carbon to the global challenge of greenhouse gas accumulation? Human-induced degradation of forests has been a major source in the buildup of greenhouse gases in the atmosphere. Over the last 150 years (from 1850 to 1998), an estimated 500 billion metric tons (over one quadrillion pounds) of carbon dioxide have been released into the environment from deforestation (IPCC 2001). This source of atmospheric carbon dioxide increase is second only to the combustion of fossil fuel, which contributed almost 1,000 billion metric tons of carbon dioxide during the same period (Schlamadinger and Marland 2000). Globally, the current standing stock of carbon in forest vegetation (including savannas), exclusive of soil carbon, represents the equivalent of 1,560 billion metric tons of carbon dioxide (IPCC 2000). This remaining carbon stock is over sixty times larger than current annual global fossil fuel-related emissions, which totaled 24.4 billion tons,(EIA 2005). A relatively small change in this stock – on the order of 1.6% – would be equivalent to annual global carbon dioxide emissions from fossil fuels. Relatively small proportional reductions in this stock have the potential to contribute to carbon dioxide buildup, as has occurred in the past. Conversely, relatively small proportional increases in this stock have the potential to contribute to mitigation of fossil-based emissions.

Since deforestation has been such a major source of carbon dioxide buildup, it is possible to utilize forests to help remove some of the accumulated carbon dioxide from the atmosphere, if we manage lands to increase forest biomass. This potential for the terrestrial biosphere to serve as a carbon sink is sizable. Nationwide for the United States (U.S.), afforestation and forest management have the potential to mitigate a total of 384 million metric tons of carbon dioxide per year (USEPA 2005), which is 6.5% of the nation's total carbon dioxide emissions of 5,842 million metric tons.

Scientific evidence of (WRI 2006) and concern about (National Academies of Science 2005) climate change continues to grow. For a society increasingly concerned about climate change, it is prudent to move forward on mitigation on all fronts. One key challenge is enacting policies that will result in increased forest biomass.

Greater use of natural sinks for carbon dioxide is one of a number of currently available strategies – along with energy efficiency, renewable energy, nuclear energy, coal to gas conversion, and geological sequestration, among others – that can be combined to significantly flatten the growth in emissions over the next 50 years (Pacala and Socolow 2004). Clearly, it is important to establish a set of effective mitigation policies, and forestry has an important role to play. This is particularly true in the forests of the Pacific Northwest, where long-lived trees and fast growth rates combine to produce some of the most carbon-rich ecosystems in the world (Smithwick *et al.,* 2002).

Market-based Approaches to Reducing Greenhouse Gas Emissions

Policies can be in two basic forms: regulations and incentives. A regulatory approach is one where requirements to reduce carbon dioxide emissions are put into place. For forestry, an example would be a requirement to conduct selective harvest, leaving a minimum amount of standing biomass in each logging operation. An incentive approach is one where a monetary reward is provided to encourage a desired outcome, for example, establishing a payment system to support the build up of biomass. There are a number of regulatory and incentive approaches for encouraging forest carbon sequestration. In this chapter we focus on how an incentive-based market approach – carbon offsets – can, and is, being used to stimulate behavioral changes that cause sequestration to occur. As we gain more experience with these market mechanisms and the pace and consequences of global warming, we will have to decide on the best—or the best mix—of policies and instruments to reduce emissions. From the perspective of forest sequestration, a regulatory policy approach – for example, a fossil fuels emission cap – may lead to an incentive policy approach – the market for emissions reductions.

The approach currently favored in international, national, regional, and state climate policy involves market-based environmental regulation. Governments are beginning to implement greenhouse gas emissions caps as a means of reducing future climate change. These caps typically apply to power plants, and some apply to industry and large commercial operations as well. These "cap-and-trade" systems are a modern form of environmental regulation which are being implemented in lieu of "command and control" technology regulation. Such market-based mechanisms for regulating greenhouse gases provide flexibility for business while ensuring that the goal of reducing emissions is met. Under this approach, once a cap on fossil fuel-based emissions is established, entities subject to the cap can trade emissions reductions. An entity that achieves reductions below its cap can sell this surplus to an entity whose emissions exceed its cap. This type of emissions trading scheme is viewed with concern and skepticism by some in the environmental community, who consider this approach to be unproven and believe that polluters should be obliged to reduce emissions at their own facilities rather than by purchasing reductions achieved by others.

Market-based greenhouse gas regulatory systems are a relatively new phenomenon, but they typically allow four mechanisms for compliance: (1) internal emissions reductions, (2) purchase of allowances in an auction, (3) trading of allowances, and (4) purchase of project-based emissions reductions, also know as "carbon offsets" or "carbon credits" – the focus of this chapter. In some trading schemes, a portion of the allowances – the government-granted right to emit – are auctioned off to the highest bidder. In this case, a company can outbid others subject to the cap if it can't reduce its facility emissions sufficient to meet the cap. Alternatively, a company can buy allowances from a company whose allowances exceed its emissions. Finally, most trading schemes allow for the purchase of offsets from projects in sectors that are not subject to the cap, although the amount, type, and location of offsets is restricted under many trading schemes. Offsets are viewed as a cost-effective tool to be used to meet greenhouse gas reduction targets; when they are not the lowest cost of the four options, then they are not likely to be used for compliance.

It is important to note that not all emissions are likely to be subject to a cap. For example, personal and business automobile use is unlikely to be capped directly. Likely policies to influence emissions from auto use include requiring more efficient vehicles, adding a carbon tax to increase the purchase price of gasoline or increasing the attractiveness of mass transit. Emissions related to land use change, such as farming and forestry activities, are more challenging to cap. Since emissions accounting on a national level includes these sectors, other types of regulations might be put into place that require certain carbon-storage enhancing land management practices.

To summarize, a capped entity can meet its cap by making reductions at its own facilities, by buying allowances in an auction, and by purchasing reductions from capped entities with surplus reductions. In addition, a capped entity can purchase reductions, i.e, carbon offsets, from a greenhouse gas reduction project. These projects reduce emissions by either preventing the release of greenhouse gases, or by sequestering carbon in vegetation or soil. While this latter strategy – carbon sequestration in forests – is the focus of this chapter, forest carbon projects compete in a global marketplace with a wide array of reduction projects, so it is important to understand the universe of carbon offset strategies, and their relative strengths.

Greenhouse gas reduction projects include three basic strategies: (1) energy efficiency and conservation (improving energy efficiency in buildings, transportation, factories and power plants), (2) shifting to lower-carbon energy sources (from coal to natural gas, for example, or developing renewable energy sources such as solar, wind, tidal, hydropower, or biofuels), and (3) preventing the creation, release or combustion of industrial greenhouse gases such as hydroflourocarbons and of methane (produced primarily by landfills and livestock). While these industrial and agricultural greenhouse gases – namely methane, nitrous oxide, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons – have much smaller concentrations in the atmosphere than carbon dioxide, they are important because their global warming potential is very high – 20 to 10,000 times higher than the effect of releasing the same mass of carbon dioxide. As a consequence, many of the early offset projects have focused on reducing emissions of industrial gases (Capoor and Ambrosi 2006).

Sequestration projects include geological sequestration (for example, capturing power plant emissions and storing them underground in geological formations), agricultural sequestration (capturing carbon dioxide in agricultural soils), and forest sequestration, which includes forest conservation (avoiding deforestation), planting trees, and managing existing forests to enhance carbon storage (for example, by extending rotations). Ocean sequestration, and sequestering carbon in marine environments such as kelp forests, is another potential strategy (Parker, 2004) which has tremendous potential but has not yet been translated into a commercial carbon offset purchase.

For a variety of reasons, forest sequestration projects have captured only 1-2% of the $10 billion global carbon market, while reducing industrial greenhouse gas emissions – especially hydrofluorocarbons – has captured over 60% of the global carbon market (Capoor and Ambrosi 2006). While forest carbon projects pose some unique challenges – such as whether the carbon storage is permanent, as discussed below – the primary reason for the small representation of forest projects is that the rules established by the Kyoto Protocol (described below) do not favor forest projects. This is largely because of the initial resistance by the environmental community to forest sequestration projects, preferring to focus the attention of emitters on directly reducing emissions, rather than offsetting them. However, increased recognition of the scale of carbon dioxide emissions from forest conversion and forest fires is leading to increased acceptance of forest carbon projects. Oregon's rules, established in 1997 for new power plants, allow forest projects, and over 20% of the carbon offset projects generated by the Oregon Carbon Dioxide Standard (and implemented primarily through the Climate Trust) involve forestry. This illustrates the importance of market trading rules in project selection, and the capacity of Oregon to influence state, regional, and national markets through creating a robust and rigorous market for forest carbon.

Current and Developing Mechanisms and Markets for Emission Reductions

The most significant system to address global climate change is that established by the Kyoto Protocol – the international agreement made under the United Nations Framework Convention on Climate Change. The treaty was first negotiated in Kyoto, Japan in December, 1997, and came into force in February, 2005, following ratification by Russia. The U.S. and Australia are both signatories of the Framework Convention, but have not ratified the Kyoto Protocol to date. Because of this, news coverage of carbon markets in the U.S. is limited and many of us imagine there is not much happening. In the meantime, the value of the global aggregated carbon markets was over US $10 billion in 2005, the first year the Kyoto Protocol was in effect (Capoor and Ambrosi 2006), larger than the entire $7.1 billion domestic wheat crop (Timmons 2006). In countries that have not ratified Kyoto – most notably the U.S. and Australia – regulatory systems to control emissions are emerging at local, state, and regional levels. In addition, a voluntary market for carbon is also emerging, along with its own rules, intermediaries, and pricing structures.

Each of these three segments – Kyoto markets, other regulatory systems, and the voluntary market – is described below.

The Kyoto Protocol and its Market Mechanisms

Countries that ratify the Kyoto Protocol commit to reduce (or limit the increase) of carbon dioxide and other greenhouse gases. The Protocol establishes emissions trading as a method of meeting country targets. A number of international, regional, and country programs have emerged to facilitate the meeting of targets under Kyoto. The largest of these to date (from a value perspective) is the multinational European Union Trading Scheme, in which all 25 member countries of the European Union participate. In 2005 – the market's first year of operation – 362 million metric tons of carbon dioxide were traded, with a market value of $8.2 billion. The price of carbon dioxide increased steadily to about $36 per metric ton in April, 2006, leading to enthusiastic predictions of robust market growth to $80 to $250 billion by 2010. After an active first quarter with $6.6 billion traded, the market crashed in May, 2006, to $13 per metric ton of carbon dioxide (and rebounded somewhat shortly after) on reports that many industries were easily meeting their targets and didn't need to reduce emissions further, largely because their initial allocation of allowances had been set too high. While some argue that the market crash was an indication of structural flaws in the trading system, others argue that "price corrections" are an inevitable component of emerging markets (Capoor and Ambrosi 2006).

In terms of volume of metric tons, the largest market segment in 2005 was the Clean Development Mechanism (CDM), a program developed under the Kyoto Protocol which allows companies or countries in the industrialized world to purchase credits generated by offset projects in the developing world to meet their emission reduction targets (Point Carbon

2006). In 2005, CDM projects generated a forward stream of reductions totaling 346 million metric tons of carbon dioxide, with a value of $2.5 billion. Over 70% of these projects come from hydrofluorocarbon projects in China. Joint Implementation is the sister mechanism to CDM and allows industrialized countries to meet their emission reduction targets through an investment in another industrialized country, which also has emission reduction targets but where costs might be lower and investments can be made more efficiently. The Joint Implementation market totaled 18 million metric tons of carbon dioxide in 2005 with a value of $82 million (Capoor and Ambrosi 2006).

The European Union Trading Scheme, the Clean Development Mechanism, and Joint Implementation all operate under rules designed to meet targets established under the Kyoto Protocol. Most significantly for the forest carbon sector, the role of sequestration offsets under these rules is limited. The Kyoto Protocol does recognize the role forests can play in removing and storing carbon dioxide from the atmosphere and storing it in trees, and establishes two mechanisms for creating forest carbon sequestration credits: Article 3.3 addresses afforestation (planting trees on lands that were not previously forested), while Article 3.4 deals with reforestation (replanting trees on deforested lands) and appropriate management of natural forests. However, avoided deforestation and forest management are currently not eligible under Kyoto in the first commitment period (2008-2012). Due to stringent application standards and complicated rules, uncertainty over the role of forest sinks after the initial commitment period of 2008-2012, and resistance by environmental groups and others to the use of forest sequestration projects in trading schemes, forest carbon projects have been very limited under the Kyoto-compliant systems (Sedjo 2006).

Markets for Emission Reductions in the U.S. and Other Non-Kyoto Countries

While the U.S. has not ratified the Kyoto Protocol, regions, states, tribes, and local governments have all been active in setting emission reduction targets and implementing programs to reach these targets. Oregon was an early innovator and the first state to establish a regulatory framework. In 1997, the state required new power plants to offset part of their carbon dioxide emissions. The Climate Trust was created at that time to purchase quality offsets on behalf of these newly regulated emitters. Washington added a similar regulation in 2004. In addition, Oregon's governor-appointed Carbon Allocation Task Force is investigating the design of a load-based cap-and-trade system. A load-based system places the cap on the utility delivering the electricity rather than on the electric generator. It is likely to include offsets as an alternative compliance mechanism. In California, Governor Schwarzenegger issued an Executive Order to establish greenhouse gas emissions goals and create a Climate Action Team to determine the best means to meet such goals. California has also established a voluntary system of reporting emissions, the California Climate Action Registry, and there are several proposed pieces of legislation, including Assembly member Pavley's California Climate Change Act of 2006. In addition to initiatives under consideration in Oregon and California, several other states are at various stages of establishing climate policy.

The Climate Trust is the largest institutional buyer of carbon offset projects in the U.S. Sidebar 1 describes the Climate Trust's criteria to determine eligibility for funding and selection for carbon offset projects. Sidebar 2 describes the Climate Trust's process for originating offset projects.

Sidebar 1

The Climate Trust's Criteria to Determine Eligibility for Funding and Selection for Carbon Offset Projects

The Climate Trust, an Oregon-based non-profit, is the largest institutional buyer of carbon offsets in the United States. It plays an important role in the implementation of Oregon's Carbon Dioxide Standard. Its focus is acquiring high quality offsets. In 2005, the Climate Trust released a request for proposals for a minimum of US$ 4.3 million in carbon dioxide offsets,[1] a similar request to those from 2000 and 2001.[2] All proposals contained the following criteria that the Climate Trust uses (1) when determining which proposed offset projects are eligible for funding, and (2) when selecting among proposed offset projects. These criteria are presented as an example of the criteria applied by a buyer of offsets. Other buyers of offsets use different, but generally similar, criteria.

Number and Size of Projects. The Climate Trust sought projects requesting $1 million or greater in carbon funding and anticipated entering into carbon purchase agreements with 2-5 projects.

Type of Greenhouse Gas. As required by Oregon statute, The Climate Trust only considered offsets that directly avoid, displace, or sequester emissions of carbon dioxide when using Oregon funds. Although the Climate Trust did not consider emissions reductions of other greenhouse gases for purposes of quantifying emissions reductions, it did consider these when evaluating co-benefits.

Additionality Requirement. The Climate Trust only funded projects where mitigation measures would not occur in the absence of offset project funding. In order to meet the additionality criterion, evidence must be provided that the carbon funding is essential for the implementation of the project. The Climate Trust assesses additionality on a project-by-project basis.

Regulatory Surplus. The Climate Trust considered only projects where the carbon dioxide emissions benefit is over and above what is required by law. An emission reduction is surplus if it is not otherwise required of a source by current regulations or other obligations.

Quantifiability of Offsets. The Climate Trust considered only projects that directly avoid, displace, or sequester the emissions of carbon dioxide, and where the amount of carbon dioxide offsets can be quantified, taking into consideration any proposed measurement, monitoring, and evaluation of mitigation measure performance.

Timing of Project Implementation. The Climate Trust considered only projects where mitigation measures will be implemented in the future, subsequent to contract execution. The Climate Trust did not consider projects where mitigation measures have been implemented prior to contract execution. Projects selected for funding must be implemented within three years from the date of execution of the carbon purchase agreement.

Length of Project Contract. The Climate Trust typically does not enter contracts with terms longer than 15 years irrespective of the lifetime of the measures implemented under the contract. Thus, if the underlying measure has an expected life of more than fifteen years, the Climate Trust will contract for a maximum of fifteen years of carbon dioxide offsets. One exception to this is biological sequestration projects which typically require a longer project life.

[1] *The Climate Trust, 2005*
[2] *The Climate Trust, 2000; The Climate Trust, 2001*

Permanence. The Climate Trust prefers projects that permanently avoid or displace emissions of carbon dioxide, such as energy-related projects, over projects that temporarily sequester carbon. The Climate Trust has invested in projects that avoid emissions or in permanent sequestration projects, i.e., those that plan to grow a forest harvest-free to old growth.

Types of projects. The Climate Trust considered any and all project activities that reduce carbon dioxide based emissions. Please be advised of the treatment of the following sectors:
Nuclear Power. As Oregon law does not permit the siting of nuclear power facilities, the Climate Trust does not fund nuclear power-based offset projects.
Biological Carbon Sequestration (includes afforestation, reforestation, forestry conservation, etc.). As a large portion of the Climate Trust's offset portfolio is currently invested in biological sequestration projects, it did not anticipate spending more than 25% of the funds from this 2005 RFP in biological sequestration projects.

Eligible Project Proposers. The Climate Trust accepted proposals from any non-profit and for-profit corporations, government agencies, national laboratories, and combinations of these parties.

Project Price Range. The Climate Trust used cost effectiveness as the primary selection factor for offsets, while achieving a balance between the desire to acquire the least expensive reasonably assured offsets available with the desire to acquire a diverse portfolio of projects. The Climate Trust anticipated that $5/metric ton CO_2 would be a competitive proposal.

Geographic Limitations and Preferences. The Climate Trust has no geographic constraint on the projects that can be funded. Note for international project applicants: Non U.S.-based projects must have a U.S. partner or affiliate organization that can be used for negotiations of the carbon purchase agreement. The Climate Trust encouraged applicants with projects based in Oregon to submit proposals.

Co-Benefits. The Climate Trust prefers projects with environmental, health, and socioeconomic co-benefits, and will request information on co-benefits from proposers. Special consideration was given to projects with excellent co-benefits.

Monitoring and Verification. The Climate Trust requires that carbon dioxide benefits be quantified by a monitoring and verification process. National and international experts are engaged to help prepare and implement monitoring and verification protocols for its offset projects, and independent third parties are required to certify the emissions benefit. It is important that realistic baselines be used as a starting point for quantifying offsets. (See Chapter 9 regarding baselines and leakage.)

Leakage. The Climate Trust requires that the potential for leakage, or the extent to which events occurring outside of the project boundary tend to reduce a project's carbon dioxide emissions benefit, be addressed. Proposals were required to describe how carbon dioxide benefit leakage is addressed by the project, both in terms of project activities to minimize leakage and in terms of adjustments to the project's carbon dioxide benefit calculations to reflect leakage.

Sidebar 2

The Climate Trust's Process for Originating Offset Projects

The Climate Trust uses a systematic, sequential process for acquiring offsets. The following flowchart is taken from the Climate Trust's five year report.[3] From a proposer's point of view, there are three phases to the Climate Trust's project selection process. It typically takes around 18 months from the time of the announcement of an RFP until the final carbon dioxide purchase agreements are completed.

Phase I: Submission of Project Information Document. This is a "short form" proposal comprised of ten pages of text, a budget spreadsheet, and an emissions benefit spreadsheet.

Phase II: Detailed Project Information Document. Selected proposals are invited to submit a more detailed project information document, including responses to project-specific questions from the Climate Trust.

Phase III: Contract negotiations. Winners of Phase II are invited to negotiate a carbon dioxide offset purchase agreement. The amount of the funding and its terms are set forth in the final purchase agreement.

[3] *The Climate Trust, 2004*

At the regional level, the fastest-moving initiative is the northeastern states' Regional Greenhouse Gas Initiative, known as RGGI. As of May, 2006, it included Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, Vermont, and Maryland. The draft rules, which are expected to be finalized in the summer of 2006, address electric generating units capable of producing 25 megawatts or more power, and commit participating states to cap their emissions at 1990 levels by 2009 and then decrease them by 10% by 2018. RGGI has proposed allowing an entity to use offsets to meet approximately 50% of the required emissions reductions (or 3.3% of total emissions). If prices rise beyond the expected level of $10 per metric ton of carbon dioxide, then additional percentages of emissions may be covered by offsets. In addition, as prices rise, a greater proportion of the offsets may take place outside of the region covered by the participating states (Biello 2006).

Although ratification of the Kyoto Protocol by the U.S. is unlikely in the near future, emission reduction discussions continue both at the national level and at the international level outside of the Kyoto framework. At the national level, the Climate Change White Paper recently issued by Senators Domenici and Bingaman includes a discussion about an offset pilot program, the McCain-Lieberman Climate Stewardship Act allows entities to use offsets for up to 15% of their required reductions, and Senator Feinstein's Strong Economy and Climate Protection Act includes unlimited offsets from the uncapped agricultural sector. At the international level, the Asia-Pacific Partnership on Clean Development and Climate, which includes Australia, India, Japan, the People's Republic of China, South Korea, and the U.S. outlines a non-binding plan to cooperate on development and transfer of technology that enables reduction of greenhouse gas emissions. Member countries account for around 50% of the world's greenhouse gas emissions, energy consumption, Gross Domestic Product, and population.

Despite these developments, it is important to note that in the U.S. we are still in the initial stages of what has been termed the "carbon market." In fact, it is not a true market yet in the classic definition. There are few buyers, few sellers, rare transactions, and limited information about the transactions. Carbon trading in the U.S. is best viewed as a proto-market, one in which there is not yet a true financial market commodity available to buy and sell. A broader national market for emissions reductions will no doubt come in time, but it is not here today. It is possible that it will develop first on the basis of the state and regional regulatory initiatives described above, with a federal trading scheme coming later. What we do have today are a series of individual transactions involving allowances from voluntary exchanges and from project-based offsets, some of which involve forestry.

Australia, as the other notable country that has failed to ratify the Kyoto Protocol, is also developing emission reduction schemes at the state level. New South Wales, the state in southeastern Australia which houses Sydney, high mountains and coast, and is the state with the most economic activity, has been the leading innovator. The New South Wales greenhouse gas abatement scheme is based on a penalty of AU$10.50 (US $8) for excess greenhouse gas emissions over the energy pool target. The target equates to a 5% per capita reduction in emissions from the electricity sector over a five year period which began in 2003 (Brand and Kappalli n.d.). In 2005, some 6.1 million certificates were exchanged, a 20% increase over 2004, with an estimated value of US $57.2 million. Activity increased sharply in the first quarter of 2006 with 5.5 million certificates valued at US $86.6 million. Forestry projects are allowed, reflecting perhaps the strong leadership role of State Forests of New South Wales, the government-owned forest agency, which has been active since the mid 1990s in developing forest carbon opportunities and structure. In April, 2005 a deal was closed to provide approximately 3.2 million tons of carbon dioxide offsets from 30,000 hectares of eucalyptus plantings (Capoor and Ambrosi 2006).

The Voluntary Carbon Market

In addition to Kyoto-compliant market mechanisms and state regulatory systems in countries that have not ratified the Kyoto Protocol, there is an emergent voluntary carbon market that – while there are no official numbers— is estimated to have transacted anywhere from 10 to 20 million metric tons of carbon dioxide in 2005. This is approximately the amount traded in the European Union Emissions Trading Scheme in a single week in April, 2006 (Bayon *et al.,* in press), illustrating the power of regulation to stimulate market activity relative to voluntary action. This is a significant point to bear in mind, given the current federal administration's preference for voluntary programs to reduce carbon emissions.

Estimates suggest the voluntary carbon market may grow five-fold to 100 million metric tons by 2007. Bayon et al. identify four categories of voluntary carbon purchases: (1) entities seeking to offset the emissions generated by their facilities or business activities, (2) entities seeking to produce carbon-neutral products such as transportation services or events, (3) government and philanthropic buyers of carbon, and (4) individual consumers seeking to offset their daily activities. Motivations for purchases include learning about carbon markets and preparing for regulation (often termed "pre-compliance,") public relations, and the desire to do the right thing. Most trading activity takes place either directly, between a project originator and a buyer, or through dozens of intermediaries – both for-profit and non-profit – that have emerged to service the voluntary market. Taiyab (2005) estimates about 30-40 intermediaries worldwide, most based in Europe, the US, and Australia. Prices vary considerably from $1 to $35 or more per metric ton of carbon dioxide, depending on the quality and location of the project, the co-benefits it provides, and the price sensitivity of the buyer.

One of the most comprehensive mechanisms for the voluntary market is the Chicago Climate Exchange (CCX), an emission registry, reduction, and trading system for all six greenhouse gases - carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, perfluorocarbons, and hydrofluorocarbons. Members make voluntary but legally binding commitments to reduce greenhouse gas emissions. The baseline period is 1998-2001. By the end of 2006 (Phase I), members are targeted to reduce direct emissions 4%, and a 6% reduction is required by 2010. The market was down in 2005 relative to the prior year, with only 1.5 million tons of carbon dioxide traded at a weighted average of $1.95 per metric ton for a total value of $2.8 million. As of the first quarter of 2006, the market has become much more active with 1.25 million tons of carbon dioxide exchanged, and prices have moved up to $3.50 per ton. CCX members range from large industrial concerns such as DuPont, to utilities such as American Electric

Power, to cities such as Chicago, IL, to farmers in Iowa and Nebraska, as well as a variety of non-profit organizations. Eligible emission offset projects include agricultural soil carbon sequestration, reforestation, landfill and agricultural methane combustion, and switching to lower-emitting sources such as biomass-based fuels (Chicago Climate Exchange web site).

The Exchange is expanding to the northeast to develop financial instruments relevant to RGGI (described above) through the formation of the New York Climate Exchange and the Northeast Climate Exchange (Capoor and Ambrosi 2006).

Understanding Carbon Offsets

What are "carbon offsets projects" and why are they an important part of a comprehensive climate policy? A carbon offset project is one implemented specifically to reduce the level of greenhouse gases in the atmosphere. A wide variety of technological approaches can be employed, including energy efficiency in buildings, factories, power plants, and transportation; renewable energy, such as wind, hydro, biomass, and solar energy; cogeneration of electricity from waste industrial heat; shifting to lower carbon energy sources, e.g., from coal to natural gas and biofuels; capturing carbon dioxide in forests and forest products and in agricultural soils; and capturing power plant emissions and storing them underground in geological formations.

However, achieving the important benefits that offsets offer to society is predicated on their being equally effective in reducing atmospheric greenhouse gas levels as on-site reductions by emitters. Thus, an offset project has three elements: (1) it cancels out emissions, (2) reductions are recorded in a greenhouse gas registry (or the atmosphere), (3) the end effect is as though the cancelled emissions had not occurred. An offset makes a basic promise: that the end result in the atmosphere is as if the emissions that are being offset never occurred in the first place.

Project-based greenhouse gas offsets hold much potential to help address climate change at the lowest overall cost. Since greenhouse gases have global rather than local effects, it makes sense to direct our mitigation funding towards the lowest cost sources. If we do this, we will have more money to spend on everything else, such as food, shelter, health care, security, and recreation. By directing funding from emitters to those who are most able to deliver mitigation cost-effectively, offsets are critical to maximizing the non-climate goods and services that we all really want.

Offsets also offer a number of other benefits, both environmental and economic. They can reduce air pollution; improve habitat, watersheds, and water quality; reduce soil erosion; and preserve biodiversity and endangered species. They can create jobs, stimulate demand for clean energy products, save money on energy, and enhance energy security by reducing oil imports. Finally, they can drive funding and new technology into uncapped sectors, helping to rectify inequities between emitters and those taking the brunt of climate change. Given that offset projects can occur across a wide variety of sectors and can potentially be located anywhere in the world, offsets can provide carbon-reducing strategies at the lowest cost.

Project-based emissions reductions, when properly implemented, are a high-quality environmental commodity. In order to ensure that real reductions are achieved, in the jargon of the offset world, it is necessary to prove project's emissions reductions have "additionality," that is, they result in emission reductions *in addition to* those that would occur in the business-as-usual scenario. If the project underlying the offsets would have occurred anyway, then atmospheric greenhouse gas levels will not really be reduced, and the emissions go unmitigated. In emissions trading schemes, additionality is addressed through the application of stringent project review processes, procedures, standards, and criteria. Proving additionality is an important challenge for offset projects.

Types of Forestry-Related Offsets

Forests and changes in forest management have the potential to serve as project-based offsets in a number of ways. The two most basic project types are those involving land management and product substitution.

Land Management-Based Offsets

Potential land management-based offsets act to increase the buildup of carbon in the forest. Offset types include avoided deforestation, afforestation, reforestation, and forest management. In all cases additionality needs to be demonstrated.

Forest Conservation simply means not clearing a forest, and can also be called avoided deforestation or forest preservation. When a forest is cleared, a pulse of carbon dioxide is emitted to the atmosphere, adding to greenhouse gas emissions.

Afforestation is planting trees on land that has not previously been forested. The trees grow, and over time contain more carbon than the prior unforested ecosystem.

Reforestation is planting of trees on land that has been logged. If the reforestation is required by logging regulations, this replanting is not "additional" and cannot serve as an offset. There are several sub-types of reforestation. One involves riparian zones, and has proven to be popular due to its watershed quality benefit. Another sub-type involves plantations to be commercially harvested at a later date, while a third is plantations of very short-rotation trees, such as hybrid poplars.

Forest management involves changing harvest approaches so that biomass is increased, such as extending rotations or increasing the number of trees that are retained at harvest. Reducing fire risk is also important and receiving increased attention, as forest fires are a significant source of carbon emissions. In addition, practices such as forest thinning to reduce fire risk can stimulate growth in the remaining trees and increase carbon storage.

Product Substitution-Based Offsets

Forests can potentially serve as offsets through substitution of forest products for higher-carbon materials and energy. There are a large number of potential technologies and processes for using biomaterials and bioenergy (Ragauskas *et al.,* 2006).

Material substitution typically involves the use of wood as a structural component in lieu of concrete and steel.

Energy substitution involves the use of bioenergy to replace fossil fuels. The energy captured in forests can be converted by various technologies to electricity, gaseous fuels, and liquid fuels.

Challenges to Carbon Markets in Forest Sequestration

Forest offsets present some unique challenges compared to other types of carbon offset projects and also produce a wide array of co-benefits. Three aspects of forestry-based offsets require more analysis, and are addressed below: permanence, ownership, and co-benefits.

Permanence

Sequestration differs from energy-related offsets in one key regard: permanence. Permanence addresses whether the emissions reductions last forever (avoided emissions) or whether they might be returned to the atmosphere, typically inadvertently. Permanence, the most challenging offset quality criteria, is also called reversibility, as the emissions benefit could be reversed. Two examples can help to illustrate this distinction. Suppose a wind farm is constructed and operates for ten years, at which time it is destroyed by a tornado. While the wind farm would no longer generate any emissions reductions in the future, all of the emissions reductions is caused in its first ten years will still reside as a benefit in the atmosphere. Contrast this to a reforestation project that grows for forty years, at which time it is consumed by a catastrophic forest fire and releases much of the carbon dioxide that it had previously absorbed. In this instance, none of the emissions benefit created by the project before the catastrophe will still reside in the atmosphere. The carbon dioxide would have been sequestered, and then "reversed" into the atmosphere.

Concerns about permanence manifest themselves in two forms: end-of-contract effects and unplanned disturbances. The contractual commitment for forest sequestration offsets can either have a specific end date or they can continue into perpetuity. A conservation easement is an example of an "into perpetuity" obligation. Several approaches have been suggested for addressing the uncertainty regarding permanence (USEPA 2005). One is a temporary crediting approach, where regulatory credit for sequestration-related reductions expire after a fixed time period. Other approaches include "renting" or "leasing" the carbon dioxide locked up by forest sequestration.

Unplanned disturbances include fire, insects, disease, and illegal harvest. All can affect a sequestration project while a contract is in effect. Approaches for addressing this type of permanence concern include discounting the anticipated reductions from a project up front (USEPA 2005), use of a reserve pool of comprised of a certain percentage of the offsets generated by a project, and use of insurance for offset performance. The Chicago Climate Exchange addresses the issue of net losses in carbon stocks (for example, from a forest fire) by requiring that a quantity of offsets equal to 20% of all forest offsets in the forest portfolio be held in a Chicago Climate Exchange carbon reserve pool throughout the life of the program (Chicago Climate Exchange). The Climate Trust has addressed forest offset risks by investing in projects which do not allow harvest of trees, by requiring the establishment of reserve pools, and by requiring that the project developer replace tons that they fail to deliver.

In addition to self-insuring, as the Chicago Climate Exchange does, there is a potential role for an insurance company or other entity to quantify the risk of non-delivery of the required carbon tons and offer insurance to the carbon buyer (or seller, depending on who retains the ultimate liability) for non-performance. The issue of vintaging – matching the timing of emission reductions or sequestration to annual required targets — is also very significant to forest carbon offsets in an illiquid market where not all vintages are available for purchase. Forward markets are developing in which future vintages will be appropriately discounted based on prevailing interest rates, future price expectations, and an assessment of the creditworthiness of the seller. All of this – along with issues of permanence and temporary crediting - may well result in lower prices for forest offset projects relative to other project types.

Ownership and Legal Title

Not all emissions reductions can qualify to be carbon offsets. There are a number of carbon offset quality criteria that serve as distinguishing factors when determining which types of emissions reduction approaches are eligible to become offsets, or make them more or less attractive to the offset buyer. One key criterion is ownership of the offsets.

When one sells an offset, one is paid for the legal rights to a ton of sequestered carbon dioxide. This sale is conducted under the terms of an emissions reduction purchase agreement. Each such contract includes extensive legal definitions regarding the offsets. In order to enter into such a contract, one must have the legal right to sell the emission reduction. The Climate Trust's contracts require that the offset developer transfer any and all rights to carbon dioxide reductions resulting from their project in exchange for funding. The offset developer (and other implementation partners) is excluded from selling the same tons to another entity, using the tons for other purposes, or selling the carbon dioxide in other environmental products. In addition, each contract also includes a requirement for written disclaimers from all project partners and participants, disclosure of sale to regulatory authorities and other parties, and definitions on what "bragging rights" are acceptable. Offset developers may be required to indemnify the purchaser against competing claims of offset ownership. In programmatic offsets in which participants enroll in a program operated by the offset developer, offset contracts require participation agreements to create a clear ownership trail to tons of CO_2. This participation agreement provides a "chain of custody" for the offsets. The documents that are necessary to transfer the rights to an offset, in addition to the contract itself, include a Bill of Sale, an Annual Offset Certificate, and third party verification of the quantity of offsets delivered.

Land-management based offsets – avoided deforestation, afforestation, reforestation, and forest management – involve the landowners consent, either as a signer of the offset contract or as a signer of a participation agreement. As such, the legal title to the offsets is generally not subject to questions regarding ownership, at least not for private landowners in the U.S. However, ownership of forest carbon rights should not be taken for granted. For example, to the deep consternation of private forestland owners, New Zealand nationalized carbon offsets from forestry, gaining a carbon asset for the national account worth approximately $2 billion and negating the need to regulate the politically powerful agricultural sector which was responsible for about half of the country's greenhouse gas emissions (Brand and Kuppalli n.d.). In Canada, where much of the forestland is owned by the Crown and licensed to forest companies for harvesting, ownership of the carbon asset associated with changes in forest management has been a source of fierce debate between provincial governments and private forest companies.

In the United States, ownership issues that do arise are not related to legal title to sell the offsets, but rather to the landowner's willingness to enter into a legally binding commitment to manage the forest to generate offsets and the potentially long-term nature of this commitment. Chapter 9 provides an overview of the experience of Oregon's Forest Resource Trust in attracting landowner participation in a long-term offset program.

Substitution-based offsets – material substitution and energy substitution – have a different type of ownership issue. Here the issue is one of a clear title to the offsets. In the case of the use of wood as a substitute for higher carbon materials, the owner of the reduction may not be the entity that chose to use wood in lieu of metal. Rather, the emission reduction would occur at the smelter, where less metal would be produced, and therefore, less fossil energy consumed and less carbon dioxide emitted. This type of emission reduction is called an indirect emission reduction. The offset occurs at a point in a product's life cycle that is not under direct control – and therefore, potentially, ownership – of the entity that engaged in the substitution. Due to this indirect nature of the emissions reduction created, material substitution is a difficult form of emissions reduction to use as the basis for an offset. The treatment of materials substitution-based reductions will depend on the rules of any trading systems that are established. Ownership of these reductions could accrue to the entity choosing to implement the low-carbon substitution, or it could accrue to the smelter, as is the case in this example.

For energy substitution, the offsets may be direct if the owner of a facility that previously burned fossil fuel converts to wood as a fuel source. The offset is tied to the amount of fossil fuel combustion that is foregone. However, wood burning offsets may be indirect as well, as in the case when a new biofueled electricity project is constructed. The emissions reductions come from reduced fossil fuel electricity generation on the power grid, but they do not have the same

Table 1

An offset market perspective: relative attractiveness of forest sequestration and other project types

Type of Carbon Offset Project	Advantages	Challenges
Energy Efficiency	Once equipment is installed, project generates permanent reductions. Measurement of energy efficiency is well developed. Any leakage is likely to be captured in program impact evaluation procedures.	Ownership may be claimed by implementer, but for indirect emission reductions involving electricity, load-serving entity may claim or be deemed to have rights.
Renewable Energy	Avoided emissions are permanent, with little potential for leakage. Measuring electricity production is routine for renewable energy projects, as it is a salable commodity.	Wind developer or generator avoiding emissions may both claim ownership. In addition, renewable energy credit market and offset market have yet to be reconciled.
Transportation	Avoided emissions are permanent.	Ownership may be difficult to establish for certain projects, e.g., where commuters do not sign a participation agreement. Baseline and reduction in vehicle miles traveled are difficult to directly measure.
Agricultural Soil Sequestration	Landowner is likely to be entitled to ownership, and may cede them to an aggregator for marketing purposes. Leakage rating is fair.	If land use practice changes or other events (drought, flood, etc) occur, carbon pulse could result. Soil carbon dynamics are complex, and the subject of considerable scientific study. Quantification is likely to remain site specific, unless a standardized approach with considerable discounting is used. A difficulty is getting landowners to commit to a long-term or permanent change in land management practices.
Geological Sequestration	It is anticipated that sequestration will exceed that for forestry, but still the subject of considerable research and uncertainty. Leakage is rated good because of well-defined project boundary.	Measuring amount of CO_2 injected is feasible. Measuring any potential leakage from the reservoir would likely be difficult.
Forestry: Forest Conservation	Landowner owns emissions benefit, and either sells it directly or via a participation agreement. Although it carries risks common to any forest-based offset (fire, disease, etc.), land is usually permanently committed to forested-state through a conservation easement.	May shift logging to different area, with little or no net emissions benefit. Benefit is measured against emissions associated with historic and predicted rate of deforestation. Actuals may be different that the assumed baseline. The difficulty is getting landowners to commit to a long-term or permanent change in forest management practices. There is also a risk of illegal logging

Table 1 continued next page

ownership status as the prior example. In some trading schemes, this type of energy substitution would create an emissions benefit for the bioenergy facility owner, while in other schemes, it would not. It is important for those considering building bioenergy facilities to gain an understanding of the structure of the trading schemes into which they hope to sell offsets, and how these schemes treat direct and indirect emissions reductions.

The emerging market for offsets is global, and it involves a much wider range of technologies and approaches than forest sequestration. It is important for those interested in forestry-based offsets to understand how these offsets compare

Table 1 Continued

Type of Carbon Offset Project	Advantages	Challenges
Forestry: Afforestation/ Reforestation	Landowner owns emissions benefit, and either sells it directly or via a participation agreement. Although it carries risks common to any forest-based offset (fire, disease, etc.), land is usually permanently committed to forested-state through a conservation easement. Leakage rating is good – Such projects are unlikely to result in displacing logging elsewhere. Complex site-specific monitoring and protocol needed, but measurement is practical and reasonably accurate.	There is a risk of illegal logging.
Forestry: Forest Management	Landowner acceptability is likely higher than with forest conservation since some revenues from logging are anticipated.	Defining baseline of anticipated predicated forest management practices is difficult. In addition, periodic active logging makes site verification more difficult. Benefit is measured against emissions associated with historic and predicted rate of deforestation. Actuals may be different that the assumed baseline. Landowner must be committed to management practice. Carries same risks of permanence as other forest-based projects (may be lower due to active management practices).

to those based upon other technological approaches. *Table 1* contrasts forestry-based offsets with other offset types such as transportation, renewable energy and geological sequestration. Forest-based offsets face some important challenges in comparison with other offset types, especially as regards to permanence, leakage, ownership, and measurability. While these are significant challenges, they are by no means insurmountable, and approaches that allow forestry-based offsets to participate in trading schemes have been or should be able to be developed. In addition, it is important to note that the types of forestry-based offsets are quite different relative to the criteria presented in the table.

The Co-Benefits of Forestry Offsets

Forest offset projects often generate attractive environmental and social co-benefits, including job generation, habitat retention/enhancement, water quality improvements, recreational opportunities, and enhancement of scenic vistas, not to mention potential co-production of timber and non-timber forest products. (*Table 2*) Many of these public benefits can be quantified and monetized, resulting in a "layer cake" of ecosystem service market sales. It is no accident that many carbon transactions in the voluntary market involve forestry and agricultural offset projects that generate considerable public benefit beyond the sequestration of greenhouse gases.

For example, the New South Wales State Forests agency in Australia has been exploring ways to attract private funding for reforestation in areas of low rainfall, using the "layer cake" strategy. In parts of Australia, removal of the original forest cover has caused greater volume of rainwater to penetrate deep into the soil and raise the water table, bringing naturally-occurring salt to the surface and increasing the salt content in surface water, to the detriment of biodiversity and agricultural production. By bundling potential revenue from timber production, carbon sequestration, and salinity reduction, State Forests is experimenting with a financially viable model to finance large-scale restoration of dryland forest regions. For example, in a pilot project in the Macquarie cachement, the agency has

Table 2

Examples of forest based project co-benefits

Project or Program Name	Funding Organization	Project Type	Co-Benefits
Deschutes River Basin Riparian Restoration, Oregon	The Climate Trust	Afforestation – Restores riparian forest cover along denuded areas of the Deschutes River watershed.	Improved water quality and stream flows, improved fish and wildlife habitat and increased aesthetic qualities.
Forest Climate Program	Future Forests (through The Pacific Forest Trust)	Forest Conservation – secured conservation easements on 5,000 acres of privately owned forestland in California to achieve forest management above requirements of the California Forest Practices Act.	Future Forests projects house numerous threatened and endangered fish and wildlife species — including Coho salmon, spotted owls, peregrine falcons and marbled murrelets — and contain stands of old-growth redwoods and Douglas - fir. In addition, the easements protect important watersheds and municipal water supplies.
Noel Kempff Climate Action Project	Fundación Amigos de la Naturaleza (FAN), the Bolivian government, The Nature Conservancy, American Electric Power, BP and PacifiCorp.	Forest Conservation – Prevents forest logging by termination of logging rights and prevents deforestation by a variety of activities to local communities on 1.6 million acres of government-owned land and incorporate that land into the Noel Kempff Mercado park.	Conserves biodiversity and provides for continued habitat for giant river otters, capybaras, pink river dolphins and black and spectacled caiman. Provides social and economic benefits to five communities in and around the park including improved schools and medical care. Provides sustainable resource opportunities such as small-scale heart-of-palm harvesting and sustainable sales of wood from certified forests.
Oregon's Forest Resource Trust Stand Establishment Program	Klamath Cogeneration Project	Afforestation – Conversion of underproducing agriculture, range and brush land back into healthy, productive forests.	Increased timber supply, increased forest cover for wildlife, improved water quality, aesthetics.
Rio Bravo Conservation and Management Area, Belize	The Nature Conservancy	Forest Conservation – Prevents deforestation and provides for sustainable management on 260,000 acres of mixed lowland, moist sub-tropical broadleaf forest.	Conserves biodiversity and provides for continued habitat for endangered black howler monkey and jaguar, numerous migratory birds, mahogany and other important tree species.

established 100 hectares of newly planted forest, funded in part by a fee from a downstream agricultural user (the Macquarie River Food and Fibre Company) for the transpiration services provided by the trees, which will eventually reduce salinity of the surface water and increase agricultural yields. State Forests retains the timber and carbon rights of the planted trees, and pays the landowner an annuity for the lease of the land.[4] This strategy is illustrated in *Figure 1*.

Closer to home, Ecotrust, a Portland-based conservation organization, recently launched a private equity forestland investment fund that will take advantage of expanding and emerging markets for the array of goods and services produced by forests.

4 *http://www.unep-wcmc.org/forest/restoration/docs/NSW_Australia.pdf*

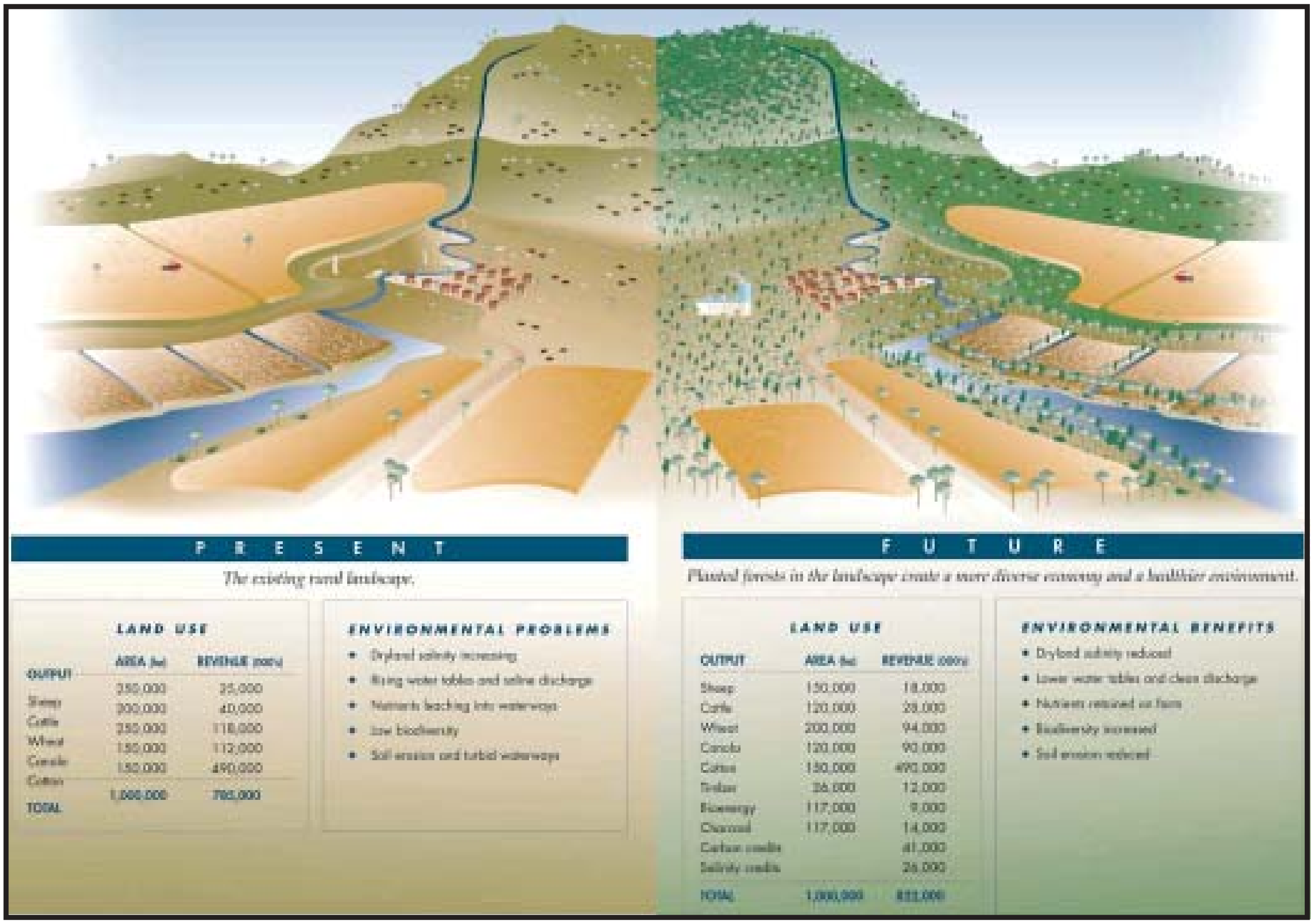

Figure 1

An example of stacking ecosystem services and commodity production in a salinity-prone watershed in Australia. The land management strategy which includes restoration and sale of enhanced ecosystem services outperforms the existing management scheme which is based solely on commodity production. Carbon credit sales play a prominent role in making this restoration strategy financially viable. *Source: http://www.unep-wcmc.org/forest/restoration/docs/NSW_Australia.pdf*

While the New South Wales example draws on ecosystem service markets to fund reforestation, Ecotrust Forests LLC is looking to emerging markets to help fund a forest management approach that results in greater value from a triple bottom line perspective – higher quality and more abundant wood products, healthier and more diverse forests, and higher employment and opportunities for local communities. This ecosystem-based forest management approach relies on longer rotations, thinnings, and enrichment plantings to increase structural and functional diversity, and results in higher carbon storage, better habitat, and enhanced recreational and scenic values, as well as producing higher value logs. The benefits of extending rotations for biodiversity, carbon storage, or wood quality are well recognized (Carey *et al.,* 1999, Haynes 2005).

However, the financial challenge is that delaying harvests delays cash flow, and results in a lower net present value at prevailing discount rates, even if the cumulative cash flow of long rotation forestry is ultimately higher.

Binkley *et al.,* (2006) compared the financial performance of an industrial regime focused exclusively on timber production with an ecosystem-based forest management regime that focused explicitly on co-producing an array of forest products and services. As in other studies, the extension of rotation from 40 to 60 years (which included one to two commercial thins at age 30 and 45) reduced the internal rate of return (IRR) from timber sales – in this case from 6% to 5.5%. However, as can be seen in *Figure 2*, the ecosystem-based forest manage-

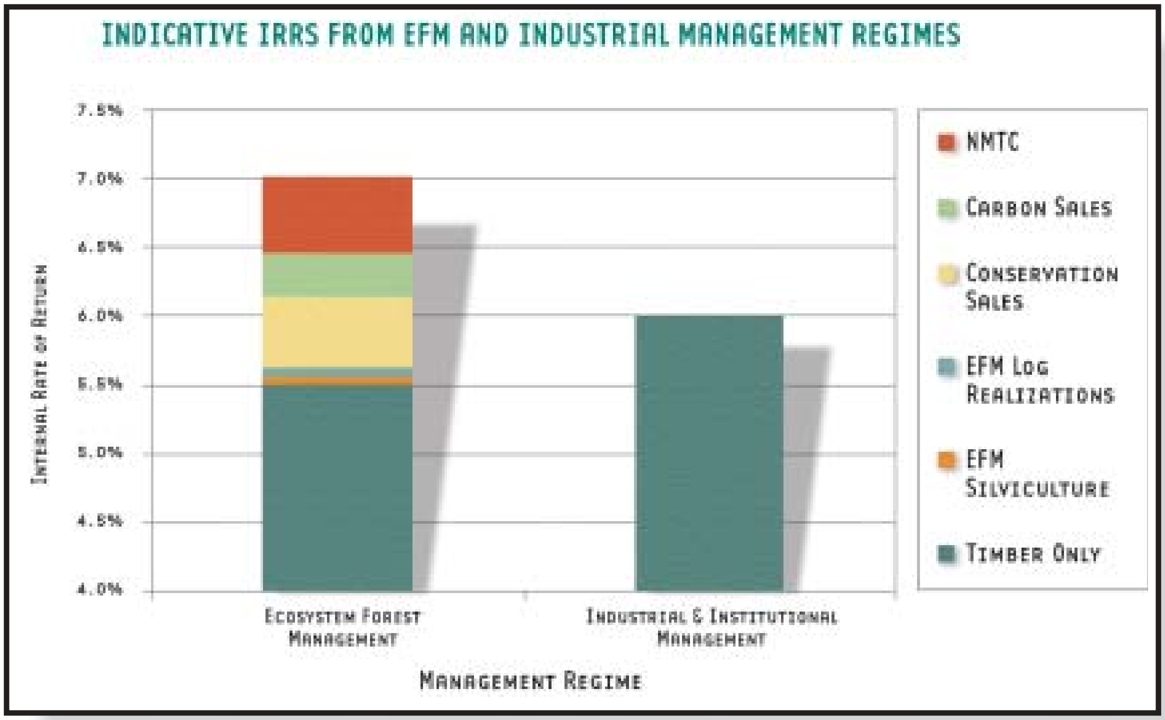

Figure 2

Source: Binkley et al, 2006. Reprinted by permission of Ecotrust

ment approach opened up other revenue sources, including a small premium from higher valued logs, the sale of conservation easements (51 basis points), the sale of carbon sequestration credits (32 basis points), and the sale of New Market Tax Credits (55 basis points), bringing the total IRR to a projected 7%, one percentage point higher than the 6% yielded by the industrial forestry approach.

The analysis includes a fairly conservative assessment of carbon potential, selling additional carbon as it is generated — rather than up front as is currently customary for voluntary forest carbon transactions. In this study, carbon is valued at $5 per metric ton of carbon dioxide, and only a portion of the carbon stored was considered. At this price, carbon alone is not enough to shift the forest management approach from industrial to ecosystem-based. However, if impacts on biodiversity are considered (captured here as conservation easement sales) and local job generation (New Market Tax Credits, a federal program to spur investment in financially distressed communities, which includes much of the rural West), and if these values can be adequately monetized and sold, a rational forestland owner would shift to the longer-rotation approach.

The concept of aggregating various sources of commodity and ecosystem service revenues – often referred to as "bundling," "stacking," or more derisively, "double-dipping" — has its detractors. Federal and state agencies responsible for administering the Endangered Species Act or Clean Water Act, for example, are concerned that allowing landowners to bundle sales of ecosystem services – in essence, allowing the same unit of land to serve as mitigation for the loss of more than one ecosystem function – might result in a net loss of habitat at the landscape level, unless an extremely sophisticated accounting system is conceived and implemented to ensure no net loss. The concern is based on the way impacts on endangered species, wetlands, and habitat are mitigated, which raises the potential that a developer might impact one acre of wetland and a separate acre of, for example, habitat for the threatened California red-legged frog, and compensate for both impacts by buying credits from a single acre at a conservation bank selling credits for both wetland and endangered species habitat under a multi-credit system. Conservation banks for mitigating impacts to endangered species, as well as other emerging ecosystem service markets, are described in *Sidebar 3*.

Sidebar 3

Reforesting an Ecuadorian Rainforest Biodiversity Hotspot: a sequestration project funded by the Climate Trust

Less than two percent of Ecuador's coastal rainforest remains. The forests in northwestern Ecuador have suffered deforestation from population growth and a doubling of farm land. Tall grasses that invade disturbed areas prevent native trees from being re-established.

The Climate Trust contracted to purchase offsets from Conservation International and Jatun Sacha Foundation from the reforestation of more than 680 acres of highly degraded pasture in northwest Ecuador. The project is located in one of the most biologically diverse areas on Earth and in one of Conservation International's top five conservation targets worldwide. Over three years, 15 native hardwood species will be replanted on the site. This project, located in the 7,140-acre Bilsa Biological Reserve, will restore and protect the land and allow it to grow back to old-growth forest. Over the 99-year life of the project, it will capture at least 65,000 metric tons of carbon dioxide. Since this project contained no financial returns or harvesting, the Climate Trust's offset funding was crucial to proceed with reforestation and protection of the site.

The Climate Trust has employed Winrock International to develop and help implement the monitoring and verification plan for this project, which will include measurement of carbon fluctuations on the ground and verification of current carbon estimates. Scientifically valid measurement of trees will be undertaken periodically throughout the project life to measure carbon accumulation. Monitoring and verification will also measure any leakage that may occur. However, leakage it not expected to occur in this project given that it is not "avoided deforestation," forcing harvesting to shift elsewhere.

In addition to sequestering carbon, this projects has many valuable environmental co-benefits. This remnant forest has a unique composition of flora and fauna, internationally renowned for both its diversity and rarity. Rare animals found at the reserve include the jaguar, several small cat species, the long wattled umbrella bird, the giant anteater and abundant populations of the threatened mantled howler monkey. The Reserve's bird species diversity (about 330 species) is among the highest of any coastal site in Ecuador. A number of bird species in the Reserve are threatened, and some of the migratory birds that breed in Bilsa spend part of their lives in Oregon forests. The ongoing botanical inventory at Bilsa has uncovered 30 plant species new to science. The Jatun Sacha Foundation conducts field research and education with researches, students, interns, and tour groups.

While the concern may be legitimate for mitigating impacts to habitat and species, there are a number of ecosystem service sales that can be appropriately grouped to create financially viable models for ecosystem-based management while creating increasing and unique incentives for habitat restoration with each sale. In the Ecotrust Forests LLC example described above, the sale of a conservation easement relinquishes development rights on the land; a carbon offset sale then provides compensation for increasing rotations to sequester additional carbon. The New Market Tax Credit, which compensates the investor for directing their investment to a distressed community with high unemployment and high poverty, is not an ecosystem service market per se, but its goal – increasing employment – is well served by ecosystem-based forest management which also produces higher carbon stores and enhanced habitat.

The issue of aggregating ecosystem service credits within a single unit of land is far more than academic. It is of vital importance to rural landscapes. In places with high development pressure and high land values, developers are motivated to pay sufficiently high prices for mitigation credits to adequately fund viable conservation banks. In rural settings with lower development activity, the price of credits is correspondingly lower, and may not be sufficient to sustain a wetland or conservation bank under a system where only one ecosystem service can be sold per unit of land. Markets for multiple ecosystem services are also required when conservation objectives are competing with intensive land uses such as agriculture and plantation forestry. For example, Temple Inland, a Texas-based company with over two million acres of forestland under management, has been exploring a conservation management strategy where commercial forestry activities can be complemented with mitigation banking, carbon storage, flood control and water filtration services. Given the small and disjointed nature of these early ecosystem service markets, the company still finds it difficult to put deals together on a regular basis, and is pursuing a "stacking" of ecosystem service revenue streams from carbon sequestration, recreational leases, wetland and stream mitigation banking, and selective timber harvesting to overcome uneven demand and uncertain pricing (Hawn 2005). Without the ability to stack ecosystem service market sales, Temple Inland – and other forestry companies - may find it difficult to expand the conservation and social benefits that their forests can provide.

In addition to enhancing the awareness of ecosystem service revenue markets by developers and others whose activities may impact habitat or water quality, market growth has also been limited by uneven capacity and interest at the array of federal and state agencies which must approve and monitor ecosystem service trades. One of the emerging approaches to creating a market for biodiversity is through the establishment of a conservation banking system, in which developers compensate for their impacts on habitat for endangered species by buying "credits" in a conservation bank which purchases and develops habitat for the species that is being impacted by the development project. While California, for example, has developed over 50 conservation banks, Oregon and Washington are just beginning to establish their first banks. Bank development in the Pacific Northwest, for both species conservation and wetlands, has been very slow, due in large part to the limited staff resources and slow response of the necessary agencies. To address this issue – and to establish a coherent set of performance standards around mitigation banks – the U.S. Army Corps of Engineers (responsible for administering Section 404 of the Clean Water Act which mandates no net loss of wetlands) and the U.S. Environmental Protection Agency (EPA) recently released a new draft regulation, the Compensatory Mitigation for Loss of Aquatic Resources, which is expected to significantly expand the use of mitigation banking. Among other provisions, the regulation imposes performance standards on both agencies and on mitigation bank owners.

While carbon markets have developed largely in isolation from other ecosystem service markets – such as wetland and conservation mitigation banking, water quality trading, flood control credits, and other emerging markets – we would do well to pay close attention to the developing rules, structures, market areas, and market leaders across all of these market types. We need to think holistically about how to structure these developing ecosystem service credit markets, both individually and in aggregate, to accomplish a host of public benefit objectives, from restoring degraded landscapes, to providing new economic development strategies for economically distressed areas, to providing incentives for approaches to forestry and agriculture which align private incentives with public values. An example of this approach is described above for Ecotrust Forests LLC, which draws on a number of emerging ecosystem service markets and economic development incentive programs to profitably buy and manage forests for carbon storage, habitat creation, job generation, and the provision of wood products. A number of non-profit and for-profit entities are emerging to capitalize on these new opportunities and the growing availability of capital and interest from socially-responsible investors (Social Investment Forum 2006)

What does this Mean for Oregon Forests?

Relative to other ecosystem service markets – such as water quality trading and conservation banking - carbon is probably the most significant near-term ecosystem service market opportunity, and has the unique advantage of being a global market. Pacific Northwest forests can store more carbon than most other forest ecosystems (Smithwick et al 2002), giving Oregon and the region a unique competitive advantage in this developing market. The region's forests also have other distinct advantages: almost all of the native tree species are commercially valuable, the forests provide scenic vistas and recreational opportunities to a growing population, forested watersheds are the source of drinking water for much of Oregon, and forests provide habitat to a wide array of commercially valuable species, including Pacific salmon. All of this suggests a viable strategy for Oregon's forestland owners, where the production of timber, carbon storage, high-quality water and habitat yield a diverse array of revenue streams which make forestry financially attractive, and retain forestlands on the landscape for generations to come.

In addition to abundant forestlands, which lend themselves well to carbon storage, Oregon also has strong institutional capacity for ecosystem market development, with leading carbon organizations such as the Climate Trust and Trexler Climate & Energy Services headquartered here. The state is recognized for its long history in leadership and innovation on environmental legislation and market creation. In a national and global system of emissions trading, Oregon can emerge as a strong player, and Oregon's forestland owners can gain a competitive advantage. Abundant carbon sinks throughout the state include not only forests but agricultural lands and marine environments, relatively clean power sources and industries, strong institutional capacity, an entrepreneurial business sector, and a progressive citizenry.

The markets are moving quickly, however, and if Oregon is to gain an advantage as a national market develops it will have to gain a seat at the table and help formulate the rules in a way that favors our natural resources and creates long-term benefits for the region's residents.

In this spirit, we suggest the following options for consideration:

- **Collaboration between the forest industry and environmental groups.**

  The forest industry and environmental groups should move beyond past history and work together to develop mechanisms to structure and sell forest carbon offsets, as well as other forest-based ecosystem services. Without an effective system in place to compensate landowners for forest stewardship, conversion of forestland will continue to increase in the region, to the detriment of all. Continued debate and lack of trust among these important constituencies will significantly limit market development, and may cause forest carbon to be excluded from an emission trading system.

- **Establish a state cap-and-trade system.**

  Oregon should continue to move aggressively on establishing a cap-and-trade system, and ensure that forest carbon offsets and other sequestration strategies are included appropriately.

- **Pursue a regional carbon market trading system.**

  Efficient and cost-effective emission reductions require deep and robust markets. While multi-state trading systems take time and commitment to develop, Oregon is not large enough to create a vigorous market on its own. The state should continue to pursue a regional trading system with sufficient volume and value to attract and support the necessary financial, technical, and informational resources.

- **Invest in infrastructure to support an active, efficient and equitable carbon market.**

  In anticipation of market development, Oregon should invest now in the legislative and institutional structures needed to support an active carbon market. This includes separation and clarification of carbon ownership rights (as distinct from the property rights of the land and timber where the carbon is stored), development of mechanisms to address permanence (for example, insurance products, temporary crediting, and pooling,) and enforcement mechanisms.

  Participating in ecosystem service markets also carries high transaction costs. The need to measure and verify that emission reductions have indeed occurred and that carbon is being sequestered as agreed is expensive and time-consuming. At this point, only very sophisticated entities and relatively large transactions can participate in these markets. Oregon needs to stimulate and nurture the formation of efficient intermediaries that can "bundle" individual transactions – for example, reforestation efforts by small forestland owners – to allow broad participation in carbon and other emerging ecosystem service markets.

- **Invest in the intellectual capital needed for market development.**

  Oregon needs to make a substantial investment in the intellectual capital necessary to support market development. This includes developing the underlying rules for all kinds of emission reductions and offsets, including forest carbon. For example, how should forest carbon be measured? Should carbon stored in wood products be considered? How about strategies that minimize the risk of catastrophic forest fires?

  In addition to developing rigorous and transparent protocols that will allow Oregon carbon offsets to be widely marketable around the globe, the state needs to recruit or develop a wide array of technical assistance entities to provide structuring, monitoring, and verification services. Much of the needed framework and accounting protocols could be provided through reviewing, adapting, and possibly adopting the thorough and well-regarded California Climate Action Registry, the voluntary registration system recently adopted in California, as well as a review of other existing and developing trading systems.

- **Develop trading platforms**

  Oregon – or the regional market of which Oregon is part – needs to entice or develop the necessary trading platforms, including market exchanges, that will create market liquidity and transparency, and encourage confidence and participation in the carbon market and market growth.

Summary

With its reliance on snowpack for summer water flows and the importance of climate-sensitive sectors such as forestry and agriculture, Oregon is particularly vulnerable to the effects of climate change. By building on its strong tradition in innovation and forward thinking, Oregon can begin to address the threat of climate change in ways that create financial opportunities, enhance the health and integrity of its landscapes, build social capital, and create a long-term competitive advantage.

The unique qualities of Oregon's forests, which are capable of producing high quality wood products while storing large amounts of carbon and producing a host of other benefits – such as habitat and scenic vistas – give Oregon a unique advantage in not only meeting a portion of its own greenhouse gas reduction targets efficiently, but in selling quality offsets to others. This competitive advantage will only materialize, however, if we act quickly and decisively in developing an effective, rigorous, and robust trading system that includes forest carbon, and meets the standards and pricing requirements of global carbon markets.

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